CSO Master Plan

Cornish District Plan

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City of Winnipeg

CSO Master Plan

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2	06/2019	Final Draft Submission	DT	MF	MF
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Contents

Tables

Figure

1. Cornish District

1.1 District Description

Cornish district is located in the central portion of the combined sewer (CS) area along the northern edge of the Assiniboine River. Cornish is bounded by Toronto and Maryland Streets to the east; Lenore, Burnell, Arlington, and Simcoe Streets to the west; Notre Dame Avenue to the north; and the Assiniboine River to the south.

Land use within Cornish district includes a mix of commercial and residential, with the majority being two-family residential. Commercial property is located along the major roadways including Portage Avenue, Notre Dame Avenue, Ellice Avenue, Sargent Avenue, and Arlington Street, which are also the regional transportation routes within the district. There is approximately 18 ha of greenspace in the district. Greenspace is limited due to the high makeup of multi-family and commercial land use. Vimy Ridge Park, located on Portage Avenue, is the only significant greenspace within the district.

1.2 Development

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

1.3 Existing Sewer System

Cornish district has an approximate area of 141 ha[1] based on the GIS district boundary information and includes CS and storm relief sewer (SRS) systems. This district does not include any areas that may be identified as separated or separation-ready. The CS system drains toward the Cornish outfall, located at the eastern end of Cornish Street where combined sewage is pumped to the Main Interceptor along Wolseley Avenue.

The CS system includes a flood pump station (FPS), CS lift station (LS), one CS primary outfall, two CS secondary outfalls, one SRS outfall and one FPS outfall. All domestic wastewater and CS flow collected in Cornish district is routed to the east end of Cornish Avenue, where the CS LS and primary CS outfall (Cornish East CS Outfall) are located.

There is a single main CS trunk sewer that collects the flow from the district. This main CS trunk changes in shape and size several times before reaching the Assiniboine River. North of Portage Avenue is serviced by a 300 mm to 750 mm CS along Simcoe Street that flows southbound from Notre Dame Avenue to Portage Avenue. From Portage Avenue, the trunk runs south on Canora Street, Walnut Street, and Maryland Street to eventually reach Cornish Avenue. The trunk sewer previously along Simcoe Street turns into a 1200 mm by 1550 mm egg-shaped CS on Canora Street and continues south, then east on Preston Avenue. The areas south of Preston Avenue are serviced by a series of laterals that collect combined sewage from the residential areas and connect to the CS collector on Westminster Avenue, which eventually connects to a 900 mm CS collector located in the southern section of Walnut at Purcell Avenue that connects to the trunk sewer for the district. Collected sewage eventually flows into a 1500 mm sewer trunk that connects into the Cornish Avenue gate chamber and CS LS at the eastern end of Cornish Avenue, as part of the primary CS outfall.

A flap gate and sluice gate are located in the Cornish east outfall pipe to prevent river water from backing up into the CS system during high river levels along the Assiniboine River. The FPS is located at the

[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.

western end of Cornish Avenue upstream from the CS LS. The FPS has a separate outfall directly to the Assiniboine River located near the Maryland bridge, and allows the CS system to discharge to the river when the flap gate remains closed during these high river level conditions. When the river level is high and gravity discharge is not possible, the excess flow is pumped by the Cornish FPS to the dedicated FPS outfall allowing gravity discharge to the river. There is no flap or sluice gate installed on the dedicated FPS outfall.

During wet weather flow (WWF) events, the SRS system provides relief to the CS system in Cornish district. The SRS system extends throughout the district and has multiple interconnections with the CS system. The SRS system in Cornish also receives SRS flow from parts of the neighboring Aubrey, Colony and Bannatyne districts. Most catch basins are still connected to the CS system in Cornish, so no partial separation has been completed. There is a main SRS trunk within the Cornish district which runs along Simcoe Street north of Portage Avenue, and then Canora Street south of Portage Avenue. The SRS system within this Simcoe/Canora trunk discharges directly to the Assiniboine River by gravity through the SRS outfall at the southern end of Canora Street. A sluice gate is located on this outfall pipe to prevent river water from backing up into the SRS system during high river levels along the Assiniboine River.

