Village of New Maryland

Storm Water Management Master Plan

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1 Introduction

The Village of New Maryland is a community with a population of approximately 4,200 people and is located in New Brunswick, just south of the capital City of Fredericton. New Maryland prides itself on its rural character with ample green space and forested areas, planned subdivisions, large building lots, and numerous parks. New Maryland has a current focus on additional green space (New subdivision parks as well as a network of walking trails), and environmental protection [source: New Maryland website www.vonm.ca]. This environmental protection extends to the development of a storm water management master plan to better control, maintain, upgrade, and manage the storm water infrastructure and to protect the safety of the New Maryland residents and their property.

Overall the topography and surface drainage within the limits of the Village of New Maryland is split into two directions, to the north and to the south: the northern surface flows discharge to the Baker Brook Watershed and the southern surface flows eventually discharge to the Rusagonis Stream Watershed (shown on Drawing 1). The general drainage follows these two directions and will be further delineated and described in more detail in following sections.

The Village of New Maryland's storm water infrastructure consists of a combination of inter linked systems, including: storm sewers, ditches, driveway culverts, outfalls, swales, and major watercourses. Due to development over the years, the storm water infrastructure has been pieced together since 1970 to present. The age of both the storm sewer and sanitary sewer infrastructure are shown on Drawing 2 and 3 respectively.

1.1 Benefits of a Storm Water Management Plan

Surface water and storm water are used to describe the runoff of water from the land due to precipitation (rainfall or snowmelt). Surface runoff is of particular concern in an urban environment where a reduction in trees and vegetation and an increase in hard surfaces occurs. The conveyance system that transports this runoff consists of private and public infrastructure which is a mix of pipes, ditches, and natural watercourses, including streams and wetlands. Surface water and storm water runoff can be a challenge to manage as it changes with land use patterns as well as climate variability.

A Surface Water Management Plan can improve safety, reduce the risk to public and private property, and enhance and maintain the natural environment.

New Maryland staff noted the following specific advantages of developing a storm water management master plan for the Village [source: Administrative Memo dated 13 July 2016]:

- Public perception that the municipality recognizes the impacts experienced by residents and is employing a methodical approach to priority assessment and implementation of long lasting storm water management solutions;
- A Master Plan will identify areas of vulnerability, locations for required mainline and culvert upsizing, and serve as a guide in establishing infrastructure changes to be levied to developers for improvements to existing systems and culverts that may be required to accommodate proposed upstream development; and

- A comprehensive assessment of the demands on storm water infrastructure with the Village at the full build out/fully developed scenario will allow for better prioritizing and planning in terms of risk management, infrastructure renewal/replacement, and identifying strategic locations for regional storm water attenuation facilities (i.e. larger "regional" dry ponds may be better than multiple small ones from an ongoing operation and maintenance perspective).

1.2 Objectives

Opus International Consultants were retained by the Village of New Maryland to develop a Storm Water Management Master Plan (SWMMP) with the following initial objectives:

- Mitigation of undesirable impacts of land development on wetlands and watercourses;
- Preservation of the natural hydrologic balance in newly developing areas and its re-establishment in already developed areas;
- Protection and enhancement of the quality of storm water discharged to wetlands and watercourses; and
- Reduction of the volume and frequency of combined sewer overflows in existing subdivisions.

1.3 Goal

The approach to the management of storm water within municipalities in North America is evolving from a **reactive approach** (only dealing with the consequences of land use change, often at great public expense), to a **pro-active approach** (eliminate the root cause of the runoff and reduce the volume and rate of runoff). We recommend the following overarching goal statement for the Village of New Maryland Storm Water Management Master Plan:

Allow for management of surface water in the Village of New Maryland to improve the quality of life for New Maryland residents, improve safety, reduce risk to public and private property, and enhance the natural environment.

2 Approach and Methodology

The approach taken to develop this SWMMP and meet the objectives was proposed as seven sequential steps as follows:

1. Comprehensive review of all available data – to establish an inventory of all relevant storm water system and surface water drainage data.
2. Preliminary mapping of major drainage zones – to establish the major drainage zones for the entire Village.
3. Additional data collection and inspection – to identify and collect additional survey data for any areas where confirmation of storm water system or storm water ditching is required.
4. Major and Minor Drainage Zones – to establish the minor drainage zones for the entire Village.
5. Assessment of existing storm water systems – to identify areas with insufficient capacity.
6. Evaluate areas of concern and develop overall Village priority areas – to establish priority areas for future work/upgrades and identify future development areas and mitigation measures required.

7. Development of long term Storm Water Management Master Plan – to establish plans for the Village identifying priority areas, cost estimates, and mapping of major and minor drainage zones.

The following sections outline the results of these seven steps and the associated recommendations for future work and planning.

3 Review of Available Data and Reports

Several sources of available information were reviewed as part of this SWMMP development. This information in conjunction with the knowledge and experience of Opus personnel were integral in efficiently determining areas of concern and eliminating any re-work. The data and information compiled and reviewed is as follows:

- LIDAR mapping and photogrammetry (recent 2015)
- Current Village of New Maryland GIS system (developed by Opus and updated yearly), layers in particular:
    - Storm and Sanitary Sewer Systems
    - Age of Infrastructure
    - Results of Wet Weather Flooding Survey (2014)
    - Watercourses and Wetlands
    - Wellfield Protection Zones
    - Topographic Data – contours and elevations
    - Drainage areas and boundaries from previous studies
    - Parks and green space
- Wet Weather Flooding Survey (2014)
- Sanitary Sewer Flow Monitoring and Inflow/Infiltration data (2003)
- Bismark Street Storm Sewer Analysis Report (2012)
- Numerous old and new design and construction as-builts for storm and sanitary sewers within the Village, including drawings as well as design notes and calculations.

All of this information was used as it provided evidence to existing and past surface drainage characteristics, problems, deficiencies, and future capacity. Relevant information from all of this available data will be discussed in future sections of this report with the associated sub basins.

4 Watersheds and Sub Basins

One of the most important steps in a storm water management plan involves delineating the physical watershed into major basins, sub basin areas, and the interconnecting network of storm sewers, ditches, culverts, outfalls, and major streams. The delineating requires the review of available topographic or LIDAR data with the overlaying development of storm sewer, ditches, culverts, as well as final field confirmation. The benefits of the delineated and field confirmed flow directions is an overall map of the Village that can aid in planning and provides a better understanding of where surface flows discharge.

4.1 Description of Surface Water and Drainage within the Village of New Maryland

As previously stated, overall the topography and surface drainage within the limits of the Village of New Maryland is split into two directions, to the north and to the south: the northern surface flows discharge to the Baker Brook Watershed and the southern surface flows eventually discharge to the Rusagonis Stream Watershed (shown on Drawing 1). Within the limits of the Village we have established a naming convention for the different basins and sub basins as follows:

- **NE:** Starting with the North or South (North to Baker Brook, or South to Rusagonis Stream) and general direction to surface flows of the basin or sub basin (Level 1).
- **NE1:** Number used to distinguish major Watershed branch divides (Level 2).
- **NE1-C:** Divide based on major outfall or major system inputs (Level 3).
- **NE1-C1:** Final separation of sub basins and field confirmed (Level 4).

