SECTION 5
STORM DRAINAGE SYSTEMS

Storm drain systems shall be designed, constructed, and tested in accordance with the current editions of the Engineering Standards for the City of Whitefish, Montana and the Montana Public Works Standards Specifications. The design shall be subject to approval by the City Engineer.

5.1 Storm Drainage Plans and Report.

Storm Drainage Plan. A Storm Drainage Plan shall be submitted for development or redevelopment that includes the creation of more than 5,000 square feet of new impervious surface area. A detailed stormwater report shall be prepared by a registered professional engineer. The storm water report shall contain the storm water calculations and a discussion of the design rationale. The plan shall include the following:

1. A map showing building site (s), open areas, drainage ways, ditches, culverts, storm sewers, inlets, storage ponds, roads, streets, and any other infrastructure improvements which may affect drainage characteristics. The map shall also include identification of the various ground surfaces (i.e. vegetation, gravel, pavement) and their respective coverage (square feet).
2. Topographic contours (one-foot intervals) and sufficient spot elevation data.
3. Description of the ultimate destination of stormwater runoff from the project and an evaluation of its impact on down slope drainage facilities.
4. Design calculations determining runoff quantities, storage requirements and peak rates.
5. Description of water quality design method and calculations.
6. A storm drainage facilities operation and maintenance plan. The plan shall:
    a. Identify ownership of all facilities.
    b. Establish a schedule for maintenance activities necessary to keep the system operationally effective.
    c. Identify the responsible party in charge of the specific maintenance duties.
7. Details and specifications (including invert and other pertinent elevation information) for all storm drainage improvements, such as storm sewer, manholes, inlets, discharge structures; and retention/detention pond dimensions and volume, side slope, and top, bottom, and maximum water surface elevations.

Pre-development and post-development runoff calculations for sizing drainage facilities shall include:

- Depiction of the drainage area on a topographical map, with acreage indicated (the offsite contributing area must be included). Provide a pre-development topography and drainage basin map and a post-development topography and drainage basin map.
- The change in peak discharge and volume of surface water entering and leaving the subject property.
- The capabilities of all downstream drainage systems within ¼ mile of the project site to handle the change in peak discharge and volume of surface water caused by the

development.

- In areas where ground water may be a factor, the analysis shall include the effects of the ground water on the total storm drainage system proposed for the development.

5.2 Methods of Design.

Storm Event Peak Rates and Volume. Two methods are to be used for determining peak storm water runoffs for the design of storm sewers, open channels and culverts. The Rational formula method is to be used to design storm sewer systems. Information on the Rational method is available in Chapter 7 of the MDT Hydrology Manual. A rainfall-intensity chart for Whitefish is presented in Appendix L. When it is necessary to know the volume of water and discharge in addition to the peak rate of flow, the SCS TR-20 Hydrologic Analysis Model or pre-approved hydrologic simulation model will be used together with a detailed routing analysis. For flow routing through detention facilities models such as; SWMM, StormNet and HydroCAD are also acceptable methods.

Culverts And Open Channel Design. Culverts shall be designed in accordance with the U.S. Department of Transportation, Hydraulic Engineering Circular No. 5. Open channels shall be designed using the energy concept and the Manning Formula. Channels in earth shall have sides with a maximum slope of one foot vertical rise for every two feet of horizontal distance. Steeper slopes will be permitted only if some type of bank protection is used to prevent erosion and sloughing of the sides into the bottom of the channel. Constructed and natural channels and culverts shall be designed with sufficient capacity to convey, at a minimum, the depth associated with the 100-year 24-hour design storm peak flow rate, assuming developed conditions for on-site tributary areas and existing conditions for any off-site tributary areas.

Storm Drain Systems and Inlets. The 10-year 24-hour design storm shall be used to size the enclosed storm sewer system and inlets.

5.3 General Design Requirements.

- All required stormwater retention/detention facilities must be constructed and in operation prior to paving and building construction unless otherwise approved by the Department of Public Works.

- The capacity of the downstream drainage course is required to be evaluated for a minimum distance of ¼ mile from the point of discharge of the development or as determined by the Public Works Department. The downstream conveyance system must be adequately sized to handle offsite peak flows conveyed through the development plus the onsite developed peak flow discharged to the drainage course from the controlling 10 year storm. This system should be shown on the drainage layout.

- The size of the controlled outlet shall be calculated for the total drainage basin when the total runoffs from both off-site and on-site areas are combined.

- The limits of the FEMA mapped 100-year flood plain shall be required to be delineated on the Final Plat as well as the engineering drawings for plat construction.

- Arrows indicating drainage direction in all public and private property shall be shown on the Construction Drawings for all hydraulic conveyance systems.

- A topographical map sufficient in area to show all areas draining onto the proposed land development must be submitted and show enough of abutting downstream properties to indicate natural or man-made drainage course into which the proposed land development is to drain. The direction of flow, acreage of areas contributing drainage to the development, the outline of the development, and location of intermittent streams or drainage courses which are within the site boundaries shall be indicated on this map.

- Surface water entering the subject property shall be received at the naturally occurring location, and surface water exiting the subject property shall be discharged at the natural location, with adequate energy dissipaters within the subject property to eliminate the potential for detriment to the existing downstream infrastructure.

5.4 Storm Sewer System - Minimum Requirements.

- Manhole Spacing. The maximum spacing between storm manholes shall be 500 feet.

- Minimum Pipe Size. The minimum diameter of any storm drain pipe shall be twelve inches except that a maximum length of sixty lineal feet of eight-inch diameter pipe may be used between inlets and manholes. The minimum size of any storm drain culvert is twelve inches.

- Storm Drain Manhole ring and Cover. The storm drain manhole ring and cover shall be East Jordan Iron Works Model 3772Z1, or an approved equal. The cover shall be marked Storm.

- Curbs and Gutters or Swales. Streets and roads shall be designed to ensure proper drainage and curbs and gutters or swales shall be required in all subdivisions. Curbs and gutters of adjoining properties shall be extended to match any new curb and gutter. Gutter, ditch, and swale flow line grades shall be greater than 0.5%.

- Culverts and Drainage Facilities. Culverts of adequate size shall be provided and installed by the subdivider where drainage channels intersect any street right-of-way or easement. All culverts shall extend at least the width of the base of the fill. The amount of backfill to be placed over the culvert and a culvert's capacity shall be determined by a licensed professional engineer. This shall include arrangements for driveway culverts. Culverts larger than 24" shall have flared ends.

- The subdivider shall provide suitable drainage facilities for any surface runoff affecting the subdivision. These facilities shall be located in street rights-of-way or in perpetual easements of appropriate width and are subject to approval by the City Engineer. Culverts shall be designed to accommodate runoff from upstream drainage areas.

- Drain Inlet Frame & Grate. The curb inlet frame and grate shall be Olympic SM 49, East Jordan Iron Works combination of product numbers 7222M1 or 7222M3 (Herringbone grate) or

an approved equal. "Dump No Waste" and fish image shall be on back. (See Standard Detail 40).

- "Beehive" Area Drain Frame & Grate. The beehive area drain frame and grate shall be Neehan Foundry model R-2560-D6 "beehive grate with frame", East Jordan Iron Works 1205-2 or an approved equal (See Standard Detail 42).

- "Drive Over" Area Drain Frame & Grate. The drive over area drain frame and grate shall be Neehan Foundry model R-2556-A Type C frame with Type G grate, East Jordan Iron Works model 1848-G or an approved equal.