During dry weather flow (DWF), the SRS system is not required; sanitary sewage flow is diverted by the primary weir at the Cornish outfall, and is intercepted through the 450 mm off-take to the Cornish SPS, where it is pumped to the interceptor pipe along Wolseley Avenue and eventually reaches to the North End Sewage Treatment Plant (NEWPCC) for treatment. During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the primary weir and is discharged to the river through the Cornish East outfall.

There are also two secondary CS outfalls within the Cornish district, which provide relieve to the CS in the district under wet weather flow events and allow direct discharge to the Assiniboine River at different points, relieving the system and reducing the possibility of localized basement flooding. The Arlington CS secondary outfall is located at Palmerston and Arlington: when the capacity of the sewer laterals along Palmerston Ave and Arlington Street are exceeded, the outfall will overflow to the Assiniboine River. The Cornish West secondary outfall is located adjacent to the Maryland Bridge, near the Cornish FPS outfall. If the WWF exceeds the capacity of the Cornish East Primary CS outfall, then the Cornish West weir will overflow to the Assiniboine River. Sluice gate protection is provided on the Arlington secondary outfall, and both sluice and flap gate protection is provided on the Cornish West secondary outfall, to restrict back-up from the Assiniboine River into the CS system under high river level conditions along the Assiniboine River.

In total, there are five outfalls to the Assiniboine River (three CSs, one SRS, and one FPS) as follows:

- ID63 (S-MA70033535) – Cornish East Primary CS Outfall
- ID83 (S-MA70017433) – Cornish FPS Outfall
- ID61 (S-MA20013630) – Cornish West Secondary CS Outfall
- ID59 (S-MA70053466) – Arlington Secondary CS Outfall
- ID60 (S-MA70017866) – Canora SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between the Cornish district and the surrounding districts. Each interconnection is shown on Figure 11 and shows locations where gravity and pumped flow can cross from one district to another. The known district-to-district interconnections are identified as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Colony

- A 450 mm carries intercepted CS 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 interceptor flows by gravity through the Cornish district into the Colony district and on to the NEWPCC for treatment. This interceptor carries intercepted CS from the districts upstream of the Cornish district, and does not interact with the Cornish CS system.
  - Wolseley Avenue and Maryland Street Interceptor invert - 225.46 m (S-TE20012409)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Aubrey

- Two 1200mm interceptor gravity sewers discharge into the Cornish district from the Aubrey district and carries sewage to the NEWPCC for treatment:
  - Wolseley Avenue – 226.20 m (S-MH20012549)
  - Wolseley Avenue – 226.04 m (S-TE20004698)

1.3.1.3 District Interconnections

Aubrey

<u>CS to CS</u>

- High Point Manhole (flow can be directed into both districts from this manhole):
  - Portage Avenue – 229.09 m (S-MH20013779)

<u>CS to SRS</u>

- A 600 mm SRS diverts from the CS flowing southbound on Home Street into Cornish district on Wellington Avenue:
  - Wellington Avenue – 226.59 m (S-MA20018010)

Bannatyne

<u>CS to CS</u>

- A 375 mm CS flows by gravity northbound on Toronto Street and connects to the CS system in Bannatyne district:
  - Toronto Street – 229.12 m (S-MH20016131)
- A 450 mm CS acts as an overflow pipe from the Bannatyne district to the Cornish district:
  - Wellington Avenue and Toronto Street – 229.76 m (S-MH70028187)

<u>SRS to SRS</u>

- A 1200 mm SRS flows by gravity into Cornish district from Bannatyne district on Wellington Avenue:
  - Wellington Avenue and Toronto Street – 226.54 m (S-MA20018024)

Colony

<u>CS to CS</u>

- High Point Manhole (flow can be directed into both districts from this manhole):
  - Toronto Street – 229.72 m (S-MH20016007)
- A 450 mm CS sewer acts as an overflow pipe from the Cornish CS system into the Colony CS system.
  - Honeymoon Avenue – 228.61 m (S-MH20013931)

<u>SRS to SRS</u>

- Two connections that flow via gravity at the intersection of St. Matthews Avenue and Toronto Street:
  - St. Matthews Avenue SRS invert at district boundary that flows from Cornish into Colony district into SRS outfall on Spence Street = 226.31 m (S-MA20015548)
  - Toronto Street SRS invert at district boundary that flows from Cornish into Colony district into SRS outfall on Spence Street = 226.68 m (S-MA70023075)

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.