All of the Level 3 sub basin areas are presented on Drawing 4. This drawing of the surface drainage provides an overview of where all surface flows within the Village are directed and is integral for the design and development of future areas and determining/minimizing the development impact.

5 Hydraulic Assessment

In general storm water and surface runoff systems consist of the following components:
The minor system – consisting of pipes, swales, and/or ditches which convey surface flows up to a 1:10-year return period rainfall event (Q_{10}). And,
The major system – consisting of overland flow paths, roadways and watercourses which convey peak surface flows up to a 1:100 year return period rainfall event (Q_{100}).
The hydraulic assessment of the Village of New Maryland system was performed to assess the capacity of existing major outfalls and trunk storm sewers utilizing the Rational Formula or utilizing data from previous reports.

5.1 Rational Formula

The Rational Formula is used to describe flows in rural and urban small drainage areas (less than 5 km^2), with consideration given to the land use type, the area size, the slope, and the rainfall intensity in the region. The results from this formula represent peak flows without existing retention due to ditches, pipes, and undersized driveway culverts. However, this peak flow is valuable in the assessment of the major outfalls and trunk sewer outfalls throughout the system.
Where data was not already available from previous studies and calculations by other methods, the Rational Formula was used to assess the outfalls throughout the Village of New Maryland.
To note: the Rational Formula is used in a current addendum to the ***New Brunswick Guide to the Minimum Standards for the Construction of Roads & Streets***, so that developers, planners, and engineers can establish runoff pre and post development and in the design of storm water mitigation and retention. Consideration should be given to using the Rational Formula in guidelines and standards for the Village storm water to be consistent with the standards in the province.

5.2 Climate Change

According to climate change prediction models, while changes in overall annual precipitation amounts are not projected to be significant, the timing and character of precipitation are. Therefore, climate change may result in higher intensity storm events (more rain in a shorter period of time), that could result in more flooding and potentially at different times of the year.

The potential changes associated with climate change increase the importance of storm water management practices that control flows, promote infiltration, and preserve and enhance water quality.

Other municipalities have already established a 1:100 year return period runoff (Q_{100}) plus 20% criteria in the design of major storm sewer systems and for the design of attenuation dry ponds. For consistency, the hydraulic assessment includes a review of outfall capacities based on both the Q_{100} and the Q_{100} +20%.

6 Results of Sub Basin Analysis and Assessment

The following sub sections detail the relevant information gathered from all previous studies, reports, and as-builts as well as the assessment of outfall capacity to design surface flows or design subsurface flows (for storm sewers) within developed areas. The sub basin areas are presented based on the naming convention mentioned in previous sections and at Level 3 as shown in Drawing 4. Drawings 5 through 9 show specific Level 3 and Level 4 sub basins and outfall locations.

6.1 NE1-A – Area to Baker Brook upstream of culvert under Route 101, New Maryland Highway

- Predominantly undeveloped land that discharges directly to Baker Brook.
- Baker Brook is conveyed under Route 101, New Maryland Highway, by a steel culvert with concrete box culverts on each end. The general condition of this culvert is good based on a field inspection (2016).
- The significant storage capacity of the channel and floodplain upstream of the Baker Brook culvert make the culvert a low risk. No calculation of design flow and capacity flows were completed for this culvert.

6.2 NE1-B – Applewood Acres Subdivision area between MacIntosh Drive, Gravenstein Street and Cortland Street

- Storm water runoff in this area is both via storm sewers as well as roadway and curb and gutter.
- Both sanitary and storm sewer systems exist in this area. The original design of the storm sewer was likely to a Q10 design standard based on the age ranging from 1977 to 1988.
- The 2014 wet weather flooding survey did not identify flooded basement issues in this area.
- This storm sewer system and surface overland flow discharge to the new culvert structure under Gravenstein which was installed in 2015 and designed for a Q_{100} flow.
- The age and design of the storm sewer system poses a minor risk for flooding.

6.3 NE1-C – Applewood Acres Subdivision south of Cortland Street (including Bismark Street trunk storm sewer), Forbes Subdivision, and Pine Ridge Estates.

- Storm water runoff in this area is both via storm sewers as well as ditches and roadways with curb and gutter.
- Both sanitary and storm sewer systems exist in this area. The original design of the storm sewer was likely to a Q_{10} design standard based on the age ranging from 1975 to 2012.
- This storm sewer system and surface overland flow discharge to the new culvert structure under Cortland Street which was installed in 2014. This culvert was replaced due to a blockage and damage of the previous culvert which occurred during a winter/spring storm event.
- The 2014 wet weather flooding survey identified residences on Cortland Street with flooded basement issues, however there was a poor survey response for residences in areas where flooding potential risks.
- This area was investigated in detail in 2012 (by Opus) to assess the operation of the Bismark Street trunk storm sewer due to reports of flooding by residents. The general findings and recommendations were as follows:
  - Based on SCS Type III stormwater analysis method, the Bismark Street trunk storm sewer was surcharged at the Q_{10} return period event. The potential surcharging could be due to the roadway surface level which poses a high risk to flooding of residences in the immediate vicinity.
  - Surcharging of the Bismark Street trunk storm sewer could extend throughout the storm sewer system.
  - Evaluation of potential areas for storm water retention to reduce surface flow inputs were not sufficient to reduce surcharging of the Bismark Street trunk.
  - It was recommended that the Bismark Street trunk storm sewer be replaced with a larger pipe to convey from a Q_{25} to Q_{50} flows.
  - Recommended that any further development contributing to this system be attenuated through the use of stormwater storage and dry ponds.
- In 2013 a small section of the Bismark Street trunk storm sewer, primarily the outfall, was replaced to a Q_{100} + 20% design flow.
- Without the recommended full upgrade of the Bismark Street trunk storm sewer, this area poses a high risk for flooding of residences.
- It would be recommended that the Bismark Street trunk storm sewer be upgraded to a Q_{100} design capacity pipe to further reduce the potential for flooding upstream.
- Although not sufficient to reduce flooding risk of the Bismark Street storm sewer trunk, it is still recommended that the design and construction of retention ponds be initiated in this area as part of the mitigation strategy to minimize flows and allow for potential development.
- Consideration should be given in future planning and design standards that major trunk storm sewers such as this be designed to a higher flow capacity (Q_{50} to Q_{100}), to avoid the risk of surcharging and flooding.

6.4 NE1-D – Area of Forbes Subdivision (Crown Avenue and Oliver Crescent)

- Storm water runoff in this area is both via storm sewers as well as roadway ditching.
- Both sanitary (1985), and newer storm sewer (2010) systems exist in this area. The original design of the storm sewer was to a Q_{10} design standard with a discharge to the main trunk storm sewer along Route 101, New Maryland Highway.
- The age and design of the storm sewer system for this small area poses a minor risk for flooding.