- Sump Requirements for Catch Basins and Manholes. An 18" sump is required for catch basins and drain inlets. A 24" sump is required for storm drain manholes.

5.5 Flow Control and Retention/Detention Pond Design Requirements.

This section outlines the requirements for sizing flow control facilities. The flow control standards are based on the Stormwater Management Manual for Eastern Washington and the Spokane County Stormwater Manual. Standard flow control facilities are detention, retention (natural depressions), and infiltration facility. Any other facility is considered a non-standard system, and shall be evaluated individually by the City Engineer. Flow control facilities are necessary to mitigate potential adverse impacts on down-gradient properties due to the increase in stormwater runoff caused by land development.

The peak rate of stormwater runoff from any proposed land development to any natural or constructed point of discharge downstream shall not exceed the pre-development peak rate of runoff. The post development volume of runoff can exceed the pre-development volume of runoff when the required down-gradient analysis demonstrates that there will be no adverse impacts on down gradient properties or existing natural and constructed conveyance systems.

5.5.1 Detention Facilities Minimum Requirements.

A detention system is a storage facility that has a surface discharge. A detention facility is intended to control peak stormwater runoff rates but does not control volume. The following minimum requirements shall be met. Additional requirements are specified in Section 5.8.

Discharge rates

Detention facilities shall be designed such that the release rate does not exceed the pre-developed conditions for multiple storm events. The analysis of multiple design storms is needed to control and attenuate both low and high flow storm events. The total post-developed discharge rate leaving the site shall be limited to the pre-development rates outlined in Table 5-1.

TABLE 5-1
Allowable Discharge Rates

Design Frequency (Type 1 -24 hr storm)	Post-Developed Discharge Rate[1]
2-year (WQr)[3]	≤ 50 % of the 2-year pre-developed
10-year	≤ 10-year pre-developed
100-year	≤ 100-year pre-developed
100-year[2] (Emergency Overflow)	Overflow route only

1 Post-developed flow is equal to the release from detention facility plus the bypass flow.

2 The emergency overflow shall direct the 100-year post-developed flow safely towards the downstream conveyance system

3 Water Quality Flow Rate Control Standards

If the detention facility is also proposed to function in conjunction with a water quality treatment facility, the following criteria must be met:

- The first orifice or outlet from the facility must be a placed a minimum 6 inches above the pond bottom; and,
- Infiltration rate shall be verified by methods outlined in Section 5.6.

Design Storms

The design 24-hour precipitation depths and recurrence interval used by Whitefish are provided in the table below. The precipitation isopluvial map data comes from the National Oceanic and Atmospheric Administration (NOAA) Atlas 2, Volume IX, 1973.

Table 5-2
City of Whitefish 24-Hour Precipitation Depths

Recurrence Interval	2 year	10 year	25 year	100 year
24-Hour Precipitation Depth (inches)	1.4	2.0	2.4	3.0

Facility Volume

The CN method requires the selection of, or the input of, a rainfall distribution and the precipitation associated with a design storm. The NRCS Type I 24-hour 10 and 100-year storm events are the design storms to be used for all flow control facilities that use a surface discharge. Detention ponds shall be sized using one of the following methods:

- Sized to contain the difference between the post development and the pre-development 24 hour storm events; or,
- Post development Level Pool Routing Method with a draw down time of 72 hours.

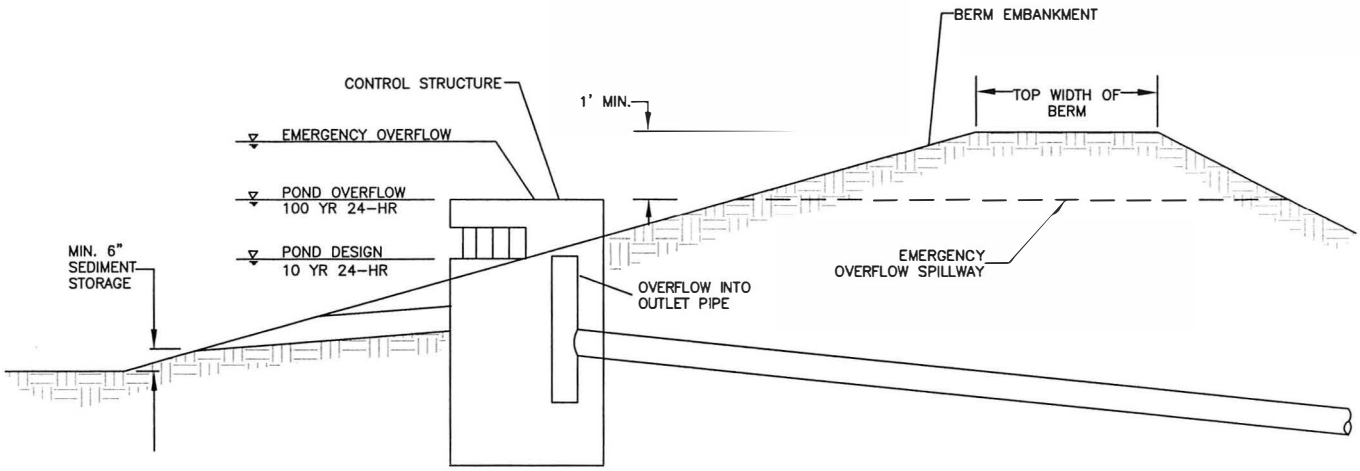
Setbacks
When a detention facility is proposed upslope of developed property or at the top of a slope inclined 15% or greater, the minimum setback from the slope must be greater than or equal to 50 feet or as determined by a licensed engineer with geotechnical experience.

Release Point
Stormwater runoff from a developed site shall leave the site in the same manner and location as it did in the pre-developed condition. The distance between the outlet structure and the inlet into the detention facility shall be maximized.

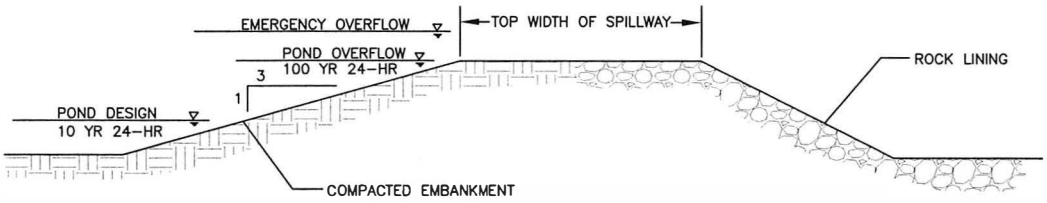
Exemption for Discharge to Whitefish River or Whitefish Lake
Neither the Whitefish River nor Whitefish Lake is vulnerable to increased flooding or erosion risk from peak flows. Therefore, if a system discharges directly to and is located within 500 feet of these water bodies they are exempt from detaining the 10-year storm.

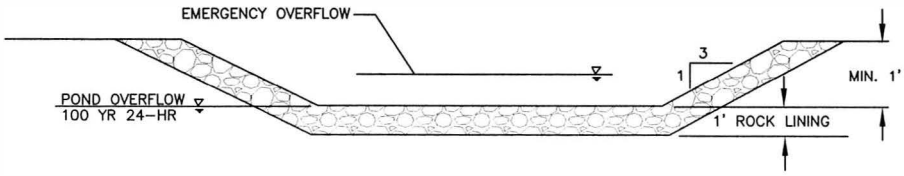
FIGURE 5-1

TYPICAL DETENTION POND OUTLET SECTION



EMERGENCY OVERFLOW SPILLWAY CROSS SECTIONS





5.5.2 Outflow Control Structures.

Control structures are manhole or catch basins with a restrictor devices used for controlling outflow from a facility to meet a desired standards. Outflow structures are required for all stormwater detention facilities. The restrictor device is usually multiple orifices, consisting of two or more orifices and/or a weir section sized to meet performance requirements.