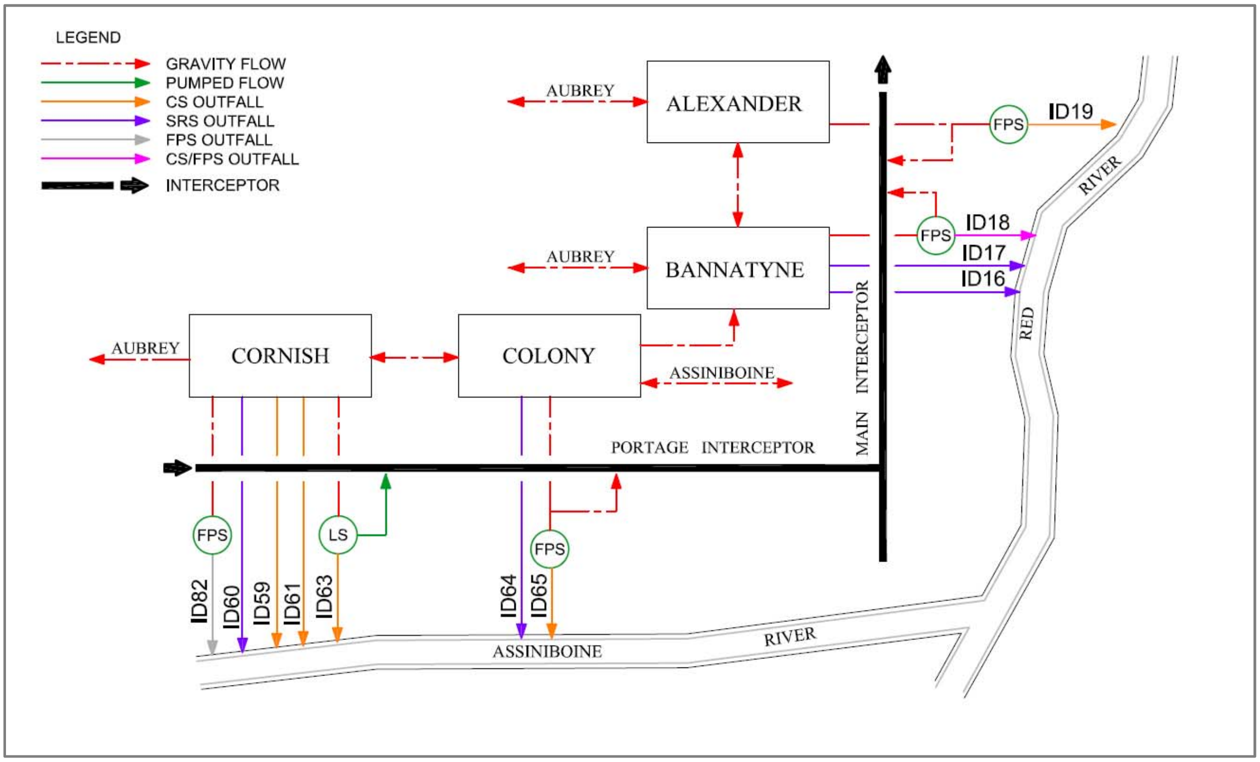


Figure 1-1. **District Interconnection Schematic**

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 11 and 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 (ID63)	S-MH70011815.1	S-MA70033535	1600 x 1450 mm	Assiniboine River Invert: 223.3 m
Flood Pumping Outfall (ID83)	S-AC70008049.1	S-MA70017433	1670 mm	Assiniboine River Invert: 223.29 m
Other Overflows (ID59 & ID61)	S-MH20012348.1 S-RE70014978.1	S-MA20013630 S-MA70053466	750 mm 400 mm	Invert: 223.38 m Invert: 224.20 m
Main Trunk	S-RE70008047.1	S-MA70017431	1450 mm	Circular Invert: 223.8 m
SRS Outfalls (ID60)	S-CO70008272.1	S-MA70017866	1980 mm	Invert: 222.1 m
SRS Interconnections	N/A	N/A	N/A	35 SRS - CS
Main Trunk Flap Gate	CORNISH_EAST_GC.1	S-CG00000755	1375 mm	Invert: 224 m
Main Trunk Sluice Gate	S-MH70011814.2	S-CG00001131	1500 x 1500 mm	Invert: 223.61 m
Off-Take	S-MH20012427.2	S-MA70017421	450 mm	Circular Invert: 223.84 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.148 m^3/s	1 x 0.059 m^3/s 1 x 0.089 m^3/s
Lift Station ADWF	N/A	N/A	0.059 m^3/s	
Lift Station Force Main	S-MH20012408.1	S-MA20013697	200 mm	Invert: 226.17 m
Flood Pump Station Total Capacity	N/A	N/A	1.87 m^3/s	1 x 0.72 m^3/s 1 x 0.29 m^3/s 1 x 0.86 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.151 m^3/s	

Notes:

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	Cornish East – 223.84 Cornish West – 223.84 Arlington – 223.85 Canora – 223.85
2	Trunk Invert at Off-Take	223.84
3	Top of Weir	224.44
4	Relief Outfall Invert at Flap Gate	Canora SRS Outfall – 221.18
5	Low Relief Interconnection (S-MH20013588)	225.88
6	Sewer District Interconnection (Colony)	226.55

7	Low Basement	228.60
8	Flood Protection Level	230.04

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

The most recent study completed in Cornish was the 1986 Basement Flood Relief study (Girling, 1986). No other work has been completed to evaluate the district sewer system since that time. Table 1-3 provides a summary of the district status in terms of data capture and study.

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 Cornish CS 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.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
11 – Cornish	1986	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 Cornish district. This consists of monthly site visits in confined entry spaces to verify that physical readings concur with displayed transmitted readings and replacing desiccants where necessary.