6.5 NE2 – A – Area of Springwater Place and undeveloped areas between Woodlawn Lane and Baker Brook

- This area includes approximately 2/3 of the Springwater subdivision and discharges via major outlets to the north to Baker Brook and to the east.
- Storm water runoff in this area is via some storm sewers (installed 1995 to 2007, small area from Springwater to Kerry), but the majority being ditches and driveway culverts.
- An independent sanitary sewer system (1979 to 1999), exists in the Springwater Subdivision.
- The 2002 flow monitoring of the sanitary sewer in this area indicate some inflow/infiltration component (peak daily flows 10 times the theoretical flows). This data is indicative of the age of the infrastructure and also indicates the presence of some groundwater, foundation drains, and/or surface water input to the system. Typically, in areas with ditches and no dedicated storm sewer system, the foundation drains were connected to the sanitary system.
- The 2014 Wet Weather Flooding Survey identified numerous residences with flooding, both surface and basement. However, there was no response from the majority of residences.
- In response to the wet weather flooding survey (mostly surface water issues of ponding/flooding were identified in this subdivision), several of the ditches, driveway culverts, and outfalls were upgraded.
- Hydraulic assessment results presented in Table 6-1 indicates that the 5 major outfalls from this area have sufficient capacity to convey the Q_{100} +20% return period flows.
- The existing storm sewer system in this area poses only a minor risk for flooding, and is limited to surface flooding at ditch and driveway culverts. A performance audit of the stormwater infrastructure in these areas (i.e inspection by staff during a significant rainfall event), could indicate areas requiring upgrading of the ditches and driveway culverts and Village crews could perform this work under routine maintenance.

Table 6-1: NE2-A Runoff Calculations and Existing Outfall Capacities

Sub Basin	Area (ha)	Tc (min)	Base C	Return Period (yrs)	Runoff Coefficient	Rainfall Intensity (mm/hr)	Total Runoff (Lps)	Ex. Storm Outfall	Outfall Capacity(Lps)
NE2-A2	20.27	30	0.45	10	0.45	42.2	1077.8	750mm Concrete Sewered	4000
				25	0.50	49.1	1380.0		
				50	0.54	54.3	1664.4		
				100	0.56	59.5	1899.4		
				100 + 20%	-	-	2279.3		
NE2-A3	0.77	15	0.4	10	0.40	65.7	56.7	Ditched	~1000
				25	0.44	76.6	72.7		
				50	0.48	84.7	87.7		
				100	0.50	92.9	100.2		
				100 + 20%	-	-	120.2		
NE2-A4	3.7	18	0.4	10	0.40	58.5	242.4	750mm Concrete Sewered	1000
				25	0.44	68.2	310.7		
				50	0.48	75.4	374.9		
				100	0.50	82.6	428.0		
				100 + 20%	-	-	513.6		
NE2-A5	3.43	22	0.4	10	0.40	51.5	197.7	525mm Concrete Sewered	800
				25	0.44	59.9	253.2		
				50	0.48	66.3	305.5		
				100	0.50	72.6	348.8		
				100 + 20%	-	-	418.5		
NE2-A6	9.43	34	0.4	10	0.40	39.0	411.5	1200mm ribbed poly. Culvert	1400
				25	0.44	45.3	526.7		
				50	0.48	50.1	635.1		
				100	0.50	54.9	724.7		
				100 + 20%	-	-	869.7		

Legend:
Tc = time of concentration
C = runoff coefficient
Ha = hectares
Yrs = years
Mm/hr = mm rainfall per hour
Lps – litres per second

6.6 NE2-B – Area of Springwater Place (Springwater Lane to Shaw Lane), undeveloped area, and Castle Acres

- Storm water runoff in Springwater Place Subdivision (approx. 1/3 of the subdivision), is via ditches and driveway culverts with outfalls to the east.
- Storm water runoff in Castle Acres Subdivision is via ditches and driveway culverts at the western end and via a combination of surface runoff (paved swales) and storm sewer in the east sections of Bradshaw Drive and Stonehurst Avenue (installed from 2000 to 2010).
- An independent sanitary sewer system exists in both the Springwater Subdivision and the Castle Acres Subdivision.
- The 2014 wet weather flooding survey identified numerous residences with flooding, both surface and basement. However, there was no response from the majority of residences.
- The 2002 flow monitoring of the sanitary sewer in this area indicate some inflow/infiltration component:
    - Peak daily flows 14 times the theoretical flows in Springwater; and
    - Peak daily flows 20 times the theoretical flows in Castle Acres.

  This data is indicative of the age of the infrastructure and also indicates the presence of some groundwater, foundation drains, and/or surface water input to the system. Typically in areas with ditches and no dedicated storm sewer system, the foundation drains were connected to the sanitary system.
- Hydraulic assessment results presented in Table 6-2 indicates that the 4 major outfalls from the Springwater Place area (NE2-B1 through NE2-B4), have sufficient capacity to convey the Q_{100} +20% return period flows. This area poses only a minor risk for flooding, and is limited to surface flooding at ditch and driveway culverts (reported), as well as minor surcharging at the most eastern ends of the subdivision.
- Hydraulic assessment results presented in Table 6-2 indicates that the 2 major storm sewer outfalls from the Castle Acres area (NE2-B6 and NE2-B7), do not have sufficient capacity to convey the Q_{100} and Q_{100}+20% return period flows without minor ponding at the inlet. As the storm water surface flows for this section of the subdivision will actually divide between storm sewer and overland, this area is considered to pose a minimal risk for flooding.
- A performance audit of the stormwater infrastructure in these areas (i.e inspection by staff during a significant rainfall event), could indicate areas requiring upgrading of the ditches and driveway culverts and Village crews could perform this work under routine maintenance.

Table 6-2: NE2-B Runoff Calculations and Existing Outfall Capacities

Sub Basin	Area (ha)	Tc (min)	Base C	Return Period (yrs)	Runoff Coefficient	Rainfall Intensity (mm/hr)	Total Runoff (Lps)	Ex. Storm Outfall	Outfall Capacity(Lps)
NE2-B1	4.38	37	0.4	10	0.40	36.9	181.1	750mm ribbed Poly. Culvert	450
				25	0.44	42.9	231.7		
				50	0.48	47.5	279.4		
				100	0.50	52.0	318.8		
				100 + 20%	-	-	382.6		
NE2-B2	8.71	39	0.4	10	0.40	35.7	348.1	900mm ribbed Poly. Culvert	700
				25	0.44	41.5	445.5		
				50	0.48	45.9	537.2		
				100	0.50	50.3	612.9		
				100 + 20%	-	-	735.4		
NE2-B3	1.42	15	0.4	10	0.40	65.7	104.5	600mm CMP Culvert	250
				25	0.44	76.6	134.0		
				50	0.48	84.7	161.7		
				100	0.50	92.9	184.7		
				100 + 20%	-	-	221.6		
NE2-B4	2.98	45	0.4	10	0.40	32.6	108.7	600mm Driveway Culvert with headwall	250
				25	0.44	37.9	139.1		
				50	0.48	41.9	167.7		
				100	0.50	45.8	191.3		
				100 + 20%	-	-	229.5		
NE2-B6	10.1	28	0.4	10	0.40	44.1	499	525mm Concrete Sewered	**745 flowing full**
				25	0.44	51.3	639		
				50	0.48	56.8	771		
				100	0.50	62.2	879		
				100 + 20%	-	-	1055.3		
NE2-B7	9.5	25	0.4	10	0.40	47.4	505	450mm Concrete Sewered	**400 flowing full**
				25	0.44	55.2	646		
				50	0.48	61.0	779		
				100	0.50	66.9	890		
				100 + 20%	-	-	1067.7		