Runoff shall enter the detention facility through a conveyance system separate from the control and outflow conveyance system. The distance between the inlet and outlet shall be maximized to reduce sediment from accumulating in the outflow structure. The types of outflow control structures are listed below.

Multiple Orifice Restrictors

- In most cases, control structure need only two orifices: one at the bottom and one near the tip of the riser;
- Minimum orifice diameter is 3 inches; and,
- Orifice shall be constructed on a tee section or on a baffle.

Risers and Weir Restrictor

- Properly designed weirs maybe used as flow restrictors. However they must be designed to provide for primary overflow of the developed 100-year peak flow discharging to the detention facility; and,
- The combined orifice and riser (or weir) over flow may be used to meet flow requirements. However the design must still provide for primary overflow of the developed 100-year peak assuming all orifices are plugged.

Skimmer

- A skimmer is used as a flow restrictor and traps floatable debris and petroleum product. A skimmer keeps the outlet pipe free of debris and reduces maintenance need;
- Provide skimming up to the 10-year event high water level or greater.

Outflow Control Structure Minimum requirements. The following minimum access requirements shall be met. Additional requirements are specified in Section 5.8.

- An access road to the control structure is required for inspection and maintenance; and,
- Manhole and catch basin lids for control structure shall be locking and rim elevation shall match proposed finish grade.

5.6 Infiltration Facilities.

Much of the Whitefish area does not lend itself to stormwater infiltration due to the presence of shallow groundwater and silty soils that infiltrate very slowly, especially once they are disturbed. An infiltration facility is used for disposing of stormwater runoff into the subsurface and can be used for flow control provided that:

- The discharge is uncontaminated or properly treated prior to the stormwater entering the infiltration facility;
- The Geotechnical Site Characterization demonstrates the suitability of the soil for subsurface

disposal; and,

- The down-gradient analysis indicates that adverse impacts are not anticipated.

The Engineer shall consider the impact of infiltration on groundwater elevations both on site and on down-gradient properties. Approval of an infiltration system shall obligate the Owner to repair, replace, or reconstruct the infiltration system if it fails to operate as designed. The maintenance and operation schedule for an infiltration system shall include such a provision.

Minimum Requirements. In addition to the requirements specified in Section 5.8, infiltration facilities shall meet the minimum requirements described below.

General Report Requirements

Provide a written report which includes as a minimum: 1) Site characteristics that pertain to the proposed infiltration system; 2) Soils report with soil logs; 3) Written civil engineer's opinion of site suitability and recommended design infiltration rate; 4) Infiltration test data and results; 5) Engineering calculations supporting the design; and 6) Site plan. The Design Engineer shall demonstrate through; infiltration testing, soil logs, and a written opinion of a licensed civil/geotechnical engineer; that sufficient permeable soils exist on the site for an infiltration system meeting the requirements herein and site-specific conditions to function properly.

Facility Volume

The NRCS Type I 10-year 24-hour storm event is the design storm to be used for all flow control facilities that use infiltration. Storage volume for all infiltration facilities shall contain the 100-year developed runoff with spillways or overflow structures where applicable. Infiltration facility shall be sized using one of the following methods:

- Sized to contain the post development storm event and draw down time of 72 hours; or,
- Sized using the post development Level Pool Routing Method and a draw down time of 72 hours.

Pretreatment

Pretreatment is required for urban watersheds with more than 0.25 acres of impervious surface before the stormwater enters the infiltration facility;

- Pretreatment volume shall be equal to 20% of WQv. The pretreatment volume is in addition to the infiltration basin's WQv sizing requirement.

Infiltration Test Requirement

The design infiltration rate shall be determined using the following test methods:

- EPA Falling Head Percolation Test Procedure (Design Manual On-site Wastewater Treatment and Disposal Systems, EPA, 1980); or
- The Double Ring Infiltrometer Test (ASTM D3385).
- For new development or redevelopment with less than 10,000 square feet of new impervious surface the soil infiltration rates rate may be determined by one of the above methods or the Montana Department of Environmental Quality (DEQ) Circular 4 Percolation Test.

The test hole or apparatus is filled with water and maintained at depths above the test elevation for not

less than 4 hours. Following the saturation period, the rate shall be determined in accordance with the specified test procedures, with a head of 0.5 feet of water. Provide data sheets for the selected infiltration test performed. Testing is to be performed by or under the direct supervision of licensed civil engineer. The report shall bear the stamp of such licensed civil engineer.

The infiltration rate shall be measured at a depth equal to the proposed bottom grade of the facility. A detention system may be required in conjunction with the infiltration system to meter flows to an infiltratable rate.

The maximum infiltration rates for the various soil types are set forth in herein Table 5-2. The maximum rate used to calculate the design infiltration rate shall be the lesser of the values set forth in Table 5-2 and the measured rate.

Table 5-2
Maximum Infiltration Rates for Soil Types

Soil Texture Class (U.S.D.A.)	**Infiltration Rates (Inches per Hour)**
1. Coarse sands, cobbles	20
2. Medium sand	8
3. Fine sand, loamy sand	2.4
4. Sandy loam	1

Infiltration Rate Safety Factors.

To obtain the design infiltration rate, the following safety factors shall be applied depending on the test method selected:

EPA Method: F.S. = 2.0
ASTM Method: F.S. = 1.75

The safety factor shall be applied to the lesser infiltration rate, either the measured rate, or the tabulated rate in Table 5-2.

Geotechnical Report Requirement

An adequate number of test holes shall be located over the proposed site to substantiate representative conditions for the final layout of the development. As a minimum condition, one test hole shall be located in each infiltration area for each 5,000 square feet of tributary area runoff to be infiltrated. Test hole locations shall be clearly identified in the geotechnical report and labeled on the drainage plan. Soil logs must be submitted to described soil type and depth and a site map shall be submitted showing the location of each test hole.

Test pits or borings shall extend at least three (3) feet below the bottom of infiltration facilities. Soil logs shall include the depth to the seasonally high ground water table and imperious strata. The wet season water table elevation measurements shall be made during the period when the water table elevation is expected to be at its maximum (generally March to mid-June).

The geotechnical report shall address the potential impact of the infiltration system on down slope areas both on-site and off-site.

An inspection of the soil by a civil/geotechnical engineer shall be made after the system is excavated, before the gravel backfill is placed, to confirm that suitable soils are present. The geotechnical report shall be amended to reflect this inspection and confirmation of suitable soils.

Depth to Groundwater and Limiting Layer

- The base of the infiltration facility shall be $\geq$ 5 feet above the limiting layer (bedrock, clay lens, etc.); and,
- The bottom of the basins should be a least 3 feet above the seasonal high groundwater table.
    - The seasonal high water table would be based on long-term piezometer records during at least one wet season or the mottled soil layer as determined by a licensed geologist, licensed engineer with geotechnical expertise, or hydrogeologist.

