



CSO Master Plan

Munroe Annex District Plan

August 2019

City of Winnipeg



CSO Master Plan

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1. Munroe Annex District

1.1 District Description

Munroe Annex district is located in the northeastern limit of the City's combined sewer network, and is immediately east of the Linden district. Munroe Annex is approximately bounded by Concordia Avenue and Chelsea Avenue to the south, Rock Street to the west, Roberta Avenue, Norilyn Bay, Sawchuk Bay, and Menno Bat to the north, and Molson Street to the east. Figure 30 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

Gateway Road bisects the Munroe Annex district into east and west; this is the only regional roadway in the district. Other major transportation routes include Raleigh Street, Watt Street, Golspie Street, Roch Street, and Louelda Street in a north-south direction and Kimberly Avenue, Linden Avenue, Chelsea Avenue, Dunrobin Avenue, and Helmsdale Avenue in the east-west direction.

Munroe Annex is primarily residential but includes a few commercial and industrial locations. Of the residential units, the majority are single-family residential, with a few multi-family and two-family units located mostly east of Gateway Road. There are a few scattered commercial and industrial land-use designations within the district. There are also six greenspace areas within the Munroe Annex district; two of these are Civic Park, a large greenspace area bordering the northwestern boundary of the district, and East Kildonan Centennial Park. Concordia Hospital is located at the eastern end of the district near Lagimodiere Boulevard.

1.2 Development

There is limited land area available for new development within Munroe Annex district. No significant developments that would impact the Combined Sewer Overflow (CSO) Master Plan are planned or expected.

1.3 Existing Sewer System

Munroe Annex district encompasses an area of 188 ha¹ based on the existing GIS district boundary information. In general, the area east of Gateway Road consists of separate LDS and WWS systems, while the area west of Gateway Road consists of a CS and SRS system. Both the east and the west sides of the district are separate systems that connect into the Munroe and Linden CS systems. There is approximately 83 percent by area (156 ha) of LDS separated area and 3 percent by area (5 ha) identifiable as separation ready. The greenspace area in the district accounts for the remaining 14 percent by area, and totals approximately 27 ha.

There are no diversion structures, flow control structures, outfalls, pumping stations or lift stations (LSs) within the district. A 975 mm and a 750 mm trunk within the CS system carry flow south by gravity towards the CS system in the Munroe district. Multiple secondary sewers extend from the CS trunks along Munroe Avenue to the east and west to service the entire area. The WWS system is mainly on the east side of the district, with northern WWS sewers diverting flows to the Valley Gardens (Area 4NE) WWS system, and southern WWS sewers diverting flows to the CS system in the Munroe district.

Although the majority of the catch basins are connected to the SRS piped network, some catch basins remain connected to the CS system. CBs currently connect to specific sections of the CS system within Munroe Annex. Future plans to separate the remaining CBs from the existing CS system into the LDS system should be considered to allow for this district to be completely separation. The majority of the SRS

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.

flows in the district are diverted to an 1800 mm LDS sewer on Greene Avenue, which carries the flows west towards the Linden district LDS system. Flows from the southwest portion of the Munroe Annex district is directed towards the 2100 mm LDS sewer on Chelsea Avenue, which carries flows west towards Linden district.

Secondary LDS sewers direct flow via gravity to a 1200 mm to 2100 mm LDS pipe that carries flow to the Linden district. There is also two secondary overflow points from the CS system in the Munroe Annex district to the 2100 mm LDS pipe on Chelsea Avenue at the intersections of Golspie Street and Chelsea Avenue, and Watt Street and Chelsea Avenue (S-TE40001450 and S-MH70022447). These cross-connection pipes have been reviewed as previous overflow locations and can now be utilized as emergency secondary overflows. Each overflow consists of a reduction in the CS collector pipe diameter to allow it to pass within the Chelsea LDS trunk sewer, and a side overflow weir interconnection into the LDS trunk sewer. A positive gate is installed at the overflow point to control when these overflows are allowed to connect into the LDS system to reduce basement flooding risks. At this time the positive gate for both of these CS-LDS interconnections are closed and are to remain closed until further evaluations have been completed.

