CSO Master Plan

Colony District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Colony District Plan
Revision:	04
Date:	August 18, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
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File Name:	Colony_Plan_Final_CO1MP_08182019_Tracked

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Document History and Status

Revision	Date	Description	By	Review	Approved
0	08/2018	Version 1 DRAFT	SG	ES	
1	12/2018	Version 2 DRAFT	SB	MF / ES / DT	
2	06/2019	Final Draft Submission	SB/JT	MF	SG
3	07/2019	Revised Final Draft Submission	SB/JT	MF	MF
4	08/18/2109	Final Submission For CSO Master Plan	MF	MF	SG

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1. Colony District

1.1 District Description

Colony district is located along the northern bank of the Assiniboine River and west of the Red River. It is near the centre of the combined sewer area, towards the western edge of the City of Winnipeg's (City's) 'downtown'. Colony is bounded by Notre Dame Avenue on the north, Kennedy and Osborne Streets on the east, the Assiniboine River on the south, and Toronto and Maryland Streets on the west. Portage Avenue runs east-west through the centre of the district, extending the district slightly more towards the Portage Avenue and Main Street intersection. The three districts that border Colony are Assiniboine to the east, Bannatyne to the north, and Cornish to the west.

The district contains a mix of residential, commercial, and institutional land usage that includes a portion of downtown, the University of Winnipeg, the Misericordia Health Centre, and the Winnipeg Art Gallery. The area outside of downtown is mostly multi-family, with commercial areas built up along major transportation routes. The available land use and green space is minimal due to the density of existing residential and commercial developments. Approximately 7 ha of the district is classified as greenspace.

1.2 Developments

There is limited land area available for development within Colony district, so no significant developments that could impact the Combined Sewer Overflow (CSO) Master Plan are expected. Some redevelopment is underway by the University of Winnipeg, but no impact to the CSO Master Plan is anticipated.

A portion of Portage Avenue is located within the Colony district. Portage Avenue is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

The Colony district covers an approximate land area of 237 hectares (ha)[1] and includes a combined sewer (CS) system and a storm relief sewer (SRS) system. This district does not include any areas that may be identified as separated. Of the total district area, 6.8 percent (16 ha) is considered separation ready. The CS system was mostly constructed between 1880 and 1950. The SRS system was added in the 1960s to relieve the CS system. Further upgrades to the SRS to separate road drainage from the CS system were completed in the 1990s.

The CS system includes a diversion chamber, flood pump station (FPS) and CS outfall gate chamber. The Colony district does not contain an independent lift station (LS) for dry weather flow (DWF). The Colony FPS and CS outfall are located next to the Assiniboine River at the end of Colony Street and Granite Way. The diversion chamber and off-take pipe are set further north from the CS outfall between Broadway Avenue and Granite Way along Colony Street.

During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the weir and is discharged through the gate chamber to the Colony CS outfall to the Assiniboine River. Sluice and flap gates are installed on the CS outfall to prevent back-up of the Assiniboine River into the CS system. When the Assiniboine River levels are particularly high, the flap gate prevents gravity discharge from the Colony CS outfall. Under these conditions, the excess flow is pumped by the Colony FPS to a point downstream of the flap gate, where it can be discharged to the river.

[1] City of Winnipeg GIS information relied upon for area statistics. The GIS records may vary slightly from the city representation in the InfoWorks sewer model. Therefore, minor discrepancies in the area values reported in Section 1.3 Existing Sewer System, and in Section 1.8 Performance Estimate may occur.

The SRS system is installed throughout most of the district and connects to the CS system via various interconnections which consist of overflow pipes and weirs. During runoff events, the SRS system provides relief to the CS system. Most catch basins are still connected into the CS system, so no partial separation has been completed and the SRS system acts as an overflow conduit for the CS to prevent basement surcharge. The SRS system discharges directly to the Assiniboine River through the Spence SRS outfall located at the south end of Spence Street. A flap gate and sluice gate are installed on the outfall pipe to control backflow into the SRS system under high river level conditions. The SRS flows into and CS flows from the Cornish district along the western edge of the Colony district.

During DWF, the SRS system is not required; sanitary sewage is diverted by the weir located on the main sewer trunk, through a 680 mm off-take pipe to the 680 mm Colony secondary interceptor pipe and back to the Portage Interceptor by gravity and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

The two outfalls to the Assiniboine River are as follows:

- ID65 (S-MA20014505) – Colony CS and FPS Outfall
- ID64 (S-MA70103641) – Colony SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Colony and the surrounding three districts. They are shown on Figure 10 and show gravity and pumped flow from one district to another. Each interconnection is listed in the following subsections:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Assiniboine

- A 1500 mm intercepted WWS flows by gravity from the Colony district into the Assiniboine district and on to the NEWPCC for treatment.
  - Broadway Avenue at Memorial Boulevard interceptor invert - 223.72 m (S-MH20013425)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Cornish

- A 450 mm intercepted WWS flows from the Cornish district into the Colony district and to the NEWPCC for treatment.
  - Furby Street and Cornish Avenue interceptor invert - 225.48 m (S-TE20012409)
- A 1500 mm intercepted WWS flows from the Cornish district into the Colony district and on to the NEWPCC for treatment.
  - Wolseley Avenue and Maryland Street Interceptor invert - 225.46 m (S-TE20012409)

1.3.1.3 District Interconnections

Assiniboine

<u>SRS to SRS</u>

- A 450 mm SRS overflow pipe diverts flow from Assiniboine district SRS system at Edmonton Street and Graham Avenue, and then flows by gravity northbound along Edmonton Street and flows into Colony district CS system.
  - Graham Avenue and Edmonton Street overflow invert into 450 SRS - 227.18 m (S-TE20005333)