Access and Setbacks

- Minimum infiltration facility setback restrictions:
    - Building Foundations: At least 50 feet up-slope and 20 feet down-slope of infiltration facility unless a reduction is geotechnically justified;
    - Back from top of slope greater than 15%: At least 50 feet or as determined by a licensed engineer with geotechnical expertise;
    - At least 200 feet from springs used for drinking water supplies;
    - Septic drain fields: At least 100 feet;
    - Shallow water supply wells (typically individual homeowner wells): At least 100 feet;
    - Easement, external tracts or property line: 20 feet; and ,
    - Floodplain: Outside 10-year High Water Level (HWL).
- Provide dedicated maintenance access route to infiltration facility from a public roadway. Access route to be dedicated by maintenance easement or drainage parcel.

Overflows

Each runoff control infiltration facility shall provide emergency surface storage for at least 10% of the 10-year, 24-hour design storm volume, a minimum of 0.5 feet deep, on the site prior to discharging runoff to a safe overflow route. The surface storage is intended to make the owner aware of a problem with the infiltration system. Overflows shall be routed to the municipal storm drainage system. The overflow route shall be shown on the plan.

Construction of Infiltration Systems

Excavation of infiltration systems shall be done with a backhoe or excavator working at "arms length" to avoid the compaction and disturbance of the completed infiltration surface. The facility site shall be cordoned off so that construction traffic does not traverse the area.

An inspection by the civil/geotechnical engineer of record or the exposed soil shall be made after the infiltration system is excavated to confirm that suitable soils are present. Infiltration areas shall not be: 1) driven on or across by any vehicles or equipment, 2) used for material storage or stockpiles, or 3)

used for vehicle or equipment parking.

Infiltration systems for runoff control shall not be utilized until construction is complete and disturbed areas have been stabilized, as determined by the City, to prevent sedimentation of the infiltration system. Temporary runoff control facilities may be needed to utilize this option. Infiltration facilities shall include observation wells.

Planting Requirements

- Plant basin with native vegetation containing a mixture of species of varying moisture tolerances. See Appendix 5A for planting guidelines.

Post Construction Verification

- Submit post-construction verification of volume and infiltration capacity:
    - Submit an as-built grading plan of the infiltration basin after construction to the City to verify the design storage volume has been provided; and,
    - Perform post-construction testing of actual short-term infiltration rates to ensure the basin functions as designed or corrective action will need to be taken.

5.7 Retention Facilities.

Retention facilities are used for storage of stormwater runoff when site conditions are not conducive to infiltration, and can be used for flow control provided that:

- The stormwater discharge is properly treated prior to the entering the facility; and,
- Retention facilities shall be sized for storage of the post-developed NCRS Type I 100-year 24-hour storm event.

Minimum Requirements. Retention facilities shall meet all requirement outlined for detention facilities and the additional requirements specified in Section 5.8.

5.8 Additional Requirements For All Flow Control Facilities.

The following minimum requirements shall be met for all flow control facilities:

General

The design of flow control facilities shall adhere to the following:

- Pond bottoms shall be located a minimum of 0.5 feet below the outlet to provide sediment storage. Sediment storage volume shall not be included in the design volume; and,
- In general, all pond bottoms shall be flat. Roadside swales are considered flat if the swale bottom slope is 1% or less. When calculating treatment volume, the designer can assume a flat bottom for swale/pond bottom slopes up to 1%.

Setbacks

- Setbacks for any detention pond, swale or ditch (measured from the maximum design operating depth) shall be at least 30 feet when located up-gradient or 10 feet when located down-gradient

from septic tanks or drain fields.

- Pond overflow structures shall be located a minimum of 10 feet from any structure or property line. The toe of the berm or top of bank shall be a minimum of 5 feet from any structure or property line.
- Building Foundation: At least 50 feet;
- Easement or property line: 20 feet from the top of the facility's slope;
- Floodplain: Outside 10-year High Water Level (HWL); and ,
- Drainage facilities located at, or adjacent to, schools, nursing homes, day-cares, or similar facilities: At least 200 feet.

Drawdown Time

Detention and infiltration facilities shall have a minimum subgrade infiltration rate of 0.5 inches/hour and drain completely within 72 hours after a storm event.

Side Slopes

Pond side slopes shall meet one of the following requirements:

- Interior side slopes shall not be steeper than 3H:1V;

Emergency Overflow Spillway

An emergency overflow spillway shall be provided to bypass the 100-year developed peak flow toward the downstream conveyance system in the event of plugged orifices or high flows that exceeds the design storm.

Emergency overflow spillways shall be analyzed as broad crested trapezoidal weirs and comply with the following requirements:

- The spillway shall have the capacity to pass the 100-year developed peak flow;
- The full width of the spillway shall be armored with riprap and extend downstream to where emergency overflows enter the conveyance system;
- Rip rap shall extend just beyond the point that bank and stream bed erosion occurs;
- If the detention/infiltration facility is located on an embankment, the overflow spillway shall be armored to a minimum of 10 feet beyond the toe of the embankment;
- The overflow path shall be identified on the construction plans and easements shall be provided as necessary.

Engineers may choose to design the detention pond multi-stage outflow structure with an emergency bypass that can route the 100-year storm through the structure and out of the pond directly into the conveyance channel. However, due to the high potential for sedimentation and plugged orifices within these structures, an emergency overflow spillway shall still be provided in order to reduce the potential for a pond berm breach for detention ponds that require an emergency overflow spillway.

Fencing

Fencing or other barriers may be required to protect the health, welfare and safety of the public for ponds with standing water over 4 feet deep. At the discretion of the City Engineer, if a pond is proposed as an amenity (i.e. enhancements to the disposal facility are proposed, such as rocks, boulders, waterfalls, fountains, creative landscaping or plant materials), the design will be reviewed on a case-by-case basis, such that the fencing requirements may be reduced or waived. At the discretion of the City Engineer, marking fences, terraces, shallower side- slopes, egress bars, etc. may be allowed instead of fencing.

Planting Requirements

Exposed earth on the pond bottom and interior side slopes shall be sodded, seeded or vegetated in a timely manner, taking into account the current season. Unless a dryland grass or other drought tolerant plant material is proposed, irrigation shall be provided. All remaining areas of the tract or easement shall be sodded or planted with dryland grass or landscaped. Refer to Appendix B for planting guidelines.

Landscaping

Where space and circumstances allow, the landscaping scheme and common use areas shall be integrated with the open drainage features and into the overall stormwater plan. Plants other than turf grass have characteristics that can provide additional stormwater management benefits such as enhanced evapotranspiration and improved soil-holding capabilities. The following general principles should guide the landscaping and selection of plants in conjunction with stormwater facilities:

- Supplemental landscaping areas should be grouped into irregular islands and borders outside of the immediate stormwater facilities and not uniformly dispersed throughout them. The constructed stormwater features should be irregular and curved in shape to look more natural. Avoid straight lines and regular shapes where and when possible;
- Trees and shrubs shall not be planted within 10 feet of drainage appurtenances such as outlet control structures, manholes, catch basins, inlets and outlets, spillways, storm drain lines, and underground disposal structures such as drywells or drain-fields. The minimum spacing between the tree or shrub and the drainage structure shall be equal to the crown diameter of the mature plant;
- Trees and shrubs shall not be planted within the treatment, storage, and conveyance zones of swales, ponds, and open channels, unless treatment and storage calculations take into account the mature tree size and allow runoff to reach the drainage facilities;
- Self-limiting plants shall be used, not spreading or self-seeding types;
- Full-size forest trees and trees with aggressive root systems should not be used except where space and circumstances allow. Deciduous trees with heavy shade and leaf-fall should also be avoided to allow the survival of the surrounding grass areas and not plug drainage facilities;
- Shrubs should be upright in form and groundcovers should have neat growth patterns to assist in their maintenance and that of the surrounding grass areas; and,
- The plant selection needs to consider the native soil conditions and altered moisture conditions created by the stormwater facilities. The plants need to be adaptable to the changes in site conditions. Plants that are self- sufficient and self-limiting do not require year-

round irrigation and require minimal care are encouraged. Guidelines for plantings are listed in Appendix B.

