MINUTES : HSCA – EPARC - Infrastructure Group
Tuesday, July 18 2017 from 7:00 – 9:00 PM
in the Hearth Room at HSCA.

Attendees: Kerri T, David B, Charlie L, John M, Peggi M, Krista K, Adam M, Barry P.
Guests: Susha Prakash, Gregory Kozhushner, and Brad Larson, all of Water Resources.

(1) Welcome & Introductions – Charlie Lund (10 min)

(2) Discuss plans for and progress of Pump Station #1 – Susha Prakash, Gregory Kozhushner, and Brad Larson, all of Water Resources (90 min)

Susha Prakash is the City project engineer. Three alternative sites are being considered. As a result of a request from this meeting another site, in the large city parking lot, will be evaluated. The site review is not expected to result in material schedule delay. Pump Station#1 is expected to be operational in 2018.

See attached maps, showing the proposed alternative locations, and the surface contours of the area (the latter provided after the meeting).

(3) Action plans for other items [by exception only]– Charlie/All (15 min) – no discussion

a. Stay in contact with the City to ensure work on approved projects proceeds expeditiously.
b. Support the city in their requests to the province and the federal government for funding.
c. Work with Water Resources to improve Sunnyside berm/barrier design.
d Support the construction of a new dam and reservoir on the Bow River upstream of Calgary.
e. Advocate that any non structural mitigation measures reflect the protection afforded by the structural measures.
f. Support the plan to address the rock bars now obstructing portions of the river channel.
g. Stay in touch with IBC and make sure they are informed as the structural measures are implemented.

(4) Date for next meeting(s): Monday, August 21 (5 min)

(5) Adjourn

9 Pump Stations

9.1 OVERVIEW

Pumping is required to relieve the minor system during Design Condition 2 due to the topography of the lower plateau relative to the 1:100 year Bow River level. Five potential pump station locations were provided by the City and are identified in Table 9-1. The pump station locations can be seen in Figure 9-1.

Table 9-1
Pump Station Locations

Pump Station	Location	Outfalls Serviced	Figure Number
1	North of Memorial & East of 3 Street NW	B42A, B43, B46	9-2
2	South of 1 Avenue NW & West of 5A Street NW	B47, B48/B48A[22], B49, B51, B53, B53A	7-12
3	South of Memorial & West of 10A Street NW	B54, B57	7-4 & 7-7
4	North of Memorial & West of 14 Street NW	B60, B61, B62, B66	7-8
5[23]	South of Memorial near the existing B48 Outfall	N/A	8-1

Design Capacity

AE utilized the MIKE Urban model to predict the flows entering each of the proposed pump stations. The design capacity was then estimated considering Design Condition 1 and 2. Table 9-2 as follows summarizes the flows into each of the pump stations.

Table 9-2
Proposed Pump Stations

Pump Station	Design Condition 1 Flow (m^3/s)	Design Condition 2 Flow (m^3/s)	Pump Station Design Capacity (m^3/s)
1	N/A[24]	0.13	1.00

[22] Only the modified B48/B48A catchment would be pumped during Design Condition 2.
[23] Pump Station 5 would allow for the City to drain the siphon as explained within Section 8.5. It would not provide discharge during Design Condition 2 and has not been explained further within Section 9.

Pump Station	Design Condition 1 Flow (m^3/s)	Design Condition 2 Flow (m^3/s)	Pump Station Design Capacity (m^3/s)
2	1.62	0.76	2.00
3	N/A	1.45	1.60
4	N/A	2.80	2.90

The catchment area upstream of Pump Station 1 is not substantial enough to warrant a large capacity pump station. However, Pump Station 1 is situated adjacent to the lowest area in the catchment and will receive major system flow that does not enter the minor system elsewhere. AE, in conjunction with the City, agreed upon the design capacity as shown within Table 9-1.

