STORM DRAINAGE DESIGN MANUAL

City of Great Falls, MT

April, 2024

ADOPTED: April 2, 2024 – Resolution 10539

Table of Contents

Chapter 1. Introduction 1-3
1.1 Purpose 1-3
1.2 Authority 1-3
1.3 Documents Included by Reference 1-3
1.4 Current Master Plan 1-4
1.5 Design Exceptions, Deviations, and Errors & Omissions 1-5
Chapter 2. Required Permits: Applicability, Submittal, Review, and Approval Process .. 2-1
2.1 Stormwater Management Permits 2-1
2.2 Department Plan Review Limitation and Permitting Disclaimer 2-6
Chapter 3. Performance Standards and Dedication Policy 3-1
3.1 Erosion Control 3-1
3.2 Temporary Construction BMPs 3-1
3.3 Post-Construction BMPs 3-2
3.4 Dedication and Acceptance 3-4
Chapter 4. Hydrologic Analysis Methodology 4-6
4.1 General Design Storms 4-6
4.2 Analysis Methodology 4-6
4.3 Rational Method 4-7
4.4 EPA SWMM Software Program 4-12
4.5 Water Quality Storm Calculations 4-14
Chapter 5. Conveyance Infrastructure Design Standards 5-1
5.1 General Design Criteria 5-1
5.2 Streets 5-1
5.3 Gutters 5-3
5.4 Inlets 5-4
5.5 Storm Drains 5-5
5.6 Culverts 5-8
5.7 Open Channels 5-9
Chapter 6. Regional Treatment Facility Policy 6-1
6.1 Introduction 6-1
6.2 General Policy 6-1

6.3 Financial Policy 6-2
6.4 Additional Requirements 6-2
Chapter 7. Runoff Control Facilities 7-1
7.1 Runoff Treatment Facilities 7-1
7.2 Flow Control Facilities 7-2
Chapter 8. Definitions 8-1

List of Tables

Table 4-1: Hydrologic Methods 4-7
Table 4-2: Frequency Correction Factors for the Rational Method 4-8
Table 4-3: Runoff Coefficients 4-9
Table 4-4: Evaporation Data (SWMM) 4-12
Table 4-5: Initial Soil Infiltration Capacity 4-13
Table 4-6: Final Soil Infiltration Capacity 4-14
Table 5-1: Encroachment and Inundation Standards for the Minor Storm 5-2
Table 5-2: Encroachment and Inundation Standards for the Major Storm 5-3
Table 5-3: Allowable Cross Street Flow 5-3
Table 5-4: Storm Drain Performance Standards 5-6
Table 5-5: Storm Drain Design Parameters 5-7
Table 5-6: Manhole Design Parameters 5-7
Table 5-7: Culvert Performance Standards 5-9
Table 5-8: Open Channel Performance Standards 5-11
Table 5-9: Open Channel Manning's Roughness Coefficients 5-12

Appendices

Appendix A. Permit Submittal Materials
Appendix B. Drainage Report Requirements and Example Calculations
Appendix C. Templates
Appendix D. Additional Hydrology Information
Appendix E. Sample Seed and Fertilizer Specifications
Appendix F. Storm Drain Fee

Acknowledgements: The City of Great Falls Public Works Department developed this Storm Drainage Design Manual with assistance from HDR, Inc. and AE2S, LLC.

Chapter 1. Introduction

1.1 Purpose

The Storm Drainage Design Manual (hereafter referred to as "Manual") is the comprehensive process and policy statement on erosion control and stormwater management for the City of Great Falls, Montana (City). This manual is intended to provide standards and guidance to maintain compliance with the City's Erosion Control Ordinance and Stormwater Management Ordinance. Compliance with these ordinances is mandated by the State of Montana through the State's General Permit for Stormwater Discharges Associated with Small Municipal Separate Storm Sewer Systems (MS4).

This manual presents technical criteria to be used in the analysis and design of drainage systems within the City limits of Great Falls, Montana, and its Urban Growth Area. This criteria is to set forth rules and regulations which provide some assurance that the health, safety, welfare, and property of the city and citizens will be safeguarded and protected through the proper control and drainage of storm and surface water. Further, this Manual will assure that there will be uniformity in performance with respect to design and construction of all drainage facilities. All proposed developments which meet thresholds established in the Official Code of the City of Great Falls (OCCGF) Sections 13.24, 17.48, and 17.52 must include provisions for storm drainage and/or erosion control. These provisions must use this manual as a guide and must be approved prior to any phase of construction. The Public Works Director or designee reserves the right in the City's best interest to issue and enforce more stringent criteria should adverse conditions exist.

1.2 Authority

This Manual has been prepared by the City's Public Works Department and duly adopted by the City Commission on April 2nd, 2024 via Resolution 10519 and Ordinance 3265.

Please note that the information in this manual will be revised on an as-needed basis as regulations and policies are modified. This information is subject to change over time and the City of Great Falls Public Works Director, the City Manager, Environmental Division Manager, and City Engineer shall approve all changes. Please reference the latest reedition located on the City's web page at the time of construction.

1.3 Documents Included by Reference

The following documents are included in this manual by reference:

- Official Code of the City of Great Falls (OCCGF)
- City Standards for Design and Construction, latest revision.
- Montana Public Works Standard Specifications (MPWSS), latest edition.
- City of Great Falls Extension of Services Plan.

- Enforcement Response Plan for the City of Great Falls.
- Montana General Permit for Stormwater Discharges Associated with Construction Activity (current version).
- Montana Small Municipal Separate Storm Sewer System (MS4) program requirements.
- Current Storm Drain Master Plan.
- Montana Department of Transportation Erosion and Sediment Control Best Management Practices Manual
- Other relevant Planning and Community Development guidance.

1.4 Current Master Plan

The City Commission has also adopted the Storm Drainage Master Plan, dated February 1989, in Title 13 of the OCCGF. Since its creation in 1989, the updates and additions listed below have been made to the Storm Drainage Master Plan and together constitute the overall Master Plan (hereafter referred to as "current Master Plan"). Where conflicts occur, the OCCGF shall govern, then the Manual, then the most recent document shall govern, unless otherwise noted. Copies of these documents are available upon request.

- "Southwest Storm Drainage Study for the City of Great Falls," February 1991, Woith-Hodges Engineering, Inc.
- "Great Falls – North Storm Drainage Master Plan for the City of Great Falls," August 2007, Morrison-Maierle.
- "Great Falls – Northeast Storm Drainage Master Plan for the City of Great Falls," June 2010, Morrison-Maierle.
- "South Great Falls Storm Drainage Master Plan (with Attachment A)," March 2011, DOWL HKM.
- "Northwest Great Falls Storm Drain Study," 2011, Thomas Dean & Hoskins.
- "18th Street South Storm Drain Improvements Study for the City of Great Falls," June 2014, Thomas Dean & Hoskins.
- "City of Great Falls Storm Drain Master Plan," 2024, Great West Engineering (under development)

The current Master Plan identifies and analyzes the existing drainage deficiencies and provides a range of macro scale drainage concepts for construction of future facilities required to serve the City at buildout, as well as providing prioritization of system maintenance and improvement projects. The recommendations in the current Master Plan may impact post-construction stormwater management requirements for development and therefore, should be considered early in the planning and design process, as noted in this Manual.

The current Master Plan may be reviewed and revised as planning horizons approach and as otherwise appropriate.

1.5 Design Exceptions, Deviations, and Errors & Omissions

This Manual is not intended to limit innovation or creativity, particularly when such efforts result in more efficient solutions. Departure from the required standards shall be determined by the Public Works Director or designee on a per project basis upon receipt of a written request which justifies the deviation. The decision to grant, deny, or modify the proposed deviation shall be based upon evidence that the deviation request meets all of the following criteria: (1) The change will meet the applicable performance requirement; (2) The change will achieve the intended result in a comparable or superior design; (3) The change will not adversely affect safety; and (4) The change will not adversely affect maintainability of the City's stormwater system. A non-standard system may take longer to review.

Any errors or omissions in the approved plans or information used as a basis for the approval of mandatory Stormwater Management Permits, may constitute grounds for withdrawal of approvals and/or stoppage of any or all of the permitted work, as determined by the City. It shall be the responsibility of the applicant and assigned agents to demonstrate why such work should continue, and to make changes to the plans as may be required by the City before approval of the plans is reinstated.

Chapter 2. Required Permits: Applicability, Submittal, Review, and Approval Process

2.1 Stormwater Management Permits

Two categories of Stormwater Management Permits exist, active-construction and post-construction. Active construction permits are required when the applicability thresholds of OCCGF 17.48 are met. Post-construction permits are required when the applicability thresholds of OCCGF 13.24 and/or OCCGF 17.52 are met. The sections of the OCCGF which are listed above are collectively referred to as the Erosion Control Ordinance. When any threshold is met and any type of permit is required, the applicant shall complete the Stormwater Management Permit application included in Appendix A. When the proposed development requires both active construction and post construction Stormwater Management Permits, the applicant is encouraged to submit for both permits at the same time.

2.1.1 Active Construction Permits

Summary

There are two types of Active Construction Permits, the Erosion Control Permit (ECP) and the Stormwater Pollution and Prevention Plan (SWPPP). For each Permit, a Stormwater Management Permit Application shall be submitted. For active construction projects which disturb more than 10,000 square feet, an ECP is required. A SWPPP is required for active construction projects which: disturb an acre or more; when soils on slopes of twelve (12) percent or more are disturbed, regardless of surface area; or when four hundred (400) cubic yards or more of soil material are placed or moved on or within a site, regardless of surface area.

Erosion Control Permit (ECP)

The following document meeting the standards outlined in the Erosion Control Ordinance and in this Manual are required to be considered a complete application:

- Stormwater Management Permit Application (Appendix A)
- Erosion Control Permit Checklist (Appendix A)
- Erosion Control Plan/Map meeting the requirements of the Checklist, the Erosion Control Ordinance, and this Manual
    - A map of the construction site showing the locations of the erosion control BMPs shall be submitted with the Erosion Control Permit application
    - The site plan/map format shall be consistent with the following:
        - The page size shall not exceed 24” by 36”.
        - The plan shall be prepared at an appropriate scale to show the required information. For sites smaller than one acre, a scale of 1” = 20’ is generally appropriate and for projects larger than one acre, a scale of 1” = 50’ is generally appropriate.

    - Where multiple sheets are necessary, a cover sheet with an index shall be included.
- Short narrative (e.g., cover letter) describing the proposed land-disturbing construction activities, any key considerations for protecting the environment from erosion during construction, the general approach to erosion control, and any waivers or variances that are being requested.
- Applicable permit application fee (under development)

Stormwater Pollution Prevention Plan (SWPPP)

The following documents meeting the standards outlined in the Erosion Control Ordinance and in this Manual are required to be considered a complete SWPPP application:

- Stormwater Management Permit Application (Appendix A)
- SWPPP application meeting the requirements of the Montana Department of Environmental Quality (MDEQ)
- Applicable Application Fee (under development)

Active Construction Permit Submittal

Applications may be included within a comprehensive development application to the Planning department. Applications not included with a larger development application may delivered digitally to the Environmental Division Manager, in person, or mailed to the location listed below:

City of Great Falls Public Works
Environmental Division
1005 25th Ave NE
P.O. Box 5021
Great Falls, MT 59403

All SWPPP applications shall also be submitted to the MDEQ.

City Review and Approval Process for an Active Construction Permit Application

The following review and approval procedure will be used by the City Public Works Department:

- The City will review the application in conformance with the review checklist and within thirty (30) working days of the receipt of a complete permit application, the Department will inform the applicant whether the application and plan are approved or disapproved based on the requirements of the Erosion Control Ordinance and checklist.
    - Expedited approval shall be granted to applicants certified under the City's Erosion Control Preferred Contractor Program (see Section 2.1.2).
- If the permit application and plan are approved, the Public Works Department will issue the permit, will give it to the Planning Department Project Coordinator, with written approval of any variances.
- If the permit application or plan is disapproved, the Public Works Department will state in writing the reasons for disapproval.
- If the Public Works Department deems the application to be incomplete, they may request additional information from the applicant. If additional information is submitted,

the Department will have thirty (30) working days from the date the additional information is received to inform the applicant that the plan is either approved or disapproved.

2.1.2 Erosion Control Preferred Contractor Program

The Public Works Department offers a Preferred Contractor Program (PCP) that provides training to contractors or personnel that develop, inspect, and maintain construction and development site Stormwater Pollution Prevention Plans. The training covers Federal, State, and local construction stormwater regulations, ordinances, and policies, regulatory expectations of construction site operators, administrative and on-site requirements to comply with the SWPPP, erosion and sedimentation control principles and stormwater inspection protocols. The Preferred Contractor Program includes an initial training course and exam administered on a three (3) year cycle. Shorter-length refresher courses are offered annually. The PCP training courses satisfy the State of Montana's certification requirements for a SWPPP Preparer and Administrator as well as the City-specific permit and policies.

Upon completion of the PCP, contractors/personnel will receive a certification. This PCP certification will allow contractors to receive approval of Erosion Control Permits (ECP) upon submission. Erosion Control Permit reviews may take up to 30 days for those submitted by contractors not certified under PCP.

The City is offering the training to contractors and encourages participation of all contractors/personnel frequently working within Great Falls. The training program will cost $XX (under development) per student. The goal of this Program is to help contractors stay up to date with regulations and best management practices and reduce the occurrence of stormwater violations.

Contractors successfully completing the PCP will be certified for a period of one (1) year and must complete the refresher course annually to remain certified. Reoccurring instances of non-compliance and/or violations may result in the removal of a contractor from the PCP. The following are examples of non-compliance and/or violations:

- Conducting regulated construction activities without submittal and approval of an ECP/SWPPP.
- Failure to properly install and maintain best management practices (BMPs) in accordance with the approved installation details.
- Failure to implement BMPs in accordance with the approved ECP/SWPPP.
- Isolated event of a stormwater and/or non-stormwater discharge that leaves the property and has the potential to enter the City's storm drain system.

All instances of non-compliance and/or violations will be addressed in accordance with the City of Great Falls Small Municipal Separate Storm Sewer System (MS4) Enforcement Response Plan.

2.1.3 Post-Construction Stormwater Management Permit

Summary

All developers applying for any of the following permits and/or approvals shall submit for approval a post-construction Stormwater Management Permit, prepared by a professional engineer with their application and/or request when the plan of development-common plan of development, or phased plan of development results in fifteen thousand (15,000) or more square feet of impervious development coverage or more than one acre of disturbance within the planning area, or where development is in a critical area as determined by the Public Works Director or Designee:

- Major subdivision plat approval;
- Minor subdivision plat approval;
- Zone change applications to accommodate multi-family, business or industrial use;
- Conditional use permits;
- Building permits;
- Planned (Unit) Development (PUD);
- New pavement or concrete parking lots and existing parking lot work which results in a negative change in the storm drainage pattern as determined by the City Engineer or designee.

For submitting a Post-Construction Stormwater Management Permit, also referred to as a "Drainage Plan", the following process shall be used:

- The applicant shall first meet the requirements of the Planning department and if necessary attend a "Pre-Application" meeting for the proposed development project.
- If necessary, the applicant or their engineer is encouraged to contact the Public Works Department to arrange a meeting to discuss the proposed post-construction stormwater management plan, any past studies, regional plans, and requirements that may be above and beyond the performance standards listed this Manual or the OCCGF.
- The applicant or their engineer shall complete the Stormwater Management Permit application in Appendix A and the necessary post-construction Stormwater Management Permit documents and submit them with the larger Planning department submittal package.

Post-Construction Stormwater Management Permit Submittal Requirements

The data required in a Post-Construction Stormwater Management Permit submittal shall include a completed Permit Application in Appendix A and supporting documentation meeting the criteria of the Review Checklist in Appendix A The supporting documentation generally includes:

- A stormwater design report
- Drainage plans
- Relevant construction drawings
- Soils information for infiltration systems (if needed)
- Maintenance Agreement, maintenance items, and/or operation and maintenance manuals (if applicable)

- Applicable permit application fee (under development)

Soils Information

If infiltration to underlying soils will be used to manage any portion of the site runoff, the applicant shall submit sufficient soils information such as a geotechnical report, hydrogeological report, or percolation test report.

The purpose of the soils analysis is to provide sufficient information such that the reviewer has a clear understanding of underlying soils and groundwater characteristics and how those will interact with and be impacted by the proposed infiltration system.

Maintenance Agreement, Maintenance Items, and Operation and Maintenance Manuals

A draft Maintenance Agreement, draft maintenance items, and draft Operations and Maintenance (O&M) manuals are encouraged at submittal. A template for the Maintenance Agreement is included in Appendix C, ensure that the Maintenance Agreement is the latest version prior to completing and signing it. The signed and notarized final agreement, finalized maintenance items, and/or final O&M manuals are required prior to issuance of Temporary Certificates of Occupancy (TCO) or Certificates of Occupancy (CO). Maintenance items or O&M manuals shall be included for each post-construction drainage and stormwater management BMP. The Maintenance Agreement shall identify specific maintenance techniques and schedules for each type of system used on the project. At a minimum, the Maintenance Agreement shall include the following:

- The post-construction stormwater management control owner.
- The party responsible for long-term O&M with current contact information.
- A list of on-site BMPs.
- An inspection checklist and schedule for routine inspections and maintenance tasks.
- Criteria for triggering a major maintenance task.
- System failure and replacement criteria (e.g. maximum allowable sediment depth), including methods for testing and disposal of accumulated sediment.
- Any other provisions identified in OCCGF 17.52.

The final signed and notarized Maintenance Agreement shall be provided to the City prior to TCO and/or CO. The permittee shall provide copies of the Maintenance Agreement to the parties responsible for O&M of each post-construction stormwater management control.

Post-Construction Stormwater Management Permit Delivery Location

Post-Construction Stormwater Management Permit applications may be included within a comprehensive development application to the Planning department.

City Review and Approval Process for a Stormwater Management Permit Submittal

The review and approval process for a Post-Construction permit is the same as the Active Construction permit, and when both are needed, the Department strongly encourages the applicant and/or their engineer to submit them at the same time.

2.2 Department Plan Review Limitation and Permitting Disclaimer

The Department will conduct a limited review of submitted plans and applications for compliance with requirements set forth in the Erosion Control Ordinance and this Manual. The Department's limited review may evaluate technical details of the drainage plans, but is not intended to be a comprehensive substantive review of the plans and engineering. Similarly, the Department's issuance of a Stormwater Management Permit approval is not an endorsement of the plan or a proposed technology, nor is it an approval or verification of the engineering data and plans.

Therefore, approval or issuance of a permit by the City does not relieve applicants or their engineer or agent from responsibility to ensure system performance, safety, and compliance with other local, State, and Federal regulations. The applicant is solely responsible for ensuring that:

- All necessary City, County, State, and Federal permits have been obtained; and
- The design, construction drawings, completed construction, and record drawings comply with acceptable engineering practices, the Erosion Control Ordinance, the Stormwater Management Permit, this Manual, and all applicable City, County, State, and Federal requirements.

Chapter 3. Performance Standards and Dedication Policy

3.1 Erosion Control

The performance standard for erosion control is based on a technology-based effluent limitation. This means that compliance is achieved through the good engineering selection and design, implementation, installation, and maintenance of land-disturbing construction activity Best Management Practices (BMPs). The categories of BMPs that provide compliance with a technology-based effluent limitation for land disturbing construction activities include:

- Erosion control practices that reduce the potential for erosion to occur;
- Sediment control practices that trap soil erosion prior to leaving the site;
- Tracking control to reduce the potential for vehicles to track sediment onto public and private streets;
- Soil stabilization practices for temporary and permanent restoration;
- Dewatering management;
- Good housekeeping practices; and
- Waste management.

