CITY OF REGINA

City of Regina

High Level Feasibility Study for Entertainment Centre

Prepared by:

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Project Number:
60141597

Date:
January 20, 2010

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Ms. Kelly Wyatt, M.B.A., P.Eng., PTOE
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2476 Victoria Avenue
Regina, SK S4P 3C8

Dear Kelly:

Project No: 60141597

Regarding: City of Regina
High Level Feasibility Study for Entertainment Centre

Please find enclosed six (6) copies of the High Level Feasibility Study for Entertainment Centre as well as a CD consisting of a PDF file of the final report.

The report findings are based on conceptual level design criteria presented by the City of Regina and design consultants, Stadium Consultants International and Office for Urbanism.

We are confident that the recommendations contained in this report will provide the City with sufficient information relating to the municipal infrastructure systems to proceed with conceptual level decisions related to the proposed entertainment centre development on the subject lands.

Sincerely,
AECOM Canada Ltd.

Rob Mosiondz, P.Eng.
Project Manager
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RM:lj

Encl.

Distribution List

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	Rob Mosiondz	January 20, 2010	Final Submission

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1. Introduction

1.1 Background

In October 2009, AECOM Canada Ltd. was retained by the City of Regina to prepare a High Level Feasibility Study for an Entertainment Centre located on lands currently occupied by portions of the CPR Regina yards near downtown Regina. The size of the proposed entertainment facility was identified to accommodate a permanent seating arrangement of 33,000 to 50,000 seats. Space for the facility would be made available by relocating the rail yard and its functions to a proposed intermodal terminal site west of the City of Regina. The CPR mainline will remain adjacent to the site. The Entertainment Facility is intended to be used for a multitude of purposes including sporting events (football, lacrosse, baseball, soccer, tennis, etc.) and entertainment events (concerts, conventions, tradeshows, etc.). **Figure 1.1** illustrates the location of the study area within the City of Regina.

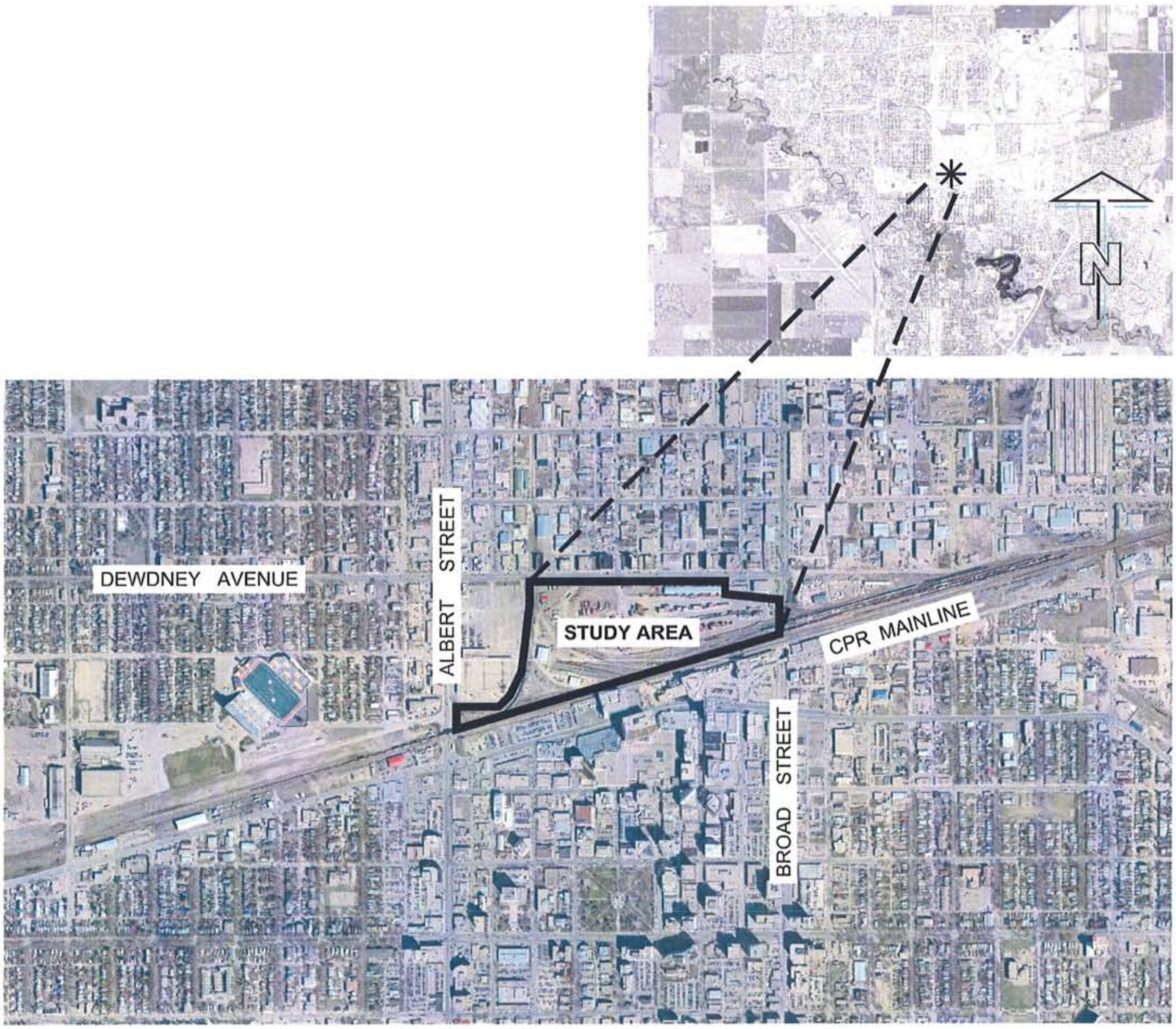

Figure 1.1 Site Plan of Study Area

1.2 Study Objectives

The primary objective of the study was to provide the City with a high level of confidence that the various municipal systems (i.e. transportation, water, wastewater and stormwater) could adequately support an entertainment facility and peripheral developments adjacent to the facility, within the parameters established at the start of the study. The study assessed the capacity of existing water, wastewater and stormwater systems and identified necessary improvements to meet day-to-day and peak event operations. The transportation assessment provides an assembly of options that should be considered to address short and long term demands related to parking, traffic management, transit, and pedestrian and bicycle access, as well as identification of proposed improvements that are deemed necessary in addressing transportation demands associated with the entertainment facility located within the study area.

Study recommendations for proposed system improvements and associated Level 'D' cost estimates are noted in each section and are summarized at the end of the study. Level 'D' estimates are preliminary in nature, indicating approximate magnitude of cost based on the City's broad requirements and limited input parameters, and are typically intended for approvals in principle and for discussion purposes.

1.3 Conceptual Layout of Study Area

Figure 1.2 illustrates the latest version of the conceptual layout of the study area forwarded to AECOM by the City, as developed by the design consultants, Stadium Consultants International (SCI) and Office for Urbanism (OFU). The layout was developed based on discussions held between the City, Crown Investment Corporation and design consultants involved in the entertainment facility configuration and downtown planning for the City. It is important to note that the illustrated conceptual layout is intended to serve as an example to demonstrate urban design principles and strategies that should be considered in subsequent development proposals for lands around the entertainment facility. While conceptual in nature, the size and configuration of the entertainment facility on the subject parcel were important considerations in the analysis and recommendations referenced in this report. As such, subsequent changes to input parameters relating to the entertainment facility or adjacent land uses may significantly change municipal servicing requirements relating to the study area.

The study area is surrounded by existing development, roads and a rail corridor. The Old Warehouse District area borders the study area to the north. The Regina Downtown area is located immediately south of the study area and the CPR mainline. Connectivity of the Warehouse and Downtown areas to the entertainment facility is an important element of the conceptual layout and development of an effective transportation management plan. The entertainment facility and amenities are proposed to be located on the westerly side of the study area.

The proposed configuration of the entertainment facility allows for permanent seating capacity of 33,000 patrons, expandable to 50,000 permanent seats. In addition to patron seating, it is estimated that the facility will require approximately 1,000 to 1,500 staff on-site during major events. Provisions were also made to accommodate an underground parking structure as part of the entertainment centre design.

Adjacent to the entertainment facility, an approximate 6.1 hectare parcel of land has been designated for complementary development such as office or retail space, residential units, community green space, shared parking areas or some combination of these uses. At the time of preparing the report, private sector proposals were being considered for the development of this land. For the purposes of this study, analysis of municipal servicing systems assumed the area would be developed based on typical commercial use parameters in the configuration proposed in the conceptual layout shown in **Figure 1.2.**

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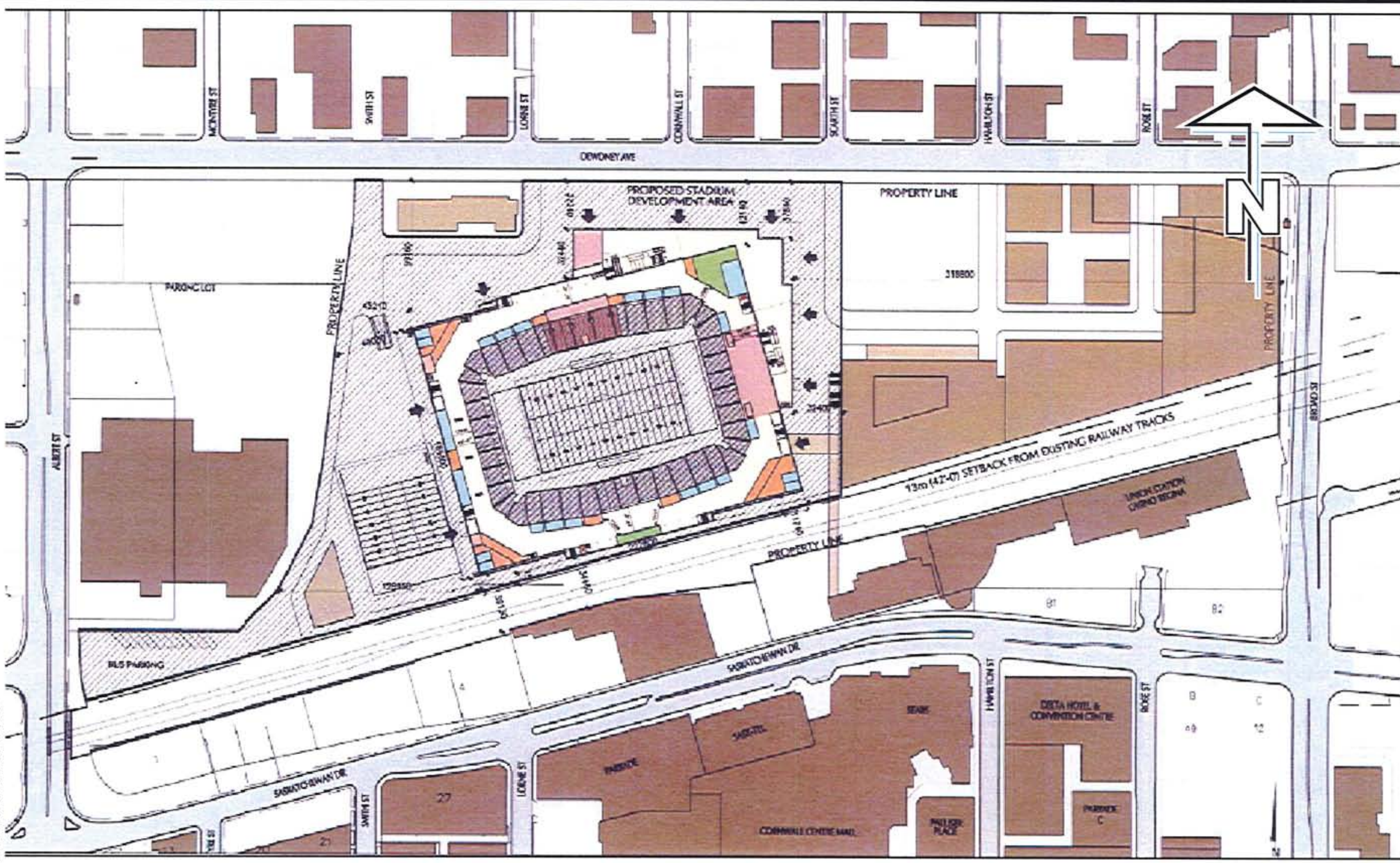

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Regina, City of
High Level Feasibility Study- Entertainment Centre
Municipal Serviceability Review

Conceptual Layout of Entertainment Centre and Surrounding Area

Figure - 1.2

2. Transportation

2.1 Parking Demand

Parking is an important consideration for any large event based entertainment centre. The proposed location has a distinct advantage for assessing parking needs in that it is in proximity to the existing Mosaic Stadium. This is a somewhat rare circumstance where we can use a surrogate location to provide insight as to how a new entertainment facility would operate. This is possible because of the proximity of the two locations and relatively similar operating conditions.

Figure 2.1 illustrates the existing Mosaic Stadium and the proposed site for the new multi-functional entertainment centre in the central rail yards. The two sites are roughly 1,000 metres apart. Because the proposed site would host some of the same events that are currently held at Mosaic Stadium, in particular CFL football games, information drawn from Mosaic Stadium can be used to shape the direction for examining parking and traffic operations at the proposed site.

Figure 2.1 Site Context

The existing Mosaic Stadium and adjacent surface parking area are pictured in **Figure 2.2**. Existing traffic and parking data was collected at Mosaic Stadium on Saturday, October 24, 2009 during a regular season CFL football game between the Saskatchewan Roughriders and the BC Lions.

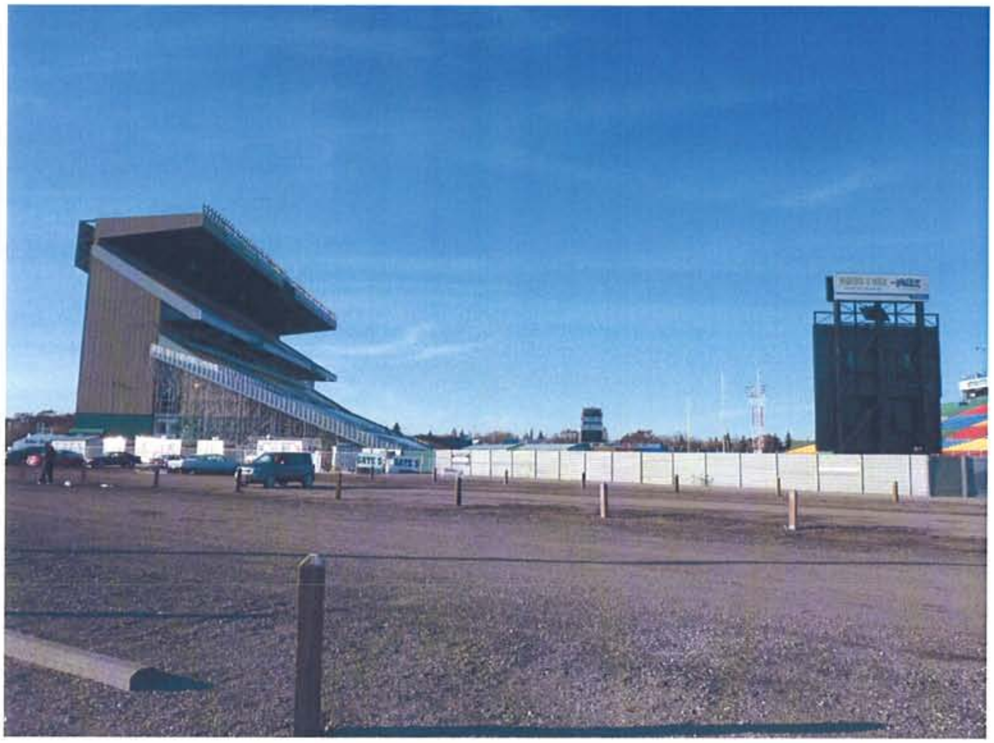


Figure 2.2 Existing Mosaic Stadium

Findings from the game day survey at Mosaic Stadium included:

- There was a sell-out crowd of over 31,000 fans attending the game.
- There was an average occupancy of 2.66 passengers per vehicle based on a sample of 2,963 vehicles. This represents a sampling of over 25% of the cars generated by the event.
- The occupancy rate was relatively similar for each area reviewed regardless of proximity to the stadium or whether the parking was on-street or off-street.
- There are approximately 2,000 off-street stalls immediately surrounding the existing Mosaic Stadium (1,600 plus an additional 400 north of the Fieldhouse) available to staff and fans. Additional free parking is available on the adjacent Evraz Place site. This amount of on-site surface parking will not be readily available at the proposed entertainment centre.
- Transit parking is available on a surface lot immediately west of Mosaic Stadium. Currently, Football Express (i.e. Regina City Transit buses transferring fans from surrounding malls), private coaches and school buses use the area.
- The game day count revealed that 46 buses carrying just over 1,700 patrons used the bus parking area. This accounts for the majority of people arriving to the game by transit. In addition, another 300 patrons were assumed to use regular Regina Transit services or other private buses that parked away from the main bus lot.
- There is approximately 1,000 staff on-site during a game. This includes media, City mechanical / electrical staff, security, vendors, 50/50 ticket sellers, volunteers, etc.

- Parking closest to the stadium filled up last. Parking in the surrounding area was deemed more attractive as it allowed fans to leave quickest after the event was over. However, note that some of the parking nearest to the stadium is pre-sold.

Table 2.1 presents the estimated parking demand for a CFL football game for the existing stadium (i.e. Mosaic Stadium) and for a proposed entertainment centre with 33,000 seats or 50,000 seats.

Table 2.1 Forecast Parking Demand

	Existing Stadium	33,000 Seat Entertainment Centre	50,000 Seat Entertainment Centre
Peak Event Attendance			
Spectators	31,000	33,000	50,000
Staff	1,000	1,000	1,500
Total Attendance	**32,000**	**34,000**	**51,500**
Arrivals by Transportation Mode			
Walk Only [1.]	1,550	1,650	2,500
Transit / Private Coach [2.]	2,000	4,950	12,500
Arrival by Car	28,450	27,400	36,500
Total Arrivals	**32,000**	**34,000**	**51,500**
Resulting Parking Demand [3.]	**10,700**	**10,300**	**13,700**

1 Walking assumed at 5% of patrons (e.g. out of town fans staying at local hotels).

2 1,700 bus passengers estimated to access the existing site on game day plus another. 300 passengers assumed off-site. Existing transit use at 6%. Forecast assumes 15% transit for the 33,000 seat facility and 25% transit for the 50,000 seat facilities, respectively.

3 2.66 passengers per vehicle estimated from game day count.

The estimate assumes an increase in transit ridership from over 6% currently (2,000 transit riders for 31,000 fans) to 15% for the proposed 33,000 seat facility, and 25% for the proposed 50,000 seat facility. Greater transit use can be expected for the proposed site. Around 2,000 surface parking stalls currently available immediately surrounding the Mosaic Stadium site will not be available at the proposed site. As such, the use of transit is expected to be higher. Note that the recent AC/DC concert at Mosaic Stadium during the summer of 2009 had upwards of 35% transit ridership. However, there was significant advertising informing the public that parking would not be easily accessible and a fairly large restricted area was cordoned off around the stadium.

The parking estimate also assumes 5% of patrons will walk to the proposed entertainment centre. This is consistent with other studies for entertainment centres and does not include trips that begin by car or transit.

The resulting parking demand is anticipated to be 10,300 vehicles for a 33,000 seat facility and 13,700 vehicles for a 50,000 seat facility.

Table 2.2 presents the existing parking demand by parking area for the game day on Saturday, October 24, 2009. The parking demand was split 62% north of the CP Rail tracks (i.e. where the stadium is located) and 38% south of the CP Rail tracks in areas such as Downtown or the Cathedral area. Cathedral West signifies the area west of Elphinstone Street.

Table 2.2 Existing Parking Demand for Mosaic Stadium

	Total Event Generated Parking Demand			
Area	**On-Street**	**Off-Street**	**Net**	**Percentage**
On-Site Parking	100	2,480	2,580	24%
Warehouse	450	1,100	1,550	14%
Evraz Place	-	1,800	1,800	17%
North of 7th Avenue	150	100	250	2%
Other (e.g. Dewdney Avenue)	500	-	500	5%
North Total	**1,200**	**5,480**	**6,680**	**62%**
Downtown	420	590	1,010	10%
Cathedral	1,860	250	2,110	20%
Cathedral West	900	-	900	8%
South Total	**3,180**	**840**	**4,020**	**38%**
Grand Total	**4,380**	**6,320**	**10,700**	**100%**

Table 2.3 provides the anticipated parking demand by parking area for a 33,000 seat entertainment centre. Note that parking for events is anticipated to occur 49% to the north of the CP mainline and 51% south of the CP mainline based on the total demand for parking, availability of parking spaces in each area and walking distance. This is similar to the residential split in Regina where approximately 50% of residents live north of the CP mainline and 50% live south of the CP mainline.

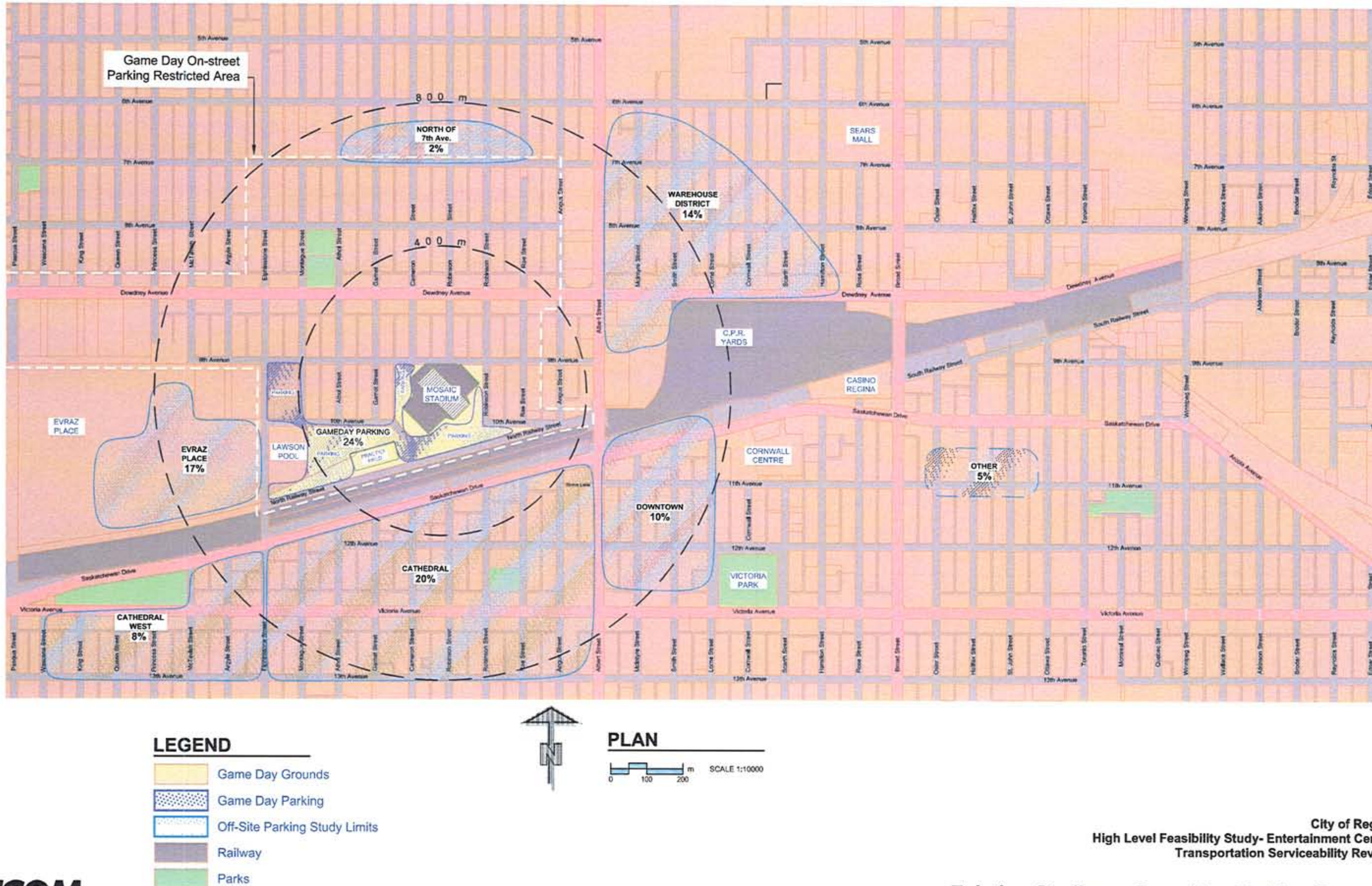
Table 2.3 Parking Demand for Proposed 33,000 Seat Entertainment Centre

	Total Event Generated Parking Demand			
Area	**On-Street**	**Off-Street**	**Net**	**Percentage**
Warehouse [1.]	990	1,750	2,740	27%
Warehouse East	680	710	1,390	13%
Mosaic Stadium Area	90	480	570	6%
Evraz Place	-	250	250	2%
Other (e.g. Dewdney Avenue)	150	-	150	1%
North Total	**1,910**	**3,190**	**5,100**	**49%**
Heritage (formerly Core)	310	220	530	5%
Downtown	1,130	2,650	3,780	37%
Cathedral	780	110	890	9%
South Total	**2,220**	**2,980**	**5,200**	**51%**
Grand Total	**4,130**	**6,170**	**10,300**	**100%**

[1.] Includes on-site parking.

Figure 2.3 illustrates the dispersion of this existing parking demand for Mosaic Stadium on game day. It indicates that people will walk upwards of 1,100 metres from their parking spot to Mosaic Stadium. It was also evident that people will park where they feel it is safe and in locations that allow for a quick exit following a game, even if this means parking a further distance away (e.g. the old Superstore site was preferred and filled first over parking immediately at Mosaic Stadium even with a similar charge for parking). Note there is an existing on-street parking ban in the North Central residential neighbourhood in effect during games. The restricted area extends from immediately north of Mosaic Stadium to 7th Avenue.

Figure 2.4 illustrates the dispersion of parking demand for a 33,000 seat entertainment centre. The acceptable walking distance was kept similar to the existing scenario and direct connections into downtown were also assumed.



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City of Regina
High Level Feasibility Study- Entertainment Centre
Transportation Serviceability Review

Existing Stadium - Game Day Parking Demand

Figure - 2.3

City of Regina
High Level Feasibility Study- Entertainment Centre
Transportation Serviceability Review

Proposed 33,000 seat Entertainment Centre - Peak Event Parking Demand

Figure - 2.4

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Table 2.4 illustrates the anticipated parking demand by parking area for a 50,000 seat entertainment centre. It is expected there will be a slight increase in the parking in the Warehouse area and the Warehouse East area (between Broad Street and Winnipeg Street) with a greater use of off-street parking lots. However, the largest increase in parking is expected to be in the Downtown area. It is anticipated the demand will spill south of 13th Avenue with a 50,000 seat facility, where the walking distance will be 1,100 metres or more to the proposed facility. A parking dispersion map was not prepared for this scenario due to the similarity to the 33,000 seat facility dispersion map.