Legend:
Tc = time of concentration
C = runoff coefficient
Ha = hectares
Yrs = years
Mm/hr = mm rainfall per hour
Lps = litres per second

6.7 SE1-A – Highland Acres Area

- Storm water runoff in this area is via a poorly defined and shallow ditch and driveway culverts. Topography is fairly flat.
- A sanitary sewer system exists that was installed in 1970.
- The 2014 wet weather flooding survey identified some residences with flooding, both surface and basement. However, there was no response from the majority of residences.
- The 2002 flow monitoring of the sanitary sewer in this area indicates a substantial inflow/infiltration component (peak daily flows 100 times the theoretical flows). This data indicates the presence of foundation drains, groundwater, and/or surface water input to the system.
- Village staff have stated thy have had numerous calls in this area regarding flooding of residences.
- This sanitary system is effectively acting like a combined sewer with groundwater, and possibly surface, foundation, and roof leaders entering the system. As the sanitary system was unlikely to have been designed for this additional flow, the system would likely surcharge making this area a significant risk for flooding of residences.
- Hydraulic assessment results presented in Table 6-3 indicates that the major outfall from this area has sufficient capacity to convey the Q_{100} + 20% return period flows.

Table 6-3: SE1-A Runoff Calculations and Existing Outfall Capacities

Sub Basin	Area (ha)	T_c (min)	Base C	Return Period (yrs)	Runoff Coefficient	Rainfall Intensity (mm.hr)	Total Runoff (LPS)	Ex. Storm Outfall	Outfall Capacity (LPS)
SE1-A1 + SE1-A2	10.47	20	0.4	10	0.40	54.7	641.2	900mm Concrete Sewered	1400
				25	0.44	63.7	821.7		
				50	0.48	70.5	991.4		
				100	0.50	77.2	1131.8		
				100 + 20%	-	-	1358.2		

Legend:
Tc = time of concentration
C = runoff coefficient
Ha = hectares
Yrs = years
Mm/hr = mm rainfall per hour
Lps – litres per second

6.8 SE1-B – Area west of Route 101 – includes a portion of Centennial Heights

- Both sanitary sewer and storm sewer (1994 and 2013) exist in this area. Also, a storm water retention dry pond is located adjacent to Route 101 and prior to the major trunk storm sewer outfall from Route 101 (1999 and 2000).
- Hydraulic assessment results presented in Table 6-4 indicates that the major outfall does not convey the Q_{100} and Q_{100} + 20% flows, however this does not take into account the attenuation of the peak flow due to the constructed dry pond. It is likely that the dry pond reduces peak flows such that the outfall is sufficient.
- Due to the presence of relatively new dedicated storm and sanitary sewers and the presence of the dry pond, this area poses a minor risk for flooding.

Table 6-4: SE1-B Runoff Calculations and Existing Outfall Capacities

Sub Basin	Area (ha)	Tc (min)	Base C	Return Period (yrs)	Runoff Coefficient	Rainfall Intensity (mm.hr)	Total Runoff (LPS)	Ex. Storm Outfall	Outfall Capacity (LPS)
SE1-B1 + SE1-B2 + SE1-B3	23.2	25	0.35	10	0.35	47.4	1078.0	900mm Concrete Sewered	ATTENUATED
				25	0.39	55.2	1380.8		
				50	0.42	61.0	1665.6		
				100	0.44	66.9	1901.2		
				100 + 20%	-	-	2281.4		

Legend:
Tc = time of concentration
C = runoff coefficient
Ha = hectares
Yrs = years
Mm/hr = mm rainfall per hour
Lps – litres per second

6.9 SE1-C – Area west of Route 101 – includes majority of Centennial Heights

- Storm water runoff in this area is via deep ditches and driveway culverts with a newer storm sewer trunk (near Route 101) installed in 1993 and upgraded in 2007 and connected to the major trunk storm sewer along Route 101 (2007 and 2008). This major trunk sewer outfall discharges to SE1-G area.
- A sanitary sewer exists in this area that was installed in 1980.
- The 2014 wet weather flooding survey identified numerous residences with flooding, both surface and basement. However, there was no response from the majority of residences.
- The 2002 flow monitoring of the sanitary sewer in this area indicate some inflow/infiltration component (peak daily flows 7 times the theoretical flows). This data indicates the presence of some groundwater and/or surface water input to the system. This data is indicative of the age of the infrastructure and also indicates the presence of some groundwater, foundation drains, and/or surface water input to the system. Typically, in areas with ditches and no dedicated storm sewer system, the foundation drains were connected to the sanitary system.
- Hydraulic assessment results presented in Table 6-5 indicates that the storm sewer outfall from this area only has sufficient capacity to convey the Q_{50} return period flows.
- Although the age of the sanitary sewer system and lack of dedicated storm sewer system can indicate a combined sewer, the flow monitoring data did not show this to be the case. As the outfall only has sufficient capacity for the Q_{50} , this area poses a medium risk for flooding.

Table 6-5: SE1-C Runoff Calculations and Existing Outfall Capacities

Sub Basin	Area (ha)	T_c (min)	Base C	Return Period (yrs)	Runoff Coefficient	Rainfall Intensity (mm.hr)	Total Runoff (LPS)	Ex. Storm Outfall	Outfall Capacity (LPS)
SE1-C1 + SE1-C2 + SE1-C3 + SE1-C4 + SE1-C5	44.62	35	0.4	10	0.40	38.2	1911.2	1200mm Concrete Sewered	**3000**
				25	0.44	44.5	2446.2		
				50	0.48	49.2	2949.8		
				100	0.50	53.9	3365.9		
				100 + 20%	-	-	4039.1		

Legend:
Tc = time of concentration
C = runoff coefficient
Ha = hectares
Yrs = years
Mm/hr = mm rainfall per hour
Lps – litres per second

6.10 SE1-D – Area west of Route 101 –mostly undeveloped and small portion of Peterson Park

- Surface water runoff is directed to the main trunk sewer along Route 101 (2004 and 2007), which discharges to an outfall to SE1-H area.
- A detailed hydraulic assessment of the existing conditions show that the major trunk storm outfall for this area has a flowing full capacity of 1800 litres/sec, however this capacity is restricted due to inlet conditions to a maximum capacity of 600 litres/sec. As presented in Table 6-6, the existing inlet restriction forces any design storm flows exceeding a Q_{10} return period to store on the west side of Route 101, making it act like an attenuation pond.
- Due to this restriction, any further development in this area will require attenuation otherwise there would be additional ponding west of Route 101 or flooding at the roadway.
- While this attenuation may continue as there are minimal impacts to property west of Route 101, future modifications to the inlet conditions could increase the capacity of the storm sewer overflow to 1800 litres/sec and meet the Q_{100} + 20% return period flow. As the existing inlet is reducing the design peak flows downstream to SE1-H (Sunrise Estates are, see section 6.14), it is not recommended to modify the inlet conditions at this time.