Future upgrades to the Outfall Gate Structure for the Canora SRS outfall are anticipated to take place in the next five to ten years. This work will include the addition of a flap gate to the Canora SRS outfall. Additional work including the installation of the necessary pumps to begin to implement the latent storage control solution recommended in this district plan may also be packaged with this flap gate installation work. This work is to be prioritized along with the other SRS outfalls requiring gate structure upgrade work.

1.6 Control Option 1 Projects

1.6.1 Project Selection

The proposed projects selected for the Cornish district to meet Control Option 1 – 85 Percent Capture in a Representative Year are listed in Table 1-4. The proposed CSO control options will include in-line storage via control gate, latent storage, and floatables management via screening. 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% Capture in a Representative Year	✓	-	-	✓	✓	-	-	-	✓	✓	✓

Notes:

- = not included
✓ = included

The existing CS system is suitable for use as latent storage. These control options will take advantage of the existing CS pipe network for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same.

The primary CS overflow for the district is to be screened under the current CSO control plan to address the floatables management requirements. The installation of a control gate at the primary CS outfall will be required for the screen operation in the Cornish district. This control gate installation will also providing the mechanism for capture of minor additional in-line storage. It should be noted however that in-line storage for the Cornish district is not a cost effective solution specifically for additional volume capture. The control gate installation is recommended primarily to provide the necessary hydraulic head for screen operations. Should screening no longer be required in the Cornish district to address the floatables management requirements, it is recommended that alternative measures such as off-line storage be investigated in the Cornish district to provide the additional volume capture in a more cost effective manner.

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 additionally it will provide the mechanism for capture of the in-line station. 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 a suitable control option for the Cornish district. There is one SRS system and SRS outfall that will provide additional storage volume. The latent storage level is controlled by river level and resulting backpressure of the river level on the proposed Canora SRS outfall flap gate, as explained in Part 3C. The storage volumes indicated in the design criteria table below is based on the river level condition of NSWL (normal summer water level) during the 1992 representative year at the outfall location.