Best Management Practices (BMPs) are schedules of activities, prohibitions of practices, maintenance procedures, managerial practices, or structural features that prevent or reduce adverse impacts (soil erosion and pollutant transfer) to receiving waters. BMPs may be implemented either during construction or installed during construction for permanent use after site development is complete.

3.2 Temporary Construction BMPs

Projects which require active Construction Stormwater Management Permits shall provide construction stormwater management BMPs that meet design standards as defined in OCCGF Chapter 17.48. Construction stormwater management BMPs shall address, where applicable, erosion and sediment control, soil stabilization, dewatering, pollution prevention measures, prohibited discharges, and surface outlets, as identified and further described within the Erosion Control Permit Plan Review Checklist located in **Appendix A**.

The selection and implementation of individual construction stormwater management BMPs is project specific and dependent upon water quality objectives, site conditions, and applicability of use. All information pertaining to the proposed methods of construction stormwater management shall be included in the Erosion Control Permit application.

Construction activities which are covered under the Construction General Permit must also adhere to all State requirements as presented within the Construction General Permit. If City and General Permit requirements are not consistent, the more stringent requirement should be assumed.

It is beyond the scope of this manual to provide detailed design and implementation guidance for construction stormwater management BMPs. The City recommends the use of the following approved sources for construction stormwater management BMP design and implementation guidance:

- Montana Department of Transportation *Erosion and Sediment Control Best Management Practices Manual.*
- City of Great Falls Preferred Contractor Program training.
- EPA's Fact Sheet for the Stormwater and the Construction Industry. https://www3.epa.gov/npdes/pubs/cu_swposter-final-fullsize.pdf
- Urban Drainage and Flood Control District *Urban Storm Drainage Criteria Manual: Volume 3 – Best Management Practices*, Chapter 7.
- Washington State Department of Transportation *Temporary Erosion and Sediment Control Manual.*

3.3 Post-Construction BMPs

Projects which require a Post-Construction Stormwater Management Permit must provide post-construction facilities meeting the criteria below.

3.3.1 Water Quality - Runoff Treatment Facilities

Runoff treatment facilities are designed to reduce pollution in stormwater discharges through volume reduction and/or reduction of pollutants within runoff. Typical pollutants of concern include suspended solids, nutrients, metals, certain bacteria and viruses, and organics. The design of post-construction treatment BMPs shall follow the standards set forth in the Montana Post-Construction Storm Water BMP Design Guidance Manual (September 2017), unless as specifically overruled in this manual.

The water quality performance standard is outlined in MDEQ's General Permit for Stormwater Discharges Associated with Small MS4s, effective as of April 1, 2022, which states:

> Implement post-construction stormwater management controls that are designed to infiltrate, evaporate, transpire, and/or capture for reuse, the post-construction runoff generated from the first 0.5 inches of rainfall from a 24-hour storm preceded by 48-hours of no measurable precipitation, or
>
> For projects that cannot meet 100% of the runoff reduction requirement, the remainder of the runoff from the first 0.5 inches of rainfall must be either:
>
> i. Treated onsite using post-construction stormwater management control(s) expected to remove 80 percent total suspended solids (TSS); or
>
> ii. Managed offsite within the same sub-watershed using post-construction stormwater management control(s) that are designed to infiltrate, evapotranspire, and/or capture for reuse; or

iii. Treated offsite within the same sub-watershed using post-construction stormwater management control(s) expected to remove 80 percent TSS.

3.3.2 Water Quantity - Peak Flow Attenuation

Peak flow attenuation facilities are designed to control and release runoff at a lesser rate through detention facilities and outfall structures. The facilities shall meet the following performance standards:

a. The stormwater runoff from a 100-year storm event (major storm) shall not be released from a proposed development at a flow rate greater than that for the 5-year design storm (minor storm) for the projected land use classification of that area.

b. The amount of runoff to be detained on-site shall be at a minimum, the difference between the 100-year and the 5-year design storm, based on full development in accordance with the projected land use. The storm duration for the recurrence intervals should be either the 2-hour or a 24-hour storm, whichever creates the larger detention facility.

c. Additional considerations may modify these standards as follows:

- In locations covered by the current Master Plan, the more stringent standard of this Manual or the current Master Plan shall be used. For example, portions of the current master planned area require the 100-year post-development peak discharge be attenuated to the 2-year pre-development peak discharge.
- If the City is aware of significant flooding issues downstream that have not already been studied by a Master Plan, the Public Works Director or designee may require additional detention or a study to evaluate the proposed development's impact on an already-known flooding problem.
- If a development has a continuous route completely owned by the applicant to the Sun or Missouri Rivers, a lesser amount of peak flow attenuation may be allowed at the sole discretion of the Public Works Director or designee .

The runoff analysis for a particular area shall be based on the projected land use classification for that area. Contributing runoff from upstream areas shall also be considered and must be based on the projected land use and topographic characteristics of those areas. Runoff calculations shall be consistent with the Master Plan for the area.

3.3.3 Point of Discharge

In general, stormwater discharge will only be permitted into the City's conveyance facilities or established natural drainage ways. Storm drainage will not be discharged from one private lot to another unless appropriate easements are executed. Stormwater discharge connections to the City's system shall adhere to the City's Standards for Design and Construction and the OCCGF.

Stormwater discharge to a wetland. All stormwater runoff generated from new development shall not discharge untreated stormwater directly into a jurisdictional wetland or local waterbody without adequate treatment. Where such discharges are proposed, the impact of the proposal on wetland functional values shall be assessed using a method acceptable to the Public Works

Environmental Division. In no case shall the impact on functional values be any less than allowed by the Army Corps of Engineers (ACE) or the Montana Department of Environmental Quality.

Discharge to sensitive resources. Stormwater discharges to critical areas with sensitive resources (e.g., cold water fisheries) may be subject to additional performance criteria, or may need to utilize or restrict certain stormwater management practices.

Discharges from "hotspots". Stormwater discharges from land uses or activities with higher potential pollutant loadings, known as "hotspots", may require the use of additional structural stormwater treatment practices and pollution prevention practices.

3.4 Dedication and Acceptance

In 1989, the City created a storm drainage utility to manage and control the detrimental aspects of storm drainage that affect the City of Great Falls. Therefore, it is the City's policy that public stormwater facilities within the right of way, as well as regional pond facilities which capture runoff from the public right of way, should be dedicated to the City for ownership. Also, stormwater facilities which convey public stormwater through private property should be dedicated to the City in a drainage easement. However, the City does make exception to this rule on a case by case basis where it is deemed best to transfer ownership and maintenance of public stormwater facilities to an individual, home owners association, property owners association, or similar separate entity.

All private stormwater facilities, including ponds, which do not convey stormwater from the public right of way and are located on private property are considered private. These facilities are owned and maintained by the property owner, in accordance with a signed Maintenance Agreement. The City reserves the right to inspect all private facilities. Private treatment and peak flow attenuation structures which are not meeting requirements must be repaired at the cost of the owner.

3.4.1 Easements and Right of Way

All public drainage infrastructure, including outfall protection and natural drainages, that conveys runoff from the public right of way shall be dedicated to the City in either an easement, or street right-of-way to the 100-year water surface elevation for street drainage, and a minimum of 1 foot above the 100-year water surface elevation for all other drainage infrastructure.

Easements to access, inspect, and perform work on City owned post-construction drainage and stormwater management facilities shall also be dedicated to the City.

Easements shall have a minimum width of 20 feet where facilities are underground and 10 feet for vehicle access to post-construction stormwater management facilities. Open channels must be located within a City easement or right-of-way. Open channel easement widths must provide a minimum of 10 feet from top of bank on one side of the channel for maintenance vehicle access, and a minimum of 2 feet on the adjacent side. Unobstructed vehicular access is required through all easements.

Private facilities under common ownership which are maintained by a home owners association, property owners association, or other ownership group also need access and maintenance easements and adequate provisions to access the facilities.

3.4.2 Acceptance

Public storm drain mains, laterals, stormwater management facilities, and other infrastructure constructed or modified as City projects, or to service new development or redevelopment, must meet City requirements prior to acceptance under the contractor, developer or redeveloper's warranty. Private stormwater systems shall not be accepted until the owner has provided the necessary operations and maintenance documents and a signed Maintenance Agreement.

Final Inspection

All public stormwater systems must be inspected by the City prior to acceptance and termination of the contractor warranty. The City reserves the right to video inspect private sites which have a connection to the City system. Two-year warranty inspections are required for systems dedicated to the public. Final inspections are arranged by contacting the Project point of contact and will consist of a visual inspection of the infrastructure and/or other means deemed acceptable by the City. This inspection typically occurs in conjunction with a pre-occupancy inspection or pre-substantial completion inspection. Visual inspection will be, at minimum, conducted by a City Inspector, Contracted agent of the City, or in the case of closed conveyances, using Closed Circuit Television (CCTV) and/or other applicable remote sensing technology. If the inspection is done by someone other than the City, the inspection field notes and summary of the inspection, and/or video or DVD must be presented to the City for review and approval prior to acceptance.

If the facility is not being properly maintained, the City will notify the landowner of the deficiencies. If the landowner does not perform the required maintenance, the City can impose fines in accordance with the OCCGF. The City can also perform the maintenance and charge the landowner the cost of said work.

Record Drawings Submittal

If the project includes private drainage and/or post-construction stormwater management facilities connected to the City public system, the applicant shall submit a final corrected plan (Record Drawings) to the City of the private facilities within 45 days of substantial completion. These shall be engineering drawings that accurately represent the project as constructed, and shall meet the Stormwater Management Permit Drainage Plan requirements shown within the Stormwater Management Permit Checklist in **Appendix A**. The City requires private facility Record Drawings to be in PDF format. The Record Drawings shall be at the same size and scale as the approved Construction Drawings.

Chapter 4. Hydrologic Analysis Methodology

This chapter provides the tools for estimating peak flow rates and volumes for sizing stormwater facilities. The City recognizes the Rational Method and EPA SWMM software program as its primary runoff calculation methods.

4.1 General Design Storms

All drainage systems must consider three separate and distinct drainage scenarios. The first is the minor storm, which recurs at fairly regular intervals. The second is the major storm, which is based on an infrequent event, and the third is the water quality event which is based on a more frequent rainfall event. The correlation between the three scenarios shall be analyzed to ensure a well-coordinated drainage system. Design storm event designations are as follows:

- Minor Storm – 5-year rainfall event (2-hr. and 24-hr.)
- Major Storm – 100-year rainfall event (2-hr. and 24-hr.)
- Water Quality Event – 0.5-inches of rainfall

The planning objectives for the more frequent storm events are to minimize inconvenience, to protect against recurring minor damage, and to reduce maintenance costs to create an orderly drainage system at a reasonable cost. The planning objectives for the major runoff events are to eliminate substantial property damage and loss of life. Runoff from the major storm may not spill onto a downstream drainage basin or subbasin, unless the downstream basin has capacity to convey the runoff flows from the upstream basin. The planning objectives for the water quality event are to capture and retain or remove pollutants from the first flush of all rainfall events to protect the health of receiving waterbodies.

4.2 Analysis Methodology

The methods presented in this section will be used in the determination and/or verification of runoff at specific design points in the drainage system. The runoff analysis for the area of development shall be based on both the existing condition and the post developed condition, or projected land use classification, for that area. Contributing runoff from upstream areas shall also be considered and must be based on the projected land use and topographic characteristics of those areas. Runoff calculations shall be consistent with the Master Plan for the area. Regardless of the hydrology methods used, final calculations shall be submitted within the Drainage Report.

In general, the Rational Method will be required to analyze smaller areas and the Environmental Protection Agency's Storm Water Management Model (EPA SWMM) method will be required to analyze larger areas. Drainage systems proposed for construction shall provide the minimum protection as determined by the methodology used. A summary of the applications and recommended criteria for use of each approved method are provided below.

Table 4-1: Hydrologic Methods

Hydrologic Method	Application	Use For
Rational Method	- Provides peak runoff rates for small basins	- Sites 10 acres or less
EPA SWMM	- Provides runoff hydrographs and runoff volumes - Useful when routing of hydrographs through stormwater facilities is required	- Major subdivisions and planned unit developments containing 10 acres or more or having a time of concentration of one hour or greater
Water Quality Storm Calculation	- Provides water quality volume for the sizing of water quality controls	- Sizing water quality facilities subject to the Water Quality Requirement

4.3 Rational Method

The Rational Method may be used where drainage plans are required for minor subdivision plats, zone change applications, conditional use permits, and building permits. The Rational Method may be used on major subdivisions and planned unit developments provided they have a total acreage of less than 10 acres, or have a time of concentration of one hour or less for the entire drainage basin including the proposed development.

The primary source for this section is the Federal Highway Administration's (FHWA) "Urban Drainage Design Manual" publication, HEC-22, Third Edition (hereafter referred to as HEC-22). The Rational Method is based on the direct relationship between rainfall and runoff and is expressed by the following equation:

$$Q_P = C_f C i A$$

Where

Q_p = Peak runoff (cfs)
C_f = Correction factor
C = Dimensionless runoff coefficient
i = Average intensity of rainfall (in/hr)
A = Drainage area (acres)

The following basic assumptions are associated with the Rational Method:

- Peak flow occurs when the entire watershed is contributing to the flow.
- Rainfall intensity is the same over the entire drainage area.
- Rainfall intensity is uniform over a time duration equal to the time of concentration.
- Frequency of the computed peak flow is the same as that of the rainfall intensity, i.e. the 10-year rainfall intensity is assumed to produce the 10-year peak flow.

4.3.1 Frequency Correction Factor (C_f)

The runoff coefficient should be modified for less frequent, higher intensity storms because infiltration and other losses have a proportionally smaller effect on runoff. The adjustment of the Rational Method for use with major storms should be made through use of the frequency factor, C_f, as provided below:

Table 4-2: Frequency Correction Factors for the Rational Method

Recurrence Interval (Years)	Correction Factor C_f
0 to 10	1.00
25	1.10
50	1.20
100	1.25
Note: C^*C_f should not exceed 1	

4.3.2 Runoff Coefficient (C)

The proportion of the total rainfall that will runoff and reach the drainage system depends on the runoff coefficient, C, which considers parameters such as soil type, imperviousness of the surface, the land slope, and the ponding characteristics of the area. The table below presents a range of required values for C.

It should be noted that the runoff coefficient is the variable of the Rational Method which is least susceptible to precise determination. A reasonable coefficient must be chosen to represent the integrated effects of infiltration, detention storage, evaporation, retention, flow routing and interception, all of which affect the time distribution and peak rate of runoff. On-site inspections and aerial photographs may prove valuable in estimating the nature of the surfaces within the drainage area.

If the basin contains varying amounts of different land cover or other abstractions, development of a composite runoff coefficient through use of the following equation is recommended:

$$C_{weighted} = \sum \frac{C_x A_x}{A_{total}}$$

Table 4-3: Runoff Coefficients

Land Use	Runoff Coefficients	
	Land Slope 5% or Less	Land Slope Greater than 5%
Parks – turfed		
Soils – clays, loams rock	0.20	0.30
Soils – sand, gravel	0.15	0.20
Agriculture		
Soils – clays, loam rock	0.15	0.30
Soils – sand, gravel	0.10	0.20
Vacant lots	0.20	0.30
Railroad yards	0.40	0.50
Single family residential	0.40	0.50
Single family mobile homes	0.40	0.50
Multiple family residential – Impervious area less than 50%	0.50	0.60
Mobile home trailer courts	0.50	0.60
Churches	0.50	0.60
Multiple family residential – Impervious area greater than 50%	0.65	0.75
Boarding and rooming houses	0.65	0.75
Small hotel and motel – Less than 10 units	0.65	0.75
Hotel and motel – Larger than 10 units	0.90	0.95
Industrial – Impervious area less than 70% of lot	0.65	0.75
General business – Impervious area less than 70% of lot	0.65	0.75
Public buildings (government services)	0.90	0.95
Schools	0.65	0.75
Industrial – Impervious area greater than 70% of lot	0.90	0.95
General business – Impervious area greater than 50%	0.90	0.95
Parking lots	0.90	0.95

4.3.3 Time of Concentration (t_c)

The time of concentration, t_c, is the time for a drop of water to flow from the most hydraulically remote point in the watershed to the point of interest. Sound engineering judgment should be used to determine the t_c. The t_c to any point in a storm drainage system is a combination of the sheet flow (overland), shallow concentrated flow, and channel flow, which includes storm drains.

Sheet Flow

Sheet flow is shallow flow over land which usually occurs in the uppermost portion of a watershed and occurs for only very short distances in urbanized conditions. The sheet flow travel time is found using the following equation or the nomograph displayed in Figure D3 in Appendix D

$$t_{ci} = \frac{1.87\left(1.1-CC_f\right)D^{1/2}}{S^{1/3}}$$

Where

t_{ci}= Sheet Flow Time of concentration (minuets)

S = Slope basin, (%)

C = Rational Method Runoff Coefficient

D = Length of Basin, Feet

C_f = Frequency Adjustment Factor (Table 4-2)

Shallow Concentrated or Street Gutter Flow

The velocity for shallow concentrated flows can be computed using the following equation:

$$V=3.28kS_p^{0.5}$$

Where

V = Velocity (ft/sec)

k = Intercept coefficient
(See Table D2, **Appendix D** for suggested k values)

S_p = Slope (percent)

Open Channel and Pipe Flow

The velocity in open channels and pipes can be determined using Manning's equation if the shape, flow depth, slope, and channel type are known. Channels can be in either natural or improved conditions. Reasonable assumptions may be made for flow depth, such as full flow. The velocity for open channel flows can be computed using the following equation:

$$V=\frac{1.49}{n}R^{2/3}\sqrt{S}$$

Where

V = Velocity (ft/sec)

n = Manning's roughness coefficient
(See Table D3, **Appendix D** for suggested Manning's n pipe values)

R = Hydraulic radius (ft)

S = Slope (ft/ft)

Velocity to Time Conversion

Using the velocity, t_c for shallow concentrated, street gutter, open channel, and pipe flows can be calculated as follows:

$$t_{ci} = \frac{L}{60V}$$

Where

t_{ci} = Time of concentration (min)

L = Length of the reach (feet)

V = Velocity (ft/sec)

Combined Time of Concentration

The individual times for sheet flow, shallow concentrated or street gutter flow, and open channel or pipe flow shall be combined to determine the total time of concentration t_c. The minimum t_c for any drainage basin shall be 5 minutes, even if the calculations produce a lesser amount.

4.3.4 Rainfall Intensity (i)

Rainfall intensity, i, is the average rainfall rate in inches per hour, and is selected based on design rainfall duration and design frequency of occurrence. The design frequency of occurrence is a statistical variable which is established by design standards or chosen by the engineer as a design parameter. For the Rational Method, the critical rainfall intensity is the rainfall having duration equal to the t_c. Therefore, for the purpose of the Rational Method, the rainfall intensity should equal the t_c for a given site.

Rainfall intensity shall be determined for various return periods and durations from Figure D1 (Appendix D) for appropriate t_c and recurrence interval. These curves were developed from data compiled by the National Oceanic and Atmosphere Administration (NOAA) at the Great Falls International Airport and recorded in the Precipitation-Frequency Atlas of the Western United States (NOAA Atlas 2).

