7. Stormwater Management System

PART I – DESIGN

7.1 General

7.1.1 The Town's stormwater management objectives are as follows:

a.) Prevent all property damage and flooding, and minimize disruption to public activity due to runoff from a 1:5 year return frequency, or more frequent, rainfall event;
b.) Prevent significant damage, physical injury, and loss of life due to runoff from a 1:100 year return frequency, or more frequent, rainfall event; and
c.) Improve stormwater quality, through filtering of contaminants, prior to discharge to receiving watercourses and prevent erosion of the receiving watercourse.

7.1.2 Refer to Section 7.12 for details regarding Stormwater Management System Design for infill or redevelopment projects.

7.1.3 The Town's stormwater management system consists of two distinct conveyance systems: a minor system and a major system (i.e. the dual drainage concept). Under this concept, the minor system is designed for drainage and the major system is designed for flood control. The minor system consists of buried storm sewers and the major system generally consists of roadways and open channels.

7.1.4 In addition to the minimum requirements set forth by these Standards, the requirements of the *Stormwater Management Guidelines for the Province of Alberta*, Alberta Environment, latest edition, must be duly addressed by the Design. Wherever feasible and applicable, Alberta Environment's stormwater quality best management practices (BMPs) shall be applied within the Design. In accordance with Alberta Environment's *Municipal Policies and Procedures Manual* (latest edition), stormwater management techniques to improve water quality shall be included to effect a minimum of 85% removal of sediments of particle size 75 µm or greater. These include grassed swales and runways to trap silt, and ponds designed with detention times to promote settling.

7.1.5 Effluent from sanitary sewers or any other potentially contaminated drainage from industrial or commercial sites shall not be discharged into storm sewers.

7.1.6 The Design shall provide for the interception, conveyance, and storage of all overland drainage which enters the Development from surrounding, undeveloped areas for the indefinite future or interim period until development of such areas occurs. Furthermore, the stormwater management system shall be designed to ensure the Development does not adversely affect the existing drainage pattern of surrounding areas, whether during or following construction.

7.1.7 Where a capacity deficiency is determined within stormwater management infrastructure located downstream of the Development, the Developer may be required to upgrade the existing infrastructure.

7.2 Minor System General Design Criteria

The following *minimum* criteria shall apply to the Design for the minor system, as applicable to the proposed development:

7.2.1 General

a.) The minor system shall be designed to accommodate runoff such that a 1:5 year rainfall event must stay within piped system, and a 1:20 year rain fall event must stay within road carriageway or drainage ditch.
b.) The minor system shall accommodate design flows such that:
   i. An equivalent width of one traffic lane remains free from inundation at design flows on local and collector roadways;

ii. An equivalent width of one traffic lane in each direction remains free from inundation at design flows on arterial roadways; and

iii. No surcharging of sewer pipes occurs.

c.) Computer simulation modeling shall be required for the design of minor drainage systems. Computer simulation modeling shall be completed using a computer program acceptable to the Town and in accordance with acceptable standard design practices. Modeling results shall be fully detailed in the Design Report to be submitted with the application for the Development Agreement.

7.2.2 Design Flows

a.) The Rational Method shall be employed to estimate design flows for areas smaller than 65 ha, as follows:

$$Q = \frac{CiA}{360}$$

Where: Q = runoff rate (m³/s)
C = runoff coefficient
i = rainfall intensity (mm/hr)
A = contributing area (ha)

b.) Runoff Coefficient

i. Where the site-specific conditions of ultimate site development are unknown, runoff coefficients may be selected from the following table on the basis of the zoning or proposed land uses for the Development.

Land Use	Runoff Coefficient, C	Imperviousness Range (%)
Parks, Reserves, Grassed Areas	0.20	10 – 50
Single Family Residential	0.40	40 – 60
Multi-Family Residential	0.70	50 – 100
Downtown Commercial	0.85	50 – 100
Neighbourhood Commercial	0.70	50 - 100
Industrial	0.70	50 - 100
Paved Areas and Roofs	0.95	90 – 100
Gravel Areas	0.3	10 - 50

ii. Where the site-specific conditions of ultimate site development are known, runoff coefficients shall be consistent with the imperviousness (imp) for each respective land use and shall be calculated using the following formula for design rainfall events with a return period of 10 years or less.

$$C \quad (0.95\ imp) \quad 0.1(1.0\ imp)$$

iii. To apply the preceding formula to determine the runoff coefficient for a design rainfall event with a return period greater than 10 years, modify the calculated runoff coefficient in accordance with the following table.