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Munroe Annex and the surrounding districts. Each interconnection is shown on Figure 30 and shows locations where gravity flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 District Interconnections

Munroe

CS to CS

- A 1200 mm CS pipe flows south by gravity on Watt Street to the CS trunk on Munroe Avenue in the Munroe district:
 - Invert at Munroe district boundary 224.74 m (S-MA40005030)
- A 900 mm CS pipe flows south by gravity on Golspie Street to the CS trunk on Munroe Avenue in the Munroe district:
 - Invert at Munroe district boundary 225.11 m (S-MA40004336)
- A 300 mm CS pipe flows south by gravity on Gateway Road to the Munroe district:
 - Invert at Munroe district boundary 227.35 m (S-MA40004574)
- A 375 mm CS pipe flows south by gravity on Roch Street to the CS trunk on Munroe Avenue in the Munroe district:
 - Invert at Munroe Annex district boundary 226.57 m (S-MA40005099)

LDS to CS

- A 525 mm LDS pipe flows south from Munroe Annex district to Munroe district on Raleigh Street:
 - Invert at Munroe district boundary 228.27 m (S-MA40004522)

WWS to CS

- A 375 mm WWS pipe flows south by gravity on Louelda Street to the CS system in the Munroe district:
 - Invert at Munroe district boundary 227.20 m (S-MA40007458)
- A 300 mm WWS pipe flows south by gravity on Moncton Avenue to the CS system in the Munroe district:

- Invert at Munroe district boundary 228.20 m (S-MA40007499)
- A 300 mm CS pipe flows south by gravity on Besant Street to the CS trunk on Munroe Avenue in the Munroe district:
 - Invert at Munroe district boundary 226.46 m (S-MA70051892)
- A 300 mm WWS pipe flows south by gravity on Grey Street to the CS system in the Munroe district:
 - Invert at Munroe district boundary 225.92 m (S-MA40005491)

LDS to LDS

- A 450 mm LDS pipe flows north on Roch Street from the Munroe district to the 2250 mm LDS trunk sewer on Chelsea Avenue in the Munroe Annex district:
 - Invert at Munroe Annex district boundary 223.98 m (S-MA40005096)

Linden

The CS and LDS systems between Munroe Annex and Linden interact at several locations.

CS to CS

- High point manholes
 - 300 mm CS at Roch Street and Roberta Avenue – 228.16 m References Munroe Annex District, 227.56 m References Linden District (S-MH40006178)
 - 375 mm CS at Roch Street and Linden Avenue – 225.78 m References Munroe Annex District, 226.66 m References Linden District (S-MH40006068)
 - 300 mm CS at Roch Street and Oakview Avenue – 227.42 m References Munroe Annex District, 227.26 m References Linden District (S-MH40006027)
 - 300 mm CS at Roch Street and Helmsdale Avenue – 227.42 m References Munroe Annex District, 227.30 m References Linden District (S-MH40005973)
- A 300 mm CS flows by gravity west at the intersection of Roch Street and Bronx Avenue from Munroe Annex district into Linden district:
 - Invert at Munroe Annex district boundary 227.76 m (S-MA40005134)

LDS to LDS

- A 2250 mm LDS trunk flows by gravity west at the intersection of Roch Street and Chelsea Avenue from Munroe Annex district into Linden district:
 - Invert at Munroe Annex district boundary 222.72 m (S-MA40005093)
- A 2100 mm LDS trunk flows by gravity west at the intersection of Roch Street and Greene Avenue from Munroe Annex district into Linden district:
 - Invert at Munroe Annex district boundary 22.84 m (S-MA40006725)
- A 750 mm LDS trunk flows by gravity north at the intersection of Roch Street and Dunrobin Avenue from Linden district into Munroe Annex district:
 - Invert at Linden district boundary 224.29 m (S-MA40006602)
- A 600 mm LDS trunk flows by gravity south at the intersection of Roch Street and Roberta Avenue from Linden district into Munroe Annex district:
 - Invert at Linden district boundary 224.15 m (S-MA40006722)
- A 450 mm LDS flows by gravity west at the intersection of Roch Street and Dunrobin Avenue from Munroe Annex district into Linden district:

- Invert at Munroe Annex district boundary 224.56 m (S-MA40006595)
- A 375 mm LDS flows by gravity north at the intersection of Roch Street and Helmsdale Avenue from Munroe Annex district into Linden district:
 - Invert at Linden district boundary 224.83 m (S-MA40006509)
- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Leighton Avenue from Munroe Annex district into Linden district:
 - Invert at Linden district boundary 224.54 m (S-MA40006148)
- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Roberta Avenue from Munroe Annex district into Linden district:
 - Invert at Linden district boundary 224.39 m (S-MA40006749)
- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Helmsdale Avenue from Munroe Annex district into Linden district:
 - Invert at Linden district boundary 224.91 m (S-MA40006501)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Linden Avenue from Linden district into Munroe Annex district:
 - Invert at Munroe Annex district boundary 224.40 m (S-MA40006701)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Oakview Avenue from Linden district into Munroe Annex district:
 - Invert at Munroe Annex district boundary 224.59 m (S-MA40006599)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Kimberly Avenue from Linden district into Munroe Annex district:
 - Invert at Munroe Annex district boundary 225.28 m (S-MA40006513)

Valley Gardens (Area 4NE)

WWS to CS

- High point manhole
 - 250 mm WWS on Dowhan Crescent at Blantyre Avenue – 228.00 m References Munroe Annex District, 228.01 m References Valley Gardens District (S-MH40004250)

LDS to LDS

- A 1650 mm LDS pipe flows south by gravity on London Street from Valley Gardens district to the LDS system in Munroe Annex district:
 - Invert at Munroe Annex district boundary 226.53 m (S-MA40004119)
- A 1375 mm LDS pipe flows south by gravity on Louelda Street from Valley Gardens district to the LDS trunk in Munroe Annex district:
 - Invert at Munroe Annex district boundary 227.26 m (S-MA40004083)
- A 525 mm LDS pipe flows south by gravity on Tregar Bay from Valley Gardens district to the LDS system in Munroe Annex district:
 - Invert at Valley Gardens district boundary 228.21 m (S-MA40004065)
- A 300 mm LDS pipe flows south on Nathan Lane from Valley Gardens district into Munroe Annex district:
 - Invert at Munroe Annex district boundary 228.26 m (S-MA40004642)

- A 300 mm LDS pipe flows south on Dowhan Crescent at Blantyre Avenue from Valley Gardens district into Munroe Annex district:
 - Invert at Munroe Annex district boundary 228.11 m (S-MA40003990)

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 system.