Table 6-6: SE1-D Runoff Calculations and Existing Outfall Capacities

Sub Basin	Area (ha)	Tc (min)	Base C	Return Period (yrs)	Runoff Coefficient	Rainfall Intensity (mm.hr)	Total Runoff (LPS)	Ex. Storm Outfall	Outfall Capacity (LPS)
SE1-D1 + SE1-D2	45.52	60	0.25	10	0.25	27.1	863.5	750mm Concrete Sewered	**600 Inlet Control *(1800 Flowing Full)***
				25	0.28	31.5	1104.1		
				50	0.30	34.8	1330.6		
				100	0.31	38.1	1517.5		
				100 + 20%	-	-	1821.0		

Legend:
Tc = time of concentration
C = runoff coefficient
Ha = hectares
Yrs = years
Mm/hr = mm rainfall per hour
Lps – litres per second

6.11 SE1-E – Area east of Route 101 – Includes mostly undeveloped land and minor residential and commercial development along Route 101

- No subdivision development exists in this area which is predominantly wooded.
- Area receives flows from major storm sewer trunk outfalls from areas SE1-A and SE1-B.
- This area poses a low risk of flooding as this area eventually flows to nearby watercourse to the east.
- Future development in this area should accommodate the outfall flows from the areas west of Route 101. This can be addressed in future Village standards for storm water.

6.12 SE1-F - Area east of Route 101 – Includes mostly undeveloped land, minor residential and commercial development along Route 101, and a section of Cedar Acres Court

- Area is predominantly wooded with portion of Cedar Acres Court.
- This area poses a low risk of flooding as this area eventually flows to nearby watercourse to the east.
- Future development in this area should accommodate the outfall flows from the areas west of Route 101. This can be addressed in future Village standards for storm water.

6.13 SE1-G – Area east of Route 101 - includes Cedar Acres Court, the majority of Sunrise Estates and undeveloped area east of Route 101

- Storm water runoff in this area is a mix of storm sewer (2004 to 2007) and via ditches and driveway culverts with outfalls generally to the east and south.
- A sanitary sewer exists in this area that was installed in 1973.
- The 2014 wet weather flooding survey identified numerous residences with flooding, both surface and basement. However, there was no response from the majority of residences.
- The 2002 flow monitoring of the sanitary sewer in this area indicates some inflow/infiltration component (peak daily flows 10 times the theoretical flows). This data is indicative of the age of the infrastructure and also indicates the presence of some groundwater, foundation drains, and/or surface water input to the system. Typically in areas with ditches and no dedicated storm sewer system the foundation drains were connected to the sanitary system.
- Hydraulic assessment results presented in Table 6-7 indicates that the storm sewer outfall from SE1-G2 does not have sufficient capacity to convey the Q_{50} return period flows. Although no evidence of surcharging at the inlet of the outfall (maybe due to upstream areas attenuating flows), this outfall could be considered in the future for upgrading by Village staff.
- Hydraulic assessment results presented in Table 6-7 indicates that the major trunk outfall through Sunrise Park (SE1-G4, SE1-G2, and SE1-G3), has sufficient capacity to convey the Q_{100} +20% return period flows. This area poses only a minor risk for flooding.

- Hydraulic assessment results presented in Table 6-7 indicates that two of the major outfalls in the Sunrise Estates area (SE1-G6 and SE1-G8), have sufficient capacity to convey the Q_{100}+20% return period flows. These areas pose only a minor risk for flooding.
- Hydraulic assessment results presented in Table 6-7 indicates that a major outfall on the east side of Sunrise Estates (SE1-G7), does not have sufficient capacity to convey the Q_{10} return period flows. This area poses a major risk for flooding, but is limited to localized surface flooding and surcharging at the most eastern ends of the subdivision. This outfall could be upgraded as part of routine maintenance by Village staff.
- A small area at the west side of Sunrise Estates (SE1-G5), does not appear to have a defined channel or surface flow outlet. It is assumed that flows from this area either infiltrate or cross the roadway during periods of significant runoff. Providing adequate drainage from this area could be performed as part of routine maintenance by Village Staff.

Table 6-7: SE1-G Runoff Calculations and Existing Outfall Capacities

Sub Basin	Area (ha)	T_c (min)	Base C	Return Period (yrs)	Runoff Coefficient	Rainfall Intensity (mm.hr)	Total Runoff (LPS)	Ex. Storm Outfall	Outfall Capacity (LPS)
SE1-G2	22.33	130	0.25	10	0.30	16.5	310.1	750mm Concrete Inlet	**450**
				25	0.33	19.2	395.9		
				50	0.36	21.2	476.8		
				100	0.38	23.2	543.4		
				100 + 20%	-	-	652.0		
SE1-G4 + SE1-G2 + SE1-G3	28.55	130	0.35	10	0.35	16.5	462.6	900mm Concrete Sewered	**2900**
				25	0.39	19.2	590.6		
				50	0.42	21.2	711.2		
				100	0.44	23.2	810.5		
				100 + 20%	-	-	972.6		
SE1-G6	1.6	17	0.4	10	0.40	60.7	108.7	600mm Corrugated Steel	**230**
				25	0.44	70.7	139.4		
				50	0.48	78.2	168.2		
				100	0.50	85.7	192.0		
				100 + 20%	-	-	230.4		
SE1-G7	3.68	14	0.4	10	0.40	68.7	283.1	600mm Concrete Culvert	**270**
				25	0.44	80.1	363.0		
				50	0.48	88.6	438.1		
				100	0.50	97.1	500.4		
				100 + 20%	-	-	600.4		
SE1-G8	1.03	13	0.4	10	0.40	72.0	83.1	Open Ditch	~1000
				25	0.44	84.0	106.5		
				50	0.48	92.9	128.6		
				100	0.50	101.9	146.9		
				100 + 20%	-	-	176.3		

Legend:
Tc = time of concentration
C = runoff coefficient
Ha = hectares
Yrs = years
Mm/hr = mm rainfall per hour
Lps – litres per second

6.14 SE1-H – Area east of Route 101 – includes mostly undeveloped land and minor residential and commercial development along Route 101

- Area receives flows from the major storm sewer trunk outfall from areas SE1-D. As presented in Section 6.10, the flows from the west of Route 101 are attenuated due to inlet restriction on the major storm sewer outfall.
- A 750 mm diameter concrete culvert exists under Sunrise Estates roadway (only access roadway to the Sunrise Estates subdivision). This culvert was found to be in good condition however there has been reports of high flows and backup of this culvert during large precipitation events.
- Another 750 mm diameter culverts exists downstream of this location under a gravel access road off Lark Street. An inspection of this culvert showed significant debris and damage. There is further evidence of surface flows overtopping the culvert at this location and residents reported surface flooding of properties located on the corner.
- Hydraulic assessment results presented in Table 6-8 indicates that both of these culverts do not have sufficient capacity to convey the Q_{100} and Q_{100} + 20% return period flows for either the un-attenuated or estimated attenuated conditions.
- As these culverts are significantly undersized, there has already been flooding of private property, and flooding of Sunrise Estates could cut off emergency access, these culverts pose a significant risk to the public.
- It is recommended that the culvert downstream at Lark Street be replaced/upgraded first or in conjunction with the culvert upgrade at the entrance to Sunrise Estates. It is also recommended that these culverts be designed to convey the un-attenuated peak design flows to allow for possible upgrades upstream and/or the modification of the inlet control to the major storm sewer outfall.