Table 2.4 Parking Demand for Proposed 50,000 Seat Entertainment Centre

	Total Event Generated Parking Demand			
Area	**On-Street**	**Off-Street**	**Net**	**Percentage**
Warehouse [1.]	1,120	2,100	3,220	24%
Warehouse East	760	850	1,610	12%
Mosaic Stadium Area	100	500	600	4%
Evraz Place	-	450	450	3%
Other (e.g. Dewdney Avenue)	150	-	150	1%
North Total	**2,130**	**3,900**	**6,030**	**44%**
Heritage (formerly Core)	350	220	570	4%
Downtown	1,280	3,710	4,990	36%
South of 13th Avenue	150	480	630	5%
Cathedral	1,300	180	1,480	11%
South Total	**3,080**	**4,590**	**7,670**	**56%**
Grand Total	**5,210**	**8,490**	**13,700**	**100%**

1. Includes on-site parking.

2.1.1 Parking Findings and Recommendations

North Central Neighbourhood

It is anticipated that residents and small businesses in the North Central neighbourhood will continue to sell off-street parking during events once the proposed facility is in operation due to the proximity of the entertainment centre to the North Central neighbourhood.

Recommendations

- On-street parking restrictions in the North Central residential neighbourhood should remain during event days. However, the area west of Elphinstone Street is beyond the 1,100 metre typical walking distance from the proposed entertainment centre and can be eliminated from the parking restriction. This area is in proximity to the Pasqua Hospital therefore, lifting the restriction would make the area along Dewdney Avenue available for hospital visitors.

Old Warehouse District

The availability of parking within the Old Warehouse District will be important to the success of the facility operation. Parking demand in the Old Warehouse District will extend as far east as Winnipeg Street, west to Albert Street and north to 4th Avenue. There are a considerable number of industrial businesses in the area that operate Monday to Friday only. Patrons attending weekend events would have access to on-street parking without impacting these businesses. Further, some of these businesses are currently making their off-street parking available to patrons during current Mosaic Stadium events.

Not all of the businesses will welcome on-street parking being taken up by facility users, while others will welcome the added street activity in the area. As a whole, the business community has been accepting of the additional street and sidewalk traffic at the existing Mosaic Stadium site and will likely have a similar response at the proposed entertainment centre location. The response may not be as positive for other area users that rely on on-street parking such as residents / owners of converted residential properties, electronics stores, light industry, etc.

It is expected on event day that 40% of the peak event parking demand (4,100 cars out of a total parking demand of 10,300 for a 33,000 seat facility) would park in the Old Warehouse area. This includes private parking areas that are given up for event day use. Patrons will walk out of the proposed facility, cross Dewdney Avenue and disburse to where they have parked. There are numerous traffic access points out of this area that will facilitate egress.

Recommendations

- With respect to peak event parking by patrons, parking in the Old Warehouse District presents an opportunity to have people and traffic dispersed following an event. The grid network in the Old Warehouse District also presents a variety of exit points for traffic following an event. On-street parking should be encouraged for this area. Off-street parking will be driven by private sector opportunities as well as supply and demand in the area.

- The City should consult with businesses and residential owners in the area to determine an appropriate parking plan during events and establish what mitigation can be provided for those impacted. An example would be localized parking zones with a 30 minute or 1 hour restriction. Residents could be issued parking permits allowing parking in excess of the zone restriction.

- Consideration should be given to developing off-street parking areas in the Old Warehouse District for staging buses during events. A good bus staging option could be the Sears Call Centre site at 4th Avenue and Broad Street. Buses could stage in this parking area during peak events. Another option for bus staging is to develop an area adjacent to the City yards on 4th Avenue. If options are not attainable in the Old Warehouse District, then a logical alternative would be to stage buses at Evraz Place. This is a City-run facility where bus staging already occurs.

- Consideration also needs to be given to handicapped parking and taxi loading areas for the entertainment centre. These issues have not been addressed at this level of review but will need to be addressed as part of a comprehensive parking plan.

Downtown

It is desirable to have patrons parking downtown during peak events. This will encourage activity in downtown pre and post-game, plus there is a substantial parking supply available for event patrons. To address this, high quality pedestrian connections across the CP mainline into downtown are recommended.

With proper pedestrian connections, the downtown is anticipated to make up over 35% of the parking demand (3,800 cars out of a total parking demand of 10,300 for a 33,000 seat facility). Available on-street parking, surface parking lots (e.g. Impark lots) and structure parking opportunities can easily accommodate the demand. Some event patrons will use their existing workday parking stalls if their office is located downtown.

There is one issue with the current traffic bylaw (Bylaw #9900) related to the downtown parking time limits that needs to be addressed. The bylaw currently allows for a maximum of two hours at downtown parking meters, even on Saturdays when parking is free. Major events (e.g. CFL games) are longer than the two hour maximum allotment and event patrons would be ticketed for parking at meters in the downtown area under the current bylaw. Outside of major events, the two hour maximum time limit at the meters is very important to maintain, as parking turnover is beneficial to downtown businesses.

Recommendations

- An exception should be considered to the two hour parking limit at downtown meters for major weekend events, pending further study related to the existing on-street occupancy on Saturdays. Even though there are no parking charges incurred on the weekend, the bylaw does not currently allow for Saturday parking for more than two hours between 8 a.m. and 6 p.m. Note that any change to the two hour limit should also be considered in consultation with the downtown businesses. The two hour restriction is currently in place to facilitate metered parking availability for downtown business patrons.

- No change to parking time limits or fee payment at downtown meters is required on weekdays. Although there is a charge for parking at downtown meters during the weekday, the meters are not enforced after 6 p.m. Most weekday event times are typically in the evening so parking at downtown meters during this time will not present an issue.

- High quality, all-weather pedestrian connections between the downtown and the proposed entertainment centre are required at two or more locations. Beyond pedestrian connections over the rail lines, the existing underground historic train-platform access at Casino Regina should also be redeveloped. These connections will assist in making the downtown area one of the preferred places to park for events.

Areas Adjacent to Downtown

Areas adjacent to downtown, including the Cathedral residential neighbourhood (west of downtown) and the Heritage neighbourhood (formerly known as the Core Group area located immediately east of downtown), are anticipated to make up an additional 9% and 5% of the parking demand, respectively. It is expected that patrons parking in these areas will primarily cross the railway for access to the facility at Albert Street and Broad Street.

Recommendations

- No changes to the traffic bylaw are proposed related to parking in these areas.

On-Site Parking

There are two issues that exist with respect to on-site parking directly at the proposed facility, including:

1. There is a desire to have on-site parking for VIP's, players and staff. It has been discussed that up to 500 stalls would be required for this purpose. The site will not easily accommodate this much parking with the uses already being considered within the given footprint (e.g. entertainment facility, practice field, truck unloading area, entry plaza, etc.).

2. Some consideration should be given to parking for medium-sized events at the entertainment centre. Although the expectations will be low for parking near the entertainment centre during peak events, there may be a heightened expectation for smaller events such as high school football / university games or theatrical events, for safety and accessibility reasons.

Recommendations

Several options exist for addressing on-site parking needs at the proposed entertainment centre site or nearby to the facility. A combination of the following solutions may be considered, including:

- Provide a minimal supply of on-site parking only – this option would allow for a nominal supply of 20 - 40 surface parking stalls (or 10 bus stalls) on the site while still accommodating other site uses. Development of the lands south of the former Superstore site is being considered for this purpose. It would be good to develop some stalls close to the building to serve for ticket purchases, VIP parking or retail operation patrons but this may not be possible. Additional parking could be gained through an on-site parking structure (i.e. below grade or above ground). An option with 215 stalls below grade is being considered.

- Provide on-street parking on roadways within the proposed development immediately east of the entertainment centre – an estimated 50 on-street parking stalls could be developed along on-site roadways on the adjacent site however, this would be dependent on the site layout and integration between the two developments. This option would allow site visitors a place to park near the main entrance but would not hold any status for addressing staff needs.

- Formalize parking on the south side of Dewdney Avenue – provide metered parking on the south side of Dewdney Avenue between Smith Street and Hamilton Street. The four block faces would provide approximately 44 stalls in front of the facility.

- Develop a parking structure – this option, if established in an overall plan with the adjacent private development, could provide parking for staff as well as patrons of the adjacent development. The cost of a 500 stall parkade is in the order of $30M+.

- Develop nearby surface parking – adequate parking for staff and visitors could be attained by purchasing or leasing property within the Old Warehouse District. The property should be within a short walking distance from the entertainment centre. The potential for structured parking over time should be considered when selecting the site. Other long, thin parcels (i.e. sliver parcels) along the CP mainline may also be developed for surface parking but are not likely to be developed into parking structures in the long term because of their shape, size and location.

- Implement shared parking with the development immediately east of the facility – with respect to parking near the facility for smaller events, one option to accomplish this would be to give preference to proposals that promote shared-use parking standards on the adjacent development site to the east of the facility. Developments with shared parking use the same parking areas for different but complementary uses. Examples include office, commercial and industrial uses where parking lots that are used during the day could then be made available for event parking in the evening.

One or more of the above options may be needed to accommodate nearby parking for staff and visitors.

2.2 Traffic Management

The proposed entertainment centre is located in the centre of the city. Large events will draw vehicles into the areas surrounding the facility, causing congestion at major intersections. Traffic management strategies may be used to improve peak event traffic operations. Most of these options are related to peak events only and do not affect the day-to-day traffic operations in the area. The analysis examines two scenarios:

- Day-to-day operations - weekdays when there are no planned events other than football practices, ticket sales and retail operations, and adjacent development to the east and west of the facility has been completed.
- Peak event operations – a major event (e.g. CFL football game) filling a 33,000 seat facility.

2.2.1 Day-to-Day Operations

The operational analysis found that the Albert Street and Dewdney Avenue intersection is already reaching capacity under existing conditions. The proposed facility and adjacent developments to the east and west along Dewdney Avenue will put further pressure on movements that are already beginning to fail. Further, left turn movements to and from Dewdney Avenue at this intersection will experience significant delay during the weekday afternoon peak period. These left turn movements will impact the through movements along Albert Street and will add to the existing delay for northbound vehicles leaving the downtown area.

The Broad Street and Dewdney Avenue intersection currently operates well for north / south traffic. Left turn movements to and from Dewdney Avenue are already reaching capacity, even with low volumes. These movements, along with eastbound right turns, will experience increased delays with the addition of the proposed development traffic during the weekday afternoon peak hour.

It is anticipated that adding travel lanes at the intersections of Dewdney Avenue at Albert Street and at Broad Street will not likely be possible due to property constraints on the corners of each intersection. Traffic signal modifications at the Dewdney Avenue and Albert Street intersection were previously identified in a traffic impact study for the former Superstore site redevelopment. These improvements are forthcoming with the redevelopment.

The traffic signal timing at the analysis intersections may require adjustments to account for the increase in east / west traffic along Dewdney Avenue. It should be noted that any additional time given to east / west movements at these intersections will come at the expense of the north / south traffic flow. Changes to the signal timing plans will have to take into consideration the development site access points. A complete analysis of the individual site access points is not possible at this time without a more definitive site plan.

Increased traffic from the proposed developments on Dewdney Avenue will put increased pressure on the Albert Street and Broad Street intersections. There is limited opportunity for intersection improvements and these intersections will operate at a decreased level of service.

Increased delay times during peak afternoon traffic may cause commuters to change their travel patterns. Some of the northbound traffic on Albert Street may shift to Broad Street to make use of additional capacity. Other north / south roadways, such as Lewvan Drive, Elphinstone Street and Winnipeg Street, may see increased traffic volumes as well. Side-street traffic in the surrounding area will likely increase as drivers attempt to avoid the delays at major intersections.

A traffic signal should be considered at Albert Street and 8th Avenue. There is an opportunity to provide better access to and from the Warehouse District by signalizing this location. This route would provide a strong east / west connection from Albert Street to Winnipeg Street. The T-intersection at Albert Street prevents through traffic from accessing the East Central residential neighbourhood via this route. As such, signalization is a good option at this location.

Recommendations

- A full Site Impact Traffic Study should be completed for the proposed development to the east of the proposed entertainment centre in order to specifically address roadway capacity issues and satisfy the City's requirements. Any future impact assessments should include the option of installing a traffic signal at the intersection of Albert Street and 8th Avenue.

2.2.2 Peak Event Operations

The lack of on-site parking for large events at the proposed entertainment centre will push parking away from the facility and into the surrounding areas. It is anticipated this will allow many of the vehicles leaving an event to avoid the congestion at the intersections immediately adjacent to the proposed facility. It may also have the effect of spreading out the post-event peak for vehicles leaving the area, as people will need to walk varying distances to reach their parking spots.

Even with these considerations, analysis indicates that the major intersections adjacent to the facility site will experience significant delay in a post-event scenario. Vehicles parked in the surrounding areas will be able to access Albert Street and Broad Street through various minor streets however, many of these vehicles will end up travelling north / south on Albert Street and Broad Street through the Saskatchewan Drive, Dewdney Avenue and 4th Avenue intersections.

Recommendations

Major changes to network operations are not justified for peak operational issues. The following peak event traffic management options are often employed for urban entertainment centre facilities and should instead be considered:

- Route-Location Signage: Some municipalities have developed defined routes for entertainment centre access / egress. Signage is employed to communicate these routes to users, including the publishing of routes and the use of roadside signage. Wayfinding techniques may also be employed for pedestrians for such things as access to buses.
- Event Signage: Temporary signs can be employed to alert drivers that an event is in progress and they should avoid the area if possible. Signs could be used to mark the boundaries of the affected area - in this case, Albert Street and Broad Street between Saskatchewan Drive and 4th Avenue. This may conflict with the desires of business owners in the area but would only be active for peak event use.

- Traffic Control Officers: Large events often make use of traffic control officers at key intersections to override the existing traffic control devices. This manual control is especially desirable in locations where large volumes of pedestrians conflict with vehicle traffic. Traffic control officers may be required where Dewdney Avenue intersects with Albert Street and Broad Street. Consideration should also be given to using traffic control officers where Saskatchewan Drive intersects with Broad Street and Albert Street.
- Turn Prohibitions: Specific turning movements at key intersections are sometimes prohibited to reduce delays caused by conflicts. The parking areas for the proposed facility site will have a large number of access points and it will be too difficult to control them all. It may be possible to restrict specific movements in the future if they are observed to cause major delays during peak events.
- Signal Timing Adjustments: It may be possible to adjust the signal timing at the major study intersections along Albert Street and Broad Street to provide priority to north / south traffic during peak events. This will help to clear the north / south traffic from the area and will discourage left turns at the busiest intersections. Rather than changing signal timing, this function could also be performed by traffic control officers.
- Alternate Lane Operations: It is possible to restrict parking on main roads (e.g. Albert Street and Broad Street) during major events to add capacity to major access / egress routes. It may also be desirable to keep those lanes open for bus access.
- Satellite Parking / Transit: Most peak event traffic control plans involve the encouragement of transit and satellite parking (parking far from the facility, walking / using shuttles to access the entertainment centre). Satellite parking will occur naturally if there is a limited amount of on-site parking. Transit options are covered in a following section of this report.
- Consideration should be given to implementing these peak event traffic management strategies. Some large cities also employ traffic monitoring programs that allow the traffic control authorities to react to issues during an event. Regardless of the measures taken, a peak event will inconvenience drivers in the vicinity of the proposed entertainment centre. The above analysis was performed for a 33,000 seat facility and it is anticipated that a larger facility will amplify the negative traffic impacts. Drivers may accept the delays associated with peak events, provided that they do not occur on a regular basis.
- It is also recommended that a comprehensive Traffic Management Plan be established prior to the entertainment centre becoming operational.

2.2.3 Dewdney Avenue Operations

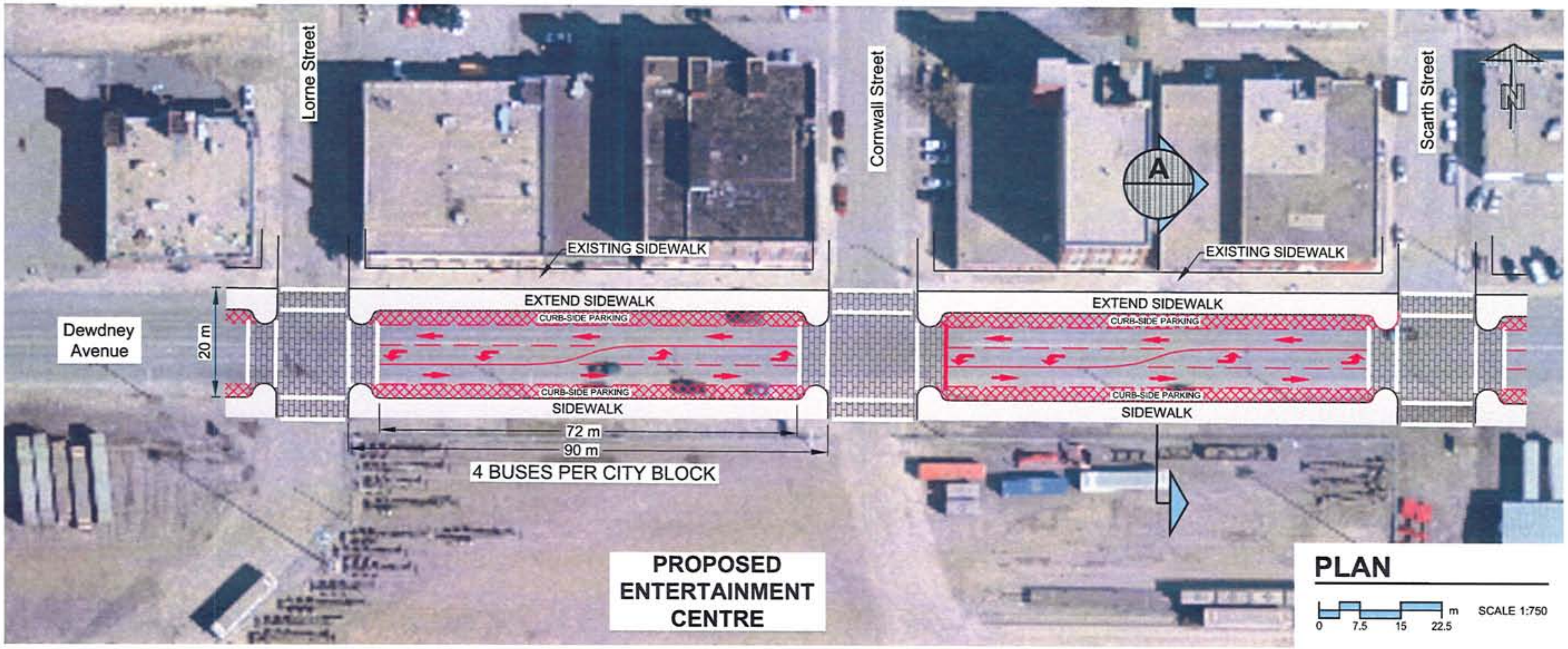
Through the site development, some consideration is needed for the function of Dewdney Avenue. **Figure 2.5** presents existing Dewdney Avenue looking east. The current 6-lane cross section (4 travel lanes and 2 parking lanes) is subject to higher speeds and has left turns occurring from the inside through lane along its length.

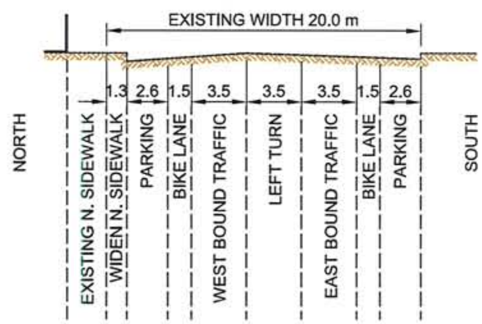
Figure 2.5 Existing Dewdney Avenue Looking East

Figure 2.6 illustrates a functional concept for improving the design and function of Dewdney Avenue in front of the proposed entertainment centre. It is proposed to have a 5-lane arrangement including 3 travel lanes (i.e. 1 through lane in either direction and a back-to-back left turn lane in the centre of the road) plus parking lanes. The main purpose of the redesign would be to allow for safer pedestrian crossings, provision of a wider north sidewalk for businesses and to slow traffic speeds through the area. The improvements could include sidewalk widening, bulb-outs, raised intersections, cycling lanes and textured intersections / crosswalks.

These improvements involve changes to the cross section of the roadway for the four block section immediately north of the proposed entertainment centre. It is anticipated that the reduced cross section of Dewdney Avenue will function acceptably under peak afternoon traffic conditions provided that the existing cross section is maintained as Dewdney Avenue approaches Albert Street and Broad Street.

The estimated cost for retrofitting Dewdney Avenue with wider sidewalks, narrower carriageway for traffic and traffic calming measures is estimated at $1M per block. Total cost for the four block length is estimated at $4M.





ALTERNATE CROSS SECTION WITH BIKE LANES

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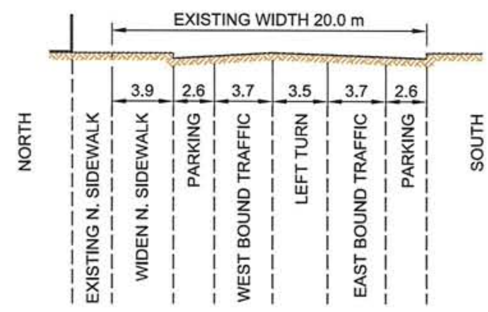

CROSS SECTION 'A'

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City of Regina
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Dewdney Avenue Modifications
Figure - 2.6

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Based on projected vehicle volumes, the cross section will operate effectively during both day-to-day operations and peak event operations. The affected section would extend for four block faces from Smith Street to Hamilton Street in front of the proposed entertainment centre. The existing 6-lane cross section of Dewdney Avenue should be maintained for the sections closer to Albert Street and Broad Street for capacity reasons.

Recommendations

- A detailed functional design should be prepared for the redesign of Dewdney Avenue adjacent to the proposed entertainment centre. The design should incorporate architectural and landscape architecture elements and be used to better the pedestrian environment along this street.
- It is possible, if desired, to close Dewdney Avenue between Smith Street and Hamilton Street during peak events. This roadway is not needed from a capacity perspective and it would serve to provide a pedestrian-only zone for crossing to and from parking spots in the Old Warehouse District. Such a closure during major events would significantly increase pedestrian activity and an event atmosphere around the front of the facility. However, there may be an impact on private businesses in the area by the removal of on-street parking in these areas.

2.3 Transit Operations

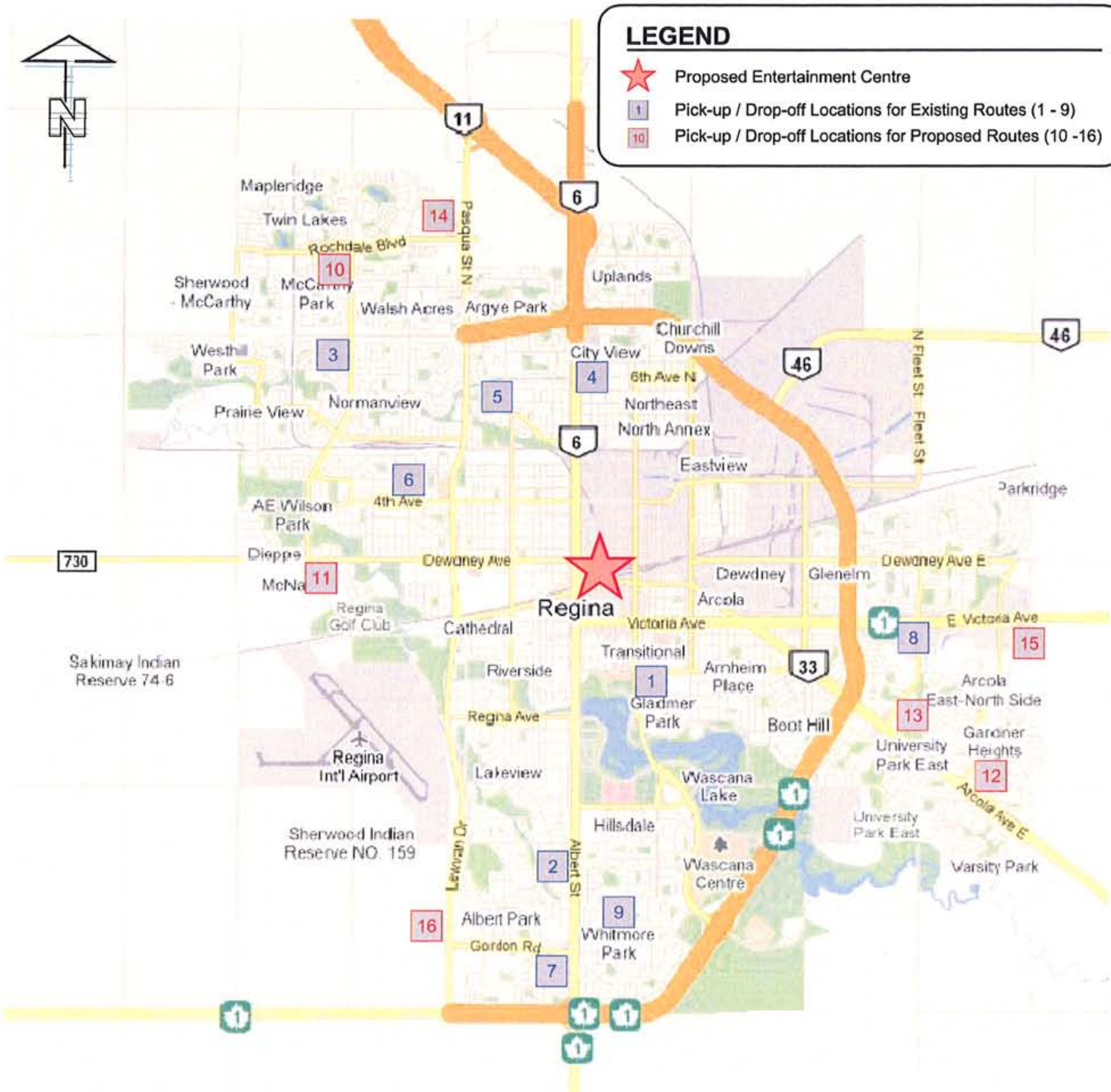
Increasing transit use to the proposed entertainment centre will generate the following key benefits:

- Serve to raise the profile of Regina Transit and likely generate new customers for the City's transit system.
- Generate more economic activity in the Downtown and Warehouse District.
- Reduce the need for expensive parking spots near the facility.
- Leverage the creation of more transit priority measures.

The existing bus parking area is pictured in **Figure 2.7.** City buses, private coaches and school buses drop passengers off right next to Mosaic Stadium and remain there until after the game.

Figure 2.7 Bus Parking Adjacent to Mosaic Stadium

For Saskatchewan Roughrider games, Regina Transit currently provides service from nine points around the City.



LOCATIONS

1. Broadway Shopping Centre
2. Golden Mile Shopping Centre
3. Normanview Crossing
4. Northgate Shopping Centre
5. Regent Park Shopping Centre
6. Rosemont Shopping Centre
7. Southland Mall (Highway No.1 W. Catchment)
8. Victoria Square Mall (Highway No.1 E. Catchment)
9. Whitmore Shopping Centre

PROPOSED:

10. Sherwood Village Mall
11. RCMP (730 Catchment)
12. Prince of Wales (33 Catchment)
13. University Park
14. Superstore North
15. Superstore East
16. Walmart (Harbour Landing)

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Football Express Pick-up and Drop-off Locations

Figure - 2.8

Figure 2.8 illustrates the pick-up points for the service known as Football Express. Football Express buses leave from and return to nine locations: Broadway Shopping Centre, Golden Mile Shopping Centre, Normanview Crossing, Northgate Shopping Centre, Regent Park Shopping Centre, Rosemount Shopping Centre, Southland Mall, Victoria Square Mall and Whitmore Shopping Centre. This figure also illustrates some potential pick-up points around the city that could be used to expand this service for use with the proposed entertainment centre.