Latent storage is accessible and has a lower risk than other storage types. A latent pump station, flap gate, and interconnecting pipes will be required to access the storage. The latent storage design criteria are identified in Table 1-5**Error! Reference source not found.**. The storage volumes indicated in design criteria table below are based on the NSWL river conditions.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	Canora – 222.18 m	Existing Sluice Gate invert.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
NSWL	223.85 m	
Trunk Diameter	1975 mm	
Design Depth in Trunk	1667 mm	
Maximum Storage Volume	1471 m3	
Force Main	125 mm	
Flap Gate Control	N/A	
Lift Station	Yes	
Nominal Dewatering Rate	0.025 m^3/s	Based on 24 hour emptying requirement
RTC Operational Rate	TBD	Future RTC/dewatering assessment

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

The addition of a latent storage pump station (LSPS) and force main that connect to the CS system are necessary for the latent storage to be dewatered. A conceptual layout for the LSPS and force main is shown on Figure 11-02 for the Canora SRS outfall. The LSPS will be located to the northwest of the SRS outfall chamber to avoid interference with nearby private residential lands. It is expected that the structure (large manhole chamber) will be situated within the street and provide minor disruption to the street and adjacent streets will provide alternative access. The latent force main will be routed north on Palmerston Avenue and connect to the Cornish CS system at the manhole on Wolseley Avenue and Canora Street. The LSPS 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.

As described in Section 1.5 above, much of this latent storage work may be pursued in conjunction with the critical flap gate installation work. This work is prioritized to occur within the Canora SRS outfall within the next five to ten years.

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 new gate chambers and the LSPS will be sized to provide sufficient flow to the pumps while all pumps are operating.

Flap gate control was not deemed necessary for this control option. Flap gate control may be considered if additional storage is required or if he river level regularly drops below the SRS flap gate elevation. The SRS flap gate control is described in the standard details in Part 3C.

1.6.3 In-Line Storage

In-line storage has been proposed as a CSO control for the Cornish district. The in-line storage will require the installation of a control gate at the CS outfall. The gate will primarily be used to provide additional hydraulic head for screening operations. The gate will also provide a secondary benefit in increasing the storage level in the existing CS to provide an overall higher volume capture, which is evaluated in further detail in this section. It is noted that the existing Cornish West secondary outfall will need to be monitored as any increases to the primary weir may adversely affect the performance at Cornish West secondary outfall. Assessment modelling did not indicate that additional overflows occur at the secondary outfall after implementation of the in-line storage arrangements described below.

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	223.80 m	Downstream invert of pipe at weir
Trunk Diameter	1450 mm	
Gate Height	0.72 m	Gate height based on half truck diameter assumption
Top of Gate Elevation	224.63 m	
Bypass Weir Height	226.53 m	
Maximum Storage Volume	202 m^3	
Nominal Dewatering Rate	0.148 m^3/s	Based on existing CS LS pump rate
RTC Operational Rate	TBD	Future RTC/dewatering rate assessment to be completed

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 11. 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 of the bypass side weir is determined in relation to the critical performance level 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 or to this critical performance level within the system 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 spill over the weir and discharge to the river. After the sewer levels in the system drops back below this critical performance level, the control gate moves back to its original position to capture the receding limb of the WWF event. The CS LS will continue with its current operation while the control gate is in position, with all DWF being diverted to the CS LS and pumped to the Main Interceptor on Furby Street. The CS LS will further dewater the in-line storage provided during a WWF event as downstream capacity becomes available after the WWF event.

Figure 11-01 provides an overview of the conceptual location and configuration of the proposed control gate and screening chambers. The proposed control gate will be installed in a new chamber within the trunk sewer alignment and be located west of the Cornish outfall gate chamber. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5 m in length and 3.5 m in width. The existing sewer configuration including the construction of an additional off-take, and force main modifications may have to be completed accommodate the new control gate chamber. This will be confirmed in future design assessments.