Pump Station 2 is unique because its critical operational scenario is Design Condition 1. AE selected the design capacity to accommodate potential variations in the improvement projects in later phases of design. It should be noted that 2.0 m^3/s is approximately the maximum pump station capacity that can be achieved in the limited space at the site.

Other Considerations

Each of the pump stations would be built with key components, such as the electrical equipment, generator room and pump room operating floor, at least 500 mm above the design flood elevation. The design flood elevation should be confirmed during preliminary design. It is anticipated that the proposed pump stations will be two storey buildings with an underground wet well. Each pump station will be fenced and include parking for operations and maintenance personnel. The appearance of the pump stations can be adjusted to fit within the community.

The City does not have specific guidelines for stormwater pump station design. AE referred to the "Wastewater Lift Station Design Standards V.1.0" (City of Calgary, 2013) and identified significant deviations where practical from a cost savings perspective. These deviations are as follows:

- The wastewater guidelines require a wet well/dry well arrangement when pumps are greater than 25 hp. However, the pump stations will require submersible pumps in a wet well only arrangement to minimize the footprint, as well as structural and excavation costs.
- Washrooms were not considered. If washrooms are desired, they would require new sanitary connections.

Operation of the pump stations during Design Condition 1 should be considered during preliminary design. The pump stations should be optimized with the rest of the proposed improvement projects while considering the system's reliance on the pump stations during Design Condition 1. Optimization of the

[24] During preliminary design, it may be decided to divert some flow to pump stations 1, 3 and 4 during Design Condition 1. This could allow the pump stations to be exercised annually or allow for modifications to the proposed improvement projects.

design should consider the pump station's ideal frequency of use, cost of power and requirements to exercise the mechanical equipment.

Each of the proposed pump stations would require a detailed geotechnical and structural investigation to determine how the proposed structure and adjacent buildings can be properly supported during excavation of a new wet well. Additional design work would be required to consider and mitigate the buoyancy effects of groundwater. During construction, it is anticipated that a significant amount of additional geotechnical, shoring and dewatering work would be required.

9.2 PUMP STATION 1

The Issue

During Design Condition 2, the minor system east of 5A Street NW surcharges to surface sending overland flows from northwest to southeast. Flows collect within a large low spot at Memorial Drive NW and 3 Street NW. This is the lowest spot in the study area and ultimately collects overland flow from the entire study area via Memorial Drive NW during Design Condition 2. Pump Station 1 is intended to pump stormwater flow from outfalls B42A, B43 and B46.

Excessive ponding within the low spot has been observed to cause property damage. This was evident during the June, 2013 events summarized within Section 3.3. This study is not intended to address overland flows from the Bow River; however, flooding is expected to occur in the same area as a result of Design Condition 2.

Relevant Information

The City requested that AE consider not providing minor system conveyance for the B46 outfall during Design Condition 2. This request was dependent on whether or not property damage would occur as a result of not servicing the trap low north of Memorial Drive NW on 5 Street NW. The request was also dependent on whether or not the major system LOS criteria would be exceeded during Design Condition 2.

AE extracted contours from the City's DEM to examine the potential for property damage. The trap low is expected to fill to an elevation of 1045.0 prior to spilling down Memorial Drive NW. The trap low is predicted to cause property damage at an elevation of 1045.1. AE was unable to verify whether or not the trap low would cause damage as the available freeboard was within the precision of the DEM. At this point, without survey of the area, it is unclear whether flooding of the trap low would lead to property damage.

Under existing conditions, during Design Condition 2, major system flows are expected to violate the LOS criteria extensively on the lower plateau. Under proposed conditions, during Design Condition 2, many of these LOS violations are expected to be resolved. Downstream of outfall B46, the major system flows and velocities will improve from the existing condition to the proposed condition regardless of whether or not the outfall is serviced. However, during proposed conditions, flows and velocities downstream of the B46 outfall will be even further improved if the outfall is serviced with pumping to enable discharge to the Bow

River. Overall, this location will receive a net reduction in QVDs, but will receive an even greater reduction if outfall B46 is serviced.