These trips are served with the City buses. Private buses provide for groups coming from further away (e.g. Saskatoon) for the game, from local bars / restaurants and from surrounding First Nations communities. These services are well used and multiple buses leave from some of the points. These buses are scheduled to leave 45 minutes before the start time of an event and return from the facility 15 minutes after the finish of an event. They generally clear out all patrons in about 30 minutes.

Table 2.5 indicates the estimate of passengers arriving at the game by bus at Mosaic Stadium. Given the number of buses counted and the capacity of these buses, it is estimated that 1,706 people arrived (and left) by transit to the Riders game using the given area. Another 300 patrons were estimated to have taken regular transit services or arrived by bus parking in another area. The capacity of the stadium is approximately 31,000, so that is about a 6% transit mode share.

Table 2.5 Existing Mosaic Stadium On-Site Bus Parking

Bus Type	Number	Passengers	Total
City Bus	15	40	**600**
Short School Bus	7	10	**70**
Long School Bus	7	46	**322**
Coach / Charter	17	42	**714**
	46		**1,706**

Several options were reviewed for locating passenger pick-up and drop-off areas. **Figures 2.9 to 2.11** illustrate the various pick-up and drop-off locations reviewed including:

- **Option 1 - Albert Street / Broad Street** - An advantage to using Albert Street and Broad Street for pick-up and drop-off locations is that they would enable fast northbound and fast southbound access. The walks to each street would be about 400 metres from the proposed facility. These streets have exclusive bus lanes that could be enforced for events. It would allow Dewdney Avenue to be turned into a pedestrian-only zone and be quite safe for pedestrians. However, the capacity for buses along Albert Street and Broad Street may be limited, as would the width of the sidewalks for accommodating waiting passengers. Driveways would have to be closed off for the event and buses would have to cycle in to the pick-up spots to accommodate people after the events. The option may conflict with existing transit operations on Albert Street and Broad Street.

- **Option 2 - Hybrid on Albert Street, Broad Street and Saskatchewan Drive** - The advantages of using multiple pick-up and drop-off areas is that it allows for the fastest service, reduces the strain on sidewalks and other areas for loading, reduces the impact on the existing transit system, and maximizes the potential ridership. Wayfinding signage would be needed to direct people to the correct stop. **Figure 2.12** pictures Saskatchewan Drive viewing west from the existing pedestrian overpass.

Albert St. and Broad St. Option #1

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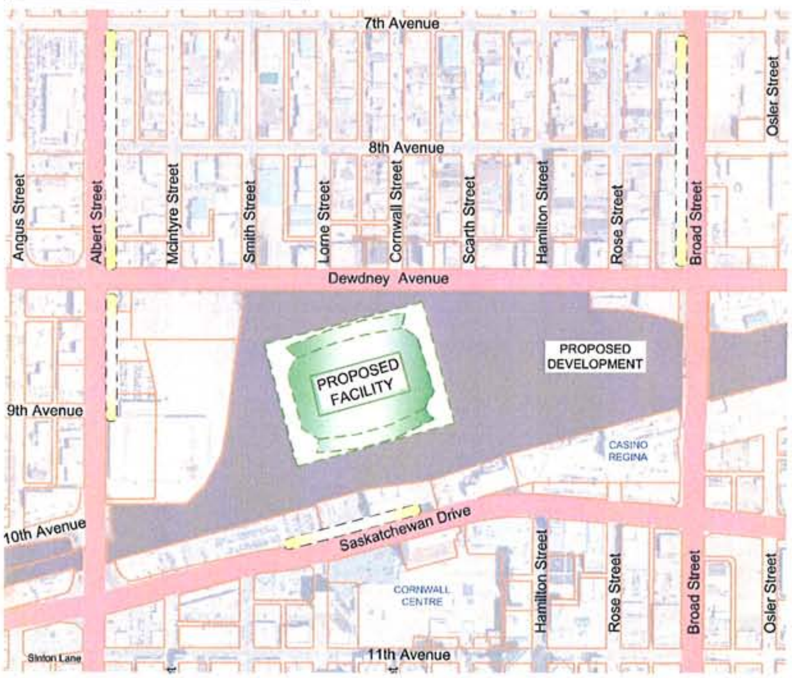
Hybrid Option #2



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LEGEND

- Proposed Entertainment Centre
- Major Roadway
- C.P.R. Yards
- Pick-up and Drop-off Locations

City of Regina
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Alternative Transit Pick-up and Drop-off Locations
Options 1 and 2
Figure - 2.9

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Dewdney Avenue Option #3

PLAN

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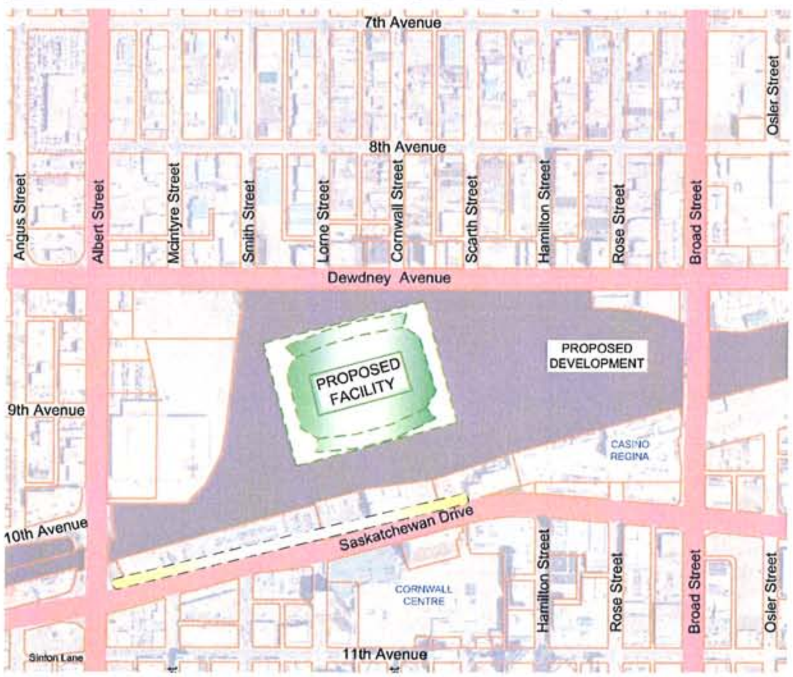
Saskatchewan Drive Option #4



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LEGEND

- Proposed Entertainment Centre
- Major Roadway
- C.P.R. Yards
- Pick-up and Drop-off Locations

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Alternative Transit Pick-up and Drop-off Locations

Options 3 and 4

Figure - 2.10

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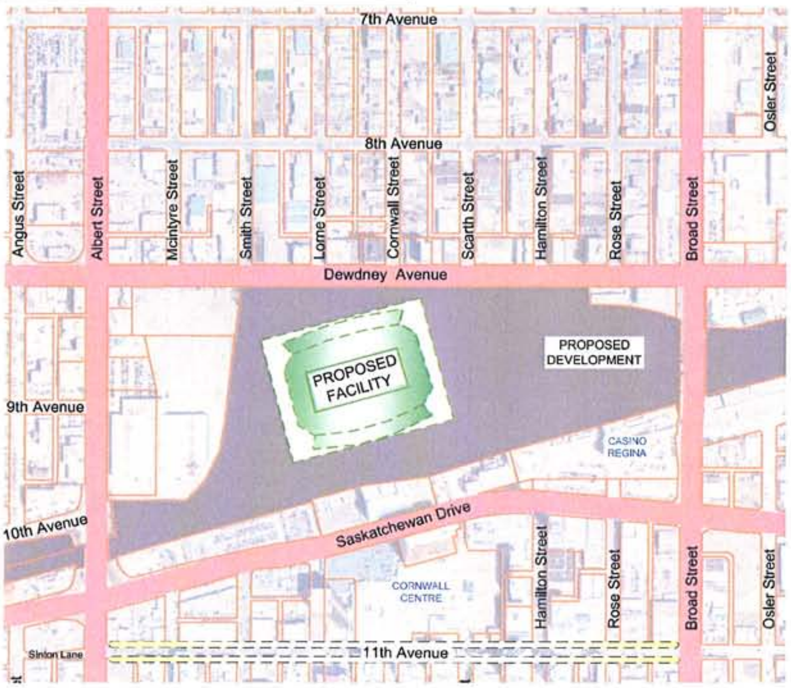
11th Avenue Option #5



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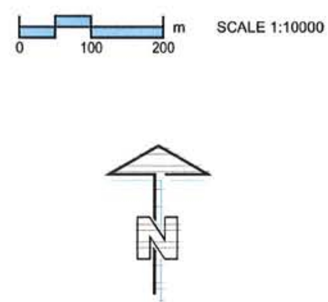

LEGEND

- Proposed Entertainment Centre
- Major Roadway
- C.P.R. Yards
- Pick-up and Drop-off Locations

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Alternative Transit Pick-up and Drop-off Locations

Option 5

Figure - 2.11

Figure 2.12 Saskatchewan Drive from Pedestrian Overpass

- **Option 3 - Dewdney Avenue** - If peak event transit operations occur on Dewdney Avenue between Albert Street and Broad Street, many buses could drop-off and pick-up passengers right outside the proposed facility which would be very convenient. **Figure 2.13** pictures Dewdney Avenue at the rail line crossing. Using Dewdney Avenue, between 30 and 40 buses would be able to load passengers at the curb right in front of the proposed facility at any given time. With the curb along Dewdney Avenue potentially being rebuilt, it can be constructed in such a way that it could easily accommodate a large number of passengers boarding buses. No transit services currently operate along Dewdney Avenue, so this option has little negative impact on existing transit services. The disadvantage to using Dewdney Avenue for pick-ups is that there is likely to be high levels of pedestrian traffic after events as people return to their cars parked in the Warehouse District or visit the bars and restaurants on Dewdney Avenue. The pedestrian traffic may interfere with the egress of buses from the site.

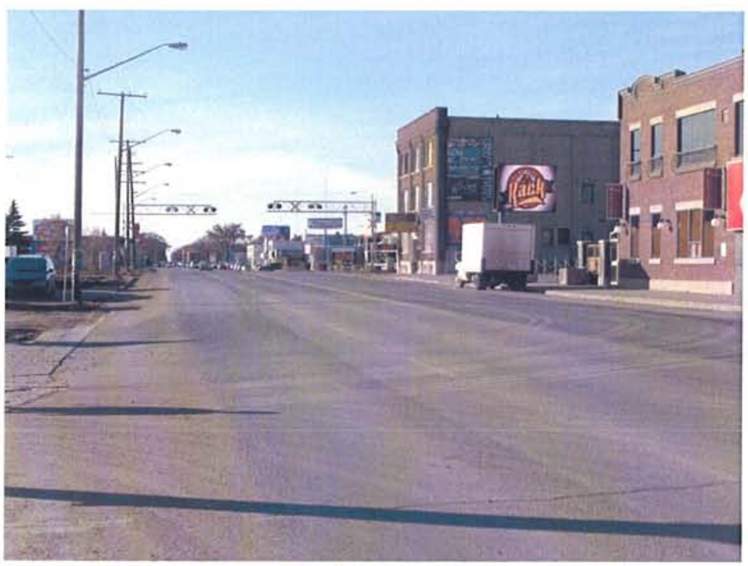


Figure 2.13 Dewdney Avenue Looking West

- **Option 4 - Saskatchewan Drive** - The advantage to using Saskatchewan Drive is that it currently does not have transit services, so using it for event transit will not interfere with regular transit services. It also would have access to the pedestrian overpasses leading directly into the proposed facility. Saskatchewan Drive is adequately wide, has few traffic signals and has meters on the north side of the roadway where passengers could be picked-up and dropped-off. This would require regular parking to be restricted during peak events.

- **Option 5 - 11th Avenue** - By the time the proposed facility will be complete, regular transit services will be operating in two directions on 11th Avenue. Some of the advantages of using 11th Avenue are that transit customers will be free of most of the event crowds at this location. Also, buses using this street will be able to make use of transit priority measures. The disadvantages of using 11th Avenue are that there may be limited chances of gaining the target transit mode share for entertainment centre events due to the limited capacity of 11th Avenue for additional buses, and that it might delay existing scheduled buses using 11th Avenue. Also, the sidewalks might not be wide enough to accommodate the crowds wanting to get on the buses. This location is farther from the site than the other options and it requires that people travelling north must walk for a significant distance in the opposite direction that they want to go.

An evaluation of the various pick-up and drop-off areas compared the various options to transit design principles such as distance, crowds, quick egress, impact on existing transit, capacity and safety. Those principles that can be met equally for all service design options are not listed (e.g. staging, marketing, use of private bus operator resources). This initial assessment suggests that the Hybrid (Option 2) and Dewdney Avenue (Option 3) have the greatest potential.

Recommendations

Capacity

- Assuming the transit services will increase from the existing transit mode share of 6% at existing events to 15% with the 33,000 seat facility, transit will carry 4,950 people to and from the facility. This will require between 75 and 100 buses, assuming some buses will cycle back to pick up more passengers. However, to provide capacity to move this many people by transit, there will have to be sufficient space at pick-up locations for waiting passengers, enough roadway capacity to allow the buses to access and egress the site in a suitable amount of time and perhaps most critically, enough vehicles to move this many people in a short amount of time. Assuming 25% transit usage for a 50,000 seat facility, a total of 12,500 people would use transit. It can be assumed that buses serving the facility would have to cycle back more times to pick up passengers.

- Increase the number of pick-up points around the city that could be used to expand transit service use to the proposed entertainment centre.

Passenger Pick-up / Drop-off Sizing

- As for the size and dimensions of the pick-up / drop-off area, a sidewalk / platform with a width of 4.5 metres is recommended. According to the Transit Capacity Manual, a person waiting for a bus needs about 1.2 sq.m. to feel comfortable. If the typical bus will carry 40 passengers, then that many people need 48 sq.m. of waiting space. A standard bus is about 12 metres long, so a space that is 12 metres long and 4 metres deep should be sufficient for the waiting passengers. Passengers do not like to stand too close to the curb, so the first 0.5 metres from the curb serves as a buffer.

- An alternative to creating deep sidewalks adjacent to the buses is to manage the crowds using some other method, perhaps by creating a long queue with the help of temporary barriers. The barriers would have to accommodate queues of at least several hundred metres for every 1,000 people expected to use that pick-up point.

Transit Priority

- Transit priority, in the form of exclusive lanes, the exclusion of regular traffic from certain roads during events, traffic signal priority and police assistance to get through key intersections ahead of other traffic, should be used in any transit plan for events. Exclusive bus lanes currently operate along Broad Street and Albert Street. Police already play a part in the access plan of events at Mosaic Stadium.

- As part of providing transit priority, some driveways may need to be closed during events to allow for less interference with bus operations and more space for passenger loading. If Dewdney Avenue or Saskatchewan Drive is not reserved for pedestrian activity, then either could be used for transit pick-up and drop-off, as long as it does not interfere with emergency vehicle access, staff access or tour / event access.

Efficient Use of Private Transit Resources

- Buses from First Bus Group and other private bus operators should be used when the need for buses exceeds what Regina Transit can provide with its own fleet.

Staging Location

- The staging location should allow sufficient space for buses to wait before they are called to pick up passengers after the event. If buses cannot layover at the proposed entertainment centre due to limited space, a few alternatives have been proposed. There are some large underutilized parking lots in the Warehouse District, such as the one at the abandoned Sears Call Centre that could be used for Regina Transit and other buses. One other alternative includes Evraz Place. Another is to have Regina Transit buses layover back at the Winnipeg Street facility. However, the buses should be ready at the pick-up stops for loading, minutes after the game is over.

Simplification of Fare Payment

- The best option to maximize ridership would be to provide event ticket holders with free access to transit, including the regularly scheduled services, before and after an event. This could possibly be done by including a "transit fee" in every event ticket which would be transferred to Regina Transit.

- The reaction of Regina Transit staff to the idea that if they received $1 for everyone attending an event was that there would be enough resources to provide good service for events. An advantage to the "transit fee" concept is that it will speed boarding.

- If fare payment will still happen on the bus, another opportunity is to allow people to buy a season's worth of transit service at a discount. These people could have a special pass or tokens. People who have a regular monthly transit pass could also be given free access to the special event transit services.

Access for Para-transit and / or Emergency Vehicles

- While regular transit riders can be dropped off several blocks from the proposed facility entrance, Para-transit riders will likely need something more akin to door-to-door service. Emergency vehicles will also need a means of coming right up to the proposed facility. They will need clear paths that will not get obstructed by other traffic of pedestrian surges. It also means their paths cannot be obstructed by buses lining up to pick up passengers.

Pick-Up / Drop-Off Locations

- The analysis suggests that the Dewdney Avenue and the Hybrid options have the greatest potential.

2.4 Pedestrian Access

Pedestrian trips need to be accommodated to mode transfer points, on and off-site parking areas, transit stops, express / charter bus loading areas and pick-up / drop-off areas.

Special events at a permanent venue are characterized by high peak pedestrian arrival and departure rates. Maximum pedestrian demand occurs after the end of an event and the high demand level meters pedestrian flow to event parking areas and transit / shuttle stations, thus metering vehicle departures from the venue area.

Existing sidewalks and crosswalks in the area will not adequately accommodate special event pedestrian traffic during ingress or egress. Without mitigation, pedestrians will tend to cross streets at undetermined points or spill out onto streets where they may be in conflict with traffic.

In particular, the CP rail line south of the proposed entertainment centre is a constraint for moving pedestrian traffic to and from the downtown area – currently there are only two crossing locations across the tracks (Broad Street and Albert Street as part of existing underpasses). The existing facilities have limited capacity for pedestrians. The rail line must be secured by fencing to prevent crossing at any locations other than the two existing underpasses or other new crossings.

Key design aspects to consider at the venue include:

- To reduce pedestrian / vehicle conflicts and to reduce frustration for drivers exiting parking lots after events, event patron parking should ideally be placed away from the immediate vicinity of the proposed entertainment centre. Further from the site, the density of pedestrians will decrease and delays for cars entering and exiting parking lots will be reduced.
- The proposed entertainment centre and on-site parking areas should be designed to avoid having a pedestrian access route and parking area access point intersect.
- Uninterrupted pedestrian walkways should be provided, connecting a pedestrian access route to parking areas, and station volunteers inside parking areas to prevent pedestrian / vehicular conflicts.
- Locate drop-off and pick-up transit shuttle points a sufficient distance away from the proposed entertainment centre while still affording patrons a convenient walking distance. As a result, station overcrowding during event egress does not impede pedestrians from accessing routes leading to other mode transfer points. This tactic also benefits transit users as traffic management team personnel can better manage queues by cordoning loading / unloading areas and closing street curb lanes to furnish additional queuing areas not available adjacent to the venue.
- Signage should be provided for pedestrians once they leave their vehicles (or transit). Pedestrian guide signs should be located at intersections close to key parking facilities and on key access routes to the proposed entertainment centre.
- The pedestrian access plan must accommodate disabled event patrons arriving via all travel modes serving a planned special event. This involves examining all routes that a disabled event patron may traverse and in turn, ensuring the patron has an unimpeded path from mode transfer point to venue seat. Accessible pedestrian routes must: (1) maintain a minimum path width, (2) include curb cuts and temporary ramps for negotiating grade separations and (3) conform to local disabilities act regulations. If a particular route (e.g. from express / charter bus station or transit station) does not meet accessibility requirements, then accessible shuttles must operate between affected mode transfer points and accessible pick-up / drop-off areas.

In addition to considering pedestrian needs arriving and leaving the facility, providing additional capacity to and from the proposed entertainment centre from adjacent areas must also be considered. It is expected that limited capacity will impede pedestrian access to and from the south (i.e. across the rail line to the Downtown and Cathedral areas). It could also be limited along the north and south sidewalks of Dewdney Avenue between Albert Street and Broad Street where all venue patrons will converge.

Obtaining additional pedestrian walkway capacity involves increasing walkway width. Tactics for achieving increased width can include: (1) temporarily removing movable sidewalk obstacles (i.e. benches, tables, etc.), (2) closing the adjacent street curb lane for pedestrian traffic and / or (3) adding additional capacity through new pedestrian connections across the rail line.

Table 2.6 identifies anticipated hourly pedestrian volumes for the hour prior to an event. A total of 34,000 pedestrians are anticipated to access the site (33,000 event spectators plus 1,000 volunteers / event staff, etc.).

Table 2.6 Pedestrian Volume Estimates for 33,000 Seat Entertainment Centre

Area	Percent of Parking Supply	Total Parking Supply	Vehicle Occupancy	Total Pedestrians
Warehouse	27%	2,740	2.66	7,300
Warehouse East	13%	1,390	2.66	3,700
Mosaic Stadium Site	6%	570	2.66	1,500
Evraz Place	2%	250	2.66	675
Other	1%	150	2.66	400
Heritage (formerly Core)	5%	530	2.66	1,400
Downtown	37%	3,780	2.66	10,050
Cathedral Area	9%	890	2.66	2,375
Subtotal (Arriving by Car then Walking)	**100%**	**10,300**		**27,400**
Walking Only				1,650
Arriving by Transit / Shuttle Buses				4,950
			Total	**34,000**

The level of service (LOS) of major pedestrian access routes and crossings should be reviewed to ensure anticipated pedestrian demand levels do not exceed available capacity during event ingress and egress. Overcrowding on pedestrian facilities compromises the safety of pedestrians, emergency evacuation procedures and may interfere with adjacent street traffic flow.

The analysis of the pedestrian LOS on sidewalks uses the calculation of pedestrians per minute per metre (ped/min/m) or pedestrian unit flow rate as the basis for LOS classification. The pedestrian unit flow rate is obtained by taking the peak pedestrian 15 minute flow rate and dividing by the product of fifteen multiplied by the effective walkway width.

An effective sidewalk width of 1.8 metres was used in the analysis – this corresponds to the Transportation Association of Canada's (TAC) Urban Supplement to the Geometric Design Guide for Canadian Roads recommendations for a desirable clear sidewalk width.

According to this measurement, on a walkway with LOS A (i.e. 16 ped/min/m), pedestrians move freely without altering their speed in response to other pedestrians or to a decrease in the sidewalk width. On the other hand, on a walkway with LOS F (>75 ped/min/m), all walking speeds are severely restricted and forward progress is made only by "shuffling." The ultimate capacity of a crossing is approximately 4,500 pedestrians per hour per metre.

Assuming no new pedestrian connections from Downtown, an assessment of the existing pedestrian capacity and LOS was conducted for the following key crossing locations:

- 9th Avenue and Albert Street – It was assumed the majority of spectators who would park at the existing Mosaic Stadium and Evraz Place would cross at this intersection. This is a total of 2,175 pedestrians or an equivalent pedestrian flow rate of 20 ped/min/m. This is a LOS B.
- Albert Street and CP Rail Underpass – Pedestrians from both the Cathedral area and the Downtown area would cross at the east and west sidewalks at this crossing. It was assumed that pedestrians from the Cathedral area would use both sidewalks equally and that half of the pedestrians from the Downtown area would use the east sidewalk. This is a total of 8,200 pedestrians or an equivalent pedestrian flow rate of 20 to 130 ped/min/m for the west and east sidewalks, respectively. This is equivalent to a LOS C and LOS F, respectively. The existing Albert Street underpass and sidewalk is pictured in **Figure 2.14.**

Figure 2.14 Albert Street Underpass

- Broad Street and CP Rail Underpass – Pedestrians from the Heritage area and the Downtown area will use the west sidewalk at the Broad Street subway. There is no east sidewalk at this location. This is a total of 7,200 pedestrians or an equivalent pedestrian flow rate of 134 ped/min/m for the east and west sidewalks, respectively. This is equivalent to a LOS F.

<u>Recommendations</u>

Based on the analysis and review of key desire lines for pedestrians, the following are recommendations to improve pedestrian access to and from the proposed entertainment centre:

- Provide a minimum of two new pedestrian overhead crossings across the CP rail line from the Downtown. Combined with the two existing crossings at Albert Street and Broad Street, an acceptable level of service (i.e. LOS C/D) is expected for all pedestrians crossing from the Downtown. There are two preferred locations:

  i. Lorne Street – An overhead pedestrian crossing at Lorne Street could start at ground level just north of Saskatchewan Drive or it could also tie across Saskatchewan Drive into the Cornwall Centre at the Bay parkade. This would allow pedestrians to cross Saskatchewan Drive above grade. Should pedestrians have to cross Saskatchewan Drive at-grade, Lorne Street would still be the preferred location over Smith Street, as the intersection of Saskatchewan Drive and Lorne Street is controlled by traffic signals. The length of the overpass could be up to 200 metres; this will depend on where the structure starts and where it ties into the proposed entertainment centre. The width for the pedestrian overpass should be 5 metres. The estimated cost of an overhead pedestrian crossing at this location is approximately $5M.

  ii. Hamilton Street – An overhead pedestrian crossing to the proposed entertainment centre could make use of the existing pedestrian overpass that exists across Saskatchewan Drive at Hamilton Street (i.e. from Sears over to the Casino Regina Show Lounge). This crossing could be extended from the Casino property across the rail line to the proposed facility. The existing link is pictured in **Figure 2.15**. The estimated cost of an overhead pedestrian crossing at this location is approximately $5M.

Figure 2.15 Existing Pedestrian Crossing over Saskatchewan Drive

- The historic underground train-platform access leading from Casino Regina should also be redeveloped. This link exists but investigation would be required to determine the extent of rehabilitation required. Only patrons 19 years or older can currently enter the Casino at this time. Consideration should be given to allowing event patrons younger than 19 years old to walk through, but not stop, in the casino. This requires a modest level of enforcement that is likely already in place. Walk-though options are used successfully in other casinos such as in Edmonton where a hotel, casino and hockey arena are joined within one facility.

- Consider improving the aesthetics and lighting for pedestrians using the Broad Street and Albert Street underpasses. It will be difficult to widen the sidewalks at these locations, but attention should be paid to these key corridors for accessing the proposed entertainment centre.

- Sidewalks on Dewdney Avenue from Albert Street to Broad Street will be full to capacity with pedestrians during events at the proposed facility. In particular, the south Dewdney Avenue sidewalk leading from Albert Street to the proposed facility site will be most constrained; this is the location where all pedestrians who have parked in the Evraz / Mosaic Stadium / Cathedral / Downtown areas will converge. There are several options available to achieve additional capacity – widen each sidewalk to the south, minimize sidewalk furniture during events (restrict permanent furniture or temporarily remove furniture) or close Dewdney Avenue from Smith Street to Hamilton Street and provide a pedestrian only zone.

- Sidewalks on both sides of Dewdney Avenue should be a minimum width of 5 metres to provide a LOS D for pedestrians.

- The function of pedestrian crossings across Dewdney Avenue will need to be considered in conjunction with a narrower three-lane cross section on Dewdney Avenue from Smith Street to Hamilton Street.