Return Period (t_R)	Runoff Coefficient Multiplier
10 year < t_R ≤ 25 year	1.1
25 year < t_R ≤ 50 year	1.2
t_R > 50 year	1.25

c.) Rainfall intensity

i. Rainfall intensity (i) is determined from the appropriate Intensity-Duration- Frequency (IDF) curve based on the time of concentration (t_c), as calculated by the following formula:

$$t_c = t_i + t_t$$

Where: t_c = time of concentration (min)
t_i = inlet time (min)
t_t = travel time (min)

ii. Inlet time, t_i, is the time for drainage to travel from the extreme limits of the catchment to the first point of inflow into the storm sewer being designed. Inlet time is dependent on the imperviousness, ground slope, and size of the catchment. A maximum inlet time of 15 minutes shall apply to single-family residential areas. Inlet time must be less than 15 minutes for commercial, industrial, institutional, and medium/high density residential areas due to a larger percentage of the area being impervious. For conceptual or preliminary designs, inlet time can be estimated from the catchment area and imperviousness using the following table:

	Design Inlet Time (t_i)	Imperviousness		
		30%	50%	> 70%
Area	$t_i \leq 8.0$ ha	8.0 min	8.0 min	5.0 min
	$8.0 < t_i < 40$ ha	9.2 min	9.2 min	6.0 min
	$t_i \geq 40$ ha	10.4 min	10.4 min	7.3 min

iii. Travel time, t_t, is the time for drainage to travel through the conveyance system from the point of inflow to the design location. Travel time is dependent on the pipe material, pipe slope, and the design flow rate.

iv. The value of the design rainfall intensity (i) for the rational formula is to be selected from the appropriate intensity duration frequency (IDF) curve, with a duration chosen to coincide with the time of concentration, t_c. The Environment Canada IDF curve for Whitecourt can be found in Appendix H.

d.) Catchment Area

i. Catchment area is the area, in ha, of the catchment contributing inflow into the storm sewer being designed.

e.) Foundation Drain Discharge Flows

i. The geotechnical report must include estimates for weeping tile flows and define any special design and construction considerations for foundations or other infrastructure within the Development that might be impacted by weeping tile flows causing settlement or other deleterious effects.

ii. Where the estimated foundation drain flows are significant during spring and summer months, they must be added to the design flows used to size infrastructure for the minor system.

iii. To be connected to foundation drain discharge collection sewers (i.e. 3rd. pipe system).

7.3 Gravity Sewer Mains

7.3.1 Pipe Diameter:

a.) Minimum 300 mm

7.3.2 Flow Velocity:

a.) Design mean flow velocity 0.9 to 1.0 m/s
b.) Minimum 0.6 m/s
c.) Maximum 3.0 m/s

7.3.3 Manning's "n": n = 0.013

7.3.4 Pipe Slope:

a.) Minimum slope shall conform to the following table:

Pipe Diameter (mm)	Minimum Slope (%)
300	0.22
375	0.15
450	0.12
≥ 525	0.10

b.) The first upstream section of sewer main shall have a minimum slope of 0.4%.

c.) Minimum slopes shall be increased by 50% for curved sewers.

7.3.5 Storm Trunk Sewer Mains

a.) Storm trunk sewers are defined as storm sewer mains which serve drainage areas greater than 30 ha.

b.) Storm trunk sewers shall be designed to accommodate, without surcharge, the anticipated design flow multiplied by a safety factor of 1.25 in order to account for potential future changes in land use and ensure trunk sewers do not surcharge before upstream lateral storm sewers.

c.) In cases where a storm trunk sewer will receive both uncontrolled flow from a drainage area greater than 30 ha *and* controlled discharge from stormwater management facilities, the storm trunk sewer shall be designed to accommodate the anticipated uncontrolled design flow multiplied by a safety factor of 1.25 plus the design maximum outflow rates from the stormwater management facilities.

7.3.6 Horizontal Alignment

a.) Storm sewer mains shall be located within the road right-of-way, in accordance with the Engineering Standard Drawings.

b.) For commercial, industrial, institutional, and multi-family residential developments, the Consultant shall design typical cross-sections depicting the locations of the various necessary infrastructure to suit the particular development. Such cross-sections shall be subject to the review and acceptance of the Town.

c.) Storm sewer mains must be located at least 3.0 m horizontally from any water or sanitary sewer main and 1.8 m horizontally from any storm sewer main or gas line, as measured between the nearest pipe walls of the two mains.

d.) Town owned and operated storm sewer mains that must cross through, or be located within, private property or any other property controlled by other authorities, shall be protected by easements, secured by the Developer, in the name of the Town as the grantee. Easements shall be of sufficient width to provide a working clearance to the satisfaction of the Town from the edge of the easement to the nearest side of the sewer main. Manholes, catch basins, and other point infrastructure should not be located within easements unless specifically authorized by the Town.

e.) Without limiting the requirements of Section 3.6.1 of these Standards, Public Utility Lot (PUL) widths shall be a minimum of 6.0 m for a single utility and 9.0 m for two utilities. A 1.0 m easement may also be required on the lots to either side of a PUL.

f.) Curved sewers shall run parallel to the centreline of the road. Long radius-type bends or a combination of 22½º bends and straight pipe shall be used to achieve the curve.

7.3.7 Vertical Alignment

a.) Sewer mains shall be installed to provide a minimum depth of cover of 1.5 m, as measured from the top of the pipe to the final finished grade at the surface unless otherwise approved. Depth shall be adequate to provide the minimum depth of cover over sump pump discharge collection sewers and catch basin leads.

b.) At crossings with water mains, refer to Section 5.2.9c).

c.) At crossings with sanitary sewer mains, refer to Section 6.2.8d).