<u>CS to CS</u>

- A 300 mm SRS overflow pipe diverts flow form Assiniboine district CS system at Carlton Street near Portage Avenue, and then flows by gravity northbound along Carlton Street and flows into Colony district CS system.
  - Portage Avenue and Carlton Street overflow invert CS - 227.61 m (S-MH20014163)

CS to SRS

- A 1050 mm SRS overflow pipe diverts flow from Colony district CS system at Portage Avenue and Donald Street, and then flows by gravity southbound along Donald Street and flows into Assiniboine district SRS system.
  - Graham Avenue and Donald Street SRS overflow invert into 1050 SRS - 225.43 m (S-MA70023000)
- A 1350 mm SRS overflow pipe diverts flow from Colony district CS system at Portage Avenue and Kennedy Street and then flows by gravity southbound along Kennedy Street and flows into Assiniboine SRS system.
  - Graham Avenue and Kennedy Street SRS overflow invert into 1350 SRS - 225.54 m (S-MA20015634)
- A 450 mm SRS overflow pipe diverts flow from Colony district CS system at Vaughan Street and Mary Avenue and flows by gravity eastbound along St. Mary Avenue and flows into Assiniboine district SRS system.
  - St. Mary Avenue and Kennedy Street SRS overflow invert into 450 SRS - 225.38 m (S-MA70022895)

Bannatyne

CS to CS

- High point CS manholes (flow is directed into both districts from this manhole):
  - Victor Street invert - 229.33 m (S-MA20017614)
  - Agnes Street invert - 229.30 m (S-MA20016379)
  - McGee Street invert - 229.65 m (S-MA20016714)
  - Maryland Street invert - 229.24 m (S-MA20016720)
  - Young Street invert - 229.10 m (S-MA20016919)
  - Cumberland Avenue and Balmoral Street invert - 229.02 m (S-MA20016981)
  - Kennedy Street invert - 229.69 m (S-MA20016934)
  - Qu`Appelle Avenue invert - 228.97 m (S-MA20016817)

CS to SRS

- High point SRS manhole: A 250 mm SRS overflow pipe diverts flow from Bannatyne district CS system near Hargrave Street and Portage Avenue and flows by gravity southbound along Hargrave Street and flows into Colony CS system.
  - Hargrave Street and Portage Avenue SRS overflow invert into 250 mm SRS – 229.02 m (S-MA20015844)
- A 525 mm SRS overflow pipe diverts flow from Colony district CS system at Vaughan Street and Webb Place and flows by gravity northbound and then turns eastbound along Ellice Avenue and flows into Bannatyne SRS system.
  - Ellice Avenue and Kennedy Street SRS overflow invert into 1200 mm SRS - 226.14 m (S-MH20016684)

- A 450 mm SRS overflow pipe diverts flow from Colony district CS system near Donald and Ellice Avenue and flows by gravity northbound along Donald Street and flows into Bannatyne SRS.
  - Donald Street and Ellice Avenue SRS overflow invert into 375 mm SRS - 227.76 m (S-MA70087485)

CS to CS

- A 250 mm CS pipe flows northbound by gravity from Colony to Bannatyne district at Ellice Avenue and Kennedy Street
  - Ellice Avenue and Kennedy Street CS invert into 250 mm CS - 228.54 m (S-MH20016689)
- A 369 mm CS pipe flows southbound by gravity from Colony to Bannatyne district at Ellice Avenue and Kennedy Street
  - Ellice Avenue and Kennedy Street CS invert into 369 mm CS – 228.48 m (S-MH70003125)
- A 450 mm CS pipe flows eastbound by gravity along Portage Avenue that flows out of Colony CS into Bannatyne CS system.
  - Portage Avenue and Smith Street CS invert CS outfall - 227.94 m (S-MA20015831)

Cornish

CS to CS

- A 300 mm high point CS manhole (flow is directed into both districts from this manhole):
  - Toronto Street – 229.72 m (S-MA20017892)
- A 450 mm CS pipe high level overflow that flows by gravity from Cornish into Colony CS system.
  - Honeyman Avenue and Canora Street CS overflow invert – 225.63 m (S-MA20015466)

CS to SRS

- A 1245 mm SRS overflow pipe diverts flow from Cornish district CS system at Toronto Street and St. Matthews Avenue and flows by gravity eastbound into the Colony SRS system.
  - St. Matthews Avenue and Toronto Street SRS invert - 226.55 m (S-MA20015548)
- A 200 mm SRS overflow pipe diverts flow from Cornish district CS system at Toronto Street and St. Matthews Avenue and flows by gravity westbound and then southbound into the Colony SRS system.
  - St. Matthews Avenue and Toronto Street SRS invert - 226.68 m (S-MA20023073)

A district interconnection schematic is included as Figure 1-1. The drawing illustrates the collection areas, interconnections, pumping systems, and discharge points for the existing district.