- It is recommended that along with a narrowing of Dewdney Avenue to a three-lane cross section, which will improve pedestrian safety in crossing Dewdney Avenue, additional pedestrian crossing treatments at the Dewdney Avenue intersections from Smith Street to Hamilton Street should be provided – curb extensions, raised pedestrian crossings, raised intersections or textured crosswalks are all considerations. These would need to be considered as corridor treatments to improve efficacy, but also with consideration for other modes that would be using Dewdney Avenue (trucks, buses, bicycles, etc.).

- Providing pedestrian treatments at the above listed intersections would connect nicely with recommendations made in Old Warehouse District Strategic Long Term Plan Report. This plan included recommendations to enhance the pedestrian experience through specially designed open spaces proposed along the Dewdney Avenue frontage and at Lorne Street and Hamilton Street. These include the introduction of chokers at key internal intersections and street closures at the intersections of Lorne Street and Hamilton Street, with Dewdney Avenue to create two landscaped pedestrian mini-malls extending north from Dewdney Avenue.

- In order to further protect pedestrians crossing Dewdney Avenue, an increased level of control may be required, especially if Dewdney Avenue is not closed to traffic. This can range from overhead mounted signs, special crosswalks, pedestrian or full traffic signals, police control or closing Dewdney Avenue to allow pedestrians to cross free of conflict with vehicles. Special crosswalks or pedestrian signals may not be effective when there is a large amount of pedestrian traffic, such as during a game or other large events, as they would create constant interruptions for vehicle traffic. These same controls may be suitable during normal weekday and weekend operations to allow pedestrians to cross Dewdney Avenue at a controlled location. There is a lack of controlled pedestrian crossings along Dewdney Avenue other than at the signals at Albert Street and Broad Street. Should new traffic signals be required to accommodate an increase in traffic, in and out of the proposed facility site / development site, these should have pedestrian phases.

- It is recommended that a functional design be prepared for Dewdney Avenue from Albert Street to Broad Street to incorporate the recommendations made for all modes of traffic. The design would assess the functionality of converting Dewdney Avenue to a five-lane cross section for vehicular traffic, widening sidewalks, providing cycling lanes and providing pedestrian crossing treatments as well as parking. The functional design could also review the location and spacing of new driveways / intersections and incorporate ideas from the Old Warehouse District's long term plan with respect to pedestrian open spaces.

The pedestrian analysis was conducted for a proposed entertainment centre with a 33,000 seat capacity. A 50,000 seat facility would generate higher pedestrian volumes during peak event operations. At least one of the following measures would be required to maintain a LOS C/D for pedestrian access to a 50,000 seat entertainment centre:

- Widen existing pedestrian crossings at Albert Street and Broad Street

- Construct an additional pedestrian walkway over the CP rail line (for a total of 3)

- Construct wider pedestrian walkways over the CP rail line (7.5 metres wide)

Widening the existing pedestrian crossings at Albert Street and Broad Street may not be possible due to space constraints. Constructing an additional pedestrian walkway over the CP rail line would require an additional $5M, for a total of $15M for three walkways. The preferred option would be to construct two 7.5 metre wide pedestrian overpasses, at an estimated cost of $14M.

If a 50,000 seat entertainment centre is constructed without providing additional pedestrian capacity, the pedestrian LOS will suffer during peak events. This may be considered acceptable, as peak events are a relatively rare occurrence. The measures recommended for a 33,000 seat entertainment centre would still provide good connectivity to the proposed development areas during day-to-day operations.

2.5 Bicycle Access

Cyclists may desire to access events at the proposed entertainment centre and should be considered within the facility plans. Special accommodations would need to be provided for event patrons that arrive by bicycle. Safety is a concern for all bicyclists and proper bicycle routes need to be provided. These routes can consist of on-road bicycle lanes and off-road pathways that are augmented with on-site paths leading to the event site.

The proposed entertainment centre would be a key destination within the City of Regina and access by bicycle should be considered through a network of on-street cycling routes. In assessing the ability to service the proposed facility with bicycle routes, several key issues must be considered: bikeways must be designed with provisions for continuity and logical connections. In most cases, the designated route should begin and end at another proposed or existing City of Regina on-road cycling facility, off-road pathway, or an attraction (i.e. Downtown, Entertainment Facility, etc.).

There may be opportunity to provide a cycling lane on Dewdney Avenue. Dewdney Avenue needs to be reviewed to determine available width for providing on-street shared cycling lanes and impact on cross section. Consideration also needs to be given to how cyclists will get to the Dewdney Avenue lanes – they would need to form part of a larger network of routes. There is an opportunity to connect Dewdney Avenue cycling lanes to the Devonian Pathway (which goes under Dewdney Avenue at Wascana Creek, a distance of 3.5 km from the proposed entertainment centre), as well as proposed cycling facilities on Broad Street.

There would also be an opportunity to connect proposed pedestrian overpasses to one-way bicycle lane couplets on Smith Street and Lorne Street. These currently end at Victoria Avenue. The pedestrian overpass at Lorne Street should be outfitted with a bike ramp on either side of the stairs to make it easier for cyclists to move their bikes up and down the stairs.

Table 2.7 indicates the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads has developed guidelines for selecting an appropriate cycling facility for roads. The guidelines shown below are based primarily on daily traffic volumes and / or truck percentages and identify required widths for these cycling facilities.

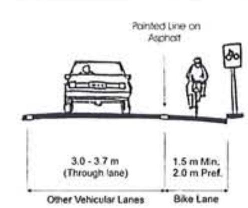
Table 2.7 Cycling Lane Widths

	AADT	Minimum	Desirable
Separate Cycling Lane	>6,000 or 10% Trucks	1.5 m	2.0 m
Shared Travel Lane	>6,000	4.8 m	5.3 m
Shared Parking Lane	-	4.0 m	4.5 m

In 2008, the Average Annual Daily Traffic (AADT) on Dewdney Avenue between Broad Street and Albert Street was 14,000 vehicles per day (vpd). Shared travel lanes with shared lane volumes higher than 6,000 vpd should typically be avoided, although they can be provided if necessary. As such, based on the Dewdney Avenue volumes, either a cycling lane or a shared cycling / parking lane would be appropriate options for on-street cycling facilities.

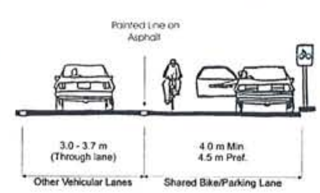
Each option is described below:

- *Cycling Lane*: On-road facility intended for the exclusive use of bicycles, usually separated from adjacent travel lanes by either a painted line or by some more positive delineators such as bollards or buttons. Bike lanes are usually limited to one-way travel, in the same direction as the adjacent traffic flow. A bike lane can be established by reducing the number and / or widths of motorized vehicular traffic lanes, prohibiting on-street parking or widening the roadway. On streets where there is on-street parking, bike lanes run to the left of parked vehicles. On streets without parking, bike lanes run alongside the curb.



On - Road Cycling Lane

- *Shared Cycling / Parking Lane*: On-road facility that is shared by bicycles and parked cars. Shared cycling / parking facilities are provided when provision / retention of parking are extremely important and on-road shared travel solutions are unfeasible. A line between the bicycle and parking lane is generally painted in this circumstance.



On - Road Cycling/Parking Lane

Recommendations

The preferred cycling facility for Dewdney Avenue is an on-road cycling lane. Separate cycling lanes are usually provided where it is deemed that a shared lane (i.e. the minimum requirement) would not provide adequate protection for the cyclist from high traffic volumes. Higher-than-normal volumes on Dewdney Avenue are anticipated during special events at the proposed entertainment centre.

The following actions should be considered regarding bicycle accommodation at the proposed entertainment centre:

- On-road cycling lanes should be considered along Dewdney Avenue to tie into the City's cycling network (expected to be under review in 2010). It would be practical to consider this until such time that Dewdney Avenue is reconstructed.
- The recommended width for cycling lanes on Dewdney Avenue is 2.0 metres. This includes 1.0 metre, which is the bicycle design envelope, and 0.5 metres on either side to provide clearance to the edge of adjacent travel lanes, curb / gutter or fixed objects.
- An additional 4.0 metres of right of way width on Dewdney Avenue would be required to accommodate cycling lanes on Dewdney Avenue.
- In order to provide continuity and connectivity to existing or future cycling facilities on Regina roadways, existing cycling lanes on Lorne Street and Smith Street should be extended from Victoria Avenue to Saskatchewan Drive.
- The pedestrian overpass at Lorne Street should be outfitted with bike ramps on either side of the stairs to make it easier for cyclists to move their bikes up and down the stairs.
- End of Trip Facilities - Security represents a major concern of bicyclists. In order to encourage bicycle travel, the following provisions should be made at the proposed entertainment centre:
    - Bicycle parking will need to be provided; these areas may need to be staffed and / or properly secured to prevent bicycle theft.
    - Bicycle parking areas should be located close to the entrance of the proposed entertainment centre as this may encourage event patrons to use their bicycles in order to access the event easier.
    - There should be no charge for bicycle parking.
    - Continue to provide bicycle racks on transit buses to allow spectators to access mass transit while carrying a bicycle.

3. Water

3.1 Existing Conditions

The existing water mains along Dewdney Avenue are 600 mm cast iron pipe and 200 mm PVC pipeline. The 600 mm water main is one of the two water mains coming from Farrell Pumping Station (FPS) located on Dewdney Avenue east of Broad Street. A second 600 mm water main runs south along Broad Street. The FPS pump capacity is estimated to be 1,366 L/s at a discharge Hydraulic Gradeline (HGL) of 617.54 m (409 kPa). **Figure 3.1** shows the water mains in the area around the proposed site.

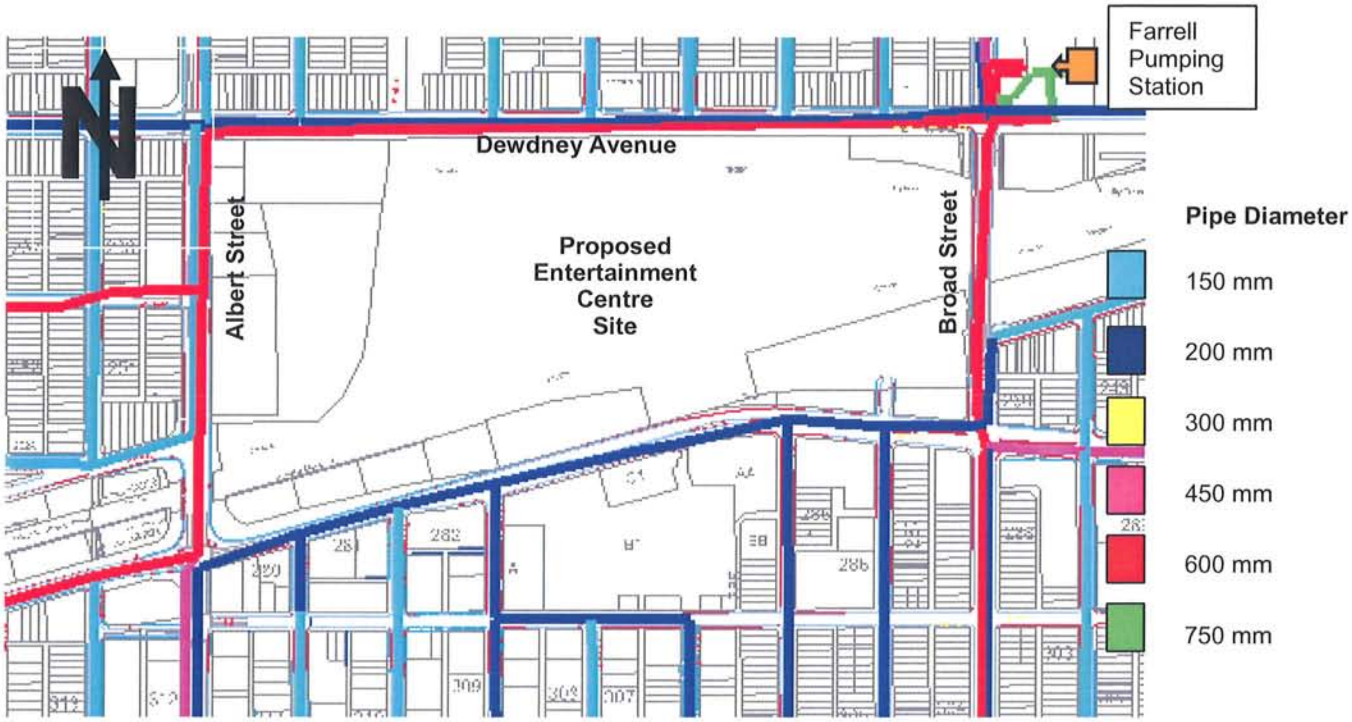


Figure 3.1 Existing Water Distribution System

3.2 Estimated Water Demand

The City has provided information on water use at Mosaic Stadium for two recent football games as shown in **Table 3.1**.

Table 3.1 Mosaic Stadium Water Consumption during Football Game Day

Date	Attendance	Total Water Consumed (L)	Average Consumption (L/Fan)
October 24, 2009	30,945	65,860	2.13
November 7, 2009	30,945	62,280	2.01

If it is assumed all water consumed on game days occurred during the 30 minute half-time, then the half-time demand would be approximately 35 L/s.

The peak water demand for the proposed facility was determined according to "Saskatchewan Multi-Use Facility Building Program Draft" dated September 25, 2009 provided by the design consultant. **Table 3.2** summarizes the total number of water fixtures according to the design consultant (33,000 seats) and a future full development with a total of 50,000 seats.

Table 3.2 Fixtures Summary

Description	Initial 33,000 Seats	Later Expansion 17,000 Seats	Full Development 50,000 Seats	Typical Fixture Flows
Sinks	496	255	**751**	**2 L/min**
Toilets	419	397	**816**	**6 L/flush**
Urinals	220	N/A	**220**	**3.8 L/flush**
Showers	46	N/A	**46**	**5 L/min**
Washing Machines	6	N/A	**6**	**70 L/cycle**
Total Number of Fixtures	**1,187**	**652**	**1,839**	

Peak water demands for this type of facility occurs typically during the intermissions or at end of the event. For the purpose of this study, the peak water demand was calculated using only sinks, toilets and urinals. Water demands were calculated based on the typical flows required by the fixture's flush valve. It was assumed low flush toilets and urinals will be used. For comparison, a standard toilet requires 13 L/flush compared to 6 L/flush for low flush toilets.

The average time to use a public washroom varies according to the gender. According to Keblanov [1], men average 40 to 45 seconds to urinate, while women require an average of 90 seconds. Keblanov's reported times included the 10 seconds required for the normal flush valve cycle. A cycle time of 45 seconds to flush fixtures was used to calculate the facility's peak water demand. **Table 3.3** summarizes the estimated peak water demands for a 45 second cycle time.

Table 3.3 Entertainment Centre Estimated Peak Water Demand

Multi-Use Facility Capacity	Initial 33,000	Later Expansion 17,000	Total 50,000
Number of Fixtures in use per second (Ea)	25	15	**40**
Estimated Water Use (L/s)	75	53	**128**

The proposed development includes 6.1 ha for commercial development. The City of Regina Development Standards Manual establishes a design population of 65 persons per ha and an average day demand of 415 lpcd. Water demands for the commercial area proposed in the new development are summarized in **Table 3.4**.

[1] *Keblanov, G. "The Super Flush Test in Stadium Plumbing Design"; Plumbing System & Design July/August 2005.*

Table 3.4 Commercial Area Water Demands

Concept	Design Peaking Factor	Development Water Demand (L/s)
Average Water Demand	1	1.9
Maximum Day Demand	2.1	4.0
Peak Hour Demand	3.2	6.1

Based on the above, the estimated peak water demand for the proposed development is 81.1 L/s for a 33,000 seat stadium and 134.1 L/s for a 50,000 seat stadium, including the commercial area and the entertainment centre.

Service connections for the commercial areas can be installed at either existing 200 mm or 600 mm water mains on Dewdney Avenue. The new service connections should be sized during the detailed design phase to accommodate the specific water requirements of each business and confirm compliance with City standards. However, the service connection for the entertainment centre must be done at the existing 600 mm water main.

3.3 Fire Flow Requirements

The proposed development will be located in the Downtown area. The City of Regina Development Standards, Table 4.5.3, establishes the Downtown Zone with a Fire Flow Requirement Designation Level 3 and a minimum fire flow of 250 L/s. However, the City reserves the right to adjust the fire flow requirements on a case by case basis. An initial fire flow requirement of 250 L/s will be used for this feasibility study.

The City's steady state WaterCAD model was used to assess the performance of the system during the Average Day Demand (ADD), the Maximum Day Demand (MDD), the Peak Hour Demand (PHD) and fire flow analysis.

The performance of the system was analyzed by comparing the PHD pressures at nodes in the vicinity of the proposed facility before and after the addition of the proposed development peak demand of 134.1 L/s. For purposes of this feasibility study, the development's water service was connected to the existing 600 mm water main located along Dewdney Avenue. All hydrant leads must be connected to the existing 600 mm water main to comply with the City Development Standards Manual. Modelling indicates the existing 200 mm water main on Dewdney Avenue does not have capacity to accommodate the fire flows required. An allowance for five hydrant leads has been proposed at an estimated cost of approximately $100,000.

WaterCAD results showed no significant impact to the existing distribution system for the estimated water demand of 134.1 L/s during PHD. A fire flow analysis was also complete during MDD and addition of the estimated proposed development peak demand of 134.1 L/s. Nodes in the area with fire flows below the required values remained the same before and after the new demand during MDD. The fire flow for the proposed development was assumed to be provided from one node only.

Based on preliminary calculations, a single 450 mm service line for the proposed development is required to comply with the City's Development standards including peak demand and fire flow requirements. The main design parameter for the single water main is the maximum flow velocity in the pipe during the fire flow analysis, with a maximum value of 3.2 m/s. The estimated cost of installing the service connection is approximately $290,000.

Some entertainment centre designs have considered a scenario where all fixtures are flushed or in use simultaneously. Preliminary modelling indicates such an event would have a significant impact on the City's water distribution system. However, the probability of occurrence is considered extremely low and would result in significant overdesign of the system. Therefore, as the project evolves, the City should consider installing a flow regulating valve at the service connection to restrict the flow to no more than 200 L/s to the facility. Separate service connections for water supply and for fire flow may also be considered by the City. This option may reduce overall pipe diameters including their appurtenances and may reduce water stagnation in service connections for extended periods of time. The estimated cost of installing a flow regulating valve is approximately $110,000.

3.4 Conclusions and Recommendations

Based on information provided by the design consultant, the peak water demand for a 33,000 seat and 50,000 seat entertainment facility, plus the adjacent commercial use, is estimated 81.1 L/s and 134.1 L/s, respectively. The City's existing water distribution system has adequate capacity to supply the new development up to 200 L/s with no significant impact to the existing users in the vicinity.

The City should therefore consider the following recommendations as the project evolves:

- A new 450 mm water service connection for the proposed development should be connected to the existing 600 mm water main on Dewdney Avenue. The estimated cost of installing the service connection is approximately $290,000.
- A 450 mm flow regulating valve should be installed at the entertainment centre service lead to restrict incoming flow to 200 L/s. The estimated cost of installing the flow regulating valve is approximately $110,000.
- Piping for fire flow requirements including hydrants leads must be connected to the existing 600 mm water main to comply with City standards for fire flow. An allowance for five hydrant leads has been proposed at an estimated cost of approximately $100,000.
- Consider the option of using only low flow water fixtures in the development to reduce water demands.
- Consider the option to supply the proposed development using more than one service connection, to address redundancy concerns related to water supply.
- Consider the option to supply the entertainment centre using more than one service connection to provide redundancy specifically to the building.
- Consider the option of installing separate service connections for water supply and fire flow requirements to the entertainment centre building.

4. Wastewater

The following discussion outlines the analysis that was performed by AECOM to develop conceptual wastewater servicing for the proposed entertainment / multi-use facility complex. It will begin with a description of the existing wastewater system in the surrounding area and the expected system response to various loading conditions, followed by a discussion of the methodologies used to estimate future wastewater loadings emanating from the entertainment complex. These discussions will then be followed by descriptions of the two servicing concepts developed to service the proposed entertainment centre and surrounding ancillary development and the expected system response or impacts on the surrounding wastewater collection system as a result of these changes. Study recommendations for proposed system improvements and associated Level 'D' cost estimates are noted in the sections that follow and are summarized at the end of the study.

As part of the wastewater servicing review, AECOM performed the following major steps:

- Developed a wastewater model of the existing wastewater collection system and determined the baseline conditions for the collection system in the surrounding area of the proposed development.
- Reviewed wastewater loading standards for entertainment centre facilities in other jurisdictions and determined the expected wastewater loadings for the facility based on data provided by the design consultants, Stadium Consultants International (SCI).
- Determined the expected loadings from the proposed ancillary development based on the City of Regina's 2008 Development Standards Manual.
- Compared these wastewater values to the design guidelines used for other similar developments in North America.
- Selected a peak diurnal scenario for input into the wastewater model based on the expected peak flows and volumes generated by the facility and the infrastructure that would be required to deliver these flows.
- Developed two separate servicing alternatives for the proposed development and determined the potential impacts on the surrounding development.
- Developed conceptual material take-offs for the Class 'D' cost estimates for the two alternatives and provided a recommended preferred alternative based on the constraints identified in the previous analyses.

4.1 Existing Wastewater System

The proposed facility will be located on the former CPR rail yard near the southeast corner of Albert Street and Dewdney Avenue as noted in **Figure 4.1** (wastewater trunks are shown in red).

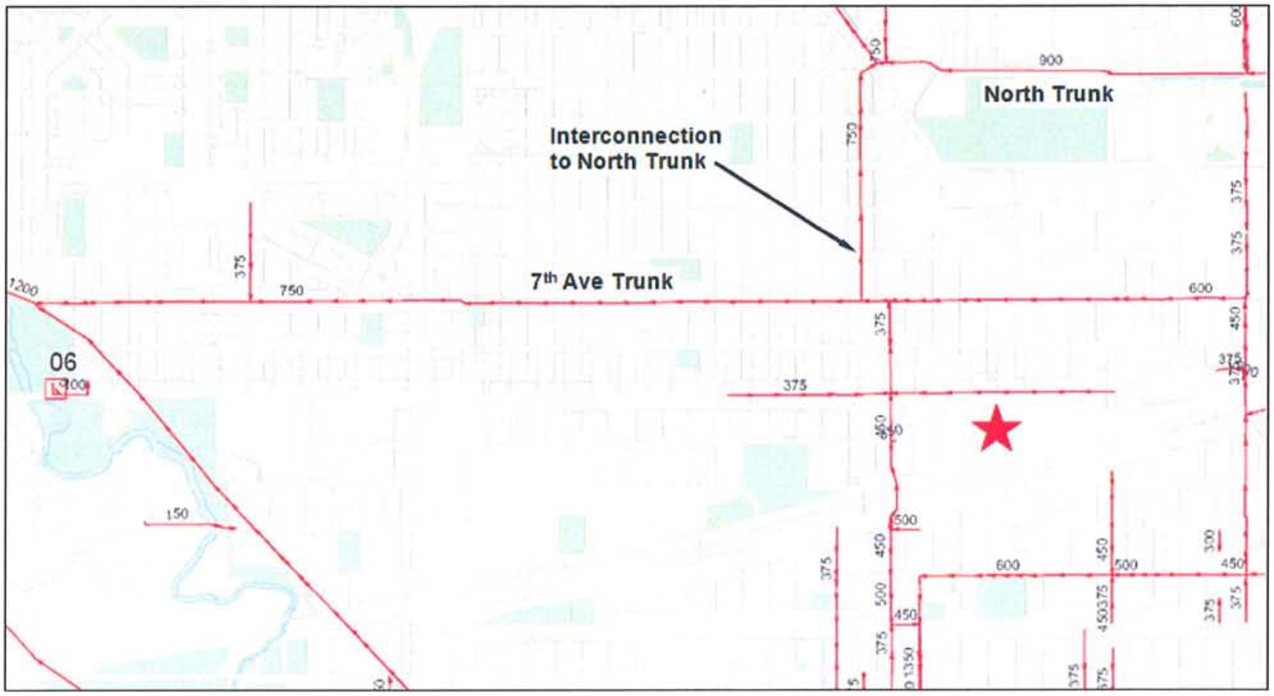


Figure 4.1 City of Regina - Proposed Entertainment Centre Site

4.1.1 Wastewater System Model

The wastewater servicing analysis was conducted using the City's existing InfoWorks CS interceptor model as a starting point which was originally developed as part of the 2008 Northwest Sector Serviceability Review by AECOM. The model included the trunk system located in the northeast and southeast quadrants of the city. The existing model was extended to the proposed entertainment complex site using standards developed as part of the Northeast Servicing and City-Wide Wastewater Modelling Study which is an assignment being performed by AECOM in parallel with this servicing study. Wastewater loadings for the surrounding wastewater system were imported from the loadings included in the previous HYDRA model developed by Cochrane Engineering and KWL Engineering in 2004.

The City of Regina has standardized on the InfoWorks CS modelling platform developed by MWH Soft (formerly Wallingford software) for its regional wastewater modelling requirements due to its superior hydraulic modelling capabilities. InfoWorks enables simulation of complex flow conditions including surcharge or pressurized flow, flow reversals, storage routing, routing through looped systems and simulations involving complex pumping systems. Pressurized flow and storage routing is particularly important since the interceptor system in Regina acts as a large wet well upstream of the McCarthy Boulevard Pumping Station (MBPS). All the sewage generated within the City limits is pumped through the MBPS to the Sewage Treatment Plant (STP) as noted in **Figure 4.2** and therefore, it is very important to recognize the effects of this storage and backwater effects on the overall interceptor system response.