7.4 Manholes

7.4.1 The maximum distance between manholes shall not exceed 120 m.

7.4.2 Manholes are required at all changes in pipe diameter, grade, and direction, at junctions, at the ends of mains, and at either end of a curved sewer.

7.4.3 At manholes where changes in pipe diameter occur, the crowns, or obverts, of the mains shall be placed at the same elevation. Regardless of the design flow and pipe slope, pipe diameter shall not be permitted to decrease through the downstream direction.

7.4.4 For straight-run manholes, a minimum drop of 12 mm shall be provided between the manhole inlet and outlet. For corner-run manholes, a minimum drop of 50 mm shall be provided between the manhole inlet and outlet.

7.4.5 For corner-run manholes, designed to achieve a necessary change in direction of the sewer main, the angle of direction change shall not exceed ±90º. This may be further restricted in cases where the estimated sewer flows through the main are not high enough to achieve sufficient cleansing velocity. For sewer mains greater than 600 mm in diameter, changes in flow direction at manholes should not exceed 45°, unless a suitable transition manhole is provided.

7.4.6 Drop structures are required at manholes with a vertical separation of 300 mm or greater between the inlet and outlet mains. Internal drop structures may be used for sewer mains of 250 mm diameter or less. External drop structures must be provided for sewer mains greater than 250 mm diameter. Refer to the Engineering Standard Drawings for further information on drop structures.

7.5 Catch Basins

7.5.1 The maximum distance between catch basins along roadways shall not exceed 120 m.

7.5.2 Catch basins shall be located such that no ponding shall occur during the 1:5 year, or more frequent, rainfall event.

7.5.3 Provide sufficient catch basins such that the flow depth in gutters does not exceed the top of curb during the 1:20 year rainfall event.

7.5.4 At intersections, locate catch basins with sufficient inlet capacity on the upstream side in order to prevent drainage from passing through the intersection.

7.5.5 At curb returns, locate catch basins on the upstream side of crosswalks.

7.5.6 At sag locations and depressions, locate catch basins with sufficient inlet capacity such that ponding does not exceed 150 mm.

7.5.7 Wherever possible, catch basins shall be located on the projection of property lines to avoid conflict with driveways.

7.5.8 Catch basins shall have a minimum barrel diameter of 900 mm and minimum sump depth of 600 mm.

7.5.9 Catch basins and leads shall not be located beyond the limits of the public rights-of-way. Where the lots are authorized to grade to the back, in accordance with Section 7.11.3, a catch basin must be provided where the drainage easement ties-in to the nearest public right-of-way.

7.5.10 Catch basins shall not be placed within the walking surface of pararamps or sidewalks.

7.6 Catch Basin Leads

7.6.1 Catch basin leads shall be designed to accommodate, without surcharge, the anticipated design flow.

7.6.2 Pipe Diameter:
a.) Minimum 250 mm

7.6.3 Flow Velocity:
a.) Minimum 0.6 m/s
b.) Maximum 3.0 m/s

7.6.4 Manning's "n":
a.) n = 0.013

7.6.5 Slope:
a.) Minimum 1.0%

7.6.6 Catch basin leads shall be a maximum of 30 m in length unless a catch basin manhole is provided at the upstream end of the catch basin lead.

7.6.7 Catch basin leads shall be installed to provide a minimum depth of cover of 1.50 m, as measured from the top of the pipe to the final finished grade at the surface.

7.6.8 Catch basin leads must be connected to a catch basin manhole or to a manhole on the storm sewer main. No direct connections to storm sewer mains shall be permitted.

7.7 Stormwater Service Connections

Each lot shall have its own stormwater service connection (if shown on the approved construction drawings) designed in accordance with the following:

7.7.1 Commercial, Industrial, Institutional, and Multi-Family Developments

a.) Service connections for commercial, industrial, institutional, and multi-family developments shall be a minimum diameter of 250 mm and sized according to the anticipated site requirements and shall include sewer mains, catch basins, catch basin leads, catch basin manholes, and manholes as required to manage onsite drainage in accordance with the other sections of this section. The service connections shall be designed with consideration of the depth requirements for servicing of these lots and the potential impact on the depth requirement for the downstream sewer main. The storm management plan shall include an inlet controlled device.
b.) For car wash facilities, wastewater from the facility must drain to the wastewater collection system and shall not be permitted to be connected to the stormwater management system.

7.7.2 Detached Residential Developments

a.) Stormwater service connections for detached residential (single family) developments shall be adequate to convey foundation drain discharge flows into the foundation drain discharge collection system.
b.) Service connection pipe diameter shall be a minimum of 100 mm.
c.) The minimum slope of service connections shall be 2.0%.
d.) Service connections shall have a minimum depth of cover of 1.5 m throughout the length of the service, as measured from the top of the pipe to the final finished grade. Service connections shall be supported throughout their entire length.
e.) Service connections shall be located such that they do not conflict with driveway locations.
f.) Service connections shall be extended beyond the gas line into the lot to terminate a minimum of 1.0 m from the back of the easement line.
g.) Lot services shall be located as shown on the Engineering Standard Drawings, with the water service located nearest the driveway, followed by the wastewater service, and then the stormwater service located furthest from the driveway on the lot. Sewer services shall be installed on the downstream side of the water service relative to the direction of flow of the sewer main.
h.) Sump pump discharge connections at the building shall be in accordance with the Engineering Standard Drawings.
i.) Where the water service is 50 mm or smaller in size, the water and wastewater services shall be located in a common trench if they are not installed by auger or boring methods.