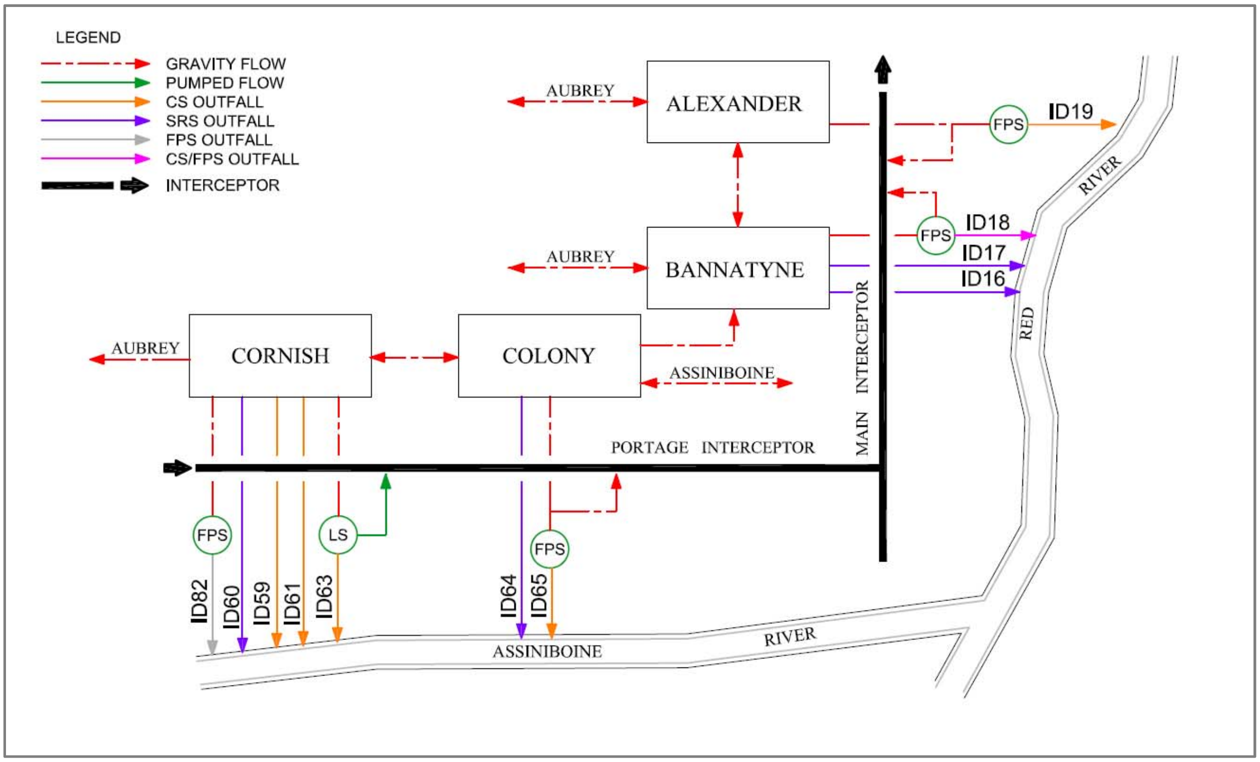


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 10 and are listed in Table 1-1.

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID65)	S-AC70016494.1	S-MA20014505	1800 mm	Circular
Flood Pumping Outfall (ID65)	S-AC70016494.1	S-MA20014505	1800 mm	Circular
Other Overflows (ID#)	N/A	N/A	N/A	
Main Trunk	S-MH20013353.1	S-MA20014788	1350 x 1800 mm	Egg-shaped
SRS Outfalls (ID64)	S-CG00001168 DS.1	S-MA70103641	2750 mm	Spence Street
SRS Interconnections	N/A	N/A	N/A	61
Main Trunk Flap Gate	S-TE70018683.1	S-CG00001169	1520 mm	Invert: 223.51 m
Main Trunk Sluice Gate	COLONY_GC.1	S-CG00001041	750 x 1000 mm	Invert: 223.21 m
Off-Take	COLONY_WEIR.1	S-MA20014797	680 mm	No Pumping Station
Dry Well	N/A	N/A	N/A	No Pumping Station
Lift Station Total Capacity	N/A	S-MA20014797 (1)	680 mm (1)	1.716 m^3/s (1) (D/s pipe pff 0.281 m^3/s)
Lift Station ADWF	N/A	N/A	0.107 m^3/s	2.75 x ADWF – 0.193 m^3/s
Lift Station Force main	N/A	N/A	N/A	
Flood Pump Station Total	N/A	N/A	2.34 m^3/s	1 x 1.32 m^3/s

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Capacity				1 x 1.02 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.400 m^3/s	

Notes:

[(1)] – Gravity pipe replacing Lift Station as Colony is a gravity discharge district

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

The critical system elevations for the existing system relevant to the development of the CSO control options are listed in Table 1-2. Critical elevation reference points are identified on the district overview and detailed maps.

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
1	Normal Summer River Level	District – 223.84
2	Trunk Invert at Off-Take	224.73
3	Top of Weir	225.76
4	SRS Outfall Invert at Flap Gate (Upstream of First Gate Chamber)	221.58
5	Low SRS Relief Interconnection (S-MH70007916)	226.12
6	Sewer District Interconnection (Interceptor Inverts at Colony District Boundary)	Assiniboine –223.15 Cornish (Furby Street and Cornish Avenue) – 224.70 Cornish (Wolseley Avenue and Maryland Street) – 225.80
7	Low Basement	228.60
8	Flood Protection Level	229.98

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

The Colony district has most recently undergone storm relief sewer work in 1998. This work included implementing a 5-year basement flood relief design level by disconnecting street inlets from the CS pipes and connecting them to the SRS pipes to regain capacity in the CS system. The inlet redirections, plus outfall improvements to increase the outfall capacity, are the most recent upgrades made to the district sewer system. A more detailed description can be found in the Colony 1998 report prepared by Dillon Consulting Limited and Sprenger & Associates Inc. (Sprenger/Dillon, 1998).

In 2011, the City installed an off-line underground storage facility at the University of Winnipeg between Young and Langside Streets beneath the Richardson Green Corridor as a pilot study for future CSO projects. The storage system consists of a series of manholes with sluice gates that operate to direct storm water runoff into four 1500 mm diameter high-density polyethylene pipes. The total length of the pipes is approximately 240 m, which amounts to a storage volume of approximately 420 m^3. Water from the storage facility is released back into a 300 mm diameter CS, which then connects back into the sewer system.

Between 2009 and 2015, the City invested $12 million in the CSO Outfall Monitoring Program. The program was initiated to permanently install instruments in the primary CSO outfalls. The outfall from the Colony Combined Sewer District was included as part of this program. Instruments installed at each of the 39 primary CSO outfall locations has a combination of inflow and overflow level meters and flap gate inclinometers if available.

No further relief projects are planned for the district. Table 1-3 provides a summary of the district status in terms of data capture and study.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
10 - Colony	1998	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Colony district. This consists of monthly site visits in confined entry spaces to verify physical readings concur with displayed transmitted readings and replacing desiccants where necessary.