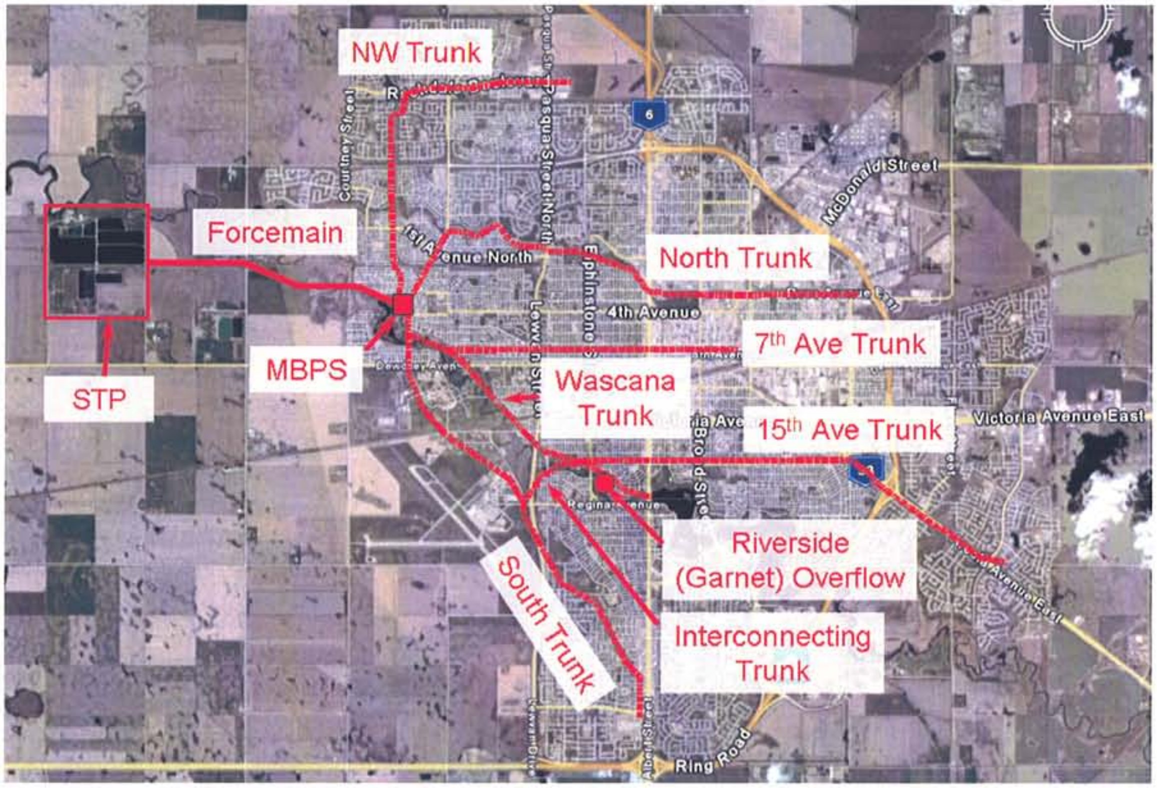


Figure 4.2 Major Components of the City of Regina Wastewater Collection System

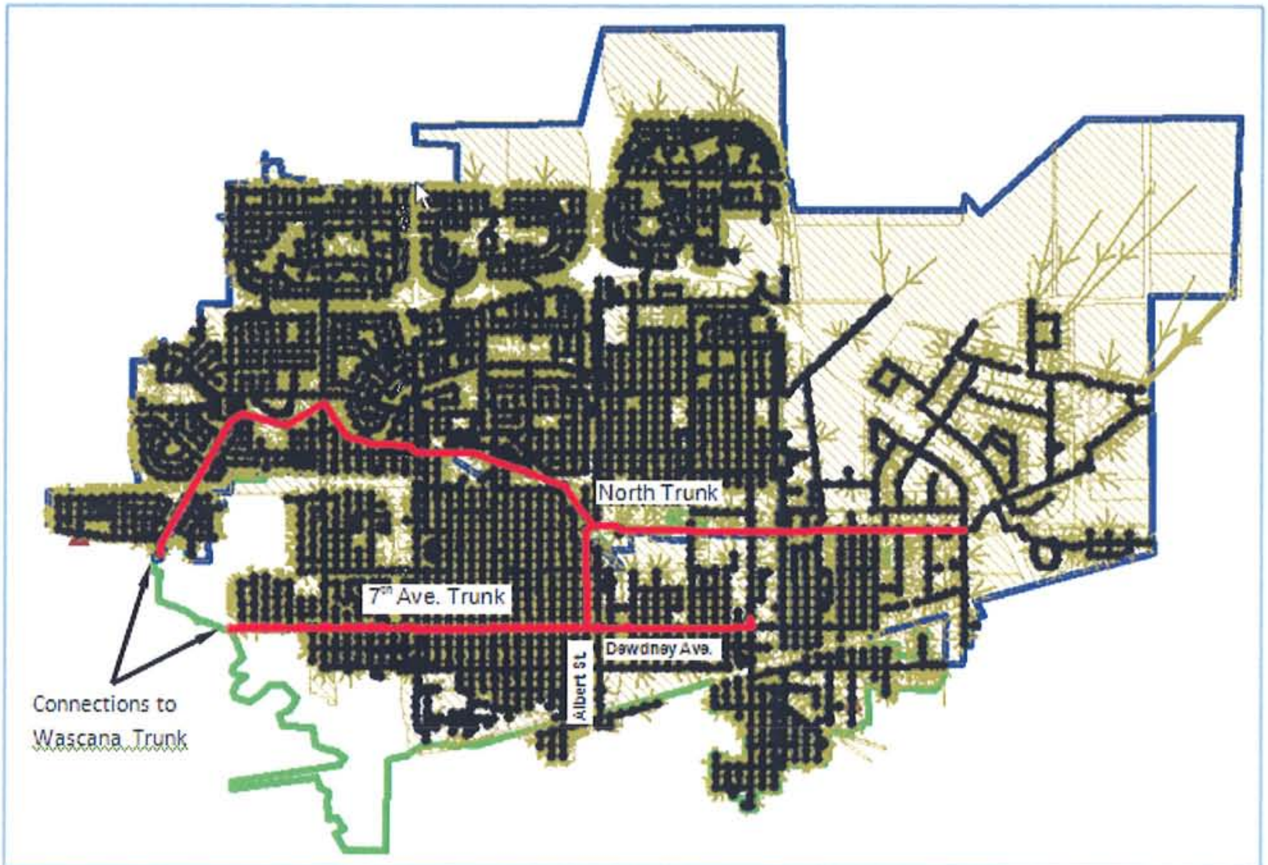


Figure 4.3 Brunskill & Northeast Sector InfoWorks WWS Model – 7th Avenue and North Avenue Trunk (Highlighted)

The InfoWorks model developed for this analysis includes the entire Brunskill wastewater system upstream of the connection of the 7th Avenue trunk to the Wascana trunk, plus the entire Northeast sector as shown in **Figure 4.3**. The service area for the model is shaded in green as noted in the figure above; the Northeast sector to the north is outlined in blue and the Brunskill system in bright green. The two systems are interconnected by a 750 mm wastewater sewer on Angus Street. The local service area for the proposed multi-use facility was assumed to outlet to the existing 375 mm wastewater sewer on Dewdney Avenue. The Dewdney Avenue sewer flows west into the 450 mm Albert Street wastewater which in turn flows north along Albert Street where it ties into the 750 mm 7th Avenue wastewater trunk. The figure above shows the extents of the 7th Avenue trunk which flows west and connects to the 1,200 mm Wascana trunk located in the southwest quadrant of the City. The Northeast sector is serviced by the North trunk (McCarthy trunk) which also connects to the Wascana trunk further north. The Wascana trunk continues northwest to the MBPS as shown in the previous figure.

Simulations of the outlet control at the Wascana trunk connection under the 10 and 25 year wet weather storm events were based on previous wastewater analyses conducted as part of 2006 Southwest Sector Wastewater Servicing Analysis and 2008 Northwest Sector Serviceability Review. The outlet control includes the effects of backwater from the MBPS on the Wascana trunk as well as the Interconnecting trunk and South trunk which form the interceptor system located in the southwest quadrant of the city.

Figure 4.4 below shows the assumed service area limits of the multi-use facility used in the wastewater servicing analyses. The total assumed entertainment centre and commercial area is roughly 13.5 Ha which excludes the park area identified in the concept plans provided by the design consultant.

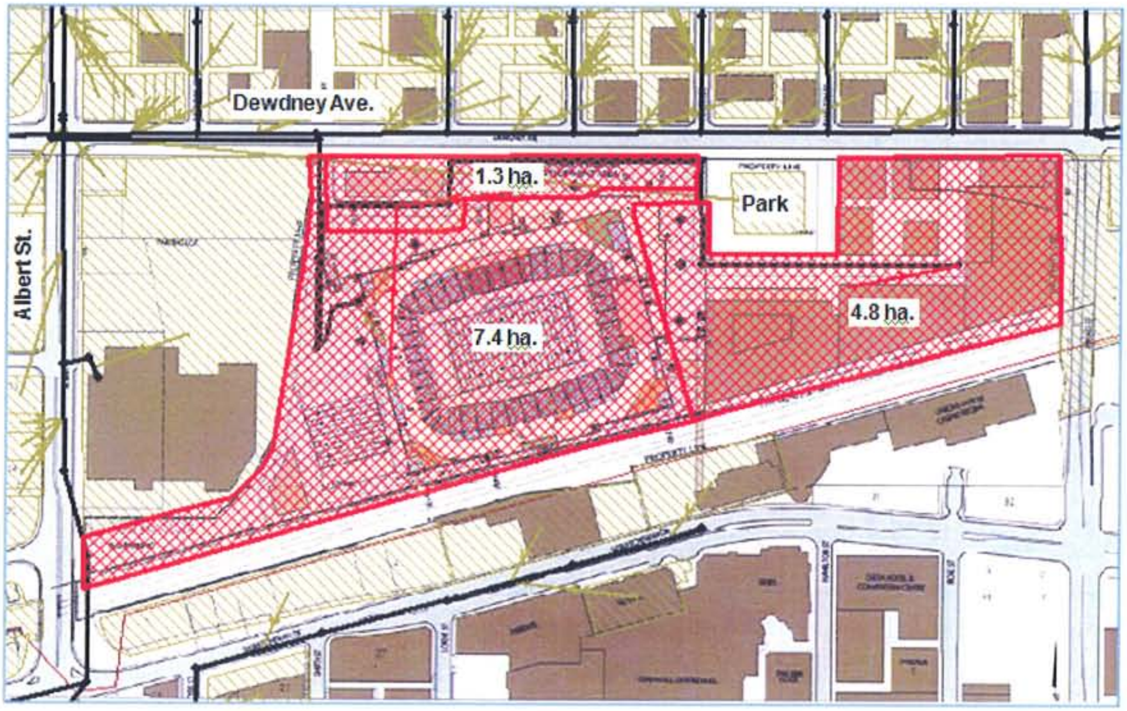


Figure 4.4 Proposed Entertainment Centre Site – WWS Catchments

Figure 4.5 shows a screen capture of the model at the proposed site including the existing wastewater infrastructure and the proposed connection point to the 375 mm Dewdney Avenue wastewater sewer. The proposed connection for the development will be roughly two blocks east of Albert Street on Dewdney Avenue as shown in the figure.

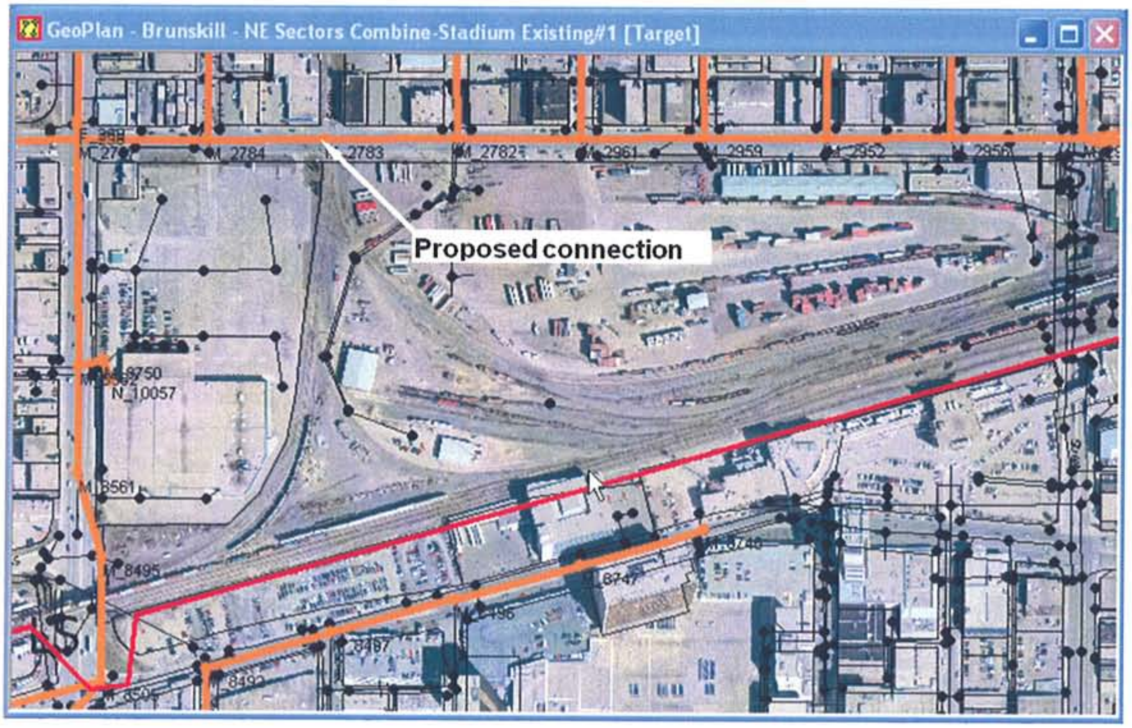


Figure 4.5 Wastewater Collection System at Proposed Multi-Use Facility Site

4.2 Existing System Response to Various Loading Conditions

The local wastewater collection system is comprised of 375 mm and 450 mm wastewater conduits along Dewdney Avenue and Albert Street. Under normal conditions, these sizes would be adequate for a typical commercial development at this site. Unfortunately, the entertainment complex is not typical since it has the potential to produce domestic flows that are orders of magnitude greater than commercial development situated on the same site.

The other complicating factor in the servicing analysis is the amount of inflow and infiltration (I&I) that appears to be present in the wastewater collection system near the entertainment complex. The following figures show modelled system response under Dry Weather Flow (DWF), and under 10 year and 25 year storm Wet Weather Flow conditions for the existing wastewater collection system along the 7th Avenue trunk up to the proposed development. The profile starts at the Wascana trunk tie-in on the left side of the figure and terminates at the Dewdney Avenue sewer connection near the proposed outlet point for the entertainment facility.

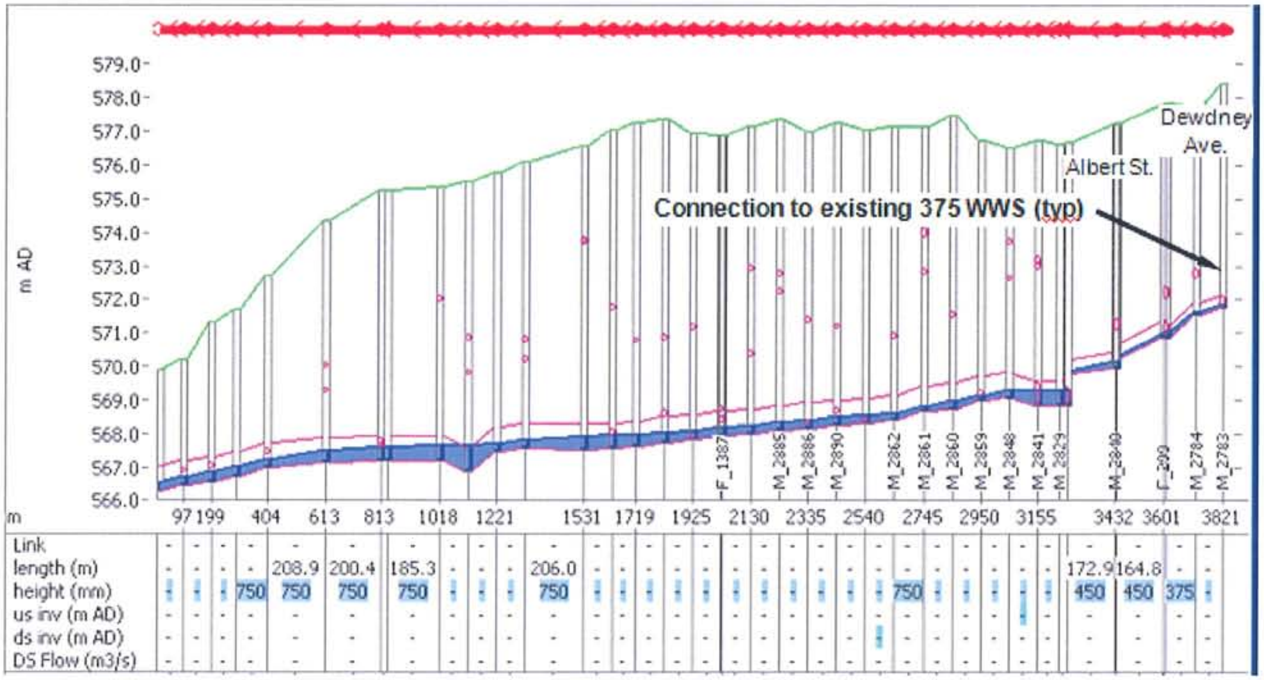


Figure 4.6 7th Avenue Trunk Existing Dry Weather Flow (DWF) Conditions

The DWF system response indicates the existing wastewater collection system appears to be adequate for the existing domestic flow, i.e. domestic sewage generated by the surrounding lands without any inflow and infiltration from rainstorm events as shown in **Figure 4.6**.

As mentioned previously, the I&I parameters and loading assumptions included in the original 2004 HYDRA model were the only parameters and loading assumptions that were available at this time and therefore they were imported into the InfoWorks model without modification. As can be seen from the following two hydraulic grade line profiles of the 7th Avenue trunk, the existing system model response using the HYDRA model loading assumptions create surcharged conditions under wet weather flow for the entire length of the 7th Avenue trunk.

Both the 10 and 25 year rainstorm events generate significant surcharging along the 7th Avenue trunk. This is particularly evident in the upper reaches along Albert Street and Dewdney Avenue. The high surcharge in the Albert Street / Dewdney Avenue area is due to relatively high I&I parameter which have been included in the original HYDRA model in the downtown area. The CPR rail yard is located right on the fringe of this high infiltration area.

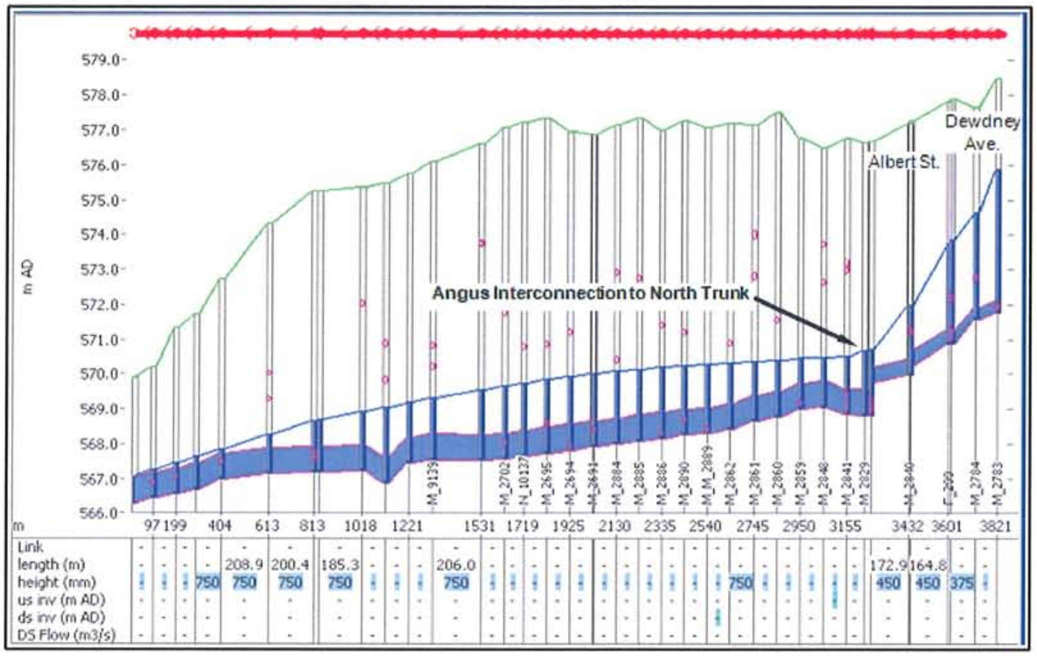


Figure 4.7 **7th Avenue Trunk Existing System Response under 10 Year Storm**

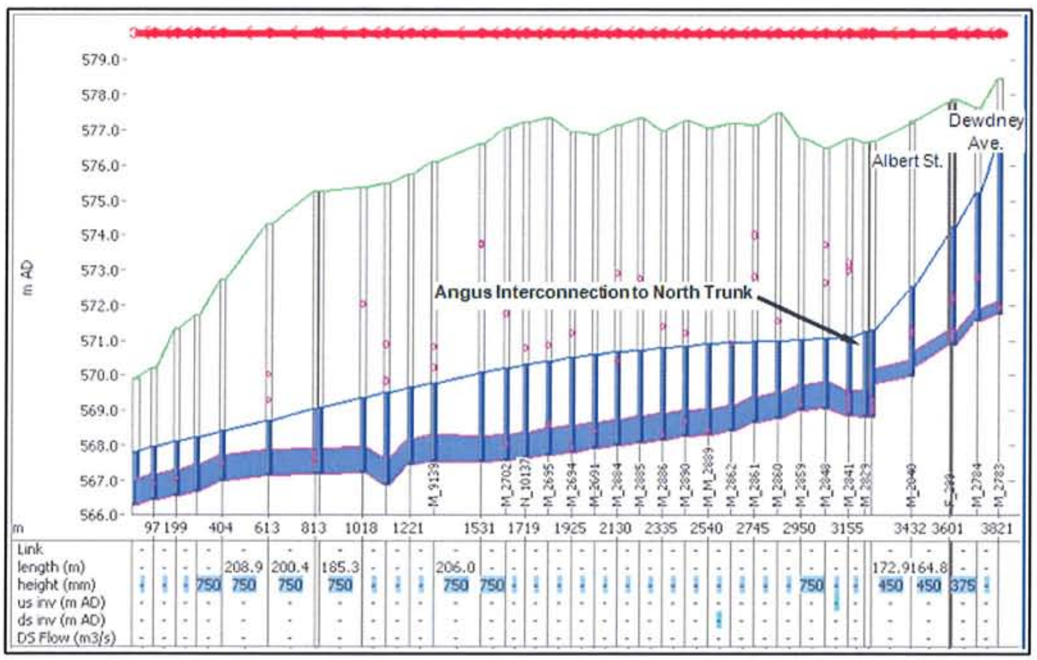


Figure 4.8 **7th Avenue Trunk Existing System Response under 25 Year Storm**

Surcharge under wet weather conditions begins near the tie-in to the Wascana trunk suggesting that the entire 7th Avenue trunk is at its current design capacity at this point. These surcharge conditions effectively limit the amount of additional discharge that can be added to the surrounding wastewater collection system.

Figure 4.9 shows the rapid system response of the hydraulic grade line near the proposed entertainment complex area during the early part of the simulation before the main surge from the rest of the wastewater interceptor system reaches the trunk sewers, i.e. before the main inflows from the Southwest quadrant reach the 7th Avenue trunk. We can see that the high hydraulic grade line in the area close to the entertainment complex is primarily the result of the rapid response I&I flows generated in the immediate vicinity of the proposed development.

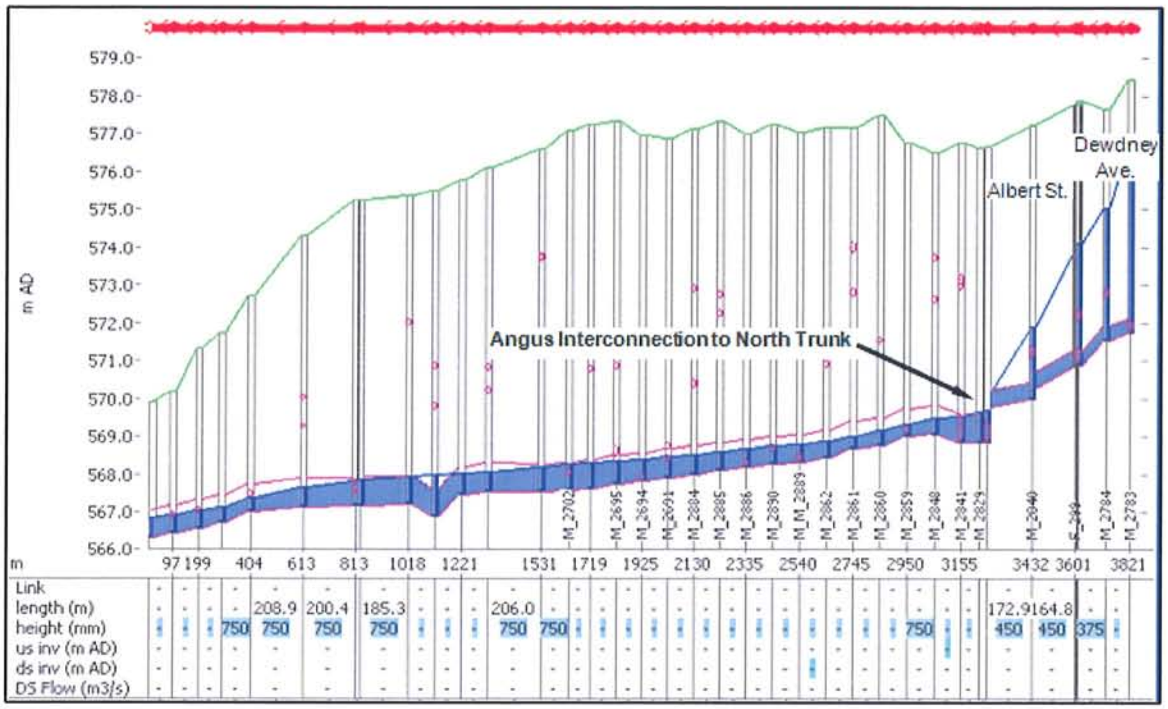


Figure 4.9 7th Avenue Trunk Existing 25 Year Storm – Rapid I&I Response

4.2.1 Existing System Capacity Constraints

Based on the analysis, it is apparent the existing surrounding wastewater collection system already develops high surcharge conditions under wet weather flow and the surrounding development is therefore already susceptible to system surcharging even without the proposed entertainment centre.

As a result of these findings, any options or alternatives developed to service the proposed entertainment facility will need to take the existing surcharged conditions into consideration. Before we can discuss these proposed alternatives and their potential impacts on the surrounding system however, we will first need to determine the potential wastewater loadings that could be generated by the proposed entertainment development. The methodology used to estimate the wastewater loading from the proposed development will be described in the following section.

4.3 Potential Wastewater Loading from the Entertainment Centre

Past experience with large stadium complexes has shown that wastewater servicing is a critical design consideration for these facilities due to the sheer number of fixtures that are needed during peak periods, i.e. intermission breaks when all the washbasins, toilets and urinals are in use. The discussion below will describe the methods used to estimate the wastewater loadings from the stadium complex both in terms of volumes and in terms of peak flows which will then be used as input into the existing wastewater collection model described in the previous section.

4.3.1 Potential Volumes Using Standards from Other Jurisdictions

In order to estimate the potential wastewater loadings, AECOM reviewed a number of similar entertainment centre developments in North America including the Meadowlands development in New Jersey and the Los Angeles Memorial Coliseum redevelopment in California. While we were unable to find detailed information on peak wastewater loadings including typical diurnal flow patterns during a major event, we were able to find some design standards which were then used to verify our estimates based on our own assumptions.

The design standards that we did find were based on wastewater generated on a per seat basis over a 24 hour period. They were primarily intended to determine the potential impact on downstream treatment facilities versus the potential impact on the surrounding wastewater collection system. Despite this shortcoming, we did find them useful in checking the total estimated volume generated using our own estimates.

The two most popular standards used in North America for determining the volume of wastewater generated by entertainment centres appears to be either 11.4 L/per seat (3 US gal per seat) or 18.9 L/seat (5 US gal per seat). The 3 US gal per seat standard was used in New Jersey including the new Meadowlands Stadium development. The 5 US gal per seat standard was used for the stadium redevelopment of the Los Angeles Coliseum in Los Angeles, California. The higher number used for the Los Angeles development was based on the assumption that a large portion of the redeveloped stadium will include luxury box seats versus regular spectator seats which would tend to generate more flow on a per seat basis.