The inline storage level increase as a result of the control gate construction has been evaluated and does not affect the performance of the upstream Cornish West CS outfall. The in-line storage allows the smaller rainfall events to be collected downstream at the Cornish East CS outfall. It is however still recommended that the impact on the secondary CS outfall at Cornish West be evaluated further during preliminary design.

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 CS LS rehabilitation or replacement project.

The nominal rate for dewatering is set at the existing LS capacity. This allows dewatering through the existing interceptor system within 24 hours following the runoff event, allowing it to recover in time for a subsequent event. Future RTC / dewatering assessment will be necessary to define additional rates. This would provide some flexibility in the ability to increase the dewatering rate for spatial rainfall events. This would dewater the district more quickly, to capture and treat more volume for these localized storms by using the excess interceptor capacity where the runoff is less.

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. If outfall screening is required, off-line screens will be proposed 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	224.63 m	
Bypass Weir Crest	224.53 m	
NSWL	223.85 m	
Maximum Screen Head	0.65 m	
Peak Screening Rate	0.53 m^3/s	
Screen Size	1.5 m x 1 m	Modelled Screen Size

The proposed side bypass overflow weir and screening chamber will be located adjacent to the existing combined trunk sewer, as shown on Figure 11-01. The screens will operate once levels within the sewer surpassed the bypass weir elevation. A side bypass weir upstream of the gate will direct the initial overflow 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 back to the interceptor and on to the NEWPCC for removal.

The dimensions for the screen chamber to accommodate influent from the side bypass weir, the screen area, and the routing of discharge downstream of the gate are 5.5 m in length and 2.5 m in width. The existing sewer configuration will have to be modified to accommodate the new chamber to continue to allow the DWF to discharge to the CS LS. The chamber has been initially located within City-owned land available as part of Cornish Avenue.

1.6.5 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 the most applicable GI controls.

Cornish has been classified as a medium GI potential district. Land use in Cornish is a 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.

1.6.6 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 Section 3C. Periodic maintenance of the gate and screens would be required, depending on the type of gate and screening selected.

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 Cornish 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 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.

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.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. An individual model was created to represent the sewer system baseline as represented in the year 2013 and a second model was created for the CSO Master Plan evaluation purposes, with all the control options recommended for the district to meet Control Option 1 implemented 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 Added to Model
2013 Baseline	135	133	7,288	58	N/A
2037 Master Plan – Control Option 1	135	132	7,288	58	IS, Lat St, SC

Notes:

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

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added to Model

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 in Table 1-9 are for the hydraulic model simulations using the year-round 1992 representative year. This 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 number represent the comparison between the existing system and the proposed control options. Table 1-9 also includes overflow volumes specific to each individual control: 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 Annual Overflow Volume (m^3)	Master Plan Overflow Reduction (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [b]
Baseline (2013)	85,517	60,293	-	19	0.272 m^3/s
Latent Storage	85,372 [a]	-[c]	-[c]	-[c]	-[c]
Latent & In-line Storage		-[c]	-[c]	-[c]	-[c]
Control Option 1	**85,372**	-[c]	-[c]	-[c]	-[c]

[a] Latent and In-line Storage were not simulated independently during the Preliminary Proposal assessment.

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

[c] Model instability issues encountered within the Cornish district as part of the Master Plan performance evaluation for overall City of Winnipeg sewer network. The individual district performance values were instead utilized for the control option performance evaluation, and are shown below:

Table 1-10. Master Plan Performance Summary – Control Option 1 (Individual Model)

Control Option	Master Plan Overflow Reduction (m^3)	Master Plan Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Revised Baseline (2013)	64,659	-	20	0.180 m^3/s
Latent Storage	64,122	547	20	0.181 m^3/s
Latent & In-line Storage	63,724	1,294	20	0.068 m^3/s
Control Option 1	**63,724**	**1,294**	**20**	**0.068 m^3/s**