4.3.5 Drainage Area (A)

The drainage area may be determined using topographic maps, supplemented by field surveys where topographic data has changed or where the contour interval is too great to distinguish the direction of flow. The drainage divide lines are determined by street layout, lot grading, structure configuration and orientation, and many other features that are created by the urbanization process.

4.4 EPA SWMM Software Program

The most current version of EPA's Stormwater Management Model (SWMM) software program shall be used for any drainage plan and will be required for major subdivisions and planned unit developments containing 10 acres or more, or having a t_c of one hour or greater. Use of EPA SWMM program requires a degree of judgment and understanding of complex drainage concepts; therefore, the City requires that development of the storm drainage runoff data using EPA SWMM software be conducted by a professional engineer trained in the use of the model. A digital copy of the model shall be included with the Stormwater Management Permit submittal.

The analysis shall follow the prescribed methodology contained in the software program. This section provides limits on variables to be used in the model. The Rainfall/Runoff and Flow Routing process modules shall be used for all areas in Great Falls larger than 10 acres in order to determine pipe sizes based on design storm rainfall hyetographs, soil conditions, land use, and topography. The program also determines the total runoff produced by a storm for design of flow control facilities. All SWMM analyses for the Great Falls areas shall use the following data:

- Table D4 (Appendix D) provides the rainfall intensities in inches/hour for the 2-hour 2-, 5-, 10-, or 100-year design storms as required for the area being evaluated.
- The evaporation data in the following table shall be used.

Table 4-4: Evaporation Data (SWMM)

Month	Evaporation (inches)	Month	Evaporation (inches)
January	0.00	July	0.26
February	0.00	August	0.23
March	0.00	September	0.15
April	0.15	October	0.10
May	0.19	November	0.00
June	0.21	December	0.00

- For subcatchment areas (areas that discharge flow into the system), the area, width and slope of each sub-basin shall be determined.
- Suggested manning roughness factors to be used for each subcatchment are shown in Appendix D:

Other parameters in the SWMM program require a degree of judgment. Some parameters drastically affect the results, while others do not significantly affect the flow computed by the SWMM program. The following input parameters have a large effect on the computer output and therefore need to be carefully analyzed. The following input data should be used.

4.4.1 Percent of Impervious Area with Zero Detention

The percent of impervious area with zero detention indicates the area that will result in immediate runoff of the storm drainage. For all types of land use classifications, 25 percent of the land shall be considered impervious and to have zero detention.

4.4.2 Percent of Impervious Area in Basin

The percent of area in the basin that will not allow water to percolate into the ground may be calculated from aerial photos or by lot sizes, land use, and other data regarding the individual lot development. In residential areas, runoff from roofs that flows onto the lawn and infiltrates into the lawn area will not be included in the impervious area. Roofs or portions of roofs that discharge runoff onto a driveway, sidewalk, or other impervious surface that drains to the street shall be included as an impervious surface. The impervious areas on a residential lot shall include sidewalks and driveways. Each area should be analyzed on a case-by-case basis. Typical rates are as follows:

- Congested residential area – 31%
- Open residential area – 29%
- Empty lot with paved street – 10%

4.4.3 Depression Storage

Depression storage is the volume that must be filled before runoff discharges from the area of influence of the depression. For impervious areas, the depression storage shall be 0.033 inch of depth, and 0.10 inches for pervious areas.

4.4.4 Infiltration Equation Parameters

Horton's equation (Horton, 1940) for prediction of infiltration capacity into the soil as a function of time shall be used as the infiltration model. The three parameters in the Horton equation are the initial value or maximum infiltration capacity, the ultimate value or minimum infiltration capacity, and the decay coefficient.

The initial infiltration capacity for the City varies with the type of soil. Refer to the table below for recommended values for soils that vary from clay to sandy soil.

Table 4-5: Initial Soil Infiltration Capacity

Soil Description	Infiltration Capacity (in/hr)
Sandy soil	1.67
Loam soil	1.00
Clay loam soil	0.75
Clay soil	0.20

The final infiltration capacity parameter for the Horton equation depends on the hydrologic soil group of the area. The NRCS Web Soil Survey of the project area shall be used to find the hydrologic soil groups, and then determine the final infiltration capacity from the table below. Use a decay rate of infiltration for the Horton equation equal to 0.00115.

Table 4-6: Final Soil Infiltration Capacity

Hydrologic Soil Group	Infiltration Capacity (in/hr)
A. Sands and gravels	0.45 – 0.30
B. Moderately fine to coarse	0.30 – 0.15
C. Moderately fine to fine	0.15 – 0.05
D. Clay soils	0.05 – 0.00

4.5 Water Quality Storm Calculations

The water quality design storm shall be used to size post-construction stormwater controls for projects subject to the Water Quality Requirement. In accordance with MDEQ's MS4 General Permit, the runoff volume for the design of post-construction stormwater management controls shall be from 0.5 inches of rainfall over a 24-hour period. The following section provides guidance on calculating the water quality volume (WQV).

4.5.1 Water Quality Volume

The WQV represents the first flush and is the amount of stormwater runoff from a rainfall event that should be retained onsite. Pollutants typically come from the impervious area and the following equation, developed by Claytor and Schueler, shall be used to calculate the WQV:

$$WQV = \frac{PR_vA}{12}$$

Where

WQV = Water quality volume (acre-feet)
P = Water quality storm rainfall depth of 0.5 inches
R_v = Runoff coefficient, $R_v = 0.05 + 0.9(I)$
I = Percent impervious cover draining to the facility converted to decimal form
A = Site drainage area (acres)

4.5.2 Water Quality Flow

The water quality flow (WQF) rate is used to determine a peak flow rate associated with the WQV for sizing flow-based treatment systems such as a biofiltration swale and flow diversion structures for off-line stormwater treatment practices. The WQF is calculated using the following procedure, which relies on the WQV computed above and utilizes the NRCS TR-55 Graphical Peak Discharge Method, as described in Claytor and Schueler.

Step 1: Determine the Runoff Curve Number

Determine the NRCS Runoff Curve Number (CN) using the following equation, which is derived from the CN method described in Chapter 2 of TR-55.

$$CN = \frac{1000}{\left[10+5P+10Q-10\left(Q^2+1.25QP\right)^{1/2}\right]}$$

Where

CN = Runoff Curve Number
P = Rainfall depth (use 0.5 inches)
Q = Runoff depth (in watershed inches)

Compute the runoff depth (Q) in watershed inches using the following equation.

$$Q = \frac{WQV*12}{A}$$

Where

Q = Runoff depth (in watershed inches)
WQV = Water quality volume (acre-ft)
A = Area (acres)

Step 2: Calculate the Time of Concentration

Calculate the t_c using methods as described in this Manual.

Step 3: Calculate the WQF

Compute the WQF based on the following procedures as identified in Chapter 4 of TR-55: "Graphical Peak Discharge Method," described as follows.

- Calculate the initial abstraction (I_a) using the following equation.

$$I_a = 0.2*\left(\frac{1000}{CN}-10\right)$$

- Once I_a has been calculated, compute the ratio I_a/P where P = 0.5 inches.
- Use the calculated values for t_c and I_a/P to read the unit peak discharge (q_u) from TR-55 Exhibit 4-II (see Appendix D). For I_a/P values of less than 0.5, use $I_a/P = 0.5$.
- Compute the WQF using the following equation:

$$WQF = q_u AQ$$

Where

WQF = Water quality flow rate (cfs)
q_u = Unit peak discharge (cfs/mi^2/inch) (See Figure D2, Appendix D)
A = Drainage area (mi^2)
Q = Runoff depth (in watershed inches)

Chapter 5. Conveyance Infrastructure Design Standards

The criteria and procedures found in this chapter establish the basis of design for drainage conveyance infrastructure including streets, gutters, inlets, storm drains, culverts, and open channels. This chapter covers design standards for permanent drainage (conveyance) infrastructure.

5.1 General Design Criteria

Conveyance systems transmit surface water up to a specific design flow to protect property and the environment. These systems may convey natural drainage, on-site discharges, or off-site discharges. Calculations relating to design of conveyance infrastructure shall be submitted for approval in accordance with this Manual. Stormwater conveyance features to be dedicated to the city including streets, curbs and gutters, inlets, storm drains, manholes and related appurtenances shall conform to City construction standards.

Runoff from both the minor (5-year) and major (100-year) storms for post developed conditions shall be analyzed and checked for compliance with this design criteria. Natural topographic features shall govern the system design and the location of easements. Wherever existing drainage patterns and slopes are defined, these shall be used. Natural drainageways are to be used whenever feasible. The natural dainageway may be dedicated as publicly owned land in the form of a park. Structures shall not be built in a drainage path and buildings adjacent to a natural drainageway shall be flood-proofed to a point at least two feet above the projected flow depth generated by the major storm.

Alteration to natural drainage patterns will be approved if a thorough investigation and analysis shows no hazard or liability. The drainage facilities so designed must be able to handle the design flows with no erosion damage. Considerations shall be given to both snowmelt and snow storage when siting and designing all storm drainage facilities. Storage of snow shall not impede the function of water quality or runoff control BMPs.

The planning and design of the drainage system shall not simply transfer the problem from one location to another or create a more hazardous condition downstream. Although improvements may not have to be made upstream or downstream of a subdivision, provisions shall be made in every development to comply with the criteria set forth in this Manual.

5.2 Streets

Streets shall be designed as an integral part of the storm drainage conveyance system. Streets are to be designed to supplement other conveyance systems to carry the major storm runoff. Subdivisions shall be laid out such that there is a street generally following the bottom of the natural drainage way. The minimum street longitudinal (in the direction of flow) slope shall be 0.5 percent. The maximum street longitudinal slope shall be 10% and shall be such that the performance criteria for street drainage are met. The minimum cross-slope on all streets shall

be 2.0 percent with a maximum of 4.0 percent. T-intersections shall not be permitted except under the following conditions:

- The slope of the street that is terminating in the intersection must be less than 2 percent for the last 100 feet to the intersection centerlines or 60 feet to the edge of transverse pavement, whichever is lesser.
- The street running through the intersection shall have a slope greater than the terminating street.
- The total depth of gutter flow on the terminating street during the 100-year storm must be at or below the intersecting street crown. A storm drain conveyance system shall be constructed if needed to meet this condition.

Standard intersections shall meet the following conditions:

- The grades of the streets sloping into the intersection shall be less than 2 percent for the last 100 feet to the intersection centerlines or 60 feet from edge of transverse pavement, whichever is lesser.
- Install storm drain inlets on the street of least grade and bring water around corner from steeper grade
- Install valley gutters at all residential intersections where gutter flow is to continue straight through the intersection.

The encroachment standards for the minor (5-year) and major (100-year) rainfall events and the allowable street cross flows are provided in the tables below

Table 5-1: Encroachment and Inundation Standards for the Minor Storm

Street Classification	Minor Storm Inundation Standard
Local (includes alleys)	- No curb overtopping, no edge of asphalt overtopping for inverted alley crown. - Flow may spread to crown of street.
Collector	- No curb overtopping. - Flow spread must leave at least one lane width free of water.
Arterial	- No curb overtopping. - Flow spread must leave at least one lane free of water in each direction and should not flood more than two lanes in each direction.

Notes: Lane Width assumed to be 12'.
Where no curbing exists, encroachment shall not extend over property boundary.
The maximum street flow velocity should not exceed 10 feet per second.

Table 5-2: Encroachment and Inundation Standards for the Major Storm

Street Classification	Major Storm Inundation Standard
Local and Collector (includes alleys)	- The depth of water at the street crown shall not exceed 6 inches to allow operation of emergency vehicles. - The depth of water over the gutter flow line shall not exceed 12 inches. - Residential dwellings and public, commercial, and industrial buildings shall not be inundated at the ground line unless buildings are flood proofed. Street flow must be confined to the right-of-way.
Arterial	- The depth of water shall not exceed the street crown to allow operation of emergency vehicles. - The depth of water over the gutter flow line shall not exceed 12 inches. - Residential dwellings and public, commercial, and industrial buildings shall not be inundated at the ground line unless buildings are flood proofed. Street flow must be confined to the right-of-way. (The most restrictive of the crown depth and gutter flow line depth criteria shall govern)

Cross-street flow occurs at intersections, sump locations, and for culvert or bridge overtopping scenarios. Cross-street flow standards for the minor and major storm are provided in Table 5-3.

Table 5-3: Allowable Cross Street Flow

Street Classification	Minor Storm Requirement	Major Storm Requirement
Local	6 inches of depth in cross pan/valley gutter.	12 inches of depth above gutter flow line.
Collector	Where cross pans are allowed, depth of flow shall not exceed 6 inches.	12 inches of depth above gutter flow line.
Arterial	No cross-flow permitted.	No cross-flow permitted. Maximum depth at upstream gutter on road edge of 12 inches.

5.3 Gutters

Gutter capacity for uniform gutter sections, as presented in HEC-22, shall be determined from the modified Manning's equation displayed in the equation below. An "n" value of 0.016 shall be used for all calculations involving street runoff.

$$Q = \left(\frac{0.56}{n}\right) S_x^{1.67} S_L^{0.5} T^{2.67}$$

Where

Q = Flow rate (cfs)
n = Manning's roughness coefficient
S_L = Longitudinal slope (ft/ft)
S_x = Cross slope (ft/ft)
T = Spread (ft)

The spread, T, in a uniform gutter section can be calculated using the modified Manning's equation (above) and solving for T as follows:

$$T=\left(\frac{Qn}{0.56S_x^{1.67}S_L^{0.5}}\right)^{0.375}$$

Where the spread is known, the depth of flow, d, in a uniform gutter section can be calculated using the following equation:

$$d=TS_x$$

Valley Gutters

Where storm drains / inlets are not needed at a local to local street intersection, and where runoff is intended to cross through the intersection, valley gutters shall be installed to transport runoff across the intersection. The minimum grade of the valley gutter shall be 0.5 percent at the flow line. Valley gutters shall be constructed in conformance with the City Standards for Design and Construction. No valley gutters are allowed on arterial or collector streets except in extreme cases when approved by the Public Works Director or designee. Valley gutters are prohibited to cross collector and arterial streets.

5.4 Inlets

Inlet Location and General Requirements

Public storm sewer inlets to be dedicated to the City shall meet the City's standards for Design and Construction. Inlets shall be placed so that the encroachment of gutter flow at the inlet does not exceed the specified encroachment for the street and design storms described in the tables above. The City generally prefers the use of combination inlets, although area inlets, curb-opening inlets and grate inlets may be considered on a case-by-case basis.

In general, inlets shall be placed at all low points (sags) in the gutter grade. Sag inlets require drainage easements or other overflow provisions to prevent flooding or storm water damage to adjacent properties. Inlets should be placed upstream of intersections/pedestrian crossings if possible to reduce nuisance flow and icing issues crossing vehicle and pedestrian traffic lanes. Where the street cross slope changes at an intersection approach, gutter flow should be intercepted with inlets prior to the cross slope transition.

Within subdivisions, mid-block inlets shall be located along property lines to reduce the potential for conflicts with future driveways and other development features. Where a curbed roadway crosses a bridge, the gutter flow should be intercepted and not permitted to flow onto the bridge.

Finally, the storm drain inlets being placed in City streets shall be designed so that the street drainage performance standards described above are met. The following additional design considerations shall be met:

- Overland flow on residential streets will be restricted to a maximum total length of 600 feet before being controlled by a storm drainage conveyance system.
- Inlets should be designed to maximize stormwater capture capacity and minimize sediment capture without affecting bicycle and pedestrian traffic.
- Sediment filter inserts may be required by the City in high sediment areas.

Inlet Spacing and Capacity Calculations

Determining the correct spacing of inlets involves multiple steps. These steps are well described and documented in Section 4.4 of HEC-22, which is suggested as a reference for inlet design. Inlet spacing and capacity calculations shall be included within the Drainage Report and shall include HEC-22's Figure 4-19 (Inlet Spacing Computation Sheet), or a similar report/table which conveys the significant calculation assumptions and results. Note that commercially available software may be used to determine grate inlet spacing and capacity.

Inlet capacity shall be evaluated based on the assumptions that inlet capacity would be reduced as follows:

- Inlets in sag locations – inlet capacity in sag locations shall reflect 25 percent plugging by debris, i.e. design capacity equals 75 percent of the theoretical capacity.
- Inlets at on-grade locations – inlet capacity on-grade shall reflect 25 percent plugging by debris, i.e. design capacity equals 75 percent of the theoretical capacity.
- The capacity of an inlet is the lesser of the computed capacity above and the capacity of the inlet lateral pipe.
- If permanent sediment filters are installed, the inlet capacity calculations shall consider the filter manufacturer's capacity restrictions of the inlet.

The theoretical capacity of inlets shall be based on best-available information such as manufacturer or industry design charts or procedures.

5.5 Storm Drains

The term storm drain is defined as an underground pipe network designed to transport storm drainage runoff to an outfall. This includes inlets, conduits, manholes and all appurtenances. The design of all storm drain conveyance system components shall be determined by a thorough analysis of the drainage area and streets involved in accordance with the provisions of this section. Capacities of storm drains shall be computed using Manning's equation unless designed for pressure flow and the hydraulic gradient shall be calculated for each storm drain system.

Storm drains are used to convey and control stormwater flows from collection to discharge points and to convey flows through an area. The design of storm drain systems shall take into consideration runoff rates, pipe flow capacity, hydraulic grade line, soil characteristics, pipe

strength, potential construction problems, and potential impacts on down-gradient properties. In the preparation of hydraulic designs, a thorough investigation shall be made of all existing structures and their performance on the waterway in question. Storm drains shall meet the following design criteria:

Table 5-4: Storm Drain Performance Standards

Parameter	Requirement
Minimum Design Capacity	
Minor Storm	Storm drains shall be designed to operate in a non-pressurized (non-surcharged) flow condition during the minor storm.
Major Storm	Storm drains may be designed to surcharge during major storm events; however, surcharging shall not result in street flooding that exceeds the criteria listed in Table 3-1 and Table 3-2.
Minimum Velocity (full)	2.5 feet per second
Maximum Velocity	12 feet per second

Storm Drain Pipe

An underground storm drain system is necessary in new development and redevelopment whenever allowable street runoff capacities are exceeded for the minor and/or major storms.

Pipes shall be designed to withstand anticipated loads in accordance with standard industry design procedures. AASHTO HS-20 loading may be assumed during design unless unique conditions of the site warrant a higher load capacity. The pipe shall be constructed of materials defined in Section 02720, “Storm Drain Systems”, of the Montana Public Works Standard Specifications (MPWSS). Said pipe shall be installed per manufacturer’s recommendations and MPWSS to provide the maximum service life. Storm drains with pressure flows shall be designed to withstand the forces of such pressure in accordance with the appropriate standards.

Storm drain pipe installed underneath street pavement sections within the right-of-way shall meet the City’s Standards for Design and Construction. Generally, reinforced concrete pipe is required. Alternatively, SDR 35 PVC may be used for pipe sizes between 4” to 24” assuming cover requirements are met and pipe bedding does not extend into the roadway gravel section. Other pipe materials may be used within the right-of-way when approved by the Public Works Director or designee and for construction in open space areas.

Table 5-5: Storm Drain Design Parameters

Parameter	Requirement
Minimum Main Pipe Diameter	
Circular Pipe	15 inches, not decreasing in flow direction
Elliptical or Arch	12 inches, not decreasing in flow direction
Minimum Inlet Lateral Pipe Diameter	12 inches, not decreasing in flow direction
Cover Depth	Provide structural calculations or pipe manufacturer's recommendations

Manholes

Manholes shall conform to MPWSS drawing Numbers 02720-3 (eccentric cone), 02720-4, or 02720-5 (eccentric cone), at the direction of the Department. Manholes dedicated to the City shall conform to the City's Standards for Design and Construction. Manholes shall be placed wherever there is a change in size, abrupt change in direction, elevation, or slope, where there is a junction of two or more systems or laterals, or to conform to the maximum distance shown in the table below.