Table 4.1 below shows a summary of the volumes generated for the proposed entertainment complex at the CPR site assuming 4 US gal per seat (average between the two design standards) for various numbers of spectators (including a non-event day) and the surrounding ancillary development. The ancillary development volumes used typical City of Regina design standards for commercial development.

Table 4.1 Wastewater Loads by Facility and Event

Facility	Non-Event Day Flow (Zero Spectators) m^3	Event Day Flow (5,000 Spectators) m^3	Event Day Flow (10,000 Spectators) m^3	Event Day Flow (20,000 Spectators) m^3	Event Day Flow (33,000 Spectators) m^3	Event Day Flow (50,000 Spectators) m^3
Existing Intermodal Facility	Negligible					
Proposed Entertainment Centre Space	0.0	75.6	151.2	302.4	499.0	756.0
SRFC Office and Training Facility (222 People)	49.9	49.9	49.9	49.9	49.9	49.9
Proposed Adjacent Commercial Area (400 People)	90.0	90.0	90.0	90.0	90.0	90.0
Totals	**139.9**	**215.5**	**291.1**	**442.3**	**638.9**	**895.9**

Table 4.1 suggests that for a 33,000 seating capacity, the total flows generated from the entertainment centre during a major event would be roughly 500 cubic metres (499.0) and that the total development has the potential to produce roughly 640 cubic metres (638.9) over a 24 hour period. For a 50,000 seating capacity, the total flows generated from the entertainment centre and the total development would increase to roughly 750 cubic metres (756.0) and 900 cubic metres (895.9), respectively. We should emphasize that these are flows generated over a 24 hour period with a significant portion of the volumes generated before and after a major event.

4.3.2 Potential Volumes and Diurnal Peak Flows Based on Fixture Counts

While it is useful to know how much volume of wastewater could be generated by the proposed entertainment centre based on the standards noted above, it is also very important to estimate the expected diurnal patterns including the potential peak flows during a major event. **Table 4.2** below shows a summary of the number of plumbing fixtures that have been identified and provided by the design consultant for the 33,000 seat and the 50,000 seat capacities, respectively. These estimates appear to be consistent with design guidelines used in other entertainment centre developments in North America.

Table 4.2 Estimated Fixture Quantities

Fixture Type	Proposed 33,000 Seat Entertainment Centre	Future Incremental Expansion to 50,000	Total Fixtures for 50,000
Sinks	498	255	753
Showers	46	0	46
Urinals	220	121	341
Toilets	421	397	818

The discharge capacities for the various fixtures types used in the wastewater loading analysis are based on the details shown in **Table 4.3.**

Table 4.3 Estimated Fixture Water Use (L/min)

Fixture Type	Water Use (L/min)	Notes
Sinks	2.0	
Showers	10.0	
Urinals	3.8	1 flush/min
Toilets	13.0	1 flush/min

We have assumed conventional toilets with flushing capacities of 13.0 litres per flush in our analysis. It should be noted that low flush or dual flush toilets would generate less than half this amount of flow per flush or roughly 6 litres per flush.

Peak Flows during the Intermission

Table 4.4 shows the potential instantaneous peak flows in litres per minute (L/min) and in litres per second (L/s) based on the discharge and flushing capacities of the fixtures identified in the previous table and the number of fixtures estimated by the design consultant.

Table 4.4 Total Water Usage (L/min and L/s)

Fixture Type	Proposed 33,000 Seat Entertainment Complex	Future Incremental Expansion to 50,000	Total for 50,000
Total Wastewater Use (L/min)			
Sinks	996.0	510.0	1,506.0
Showers	460.0	0.0	460.0
Urinals	836.0	459.8	1,295.8
Toilets	5,473.0	5,161.0	10,634.0
Total Flows	7,765.0	6,130.8	13,895.8
Total Wastewater Use (L/s)			
Total Flows	**129**	**102**	**232**

As noted in the previous table, it is possible for the stadium to generate between 130 to 230 L/s depending on the ultimate entertainment centre capacity and the number of fixtures functioning at the same time within the entertainment centre complex. For the purposes of the wastewater loading analysis and the subsequent analyses in this report, we will assume the upper limit of 232 L/s as the expected peak discharge rate from the entertainment centre plumbing system and this is the rate that will be delivered to a proposed lift station for the entertainment centre.

Potential Volume during the Intermission Period Peak

Table 4.5 shows the volume of wastewater that could be generated within the entertainment centre complex during the intermission period peak assuming 25 minutes of peak flow generation.

Table 4.5 Total Wastewater Volume (m^3)

	Proposed 33,000 Seat Entertainment Centre	Future Incremental Expansion to 50,000	Total for 50,000
Volume for 25 minute Intermission Period	194	153	347

As noted in the table, the lower limit of volume generated by the entertainment centre during the peak major event is roughly 200 cubic metres (194) for a 33,000 entertainment centre capacity and an upper limit of just less than 350 cubic metres (347) for a 50,000 capacity entertainment centre based on the number of fixtures.

Proposed Wastewater Loadings from the Lift Station to the Wastewater Collection System

Because of the possibility that the entertainment centre will be developed below grade, we have assumed that a lift station will be required to lift the sewage from the entertainment centre plumbing system to the wastewater collection system. In order to provide a safe level of service, the lift station should be sized to have a firm capacity similar to the peak flows that could be generated by the entertainment centre plumbing system or roughly 230 L/s (232 L/s) for the 50,000 seat capacity complex and 130 L/s (129 L/s) for the 33,000 seat complex as noted in Table 4.4.

For the purposes of the collection system analysis, we have assumed a lift station for major events will have a firm capacity of 200 L/s and a total capacity of 300 L/s for the 50,000 seat capacity complex, i.e. a station configured with three identical pumps capable of delivering 100 L/s each. A firm capacity of 200 L/s should be adequate for the proposed entertainment centre due to some storage that will be available in the pump station's wet well.

The total capacity of the lift station will therefore be 300 L/s and this is the capacity that should be accommodated by the wastewater collection system. The storage requirement for a 25 minute peak intermission period at 300 L/s is therefore 450 cubic metres.

Although not analyzed in detail, the 33,000 seat capacity entertainment centre would require a firm capacity of roughly 130 L/s. This would require a total station capacity of approximately 200 L/s (195 L/s or three 65 L/s pumps).

4.4 Alternative 1 – On-Site Storage Servicing Concept

4.4.1 Alternative 1 - Design Assumptions

The following are the design parameters that were used for inclusion into the InfoWorks model:

Proposed Entertainment Centre and Site Loading

- The wastewater system must have provision for an entertainment centre flow of 300 L / sec. for 25 minute duration, i.e. 0.30 m^3/sec.
- Peripheral commercial / retail on-site development converted to equivalent population [avg. daily flow 225 lpcd (litres per capita per day)].
- An extraneous flow allowance of 31,000 l/Ha/day was applied to account for wet weather infiltration to the wastewater collection system, including from weeping tiles in buildings that are draining to the wastewater system.

Figure 4.10 below shows the InfoWorks model of the proposed entertainment centre development including internal site wastewater infrastructure to accommodate future commercial / retail development. Development of the existing commercial area west of the entertainment centre and the park area was not included in the model.

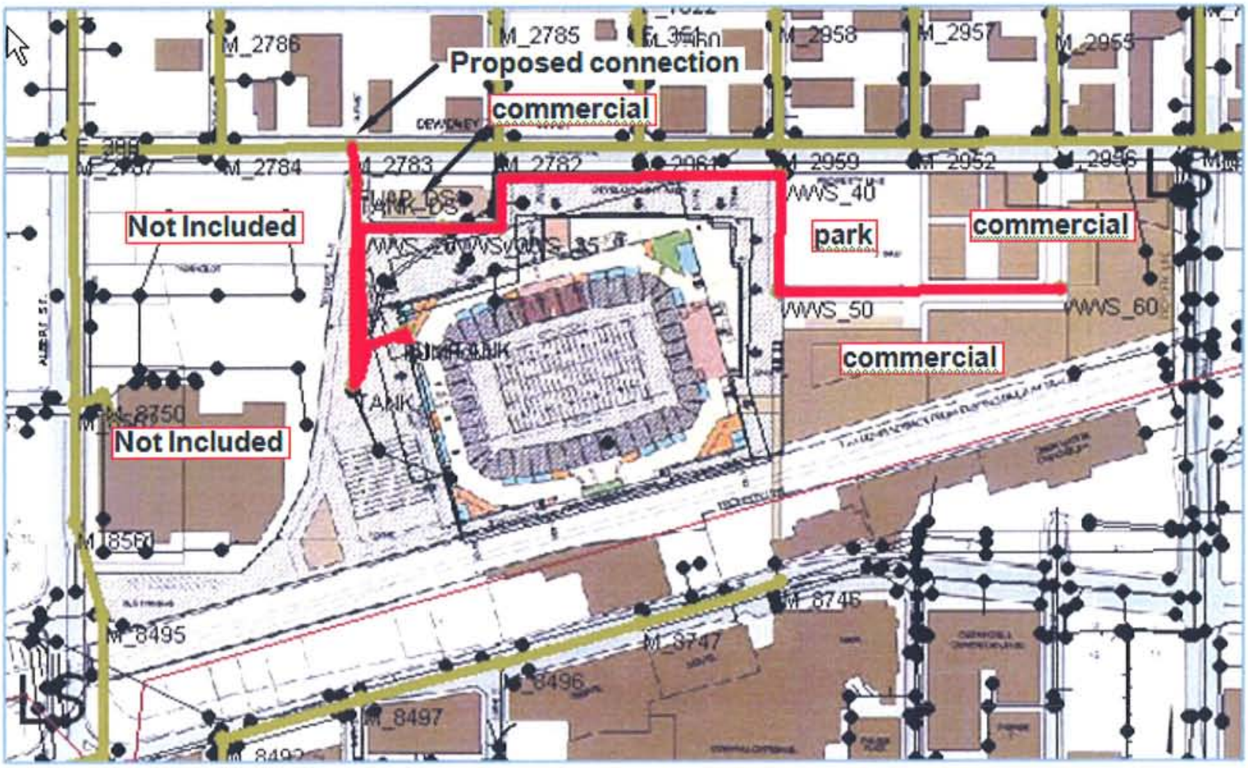


Figure 4.10 Alternative 1: Proposed WWS Infrastructure for Proposed Multi-Use Facility

A number of options were modelled for the site. Due to the high surcharge levels in the existing local wastewater sewers for the 10 and 25 year storms, it was assumed that on-site storage is required to accommodate the entire intermission period peak. The analysis considered either storage tanks or oversized pipes of various sizes which was later refined to ultimately suggest a 2.0 m diameter storage pipe. This suggested configuration was mostly due to limited opportunities for tank locations and cost. The required capacity and physical requirements of the storage element are as follows:

- Storage Element Volume: 300 litres x 60 sec x 25 min. / 1,000 = 450 m^3
- A Flap Valve / Gate would be required to control storage element discharge from the storage element during high water levels.
- Relatively straight run of pipe with inflow from entertainment centre lift station and commercial development flowing in at the top end for constant flushing.

A local allowance of 31,000 l/ha/ day was applied for the improved entertainment centre site independently in the model. This local allowance is routed internally through the on-site storage element.

Hyetograph Timing

The timing of the estimated wastewater flow from the entertainment centre was modelled to coincide with the peak intensity of the rainfall events as well as the peak diurnal pattern of the dry weather flow to establish a worst case scenario. **Figure 4.11** below shows the assumed peak inflow from the lift station of 0.30 m^3/s (300 L/s) for 25 minutes coinciding with the peak rainfall intensity.

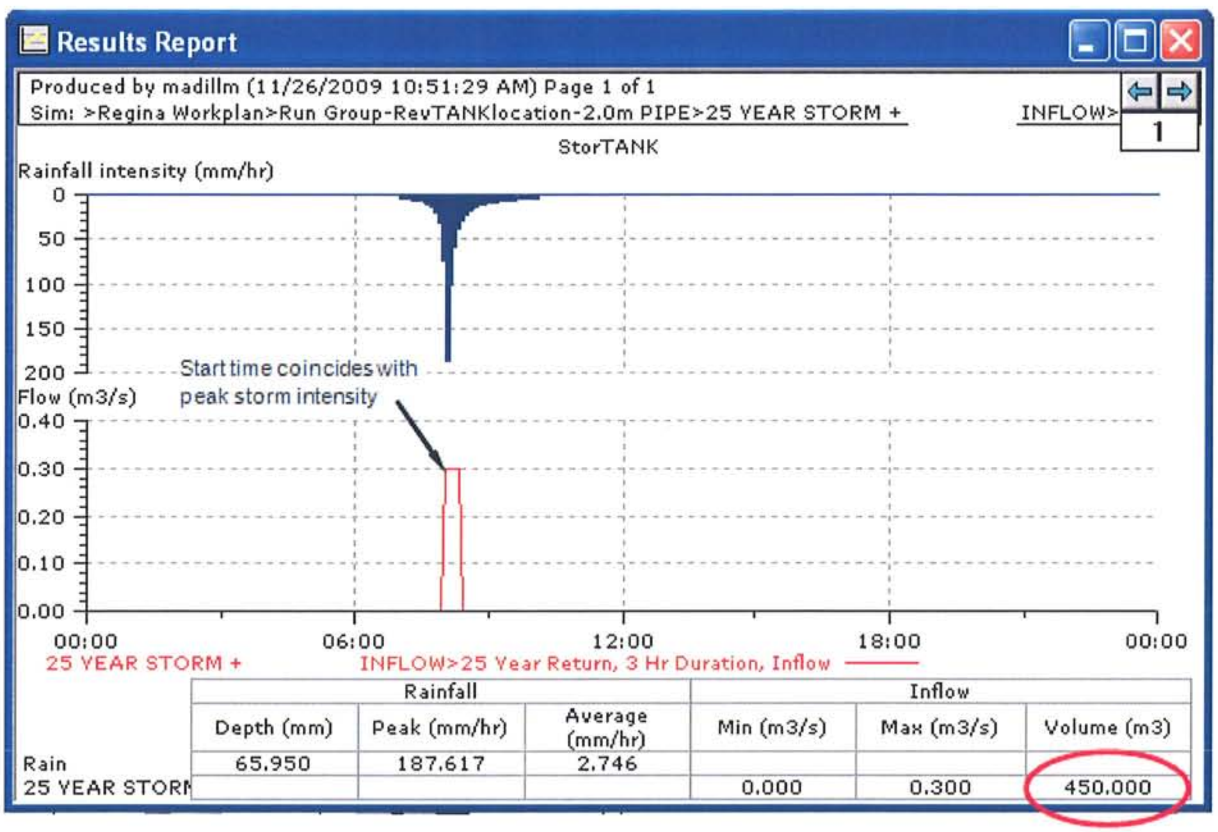


Figure 4.11 Modelled Inflow to Storage Element

4.4.2 Alternative 1 – On-Site Storage Servicing Concept Layout

Figure 4.12 below illustrates the key on-site components to contain and release the anticipated flows generated by the development of the entertainment centre site. The flow of 300 L/s for 25 minute duration (0.30 m^3/sec) is assumed to be pumped from a lift station by forcemain into the storage element estimated to be approximately 150 metres long and 2.0 m in diameter. For a 33,000 seating capacity the flow would be reduced to 200 L/s which would require a storage element roughly 100 metres long or roughly 300 cubic metres of storage volume versus the 50,000 seat capacity configuration of 450 cubic metres of storage volume.

The storage element was situated as close as possible to the connecting wastewater sewer to minimize grade losses to the connection point. A flap gate was modelled to release flow to the 250 mm discharge pipe to Dewdney Avenue only if the downstream water level permits. In the event of high surcharge levels in the Dewdney Avenue pipes, the flows would be contained until the peak subsides. Local wastewater from the proposed on-site commercial developments is routed internally north of the entertainment centre discharging into the upper end of the storage element. This will offer some continual flushing of the storage element between the more intermittent peak discharges from the entertainment centre. The required internal on-site components up to the connection to the existing 375 sewer on Dewdney Avenue are highlighted in red.

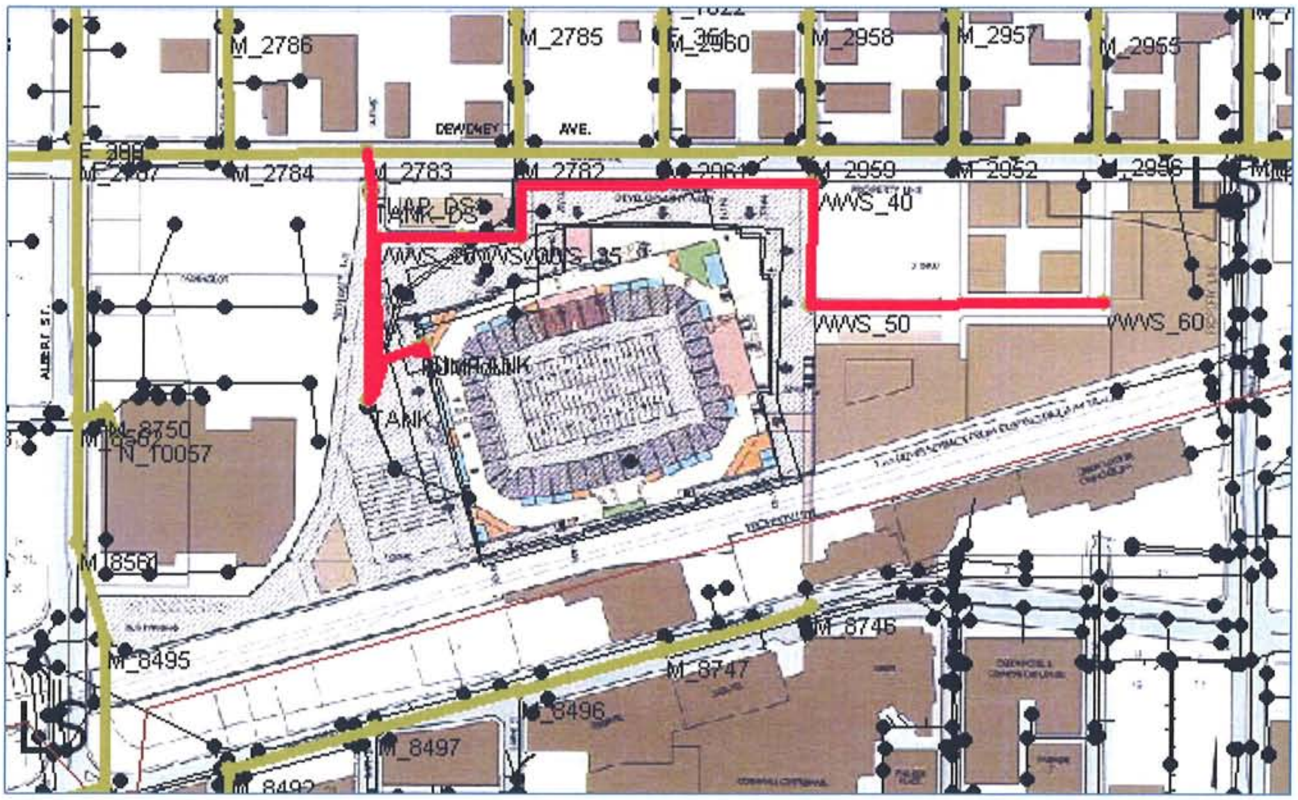


Figure 4.12 Conceptual Model Configuration

The top of the storage element is situated approximately 4 metres below ground level. The flap gate provides dual protection in the event of high surcharge levels from a large magnitude rainfall event. If water levels in the Dewdney Avenue sewers exceed the tank levels, the flap gate will prevent flows from backing up into the storage tank. At this same time, the entertainment centre would not be discharging to the sewer system until such time as the sewer levels in the surrounding collection system recede. This stresses the importance of locating the top of the tank as deep as possible to better control high water level conditions and have less impact on the surrounding sewer system but at the same time still provide a gravity discharge.

Expected On-Site Storage Tank Performance

Figure 4.13 below shows the surcharge level for the 25 year storm at Dewdney Avenue at a snapshot in time, i.e. 8:15 hours into the simulation. The water levels at this point in time exceed the water level in the storage element. The flap gate prevents a backup from the sewers into the storage element and holds the entertainment centre discharge until the water level on Dewdney Avenue recedes.

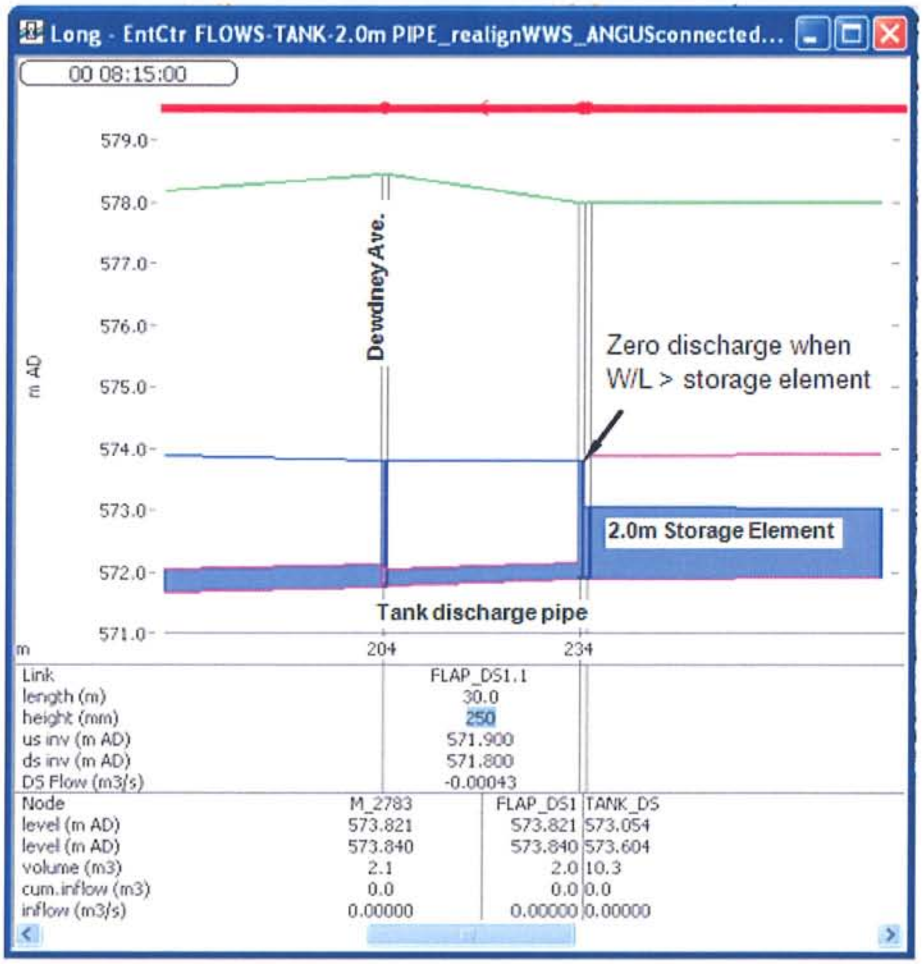
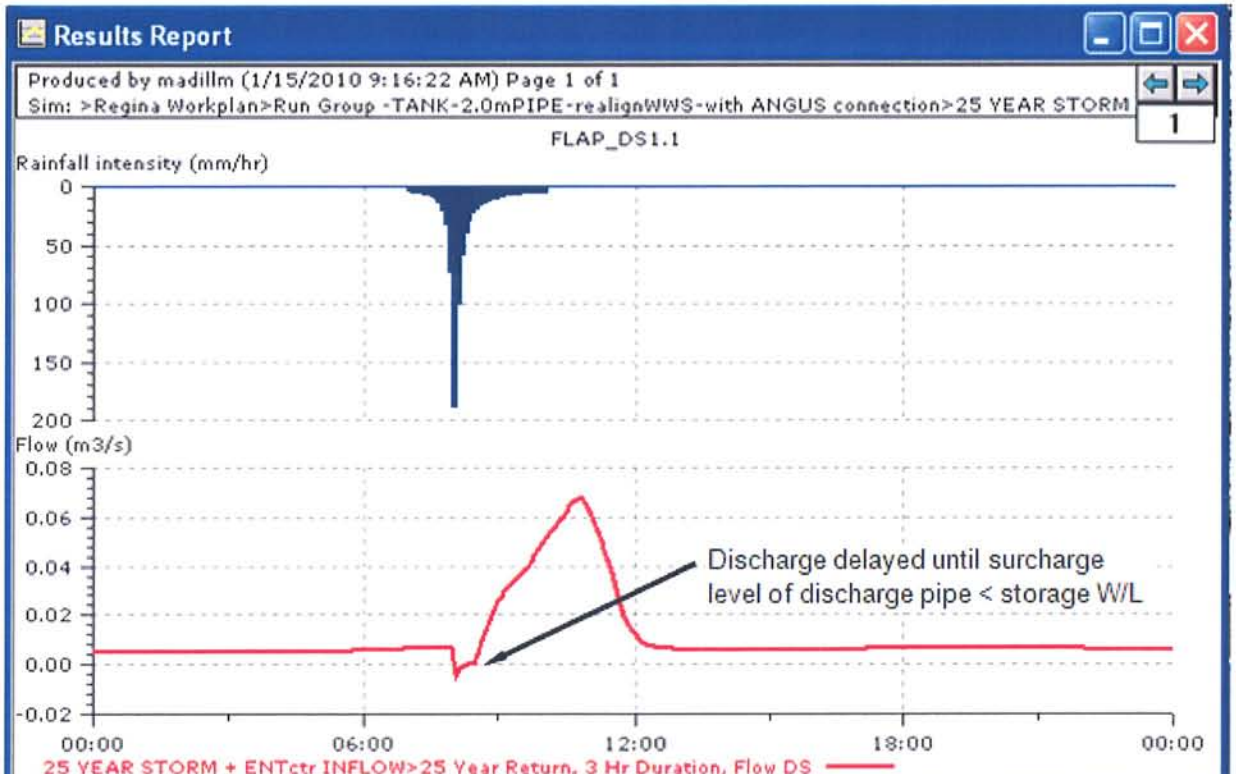


Figure 4.13 High Surcharge of Receiving Sewers on Dewdney Avenue - 25 Year Storm + Entertainment Centre Inflow

The discharge coming out of the tank is 0 L/s (-0.43 L/s in the model) at this snapshot in time when the sewer level in the surrounding collection system is at its peak, i.e. 573.84 m versus the tank level of 573.60 m. The lift station would be delivering 300 L/s into the top end of the tank at this same moment in time.

Figure 4.14 illustrates the discharge hydrograph of the storage element for the 25 year event. There are two very important results shown by the graph. The first is that the outflow from the entertainment complex is reduced to "zero" outflow during the high surcharge levels in the Dewdney Avenue street sewer. The second important result is that the peak outflow from the site going in to the surrounding collection system is reduced to roughly 68 L/s from the peak inflow of 300 L/s coming out of the entertainment centre lift station.



	Rainfall			Flow DS		
	Depth (mm)	Peak (mm/hr)	Average (mm/hr)	Min (m3/s)	Max (m3/s)	Volume (m3)
Rain	65.950	187.617	2.746			
25 YEAR STORM				-0.005	0.068	930.935

Figure 4.14 24 Hour Storage Element Discharge Hydrograph - 25 Year Storm + Entertainment Centre Inflow

The peak discharge rate through the 250 mm discharge pipe to Dewdney Avenue is 0.068 m^3/s in the model with a total volume of discharge of 931 m^3 over a 24 hour period. The total volume of 931 cubic metres is very close to the 900 cubic metres estimated in the "Wastewater Loads by Facility and Events Table included in Section 4.3.1. This volume discharge result to some extent helps to verify our detailed diurnal analysis for peak flows coming out of the entertainment centre complex.