1.6 Control Option 1 Projects

1.6.1 Project Selection

The proposed projects selected to meet Control Option 1 – 85 Percent Capture in a Representative Year for the Colony sewer district are listed in Table 1-4. The proposed CSO control projects will include latent storage, gravity flow control, control gate, in-line storage and floatable management. Program opportunities including green infrastructure (GI) and real time control (RTC) will also be included as applicable.

Table 1-4. District Control Option

Control Limit	Latent Storage	Flap Gate Control	Gravity Flow Control	Control Gate	In-line Storage	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year	✓	-	✓	✓	✓	-	-	-	✓	✓	✓

Notes:

- = not included
✓ = included

The existing CS and SRS systems are suitable for use as in-line and latent storage. These control options will take advantage of the existing CS and SRS pipe networks for additional storage volume. Existing DWF from the collection system would remain the same, and overall district operations would remain the same, although additional WWF will be collected from the SRS and transferred to the existing CS system and forwarded to the NEWPCC for treatment.

A gravity flow controller is proposed on the CS system to monitor and confirm the dewatering rate from the district back into the Main Street interceptor.

All primary overflow locations are to be screened under the current CSO control plan, Installation of a control gate will be required for the screen operation, and it will provide the mechanism for capture of the in-line storage.

Floatable control will be necessary to capture any floatables in the sewage. Floatables will be captured with all implemented control options to some extent, but screening may be added as required to reach the desired capture level.

GI and RTC will be applied within each district on a system wide basis with consideration of the entire CS area. The level of implementation for each district will be determined through evaluations completed through district level preliminary design.

1.6.2 Latent Storage

Latent storage is proposed as a control option for Colony district. The latent storage level in the system is controlled by river level, and the resulting backpressure of the river level on the SRS outfall flap gate, as explained in Part 3C. The latent storage design criteria are identified in Table 1-5. The storage volumes indicated in Table 1-5 are based on the NSWL river conditions.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	221.58 m	
NSWL	223.84 m	
Trunk Diameter	2550 mm	
Design Depth in Trunk	2253 mm	
Maximum Storage Volume	4,380 m^3	
Force main	150 mm	
Flap Gate Control	N/A	
Pump Station	Yes	
Nominal Dewatering Rate	0.045 m^3/s	Based on 24 hour emptying requirement
RTC Operational Rate	TBD	Future RTC/ dewatering assessment

Notes:

RTC = real time control

NSWL = normal summer water level

The addition of a pump and force main that connects back to the CS system will be required for latent storage. A conceptual layout for the latent storage pump station (LSPS) and force main is shown on Figure 10-02. The LSPS will be located adjacent to the existing gate chamber on Spence Street to avoid interference with nearby residential lands and disruption to existing sewers. The latent force main will pump north to the nearby 300 mm CS sewer and into the manhole (S-MH20013095) south of the intersection of Balmoral Street and Scotia Street. The pump station will operate to dewater the SRS system in preparation for the next runoff event, the requirement for the system to be ready for the next event within a 24-hour period after completion of the previous event.

The LSPS would connect to the SRS outfall chamber and discharge back to the CS system once capacity allows. Figure 10 identifies the extent of the SRS system within Colony district that would be used for latent storage. The maximum storage level is directly related to the NSWL and the size and depth of the

SRS system. Once the level in the SRS exceeds the NSWL river level, the flap gate opens, and the combined sewage is discharged to the river.

The river level will keep the SRS flap gate closed and system level maintained at the NSWL for the representative year assessment. This level utilizes 88 percent of the SRS pipe height and, therefore, additional flap gate control was not recommended as part of the 85 percent capture target assessment. The lowest interconnection between the combined sewer and relief pipe is higher than the proposed latent and in-line storage control levels, meaning that the two systems would function independently.

As described in the standard details in Part 3C wet well sizing will be determined based on the final pump selection, operation and dewatering capacity required. The interconnecting piping between the existing gate chamber and the pump station would be sized to provide sufficient flow to the pumps while all pumps are operating.

1.6.3 In-line Storage

In-line storage has been proposed as a CSO control for Colony district. The in-line storage will require the installation of a control gate at the CS outfall. The gate will increase the storage level in the existing CS to provide an overall higher volume capture and provide additional hydraulic head for screening operations.

A standard design was assumed for the control gate, as described in Part 3C. A standard approach was used for conceptual gate sizing by assuming it to be the lesser of the height of half of the site-specific trunk diameter or the maximum height of the gate available. The design criteria for in-line storage are listed in Table 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	224.52 m	
Trunk Diameter	1350 x 1800 mm	
Gate Height	0.75 m	Gate height based on half trunk diameter assumption (flood assessment included)
Top of Gate Elevation	225.86 m	
Bypass Weir Level	225.76 m	
Maximum Storage Volume	284 m^3	
Nominal Dewatering Rate	0.40 m^3/s	Minimum pass forward rate for gravity discharge district
RTC Operational Rate	TBD	Future RTC/dewatering review on assessment

Note:
RTC = Real Time Control
TBD = to be determined

The proposed control gate will cause combined sewage to back-up in the collection system to the extent shown on Figure 10. The extent of the in-line storage and volume is related to the top elevation of the bypass side weir. The level of the top bypass side weir and adjacent control level gate are determined in relation to the critical performance levels in the system for basement flooding protection: when the system level increases above the bypass weir crest and proceeds above the top of the control gate during high flow events, the gate drops out of the way. At this point, the district will only provide its original interception capacity via the primary weir for the district, and all excess CS would flows over the weir and discharge to the river. After the sewer levels in the system drops back below the bypass side weir critical performance level, the control gate moves back to its original position to capture the receding limb of the

WWF event. The existing gravity pipe pass forward flow will continue its current operation while the control gate is in either position, with all DWF being diverted to the existing gravity pipe.