Table 5-6: Manhole Design Parameters

Parameter	Requirement
Maximum Manhole Spacing	
15" to 36" diameter storm drain	400'
42" to 60" diameter storm drain	500'
66" and larger diameter storm drain	600'
Minimum Manhole Size	
15" to 24" diameter storm drain	4' manhole diameter
27" to 36" diameter storm drain	5' manhole diameter
42" diameter storm drain	6' manhole diameter
48" and larger diameter storm drain	Junction box or tee manhole

Private to City Connections

All discharge connections from private sites to the City's storm drain system shall meet the City's Standards for Design and Construction. 4" and 6" connections may utilize an in-line wye or inserta tee. Connection sizes 8" and larger shall connect at a manhole. All applicable connection fees and permits shall be obtained and the connection shall be inspected by City staff. The design should consider installation of backflow prevention devices to prevent stormwater from within the City's storm drain system from surcharging to private property. If utilized, backflow preventers must be installed on-site and not within the public right-of-way. If

the development does not use backflow prevention, the City is not responsible for any flooding damages associated with backflow from the City's system.

5.6 Culverts

A culvert is a pipe used to convey the design flow under a roadway or embankment flow, without causing excessive backwater or overtopping of the structure, and without creating excessive downstream velocities. The design of culverts shall be conducted in accordance with the provisions of this section.

Methods and Procedures

The analysis and design of culverts involves multiple steps. These steps are well described and documented in FHWA's "Hydraulic Design of Highway Culverts" publication, HDS-5, Third Edition, which should be used for reference. However, the analysis of culverts is typically done using commercially available computer software packages. Regardless of the selected methodology, design calculations and results shall be included within the Drainage Report and shall include, at a minimum, the following:

- Complete culvert calculations that state the design peak flow rates, culvert size, slope, inverts, length, material type, wall thickness, and Manning's coefficient.
- Type of inlet and outlet control.
- Headwater depths and water surface elevations for the design storm events.
- Velocities at the inlet and outlet for the design storm events.
- Flow control type (inlet or outlet).
- Roadway cross-section and roadway profile.

Outlet Protection

Pipe and culvert outfall protection shall be located at the downstream side of culvert crossings and generally placed on the same alignment and grade as the existing drainage way. Analysis of erosion and scour potential is required at all culvert outfalls. FHWA's "Hydraulic Design of Energy Dissipaters for Culverts and Channels" publication, HEC-14, Third Edition (hereafter referred to as HEC-14), is recommended for reference when designing outlet protection at culvert outfalls. Hard armoring and cutoff walls are generally required at all outfalls.

Design Standards

The following minimum culvert design standards shall be met:

- Culvert minimum slope shall be 0.5 percent, unless the average slope of the natural channel is less, in which case, the average slope of the natural channel should be used.
- The structural design of culverts shall be the more stringent of:
    - Methods and criteria recommended by the manufacturer for that culvert type and for the conditions found at the installation site.

- Minimum standards set forth by AASHTO for HS-20 loading.
- If more severe loading conditions than HS-20 would occur, minimum standards set forth by AASHTO for that loading condition.

- All culverts shall be fitted with flared end sections, headwalls, wingwalls or other approved methods of reducing entrance losses. Projecting ends are not permitted.
- For large structures, where groundwater is a problem, or where the pipe is in inlet control, the design shall include necessary provisions to resist hydrostatic uplift forces that could result in failure of the structure.
- Culvert slopes shall be designed so that neither silting nor excessive velocities resulting in scour can occur.
- Ponding above culvert inlets will not be allowed if such ponding will cause property or roadway damage, culvert clogging, saturation of fills, detrimental upstream deposits of debris, or inundate any other structure.
- If a large elevation change exists from the upstream to downstream ends of the culvert, a drop inlet culvert may be used.

Table 5-7: Culvert Performance Standards

Parameter	Requirement
Allowable Street Overtopping (Major Storm)	
Local and Collector Streets	Maximum depth of 6 inches at the street crown.
Arterials	No overtopping allowed.
Structure (Building) Flooding	Residential dwellings and public, commercial, and industrial buildings shall not be inundated at the ground line in the major storm event.
Maximum Headwater/Diameter Ratios (HW/D)	
10-year, 24-hour rainfall event	HW/D < 1.0
100-year, 24-hour rainfall event[1]	HW/D < 1.5
Minimum Velocity (Minor Storm)	2.5 feet per second

[1] If contributing watershed is greater than 1 square mile, is predominantly undeveloped, and is not covered by the current Master Plan, USGS StreamStats may be used.

5.7 Open Channels

All open channels shall be designed to carry the major storm runoff (100 year recurrence interval) with allowance for flow being carried by other types of conveyance systems.

General and Performance Standards

Open channels are classified into two major groups:

- Natural channels - include all watercourses that have been established by nature and are oftentimes regulated by State and/or Federal agencies.
- Constructed channels - are man-made or are natural channels that have been significantly altered by human effort. They can be vegetated or hard armored with riprap, gabions or other materials. All proposed channels, including concrete, asphalt, and mortared, be approved by the Public Works Director or designee.

The use of open channels shall generally be limited to undeveloped areas that can conform to the requirements of the hydraulics, topography, and right-of-way limitations. The geometry of constructed channels should generally be trapezoidal. Vegetated channels shall be designed such that:

- Side slopes are 4H:1V or flatter unless approved by the Public Works Director or designee and appropriate vegetation establishment and maintenance approaches are used.
- Drop structures may be used to control the grade to meet the velocity performance requirements.
- The design shall consider the vegetation's ability to withstand projected channel velocities and shear stresses such that the channel is stable for the 100-year event. Permanent channel protection measures such as turf reinforcement mat shall be designed if velocities exceed 5 feet per second in the 5-year event.
- Unless the vegetated channel is also providing a post-construction water quality improvement benefit, the grass species selected for seeding shall conform to requirements set forth by the City's standard specifications (see **Appendix E**).
- Vegetation must maintain a 70 percent vegetative cover.
- Vegetated channels, if designed appropriately, may also provide post-construction water quality improvement (e.g. biofiltration swale).

Hard armored channels may only be utilized when the conditions for vegetated channels cannot be met and when approved by the Public Works Director or designee. General requirements for hard-armored channels are:

- Concrete, gabions, slope mattresses, riprap and other approved measures can be used.
- Side slopes shall be 3H:1V or flatter, unless fenced. Side slopes shall not exceed manufacturer or engineer specifications.
- When a hard-armored channel has a higher velocity than a downstream vegetated channel, an energy dissipation is required to avoid excessive erosion at the channel transition.

Specific requirements for concrete channels include:

- Concrete channels shall be continuously reinforced, both longitudinally and laterally.

- Design of concrete channels on bends or curves shall take into consideration the centrifugal and gravitational forces on the flow within the channel section.
- Design and construction of concrete channels shall consider the full range of expected climatic conditions that could cause frost heave or differential settlement.
- Concrete channels shall be protected from hydrostatic uplift forces by the use of drain piping, weep holes, or appropriate footings.
- The concrete shall be finished, as close as possible, to the degree of roughness used in the design of the channel.
- Concrete channels must have the bottom sloped so that the flow is channelized towards the center line.

Specific requirements for flexible hard-armored channels include:

- Gabions, slope mattresses and riprap smaller than 12 inches shall either be buried on maintainable slopes or grouted to prevent vandalism.
- Appropriate transitions between the flexible hard armoring and subgrade is required, which may include a filter fabric, manufacturer-recommended material(s), or sub-base aggregate.
- Riprap material shall be of sound quality, have at least three fractured faces, and have sharp, angular, clean edges.
- Riprap shall be generally uniform in dimensions with the longest side no longer than 3 times the shortest length.

Open Channels shall meet the following performance standards:

Table 5-8: Open Channel Performance Standards

Parameter	Requirement
Minimum Freeboard (Major Storm)	
Vegetated Channel	1 foot or additional capacity or 1/3 of the design flow, whichever is smaller
Hard-Armored Channel	0.5 feet or additional capacity or 1/3 of the design flow, whichever is smaller
Minimum Grade	0.5 Percent
Minimum Velocity (Minor Storm)	2.0 feet per second
Maximum Velocity (Major Storm)	7.5 feet per second[1]
Stability (Negligible Erosion)	25-Year Event (includes outfalls)
Flow Regime (Major Storm)	Subcritical Flow[2]

[1] Maximum velocity may exceed 7.5 fps with an approved design deviation.
[2] If Froude Number is above 0.7, Engineer shall complete a sensitivity analysis of the estimated Manning's n-value to determine if a reasonable estimate of the n-value would cause critical or supercritical flow. If critical or supercritical flow occurs, the hydraulic design or armoring plan shall be adjusted as needed to provide a stable channel.

Design Criteria

Flow through open channels is generally calculated using Manning's equation:

$$Q = \frac{1.49}{n} A R^{2/3} \sqrt{S}$$

Where

Q = Flow (cfs)
n = Manning's roughness coefficient
A = Cross-sectional area (ft^2)
R = Hydraulic radius
S = Slope (ft/ft)

Design of an open channel is usually based upon an assumed roughness coefficient (Manning's "n" value). Specific maintenance requirements should be designed to maintain an open channel with an "n" value approximating that used in the original design calculations. Required open channel roughness coefficients are provided in the following table.

Table 5-9: Open Channel Manning's Roughness Coefficients

Lining Type	Typical Manning's n
Concrete	0.013
Grouted Riprap	0.030
Asphalt	0.016
Bare Soil	0.020
Rock cut (smooth, uniform)	0.035
Gravel Mulch	0.040
Cobble	0.050
Riprap	0.065
Grass Swale	0.025

Channel Protection

Channel protection is required if the velocity within a channel exceeds the maximum permissible velocity for the soil or channel lining. The protection usually consists of an erosion-resistant material such as riprap. The ability of riprap revetment to resist erosion is related to the size, shape, and weight of the stones.

FHWA's "Design of Roadside Channels with Flexible Linings" publication, HEC-15, Third Edition (hereafter referred to as HEC-15) is recommended for reference when designing channel protection measures.

Chapter 6. Regional Treatment Facility Policy

6.1 Introduction

The City has identified significant liability concerns with requiring developments to capture and convey stormwater from existing public right-of-way, or newly established right-of-way dedicated as part of the project or Common Plan of Development, to private stormwater facilities. The City finds that the potential liability assumed by requiring this type of practice exceeds the "Maximum Extent Practicable" for its MS4 program implementation, within the intended meaning of this standard at Section 402 (p)(3)(B)(iii) of the Federal Clean Water Act. Therefore, when applicable, the water quality and quantity component originating from the right-of-way and property development which does not meet criteria for on-site facilities should be accounted for in a Regional Treatment Facility (RTF), and not a private pond or treatment facility. RTFs are critical components of the City's overall stormwater management approach. These facilities can provide retention, detention, and treatment of stormwater runoff that extend beyond any specific development to a drainage basin as a whole. In order to recognize this benefit, the City is adopting a RTF policy. This policy will enable the City to continue acting as the primary responsible party for maintaining RTFs.

6.2 General Policy

Threshold

A RTF shall be considered when a proposed development serves 200 or more residential lots, when the total basin contributing to the RTF serves 200 or more residential lots, when an existing facility is considered by the City as a RTF, or when the City deems necessary.

Authority

The City is the primary responsible party for reviewing, approving, operating, and maintaining RTFs. This allows for the highest degree of certainty that the RTF will meet or exceed the design specifications required by the City in order to meet its Municipal Separate Storm Sewer Systems (MS4) permit through the Montana Department of Environmental Quality (DEQ) and the U.S. Environmental Protection Agency. As a result, the City intends to review, approve, or oversee the design and construction of any RTF as well as maintain ownership over the facility throughout the facility's life.

Design Criteria

In general, the RTF shall be designed to meet the criteria of this Manual. Both a water quantity component and a water quality treatment component shall be integral to the design. The total contributing basin shall be considered. The City may require additional design criteria in order to maximize the efficiencies of construction and management based on anticipated growth factors from the contributing basin.

6.3 Financial Policy

In accordance with the City's Extension of Services Plan, those who contribute stormwater flows to the facility will bear the cost of the facility in proportion to their use. The City may share in the cost of funding the RTF. The City's cost participation will be limited to available capital improvements funding. The developer will be responsible for the balance of the cost not funded by the City or other funding sources. Both the developer and/or the City may be eligible for reimbursement of costs incurred for funding RTFs.

Total Capital Cost

Capital improvements costs associated with RTFs shall include design, construction, land acquisition, legal, and administrative components. These costs shall be determined based upon a full-buildout RTF serving the total area benefiting from the facility.

Proportional Share

The proportional share shall be determined based upon a unit cost for the total contributing acreage and/or based on total contributing volumes and flows. The unit cost shall be the total capital cost divided by the total contributing acreage and/or total contributing volume and flow. The City will require an exhibit describing the proposed basin for each RTF and relevant calculations summarizing the unit cost or proportional share.

Reimbursements

As new developments are approved that will be served by that RTF, they shall be assessed a reimbursement for their proportional share. Reimbursements for RTFs shall account for the time value of money. The rate to be used in calculating the time value of money costs shall be the Engineering News Record Construction Cost Index Ratio at the time of the assessment. Should a development need additional capacity over and above the design capacity of the RTF as calculated for that specific development area, an additional surcharge will be calculated and may be levied on the contributing development.

Phasing

On a case by case basis, the City may allow phased improvements to a RTF, assuming provisions to accommodate the full-buildout RTF are provided with the initial phase. In such cases, future cost shares shall be appropriated and assessed at the time of the phased improvements or in accordance with an approved phasing plan.

6.4 Additional Requirements

The following criteria, and any other criteria deemed necessary by the Director of Public Works or designee, must be met:

- When stormwater will be conveyed to an existing RTF that is currently owned/operated by the City
    - The use of the RTF must be approved by the Public Works Director or designee.

- An engineering evaluation is provided demonstrating that the existing RTF has available capacity to meet the Water Quality and Quantity Requirement for runoff from the right of-way of the street in question.
- The project proposing to discharge to the RTF may be responsible to construct alterations relative to the size of the proposed development, or planned phased improvements, in order to address Water Quality and Quantity Requirement.

Chapter 7. Runoff Control Facilities

Permanent runoff facilities are divided into water quality treatment and flow control. The purpose of water quality treatment facilities is to reduce pollutant loads and concentrations in stormwater runoff. The purpose of flow control facilities is to mitigate the impacts of increased storm runoff volumes and flow rates on receiving streams and infrastructure. Note that some runoff control facilities may be designed to attain both flow control and water quality treatment requirements. Calculations relating to design of runoff control infrastructure shall be submitted for approval in accordance with this Manual.

7.1 Runoff Treatment Facilities

All projects requiring a post-construction Stormwater Management Permit shall include runoff treatment BMPs which meet the water quality performance standards stated in Chapter 3. Treatment BMPS shall use the sizing and design parameters of the *Montana Post-Construction Stormwater BMP Design Guidance Manual* and the following general requirements:

- Each treatment BMP shall be sized based on the WQV.
- The WQV calculations and facility design documentation must be provided within the Drainage Report.
- Design measures shall be taken to mitigate the potential for damage resulting from large runoff events which produce large volumes of runoff and high velocities.
- Specialized analysis, design, and construction steps may be required for placement of any ponding or infiltration facility located near or up-gradient from a building foundation. A soils analysis shall be conducted to assess the feasibility of infiltration and potential adverse impacts of stormwater infiltration with the use of such facilities.
- Projects subject to additional permits from other jurisdictions (e.g. MDEQ, US Army Corps of Engineers, etc.) and projects which discharge stormwater to critical areas with sensitive resources (i.e. wetlands) may be subject to additional performance criteria.
- Projects which seek to reuse runoff may be subject to water-rights requirements. Contact Montana DNRC for further discussion on this topic.
- Active construction stormwater management BMPs may not be removed from a project until post-construction stormwater management controls are functional, including established vegetation, when applicable.
- Ease of maintenance shall be a paramount consideration in the design and construction of all runoff treatment facilities. Maintenance access which accommodates the equipment necessary to perform maintenance shall be provided.

Inspection of Facilities

The City will conduct a compliance inspection prior to completion of construction to verify that the elements of the approved BMPs have been implemented. The City Environmental Division will also provide technical assistance site visits upon request.

The City may establish inspection programs based on, but not limited to: routine inspections, random inspections, inspections based on complaints or other contaminants or pollutants, inspections of businesses or industries of a type associated with higher than usual discharges of contaminants, and joint inspections with other agencies. Inspections may include, but are not limited to, reviewing maintenance and repair records, and evaluating the condition of runoff treatment facilities.

All private stormwater treatment facilities shall have an enforceable Maintenance Agreement with the City and/or other applicable parties which include specific thresholds for each element of the treatment system to ensure proper functioning of the system.

7.2 Flow Control Facilities

All projects requiring a post-construction Stormwater Management Permit shall include runoff flow control facilities which meet the water quantity performance standards stated in Chapter 3. Standard flow control facilities include detention or retention facilities which reduce the flow rate discharging from by pond via an outlet control structure, evaporation, infiltration, or other approved method. All other facilities are considered non-standard and must be approved for use by the Public Works Director or designee.

The design of flow control facilities requires consideration of a variety of factors including, but not limited to: hydrology, hydraulics, structural design, geotechnical considerations, landscaping, vegetation, and environmental concerns. The City's minimum design considerations are provided within the following sections; however, it is beyond the scope of this Manual to provide detailed stormwater management facility design guidance. It is the responsibility of the project owner to utilize a design which considers all appropriate factors and does not adversely affect nearby structures or properties.

Facility design must account for all stormwater runoff upstream of the development. Runoff which originates off-site must either be routed around the facility, or the facility must be designed to safely manage off-site flows. The City encourages innovative measures to limit the maximum runoff from any proposed development. Any requests for the use of innovative approaches shall be accompanied by appropriate design computations and shall demonstrate that the methods will not create public nuisances or have adverse environmental impacts. Such strategies may include any of the following:

- Retention with disposal through seepage into the groundwater, evaporation into the atmosphere, and/or plant uptake through transpiration.
- Increase the time of concentration by lengthening the overland flow path, terracing, or flattening of slopes.
- Roof detention.
- Roughening surfaces or utilizing filter berms.
- Underground storage.
- Other new or innovative methods.

7.2.1 Detention Basins

Detention basins are designed to reduce peak outflows through storing excess flows and controlling outflows with outlet control structures such as weirs and orifices. Detention facilities are typically designed to completely drain after all flows have been routed through following a rain event; however, they can also be designed to “stack” on top of water quality facilities such as retention/infiltration basins or wet basins. It is beyond the scope of this Manual to provide detailed design guidance, City specific requirements are listed below.

Specific Requirements

Setbacks - Facilities should be located such that they will not adversely affect existing infrastructure (e.g. utilities, structures, etc.). Facilities should be located such that access, maintenance, and operations needs are satisfied

Embankments and Basin Geometry - The maximum water depth at any time should not exceed 3-feet; however, depths greater than 3-feet may be allowed if approved by the Public Works Director or designee and fenced on all sides. Side slopes shall be no steeper than 3H:1V unless the area is fenced. Safety benches should be considered within larger ponds to provide a shallow area for people and animals that inadvertently enter the open water, to exit the basin. Points of inflow should be armored to prevent erosion. If the embankment falls under the jurisdiction of Montana DNRC, it must be designed to meet the applicable requirements.