Figure 4.15 shows the modelled system peaks from the lift station to the existing sewers on Dewdney Avenue. Water levels shown represent the 25 year event with entertainment centre flows.

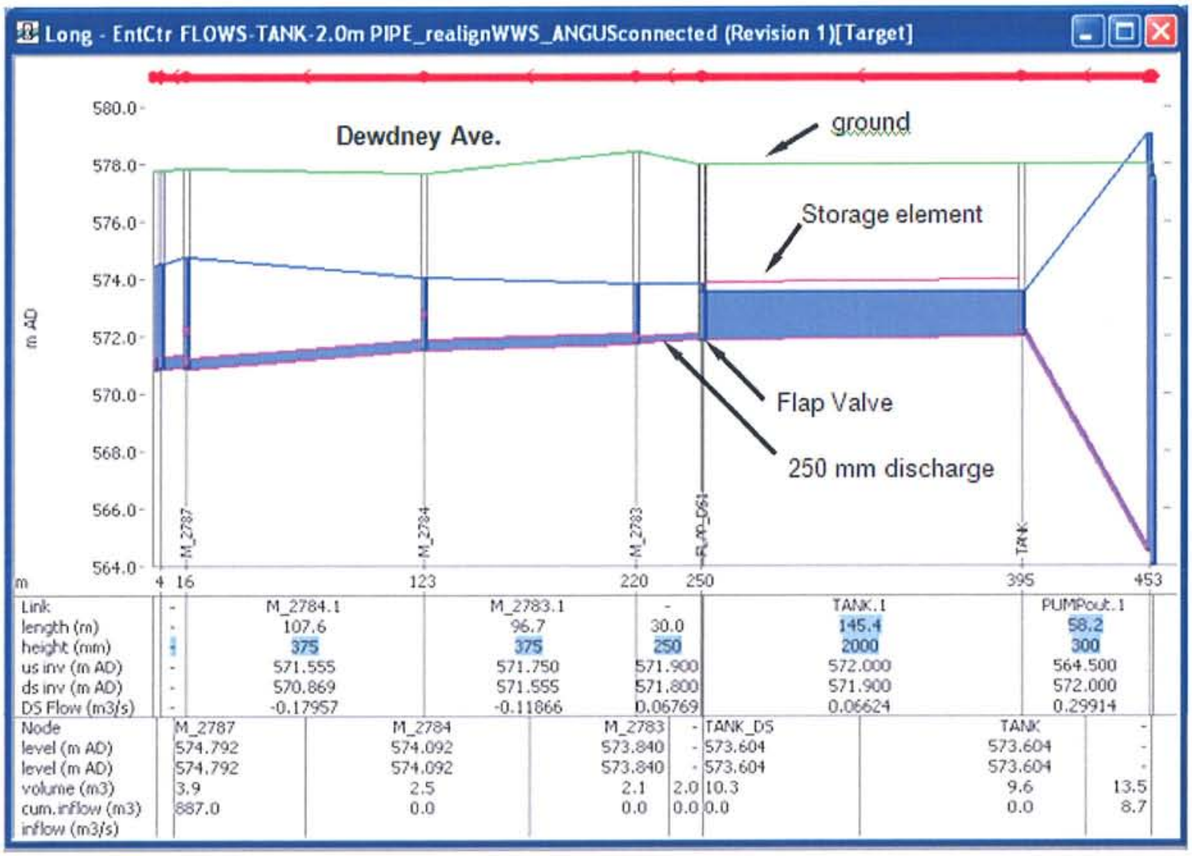


Figure 4.15 High Surcharge of Receiving Sewers on Dewdney Avenue - 25 Year Storm + Entertainment Centre Inflow

Figure 4.16 below highlights the on-site wastewater sewer (in red) servicing the proposed commercial development north and east of the entertainment centre.

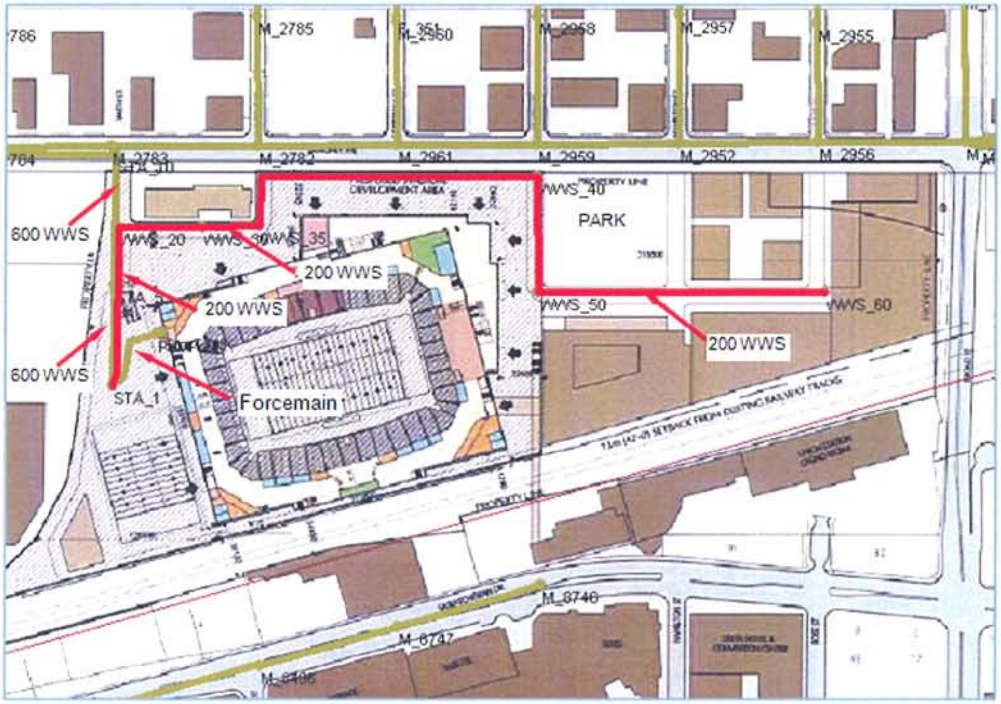


Figure 4.16 On-Site Wastewater Servicing to Support Retail / Commercial

Figure 4.17 is a profile of the wastewater sewer servicing the on-site retail / commercial development.

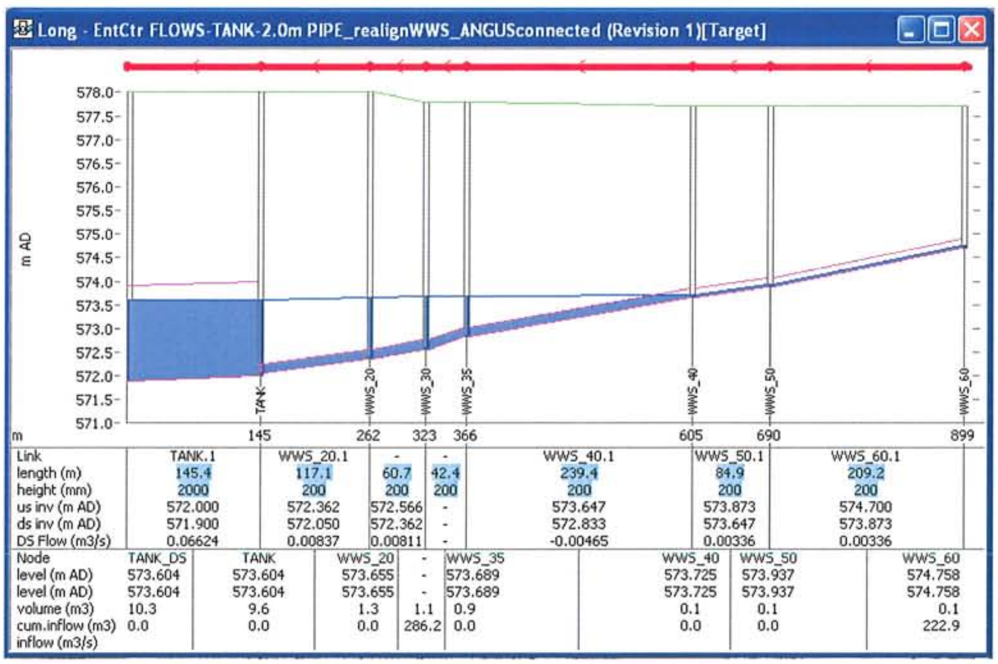


Figure 4.17 Profile: On-Site Wastewater Sewers to Storage Element

4.5 Alternative 2 – Conventional Pipe Servicing Concept

4.5.1 Alternative 2 - Design Assumptions

The design assumptions are the same as those detailed in Section 4.4.1.

4.5.2 Alternative 2 – Conventional Pipe Servicing Concept Layout

This alternative explored the option of no on-site storage for the wastewater generated by the entertainment centre site. This requires the installation of new 600 mm parallel wastewater sewer main as shown in **Figure 4.18**.

Due to the high surcharge levels observed along the Albert Street sewer for the 10 year and 25 year rain storms under existing conditions, it is necessary to extend the parallel main from Dewdney Avenue along Albert Street to the 7th Avenue trunk. **Figure 4.18** shows the alternative routing for the parallel main.

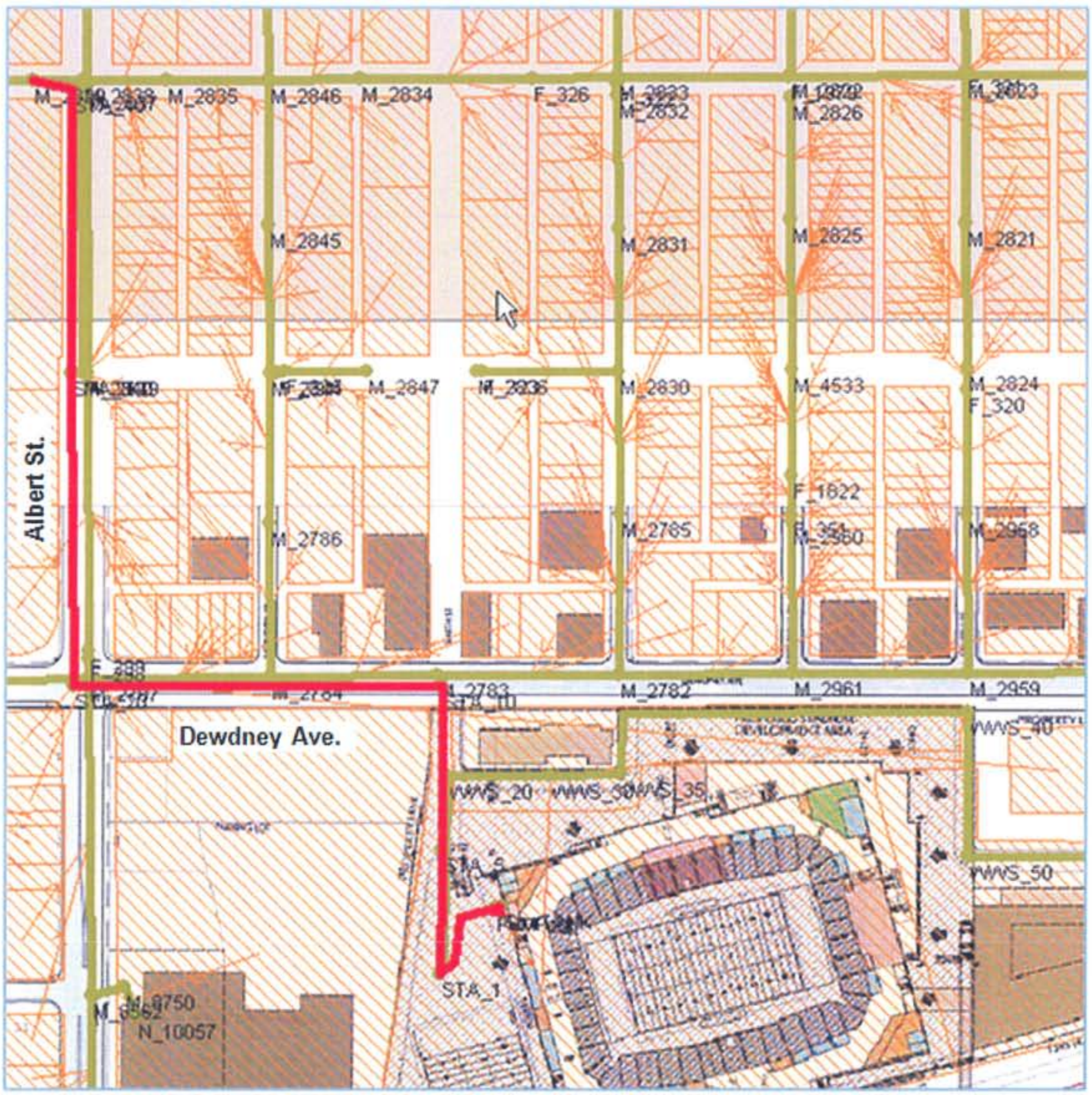


Figure 4.18 Alternative 2: Conventional Pipe Servicing Option

Hyetograph Timing

The peak discharge rate through the 600 mm discharge pipe to Dewdney Avenue is 0.307 m^3/s (307 L/s) with a total discharge volume of 928 m^3 over a 24 hour period coinciding with the 25 year rainfall event.

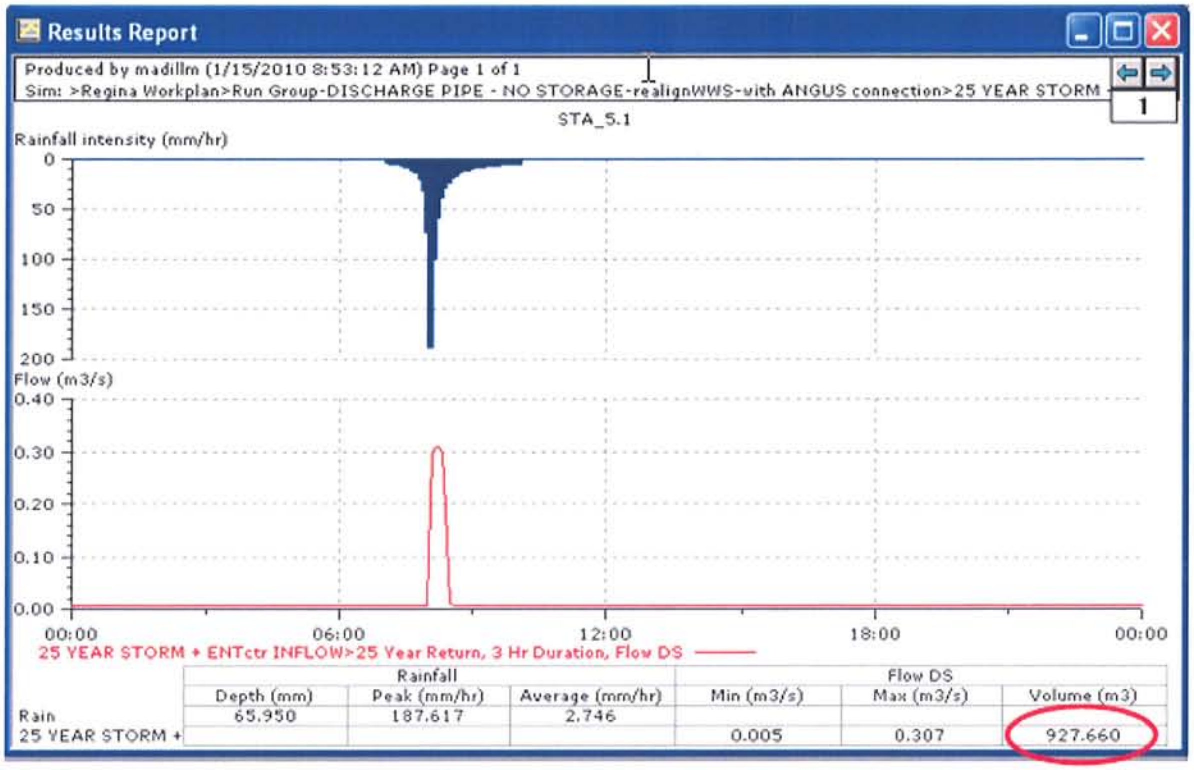


Figure 4.19 Entertainment Centre Major Event Discharge to Dewdney Avenue – 25 Year Storm

Expected Conventional Pipe Servicing Alternative Performance

This alternative is similar to Alternative 1 in that it assumes a lift station from the entertainment centre discharging by forcemain to a new 600 mm gravity sewer to Dewdney Avenue but there is no on-site storage element. The new 600 mm sewer main extends west and crosses below the existing 450 mm wastewater sewer at Albert Street. The new line then continues north along Albert Street and connects to the 750 mm 7th Avenue trunk.

This alternative does not include a flap gate to hold back flow during high surcharge conditions as did the previous alternative. This alternative does not provide on-site storage therefore, the use of a flap gate is not required, it instead discharges the potential major event flows directly to the wastewater system as the flow is generated but at a location where the impacts are minimized. The nearest location where the impacts are minimal is the 7th Avenue trunk.

The following peak profile shown in **Figure 4.20** shows the new major event wastewater discharge from the entertainment centre site to the connection at 7th Avenue for the dry weather condition. The entertainment centre discharge is the same as the previous alternative (300 L / sec. – 25 min. duration) through the lift station plus the on-site domestic retail / commercial flows.

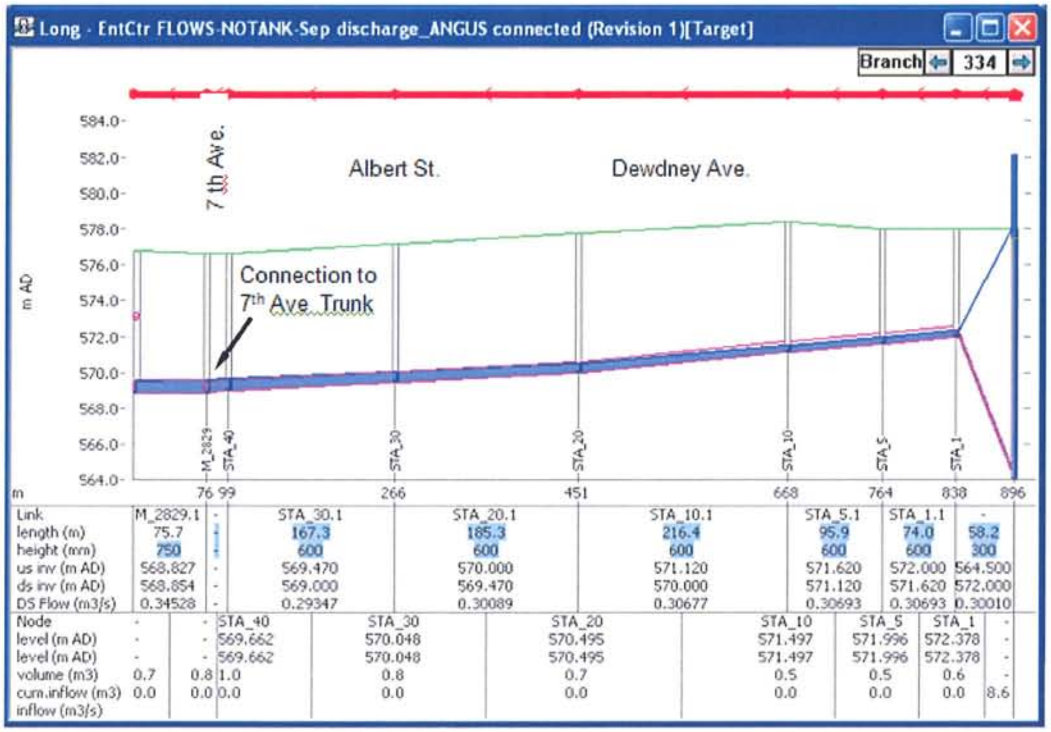


Figure 4.20 Parallel WWS from Entertainment Centre Site – Entertainment Centre DWF

The peak profiles shown in the following figures demonstrate the impact of the entertainment centre development flows for the conventional pipe servicing option along Dewdney Avenue and Albert Street for the 10 year and 25 year wet weather storm events with major event entertainment centre flows.

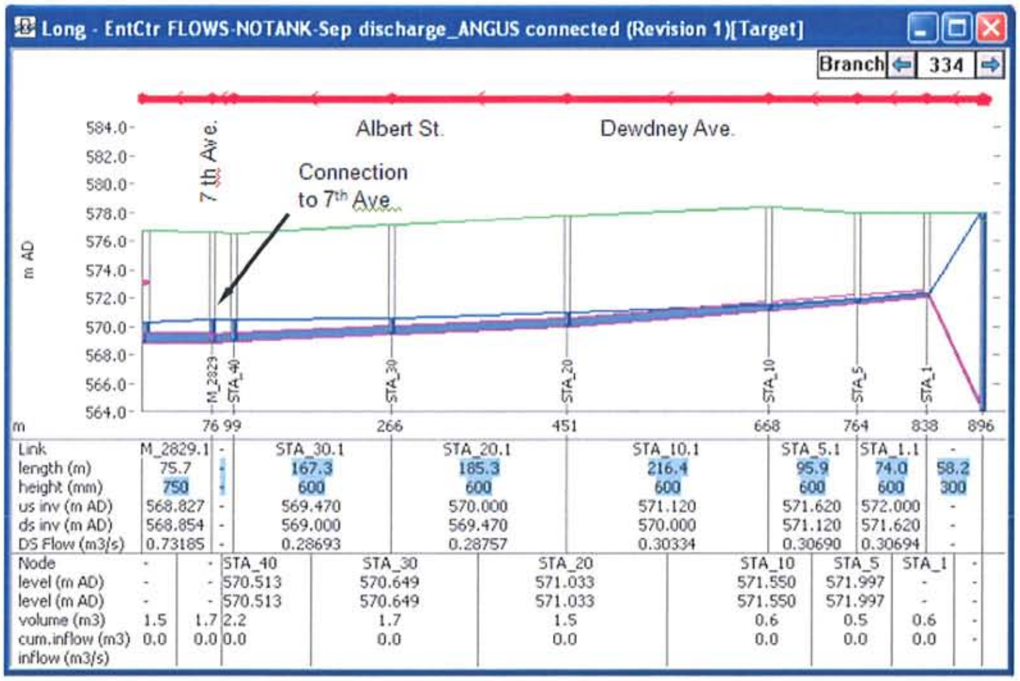


Figure 4.21 10 Year + Entertainment Centre Inflow (Peak) from Lift Station to 7th Avenue Connection

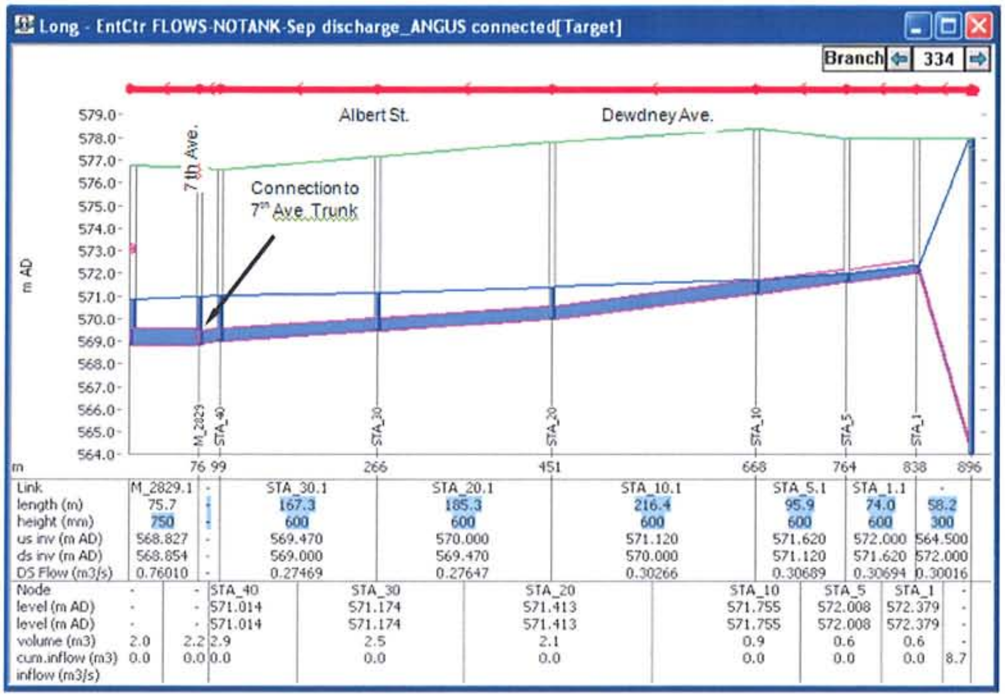


Figure 4.22 25 Year + Entertainment Centre Inflow (Peak) from Lift Station to 7th Avenue Connection

The following profile shows the impact on the 7th Avenue trunk with the additional contribution from the entertainment centre development for the 10 year rainfall event. Immediately below is the same profile under existing conditions. We can see that there is a very slight increase in the HGL along the 7th Avenue trunk itself but also a slight decrease along the top sections along Albert Street and Dewdney Avenue due to the reduction in I&I, i.e. the new development will have a tighter wastewater system than the existing system.