5.9 Floodplains.

In the City of Whitefish, floodplain requirements are administered by the City Planning Department. Contact the City Flood Plain Administrator for more information and specific requirements.

5.10 Preservation of Natural Drainage Ways (Critical Stormwater Conveyances).

New development shall be designed to protect existing natural drainage features that convey or store water or allow it to infiltrate into the ground in its natural location. Preserving the natural drainage ways, referred to as critical stormwater conveyances in the Critical Areas Ordinance, will help ensure that stormwater runoff can continue to be conveyed and disposed of at its natural location. Preservation will also increase the ability to use the predominant systems in conjunction with regional stormwater facilities. All proposed construction projects must complete a Critical Areas Checklist (see Section 1.16) and identify on that checklist the presence of a natural drainage way (critical conveyance).

Design Requirements
Constructed and natural channels that are altered shall be designed with sufficient capacity to convey, at a minimum, the depth associated with the 100-year 24-hour storm peak flow rate, assuming developed conditions for on-site tributary areas and existing conditions for any off-site tributary areas.

Definitions
Drainage ways that need to be preserved have been mapped and this map is available from the Public Works Department. The maps denoting these drainage ways are not definitive. The maps are only one tool that may be used to identify existing natural drainage ways; field verification will typically be required to fully identify the existence of a drainage way and its significance with regard to a natural conveyance system.

Because every site is unique, the City Engineer shall make interpretations, as necessary, based on site visits and technical information as to the exact location on a project site. The City Engineer may also require the project owner to provide engineering information to assist in this determination.

All projects shall be reviewed for the presence of natural drainage ways, and a determination will be made as to their significance with regard to preservation of natural conveyance and potential use as part of a regional system.

Protection

- No cuts or fills shall be allowed in predominant natural drainage ways except for perpendicular driveway or road crossings with engineering plans showing appropriately sized culverts or bridges. Natural drainage ways shall be preserved for stormwater conveyance in their existing location and state, and shall also be considered for use as regional facilities;
- Less prominent drainage ways in a non-residential development and in a residential

development containing lots 1 acre or smaller may be realigned within the development provided that the drainage way will enter and exit the site at the pre-developed location and that discharge will occur in the same manner as prior to development;

- Realignment of a less prominent drainage way shall be defined as still following the "basic" flow path of the original drainage way. An acceptable example would be if the drainage way is proposed to be realigned such that it will follow a new road within the proposed development, and will be left in its existing state or utilized as part of the project's on-site stormwater system.
- Stormwater leaving the site in the same manner shall be defined as replicating the way the stormwater left the site in its existing condition. If the drainage way is preserved in its existing location and is left undisturbed, this goal should be met;
- If the City Engineer accepts the proposal to allow a less predominant drainage way to be routed through the site via a pipe or approved drainage material, the following additional criteria shall be met:
    - Where the less prominent drainage way enters the site, the design shall ensure that the entire drainage way is "captured" as it enters the site; i.e. the surrounding property shall not be regraded to "neck-down" the drainage way so that it fits into a drainage easement or tract or structure intended to capture and reroute the off-site stormwater runoff;
    - Where the less prominent drainage way exits the site, the design shall ensure that the stormwater leaves the pipe, pond or structure a significant distance from the edge of the adjacent property so that by the time the stormwater reaches the property boundary, its dispersal shall mimic that of the pre-developed condition; and,
    - Since some of the less prominent drainage ways may also be useful for managing regional stormwater, if identified as a significant drainage way (i.e. necessary conveyance for flood control, or being considered as a connection to a planned regional facility or conveyance route), then the drainage way may be subject to the same limitations and criteria as a predominant drainage way.

- The size of the tract or easement containing the drainage way shall be determined based on an analysis of the existing and proposed stormwater flows directed to these drainage systems and any access and maintenance requirements found in this manual; and,
- All new development containing lots that are 1 acre or smaller shall be required to set aside the drainage way as open space in a separate parcel. For new development containing lots that are greater than 1 acre, the drainage way may be set aside in either a parcel or an easement.

5.11 Water Quality Treatment Standards.

Water quality treatment facilities are designed to remove pollutants contained in stormwater runoff. The pollutants of concern include sand, silt, and other suspended solids; dissolved metals such as copper, lead and zinc; dissolved nutrients such as nitrogen and phosphorus; certain bacteria and viruses; and organics such as petroleum hydrocarbons and pesticides.

Many treatment facilities, if designed correctly, can function as both a water quality treatment facility and a flow control facility. This section describes design criteria for water quality treatment and Section 5-5 provides design criteria for flow control.

Stream and River Flow Control Standard

- Post development runoff rate shall be limited to no more than 50% of the pre-development 2-year, 24-hour peak runoff rate (based on SCS Type 1 unit hydrograph); and,
- The post development 10-year peak runoff rate shall be no greater than the pre-development 10-year, 24-hour peak runoff rate (based on SCS Type 1 unit hydrograph).

Wetland Standards

- An on-site wetland assessment is required for all new development. General wetland mapping for the Whitefish planning area is available through the Planning Department.

Water Quality Volume (WQv) Standard

- The water quality volume for the design of BMPs is based on a snowmelt event. The design volume is the runoff from **1.1 inches** of equivalent snow pack moisture.

  The treatment volume in cubic feet is determined by multiplying the site area in square feet, by 1.1 inches (0.09 ft). Best Management Practices are designed to capture and provide treatment for a specific volume of stormwater runoff. This volume is equivalent to the runoff from an 80th percentile storm, meaning that 80 percent of the most frequently occurring storms are fully captured and treated. Frequent small storm events, known as "first-flush events" carry the majority of stormwater pollutants. The primary pollutant removal mechanism consists of physical settling of suspended sediments and associated adsorbed pollutants. Secondary pollutant removal mechanisms include filtering, biological uptake and adsorption.

Water Quality Treatment BMPs.

General guidance for water quality treatment is provided in various stormwater design and BMP manuals including Section 10 of the HEC-22 Manual and the Stormwater BMP Design Supplement for Cold Climates.

The following BMP design manual has adapted treatment methods to cold climates such as that of Whitefish:

Minnesota Urban Small Sites BMP Manual available at
www.metrocouncil.org/environment/watershed/bmp/manual.htm.

Another BMP design reference guide that is available online is:

City of Knoxville BMP Manual
www.ci.knoxville.tn.us/engineering/bmp_manual

The stormwater design report must include a water quality treatment section that describes the Best Management Practices that are chosen to treat the water quality design storm. The chosen BMPs should be tailored to the needs of the site and the anticipated characteristics of storm water generated. Infiltration techniques may be allowed where soil and groundwater conditions are suitable. The stormwater plan and report must provide specifics on the operation, maintenance and inspection of the

water quality treatment facilities. Easements must be provided for maintenance of the facilities. The use of multiple complimentary practices is encouraged. All treatment BMP facilities shall be installed upstream of flow control facilities.

Description of Best Management Water Quality Practices. This section describes typical water quality practices and provides general guidelines for their use.

A. **Infiltration ponds and trenches** - The infiltration section of these standards, section 5.5, provides further guidance on appropriate use of these stormwater management methods.