Emergency Spillway - An emergency overflow spillway which is designed to safely pass the 100-year developed peak flow must be provided to allow overflow which may result from excessive inflow or clogging of the primary outlet. The spillway should be located such that overflows discharge into established drainage features such as open channels, swales, or other approved storage or conveyance features. The spillway should be protected from erosion with appropriate material. Large riprap is discouraged in favor of other materials.

Drawdown Time - Flow control facilities must be designed to release and/or infiltrate excess stormwater in a timely manner to ensure that the entire storage volume is available for subsequent storms and to minimize hazards; therefore, the water surface in the facility shall return to the pre-storm level within 72-hours after cessation of the 100-year storm event.

Fencing - If the facility will be an "attractive nuisance" or is not considered to be reasonably safe by the Director of Public Works or designee, it may need to be fenced and/or signed. A fence is required on facilities in which water depths exceed 3-feet.

Roof Storage - Roofs shall be structurally designed by a registered engineer for the added loads. Roof membranes, flashing, and penetrations shall be designed for the maximum possible water depth. The impact of snowmelt and ice shall be considered. The impact of improperly maintained drains and outlets shall be considered. Roof scuppers shall provide emergency relief if drains fail, as per the building code requirements.

Parking Lot Storage - The maximum allowable design depth in parking lots is 2 feet. Storm drain inlets with orifice flow controls shall be designed in conformance with the construction standards. Regular maintenance shall be provided by the property owner. Signs shall be posted warning the public that the parking lot is a storm drainage detention area.

Multi-Purpose Use - Detention facilities designed for multi-purpose use (sporting areas, neighborhood parks, play areas, picnic areas, etc.) are allowed. Multi-use amenities shall be anchored to prevent floatation. Runoff from more frequent storms shall be stored separately from the multi-purpose use areas. These separate storage areas should, at a minimum, be sized to store the WQV. The developer shall make arrangement for maintenance of such amenities unless such responsibility is accepted by the City. Inlets shall be designed such that all sediment larger than 0.20 inches in diameter is trapped on a concrete slab that can be cleaned with a front-end loader. Outlet structures shall be equipped with debris racks to remove all debris greater than 4 inches in width. Outlets shall be designed with a baffle system to prevent oil and floating debris from discharging to the downstream storm drain system.

Water Quality Treatment - Designing detention basins to serve the secondary benefit of water quality treatment is encouraged. Runoff generated from the water quality event shall be routed through a sediment trap, sediment forebay, or other appropriate water quality BMP prior to discharging to a flow control facility in order to facilitate removal of transported sediments and debris. If other potential pollutants such as oils, grease, or fuel (gasoline and diesel) could be present in the site runoff, it may be necessary to provide added measures to remove these contaminants.

Vegetation and Landscaping - The pond bottom and embankment slopes shall be sodded, seeded, or vegetated in accordance with construction management requirements, taking into account the current season and expected soil conditions throughout different locations within the facility. Unless a dryland grass or other drought tolerant plant material is proposed, irrigation shall be provided. The City's recommended seed mix specifications are provided in **Appendix E**. Plant selection should consider the native soil conditions and altered moisture conditions created by the stormwater facilities. Utilize plant species native to the area to the extent practicable. Floatable or erodible material (e.g., wood chips, straw mulch, etc.) shall not be used within flow control facilities. Vegetation on embankments should be limited to shallow rooted varieties.

Embankments and Basin Geometry - The 100-year water surface elevation shall be no less than one foot below the adjacent ground, window well, finished floor, top of foundation or any other entry point vulnerable to flooding for adjacent residential dwellings and public, commercial, and industrial buildings. The bottom of the basin shall be located 0.5 feet below the primary outlet to provide sediment storage. This sediment storage area should not be included in design volume calculations.

Groundwater - Groundwater levels must be considered in the design to ensure that sufficient capacity will be available in the basin. For standalone detention basins, the historic, seasonally-high water table level shall be a minimum of two feet below the bottom of basin to avoid saturated conditions which interfere with proper maintenance.

Ownership

All storm drainage facilities installed consistent with this Manual within City-owned land, shall upon acceptance by the Director of Public Works or designee, become the property of the City. The City shall maintain and operate all accepted public storm drainage facilities located within

City-owned land, City rights-of-way, and City easements. The Director of Public Works will not accept facilities which are not consistent with this Manual.

All storm drainage facilities installed on private property which are not city owned are to be privately owned and maintained per the provisions of the Maintenance Agreement. Access and/or maintenance easements may need to be granted for private ponds and stormwater facilities under shared or common ownership.

Maintenance Considerations

Ease of maintenance shall be a paramount consideration in the design and construction of all permanent stormwater management facilities. Maintenance access which accommodates the equipment necessary to perform maintenance shall be provided.

Facilities located on private land shall be maintained by the landowner, but are subject to inspection by the City. If the facility is not being properly maintained, the City will notify the landowner of the deficiencies. If the landowner does not perform the required maintenance, the City can impose fines in accordance with the OCCGF. The City can also perform the maintenance and charge the landowner the cost of said work.

7.2.2 Outlet Control Structures and Discharge Pipes

Outlet structures which control release rates are required for all stormwater detention basins. Common outflow control structures include orifices, weirs, and skimmers. Analysis and design of outlet structures involves multiple steps. These steps are well described and documented in resources such as Chapter 8 of HEC-22, which is suggested as a reference for outlet structure design.

Specific Requirements

Outlet structures and discharge pipes should be located such that stormwater runoff leaves the site in the same manner and location as it did in the pre-developed conditions. Screening should be provided to prevent blockage for orifices smaller than 6-inches in diameter. Anti-seep collars should be placed on outlet conduits through embankments. Install removable trash and safety racks at outlet orifices, pipes, and weirs where safety or debris issues are anticipated. Outlets and stilling basins shall be designed to prevent erosion.

7.2.3 Infiltration Basins

Infiltration/retention basins are designed to reduce peak flows through infiltration and/or permanent storage of excess flows. In some cases, these facilities may be allowed to infiltrate a majority of the excess runoff and discharge the remaining volume. Infiltration basins may also be used to meet water quality requirements through infiltration into the underlying soils.

Design Parameters

The City's minimum design considerations are provided within the following section; however, it is beyond the scope of this Manual to provide detailed stormwater infiltration facility design guidance. There are many applicable design guidance references and the City urges all designers to utilize and adhere to appropriate guidance.

Setbacks - The basin shall be located at least 200-feet from springs used for drinking water supply. The basin shall be located at least 100-feet from septic drain fields. The basin shall be located at least 100-feet from shallow water supply wells.

Water Quality Treatment - If the retention/infiltration basin is used in combination with a detention basin to control the quantity of runoff, the total draw-down time for the facility shall not exceed 72-hours. The retention/infiltration basin shall be protected from high sediment loads during construction and until site vegetation is established. The WQV shall be routed through a sediment trap, sediment forebay, or other appropriate runoff treatment facility, prior to discharging to the infiltration basin in order to facilitate removal of transported sediments and debris. If other potential pollutants such as oils, grease, or fuel (gasoline and diesel) could be present in the site runoff, it may also be necessary to provide added measures to remove these contaminants.

Groundwater - The depth to the historic, seasonal high groundwater table shall be at least 3 feet below the bottom of basin.

Limitations - Infiltration basins are not permitted where hydrogeological conditions exist that indicate the potential for infiltrated stormwater to impact on- or off-site facilities or structures and where potential impacts will not be confined to the project site. Infiltration/retention basins are not appropriate for use with tight clays or other soils with low infiltration rates or in areas with a shallow water table.

Chapter 8. Definitions

Best Management Practices (BMPs) – Schedules of activities, prohibitions of practices, maintenance procedures, managerial practices, or structural features that prevent or reduce adverse impacts (soil erosion and pollutant transfer) to receiving waters. BMPs may be implemented either during construction or installed during construction for permanent use after site development is complete.

Common Plan of Development – For the purpose of this Manual, *Common Plan of Development* or *Common Plan of Development or Sal*e means an area where multiple separate and distinct construction, development or redevelopment activities may take place at different times on different schedules under one 'common plan.' The 'common plan' is defined as an announcement or piece of documentation (including a sign, public notice or hearing, sales pitch, advertisement, drawing, permit application, zoning request, computer design, etc.) or physical demarcation (including boundary signs, lot stakes surveyor marking, etc.) indicating construction, development or redevelopment activities may occur at a location or locations. A 'common plan' includes, but is not limited to, any application for any of the following City approvals inclusive of all utility, roadway, or right-of-way modifications or extensions, and any other appurtenances that must be install or modified in order to provide services or support the proposed construction site or finished development or redevelopment.

- Major subdivision plat approval.
- Minor subdivision plat approval.
- Boundary line adjustment and/or lot aggregations.
- Zoning change.
- Conditional use permit.
- Building permit.
- Planned unit development.

Erosion Control Ordinance – The relevant portions of the Official Code of the City of Great Falls including Title 13 Chapter 24 and Title 17 Chapters 48 and 52.

Final Stabilization – The time at which all soil-disturbing activities at a site have been completed and a vegetative cover has been established with a density of at least 70% of the pre-disturbance levels, or equivalent permanent, physical erosion reduction methods have been employed. Final stabilization using vegetation must be accomplished using seeding mixtures or forbs, grasses, and shrubs that are adapted to the conditions of the site. Establishment of a vegetative cover capable of providing erosion control equivalent to pre-existing conditions at the site will be considered final stabilization.

Flow Control – Type of BMP utilized to reduce the flow rate or volume of post-development runoff. These BMPs are also designed to reduce soil erosion downstream of a development.

Impervious Areas – Areas where precipitation infiltration is limited due to building roofs, roads, parking lots, sidewalks, bedrock, natural soil (clay), etc.

Low Impact Development – A method to control stormwater runoff at or near the source with a goal of mimicking natural, pre-developed stormwater runoff conditions in an urban location.

Post-development Conditions – Hydraulic or development conditions after a property is developed or redeveloped. This factors in the change in runoff coefficient due to increased impervious areas over pre-development conditions.

Pre-development Conditions – Hydraulic or development conditions prior to property development or redevelopment.

Redevelopment – Alterations of a property that change the "footprint" of a site or building in such a way that results in the disturbance of equal to or greater than one acre of land. The term is not intended to include such activities as exterior remodeling, which would not be expected to cause adverse stormwater quality impacts and offer no new opportunity for stormwater controls.

Runoff Treatment – Type of BMP utilized to remove or reduce pollutants within stormwater discharges.

Stormwater Pollution Prevention Plan (SWPPP) – A plan describing temporary best management practices to be implemented during construction to reduce stormwater impacts.

Water Quality Storm – 0.5 inches of rain in 24 hours. Runoff treatment BMPs are designed to treat runoff from this storm.

Appendix A. Permit Submittal Materials

Public Works Department
Environmental and
Engineering Divisions
1005 & 1025 25th Avenue NE
P.O. Box 5021
Great Falls, MT 59404
406-727-8390 – 406-771-1258

For Office Use Only:
Date Received:
Permit #:

STORMWATER MANAGEMENT PERMIT APPLICATION

(Complete all applicable items)

Project Information:

Site Address: _____

Description of Work: _____

Lot Number: _____ **Subdivision (if applicable):** _____

Project Classification:

❑ Residential Lot ❑ Commercial Property ❑ Subdivision

❑ City Contracted ❑ Business District Development/Redevelopment

Project Size:

Land Disturbance: _____ Impervious Surface Created or Altered: _____

Part of a larger common plan of development or sale that will disrupt more than one (1) acre? _____

Permit:

❑ Construction Site Erosion Control Permit $XX.00 (under development)

❑ Post-Construction Stormwater Management Permit $XX.00 (under development)

Contact Information:

APPLICANT: _____ Phone: _____ Fax: _____

Contact Name: _____ Email: _____

Mailing Address: _____ State _____ Zip Code _____

PROPERTY OWNER: _____ Phone: _____ Fax: _____

Mailing Address: _____ State _____ Zip Code _____

GENERAL CONTRACTOR: _____ Phone: _____ Fax: _____

Contact Name: _____ Email: _____

Mailing Address: _____ State _____ Zip Code _____

ENGINEER: _____ Phone: _____ Fax: _____

Contact Name: _____ Email: _____

Mailing Address: _____ State _____ Zip Code _____

Notes:

No land disturbance which exceeds City code thresholds is permitted on any project site without an approved City of Great Falls Construction Stormwater Management Permit

This permit is separate from any permits required by the Montana Department of Environmental Quality. A State Stormwater Construction Permit is required for all land disturbance activities equal to greater than one (1) acre or for land disturbance activities less than one (1) acre that are part of a larger common plan of development or sale that would disturb one (1) acre or more.

Public Works Department
Environmental and
Engineering Divisions
1005 & 1025 25th Avenue NE
P.O. Box 5021
Great Falls, MT 59404
406-727-8390 – 406-771-1258

For Office Use Only:
Date Received:
Permit #: _____

Project Schedule

Start Date: _____ Completion Date: _____ Final Stabilization Date: _____

Waterbodies and Storm Conveyance Systems

Waterbodies within 200 feet of Project (Lakes, Rivers, Streams, Wetlands, Sloughs, etc.):

1. _____ 3. _____
2. _____ 4. _____

Storm Conveyance Systems within 200 feet of Project (Storm Sewer, Ditches, Detention Facilities, etc.):

1. _____ 4. _____
2. _____ 5. _____
3. _____ 6. _____

Acknowledgement Certificate

I certify that I am the Owner or Owner's authorized agent. If acting as an authorized agent, I further certify that I am authorized to act as the Owners agent regarding the property at the above-referenced address for the purpose of filing applications for decisions, permits or review under the City of Great Falls Ordinance Title 13 Chapter 24 and Title 17 Chapters 48 and 52 and have full power and authority to perform on behalf of the Owner all acts required to enable the City to process and review such applications. I certify that the information on this application is true and correct and understand that I shall not start this project until this application is approved. I shall comply with the laws of the State of Montana and the ordinances of the City of Great Falls.

Signature of Legally Responsible Person — Date Signed

Name (Printed) — Title

For Office Use Only

Construction Site Erosion Control Permit	**By**	**Date**
❑ Erosion Control Permit Checklist	**Site Visit:**	
❑ Erosion Control Plan/Map	**Approval:**	
❑ Narrative		
❑ Payment - $XX.00 (under development)	**Comments:**	
Stormwater Pollution and Prevention Plan (SWPPP)		
❑ SWPPP/MT Stormwater Discharge Permit (NOI)		
❑ Payment - $XX.00 (under development)		
Post-Construction Stormwater Management Permit		
❑ Checklist (under development)		
❑ Drainage Plan/Map (usually contained in the Report)		
❑ Stormwater Management Plan Drainage Report		
❑ Digital Copy of SWMM Model (If Applicable)		
❑ Geotechnical Report / Soils Info (If Applicable)		
❑ Maintenance Agreement (w/ maint. items and O&M)		
❑ Environmental Payment - $XX (under development)		
❑ Engineering Payment -$XX (under development)		

Public Works Department
Environmental Division
1025 25th Avenue NE
P.O. Box 5021
Great Falls, MT 59404
406-727-8390

For Office Use Only:
Date Received: _____
Permit #: _____

EROSION CONTROL PERMIT CHECKLIST

(Complete all applicable items)

Project Information:

Site Address: _____

Description of Work: _____

Lot Number: _____ **Subdivision (if applicable):** _____

General Submittal Components

Component	Complete	Comment
Erosion Control Permit Application	❑ Yes	
Design Waivers or Variances (if Applicable)	❑ Yes ❑ NA	

Construction Stormwater Management Site Plan

Requirement	Addressed	Comment
Project name (e.g., subdivision name)	❑ Yes ❑ NA	
Developer and landowner name if different	❑ Yes ❑ NA	
Preparation date	❑ Yes ❑ NA	
Name of preparer	❑ Yes ❑ NA	
North arrow	❑ Yes ❑ NA	
Graphic scale	❑ Yes ❑ NA	
Legal description	❑ Yes ❑ NA	
Municipal boundaries	❑ Yes ❑ NA	
Property boundaries (bearings, lengths, curve data)	❑ Yes ❑ NA	
Easements/rights-of-ways (location, width, purpose, ownership)	❑ Yes ❑ NA	
Dedication for public use (boundaries, area, purpose)	❑ Yes ❑ NA	
No build/alteration zones	❑ Yes ❑ NA	
No ingress/egress zones	❑ Yes ❑ NA	
Adjacent land uses within 150' of subject parcel	❑ Yes ❑ NA	
Roads (names, ownership, etc)	❑ Yes ❑ NA	
Driveways and road access onto public and private roads	❑ Yes ❑ NA	

Requirement	Addressed	Comment
Sidewalks / trails	❑ Yes ❑ NA	
Existing and proposed buildings/structures within 150’ of project area	❑ Yes ❑ NA	
Fences, buffers, and berms	❑ Yes ❑ NA	
Pervious and impervious surface by type	❑ Yes ❑ NA	
Existing and Proposed Utilities (type & location)	❑ Yes ❑ NA	
Existing and Proposed Permanent Stormwater Facilities	❑ Yes ❑ NA	
Irrigation canals including diversion point(s), etc.	❑ Yes ❑ NA	
Wetlands	❑ Yes ❑ NA	
Existing vegetation (including woodlands)	❑ Yes ❑ NA	
Wildlife habitat, including critical wildlife habitat	❑ Yes ❑ NA	
Environmentally sensitive features	❑ Yes ❑ NA	
Water resources (rivers, ponds, etc.) within 200’ of project area	❑ Yes ❑ NA	
Floodplains	❑ Yes ❑ NA	
Ground contours when the average slopes exceed 10 percent	❑ Yes ❑ NA	
Existing and Proposed Construction Stormwater Management BMPs	❑ Yes ❑ NA	
Limits of clearing and grading	❑ Yes ❑ NA	
Existing and proposed site topography	❑ Yes ❑ NA	
Existing and proposed runoff direction	❑ Yes ❑ NA	
Protection of waterways, receiving surface waters and natural resources	❑ Yes ❑ NA	
Stockpile locations, staging areas and access points defined	❑ Yes ❑ NA	
Construction Stormwater Management Plan is phased with construction	❑ Yes ❑ NA	
Erosion and Sediment Control Requirements Erosion and sediment control BMPs are designed and specified to:		
Control stormwater volume and velocity within the site to minimize soil erosion through use of controls such as check dams, fiber rolls, etc.	❑ Yes ❑ NA	
Control stormwater discharges, including both peak flowrates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and streambank erosion through use of controls such as stilling basins, fiber rolls, etc.	❑ Yes ❑ NA	
Minimize the amount of soil exposed during construction activity	❑ Yes ❑ NA	