Figure 10-01 provides an overview of the conceptual location and configuration of the control gate, bypass weir and screening chambers. The proposed control gate will be installed in a new chamber within the existing trunk sewer alignment near the existing FPS. The dimensions of the chamber will be 5.0 m in length and 2.5 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The existing sewer configuration may have to be modified to accommodate the new chamber. This will be confirmed in future design assessments.

The physical requirements for the off-take and station sizing for a modification to pumping capacity have not been considered in detail, but they will be required in the future as part of an RTC program or FPS rehabilitation or replacement project.

The nominal rate for dewatering is already set at the existing pipe capacity as the district is a gravity discharge district. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflows at this district. This future RTC control will provide the ability to capture and treat more volume for localized storms in other districts by using the excess interceptor capacity made available by restricting the pass forward flows through the control device where the runoff is less.

1.6.4 Gravity Flow Control

Colony district does not include a LS and discharges to the Portage Interceptor by gravity. A flow control device will be required to control the diversion rate for future RTC and dewatering. The controller will include flow measurement and a gate to control the discharge flow rate. A standard flow control device was selected as described in Part 3C.

The flow control would be installed at an optimal location on the connecting sewer between the proposed in-line control and existing diversion chamber. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objective. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.5 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens will be designed to maintain the current level of basement flooding protection.

The type and size of screens depend on the specific station configuration and the head available for operation. A standard design was assumed for screening and is described in Part 3C. The design criteria for screening, with an in-line control gate implemented, are listed in Table 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	225.86 m	
Bypass Weir Crest	225.76 m	
Normal Summer River Level	223.84 m	
Maximum Screen Head	1.92 m	
Peak Screening Rate	0.82 m^3/s	

Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed side bypass overflow weir and screening chamber will be located adjacent to the proposed control gate and existing CS trunk, as shown on Figure 10-01. The screens will operate with the control gate in its raised position. A side bypass weir upstream of the gate will direct the flow to the screens located in the new screening chamber, with screened flow discharged to the downstream side of the gate to the river. The screening chamber will include screenings pumps with a discharge returning the screened material to the CS system for routing to the NEWPCC for removal.

The dimensions for the screen chamber to accommodate influent from the side weir, the screen area, and the routing of the discharge piping downstream of the gate are 3.2 m in length and 3.1 m in width. The existing sewer configuration may have to be modified to accommodate the new chamber.

1.6.6 Green Infrastructure

The approach to GI is described in Section 5.2.1 of Part 2 of the CSO Master Plan. Opportunities for the application of GI will be evaluated and applied with any projects completed in the district. Opportunistic GI will be evaluated for the entire district during any preliminary design completed. The land use, topography, and soil classification for the district will be reviewed to identify applicable GI controls.

Colony has been classified as a medium GI potential district. Land use in Colony is mix of residential, commercial, and institutional, the south end of the district is bounded by the Assiniboine River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

1.6.7 Real Time Control

The approach to RTC is described in Section 5.2.2 of Part 2 of the CSO Master Plan. The application of RTC will be evaluated and applied on a district by district basis through the CSO Master Plan projects with long term consideration for implementation on a system wide basis.

1.7 System Operations and Maintenance

System operations and maintenance (O&M) changes will be required to address the proposed control options. This section identifies general O&M requirements for each control option proposed for the district. More specific details on the assumptions used for quantifying the O&M requirements are described in Part 3C of the CSO Master Plan.

In-line storage will impact the existing sewer and will require the addition of a new chamber and a moving gate at the outfall. In-line storage dewatering will be controlled with the existing Clifton CS LS, which will require more frequent and longer duration pump run times. Lower velocities will occur in the CS trunk in the vicinity of the control gate due to lower pass forward flows, and may create additional debris deposition requiring cleaning. Additional system monitoring, and level controls will be installed, which will require regular scheduled maintenance.

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

Floatable control with outfall screening will require the addition of another chamber with screening equipment installed. The chamber will be installed adjacent to the control gate chamber and will operate in conjunction with it. Screening operation will occur during WWF events that surpass the in-line storage control level. WWF will be directed from the main CS trunk, over the side weir in the control gate chamber and through the screens to discharge into the river. The screens will operate intermittently during wet weather events and will likely require operations review and maintenance after each event. The frequency of a screened event will correlate to the number overflows identified for the district. Having the screenings pumped back to the interceptor system via a small LS and force main will be required. The screenings return will require O&M inspection after each event to assess the performance of the return pump system.

The latent storage would take advantage of the SRS infrastructure already in place, therefore, minimal additional maintenance will need to be anticipated. The proposed latent LSPS will require regular maintenance that would depend on the frequency of operation. The flap control gate will require maintenance inspection for continued assurance that the flap gate would open during WWF events.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	230	230	15,636	52	N/A
2037 Master Plan – Control Option 1	230	230	15,636	52	IS, Lat St, SC

Notes:

Total area is based on the model subcatchment boundaries for the district.

IS = In-line Storage
Lat St = Latent Storage
SC = Screening

No change to the future population was completed as from a wastewater generation perspective from the update to the 2013 Baseline Model to the 2037 Master Plan Model. The population generating all future wastewater will be the same due to Clause 8 of Environment Act Licence 3042 being in effect for the CS district.

City of Winnipeg hydraulic model relied upon for area statistics. The hydraulic model representation may vary slightly from the City of Winnipeg GIS Records. Therefore, minor discrepancies in the area values reported in Section 1.3 Existing Sewer System, and in Section 1.8 Performance Estimate may occur.

The performance results listed in Table 1-9 are for the hydraulic model simulations using the year-round 1992 representative year. The table lists the results for the Baseline, for each individual control option and for the proposed CSO Master Plan - Control Option 1. The Baseline and Control Option 1 performance numbers represent the comparison between the existing system and the proposed control options. The table also includes overflow volumes specific to each individual control option; these are listed to provide an indication of benefit gained only and are independent volume reductions.