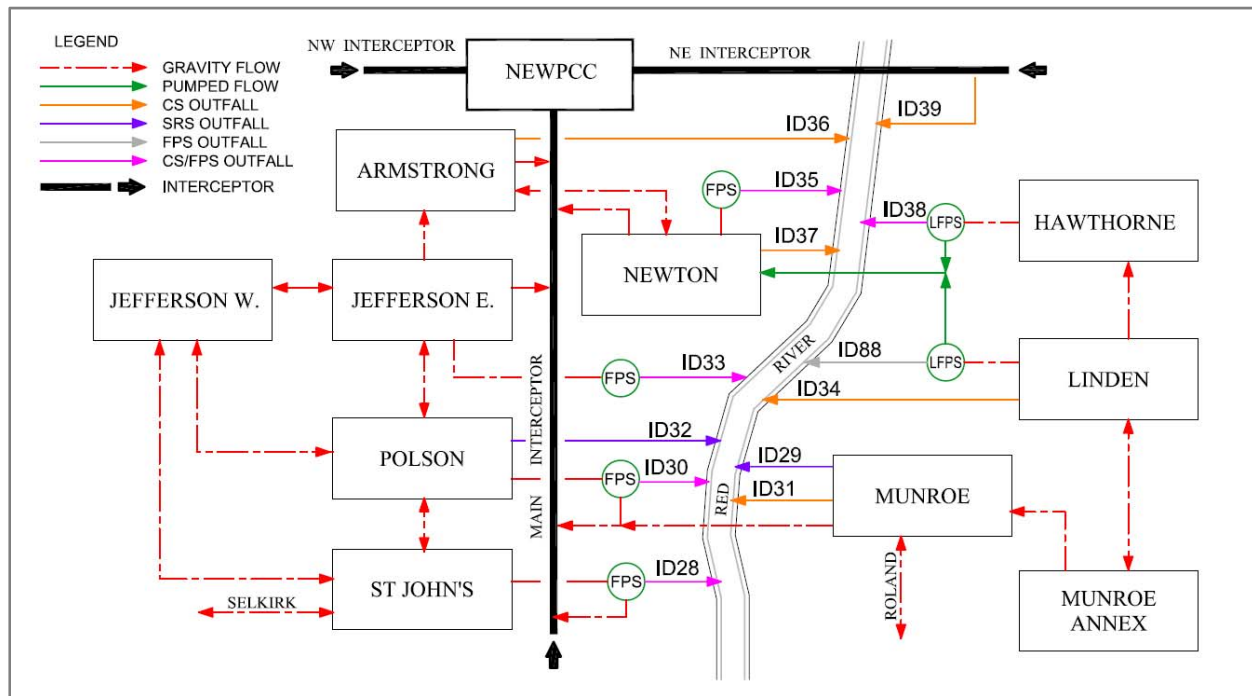


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 30 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 (ID23)	N/A	N/A	N/A	No CS outfall within the district.
Flood Pumping Outfall (ID23)	N/A	N/A	N/A	No Flood Pumping Station within the district.
Other Overflows (ID24 & ID26))	N/A	N/A	N/A	
Main Trunk	N/A	N/A	N/A	There is not a single CS trunk within the district.
SRS Outfalls (ID25)	N/A	N/A	N/A	There is no dedicated SRS outfall in the district.
SRS Interconnections	S-TE40001450.2	S-TE40001450	Weir width: 3000 mm Weir Crest: 225.66	This is a cross-connection between a CS and LDS system
	S-MH70022447.2	S-MH70022447	Weir Width: 900 mm	This is a cross-connection between a CS

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
			Weir Crest: 225.59	and LDS system
Main Trunk Flap Gate	N/A	N/A	N/A	No CS outfall within the district.
Main Trunk Sluice Gate	N/A	N/A	N/A	No CS outfall within the district.
Off-Take	N/A	N/A	N/A	No CS outfall within the district.
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	N/A	
ADWF	N/A	N/A	0.141 m ³ /s	
Lift Station Force Main	N/A	N/A	N/A	No lift station within the district.
Flood Pump Station Total Capacity	N/A	N/A	N/A	No Flood Pumping Station within the district
Pass Forward Flow – First Overflow	N/A	N/A	N/A	

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	N/A
2	Trunk Invert at Off-Take	N/A
3	Top of Weir	N/A
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection (S-MH70022447)	225.59
6	Sewer District Interconnection (Munroe - 1200 mm CS)	225.07
7	Low Basement	225.40
8	Flood Protection Level (Munroe, Linden, Hawthorne)	229.04

^a City of Winnipeg Data, 2013

1.4 Previous Investment Work

Table 1-3 provides a summary of the district status in terms of data capture and study. The most recent study completed in Munroe Annex was the *Munroe, Roland, Hart Combined Sewer Study* (Wardrop Engineering Consultants, 1985). The study's purpose was to develop sewer relief options to reduce surcharge level and relieve basement flooding. No further study work has been completed on the district

sewer system since that time. As a result of this study several measures to implement separation of the Munroe Annex district was completed. The Munroe Annex district was in fact part of the Munroe district originally but was separated to distinguish the portion of the district where the majority of the separation work recommended as part of this study was completed.

The district is deemed to be close to complete separation at this time as a result of previous investment work. Two individual systems are present to capture and route surface runoff, with the eastern section of the district draining to the Chelsea LDS system and the west section draining to the SRS system that flows from Munroe Annex to the adjacent Linden district and ultimately to the Red River.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
30 – Munroe Annex	1985	Future Work After Complete Separation	2013	Study Complete Separation Work Ongoing	N/A

Source: Report on *Munroe, Roland, Hart Combined Sewer Study*, 1985

1.5 Ongoing Investment Work

There is not any current or proposed CSO or sewer relief investment work occurring in Munroe Annex district.

1.6 Control Option 1 Projects

1.6.1 Project Selection

The Munroe Annex district is an almost completely separate system and primarily has the remaining work required to allow for complete separation of the district proposed to meet CSO Control Option 1. Table 1-4 provides an overview of the control options included in the 85 percent capture in a representative year option. 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	In-Line Storage	In-line Control Gate	Gravity Flow Control	Off-line Storage	Storage / Transport Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year *	-	-	-	-	-	-	-	✓	✓	✓	-

Notes:- = not included

✓ = included

* = Cross connection work not covered in the above table.