Table 6-8: SE1-H Runoff Calculations and Existing Outfall Capacities

Sub Basin	Area (ha)	T_c (min)	Base C	Return Period (yrs)	Runoff Coefficient	Rainfall Intensity (mm.hr)	Unattenuated Total Runoff (LPS)	Estimated Attenuated Runoff (LPS)	Ex. Storm Outfall	Outfall Capacity (LPS)
SE1-D1 + SE1-D2 + SE1-H1	49.68	66	0.3	10	0.30	25.5	1064.1	800	750mm Concrete Culvert	**600**
				25	0.33	29.6	1360.3	850		
				50	0.36	32.7	1639.3	910		
				100	0.38	35.8	1869.3	950		
				100 + 20%	-	-	2243.2	1020		

Legend:
Tc = time of concentration
C = runoff coefficient
Ha = hectares
Yrs = years
Mm/hr = mm rainfall per hour
Lps – litres per second

6.15 SE2-A – Area west of Route 101 – includes mostly undeveloped land, Peterson Park, and commercial and residential property along Route 101

- The storm and surface flows for this area are alongside Route 101 and discharge to an existing culvert under Route 101 located at the New Maryland Village limits.
- The culvert crossing Route 101 has caused flooding of the roadway at this location due to significant rainfall events. Due to location, this culvert falls under the responsibility of the Province (New Brunswick Department of Transportation and Infrastructure, NBDTI), and further consultation should be had with the Province regarding upgrading this culvert to prevent flooding.

6.16 SW1-A – Area undeveloped which drains to the west

- No existing developments are present in this area and the surface runoff direction is to the west.
- Presence of numerous watercourses and wetlands within this area.
- Future development should include measures to protect the natural environment and minimize runoff flows and volume.

7 Priorities

In determining the types of capital projects for prioritization, the following tiered system was developed. This tiered system is based on the premise that risk to people, property, and public health & safety is the highest priority, which mirrors the established goal of the Storm Water Management Master Plan as presented in Section 1.0.

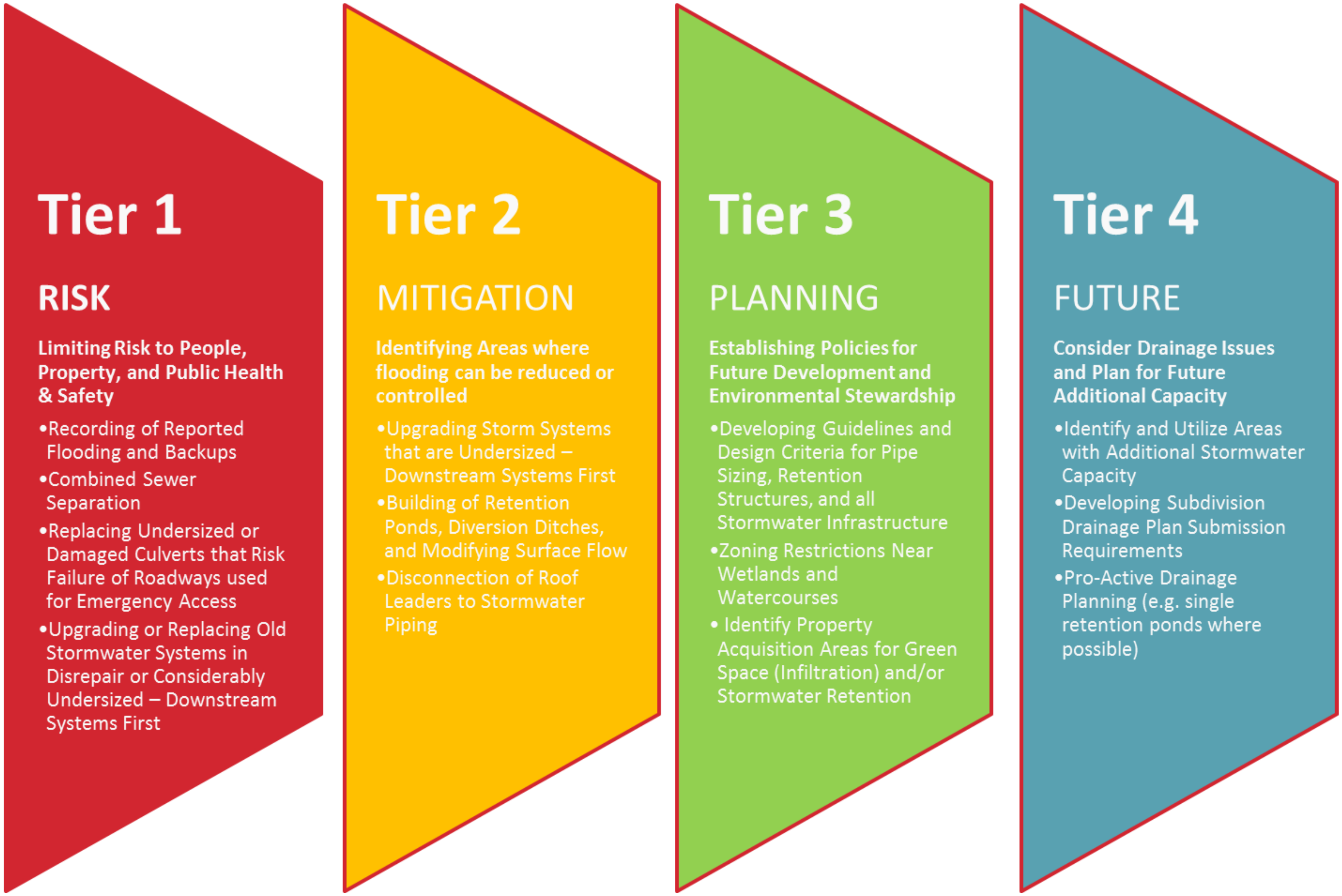

Figure 7-1: Tier Priorities

7.1 Tier 1 Priority Projects List

The following Tier 1 Priority Project List and Costs were developed based on all of the findings of assessment work.

Table 7-1 lists these recommended capital projects for Tier 1 from highest to lowest priority based on the best benefit to the maximum amount of residents as well as the determined Risk. These priority projects are also indicated on Drawing 4.