Requirement	Addressed	Comment
Minimize the disturbance of steep slopes	❑ Yes ❑ NA	
Minimize sediment discharges from the site through use of perimeter controls such as silt fence, fiber rolls, diversion berms, etc.	❑ Yes ❑ NA	
Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible	❑ Yes ❑ NA	
Minimize soil compaction and, unless infeasible, preserve topsoil	❑ Yes ❑ NA	
Soil Stabilization Requirements The following soil stabilization requirements are clearly communicated:		
Stabilization of disturbed areas must be initiated immediately whenever any clearing, grading, excavating or other earth disturbing activities have permanently ceased on any portion of the site, or temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days *Identify where this is communicated within the comment box (e.g. Site Plan, Page __ of SWPPP, etc.)*	❑ Yes ❑ NA	
If initiating vegetative stabilization measures immediately is infeasible, alternative stabilization measures must be specified	❑ Yes ❑ NA	
Pollution Prevention Measures Pollution prevention measures are specified to:		
Specify treatment of wash waters in a sediment basin or alternative control that provides equivalent or better treatment prior to discharge	❑ Yes ❑ NA	
Minimize the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste and other materials present on the site to precipitation and to storm water	❑ Yes ❑ NA	
Minimize the discharge of pollutants from spills and leaks and implement chemical spill and leak prevention and response procedures	❑ Yes ❑ NA	
Prohibited Discharges		
Wastewater from washout of concrete is prohibited or managed by appropriate controls *Identify where this is communicated within the comment box*	❑ Yes ❑ NA	
A statement (or statements) prohibits discharges of the following: *Identify where these requirements are communicated within the comment box*		
Wastewater from washout and cleanout of stucco, paint, from release oils, curing compounds and other construction materials	❑ Yes ❑ NA	
Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance	❑ Yes ❑ NA	
Soaps or solvents used in vehicle and equipment washing	❑ Yes ❑ NA	

Dewatering Requirements		
Requirement	**Addressed**	**Comment**
If applicable, discharges from dewatering activities are managed by appropriate controls such as sedimentation basins, sediment traps, etc. *Note: This does not preclude the contractor from the requirement to obtain a dewatering permit from MT DEQ.*	❑ Yes ❑ NA	
Surface Outlets		
Requirement	**Addressed**	**Comment**
When discharging from basins and impoundments, outlet structures that withdraw water from the surface are used (unless infeasible)	❑ Yes ❑ NA	
Stormwater Pollution Prevention Plan Requirements *For sites not subject to the Montana DEQ Construction General Permit.* *Sites subject to the Montana DEQ Construction General Permit shall submit a SWPPP consistent with the Montana DEQ Construction General Permit Requirements.*		
Requirement	**Addressed**	**Comment**
Description of project activity	❑ Yes ❑ NA	
Total disturbed area	❑ Yes ❑ NA	
Existing impervious area	❑ Yes ❑ NA	
List surface waters and storm conveyance systems within 200' of project	❑ Yes ❑ NA	
Description of outfall and receiving surface waters	❑ Yes ❑ NA	
Description of site soil	❑ Yes ❑ NA	
Description of watershed tributary to site	❑ Yes ❑ NA	
A sequence of construction of the development site, including stripping and clearing; rough grading; construction of utilities, infrastructure, and buildings; and final grading and landscaping. Sequencing shall identify the expected date on which clearing will begin, the estimated duration of exposure of cleared areas, areas of clearing, installation of temporary erosion and sediment control measures, and establishment of permanent vegetation.	❑ Yes ❑ NA	
Seeding mixtures and rates, types of sod, method of seedbed preparation, expected seeding dates, type and rate of lime and fertilizer application, and kind and quantity of mulching for both temporary and permanent vegetative control measures.	❑ Yes ❑ NA	
Provisions for maintenance of control facilities, including easements and estimates of the cost of maintenance.	❑ Yes ❑ NA	

Certified By: _____ Date: _____

Signature: _____

DATE RECEIVED

CITY OF GREAT FALLS
PUBLIC WORKS DEPARTMENT
CONSTRUCTION EROSION CONTROL PERMIT PLAN REVIEW CHECKLIST

NAME OF PROJECT	PROJECT FILE NO.	ADDRESS
TOTAL PROJECT ACRES		TOTAL DISTURBED ACRES
Latitude:	Longitude:	
GPS LOCATION OF CONSTRUCTION SITE		
APPLICANT	ADDRESS	PHONE NUMBER
OWNER *(If different from Applicant)*	ADDRESS	PHONE NUMBER

Review History

First Review

Plan Received on: _____ **Approved/Denied:** _____
Review Completed on: _____ **Comments:** _____
Reviewed by: _____ _____

Second Review

Plan Received on: _____ **Approved/Denied:** _____
Review Completed on: _____ **Comments:** _____
Reviewed by: _____ _____

Third Review

Plan Received on: _____ **Approved/Denied:** _____
Review Completed on: _____ **Comments:** _____
Reviewed by: _____ _____

REPORT OF TECHNICAL REVIEW

___ The Construction Stormwater Management Plan for the above named project or activity **includes** the necessary components identified within the attached checklist.

___ The Construction Stormwater Management Plan for the above named project or activity **does not include** the necessary components identified within the attached checklist through failure to include the following:

_____

_____

_____

Review by: _____

Signature: _____ **Date:** _____

Project Name: _____ Applicant: _____

General Information	Complete	Incomplete	N/A
1. Describe the project location (address, parcel number, etc…)			
a. Description of project activity			
2. Areas (ac)			
a. Total disturbed area			
b. Existing impervious area			
3. Construction schedule/sequence			
4. Identify site features			
a. Limits of improvements relative to neighbors or a Vicinity Map			
b. Limits of clearing and grading			
c. Existing vegetation delineated			
d. Existing and proposed site topography			
e. Existing and proposed runoff direction			
f. Surface waters and storm conveyance systems within 200' of project			
g. Description of outfall and receiving surface waters			
h. Protection of waterways, receiving surface waters and natural resources			
i. Construction Stormwater Management Plan is phased with construction			
j. Stockpile locations, staging areas and access points defined			
k. Show all areas of construction, including but not limited to: structures, retaining walls, roads, drives, utilities, trenches, scaffolds, catch basins, etc.			
l. Description of site soil			
m. Description of watershed tributary to site			
5. Maintenance Plan for Control Facilities			
6. Copies of Design Waivers or Variances			
7. Copy of NOI and SWPPP as submitted to DEQ, if applicable			
Erosion and Sediment Controls			
1. Design considerations and erosion control BMPs are specified to:			
a. Control stormwater volume and velocity within the site to minimize soil erosion through use of controls such as check dams, fiber rolls, etc.			
b. Control stormwater discharges, including both peak flowrates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and streambank erosion through use of controls such as stilling basins, fiber rolls, etc.			
c. Minimize the amount of soil exposed during construction activity			
d. Minimize the disturbance of steep slopes			

Project Name: _____ Applicant: _____

Erosion and Sediment Controls (cont.)	Complete	Incomplete	N/A
e. Minimize sediment discharges from the site through use of perimeter controls such as silt fence, fiber rolls, diversion berms, etc.			
f. Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible			
g. Minimize soil compaction and, unless infeasible, preserve topsoil			
Soil Stabilization			
1. The following soil stabilization requirements are clearly communicated:			
a. Stabilization of disturbed areas must be initiated immediately whenever any clearing, grading, excavating or other earth disturbing activities have permanently ceased on any portion of the site, or temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days			
b. If initiating vegetative stabilization measures immediately is infeasible, alternative stabilization measures must be specified			
Dewatering			
1. If applicable, discharges from dewatering activities are managed by appropriate controls such as sedimentation basins, sediment traps, etc. *Note: This does not preclude the contractor from the requirement to obtain a dewatering permit from MT DEQ.*			
Pollution Prevention Measures			
1. Pollution prevention measures are specified to:			
a. Specify treatment of wash waters in a sediment basin or alternative control that provides equivalent or better treatment prior to discharge			
b. Minimize the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste and other materials present on the site to precipitation and to storm water			
c. Minimize the discharge of pollutants from spills and leaks and implement chemical spill and leak prevention and response procedures			
Prohibited Discharges			
1. Wastewater from washout of concrete is prohibited or managed by appropriate controls			
2. A statement (or statements) which prohibit discharges of the following:			
a. Wastewater from washout and cleanout of stucco, paint, from release oils, curing compounds and other construction materials			
b. Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance			
c. Soaps or solvents used in vehicle and equipment washing			
Surface Outlets			
1. When discharging from basins and impoundments, outlet structures that withdraw water from the surface are used (unless infeasible)			

DATE RECEIVED

CITY OF GREAT FALLS
PUBLIC WORKS DEPARTMENT
POST-CONSTRUCTION STORMWATER MANAGEMENT
PLAN REVIEW CHECKLIST

NAME OF PROJECT	PROJECT FILE NO.	ADDRESS
TOTAL PROJECT ACRES		TOTAL DISTURBED ACRES
Latitude:	Longitude:	
GPS LOCATION OF CONSTRUCTION SITE		
APPLICANT	ADDRESS	PHONE NUMBER
OWNER *(If different from Applicant)*	ADDRESS	PHONE NUMBER

Review History

First Review

Plan Received on: _____ **Approved/Denied:** _____
Review Completed on: _____ **Comments:** _____
Reviewed by: _____ _____

Second Review

Plan Received on: _____ **Approved/Denied:** _____
Review Completed on: _____ **Comments:** _____
Reviewed by: _____ _____

Third Review

Plan Received on: _____ **Approved/Denied:** _____
Review Completed on: _____ **Comments:** _____
Reviewed by: _____ _____

REPORT OF TECHNICAL REVIEW

____ The Stormwater Management Plan for the above named project or activity **includes** the necessary post-construction controls in order to comply with the State and local post-construction stormwater requirements (as identified within the attached checklist).

____ The Stormwater Management Plan for the above named project or activity **does not include** the necessary post-construction controls in order to comply with the State and local post-construction stormwater requirements (as identified within the attached checklist) through failure to include the following:

_____

_____

_____

Review by: _____

Signature: _____ **Date:** _____

Project Name: _____ Applicant: _____

General Information	Complete	Incomplete	N/A
1. Location			
a. Address, subdivision name, legal description, etc…			
2. Type of development (residential, commercial, etc...)			
3. Areas (ac)			
a. Total disturbed area			
b. Existing impervious area			
c. Post-development impervious area			
4. Drainage basin maps are provided which clearly label the following:			
a. Existing basin boundaries			
b. Existing time of concentration flowpaths for each basin			
c. Post-development basin boundaries			
d. Post-development time of concentration flowpaths for each basin			
e. Discharge location(s)			
f. Receiving waters within 200 feet of project are identified			
5. Montana Licensed Engineer Stamp			
Drainage Plan Content			
1. Topographic map of existing and finished grade contours at 2-foot max intervals			
2. Arrows indicating the direction of flow			
3. Location of each permanent stormwater control			
4. Plan and profile of each permanent stormwater control			
5. Invert elevations, slopes, and lengths of storm drain facilities			
6. Size, types, invert elevations and lengths of all culverts and pipe systems			
7. Discharge points clearly labeled			
8. Receiving surface waters identified			
9. Existing on-site natural resources identified and protected			
10. Jurisdictional waterways, FEMA floodplains identified			
Calculations and Design Documentation			
1. Hydrology calculations			
a. State runoff method used (rational, SWMM, etc…)			
b. State modeling constants and assumptions			
c. Description of design storms (frequency, depth, duration)			
d. Existing and post-development land uses			

Project Name: _____ Applicant: _____

Calculations and Design Documentation (Continued)	Complete	Incomplete	N/A
e. Existing and post-development peak runoff rate for each applicable design storm			
f. Existing and post-development runoff volume for each applicable design storm			
2. Post-construction BMP sizing calculations			
a. State design requirements (0.5-inch requirement, TSS removal, or other)			
b. Required permanent controls capacities, flow rates, and operating levels			
c. Sizing calculations with results			
d. A statement documenting compliance with design requirements (Appendix C)			
e. If 0.5-inch or TSS removal requirements are not met, provide documentation showing the impracticability of infiltration, evapotranspiration, capture for reuse, and treatment.			
3. Culvert and pipe system capacities and outlet velocities			
4. Ditch capacities and velocities			
Additional Information			
1. Permits, easements, setbacks, and discharge agreements			
2. Floodplain maps			
3. Operations and Maintenance Manual for each permanent stormwater control			
a. Identify the owner			
b. Identify the party responsible for long-term O&M			
c. A schedule of inspection and maintenance for routine and non-routine maintenance tasks to be conducted			
d. System failure and replacement criteria to define the structure's performance requirements			
4. Soils information, Geotechnical Report, Percolation Test Report, or Hydrogeological Report			

Appendix B. Drainage Report Requirements and Example Calculations

Drainage Report Requirements

The Drainage Report shall contain the information and calculations supporting the design of the storm drainage system detailed in the engineering drawings. Such information and calculations shall be presented in a neat and orderly fashion to facilitate review. Such information shall meet the criteria of the Post-Construction Stormwater Permit Design Review Checklist (Appendix A). The report shall be prepared by a licensed professional engineer, an example certification statement is included in Appendix C.

The report shall include an analysis of the area under consideration in reference to the land use, historical and developed conditions, existing topography, contributing runoff from upstream areas, control easements or features, permanent erosion and sedimentation control measures and facilities, and continuity with the existing drainage patterns and any relevant storm drainage area master plans. Natural drainage ways are to be used whenever possible.

The report shall contain the hydrologic analysis including areas, storm frequencies, rainfall intensities, runoff coefficients, times of concentration, adjustments for infrequent storms, and all runoff computations.

Calculations of street flows for both initial and major storms shall be provided with regard to street encroachments, theoretical capacities and allowable gutter flows. The report shall include the calculations for sizing of storm sewer systems, including inlets, culverts and open channels.

All calculations, mass diagrams, and/or hydrographs required to size the detention facility and determine its discharge shall also be included. Infiltration systems shall include soils information and shall consider groundwater. Calculations for specific detention time shall be provided if required by the City Engineer.

All drainage reports shall include a cover indicating the date, the name of the project or subdivision, the engineer designing the system, a statement of compliance with the storm drainage design criteria, and shall be stamped and signed by a Montana licensed professional engineer.

EXAMPLE CALCULATION - STORAGE VOLUME REQUIRED BY USE OF THE RATIONAL METHOD

DEVELOPMENT: EXAMPLE
STORM DRAINAGE CALCULATION BY:
DATE:

ALLOWABLE DISCHARGE FOR 5 YEAR POST DEVELOPED CONDITION

	Total Area	Undetained Area	
	5-Yr	100-Yr	
A =	0.85	0.1	Acres
T_c =	7	5	Min
Cavg =	0.7	0.4	
C_f =	1	1.25	
I =	2.6	6	
Q= (C_f)(C)(I)(A) =	1.55	0.30	cfs

Allowable Orifice Discharge = 1.55 cfs - 0.30 cfs = 1.25 cfs

Land Use	**Commercial**	
Total Area (Ac)	**0.85**	
Composite Runoff Factor	**0.70**	
Adjusted Runoff Factor Using 1.25 Frequency Factor	**0.875**	
Allowable Orifice Discharge (cfs)	**1.25**	
Maximum Storage Capacity (cu ft)	**2,001**	Iterate until overflow rate is 0

Time (Min)	5-Yr 2-Hr Intensity (in/hr)	5-Yr 2-Hr Runoff Rate (cfs)	100-Yr 2-Hr Intensity (in/hr)	100-Yr 2-Hr Runoff Inflow (cfs)	* Outflow Rate (cfs)	5 Min Volume Required (cf)	Volume Accumulated (cf)	Volume Provided (cf)	Overflow Rate (cfs)	Volume Stored (cf)
5	0.04	0.02	0.08	0.06	0.02	12	12	2,001	0.00	12
10	0.17	0.10	0.24	0.18	0.09	27	39	2,001	0.00	39
15	2.90	1.73	6.10	4.54	0.17	1311	1,350	2,001	0.00	1,350
20	1.50	0.89	2.90	2.16	0.98	354	1,704	2,001	0.00	1,704
25	1.19	0.71	2.41	1.79	1.10	207	1,911	2,001	0.00	1,911
30	0.97	0.58	1.98	1.47	1.17	90	2,001	2,001	0.00	2,001
35	0.76	0.45	1.57	1.17	1.19	-6	1,995	2,001	0.00	1,995
40	0.61	0.36	1.30	0.97	1.19	-66	1,929	2,001	0.00	1,929
45	0.49	0.29	1.01	0.75	1.17	-126	1,803	2,001	0.00	1,803
50	0.42	0.25	0.84	0.62	1.13	-153	1,650	2,001	0.00	1,650
55	0.36	0.21	0.71	0.53	1.08	-165	1,485	2,001	0.00	1,485
60	0.32	0.19	0.59	0.44	1.03	-177	1,308	2,001	0.00	1,308
65	0.28	0.17	0.52	0.39	0.97	-174	1,134	2,001	0.00	1,134
70	0.24	0.14	0.44	0.33	0.90	-171	963	2,001	0.00	963
75	0.23	0.14	0.37	0.28	0.83	-165	798	2,001	0.00	798
80	0.20	0.12	0.32	0.24	0.75	-153	645	2,001	0.00	645
85	0.19	0.11	0.28	0.21	0.68	-141	504	2,001	0.00	504
90	0.17	0.10	0.25	0.19	0.60	-123	381	2,001	0.00	381
95	0.14	0.08	0.24	0.18	0.52	-102	279	2,001	0.00	279
100	0.13	0.08	0.23	0.17	0.45	-84	195	2,001	0.00	195
105	0.11	0.07	0.22	0.16	0.37	-63	132	2,001	0.00	132
110	0.08	0.05	0.20	0.15	0.31	-48	84	2,001	0.00	84
115	0.07	0.04	0.19	0.14	0.24	-30	54	2,001	0.00	54
120	0.06	0.04	0.18	0.13	0.20	-21	33	2,001	0.00	33
125		0.00	0.00	0.00	0.15	-45	0	2,001	0.00	0
Volume Required							**2,001**			

*Head computed by multiplying the maximum head times the proportion of the incremental volume accumulated to the total volume

*OUTFLOW RATES BASED ON CIRCULAR ORIFICE Q=C*A*(2GH)^1/2

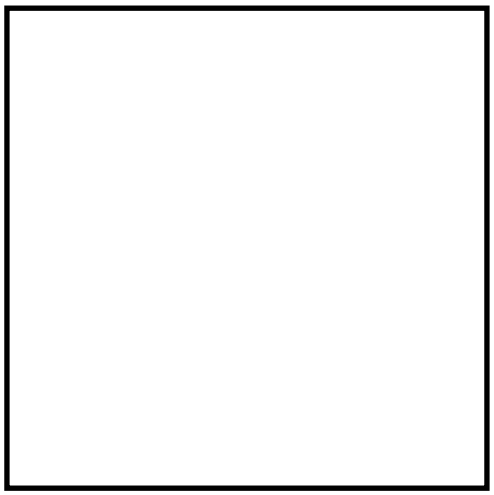
HEAD (FT)	RADIUS (IN)	AREA (SF)	OUTFLOW (CFS)
1.50	3.00	0.196	1.194
1.40	3.00	0.196	1.154
1.30	3.00	0.196	1.112
1.20	3.00	0.196	1.068
1.10	3.00	0.196	1.023
1.00	3.00	0.196	0.975
0.90	3.00	0.196	0.925
0.70	3.00	0.196	0.816
0.50	3.00	0.196	0.690
0.30	3.00	0.196	0.534
0.20	3.00	0.196	0.436
0.10	3.00	0.196	0.308
0.00	3.00	0.196	0.000
ORIFICE COEFFICIENT		0.62	

MAXIMUM HEAD (FT)	ORIFICE AREA (SF)
1.50	0.196

Appendix C. Templates

EXAMPLE CERTIFICATION

I hereby state that this Drainage Report has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community of professional engineers. The analysis has been prepared utilizing procedures and practices specified by the City of Great Falls and within the standard accepted practices.



PE STAMP OR SEAL

_____ _____

Signature **Date**

MAINTENANCE AGREEMENT FOR _____PRIVATE STORMWATER SYSTEMS

This Maintenance Agreement made and entered into by and between [NAME OF GRANTOR], hereinafter referred to as "GRANTOR," and the CITY OF GREAT FALLS, hereinafter referred to as the "CITY."