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 Sewer Separation

The redirection of the existing CBs to the adjacent SRS in Chelsea Avenue and extension of the minor SRS systems in the Kimberly Avenue and Rayleigh Avenue locations would allow the system to be completely separated. It is recommended that an investigation into the system be completed to ensure that no additional WWS/CS connections to the existing SRS network are present.

Also, as part of the remaining sewer separation work, it is recommended that the interconnection between the CS and LDS systems at Golspie Street and Chelsea Avenue be modified. Each of the two CS-LDS interconnections were assessed as part of the CSO Master Plan and indicated two overflows at the Golspie Street cross connection for the representative year assessment. The reduction in pipe diameter through the cross connection is taken as a limiting factor and the weir level was taken to be too low for the WWF flows within the system. It is proposed to raise the weir and increase the pipe diameter to ensure that the cross connection does not operate for the representative year event. Optimizing the weir level/pipe diameter would require additional flow monitoring, and this is recommended that this be undertaken prior to any construction work. Further investigation and monitoring also would be needed to allow this cross connection to be abandoned. It should be noted that this work has not been included in the sewer separation capital cost estimates for the Munroe Annex district.

Upon completion of removing the WWS connections to the existing SRS connections at the Watt and Golspie locations, the SRS systems that extend through the northern portion of the district can be classified as LDS systems.

It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the conditions modelled under the 1992 representative year conditions.

1.6.3 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.

Munroe Annex has been classified as a high GI potential district. Land use in Munroe Annex is primarily residential but includes a few commercial and industrial locations. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels. The flat roof commercial buildings make for an ideal location for green roofs. There are also higher areas of greenspace which could be used for bioretention garden projects.

1.6.4 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

Major changes to the existing system operations and maintenance (O&M) requirements for the Munroe Annex district will be minimal. The sewer separation work outstanding will include the installation of additional sewers that will require inspection, cleaning and rehabilitation.

It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Munroe Annex district.

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 **Error! Reference source not found.**

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added To Model
2013 Baseline	177	177	5,585	7	N/A
2037 Master Plan – Control Option 1	177	177	5,585	7	SW/Pipe

Notes:

SW/Pipe – Static Weir Increase and pipe diameter increase

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 of this district (from outfall perspective) is provided in the Munroe District Engineering Plan as Munroe Annex does not have a CS outfall. The overflow volume of 201m³ is noted for the existing conditions and 0 m³ for implementation the Control Option 1 conditions have been included in the Munroe performance estimate.

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 1-6. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-6. 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 Cost (Over 35-year period)
Sewer Separation Minor Work Outstanding	N/A	\$ - ^b	N/A	N/A
Static Weir / Pipe Diameter Increase	N/A ^a	\$15,000 ^c	N/A	N/A
Subtotal	N/A	\$15,000	N/A	N/A
Opportunities	N/A	\$0	N/A	N/A

Table 1-6. 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 Cost (Over 35-year period)
District Total	N/A	\$15,000 ^{b c}	N/A	N/A

^a Static Weir / pipe diameter increase not included in the Preliminary Proposal costs

^b Separation proposal costs developed as refinement to CO1MP work following submission of CSO Master Plan Control Option 1 costs. Costs for this item of work found to be \$480,000 in 2019 dollars.

^c No costs have been included for any monitoring needed to determine the optimum weir level

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 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 estimate 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 differences between the Preliminary Proposal and CSO Master Plan estimates are identified in Table 1-7.

Table 1-7. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Static Weir / Pipe Diameter Increase	Static Weir / Pipe Diameter Increase was not included in the preliminary estimate	Recent cross connection added to the Master Plan model and option
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 to 2019	Capital Costs have been inflated to 2019 values based on an assumed value of 3 percent per for	Preliminary Proposal estimates were based on 2014-dollar values.	

	construction inflation.		
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1.10 Meeting Future Performance Targets

The remaining catch basin disconnections and proposed static weir/pipe diameter increase work recommended for the Munroe Annex district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target.

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 1-8.