Table 1-9. Performance Summary – Control Option 1

Control Option	Preliminary Proposal	Master Plan			
	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Baseline (2013)	89,783	163,833	-	20	0.347 m^3/s

Latent Storage	-[b]	126,058	37,775	20	0.354 m^3/s
In-Line Storage	82,693	108,985	54,848	20	0.354 m^3/s
Latent & In-line & Offline Storage	14,196 [c]	N/A	N/A	N/A	N/A
Control Option 1	**14,196**	**108,985**	**54,848**	**20**	**0.354 m^3/s**

[a] Pass forward flows assessed on the 1-year design rainfall event

[b] Latent Storage, In-Line Storage and Off-line Storage Tank solutions not modelled as single options for the Preliminary Proposal assessment. Each was modelled together and it's impact assessed.

[c] Preliminary Proposal included offline storage tank within this district to achieve the 85 percent capture target in the Master Plan re-assessment

The CSO Master Plan assessment did not require the selection of an off-line tank to achieve the 85 percent capture target in the representation year. As part of the refinements during the CSO Master Plan assessment, it was found that the cumulative 85 percent target was achieved prior to needing the benefits provided by the off-line tank. As the off-line tank is considered the highest marginal cost solution in comparison to the in-line and latent storage options recommended, it was removed from the recommendations for this district. Note however that the inclusion of off-line storage has been considered as one of the recommendations to meet future performance targets; see Section 1.10 below.

The percent capture performance measure is not included in Table 1-9, as it is applicable to the entire CS system and not for each district individually.

1.9 Cost Estimates

Cost estimates were prepared during the development of the Preliminary Proposal and have been updated for the CSO Master Plan. The CSO Master Plan cost estimates have been prepared for each control option, with overall program costs summarized and described in Section 3.4 of Part 3A. The cost estimate for each control option relevant to the district as determined in the Preliminary Proposal and updated for the CSO Master Plan are identified in Table 1-10. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-10. Cost Estimate – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance (Over 35-year period)
Latent Storage	$1,680,000	$2,340,000	$76,000	$1,640,000
In-Line Storage	$7,740,000 [a]	$2,360,000 [c]	$44,000	$940,000
Screens		$2,790,000 [d]	$54,000	$1,170,000
Gravity Flow Control	N/A [b]	$1,280,000	$34,000	$740,000
Off-line Storage Tank	$8,950,000	N/A [e]	N/A [e]	N/A [e]
Subtotal	**$18,360,000**	**$8,770,000**	$209,000	**$4,490,000**
Opportunities	N/A	$880,000	$21,000	$450,000
District Total	**$18,360,000**	**$9,650,000**	**$230,000**	**$4,940,000**

[a] In-Line storage and screening costs not separated during the Preliminary Proposal

[b] Gravity Flow Control not included in the Preliminary Proposal

[c] Cost associated with new off-take construction, as required, to accommodate control gate location and allow intercepted CS flow to reach the Portage Interceptor not included.

[d] Cost for bespoke screening return/force main not included in Master Plan as will depend on selection of screen and type of screening return system selected.

[e] Offline storage tank found to not be required to meet 85 Percent Capture target and was removed during Master Plan assessment.

The estimates include changes to the control option selection since the Preliminary Proposal, updated construction costs, and the addition of GI opportunities. The calculations for the CSO Master Plan cost estimate includes the following:

- Capital costs and O&M costs are reported in terms of present value.
- A fixed allowance of 10 percent has been included for GI, with no additional cost for RTC. This has been listed as part of the Opportunities costs.
- The Preliminary Proposal capital cost is in 2014-dollar values.
- The CSO Master Plan capital cost is based on the control options presented in this plan and in 2019-dollar values.
- The 2019 Total Operations and Maintenance (over 35-year period) cost component is the present value costs of each annual O&M cost under the assumption that each control option was initiated in 2019.
- The 2019 Annual Operations and Maintenance Costs were based on the estimated additional O&M costs annually for each control option in 2019 dollars.
- Future costs will be inflated to the year of construction.

Cost estimates were prepared during the development of the Preliminary Proposal and updated for Phase 3 during the CSO Master Plan development. The differences identified between the Preliminary Proposal and the CSO Master Plan are accounting for the progression from an initial estimate used to compare a series of alternative plans, to an estimate focusing on a specific level of control for each district. Any significant differences between the Preliminary Proposal and CSO Master Plan estimates are identified in Table 1-11.

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	In-line Storage	Unit cost updates Separation of screening and in-line	In-line and Screening included as combined cost in Preliminary Proposal
	Screening	Unit cost updates Separation of screening and in-line	In-line and Screening included as combined cost in Preliminary Proposal
	Gravity Flow Control(	A flow controller was not included in the preliminary estimate	Added for the Master Plan to further reduce overflows and control in-line
	Removal of Off-line Storage	Not included in the Master Plan	Removed through marginal analysis
	Latent Storage	Unit cost updates	
Opportunities	A fixed allowance of 10 percent has been included for program opportunities	Preliminary Proposal estimate did not include a cost for GI opportunities	
Lifecycle Cost	The lifecycle costs have been adjusted to 35 years	City of Winnipeg Asset Management approach	
Cost escalation from 2014	Capital Costs have been inflated	Preliminary estimates were	

to 2019	to 2019 values based on an assumed value of 3 percent per for construction inflation	based on 2014-dollar values	

1.10 Meeting Future Performance Targets

The regulatory process requires consideration for upgrading Control Option 1 to another higher-level performance target. For the purposes of this CSO Master Plan, the future performance target is 98 percent capture for the representative year measured on a system-wide basis. This target will permit the number of overflows and percent capture to vary by district to meet 98 percent capture. Table 1-12 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified for Control Option 1.