B. **Dry wells** - A subsurface storage facility that receives and temporarily stores roof runoff. This runoff is discharged through infiltration to the surrounding soil. A dry well may be either a structure and/or excavated pit filled with aggregate. Runoff should drain within 72 hours. The maximum drainage area to a dry well is 1 acre and dry wells should be applied to relatively small sites. In Montana the EPA has permitting authority over installation of dry wells.

C. **Porous pavement** – A permeable pavement surface with an underlying stone reservoir to temporarily store surface runoff before it infiltrates into the subsoil. This porous surface replaces traditional pavement, allowing parking lot stormwater to infiltrate directly and receive water quality treatment. The ideal application for porous pavement is for low-traffic or overflow parking areas. The base of the stone reservoir should be below the frost line to reduce the risk of frost heave. Porous pavement cannot be used where sand is applied because sand will clog the surface of the material.

D. **Vegetated filter strip** – Treats sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing some infiltration into underlying soils. With proper design and maintenance, filter strips can provide relatively high pollutant removal. However, it is difficult to maintain sheet flow, so the practice may be "short circuited" by concentrated flows, receiving little or no treatment. Filter strips are best suited to treating runoff from streets, roof downspouts, and small parking lots. Typically, filter strips are used to treat very small drainage areas. The limiting design factor, however, is not the drainage area but the length of flow leading to it. When flow concentrates, it moves too rapidly to be effectively treated by a grassed filter strip.

E. **Vegetated swale** – Vegetated swales are vegetated, open channels designed to treat and attenuate stormwater runoff. As stormwater runoff flows through these channels, it is treated through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Variations of the grassed swale include the grassed channel, dry swale, and wet swale. The specific design features and methods of treatment differ in each of these designs, but all are improvements on the traditional drainage ditch.

   Vegetated swales should generally treat small drainage areas of less than 5 acres. If the practices are used to treat larger areas, the flows and volumes through the swale become too large to design the practice to treat stormwater runoff through infiltration and filtering. Grassy swales are designed to have a gentle slope between 0.5% and 5%. An underdrain may be required for

slopes less than 1.5% if significant amounts of standing water remain after a storm event. Side slopes may not exceed 4 horizontal to 1 vertical, and should be minimized to the extent possible. Maximum surrounding ground slopes should be 10% to reduce the velocity of incoming water. The minimum length for swales is 20 feet. Check dams need to be added when steep slopes create erosive runoff velocities.

Facility storage depth may range from 6 to 12 inches. A freeboard (6 to 12 inches) is required if the adjacent area may be damaged in the case of flooding. The minimum bottom width is 2 feet with a minimum total width of 8 feet. If stormwater will enter the swale through a pipe or other point source, an inlet flow spreader is required; for long swales, additional flow spreaders or check dams are recommended every 12 t0 20 feet. River rock can be used to create an attractive, effective check dam.

Curb cuts- An energy dissipater is required at curb cuts to prevent erosion. Also, provide a concrete spillway at curb cut to prevent grass from blocking the flow of water. Tire stops or curbs with curb cuts should be located 6 inches back from the edge of the swale.

F. **Bioretention** - Landscaping features adapted to provide on-site stormwater treatment. They are commonly located in parking lot islands or within small pockets of residential land. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. During storms, runoff ponds above the mulch and soil in the system. Runoff from larger storms is generally diverted past the facility to the storm sewer system. The remaining runoff filters through the mulch and prepared soil mix. Typically, the filtered runoff is collected in a perforated subdrain and returned to the storm sewer system. Bioretention should be used on small sites of 5 acres or less. When used to treat larger areas, they tend to clog. In addition, it is difficult to convey flow from a large area to a bioretention area.

G. **Wet pond** (stormwater pond, retention pond, wet extended detention pond) – Constructed basins that have a permanent pool of water. Ponds treat incoming stormwater runoff by settling and algal uptake. The primary removal mechanism is settling as stormwater runoff resides in this pool, and pollutant uptake, particularly of nutrients, also occurs through biological activity in the pond. Wet ponds are among the most cost-effective and widely used stormwater practices. While there are several different versions of the wet pond design, the most common modification is the extended detention wet pond, where storage is provided above the permanent pool in order to detain stormwater runoff to provide settling. Wet ponds need sufficient drainage area to maintain the permanent pool, typically about 25 acres.

H. **Level Spreader** – An outlet constructed at zero grade consisting of a vegetated or rock-surface structure, used to disperse or "spread" concentrated flow thinly over a receiving area. The purpose is to spread runoff over a wide area to prevent erosion of the receiving area. Additional benefits of infiltration and filtration may also occur. This practice applies where concentrated flow is dispersed within wooded areas adjacent to bodies of water and in areas requiring a filter strip to treat water. Its use should also be limited to drainage areas less than ten acres and where receiving areas have relatively flat slopes.

I. **Soil Amendment** – Material added to a soil to improve its physical properties, such as water retention, permeability, infiltration, drainage, aeration and structure. Soil amendments increase the spacing between soil particles so that the soil can absorb and hold more moisture. This in turn reduces runoff. The amendment of soils changes physical, chemical and biological characteristics so the soils become more effective in maintaining water quality.

J. **Enhancement Options for Dry Detention Ponds** (Extended Dry Detention Ponds) – Dry detention ponds are typically designed to empty in less than 24 hours, resulting in lower contaminant removal than wet ponds. If water quality is the intended goal of the pond, a wet or extended detention pond design should be considered. Dry detention ponds may be used, however, as part of an overall water quality treatment train approach. For greater details and for design issues specific to cold climates see the ***Minnesota Urban Small Sites BMP Manual***. The following are design alternatives that enhance the treatment potential of dry detention ponds:

- Sediment Forebay. The treatment efficiency of a dry pond can be increased by incorporating a forebay into the pond design. A sediment forebay facilitates maintenance and improves pollutant removal by trapping larger particles near the inlet of the pond. The forebay should include a deep permanent pool (greater than 3 feet) to minimize the potential for scour and re-suspension.

- Extended Storage. Traditional dry ponds have rarely been considered acceptable ponds from a water-quality perspective. The potential for scour and small detention times almost always eliminates these ponds from consideration as a water quality BMP. However, designs that eliminate scour by controlling the flow through the pond can provide acceptable treatment. Enhanced dry ponds that utilize extended storage principles can serve to meet water quality goals; however, they must be carefully and properly designed, implemented and maintained. To operate properly these treatment systems need outlet controls with filters, weirs or other energy-dissipation and flow-spreading devices constructed as part of the pond.

- Micropool at the Outlet. The performance of a dry pond can be enhanced through the provision of a micropool at the outlet. The micropool is typically relatively shallow and underdrained. Its purpose is to concentrate finer sediment and reduce re-suspension. The micropool is normally planted with hardy wetland species such as cattails.

- Pond Shape. To maximize the treatment potential of the pond, the inlet and outlet should be positioned in such a way that short-circuiting in the basin is minimized. Ponds that are considerably longer than wide will likely provide additional detention time for settling and biological treatment. Baffles and curved flow paths can also be used to increase settling efficiency. A pond with a length to width ratio >3:1 will have an acceptable flow path.

- Energy dissipation around inlet. This minimizes erosive energy and spreads the water.

- Vegetate and stabilize the pond surface. A vegetated pond bottom, such as grass, treats early inflow and prevents erosion of the pond's soil surface.

K. **Site Design BMPs**. Site design BMPs that may be incorporated include reducing the amount of impervious surfaces, conserving natural areas, minimizing directly connected areas, and protecting slopes and channels.