Table 7-1: Tier 1 – Risk Priority Project List and Costs

Project Description	Estimated Cost	Risk Rationale
Daniel Drive Servicing Upgrade - Phase 1 Route 101 Intersection to Alban Street Intersection Replacement of Sanitary Sewer and installation of New Stormwater System and New Watermain	$640,000 (includes sidewalk, curb and gutter)	• No dedicated stormwater system and shallow ditching • Sanitary Sewer acting like a Combined Sewer and considerable measured inflow/infiltration (2002) • Ability to connect residents to water services • Upgrading most downstream section will reduce risk of surcharging and flooding in upstream sections.
Bismark Street Storm Sewer Upgrade - Phase 2 End of Phase 1 (2013) to Loddington Street Intersection Upgrade of Stormwater Trunk Main to accommodate 1:100 year return period flow capacity	$330,000	• Reported Flooding and Sewer Backups • Existing Undersized Storm System with approx. 1:5 to 1:10 year return period flow capacity • Significant number of residences located upstream of this work
Bismark Street Storm Sewer Upgrade - Phase 3 End of Phase 2 at Loddington Street to Melrose Street Intersection Upgrade of Stormwater Trunk Main to accommodate 1:100 year return period flow capacity	$210,000	• Reported Flooding and Sewer Backups • Existing Undersized Storm System with approx. 1:5 to 1:10 year return period flow capacity • Significant number of residences located upstream of this work
Daniel Drive Servicing Upgrade – Phase 2 and Phase 3 Alban Street Intersection to Kimberley Street Replacement of Sanitary Sewer and installation of New Stormwater System and New Watermain	$1,200,000 (includes sidewalk, curb and gutter)	• No dedicated stormwater system and shallow ditching • Sanitary Sewer acting like a Combined Sewer and considerable measured inflow/infiltration (2002) • Ability to connect residents to water services • Work could be accomplished over multiple years
Sunrise Estates Drive/Lark St. Culvert Replacements Replacement of Culverts and Drainage Upgrades	$60,000	• Reports of flooding at Lark Street and surface flows to private property • Undersized culvert at Sunrise Estates Drive which is the only roadway into the subdivision

7.2 Tier 2 Mitigation Projects and Options

The following Tier 2 Mitigation Projects and Options were developed based on all of the findings of the assessment work and in conjunction with discussions with Village of New Maryland personnel.

Performance Audit and Upgrades
Based on what was noted in areas with above ground and ditch type storm infrastructure, the driveway culverts were identified as causing localized flooding and in some cases washouts. A performance audit of stormwater infrastructure during wet weather (i.e inspection by staff during a significant rainfall event), is recommended to identify these areas and develop a plan for upgrading any driveway culverts that are restricting storm water flows. It is further recommended that the culvert upgrades proceed from the most downstream culverts first to avoid moving problems downstream.

Installation of Catch Basin Flow Restrictors
In areas where the main trunk storm sewer has capacity issues, the installation of catch basin flow restrictors may be beneficial in reducing peak flows and storing storm water in the streets curb and gutter. The flow restrictors reduce the inflow of storm water from the catch basins which are typically at a rate of Q_{25}, that flow into a minor system with a capacity of Q_{10}. It should be noted that although restrictors are effective in reducing flows, there is a dis-benefit to having storm flows in streets for a longer period of time (safety issue to travelling public), and there are long term cleaning and maintenance requirements for the flow restrictors.
It may be more beneficial to install catch basin flow restrictors in newer development areas to minimize the size required of a minor storm sewer. In these newer areas, the roadway curb and gutter can be incorporated into a deeper boulevard area so that storm water can remain in the streets while minimizing the safety issue.

Roof Leader Investigation and Disconnection
Roof leader connections to foundation drains and storm sewers can lead to significant amounts of extraneous peak storm sewer flows. A visual investigation would allow the Village to determine the extent of the roof leader problem and if necessary, initiate a roof leader disconnection program whereby residents are asked to direct roof downspouts to overland areas. Another green option would be a rain barrel program whereby residents can direct roof flows to a barrel and utilize this water for watering yards and gardens. It is cautioned that rain barrels can be a maintenance issue with residents as they must be disconnected during winter months to avoid damage.

Designed and Constructed Attenuation Pond in Bismark Area
As part of the Bismark Street Storm Sewer Analysis in 2012, an option was investigated to reduce the flows to the Bismark Street trunk storm sewer by providing a constructed storm water retention/attenuation pond at the end of Baldwin Street. Although this option did not provide the full reduction in storm flows that were needed for Bismark Street, this option would reduce the storm flows slightly and may also provide for additional storage and therefore additional development around Bellflower and Melba Streets. This area is also where storm water has been known to pond and can go to the north or to the south direction so a defined channel and pond may be beneficial.

A detailed evaluation would be required that would consider all possible future inputs to the pond to develop the correct size and area needed to construct. The detailed design and costing would then allow for a business case to be performed for this option.

Forbes Property Sustainable Green Infrastructure Plan
As the Forbes Property in the Applewood Acres subdivision is a remaining area for development, it is recommended that the development proposal for this area include a requirement for green stormwater infrastructure with innovative storm water control methods.

Stormceptor Requirement for Parking Areas
It is proposed that all parking areas be required to install Stormceptor devices at the last point of discharge in order to prevent oil, gasoline, grease, sand, and grit from entering and wetlands watercourses. It is noted that Stormceptors require additional yearly maintenance, however this requirement will aid in minimizing potential contamination to watercourses and wetlands.

7.3 Tier 3 Planning Initiatives

The following Tier 3 Planning Initiatives were developed based on all of the findings of the assessment work and in conjunction with discussions with Village of New Maryland personnel. These Tier initiatives relate to best practices and guidelines for the Village future and existing stormwater infrastructure.

No Net Increase of Storm Water from Development
Although the Village already has a "no net increase" policy, it should be strengthened to require design review and calculations in accordance with the Provincial New Brunswick Department of Transportation and Infrastructure guidelines for subdivision development in rural areas. These guidelines have specific design and submission requirements related to stormwater control and attenuation ponds to achieve the no net increase.

In conjunction with this, the existing storm water flows (Q_{100} + 20% from current development areas), as indicated in this SWMMP, should be declared as existing boundary flow conditions and should be conveyed through any new development by the proponent.

Trunk Storm Sewers to Convey Q_{100} + 20%
Although traditional storm sewer design is Q_{10} capacity, the main trunk storm sewers should be designed for a Q_{100} + 20% capacity to avoid surcharging similar to what is occurring at the Bismark Street storm sewer. This eliminates surcharging as well as allows for capacity for any increase in storm flows due to climate change and for future development.

Consider a Q_{25} Design Capacity for Storm Sewers
Although the majority of municipalities have a storm sewer design standard of Q_{10} capacity, it is suggested that the Village increase the design standard for its new development storm sewer to Q_{25} capacity. This increase in capacity of the storm sewer would allow for the impacts of additional development but also the effects of possible climate change. It is felt that there would only be a minimal (10 to 15%), increase in the cost of infrastructure with a significant long term benefit.