Overall the Colony district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. Opportunistic sewer separation within portions of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

Table 1-12. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic Separation • Off-Line Storage (Tank/Tunnel) • Increased GI

The control options for the Colony district has been aligned for the 85 percent capture performance target based on the system wide assessment. The expandability of the district to the future 98 percent capture target will be restricted depending on the interaction of the system wide performance.

The cost for upgrading to meet an enhanced performance target depends on the summation of all changes made to control options in individual districts and has not been fully estimated at this stage of master planning. The Phase In approach is to be presented in detail in a second submission for 98 percent capture in a representative year, due on or before April 30, 2030.

1.11 Risks and Opportunities

The CSO Master Plan and implementation program are large and complex, with many risks having both negative and positive effects. The objective of this section is to identify significant risks and opportunities for each control option within a district.

The CSO Master Plan has considered risks and opportunities on a program and project delivery level, as described in Section 5 of Part 2 of the CSO Master Plan. A Risk And Opportunity Control Option Matrix covering the district control options has been developed and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-13Table 1-13.

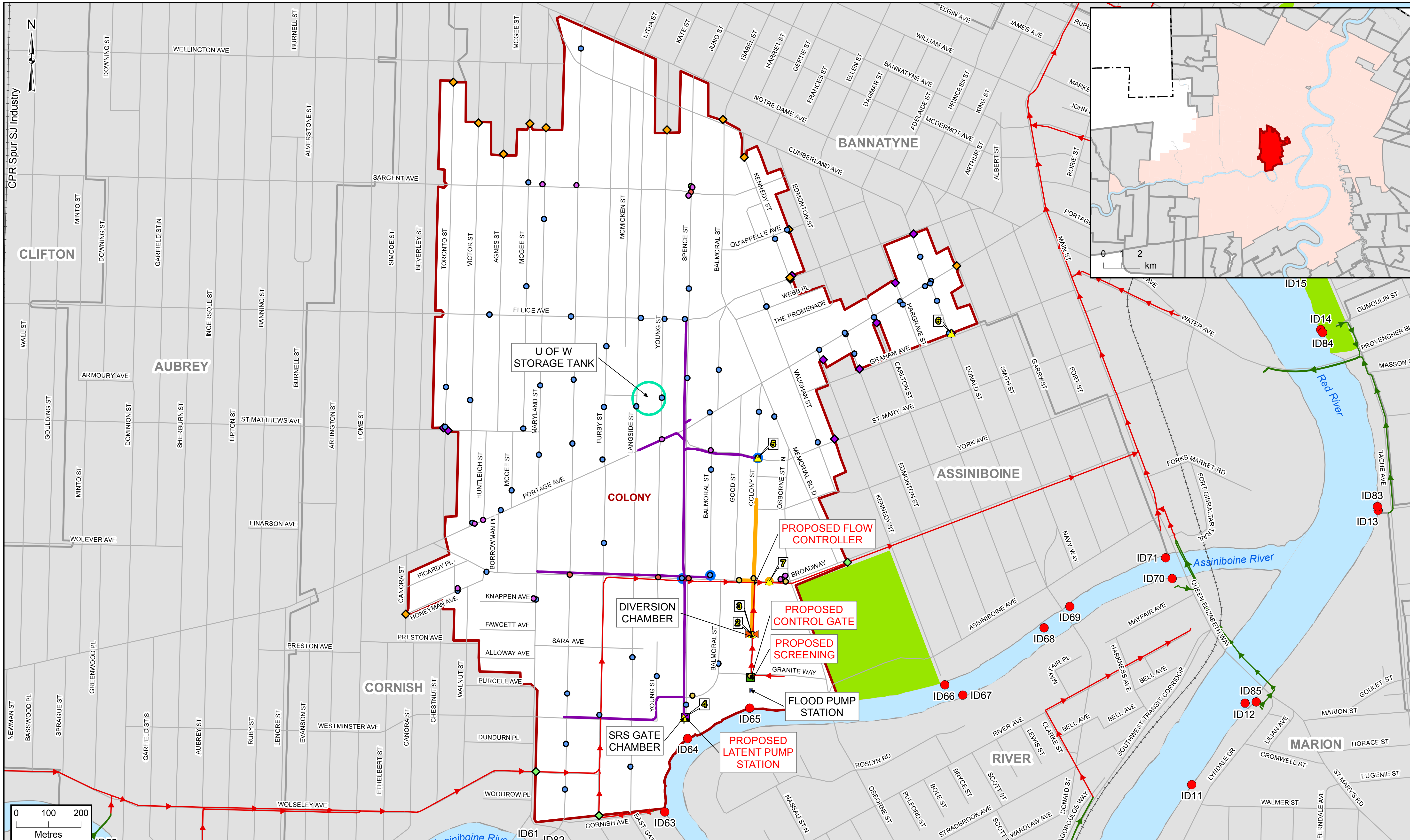
Table 1-13. Control Option 1 Significant Risks and Opportunities

Risk Number	Risk Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
1	Basement Flooding Protection	**R**	**R**	-	-	-	-	-	-
2	Existing Lift Station	-	**R**	-	-	-	-	**R**	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	**R**	-
6	Sewer Condition	**R**	**R**	-	-	-	-	-	-
7	Sewer Conflicts	**R**	**R**	-	-	-	-	-	-
8	Program Cost	**O**	**O**	-	-	-	-	-	**O**
9	Approvals and Permits	-	-	-	-	-	**R**	-	-
10	Land Acquisition	-	-	-	-	-	**R**	-	-
11	Technology Assumptions	**R**	-	-	-	-	**O**	**O**	-
12	Operations and Maintenance	**R**	**R**	-	-	-	**R**	**O**	**R**
13	Volume Capture Performance	**O**	**O**	-	-	-	**O**	**O**	-
14	Treatment	**R**	**R**	-	-	-	**O**	**O**	**R**

Risks and opportunities will require further review and actions at the time of project implementation.