7.8 Foundation Drain Discharge Collection Sewers

7.8.1 Foundation drain discharge collection sewers shall be designed to convey, without surcharge, the anticipated design flow from detached residential stormwater service connections into the Town's storm sewer system.

7.8.2 Pipe Diameter:
a.) Minimum 150 mm

7.8.3 Flow Velocity:
a.) Minimum 0.6 m/s
b.) Maximum 3.0 m/s

7.8.4 Manning's "n":
a.) n = 0.013

7.8.5 Slope:
a.) Minimum slope shall be in accordance with the table provided in Section 7.3.4a).

7.8.6 Foundation drain discharge collection sewers are dedicated strictly to the collection of discharge from sump pumps which must be installed in all buildings with basements and weeping tiles. No other type of connection shall be permitted to these sewers. Roof leaders on buildings must drain to the surface, unless otherwise authorized by the Town.

7.8.7 The sewers shall be provided inside of the private side of the property line along all single- family residential lots and multi-family residential (non-apartment) units.

7.8.8 These sewers shall have a minimum depth of cover of 1.5 m and a maximum depth of cover of 2.90 m, as measured from the top of the pipe to the final finished grade.

7.8.9 Foundation drain discharge collection sewers must be connected to a catch basin manhole or to a manhole on the storm sewer main. No direct connections to storm sewer mains or catch basin leads shall be permitted.

7.8.10 The sewers must be located at least 3.0 m horizontally from any water or sanitary main and 1.8 m horizontally from any storm sewer main or gas line, as measured between the nearest pipe walls of the two mains.

7.8.11 Curved sewers shall run parallel to the adjacent property line. Long radius-type bends or a combination of 22½º bends and straight pipe shall be used to achieve the curve.

7.8.12 Cleanouts
a.) Cleanouts must be provided on sump pump discharge collection sewers for maintenance.
b.) Cleanouts shall be in accordance with the Engineering Standard Drawings.
c.) The maximum distance between cleanouts shall not exceed 100 m.
d.) Cleanouts are required at all changes in pipe diameter, grade, and direction, at junctions, at the ends of sewers, and at either end of a curved sewer.
e.) Wherever possible, cleanouts shall be located on the projection of property lines to avoid conflict with driveways.
f.) Cleanouts shall consist of a bi-directional tee design.

7.9 Oil and Grit Interceptors

7.9.1 The Town may require oil and grit interceptors (OGIs) be installed on new or redeveloped commercial or industrial sites. This requirement will depend on a number of factors including, but not necessarily limited to, business type, hours of operation, parking area, location, use of hazardous materials onsite, and downstream infrastructure.

7.9.2 Developments with large parking areas or risk of petroleum product spill will be required to install an oil and grit separator. All gas/service stations must have a stormceptor or other oil and grit separator as approved by the Town.

7.9.3 The Town may require OGIs to be installed in a new residential subdivision where the Development is immediately upstream of a stormwater management facility or discharges to a natural drainage course.

7.9.4 OGIs shall use the hydraulic energy of the conveyed stormwater to separate, trap, and store stormwater pollutants.

7.9.5 OGIs must be capable of trapping fine sand, silt, clay and organic particles in addition to larger sand and gravel particles, and small floatables.

7.9.6 OGIs shall be capable of removing 85% of the average annual total suspended solids (TSS) load and 95% of the floatable free oil without scouring previously captured pollutants.

7.9.7 The Design shall provide calculations substantiating removal efficiencies and shall include correlation to field monitoring results for the proposed OGI system.

7.10 Lift Stations and Stormwater Force Mains

7.10.1 Refer to Section 6.6 of these Standards.

7.11 Major System General Design Criteria

The following *minimum* criteria shall apply to the Design for the major system, as applicable to the proposed development:

7.11.1 General

a.) The major system shall be designed to accommodate runoff generated by a 1:100 year rainfall event.
b.) The maximum depth of peak flows and ponding shall not exceed 150 mm on arterial roadways.
c.) Apply computer simulation modeling in accordance with Section 7.2.1c.
d.) The Design must include an analysis of the capacity and characteristics of the downstream receiving drainage course and identification of any measures to be completed to prevent downstream flooding and/or for erosion and sediment control.
e.) Major system design shall ensure that all structures are protected from a 1:100 year event.