AE recommends that, during preliminary design, a detailed survey and subsequent analysis be conducted to determine whether or not flooding in the trap low would cause property damage. In the event that it does, the following options could be considered to mitigate damages during Design Condition 2:

- AE has proposed a groundwater collection system as part of a separate study entitled the "*River Flood Mitigation Conceptual Design Study*". Outfall B46 could be serviced via the groundwater collection system and conveyed to Pump Station 1.
- The lot at 536 Memorial Drive NW could be re-graded. This would allow for a greater ponding depth and a defined overland spill route.
- Outfall B46 could be serviced via a stormwater pipe along the north side of Memorial Drive NW leading to Pump Station 1.

Proposed Improvement Project

An improvement project (refer to Figure 9-2) would consist of the following:

- A new stormwater pump station and forcemain constructed on City land in the northeast quadrant of Memorial Drive NW and 3 Street NW.
- A new 900 mm forcemain between the proposed pump station and the Bow River
- A new outfall at the forcemain outlet complete with energy dissipation[25].
- Outfalls B42A and B43 would be interconnected to allow both minor systems to drain to the proposed Pump Station 1. This interconnection would be accomplished by a 450 mm and 750 mm pipe. The connection should be graded to the east and aligned with the outgoing inverts of the parallel systems.

Pump Station

Pump Station 1 would be sized to handle a peak flow of 1 m^3/s.

The below grade portion of the station would be a wet well with two 90 hp wet well mounted submersible pumps that discharge into a single forcemain. Submersible pumps have been selected within this study, but mixed flow vertical style pumps could potentially be used as an alternative. However, removing vertical style pumps for maintenance purposes is typically more effort than removing well mounted submersible pumps.

[25] Energy dissipation is an engineered solution to reduce velocities by incurring a head loss at the downstream outlet. High velocities have the potential to injure members of the public and erode the bank and channel of the Bow River.

Forcemain

The proposed pump station would require a 900 mm diameter forcemain to convey flow from both pumps to the Bow River. The forcemain would extend approximately 120 m from the pump station to a new outfall on the Bow River. Considerations for the new outfall should be as follows:

- Potentially integrating or replacing the existing outfall with the proposed outfall.
- Construction of a trash rack to keep the forcemain outfall open and unrestricted.
- Installation of a backflow preventer (non-return valve) on the forcemain.
- Construction of energy dissipation to reduce outlet velocity and potential riverbank erosion.
- Approvals would be required for any outfall modifications or new outfalls.

Constructability

The improvement project has several constructability considerations as noted below:

- The pump station wet well would be deep and close to the river. A geotechnical investigation, together with shoring and dewatering will likely be required to facilitate safe construction.
- Interconnecting outfalls B43 and B42A would require construction within the Memorial Drive NW ROW. Construction would be adjacent to the existing 1200 mm sanitary trunk on Memorial Drive NW. Consideration should be given to avoiding disturbance with the sanitary trunk.
- The gravity trunk into the proposed pump station would cross two existing sanitary forcemains. These forcemains may have to be relocated vertically to allow for a gravity inlet into the pump station. This should be confirmed during preliminary design.
- The proposed forcemain would have to cross the existing 1200 mm sanitary trunk along Memorial Drive NW.
- Trenchless installation was considered for the forcemain across Memorial Drive NW. Open cut construction could be considered during preliminary design; however, it would impact traffic on Memorial Drive NW.

The station wet well footprint would be approximately 5 m wide by 9 m long. The bottom of the wet well would be located approximately 6.5 m below grade. At this depth, the excavation dimensions would be as large as 17 m by 21 m if no means of shoring is used during construction. The identified site location is approximately 14 m by 37 m and would require shoring to minimize impact on the neighboring streets, existing utilities and the building to the east.