1.12 References

Sprenger & Associates Inc. and Dillon Consulting Limited (Sprenger/Dillon). 1998. *Independent Review of the Colony Combined Sewer Relief Report.* Prepared for the City of Winnipeg, Water and Waste Department. September.



LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Low CS Manhole
- Low SRS Connection

District Boundary Crossing
- CS
- SRS
- WWS

Inter-System Connection
- CS - LDS
- CS - WWS
- SRS - CS
- SRS - LDS
- SRS - WWS

- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed Control Gate
- Proposed SRS Latent Storage Pump
- Latent Storage Limit
- Extent of In-line Storage

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

Notes:
1. Map data source - City of Winnipeg, 2013

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 10
District Overview Map
Sewer District: Colony
City of Winnipeg
Combined Sewer Overflow Master Plan

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LEGEND

- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Pump Location

Sewer By Type
- CS
- LDS
- SRS
- WWS

Pump Station Type
- Flood Pump Station

- Land Parcel

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Control Gate
- Screening

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

Notes:
1. Map data source - City of Winnipeg, 2013

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 10-01
Control Gate and Screening
Sewer District: Colony
City of Winnipeg
Combined Sewer Overflow Master Plan

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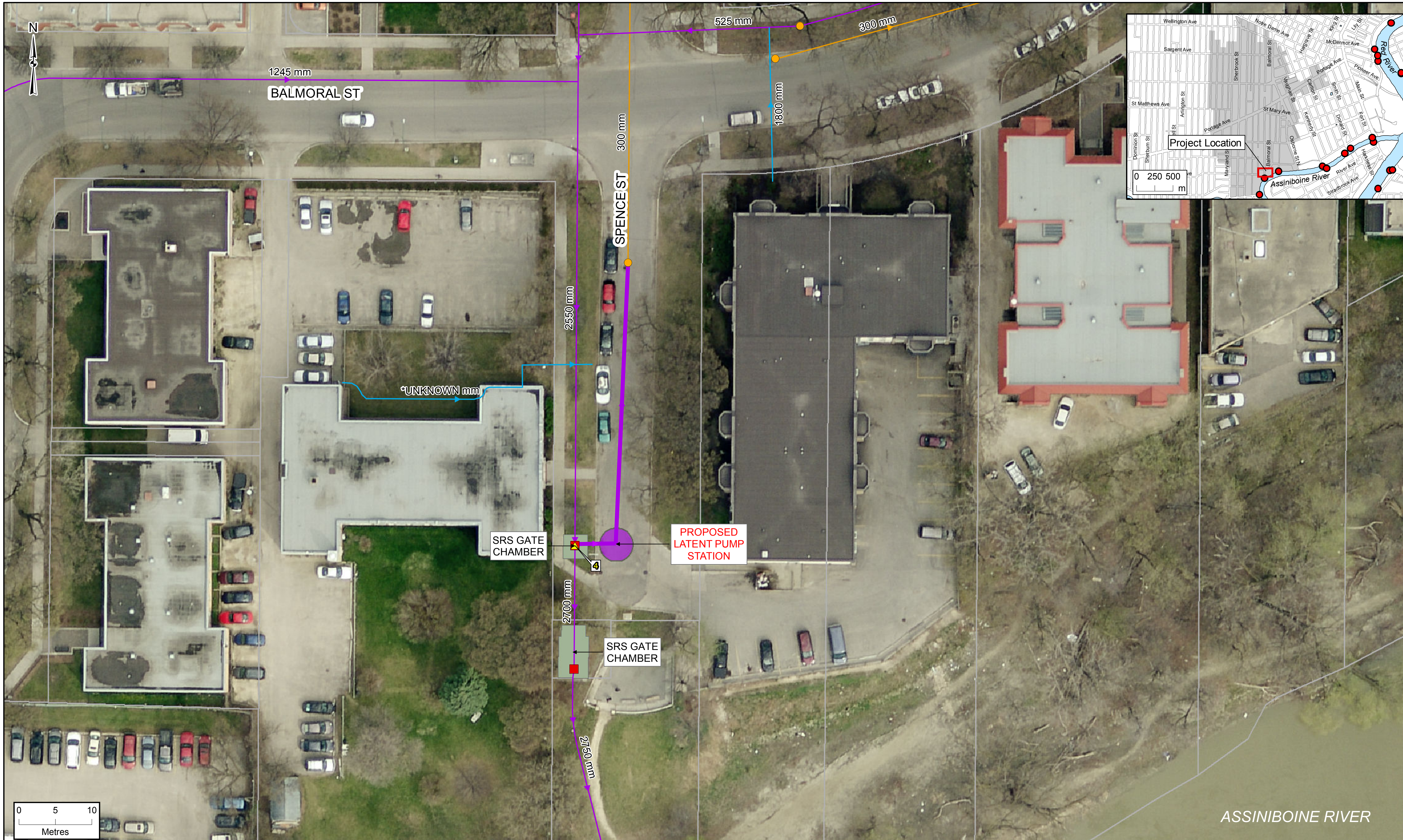

LEGEND

- Critical Elevation
- Manhole
- Sluice Gate

Sewer By Type
- CS
- LDS
- SRS

- Land Parcel

CSO MASTER PLAN PROPOSED SOLUTIONS
- Proposed Latent Force Main
- Latent Pump

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

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Notes:
1. Map data source - City of Winnipeg, 2013

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THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 10-02
Latent SRS Control
Sewer District: Colony
City of Winnipeg
Combined Sewer Overflow Master Plan

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LEGEND

Critical Elevation
Manhole
Sewer By Type
CS
LDS
SRS
WWS
Land Parcel

CSO MASTER PLAN
PROPOSED SOLUTIONS
Flow Controller

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

Notes:
1. Map data source - City of Winnipeg, 2013

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 10-03
Gravity Flow Control
Sewer District: Colony
City of Winnipeg
Combined Sewer Overflow Master Plan

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