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

The percent capture performance measure is not included in Table 1-9 and Table 1-10, 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 1-11. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-11. 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	$1,580,000	$2,440,000	$71,000	$1,520,000
In-line Control Gate	N/A [a]	$2,420,000 [b]	$44,000	$950,000
Screening		$2,350,000 [c]	$54,000	$1,150,000
Subtotal	**$1,580,000**	**$7,210,000**	**$168,000**	**$3,620,000**
Opportunities	N/A	$720,000	$17,000	$360,000
District Total	**$1,580,000**	**$7,930,000**	**$185,000**	**$3,980,000**

[a] Screening and In-line Storage were not included in the Preliminary Proposal 2015 costing. Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for these items of work found to be $2,500,000 in 2014 dollars

[b] Costs associated with new off-take construction, as required, to accommodate control gate and screening chambers in location and allow intercepted CS flow to reach existing Cornish CS LS was not included in Master Plan

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

The estimates include changes to the control option selection since the Preliminary Proposal, updated construction costs, and the addition of GI opportunities. The estimate for the in-line storage costs does not include the costs to construct the new off-take to the LS. 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 Opportunities costs.
- The Preliminary Proposal capital cost is on 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 Annual 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 control options, to an estimate focusing on a specific level of control for each district. Any significant difference between the Preliminary Proposal and CSO Master Plan estimates are identified in Table 1-12.

Table 1-12. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Latent	Updated unit costs One of the two SRS locations, the Canora SRS Outfall, includes a LS system	
	Control Gate	A control gate was not included in the Preliminary Proposal estimate	Added for the MP primarily to allow for screening operation, but also to further reduce overflows
	Screening	Screening was not included in the Preliminary Proposal estimate	Added in conjunction with the Control Gate
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 Costs	The lifecycle costs have been adjusted to 35 years.	City of Winnipeg Asset Management approach	
Cost escalation from 2014 to 2019	Capital Costs have been inflated to 2019 values based on an assumed value of 3 percent per for construction inflation.	Preliminary Proposal estimates were 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 1-13 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 Cornish 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. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. Flap gate control upgrades to the latent storage arrangements currently recommended could be implemented to provide further volume capture. It is recommended to review the Aubrey district upstream of Cornish, as the available latent storage could further be utilized though existing infrastructure alterations to CS to SRS connections or new interconnections to increase flow to the SRS system for low to medium rainfall events. 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 1-13. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic separation • Latent Storage (Revised Interconnections or Flap Gate Control) • Off-line Storage (Tank/Tunnel) • Increase use of GI

The control options selected for the Cornish district have been aligned for the requirement to provide screening on each of the primary outfalls and not specifically for the 85 percent capture performance target based on the system wide basis. The expandability of this district to meet the 98 percent capture would be based on a stepped approach from the system wide basis.

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 Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-14.