During preliminary design, consideration could be given to a shallower wet well. This would increase the plan area of Pump Station 1. AE anticipates that a wet well footprint would be as large as 7 m wide by 9 m long with a depth of 5 m. The larger footprint could incur a slightly larger cost and a different pump configuration; however, this should also be confirmed during preliminary design.

Interim Improvement Project

The City identified a grated top manhole between the eastbound and westbound lanes on Memorial Drive NW at 5 Street NW which discharges to the sanitary system (refer to Detail B on Figure 9-2). In an effort to reduce stormwater inflow to the sanitary system, the City has requested that AE propose options to remove the interconnection. These options are as follows:

1. Install a new catchbasin with a grated top inlet adjacent to the existing inlet. Extend a short lead from the new catchbasin to the east to a new manhole on the existing 300 mm storm sewer. Re-grade Memorial Drive NW to move the low spot to that of the proposed catchbasin.
2. Re-grade Memorial Drive NW in the vicinity of the grated top manhole to remove the low point.
3. Similar to Option 1, a newly proposed catchbasin could be serviced by extending a long lead to an existing catchbasin to the northwest.

AE recommends that the City confirm that the grated top manhole is connected to the sanitary system and survey the inlet to confirm its location. Based on currently available information, AE recommends Option 1; however, this interconnection should be investigated further during preliminary design.

Any of the proposed options would necessitate a partial closure of Memorial Drive NW at accommodate construction.

9.6 POWER SUPPLY

The proposed pump stations would require 3 phase - 600V primary power supply. This primary power supply may require dedicated power lines. The pump stations would also require a backup power supply to avoid loss of service during a flood event. AE has proposed backup generators; however, consideration should also be given to redundant power lines during preliminary design.

There are two options for a backup power supply by generators:

- **Individual Backup** – A separate generator for each pump station.
- **Combined Backup** – 2 generators which service 2 pump stations each.

The City has favoured natural gas fueled generators at other lift stations in order to remove the likelihood of a fuel spill or leak near the river or into the stormwater system. Also, natural gas units do not have the additional maintenance requirements associated with the storage of diesel fuel. If natural gas fueled units were to be used, the City would have to review their emergency response plans in order to confirm that the gas supply would not be shut-off during a flood or high river event.

9.6.1 Individual Backup Power Supply

Individual generators could be installed within the building floor plan area directly above the wet well. These generators would be sized according to Table 9-3. Individual generators may be more cost effective than a combined generator when considering a single pump station.

Table 9-3
Backup Power

Pump Station	Backup Generator Size
1	300 kW
2	600 kW
3	400 kW
4	600 kW

9.6.2 Combined Backup Power Supply

It would also be possible to use two standby generators to power the four pump stations. A generator could be located in either Pump Station 1 or 2 and Pump Station 3 or 4. This would result in dedicated underground power supply cables being installed between the corresponding pump stations. The primary objective for this approach is to realize cost savings for a full build-out scenario.

AE believes that the cost of the transformers and the cable required between the proposed locations for Stations 1 and 2 (approximately 610 m) and Stations 3 and 4 (approximately 550 m) will be significant. It is also important to note that the cost of the generators and accessories tend to scale linearly with capacity and therefore capital cost savings using this approach are unlikely. However, if space limitations at individual pump stations require the purchase of additional property to accommodate a local backup power system, the combined backup option would become more attractive. An investigation into the specific electrical code requirements for remotely located generators would need to be considered during preliminary design stages. No additional cost provision related to the potential electrical code implications has been included in the conceptual cost estimates.

9.7 SUMMARY

Refer to Table 9-4 for a summary of the technical information pertaining to each of the proposed pump stations.