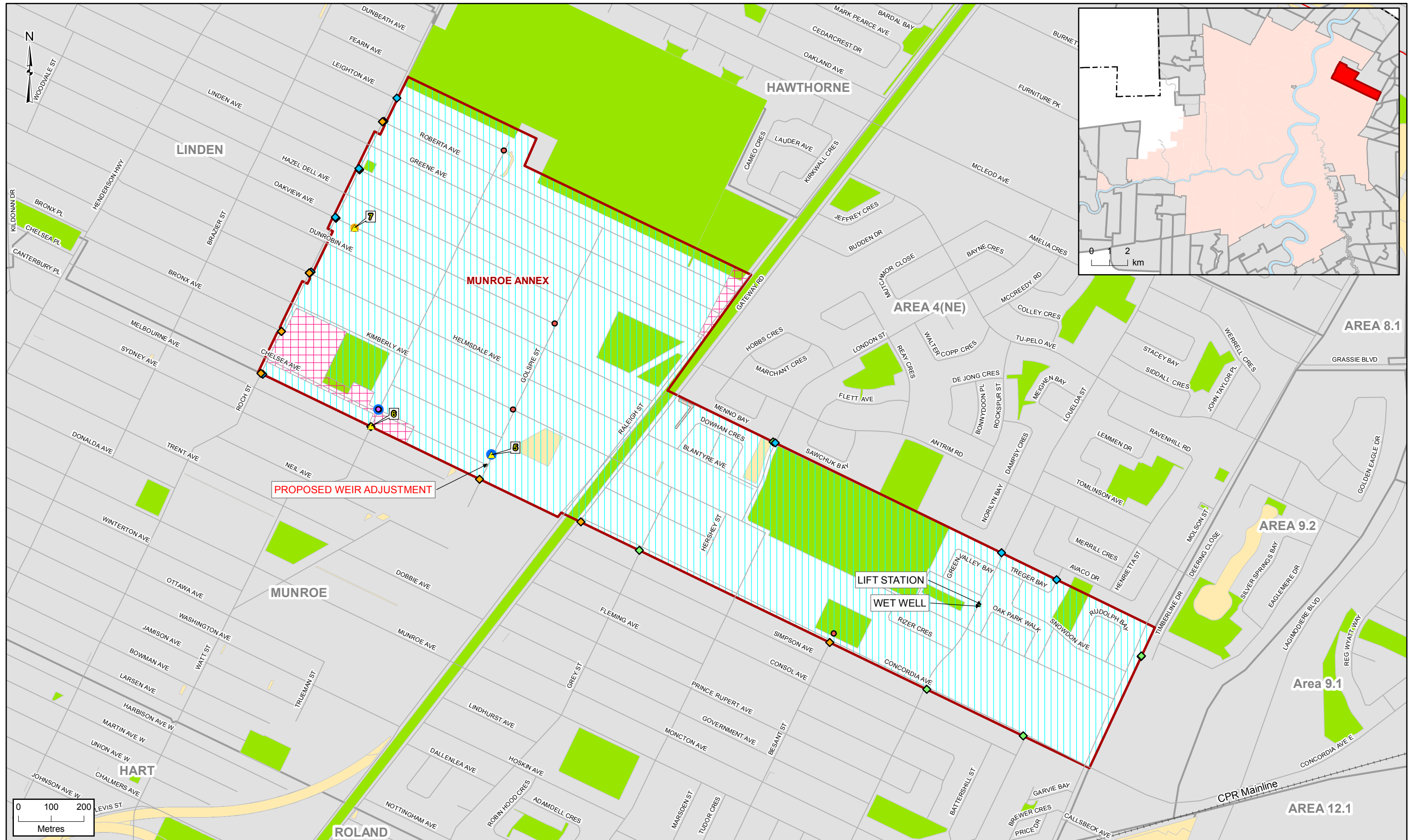
Table 1-8. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Wardrop Engineering Consultants. 1985. *Munroe, Roland, Hart Combined Sewer Relief Study*. Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. June.



LEGEND			
▲ Critical Elevation	— Inter-System Connection	◆ District Boundary Crossing	→ Interceptor Sewer
● Low CS Manhole	● CS - WWS	◆ CS	→ Force Main
● Low SRS Connection	● SRS - CS	◆ LDS	— Street
	● SRS - LDS	◆ WWS	++ Railway
			▭ District Boundary
			▭ Greenspace
			▭ City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS	
▭	Sewer Separation - Complete
▭	Sewer Separation - Ready

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 30
District Overview Map
Sewer District: Munroe Annex
City of Winnipeg
Combined Sewer Overflow Master Plan