It should be noted that the infrastructure constructed 30 years ago to a Q_{10} capacity standard then is likely only a Q_5 capacity based on today's storm flows, likely due to the effects of climate change.

7.4 Tier 4 Future Development Best Practices

The following Tier 4 Future Initiatives were developed based on all of the findings of the assessment work and in conjunction with discussions with Village of New Maryland personnel.

Drainage Plan Submissions
Utilize the information for existing storm water flows at discharge locations available from this SWMMP in future development designs.
Future Development Plans should include the following design details to allow for a better review and understanding of the drainage within the development as well as the impacts when storm flows discharge to adjacent properties:

- Show land contour information for the development area and also outside the development area.
- Proposed land contour information should be shown where different to existing.
- Show all directions of surface flow including across proposed properties, indicated by arrows.
- Show provisions for accommodating overland flows from adjacent properties (i.e. where existing flows enter the development area from adjacent properties and where flows leave the development area).
- Show all proposed surface types in properties including approximate driveways, any parking, roof square footage for type of development, and greenspace.
- Drainage patterns should flow along lot lines where possible, and lot lines and drainage patterns should not be altered without written permission of adjacent property owner and approval by the developers grading and drainage plan designer.
- Indicate where major storm infrastructure will be located and the direction of flow and capacity.
- Indicate the design flow capacity of all storm sewer piping (full flow capacity at design slope).
- Indicate that properties are to be graded in accordance with general land topography (so as to ensure storm flows are directed to designed infrastructure.
- All preliminary and final development design plans should be stamped by a Professional Engineer.
-

Regional Retention Pond Designs
Rather than have numerous smaller retention/attenuation ponds throughout the Village to maintain the no net increase in storm water runoff, it is proposed to review the potential for single regional ponds to service proposed and anticipated development areas. This review requires assessing all areas and direction of surface flows, as presented in this SWMMP, in conjunction with the development areas and developing priority locations. This information can be used in regional planning and in negotiations with developers for possible collaboration and funding.

8 Recommendations

The following recommendations are based on the results of the SWMMP and findings:

- Implement the Priority Projects in Tier 1 in the next 1 to 5 years in conjunction with Village Capital Projects.
- Investigate possible funding sources (provincial and federal), for future projects and adaptation projects and studies.
- Develop business cases to submit to Provincial and Federal Governments for possible cost sharing – new infrastructure investment strategies.
- Design and implement Tier 2 projects to be considered after all Tier 1 projects.

Concurrently with Tier 1 work, initiate additional work on Tier 3 Planning Guidelines, and Tier 4 Future Development as it allows for controlled continued development and growth for New Maryland.

Appendix -

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VILLAGE OF NEW MARYLAND

MAJOR AND MINOR WATERSHED BOUNDARIES

Legend

- Major_Watershed_Bndy
- Minor_Watershed_Bndy
- Street_Network
- Water Course
- Water Flow
- Property_Data_VoNM
- Municipal_Bdies

Scale

0 250 500

Metres

1:9,000 @ A1

Map No	1	Date	12/10/2016
Revision		Revision Date	

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Storm Sewer System

Legend

- Storm_Main
- Attenuation Pond
- Property Parcels
- Street Network
- Water Course
- Wetlands
- Water Bodies
- Municipal_Bdies

Scale
0 180 360
Metres
1:6,500 @ A1

Map No	Date
2	11/10/2016
Revision	Revision Date

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Sanitary Sewer System

Legend

- Sanitary_Main
- Lagoon
- Treatment Plant
- Property Parcels
- Street Network
- Water Course
- Wetlands
- Water Bodies
- Municipal_Bdies

Scale
0 180 360
Metres
1:6,500 @ A1

Map No	Date
3	11/10/2016
Revision	Revision Date

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VILLAGE OF NEW MARYLAND

MINOR WATERSHED BOUNDARIES AND DRAINAGE AREAS
LEVEL 2 AND LEVEL 3

Legend

- Level 2 - Minor Watershed
- Level 3 - Drainage Areas
- Water Flow
- Street Network
- Property Parcels
- Priority Areas
- Water Course
- Wetlands
- Water Bodies
- Municipal_Bdies

Scale

0 250 500
Metres

1:9,000 @ A1

Map No 4	Date 14/02/2017
Revision	Revision Date

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VILLAGE OF NEW MARYLAND

SUBDIVISION CATCHMENT AREAS

Applewood Acres, Baker Brook, Forbes Subdivision

Legend

- Level 3 - Drainage Areas
- Level 4 - Drainage SubAreas
- Water Flow
- Drainage Flow
- Culvert
- Storm Pipe
- Street Network
- Property Parcels
- Water Course
- Contours
- Wetlands
- Water Bodies
- Municipal_Bdies

Scale

0 70 140
Metres

1:2,500 @ A1

Map No	Date
5	11/10/2016
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VILLAGE OF NEW MARYLAND

SUBDIVISION CATCHMENT AREAS

Springwater Place and Castle Acres

Legend

- Level 3 - Drainage Areas
- Level 4 - Drainage SubAreas
- Water Flow
- Drainage Flow
- Culvert
- Storm Pipe
- Street Network
- Property Parcels
- Water Course
- Contours
- Wetlands
- Water Bodies
- Municipal_Bdies

Scale 0 70 140 Metres

1:2,500 @ A1

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VILLAGE OF NEW MARYLAND

SUBDIVISION CATCHMENT AREAS

Centennial Heights, Highland Acres, Pine Ridge Estates

Legend

- Level 3 - Drainage Areas
- Level 4 - Drainage SubAreas
- Water Flow
- Drainage Flow
- Culvert
- Storm Pipe
- Street Network
- Property Parcels
- Water Course
- Contours
- Wetlands
- Water Bodies
- Municipal_Bdies

Scale

0 70 140
Metres

1:2,500 @ A1

Map No	7	Date	11/10/2016
Revision		Revision Date	

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VILLAGE OF NEW MARYLAND

SUBDIVISION CATCHMENT AREAS

Cedar Acres Court And Peterson Mini Home Park

Legend

- Level 3 - Drainage Areas
- Level 4 - Drainage SubAreas
- Water Flow
- Drainage Flow
- Culvert
- Storm Pipe
- Street Network
- Property Parcels
- Water Course
- Contours
- Wetlands
- Water Bodies
- Municipal_Bdies

Scale

0 80 160
Metres

1:3,000 @ A1

Map No	Date
8	11/10/2016
Revision	Revision Date

VILLAGE OF NEW MARYLAND

SUBDIVISION CATCHMENT AREAS

Sunrise Estates

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Legend

Level 3 - Drainage Areas	Culvert	Water Course	Wetlands
Level 4 - Drainage SubAreas	Storm Pipe	Contours	Water Bodies
Water Flow	Street Network		Municipal_Bdies
Drainage Flow	Property Parcels		

Scale

0 70 140
Metres

1:2,500 @ A1

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Revision		Revision Date	

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