7.11.2 Conveyance Components

a.) Major system conveyance components must provide continuous overland flow routes to a designated receiving watercourse.
b.) Overland flow routes shall accommodate design flows plus anticipated overflows from stormwater management facilities.
c.) The depth of peak flows and ponding for major system conveyance components (i.e. roadways, channels, etc.) shall be limited to prevent significant hazard to the public, property damage, and erosion.
d.) The maximum depth of peak flows and ponding along major system conveyance components shall be a minimum of 350 mm below the lowest anticipated landscape grade or opening along adjacent lots and buildings.
e.) Manning's n:
    i. = 0.013 for roadways
    ii. n = 0.050 for grassed boulevards
f.) Arterial roadways shall not form a part of the major system conveyance system. Where the nature of the terrain imposes unreasonable difficulty in achieving this objective, the Town may authorize the use of an arterial roadway as part of the major system conveyance system provided the all other applicable conditions are met. Such situations shall be reviewed by the Town on a case-by-case basis.
g.) Concrete Swales
    i. Within public right-of-ways and easements, swales may be employed for the collection and conveyance of runoff to appropriate points of interception or release. Minimum width of such right-of-ways or easements to be 4.0 m for concrete swales and 6.0 m for multi-use easement.

ii. Swales shall be in accordance with the Engineering Standard Drawings.

h.) Culverts

i. Culverts may be provided to connect swales and drainage channels across roadways and other surface improvements.

ii. Culverts shall be a minimum 400 mm diameter.

iii. Refer to the Engineering Standard Drawings.

iv. Energy dissipation and sediment and erosion control must be considered in culvert design.

v. Minimum cover above pipe to be 600 mm or as otherwise approved.

7.11.3 Lot and Landscape Grading

a.) Lot grading plan will be submitted to the Town for approval.

b.) Lots shall be designed to drain from back to front. Where the nature of the terrain imposes unreasonable difficulty in achieving this objective, the Town may authorize an alternate approach, provided all other applicable conditions are met. Such situations shall be reviewed by the Town on a case-by-case basis. The Town may require the installation of suitable flow velocity and erosion controls, and the establishment of a suitable easement along the back of the lots.

c.) A minimum grade of 10% shall be provided out to a minimum of 2.0 m around all buildings.

d.) A minimum grade of 2% and maximum grade of 10% shall be provided on all landscaped areas.

e.) A minimum grade of 2% and maximum grade of 8% shall be provided on all driveways.

f.) Lot and landscape grading shall be designed such that the maximum depth of peak flows and ponding shall be a minimum of 150 mm below the lowest anticipated finished ground elevation at buildings. A suitable overflow route or sufficient ponding volume must be provided from or at all ponding areas to achieve this minimum freeboard and limit ponding to a maximum depth of 350 mm.

g.) Reverse slope driveways or other lot improvements that may capture runoff and fail to drain during major rainfall events shall be avoided.

7.11.4 Storage Components

a.) Major system storage components, also referred to as stormwater management facilities, which are to be owned and operated by the Town, shall be designed based on the critical volume determined for each stormwater management facility from the 1:100 year rainfall event, and as prescribed by applicable Alberta Environment and Parks standards and guidelines. The design of these facilities must incorporate calculations for a range of rainfall durations to assess which will result in the critical volume for the catchment area.

b.) Commercial, industrial, institutional, and high-density residential developments (including apartment and high-density multi-family sites) require onsite stormwater management facilities. These stormwater management facilities shall be designed based on the critical volume determined from the 1:25 year rainfall event. Suitable overland flow routes shall be provided from the facility to accommodate overflows for more significant rainfall events. The Design must limit post-development peak runoff flows from the Development to predevelopment rates.

c.) Where one or more stormwater management facilities are proposed in an Area Structure Plan, the Developer shall consult with the Town regarding site-specific requirements for each facility. Such may include special landscaping, fencing, lighting, recreational, and operation and maintenance requirements. The Town may also have specific requirements for stormwater quantity or quality control, which must be adequately addressed by the Design.

d.) The geotechnical report shall be integral to the design of stormwater management facilities.

e.) Warning signage shall be provided around all stormwater management facilities for public safety, to the satisfaction of the Town.

f.) Where stormwater management facilities will be constructed in phases, the Design shall fully detail how such phasing shall be achieved and how the interim system shall operate.

g.) Landscaping in and around stormwater management facilities shall incorporate bark chips or other floatable decorative landscaping materials only above the 1:100 year flood line and have a maximum of 75 mm of wood chip mulch. Biodegradable erosion blankets shall be used below the 1:100 year flood line.

h.) Detailed operation and maintenance manuals shall be provided for all stormwater management facilities in accordance with Section 1.18.

i.) Wet Ponds

- Inlet and outlets structures must be protected with suitable fencing and guardrails.