WITNESSETH

WHEREAS, the CITY is authorized and required to regulate and control disposition of storm and surface waters within the CITY OF GREAT FALLS as set forth by CITY ordinances; and

WHEREAS, the GRANTOR is the owner of a certain tract or parcels of land hereafter referred to as "the property," more particularly described as ONE PARCEL LOCATED IN THE XX OF SECTION XX, T XX N, R X E, PM MT, CITY OF GREAT FALLS, CASCADE COUNTY, MONTANA. All those certain lots, pieces or parcels of land, together with buildings and improvements thereon, and the appurtenances thereunto belonging, lying, situated and being in the CITY of GREAT FALLS as shown on [COS FILING #XXXX], duly recorded in the Cascade County Clerk & Recorder's Office in Deed Book or Plat Book [number] at page [number] reference to which the plat is hereby made for a more particular description thereof.

WHEREAS, the GRANTOR desires to construct certain improvements on the property which will alter existing storm and surface water conditions on the property and adjacent lands; and

WHEREAS, in order to accommodate and regulate these anticipated changes in existing storm and surface water flow conditions, the GRANTOR, its heirs and assigns, desire to build and maintain at their expense a storm and surface water management facility and system. This is shown on the following plans:

Figure name/Figure number, date on figure
Figure name/Figure number, date on figure; and

WHEREAS, the CITY has reviewed and approved these plans subject to the execution of this agreement;

NOW THEREFORE, in consideration of the benefit received by the GRANTOR, its heirs and assigns, and as a result of the CITY approval of its plans, the GRANTOR, it heirs and assigns, with full authority to execute deeds, deeds of trust, other covenants and all rights, title and interest in the property described above hereby covenant with the CITY as follows:

1. GRANTOR, its heirs and assigns shall construct and perpetually maintain, at its sole expense, the storm drainage facility and system in strict accordance with the plan approval granted by the CITY. The storm drainage facility and system referred to throughout this document consists of (list and/or describe the components of the on-site storm drainage facility).

2. Under this Agreement, the CITY will perform inspections of the property and improvements and provide approvals or Certificates of Occupancy. Providing a substantive review of the plans, property and/or improvements, is only performing a general public duty and does not assume a specific duty to GRANTOR or third parties. The CITY's review, approvals, and/or inspections are not an endorsement of the plan or construction. GRANTOR is exclusively responsible for ensuring that its plans and construction comply with applicable regulations and/or laws. GRANTOR must rely on its own experts as to the sufficiency of the development or individual properties therein. Neither the GRANTOR nor any third party may rely upon the CITY's limited review or approval anticipated herein.

3. "Record" drawings of the storm drainage facility and system shall be supplied to the City of Great Falls Environmental Division upon completion of the construction, whether or not changes to the original plan documents are made. "Record" drawings shall be delivered to:

Environmental Division
C/O Public Works Department
PO Box 5021
Great Falls, MT 59403

4. GRANTOR, its heirs and assigns shall, at its sole expense, make such changes or modifications to the storm drainage facility and system. Changes or modifications may, in the CITY'S discretion, be determined necessary to ensure that the facility and system are properly maintained and continues to operate as designed and approved.

5. The CITY, it agents, employees and contractors shall have the perpetual right of ingress and egress over the property of the GRANTOR, its heirs assigns, and the right to inspect at reasonable times and in a reasonable manner, the storm drainage facility and system. Inspection is in order to insure that the system is being properly maintained and is continuing to perform in an adequate manner. Attachment A (TITLE OF ATTACHED O & M PLAN/MANUAL) to this agreement provides a list of items to be inspected by the CITY.

6. The GRANTOR, its heirs and assigns agree that should it fail to correct any defects in the above described facility and system within fifteen (15) days from issuance of written notice, or shall fail to maintain the facility in accordance with the approved design standards and in accordance with the law and applicable regulations, or in the event of an emergency as determined by the CITY in its sole discretion, the CITY is authorized to enter the property to make all repairs, and to perform all maintenance, construction and reconstruction the CITY deems necessary. The CITY shall assess the GRANTOR, its heirs or assigns for the cost of the work, both direct and indirect, and applicable penalties. Said assessment shall be a lien against all properties described within this Maintenance Agreement and may be placed on the property tax bills of said properties and collected as ordinary taxes by the CITY.

7. The GRANTOR warrants that it has conducted site investigations sufficient to be aware of all natural conditions, including but not limited to flooding and expansive soils, that may affect the installation of improvements on the site and that the plans submitted account for all such conditions. The GRANTOR indemnifies, defends, and holds the CITY harmless for natural conditions and for any faults in its own assessment of those conditions.

8. GRANTOR indemnifies, defends, releases and holds harmless the City, and its officials, officers, agents, servants and employees, against any loss or damage to property or any injury to or death of any person arising out of or resulting from the construction, installation, operation, ownership or maintenance of the project or which is proximately caused by the Owner, its agents, officers and/or assigns; provided that the indemnity shall not apply if and to the extent such loss or damage is caused by the gross negligence or willful misconduct of the City, its agents or employees.

9. GRANTOR agrees to not transfer or assign responsibility under this agreement without the CITY's express written consent, which shall not be unreasonably withheld. The GRANTOR shall provide the CITY written notice of any intent to sell, assign, or transfer all or a portion of the Property in advance of such action. Notification shall be provided to:

Environmental Division
C/O Public Works Department
PO Box 5021
Great Falls, MT 59403

10. The provisions of this Agreement shall be severable and if any phase, clause, sentence or provision is declared unconstitutional, or the applicability of the GRANTOR, its heirs and assigns is held invalid, the remainder of this Covenant shall not be affected thereby.

11. *Default.* The GRANTOR acknowledges that default under this agreement (as described below) may cause the CITY to rescind the CITY's approval to the GRANTOR to discharge storm water from the facility to the MS-4; as well as, cause the CITY to exercise other rights (also described below):

    A. *Cures Taking More than Thirty Days.* No party shall be in default under this Agreement unless it has failed to perform, as required under this Agreement, for a period of thirty (30) days after written notice of default from the other party. Each notice of default shall specify the nature of the alleged default, and the manner in which the default may necessarily be cured satisfactorily. If the nature of the alleged default is such that it cannot be reasonably cured within the thirty (30) day period, then commencement of the cure within such time period and the diligent prosecution to completion of the cure shall be deemed a cure.

    B. *Rights of the CITY.* The GRANTOR acknowledges that failure to install the [storm drainage facility and system] identified in this Agreement, in accordance with the approved plans, is a breach and may void this Agreement, if the GRANTOR fails to cure consistent with this Agreement. In the event that the CITY is not in default under this Agreement, the CITY shall have all rights and remedies provided by law or equity, including but not limited to those provided in the OCCGF (including penalties) and specific performance.

    C. *No Third-Party Beneficiaries.* This Agreement is made and entered into for the sole protection and benefit of the parties hereto and their successors and assigns. No other person shall have any right of action based upon any provision of this Agreement.

12. *Covenants Running with the Land, Easements.* This Agreement and the approvals by the CITY, on which it is based, run with the land and bind the present GRANTOR's, their devisees, heirs, successors, and assigns, and any and all parties claiming by, through, or under them, shall be taken to agree and covenant with each of the parties to the Agreement, and to conform to the provisions, covenants and terms of this Agreement. This Agreement applies to any party to whom that land is conveyed by any means, in whole or in part, and is binding on them, as if they were the GRANTOR who has signed below. To the extent that the improvements are to be located on the private property, the GRANTOR will grant to the CITY from time to time such easements, rights-of-way and similar licenses the CITY may reasonably request.

13. This Agreement shall be recorded at the Clerk & Recorder's Office of CASCADE COUNTY at the GRANTOR's expense.

14. The CITY's designated contact with GRANTOR is _____, phone number: _____ mailing address: _____. GRANTOR may change its point of contact by giving the CITY fifteen (15) days written notice of the change, as provided herein.

15. In the event that the CITY shall determine its sole discretion at any future time that the facility is no longer required, then the CITY shall at the request of the GRANTOR, its heirs and assigns execute a release of this Maintenance Agreement, which the GRANTOR, its heirs and assigns shall record, in the Clerk & Recorder's Office of CASCADE COUNTY at its expense.

16. The provisions, covenants and terms of this Agreement shall run with the land.

17. The failure to enforce any particular provision of this Agreement on any particular occasion shall not be deemed a waiver by any party of any of its rights hereunder, nor shall it be deemed to be a waiver of subsequent or continuing breaches of that provision, unless such a waiver be expressed in a writing by the party to be bound.

18. *Specific Performance.* The parties specifically agree that damages may not be an adequate remedy for breach of this Agreement, and that the parties are entitled to compel specific performance of all material terms of this Agreement by any party in default hereof, in addition to any other legal remedies.

19. The Agreement represents the entire agreement of the parties with respect to the subject matter thereof. There are no other agreements, oral or written, except as expressly set forth herein and this Agreement supersedes all previous agreements, oral and written.

20. This Agreement may be executed in counterparts, each of which shall be deemed an original.

IN WITNESS THEREOF, the GRANTOR and CITY have caused this Agreement to be executed and intend to be legally bound thereby as of the later of the dates set forth below.

[GRANTOR]

By_____

Print Name: _____

Print Title: _____

Date: _____

State of Montana

County of _____

This instrument was signed before me on

NOTARIAL SEAL

_____ by
Date

_____.
Print name of signer(s)

_____
Notary Signature

City of Great Falls, Montana

By_____
Gregory T. Doyon, City Manager

Date: _____

ATTEST:

(Seal of the City)

_____
Lisa Kunz, City Clerk

APPROVED AS TO FORM

By_____

David Dennis, City Attorney

* By law, the City Attorney may only advise or approve contract or legal document language on behalf of the City of Great Falls, and not on behalf of other parties. Review and approval of this document was conducted solely from the legal perspective, and for the benefit, of the City of Great Falls. Other parties should not rely on this approval and should seek review and approval by their own respective counsel.

Appendix D. Additional Hydrology Information

Table D1: Manning's Roughness Coefficient for Overland Sheet Flow

Surface Description	n
Smooth asphalt	0.011
Smooth concrete	0.012
Ordinary concrete lining	0.013
Good wood	0.014
Brick with cement mortar	0.014
Vitrified clay	0.015
Cast iron	0.015
Corrugated metal pipe	0.024
Cement rubble surface	0.024
Fallow (no residue)	0.05
Cultivated soils	
Residue cover < 20%	0.06
Residue cover > 20%	0.17
Range (natural)	0.13
Grass	
Short grass prairie	0.15
Dense grasses	0.24
Bermuda grass	0.41
Woods*	
Light underbrush	0.40
Dense underbrush	0.80
*When selecting n, consider cover to a height of about 30 mm. This is only part of the plant cover that will obstruct sheet flow.	

Source: FHWA HEC-22, Table 3-2

Table D2: Intercept Coefficients for Velocity vs. Slope Relationship

Land Cover/Flow Regime	k
Forest with heavy ground litter; hay meadow (overland flow)	0.076
Trash fallow or minimum tillage cultivation; contour or strip cropped; woodland (overland flow)	0.152
Short grass pasture (overland flow)	0.213
Cultivated straight row (overland flow)	0.274
Nearly bare and untilled (overland flow); alluvial fans in western mountain regions	0.305
Grassed waterway (shallow concentrated flow)	0.457
Unpaved (shallow concentrated flow)	0.491
Paved area (shallow concentrated flow); small upland gullies	0.619

Source: FHWA HEC-22, Table 3-3

Table D3: Manning's Coefficient (n) for Pipes

Conduit Material	Manning's n*
Concrete Pipe	0.013
CMP	0.025
Plastic pipe (smooth)	0.010
Pavement/gutter sections	0.016

Table D4: 2-Hour Design Storm Rainfall Distribution

2 Year – 2 Hour Storm		
5-Minute Time Increment	Rainfall (Inches/5 Min.)	Rainfall Intensity (Inches/Hr)
1	0.003	0.04
2	0.020	0.24
3	0.183	2.20
4	0.092	1.10
5	0.071	0.85
6	0.057	0.68
7	0.045	0.54
8	0.037	0.44
9	0.028	0.34
10	0.023	0.28
11	0.018	0.22
12	0.017	0.20
13	0.016	0.19
14	0.015	0.18
15	0.014	0.17
16	0.013	0.16
17	0.012	0.14
18	0.011	0.13
19	0.010	0.12
20	0.009	0.11
21	0.008	0.10
22	0.007	0.08
23	0.006	0.07
24	0.005	0.06
Total	0.720 Inches	

5 Year – 2 Hour Storm		
5-Minute Time Increment	Rainfall (Inches/5 Min.)	Rainfall Intensity (Inches/Hr)
1	0.003	0.04
2	0.014	0.17
3	0.242	2.90
4	0.125	1.50
5	0.099	1.19
6	0.081	0.97
7	0.063	0.76
8	0.051	0.61
9	0.041	0.49
10	0.035	0.42
11	0.030	0.36
12	0.027	0.32
13	0.023	0.28
14	0.020	0.24
15	0.019	0.23
16	0.017	0.20
17	0.016	0.19
18	0.014	0.17
19	0.012	0.14
20	0.011	0.13
21	0.009	0.11
22	0.007	0.08
23	0.006	0.07
24	0.005	0.06
Total	0.970 Inches	

Table D4: 2-Hour Design Storm Rainfall Distribution (continued)

10 Year – 2 Hour Storm			100 Year – 2 Hour Storm		
5-Minute Time Increment	Rainfall (Inches/5 Min.)	Rainfall Intensity (Inches/Hr)	5-Minute Time Increment	Rainfall (Inches/5 Min.)	Rainfall Intensity (Inches/Hr)
1	0.004	0.05	1	0.007	0.08
2	0.028	0.34	2	0.020	0.24
3	0.308	3.70	3	0.508	6.10
4	0.159	1.91	4	0.242	2.90
5	0.121	1.45	5	0.201	2.41
6	0.083	1.00	6	0.165	1.98
7	0.074	0.89	7	0.131	1.57
8	0.060	0.72	8	0.108	1.30
9	0.050	0.60	9	0.084	1.01
10	0.042	0.50	10	0.070	0.84
11	0.034	0.41	11	0.059	0.71
12	0.031	0.37	12	0.049	0.59
13	0.028	0.34	13	0.043	0.52
14	0.025	0.30	14	0.037	0.44
15	0.021	0.25	15	0.031	0.37
16	0.019	0.23	16	0.027	0.32
17	0.017	0.20	17	0.023	0.28
18	0.015	0.18	18	0.021	0.25
19	0.013	0.16	19	0.020	0.24
20	0.011	0.13	20	0.019	0.23
21	0.009	0.11	21	0.018	0.22
22	0.007	0.08	22	0.017	0.20
23	0.006	0.07	23	0.016	0.19
24	0.005	0.06	24	0.015	0.18
Total	1.170 Inches		Total	1.931 Inches	

Table D5: 24-Hour Design Storm Rainfall Data

	Incremental Rainfall (inches)					
Hour	**2yr-24hr**	**5yr-24hr**	**10yr-24hr**	**25yr-24hr**	**50yr-24hr**	**100yr-24hr**
1	0.01	0.03	0.02	0.02	0.03	0.01
2	0.01	0.08	0.08	0.08	0.21	0.11
3	0.02	0.04	0.02	0.10	0.23	0.18
4	0.05	0.07	0.09	0.06	0.10	0.12
5	0.07	0.01	0.18	0.12	0.06	0.06
6	0.06	0.16	0.16	0.14	0.07	0.08
7	0.02	0.18	0.17	0.13	0.13	0.15
8	0.06	0.25	0.13	0.21	0.20	0.22
9	0.09	0.22	0.15	0.16	0.11	0.13
10	0.04	0.33	0.24	0.18	0.02	0.03
11	0.13	0.14	0.16	0.14	0.08	0.14
12	0.18	0.19	0.12	0.24	0.12	0.12
13	0.20	0.11	0.15	0.16	0.17	0.19
14	0.15	0.02	0.13	0.30	0.09	0.11
15	0.13	0.04	0.11	0.18	0.35	0.34
16	0.09	0.05	0.20	0.20	0.17	0.16
17	0.08	0.05	0.12	0.14	0.06	0.20
18	0.04	0.04	0.13	0.19	0.15	0.75
19	0.06	0.03	0.07	0.11	0.50	0.55
20	0.05	0.06	0.05	0.20	0.70	0.15
21	0.02	0.02	0.03	0.06	0.06	0.06
22	0.05	0.03	0.04	0.04	0.01	0.08
23	0.06	0.01	0.06	0.03	0.02	0.09
24	0.03	0.04	0.01	0.01	0.01	0.02
Total	1.70”	2.20”	2.62”	3.20”	3.65”	4.05”

Source: Based on NWS Records from 1898-1989 and NOAA Atlas 2

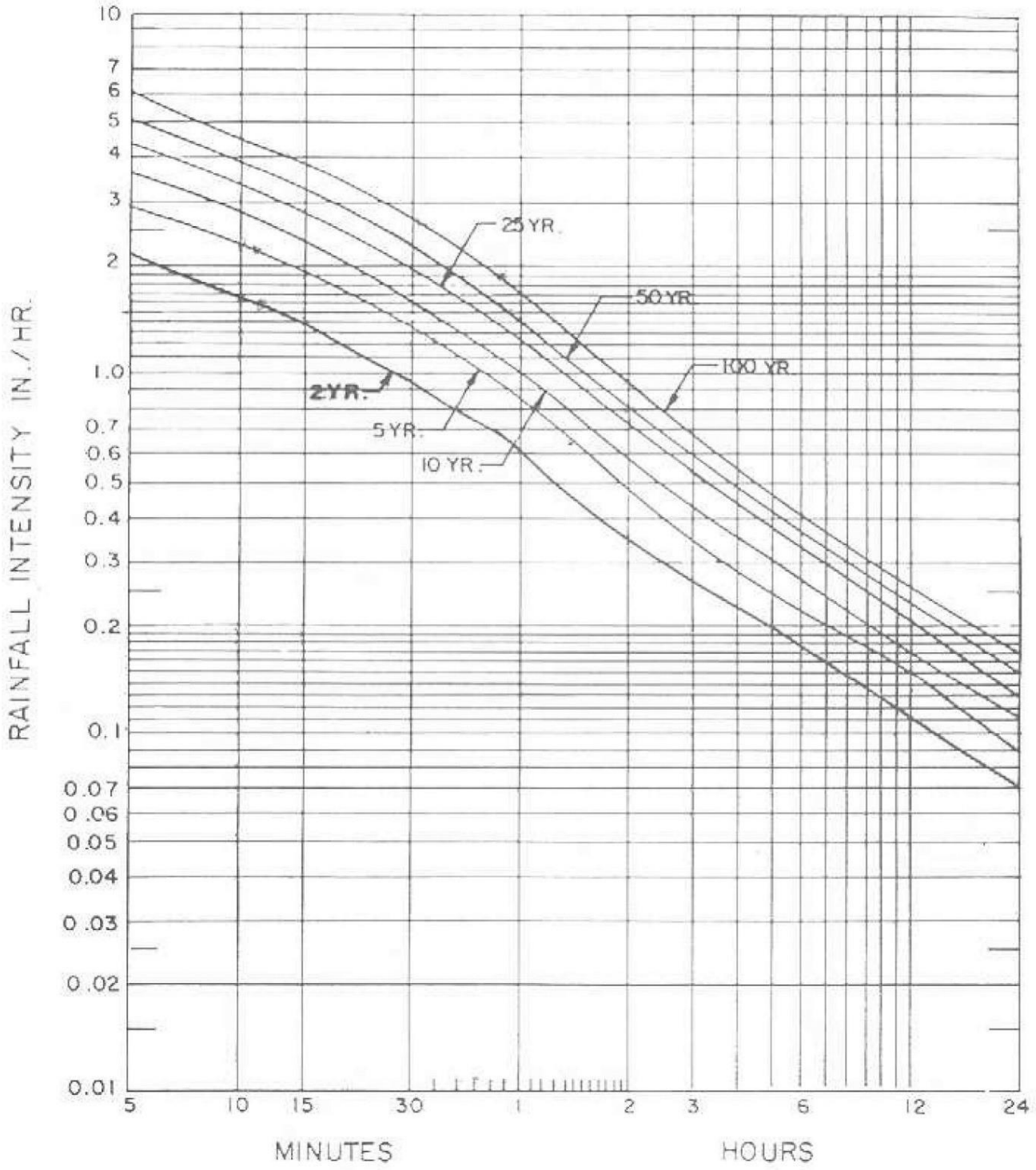


Figure D1: Rainfall Intensity Duration Curves
Source: Based on NWS Records from 1898-1989 and NOAA Atlas 2