Table 9-4
Pump Station Summary

	Pump Station 1	Pump Station 2	Pump Station 3	Pump Station 4
Capacity (m^3/s)	1.0	2.0	1.6	2.9
Number of Pumps	2	6 (new station) 3 (ex. station)	4	5
Pump Size (hp)	90	60 (new station) 60 (ex. station)	60	90
Wet Well Depth (m)	6.5	6.8	7.0	7.0
Footprint (m)	5 x 9	10.5 x 6.5 (new)	7.5 x 9	11 x 11.5
Construction Footprint (m)	17 x 21	15 x 11 (shored)	12.5 x 14.0 (shored)	16.5 x 16.5 (shored)
Generator Size (kW)	300	600	400	600
Power Supply	3 Phase - 600 V	3 Phase - 600 V	3 Phase – 600 V	3 Phase - 600 V
Forcemain Diameter (mm)	900	900	1200	1650

9.8 USE OF PUMP STATIONS TO MITIGATE SEEPAGE

AE is currently working on the "*River Flood Mitigation Conceptual Design Study*", which includes an examination of the impacts of groundwater seepage due to a high river level. As part of this study, AE identified the opportunity to use the pump stations proposed within the NWIC Drainage Study – Sunnyside Review to mitigate river related seepage effects in Sunnyside.

Perforated drains could be constructed on the land side of the Sunnyside berms and routed towards the proposed pump stations to convey groundwater during a high river condition. The connections between the perforated drains and the pump stations would typically be closed to avoid unnecessary pumping of groundwater. However, as the river levels rise beyond a threshold value the gated connections would be opened to allow groundwater pumping for seepage control. The groundwater pumping could be coincident

with surface water pumping, thereby increasing the total flows to the pump station; however, our analysis indicates that peak flood levels on the river and surface runoff from the Sunnyside area have little dependence on each other.

The recommended river level of protection and the associated seepage rates have not been confirmed at this time. Although the predicted seepage values have yet to be quantified, the work done to date identified seepage rates that vary significantly depending on the permeability or K value. The K values could range from 8.64 m/d to 864 m/d depending on the subsurface materials in the area, which to date have not been field confirmed. Considering this range of K values, the following pump station capacities would be required to mitigate seepage for a 1:100 year river level with a duration similar to that of the expected hydrograph provided by the City.

Table 9-5
Pump Station Design Capacities to Mitigate Seepage

Pump Station	Drainage Related Design Capacity (m^3/s)	River Seepage Related Design Capacity (m^3/s)		
		K Value (m/d)		
		8.64	86.4	864
1	1.00	0.026	0.32	3.35
2	2.00	0.037	0.45	2.00
3	1.60	0.034	0.41	6.50
4	2.90	0.019	0.23	3.50

As noted in Table 9-5 above, if the K value is equal to or less than 86.4 m/d, the pump station capacities required to control seepage are lower than the capacities identified the study. However, if the K value is greater than 86.4 m/d, the capacities of Pump Stations 1, 3 and 4 would need to be increased.

It is also worth noting that to increase the capacity of Pump Station 1, the adjacent land parcel to the east would need to be acquired.

Pump Station 2 was not considered for a capacity increase because of physical space limitations on site.

Should Pump Station 3 not be able to accommodate the required flows, consideration should be given to utilizing the pump station proposed as part of the B48/B48A improvement project. This pump station is currently only intended to drain the siphon on the dedicated trunk; however, it could be expanded if necessary.

AE recommends that prior to pump station design, a field program be conducted to more accurately assess the K values in the area to better predict the seepage flows during a high river event. This information will enable the City to determine appropriate pump station sizes that will provide multiple benefits for both drainage and river related seepage.

The pump station cost estimates included in this study are based on the requirements of this study (i.e., the pump station sizes have not increased to include seepage control).