v. The facility's anticipated high water level during a 1:5 year rainfall event shall be at or below the pipe obvert at the nearest manhole on the inlet storm sewer main. This will typically require the installation of a drop structure on the inlet storm sewer main.
vi. Sediment basins shall be provided at inlets for control of heavy solids. Outlets shall include a slide gate or other suitable feature to control outflow from the facility.
vii. Outlet capacity shall be sufficient to ensure post-event drawdown allows storage capacity to be available for the 1:5 year rainfall event with 24 hours and for the 1:25 year event within 48 hours, and that 90% of the facility's full storage capacity is available within 96 hours.
viii. An emergency overflow must be provided to redirect flows in excess of the design peak flow for the facility. The overflow shall tie-in to a suitable overland flow route.
ix. Pond design shall include provisions for maintenance of the dry pond between rainfall events.
x. The pond shall be graded to promote proper drainage of the facility between rainfall events. Minimum slope of the pond bottom shall be 2%.
xi. Side slopes must meet recommendations of the geotechnical report and shall be in accordance with the Engineering Standard Drawing.
xii. The pond bottom and side slopes shall be constructed of materials as recommended by the geotechnical report.
xiii. Landscaping in and around stormwater management facilities shall be as per the approved landscaping plan submitted.
xiv. Stormwater quality best management practices must be addressed by the design for the facility.
xv. All-weather vehicle access must be provided to all inlet, outlet, and control structures, and other works in or around the facility which may require maintenance.

k.) Constructed Wetlands
i. Constructed wetlands store stormwater runoff for extended periods of time to restrict post-development peak discharge rates and improve stormwater quality. Constructed wetlands are specifically recommended for any storage facilities that are located immediately upstream of a receiving watercourse, at the end of a storm sewer main.
ii. Requirements for the design of constructed wetlands for stormwater management shall be reviewed on a case-by-case basis in order to address site- specific stormwater quantity and quality requirements within existing environmental factors.
iii. Minimum requirements of current Alberta Environment and Parks standards and guidelines pertaining to the design of constructed wetlands shall expressly apply.

l.) Underground Storage Facilities
i. Underground storage facilities include various proprietary systems for storing surface runoff in buried storage vaults. Such facilities are not preferred and shall only be allowed upon the discretion and written acceptance of the Town.

7.12 Stormwater Management System Design for Infill and Redevelopment Projects

7.12.1 Refer to Section 1.23 for submission requirements.

7.12.2 The Design shall provide for the interception, conveyance, and storage of all overland drainage which enters the Development from surrounding areas for the indefinite future or interim period until infill or redevelopment of such areas occurs. Furthermore, the stormwater management system shall be designed to ensure the Development does not adversely affect the existing drainage pattern of surrounding areas, whether during or following construction.

7.12.3 Peak allowable outflow rate from the onsite collection system to the receiving storm sewer system shall be equal to pre-development flows or equal to the available conveyance capacity of the receiving sewer during a 1:5 year rainfall event, whichever is less.

7.12.4 Sewers
a.) Pipe Diameter:
i. Minimum 250 mm

b.) Flow Velocity:
    i. Minimum 0.6 m/s
    ii. Maximum 3.0 m/s
c.) Manning's "n":
    i. n = 0.013
d.) Slope:
    i. Minimum slope shall be in accordance with the table provided in Section 7.3.4a).
e.) Pipe Design
    i. Strength design shall be integral to the pipe selection process.
f.) Depth of Cover
    i. Sewer mains shall be installed to provide a minimum depth of cover of 1.50 m, as measured from the top of the pipe to the final finished grade at the surface.

7.12.5 Where conditions are favourable, sump pump discharge should be connected to the stormwater collection system in accordance with Section 7.8.

7.12.6 Lot and landscape grading shall be designed such that the maximum depth of peak flows and ponding shall be a minimum of 300 mm below the lowest anticipated opening elevation at buildings. A suitable overflow route or sufficient ponding volume must be provided from or at all ponding areas to achieve this minimum freeboard and limit ponding to a maximum depth of 350 mm.

7.13 Storm Outfalls

7.13.1 Outfall pipe obvert shall be above the high water level of the receiving channel under the 1:5 year rainfall event. Outfall pipe invert shall be above the normal ice level of the receiving channel under average annual precipitation conditions. Where these requirements cannot be reasonably achieved, the outfall pipe obvert shall be 1.0 m below the normal water level of the receiving channel under average annual precipitation conditions.

7.13.2 Drop structures and energy dissipation works shall be included where necessary to prevent erosion. Further erosion protection works including, but not necessarily limited to, rip rap and filter fabric treatment, shall be required at the end of storm outfalls into the downstream channel.

7.13.3 For concrete sewer pipe, pipe joints shall be grouted inside and out, or otherwise sealed with a suitable product or method to improve joint integrity, for at least 10 pipe lengths upstream from the outfall.

7.13.4 Storm outfalls must include gratings over outlets for public safety. Gratings shall have a maximum clear bar spacing of 150 mm and shall be suitably anchored to the outfall structure. Grated outlet structures must be designed with twice the required hydraulic capacity in order to prevent plugging, and designed for a maximum flow velocity of 1.0 m/s through the grating. Gratings must be designed to allow maintenance access.

7.13.5 Storm outfall structures must be protected with suitable fencing and guardrails.

7.13.6 Storm outfalls shall be located such that there is minimal impact to adjacent property. Landscaping around outfalls shall be compatible with adjacent land use and provide for low maintenance, using native plant material and a grass seed mix.