Exhibit 4-II Unit peal discharge (q_u) for NRCS (SCS) type II rainfall distribution

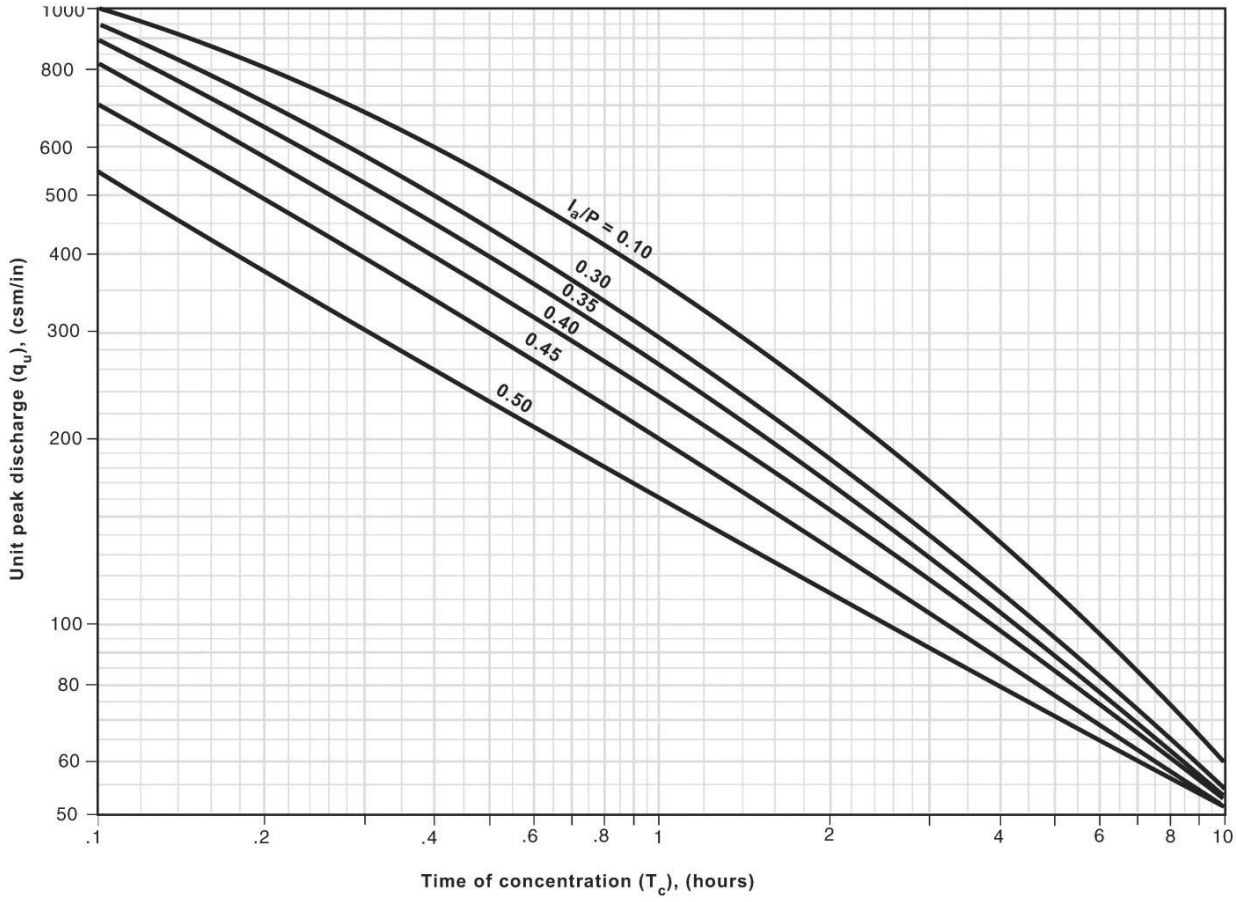


Figure D2: Unit Peak Discharge (q_u) for NRCS (SCS) Type II Rainfall Distribution
Source: TR-55, Exhibit 4-II

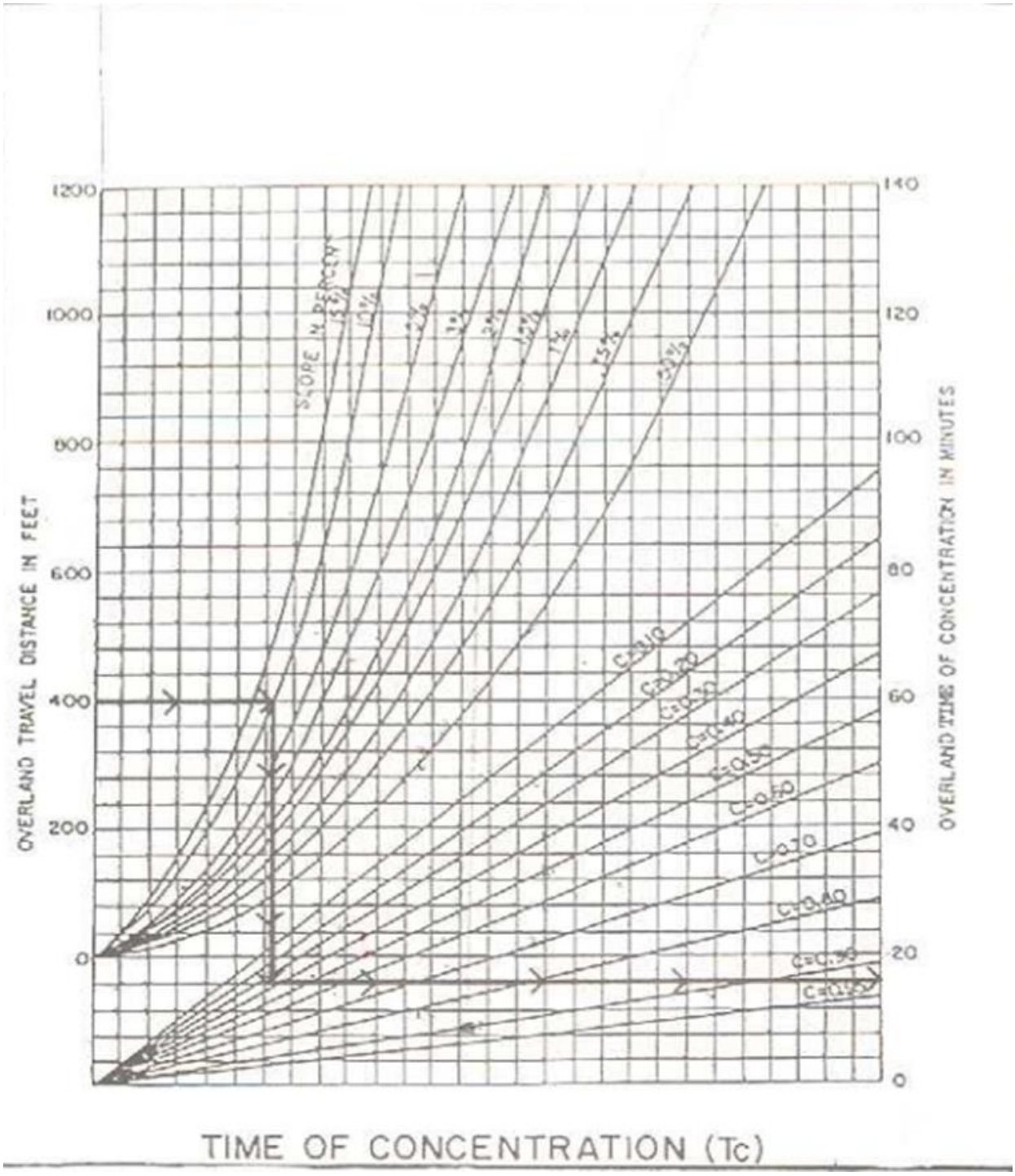


Figure D3: Overland Time of Flow Curves

Appendix E. Sample Seed and Fertilizer Specifications

SEEDING

GENERAL

SUMMARY

Section includes:
Grass seeding requirements.
Maintenance.

Related Sections include, but are not limited to:
1. MPWSS Section 01300 – Submittals.
2. Section 01400 – Quality Control.

REFERENCES

Montana Department of Transportation Standard Specifications for Road and Bridge Construction, 2006 Edition.

DEFINITIONS

Weeds include, but are not limited to, Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

SUBMITTALS AT PROJECT CLOSEOUT

Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture.

Maintenance Data: Include maintenance instruction; types, application frequency, and recommended coverage of fertilizer.

QUALITY ASSURANCE

Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging and location of packaging.

Submit a purity analysis and germination test of the seed mixture(s) proposed.

REGULATORY REQUIREMENTS

Comply with the Montana Seed Law.

DELIVERY, STORAGE, AND HANDLING

Deliver grass seed mixture in sealed containers, open or damaged packaging is not acceptable.

Deliver fertilizer in waterproof bags, labeled according to Montana fertilizer laws and bearing weight, chemical analysis, name of manufacturer, and warranty of the producer.

PRODUCTS

SEED MIXTURE

Seed Mixture: Furnish seed that meets Montana Seed Law and seeding regulations for individual areas to be seeded.

Furnish seed free of prohibited noxious weed seed with restricted weed seed not exceeding Montana Seed Law.

Seed delivered in tagged and labeled bags showing percentage of purity and germination. Seed shall be applied on a pure live seed basis, which accounts for germination rate and purity.

Seed shall be tested within twelve months prior to date of seeding and conform to latest Montana Seed Law.

Wet, moldy, or otherwise damaged seed will be rejected.

Western Native Seed Mixture – the seed mixture and species shall be as follows or Engineers approved equivalent:

Critana Thickspike Wheatgrass	25%
Slender Wheatgrass	25%
Green Needlegrass	20%
Western Wheatgrass	20%
Secar Bluebunch Wheatgrass	10%

The application rate shall be 2 pounds per 1,000 sq. ft., pure live seed, drill seed, or approved distributor's recommendation.

EXECUTION

PREPARATION

Verify that prepared topsoil is ready to receive Work of this Section.

SEED BED

Topsoil shall be raked level and all sod, hard lumps, gravel, concrete, or other debris materials shall be removed.

Finished surfaces shall be smooth and level.

SEEDING

The planting depth shall be ½ inch. Seed bed shall be lightly harrowed upon completion of seeding.

Perform seeding, per distributor's recommendation, when the temperature and moisture are favorable for germination and plant growth. Seed preferably before June 1st and after October 1st of each year. If seeding between June 1st and October 1st, then water seeded area per distributor's recommendation. Ensure watering technique does not wash seed mixture away. Seeding dates and watering techniques must be approved by the Engineer.

Do not sow immediately following rain, when ground is too dry, or during windy periods.

Seed areas disturbed by construction in berms and lawn areas as determined by the Engineer.

FERTILIZER

Fertilizer for Western Native Seed Areas – fertilizer for the dryland seeded areas shall consist of the following or Engineer approved equivalent:

Nitrogen	50 lb/acre
Phosphate	50 lb/acre
Potash	10 lb/acre

MAINTENANCE

Apply moisture, fertilizer, and mulch, at the Contractor's discretion, to provide the proper environment for seed germination and sustained growth.

Re-seed any areas as determined by the Engineer to have insufficient grass cover.

Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

Repairs shall be made as necessary before final acceptance by Engineer at no additional cost to Owner.

Appendix F. Storm Drain Fee

History of Storm Drain Fee

The City's 1987 Storm Drainage Master Plan highlighted major deficiencies in the City's storm drainage system. The Storm Drainage Master Plan recommended the creation of a storm drain fee to pay for necessary upgrades and maintenance.

A city-wide storm drain fee was first created by Resolution 8265 (Approved April 18, 1989). This resolution was amended with Resolution 8315 (Approved Sept. 19, 1989).
Resolution 8315 sets the framework for assessing the storm drain fee for each city lot by establishing a Land Use Classification and corresponding rate. The rate portion of this resolution has typically been updated annually through subsequent rate resolutions to adjust for things such as operational costs and inflation. These rates were last updated in 2019 under Resolution 10316.

Calculating the Storm Drain Fee

A storm drain fee is assessed to every developed parcel within the City. For new development, the City assesses storm drain fees within 60 days of the first building permit being issued. Credits are given to developed parcels with large tracts of vacant land and for properties eligible for a Detention Credit. Undeveloped vacant city lots are exempt from paying a storm drain fee.

Developed Parcel

Developed parcels include all city lots that have a building, driveway, parking lot, or any other feature that creates additional runoff beyond what would be created from vacant undeveloped land.

Every developed parcel is charged a storm drain fee including a base fee per water service account plus a fee based on the lot's area and Land Use Classification Group. See Table 11-1 below summarizing the City's storm drain fee rates as of Nov. 2019 per Resolution 10316. For current City storm drain fee rates, see the most current resolution with updated base fees and rates for each Land Use Classification Group.

Table 1: Monthly Storm Drain Fee Rate Summary (Based off Resolution 10316)

Land Use Classification Group	Type of Use	Base Fee	Rate (Cost per Sq Ft)	Rate (Cost per 10,000 Sq Ft)
A	Single Family Residential	$2.03	$0.0006087119	$6.09
B	Multiple Residential	$2.03	$0.0007608899	$7.61
C	Commercial	$2.03	$0.0009891569	$9.89
D	Heavy Commercial	$2.03	$0.0013696018	$13.70
E	Parcel that does not Discharge to underground City storm drain	$2.03	$0. 0001521780	$13.70

Land Use Classification Group

All developed parcels are given a Land Use Code by the City Planning Department. The Land Use Code is used to determine the parcel's Land Use Classification Group using Table 11-2 below. The Coefficient of Runoff is used to equitably assess storm drain fee rates to the different Land Use Classification Groups. See Resolution 8315 for more detailed information.

Table 2: Land Use Classification Group

LAND USE CLASSIFICATION GROUP	LAND USE CODE	COEFFICIENT OF RUNOFF	DESCRIPTION
A	111	0.40	Single Family
A	140	0.40	Mobile Single Family
B	112	0.50	Two Family Residential
B	114	0.50	Three-Four Family Residential
B	141-144	0.50	Mobile Homes & Trailer Courts
C	115-119	0.65	Multiple Dwelling
C	120-124	0.65	Boarding & Rooming Houses
C	151	0.65	Hotel & Motel
C	210	0.65	Light Industry
C* (A)	410	0.40	Railroad and Public Utilities
C	680	0.65	Schools Public & Private
C	690	0.65	Churches
C	740	0.65	Semi-Public
D	152-155	0.90	Hotel & Motel
D	220	0.90	Heavy Industry
D	530	0.90	General Business
D	540	0.90	Shopping Centers
D	610	0.90	Office Buildings, Financing, & Banks
D	670	0.90	Public Buildings (Governmental Services)
D	770-780	0.90	Parking Lots
E	Varies	0.10	Any of the above parcels that don't discharge runoff to an underground storm drain

*Railroad and Public Utilities are in Group A for billing purposes due to lower runoff rates.

Group E is for developed parcels that do not directly discharge to an underground City storm drain system. This is the lowest tiered rate for developed parcels. Resolution 8315 Exhibit B includes a map delineating the parcels in Group E as it existed in August 1989. The City Engineering Division maintains an updated map of parcels in Group E. These are parcels that would normally be in Group A, B, C, or D but are put in the lower tiered Group E since they don't utilize City underground storm main infrastructure to drain the runoff from their property to the river. Many of these properties are located near the Missouri and Sun Rivers.

Storm Drain Fee Example Calculation

Parcel: 10,000 sf lot in Group B with one water service account

- = $2.03 + 0.0007608899 * 10,000 sf lot
- = $2.03 + $7.61
- = $9.64 per mo.

Notes:

- Land Use Classification Group A caps out at 15,000 sf as long as the parcel's area that is greater than 15,000 sf is agricultural or undeveloped
- Parcels within Group E are capped out at 10,000 sf if these parcels are designated by the Planning Department as Single Family or Mobile Single Family.

Vacant Land

City parcels that are undeveloped and vacant are except from storm drain fees. These parcels are vegetated lots with no developed features that create more runoff than would be expected from naturally vegetated land. These lots also do not have any connected City services such as water and sewer.

Vacant Land Credit

Developed land that has a large section of vacant land may have the vacant land excluded from the area used to calculate their storm drain fee. To be eligible for this credit, the vacant land must be greater than 10,000 sf with the lot being in the B, C, or D Land Use Classification. The vacant land must not have any developed features including landscaping.

Detention Credit

Credit against monthly storm drain bills shall be allowed for developments that detain more than the difference between the 100-year and 5-year developed runoffs. The credit shall be based on the amount of reduction of the 5-year developed peak flow. If the detention reduced the 5-year peak flow 50% for example, the charge per square foot of lot shall be reduced 50% as well. The detention credit however is subject to a minimum storm drain fee for developed properties.

- Minimum Storm Drain Fee: The lowest tiered rate for any developed parcel is the Group E rate. Groups B, C, and D may utilize the Detention Credit to reduce the storm drain fee rate down to the Group E rate. The Group E rate is applied to the entire developed area of the parcel including any ponds.
- Calculating the Minimum Storm Drain Fee: Calculate both the storm drain fee based off the Detention Credit for the given Group; and based off the parcel having the lowest tiered rate which is the Group E rate. The storm drain fee is the higher of the two calculations. If the detention pond is oversized to the point where it acts as a full retention pond, the Group E rate would be utilized.

- Parcels in Group A generally are not required to have on-site detention ponds and are thus not eligible for a Detention Credit.
- Parcels with oversized detention ponds must reduce the 5 year post developed runoff using a 100 year storm by a minimum of 20% to be eligible for a Detention Credit.
- Property owners seeking a Detention Credit for new development should submit their storm drain report with a request for a Detention Credit with supporting information.
- Methods used for computation of peak flows shall be in compliance with this manual.

Storm Drain Fee Appeal

Storm drain fees are assessed with the authority of the City code and City resolutions. Fees are calculated by City Engineering's interpretation of code and resolutions. This manual summarizes those interpretations.

Property owners may appeal their storm drain fee by contacting the City Finance Department. City Finance can provide a Storm Drain Fee Appeal application form. These forms are also available on the City of Great Falls official website. Return the application form to the City Finance Department where it will be routed to City Engineering for review. Property owners may contact City Engineering with questions about the appeal process.