L. **Structural Treatment BMPs**. Use of Structural Treatment BMPs in a design plan must be accompanied by a report that provides the basis for selection, design criteria, pollutant removal information, and maintenance requirements.

5.12 Whitefish Lake Regulations.

Whitefish Lake Water Quality Plan. All development of property that abuts the lake shall submit a water quality protection plan in accordance with section 5.11. The water quality protection plan shall be developed a qualified professional, which shall make recommendations regarding stormwater management, impervious surface, grading and filling, and vegetation protection and restoration so that the estimated discharge of sediment, nutrients, and other pollutants to the lake during and after construction would be no greater than if the site had a seventy-five (75) foot buffer.

Whitefish Lake Lakeshore Regulations. Whitefish Lake and Lakeshore Protection Regulations require permits for construction within thirty (30) horizontal feet of the perimeter of the lake (mean annual high water).Any construction activity which will affect the lakeshore protection zone should incorporate all necessary means to prevent pollution of the lake, including erosion, sediment, and storm runoff controls. The proposed activity should not cause, directly or indirectly, increased sedimentation, an increase in suspended sediments, or an increased discharge of nutrients into the lake either during its construction or utilization. For details on the lake regulatons and mean annual high water elevation refer to Title 13 Lake and Lakeshore Protection Regulations of the Municipal Code.

5.13 Maintenance of Stormwater Facilities.

Insufficient maintenance of stormwater control facilities can lead to poor performance, shortened life, increased maintenance and replacement costs, and property damage. The City of Whitefish maintains the stormwater system structures located within the public road right of way. The project Owner is to provide for the perpetual maintenance of all elements of the stormwater system located outside the public right of way. The high-frequency maintenance of vegetated cover, turf grass, and other landscaping within the public right of way and within easements that accommodate public road runoff is the responsibility of the adjacent property owner. See Appendix 5A for an example Site Inspection Checklist. When applicable, the following maintenance-related items shall be submitted with the Drainage Submittal for all projects:

- A copy of the conditions, covenants and restrictions (CC&Rs) for the homeowners' association (HOA) in charge of operating and maintaining all elements of the stormwater system;
- A Financial Plan outlining the funding mechanism for the operation, maintenance, and repair

of the private stormwater system, including contingencies; and,
- An Operations and Maintenance (O&M) Manual.

Homeowners' And Property Owners' Associations.
For privately maintained stormwater systems in residential neighborhoods, a homeowner's association, or alternate entity acceptable to the City, shall be formed to maintain the facilities located outside of the public right-of-way.

A draft copy of the CC&Rs for the HOA in charge of operating and maintaining the facilities associated with the stormwater system shall be submitted as part of the Drainage Submittal review package. The CC&Rs shall summarize the maintenance and fiscal responsibilities of the HOA and reference the O&M Manual. HOA dues shall provide funding for the annual operation and maintenance of all facilities associated with the stormwater system. See Appendix O for a sample document.

For commercial/industrial and multi-family residential developments with joint stormwater systems and multiple owners, a property owners' association (POA) or similar entity such as a business shall be formed, or a reciprocal-use agreement executed.

Homeowners' associations and property owners' associations are to be non-profit organizations. A standard business license is not acceptable for this purpose.

Operation And Maintenance Manual.
For stormwater systems operated and maintained by a HOA,or POA an O&M Manual is required. The O&M Manual summarizes the tasks required to ensure the proper operation of all facilities associated with the stormwater system and must include, as a minimum:
- Description of the entity responsible for the perpetual maintenance of all facilities associated with the stormwater system, including legal means of successorship;
- Description of maintenance tasks to be performed and their frequency;
- An inspection check list to be used for the annual maintenance inspections.
- A list of the expected design life and replacement schedule of each component of the stormwater system; and,
- A general site plan (drawn to scale) showing the overall layout of the site, all the facilities associated with the stormwater system, and their elevations.

Financial Plan.
A Financial Plan is required in order to provide the entity responsible for maintenance with guidance with regard to financial planning for maintenance and replacement costs. The Financial Plan shall include the following items:
- A list of all stormwater-related facilities and their expected date of replacement and associated costs;
- Sinking fund calculations that take into consideration probable inflation over the life of the infrastructure and estimates the funds that need to be set aside annually; and,
- A mechanism for initiating and sustaining the sinking fund account demonstrating that perpetual maintenance of all facilities associated with the stormwater system will be sustained.

If the required maintenance and repairs are not being performed and inhibit the intended function of the stormwater system the City will hire a contractor to perform the required maintenance and all such expenses shall be borne by the HOA, POA, or responsible property owner.

Parcels And Easements.
Flow control and treatment facilities must be located within an individual parcel. For lots larger than 1 acre, the drainage facility may be located within a drainage easement if the facility does not occupy more than 10% of the lot and does not straddle private property lines. Stormwater facilities serving commercial projects do not generally require parcels or easements unless they serve more than one parcel.

A stormwater facility, as defined for this section, is a natural drainage way, constructed conveyance, swale, or flow control facility. It is acceptable for other types of drainage systems, such as a pipe, to be in a drainage easement. Other stormwater drainage systems in a drainage easement, such as pipes, shall not straddle private property lines.

Parcels.
A drainage parcel for access, maintenance, operation, inspection and repair shall be dedicated to the entity in charge of the maintenance and operation of the stormwater system. A parcel will be dedicated when any of the following situations are present:

- Facilities associated with a stormwater system serving a residential development are located outside of the public right of way;
- Drainage ditches are located in residential neighborhoods. The limits of the parcel may have to be delineated with a permanent fence when the ditch is located near property lines; or,
- A natural drainage ways is present.

Parcels shall be of sufficient width to provide access to, and maintain, repair or replace elements of, the stormwater system without risking damage to adjacent structures, utilities and normal property improvements, and without incurring additional costs for shoring or specialized equipment.

Easements.
A drainage easement for access, maintenance, operation, inspection, and repair shall be granted to the entity in charge of the maintenance and operation of the stormwater system. The easement shall grant to the City of Whitefish the right to ingress/egress over the easement for purposes of inspection or emergency repair. If not in a parcel, the following infrastructure shall be placed within drainage easements:

- Elements of a stormwater system, such as a pipe, located outside the public right-of-way. Easements for stormwater conveyance pipes shall be of sufficient width to allow construction of all improvements, including any associated site disturbances, and access to maintain, repair or replace the pipe and appurtenances without risking damage to adjacent structures or incurring additional costs for shoring or special equipment.
    - No storm pipe in a drainage easement shall have its centerline closer than 5 feet to a private rear or side property line.
    - The storm drain shall be centered in the easement.
    - The minimum drainage easement shall be 20 feet.

    - The drainage easement shall not straddle lot lines;
- For drainage ditches and natural drainage ways, the easement width shall be wide enough to contain the runoff from a 100-year 24 hour storm event for the contributing stormwater basin. Constructed drainage ditches will not be allowed to straddle lot lines. Natural drainage ways located on lots larger than 1 acre may be placed in an easement; and,
- Easements for access roads and turnarounds shall be at least 20 feet wide.

Easement documents shall be drafted by the project owner for review by the City Engineer and recorded by the project owner. An example stormwater facility easement document is provided in Appendix O.

5.14 Pumping Systems

Storm water pumping stations are not acceptable for use within the City of Whitefish City Limits without approval from the City of Whitefish Public Works Department.