7.13.7 All-weather vehicle access must be provided to all storm outfalls for maintenance purposes.

PART II – MATERIALS

7.14 Storm Sewer Mains, Catch Basin Leads, and Foundation Drain Discharge Collection Sewers

Storm sewer mains, catch basin leads, and foundation drain discharge collection sewers shall be polyvinyl chloride (PVC) or concrete pipe conforming to the following:

7.14.1 PVC Pipe and Fittings

a) PVC pipe shall be acceptable for sewer mains up to 900 mm diameter.

b) PVC pipe and fittings shall meet CAN/CSA-B182.2 with locked-in elastomeric ring gasket and integral bell system joint type.

c) Minimum pipe dimension ratio shall be DR35. Strength design, considering trench and road loading, shall be integral to pipe design process.

d) Pipe shall be installed within two years from the production date indicated on the certification.

e) Joint lubricants shall be compatible with gasket material.

7.14.2 Concrete Pipe and Fittings

a.) Non-Reinforced Circular Concrete Pipe and Fittings

i) Non-reinforced concrete pipe shall be acceptable for 200 mm to 250 mm diameter sewer mains where strength design, considering trench and road loading, for the pipe is suitable.

ii) Pipe and fittings shall meet CAN/CSA-A257.1, Class 3, and designed for flexible rubber gasket joints to CAN/CSA-275.3, and constructed with Type HS sulphate resistant Portland cement to CAN/CSA-A3000.

b) Reinforced Circular Concreate Pipe and Fittings

i) Reinforced concrete pipe shall be acceptable for sewer mains with a diameter of 250 mm and up.

ii) Pipe and fittings shall meet CAN/CSA-257.2, concentric reinforcing, designed for flexible rubber gasket joints to CAN/CSA-275.3, and constructed with Type HS sulphate resistant Portland cement to CAN/CSA-A3000.

iii) Strength design, considering trench and road loading, shall be integral to pipe design process. D-load shall be as determined by load analysis.

7.15 Culverts

7.15.1 Corrugated metal pipe (CMP) shall be acceptable for culverts and temporary inlets and outlets for stormwater management facilities.

7.15.2 CMP shall conform to CAN/CSA-G401 with welded or coupled joints.

7.16 Manholes

7.16.1 Manholes shall be minimum 1,200 mm in diameter and in accordance with the Engineering Standard Drawings.

7.16.2 Catch basin manholes shall be minimum 1,200 mm in diameter.

7.16.3 Manhole materials shall be reinforced concrete, constructed of Type HS sulphate resistant cement.

7.16.4 Precast manhole sections, adjusting neck rings, and manhole steps shall conform to CAN/CSA- A257.4 and ASTM-C478.

7.16.5 Pre-benched standard manhole bases shall be used and shall include pre-cored connections with watertight joints, Duraseal or accepted alternate.

7.16.6 Manhole joints shall meet the requirements of CAN/CSA-257.3 and ASTM-C443. Furthermore, all joints shall be sealed with a suitable non-shrink grout on the inside and outside for the circumference of the manhole.

7.16.7 Manhole steps shall be standard safety type, constructed of hot-dipped iron in accordance with ASTM-A615 and ASTM-A123 or aluminum, forged of 6061-76 aluminum alloy, with a minimum tensile strength of 200 MPa.

7.16.8 Frames and Covers

a) Frames and covers shall be made of iron conforming to ASTM-A48 and in accordance with the Engineering Standard Drawings.
b) Frames for manholes on paved surfaces shall be Norwood NF-80 floating type with rubber gasket seal and solid cover, as manufactured by Norwood Foundry Ltd., or accepted alternate.
c) Frames for manholes not on paved surfaces shall be Norwood NF-39 with solid cover, as manufactured by Norwood Foundry Ltd., or accepted alternate.
d) Cover shall be imprinted with the word “Storm”.

7.16.9 Perched manholes, or accepted alternate, are required for sewer mains from 600 mm to 1,050 mm in diameter and in accordance with the Engineering Standard Drawings.

7.16.10 Tee-riser manholes, or accepted alternate, are required for sewer mains greater than 1,050 mm in diameter and in accordance with the Engineering Standard Drawings.

7.16.11 For manholes exceeding 7 m in depth, the Town may stipulate additional requirements for manholes.

7.16.12 The Town may require lockable covers be provided where safety or security risks may be a concern. Where required, such shall be subject to the review and acceptance of the Town.

7.17 Catch Basins

7.17.1 Catch basins shall be minimum 900 mm in diameter with a minimum sump depth of 600 mm in accordance with the Engineering Standard Drawings.

7.17.2 Catch basin materials shall be reinforced concrete, constructed of Type HS sulphate resistant cement.

7.17.3 Catch basin steps shall be standard safety type, constructed of hot-dipped iron in accordance with ASTM-A615 and ASTM-A123 or aluminum, forged of 6061-76 aluminum alloy, with a minimum tensile strength of 200 MPa.