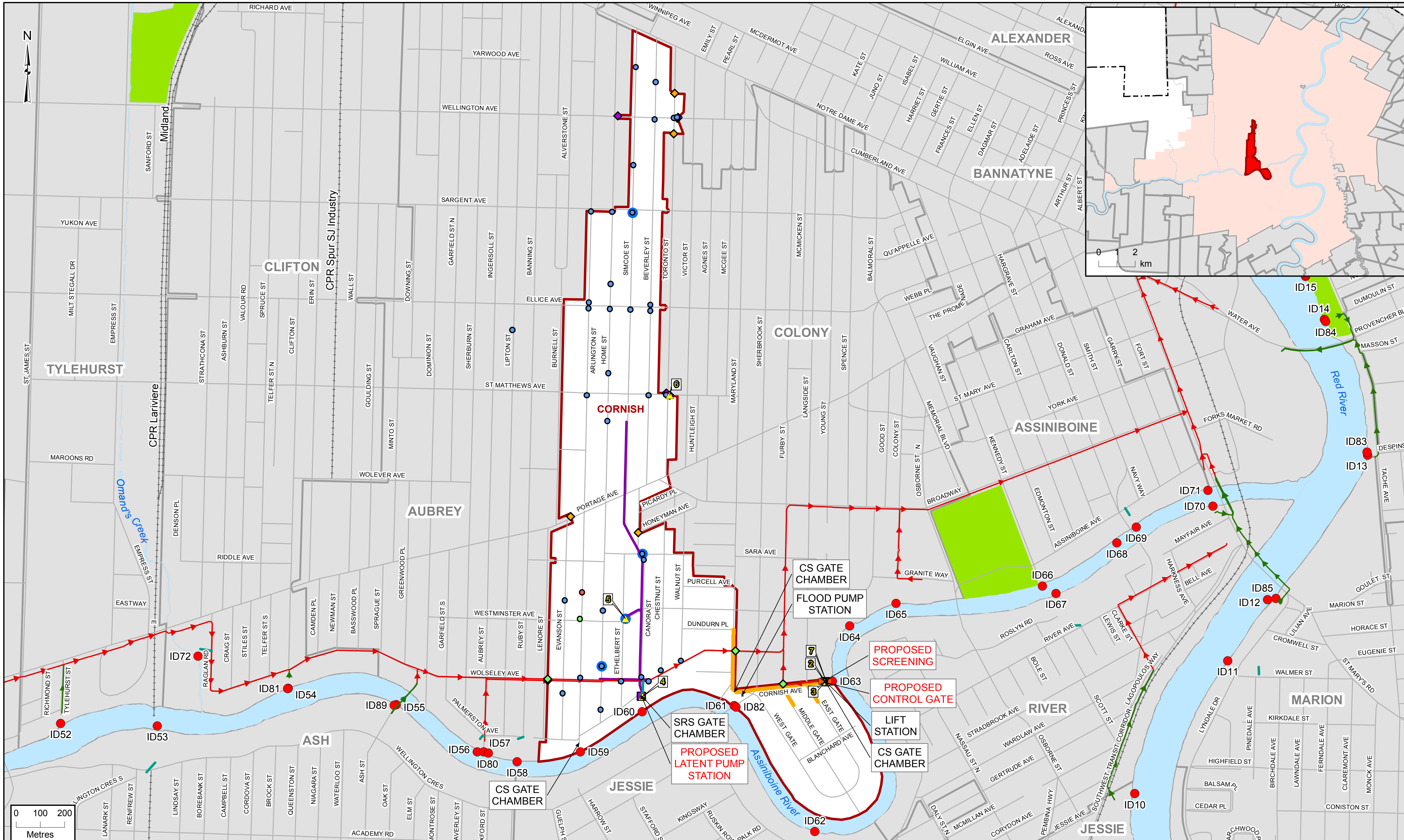
Table 1-14. Control Option 1 Significant Risks and Opportunities

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

Girling, R.M. 1986. *Basement Flooding Relief Program Review – 1986.*



LEGEND

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

Inter-System Connection

- CS - WWS
- SRS - CS
- SRS - WWS

District Boundary Crossing

- CS
- 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
- Latent Force Main

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

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

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FIGURE 11
District Overview Map
Sewer District: Cornish
City of Winnipeg
Combined Sewer Overflow Master Plan

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LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Pump Location
- Force Main
- Sewer By Type
  - CS
  - WWS
- Control Structure Type
  - Gate Chamber
- Pump Station Type
  - Lift Station

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

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WATER AND WASTE DEPARTMENT

FIGURE 11-01
Control Gate and Screening
Sewer District: Cornish
City of Winnipeg
Combined Sewer Overflow Master Plan

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LEGEND

Legend	Sewer By Type	Control Structure Type	
Critical Elevation	CS	Gate Chamber	Land Parcel
CSO Outfall	SRS		
Manhole	WWS		
Sluice Gate			

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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WATER AND WASTE DEPARTMENT

FIGURE 11-02
Latent SRS Control
Sewer District: Cornish
City of Winnipeg
Combined Sewer Overflow Master Plan

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LEGEND

- CSO Outfall
- Manhole
- Sluice Gate
- Pump Location

Sewer By Type
- CS

Control Structure Type
- Gate Chamber

Pump Station Type
- Flood Pump Station

- Land Parcel

CSO MASTER PLAN
PROPOSED SOLUTIONS

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

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

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FIGURE 11-03
Flood Pumping Station
Sewer District: Cornish
City of Winnipeg
Combined Sewer Overflow Master Plan

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