Pump systems (includes the pumps, force mains, electrical and power supply equipment, structures and appurtenances) are not an approved method of conveying, storing, or treating storm water. A deviation must be approved in order to pump storm water. The pump system shall not be used to circumvent any code, engineering standard, or permit condition. The construction and operation of the pump system shall not violate any other City requirements.

The Developer shall demonstrate that the pump system is the only feasible alternative available to provide drainage. Pump systems shall be owned, operated, maintained, repaired, and replaced (as needed) by property owner(s) served by such system. Each pump shall be capable of discharging the design flow rate for the 100-year, 24-hour design storm.

The pump system shall have dual, alternating pumps with emergency on-site, back-up power supply and an external alarms system for system failure and high water level indicator. A safe emergency overflow route shall be provided, if possible. A Maintenance and Operation Schedule shall be prepared and submitted for review prior to permit insurance. A note on the approved plan shall stipulate that the private property owner(s) shall be responsible for any and all claims for injuries and damage due to the operation or non-operation of the pump equipment.

5.15 Easement Requirements.

Where possible, public conveyance systems shall be constructed within the public right-of-way. When site conditions make this infeasible, public utility easements or dedicated tracts shall be provided. Private drainage facilities shall be constructed outside of the public right-of-way, on private property.

When vehicles access for maintenance is required, a dedicated tract or access easement shall be provided. The access easement conditions shall prohibit the property owner from installing any landscaping, improvements, retaining walls, etc., which would hinder access to the drainage facility or necessitate restoration of access easement area.

For pipes/vaults 5 feet and greater in width, the minimum utility easement width shall be outside

dimension plus 15 feet, rounded to the nearest whole foot, but not less than 20 feet in width. For maintenance access roads, the minimum access easement width shall be 15 feet.

5.16 Illicit Connections.

Federal regulations define an illicit discharge as "any discharge that is not composed entirely of storm water…." Examples of illicit discharges include; improperly connected/maintained sanitary sewers, dewatering construction sites (construction water requires pretreatment and/or a permit prior to discharge into the stormwater system), equipment washing, and improper vehicle/machinery maintenance.

Runoff that is discharged into a stream shall meet the Natural Resources Conservation Service standards and comply with Montana Department of Environmental Quality, and NPDES Phase II Requirements as applicable. Also, drainage and dewatering systems shall not discharge into any sanitary sewer facility.

APPENDIX 5A

EXAMPLE

Site Inspection Checklist

Inspection # _____ Final? – Yes / No

Date: _____ Time: _____ Weather: _____

Construction inspector: _____

Project name: _____

Address: _____

Proposed use of this property: _____

Site development classification: SSFR *or* LRCD Zoning classification: _____

Erosion and Sediment Control:

	Yes	No	N/A
1. Is there a good stand of grass on all areas disturbed by construction?			
2. Is there a good stand of grass within all ditches and swales?			
3. Is there a good stand of grass within the detention basin?			
4. Are erosion and sediment control devices properly installed at the correct locations?			
5. Is there any evidence of erosion or sedimentation downstream from the project site?			

Storm Drainage Structures: (catch basins, inlets, manholes, junction boxes)

	Yes	No	N/A
1. Are all drainage structures installed at the proper location per approved plans?			
2. Are all drainage structures installed at the proper grade and cross slope?			
3. Are curb irons and manhole lids installed correctly? Proper size?			
4. Do curb irons and manhole lids have anti-pollution message per COK standard details?			
5. Are structure inverts shaped to prevent ponding water? Free from silt and debris?			
6. Are pipes properly grouted and fitted into each drainage structure?			

Storm Drainage Pipes:

	Yes	No	N/A
1. Has the proper aggregate backfill been used (Class A Grade D)? Adequately compacted?			
2. Does pipe size and pipe material agree with the approved plans?			
3. Does the location and grade of storm drainage pipes agree with the approved plans?			
4. Are pipe sections joined correctly (coupling bands for CMP, joints, gaskets, etc.)			
5. Are pipes in good condition and undamaged?			
6. Are proper outlet structures, headwalls, riprap or other erosion control measures in place?			

Ditches and Swales:

	Yes	No	N/A
1. Are the ditches and swales located per the approved plans?			
2. Does the constructed cross section (width, depth) agree with the approved plans?			
3. Are erosion control measures in place? Riprap?			

Stormwater Quality Structure: (O/W separator, sand filtration device, etc.)

	Yes	No	N/A
1. Is the correct brand, size, and model installed as per approved plans?			
2. Is the structure installed at correct location, grade and elevation as per approved plans?			
3. Is the structure located within the designated easement?			
4. Are liftholes plugged and all joints sealed to prevent leakage?			

Stormwater Detention Basin:

	Yes	No	N/A
1. Was Detention Basin installed as first item of construction, to prevent erosion/sediment?			
2. Does the basin size and location agree with the approved plans & detention calculations?			
3. Is the basin located within the detention basin easement, including fill and cut slopes?			
4. Is the bottom of the detention basin graded to the outlet structure to prevent ponding?			
5. Is there a good cover of vegetation on the slopes and bottom (to prevent erosion)?			
6. Is the outlet structure constructed to agree with approved plans & detention calculations?			
7. Are the detention basin slopes at the approved grades (no steeper than 2:1 H:V)?			
8. Is the detention basin berm graded at the proper elevation and width, all the way around?			
9. Is the first flush volume adequate? With a controlled release over 24 hours?			
10. Is there any evidence of utility lines or pipes within the detention basin easement?			

Streets:

	Yes	No	N/A
1. Are streets in good condition and free from damage? (no cracks, upheaval or settlement)			
2. Are the streets located correctly as per approved plans? Curves (PC, PT, tangents)?			
3. Are the street widths adequate?			
4. Does the street cross section (pavement and base depths) meet the approved plans?			
5. Are streets crowned and gutters graded properly to prevent ponding?			
6. Has the curb been backfilled?			
7. Is there a good stand of grass within the street right-of-way?			
8. Are street signs in compliance with City and FHWA standards and installed properly?			
9. Are pavement markings, lines and symbols correct?			
10. Have streetlights been installed correctly with adequate setbacks?			
11. Have property pins been set and protected?			
12. Are entrance signs and other structures located outside of the street right-of-way?			

Curbs and Sidewalks:

	Yes	No	N/A
1. Are curbs and sidewalks in good condition and free from damage?			
2. Does the location, type, and height of curb and gutter agree with the approved plans?			
3. Are the curb and sidewalk radii and curves correct for all entrances and cross streets?			
4. Are curb contraction joints installed with 5 ft maximum spacing?			
5. Are curb expansion joints installed with 25 ft maximum spacing and at fixed objects?			
6. Is the sidewalk width and location adequate?			
7. Are sidewalk cross sections adequate, with proper finishing and joints?			
8. Are sidewalk ramps and cuts installed to meet ADA requirements?			

Entrances and Driveways:

	Yes	No	N/A
1. Do the entrance and driveway widths match the approved plans?			
2. Are the entrance and driveway radii adequate for each property?			
3. Are the entrance and driveway cross sections adequate, with proper finishing and joints?			
4. Are sight distances adequate, with no obstacles such as trees, fences or signs?			

Retaining Walls:

	Yes	No	N/A
1. Are retaining walls located as per approved plans?			
2. Do the retaining walls agree with the approved height, length, and construction material?			
3. Do the retaining walls have sufficient footer size and steel reinforcement?			
4. A detailed construction inspection is required for retaining walls over 4 feet in height.			
5. Has the contractor been notified of the requirements regarding 3rd party inspection?			