7.17.4 Frames and Covers

a) Frames and covers shall be made of iron conforming to ASTM-A48 and in accordance with the Engineering Standard Drawings.
b) Top inlet, round top frames and covers shall be Norwood NF-38 or NF-39 open grate type, as manufactured by Norwood Foundry Ltd.
c) Side inlet frames and covers for straight-faced curb shall be Norwood NF-51 two piece or NF-36A, as manufactured by Norwood Foundry Ltd.
d) Side inlet frames and covers for rolled-faced curb shall be Norwood NF-33, K-2, or DK-7, as manufactured by Norwood Foundry Ltd.,

7.18 Stormwater Service Connections

7.18.1 Single-family residential sewer services shall be PVC pipe conforming to Section 7.14.1.

7.18.2 Tee-type fittings shall be used to connect service connections to sewer mains for all new construction. For existing concrete main service connection inserted tee-type fittings shall be used whenever possible. The tee-type fittings will be positioned such that the service connection discharges into the upper half of the sewer main. Stainless steel strap-on type service saddles shall only be permitted for service connections to existing mains, or where otherwise this may be the only option (i.e. connections to large diameter sewer mains).

7.18.3 Sewer services for all other developments, in accordance with Section 7.7, shall comply with Section 7.14.

7.19 Oil and Grit Interceptors

7.19.1 Oil and grit interceptors shall be as manufactured by Stormceptor, CDS Technologies, or accepted alternate.

7.20 Stormwater Force Mains

7.20.1 Refer to Section 6.10 of these Standards.

7.21 Bedding and Backfill

7.21.1 Refer to Section 5.13 of these Standards.

PART III – CONSTRUCTION

7.22 General

7.22.1 The following sections represent the minimum requirements for some typical, key construction procedures for stormwater management system construction. These minimum requirements must be met or exceeded by the detailed construction specifications and drawings developed by the Consultant.

7.22.2 Construction activities must adhere to the provisions of the Erosion and Sediment Control Plan prepared for the Development in accordance with Section 1.10.1.7.

7.23 Quality Assurance

7.23.1 Refer to Section 6.13 of these Standards.

7.24 Quality Control Testing

7.24.1 Refer to Section 5.16 of these Standards.

7.25 Site Preparation

7.25.1 Prepare the site in accordance with Section 3.26 of these Standards.

7.26 Clearing

7.26.1 Conduct clearing in accordance with Section 3.27 of these Standards.

7.27 Grubbing

7.27.1 Complete grubbing in accordance with Section 3.28 of these Standards.

7.28 Topsoil Stripping and Stockpiling

7.28.1 Strip and stockpile topsoil in accordance with Section 3.29 of these Standards.

7.29 Trench Excavation

7.29.1 Refer to Section 5.22 of these Standards.

7.30 Alignment and Grade

7.30.1 Lay pipe to the required alignment and grade, with manholes and all other appurtenances at the locations identified on the construction drawings.

7.30.2 Provide minimum 1.50 m depth of cover on sewer mains, unless otherwise authorized by the Town in writing. Where depth of cover is less than 1.50 m provide insulation.

7.30.3 Acceptable tolerances are as follows:

a) Alignment – the centreline of the pipe shall not be more than 100 mm off the specified alignment.
b) Elevation – the pipe invert shall not be more than 6 mm plus 0.01 mm per mm diameter of the pipe off the specified elevation.

c) Joints – for concrete pipe, deflections at joints shall not exceed that specified by CAN/CSA-A257. For PVC pipe, deflections at joints shall not exceed those recommended by the manufacturer.

7.30.4 All pipe shall be laid sloping in the desired direction with no reversed grades on any pipe lengths.

7.30.5 Maintain, and provide to the Town upon request, grade sheets for the installation of the pipe.

7.30.6 No deviation shall be made from the required alignment or grade without the written consent of the Town.

7.31 Pipe Bedding and Pipe Zone Backfill

7.31.1 Refer to Section 5.24 of these Standards.

7.32 Pipe Installation

7.32.1 Refer to Section 6.22 of these Standards.

7.33 Setting Manholes

7.33.1 Refer to Section 6.23 of these Standards.

7.34 Setting Catch Basins

7.34.1 General
a.) Bases shall be placed on solid, unfrozen ground.
b.) Construct catch basin unit plumb and true to alignment and grade.

7.34.2 Catch Basin Completion
a) Backfill around the catch basin with sand, as specified in Section 5.13.2, or fillcrete. Course sand backfill (1 3/8 screenings or acceptable approved alternate), shall be placed and compacted to minimum 98% Standard Proctor Density in uniform lifts not exceeding 150 mm in depth.
b) Place frame and cover to the elevation indicated, and adjust tops flush finished grades.
c) Where grade rings are not available in the height required for proper spacing any other materials used to correct heights must be approved by the Town of Whitecourt and cannot be deleterious materials (i.e. Styrofoam, wood, brick, etc.).

7.35 Stormwater Service Connections

7.35.1 Refer to Section 6.24 of these Standards.

7.36 Trench Backfill

7.36.1 Refer to Section 5.31 of these Standards.

7.37 Stormwater Main Inspection and Testing

7.37.1 CCTV inspection to be completed for all stormwater mains, catch basin leads, and foundation drain discharge collection sewers.

7.37.2 Refer to Section 6.26 of these Standards.

7.38 Stormwater Service Inspection and Testing

7.38.1 Refer to Section 6.27 of these Standards.

7.39 Final Inspection of Stormwater Mains

7.39.1 Refer to Section 6.28 of these Standards.