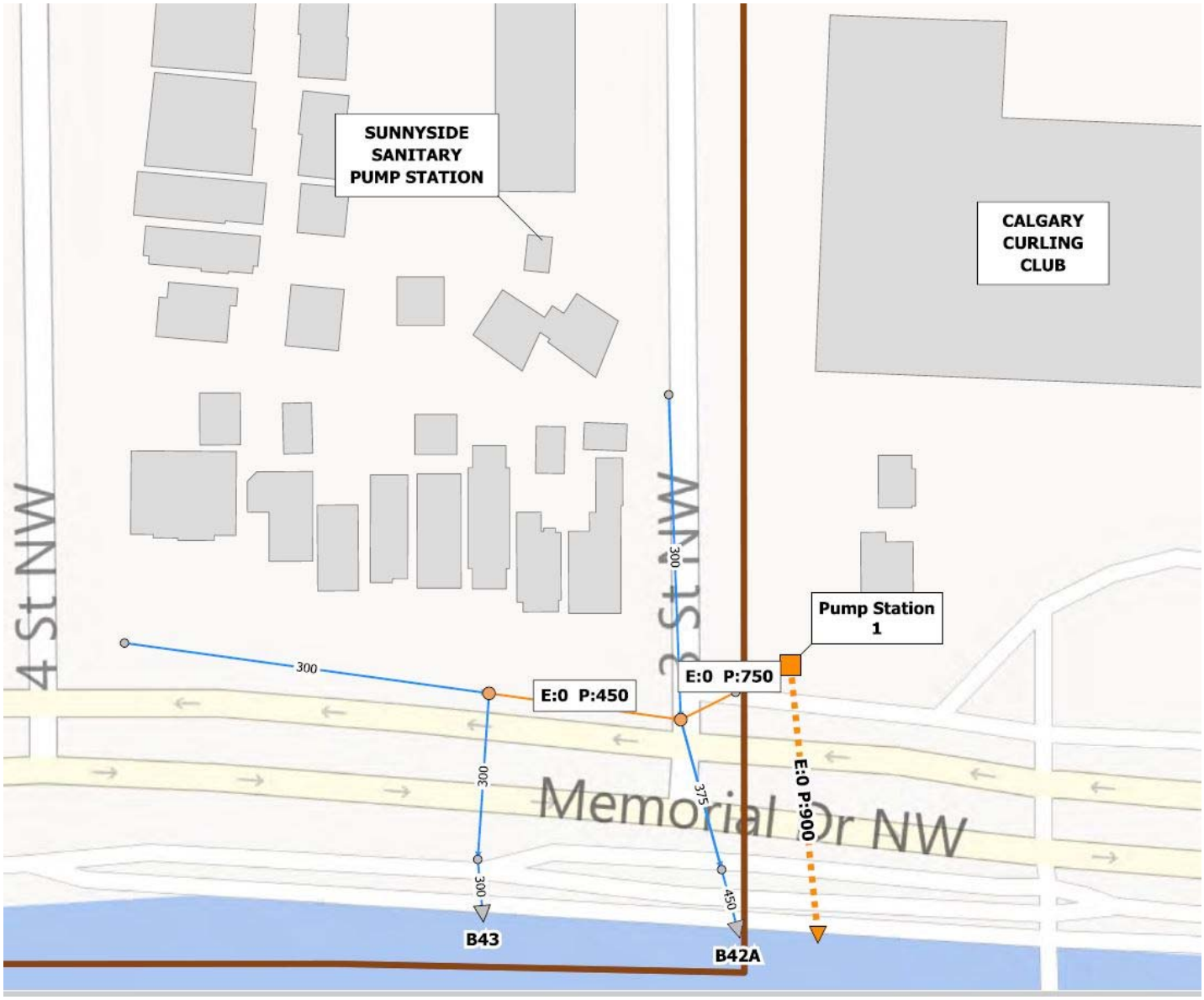
9.8.1 Dual Purpose Conveyance Piping

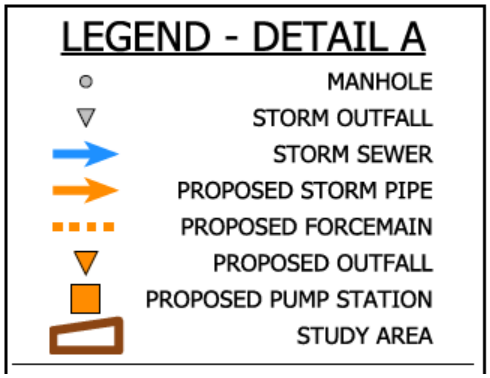
The proposed groundwater conveyance piping could be utilized to serve a dual purpose. The perforated pipe could drain groundwater to the proposed pump stations and serve as stormwater conveyance piping during Design Condition 2. Potential locations for this use are as follows:

- Many of the Problem Area 8 improvement projects
- The last conveyance pipe upstream of Pump Station 3.
- Minor system conveyance between outfall B46 and Pump Station 1.
- Minor system conveyance between outfalls B64/B65 and Pump Station 4.

AE recommends that dual purpose conveyance piping be considered during preliminary design of these improvement projects. Significant cost savings could be realized; however, the pump stations would have to be sized to accommodate groundwater flows.

Excerpt from NWICDS Figure 9-2 - Pump Station #1 Detail





Alternative PS#1 Locations Under Consideration by Water Resources

Yellow Dot - NWICDS Proposed Location
Red Stars - Alternative locations under consideration

LEGEND

- STORM OUTFALL
- STORM SEWER
- PROPOSED STORM PIPE
- PROPOSED FORCEMAIN
- PROPOSED OUTFALL
- PROPOSED PUMP STATION
- STUDY AREA

NORTHWEST INNER CITY DRAINAGE STUDY - SUNNYSIDE REVIEW		
PROPOSED IMPROVEMENT PROJECT OVERVIEW	REV. NO.	A
	DRAWING NUMBER	FIGURE 7-0
	SHEET	

Water Services

Flood Resiliency Project: Sunnyside Storm Lift Station #1

July 2017

Preliminary Survey Work

As part of the Community Drainage Improvements (CDI) Program following the 2013 flood, The City conducted the North West Inner City Drainage Study (NWICDS) – Sunnyside Review. This study recommended a new lift station, referred to as Lift Station #1, in order to address the flooding issues on the east side of Sunnyside.

Storm lift stations are used throughout the city to lift water from low-lying areas to higher areas where it can flow by gravity through the drainage system or outlet via a forcemain.

The NWICDS proposes that the new Lift Station #1 be located on the green space south of the Calgary Curling Club. We are currently gathering information to help with location feasibility assessment and conceptual design development of the project. The lift station will serve to pump overland drainage water collected within the large low spot at Memorial Drive and 3 Street N.W., particularly when the outfall gates are closed.

Surveying

The City of Calgary field crew will be conducting a survey starting between the week of July 10th until July, 21st, 2017. They will be in the area spanning 5 Street N.W (See map below).

Community benefits

Upgrades and new infrastructure are needed so the current system can better handle serious rainfall events that cause local flooding. The proposed Sunnyside Lift Station #1 will operate at a capacity of 1,000 L/s and would be able to handle a one-in-fifty year rainfall event. This project will better protect the community from flooding caused by significant rainfall events.

Sunnyside storm lift station #1 location.

Project timeline

We are currently in conceptual design phase with detailed design to be completed in May 2018. Construction is anticipated to begin in Q3 of 2018.

Project information

Please contact 311 if you have any questions or concerns about this project.

Map of Survey Extent

Survey extent for the Sunnyside Lift Station #1 Project represented by the yellow area

What is the Community Drainage Improvement (CDI) program?

The CDI program, a continuation of The City's community level drainage work, was launched in 2010 to mitigate flooding in areas throughout Calgary. Drainage studies were undertaken to come up with solutions for areas that were frequently hit by flooding caused by extreme rainfall events in older areas of the city. Solutions can range from constructing new or upgrading storm lift stations, adding storm drainage pipes, increasing the size of drainage pipes and adding storm ponds to help mitigate flooding.


1045.0
1045.5
1051
1047.5
1042.5
25m
80ft
Map Scale 1/ 648


50m
100ft
Map Scale 1/ 1295