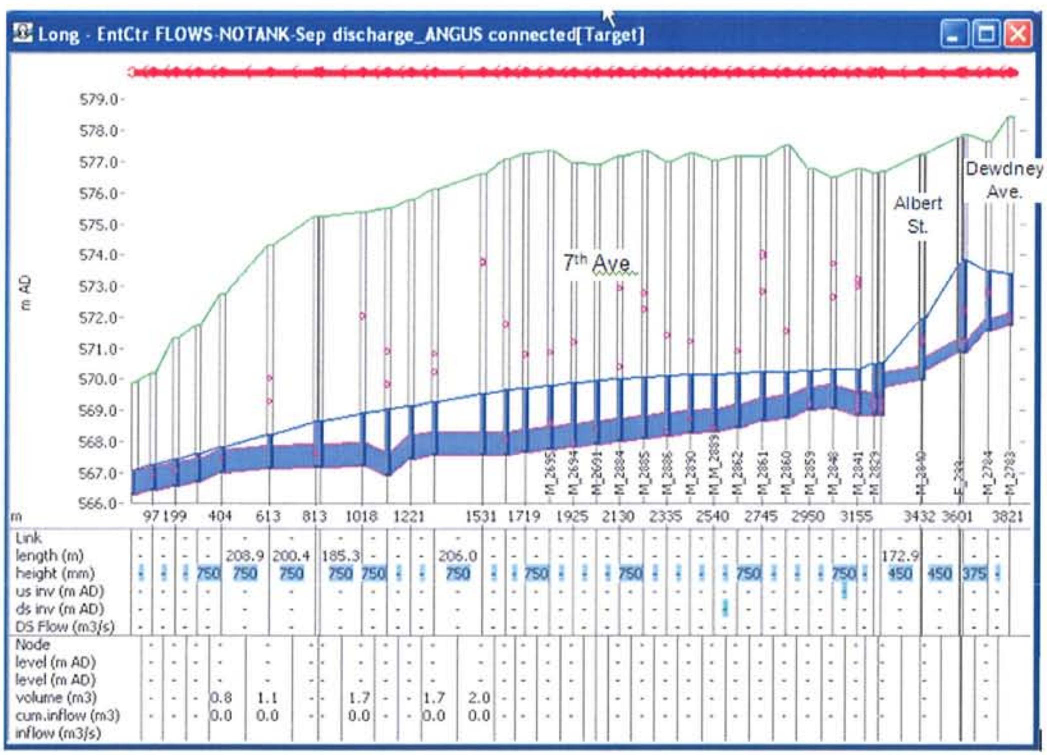


Figure 4.23 7th Avenue Trunk Profile (10 Year + Entertainment Centre Inflow)

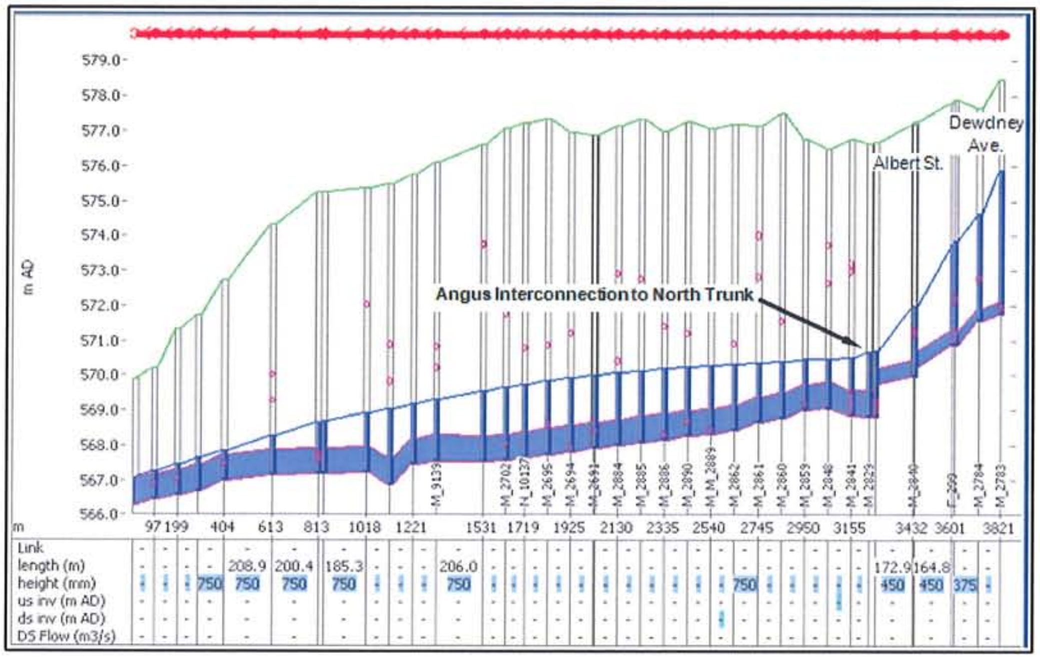


Figure 4.24 7^{th} **Avenue Trunk Profile (10 Year – Existing Conditions)**

The following profile shows the impact on the 7^{th} Avenue trunk with the additional contribution from the entertainment centre development for the 25 year rainfall event. Again we can see that the HGL with the addition of the flows from the entertainment centre complex does not have a large impact on the 7^{th} Avenue trunk.

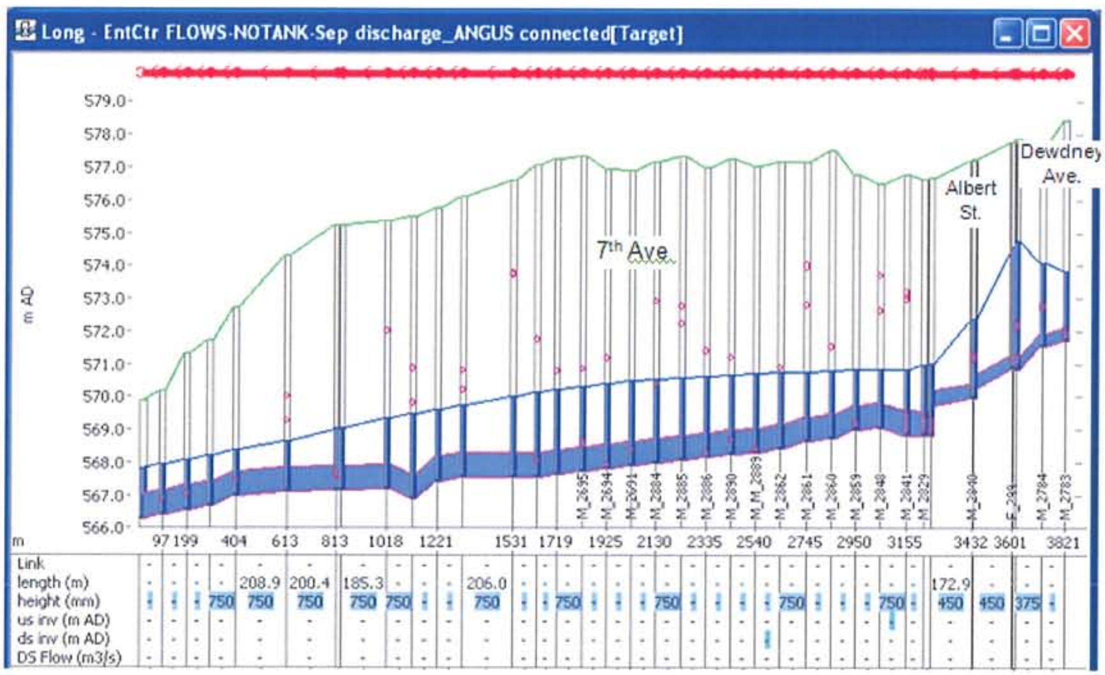


Figure 4.25 7^{th} **Avenue Trunk Profile (25 Year + Entertainment Centre Inflow)**

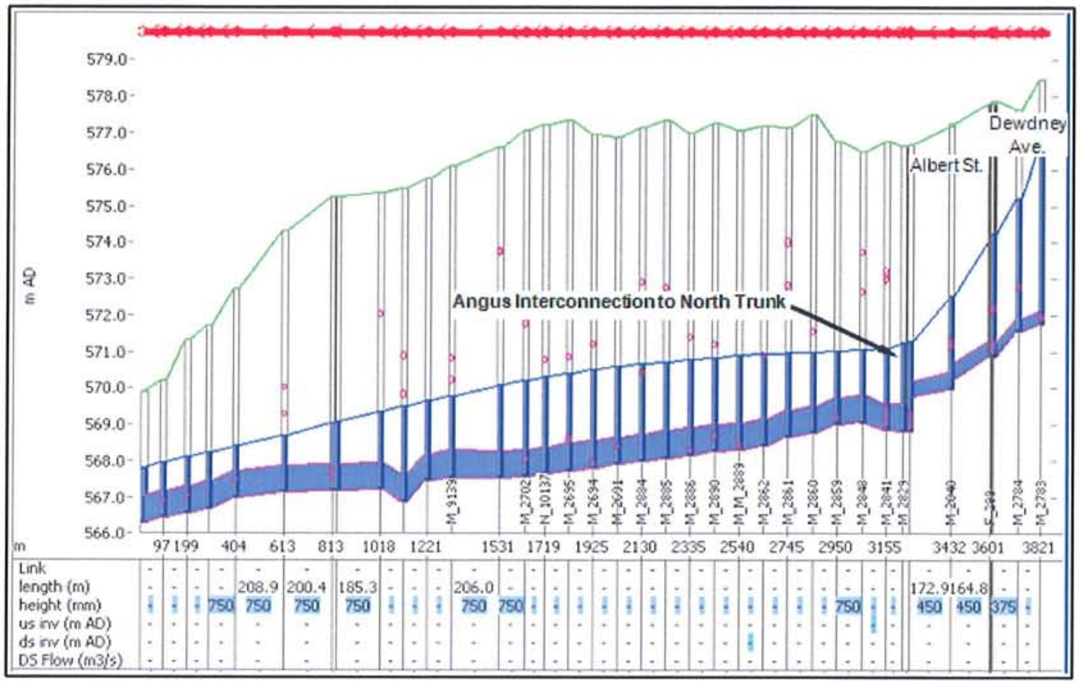


Figure 4.26 7th Avenue Trunk Profile (25 Year Existing Conditions)

Local on-site commercial wastewater service is also modelled as per the previous alternative. The estimated population of the commercial development for the site was 400 persons at 225 lpcd. An extraneous flow of 31,000 L/H/day was directed to the internal WWS system as a base flow.

Figure 4.27 shows internal site commercial / retail piping and discharge piping from the site to the connection to the existing system at 7th Avenue.

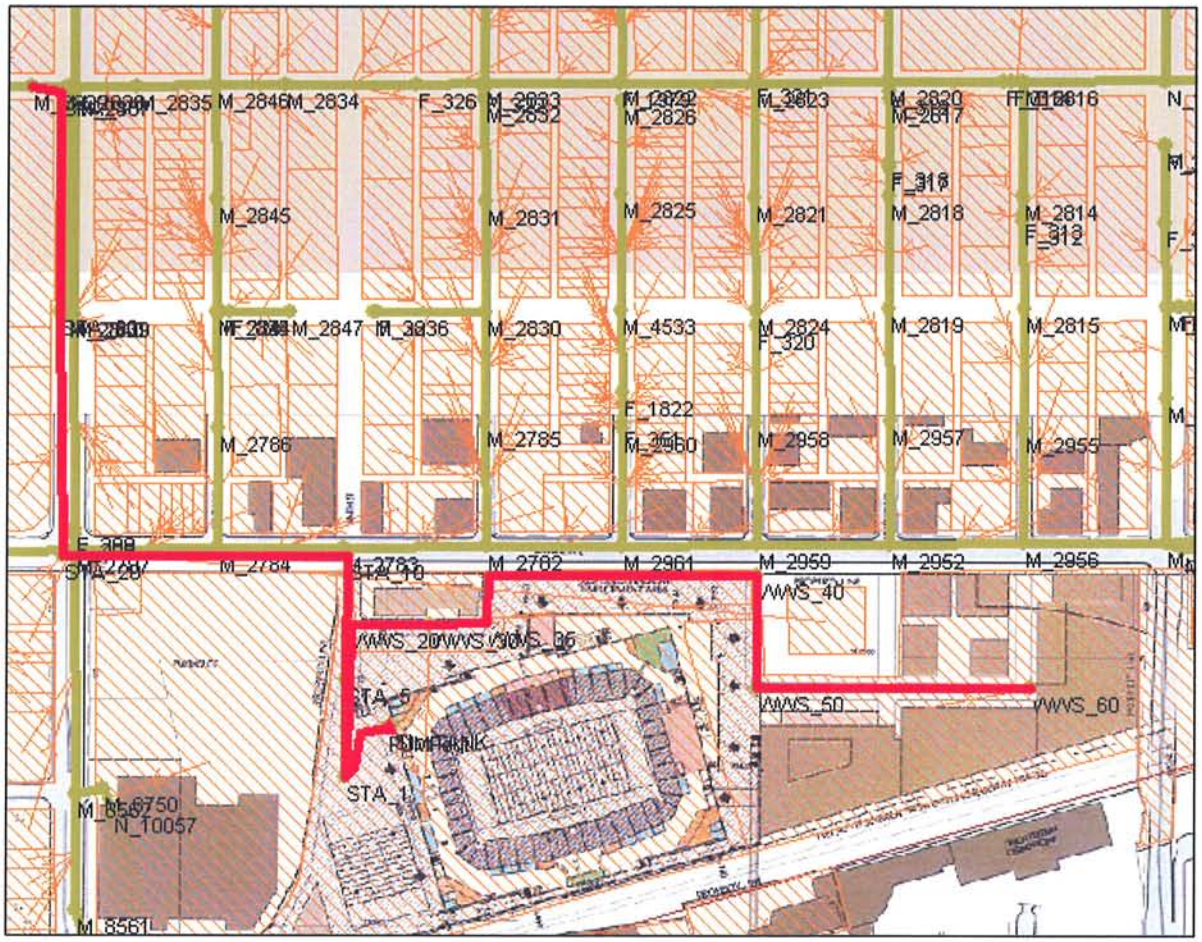


Figure 4.27 Alternative 2: 200 mm Internal Wastewater Sewers and 600 mm Discharge Main

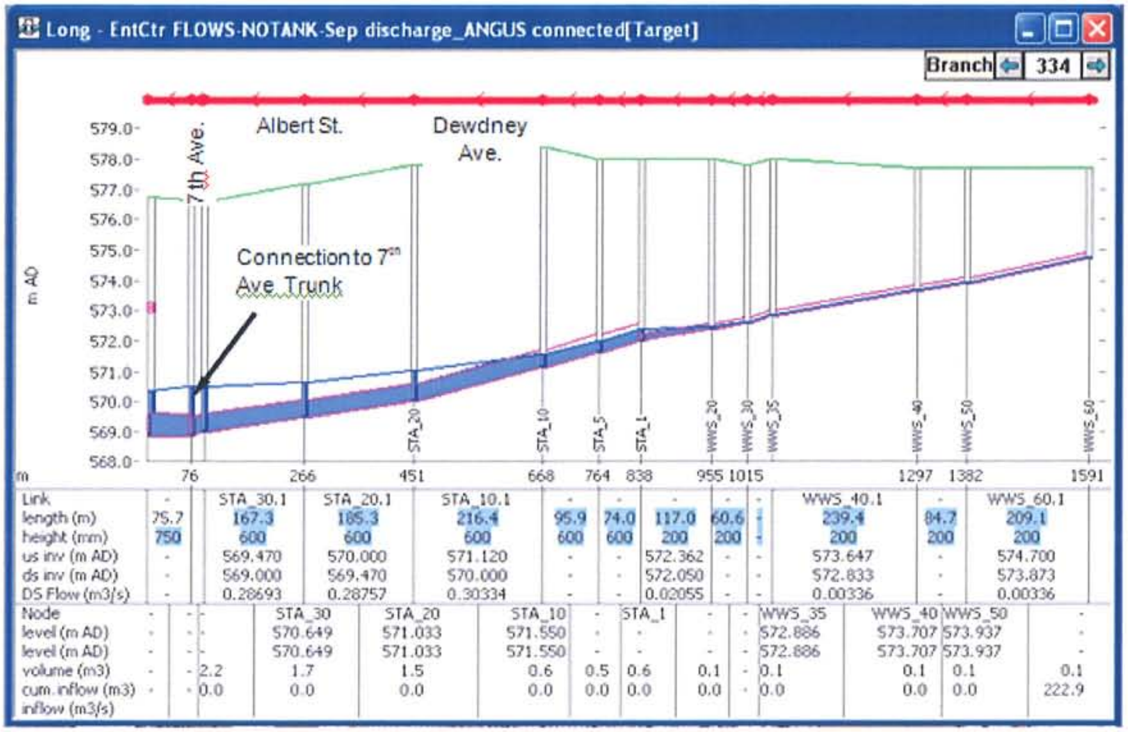


Figure 4.28 10 Year + Peak Entertainment Centre Inflow and Retail WWS to 7th Avenue Connection

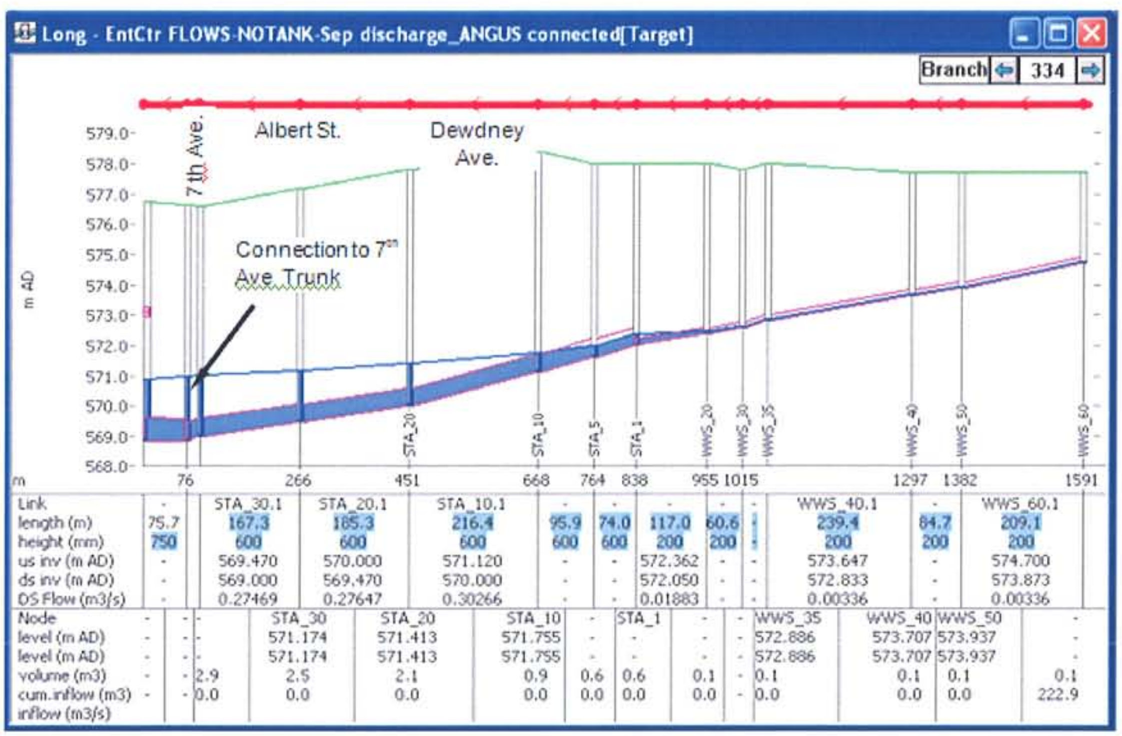


Figure 4.29 25 Year + Peak Entertainment Centre Inflow and Retail WWS to 7th Avenue Connection

4.6 Conclusions and Recommendations

Based on information provided by SCI, the peak wastewater generated by the new 50,000 seat entertainment centre and ancillary development at full development is estimated to be between 200 L/s and 250 L/s (calculated at 232 L/s). The total volume of wastewater for a 50,000 seat entertainment centre complex is estimated to be in the order of 900 cubic metres over a 24 hour period and roughly 350 cubic metres during the 25 minute intermission period peak.

For a 33,000 seat entertainment centre, the peak wastewater generated by the new facility is estimated to be between 100 L/s and 150 L/s (calculated at 129 L/s). The total volume of wastewater for a 33,000 seat entertainment centre complex is estimated to be in the order of 640 cubic metres over a 24 hour period and roughly 200 cubic metres during the 25 minute intermission period peak.

The entertainment centre complex may be configured below grade and therefore, we have assumed a lift station to accommodate the facility's flows. A lift station with a firm capacity approaching the peak intermission period flow rate will have a total station capacity of roughly 300 L/s for a 50,000 capacity entertainment centre and 200 L/s for a 33,000 capacity entertainment centre. For the 25 minute peak intermission period, we have assumed that this is the flow rate that will be pumped into the proposed wastewater collection system from the development.

The City's existing surrounding wastewater collection system does not have adequate capacity to accommodate the new facility. We have shown that the surrounding area is already susceptible to significant high surcharged sewers under wet weather flow conditions and there will likely be significant impact to existing development in the area if measures are not taken to mitigate against these high surcharges.

We have reviewed two separate configurations for servicing the site: Alternative 1 – On-Site Storage Servicing Concept and Alternative 2 – Conventional Pipe Servicing Concept, both of which have their advantages and disadvantages. The on-site storage option effectively limits the outlet flows from the proposed development to discharges that can be accommodated by the surrounding wastewater collection system without causing significant impacts. This is the lower capital cost alternative with an estimated construction cost of $3.8M for a 50,000 capacity entertainment centre and $2.9 M for a 33,000 capacity complex. On-site storage however, has long-term maintenance issues and costs. Because of the nature of the proposed development, i.e. likely a significant proportion of restaurants and bars, not to mention the fast food options that will be available in the entertainment centre complex itself, we are concerned about the amount of fat, oil and grease (FOG) that may find its way into the storage elements.

Similarly, the conventional pipe option (Alternative 2) has been extended to 7th Avenue trunk to try and mitigate against potential impacts to the surrounding wastewater collection system. The capital cost of Alternative 2 is $4.8M for the 50,000 seat entertainment centre and $4.2M for the 33,000 seat entertainment centre. The long-term costs however, are likely significantly less than the on-site storage option. The impacts of a tie-in at 7th Avenue, as this servicing review suggests, are less than what they would have been had the system been tied in to the local sewer system but until the citywide wastewater modelling analysis is complete, we will not know the full impacts of the entertainment complex on the City's wastewater interceptor trunk system.

The City should therefore consider the following recommendations as the project evolves:

- In the interim, plan the layout of the entertainment centre facility based on the on-site storage option (Alternative 1) since this option presents the most difficulty in implementation with regards to space requirements.

- Consider the recommended alternative to be the conventional pipe servicing option (Alternative 2) and set aside enough budget for this option. The construction value has been estimated at roughly $4.8M for the 50,000 seat complex and $4.2M for the 33,000 seat complex. Alternative 2 presents the least amount of risk in terms of long-term maintenance issues and cost.

- As the citywide wastewater interceptor model is developed, revisit the conventional pipe servicing option and see if there are any changes in the potential impacts or if there are other opportunities or reasons to upgrade the 7th Avenue trunk.

5. Stormwater

5.1 Design Basis

The catchments containing the proposed multi-use facility belong to a much larger watershed which contributes to Wascana Creek. This study does not examine the entire watershed but looks at a number of smaller catchments directly affected by the development. These catchments have a combined area of approximately 15 hectares.

The multi-use facility site is situated on a hill and sheds water in three directions as shown on **Figure 5.2.** Lands to the north of the hill generally drain towards Dewdney Avenue where low flows are intercepted by a number of catch basins along the south side of Dewdney Avenue. Flows in excess of the minor system (pipe network) capacity are routed overland through street flow. These overland flows from the northern portion of the land are routed in two directions: some of the flow is routed west to Albert Street and south to the Albert Street rail underpass, and some is routed east to Broad Street and south to the Broad Street rail underpass. Flows from the southeast portion of the site are routed toward the Broad Street rail underpass either through the minor system, overland or through the water table. Similarly, flows from the southwest portion of the site are routed west toward the Albert Street rail underpass. As the Albert Street and Broad Street underpasses are low points in the stormwater major system (overland flow system), any runoff contributing to these areas must be pumped into the minor system via stormwater lift stations.

5.1.1 Design Storm

The design storm applied to this stormwater analysis was the City of Regina 1 in 100-year Chicago Distribution based on the Regina annual (summer) Intensity Duration Frequency (IDF) curve developed for the City of Regina by KGS Group. The design storm used a time increment of 5 minutes resulting in a peak rainfall intensity of 245.89 mm/hr and a total rainfall of 120.6 mm. The duration was set to 1,440 minutes (24 hours). The design storm hyetograph used for the stormwater analysis is shown in **Figure 5.1.**

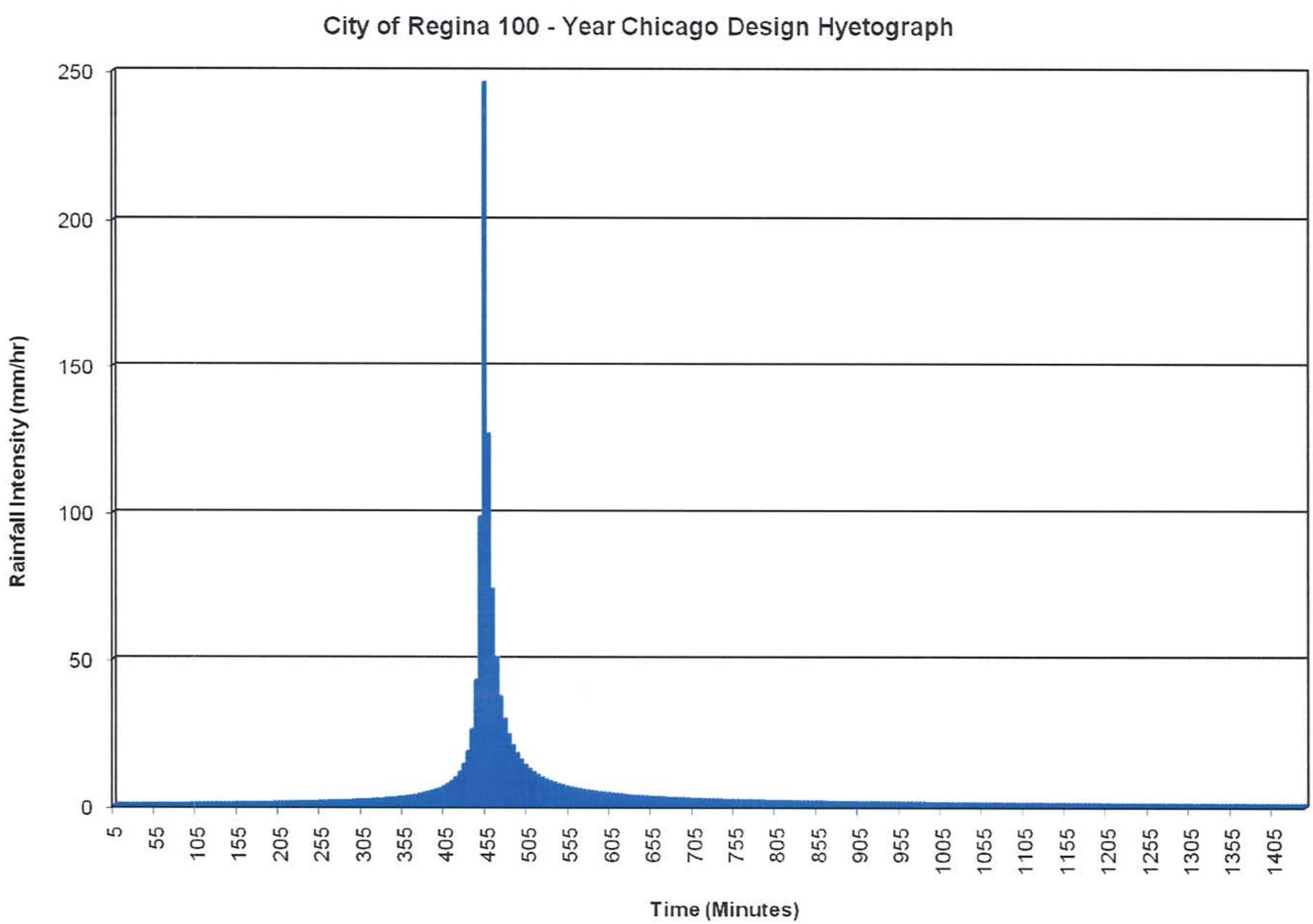


Figure 5.1 100-Year Chicago Design Hyetograph

5.1.2 Stormwater Modelling Platform and Parameters

The XPSWMM modelling platform was used to determine pre-development and post-development flows and volumes for the stormwater management facilities (storage elements). The model parameters used for the non-linear reservoir routing (runoff) method in XP-SWMM were based on previous studies completed for the City of Regina and are given in **Table 5.1.**

Table 5.1 XPSWMM Model Parameters

Component	Parameter	Value
Impervious Area Runoff	Depression Storage	6.0 mm
	Manning's "n"	0.015
Pervious Area Runoff	Depression Storage	12.0 mm
	Manning's "n"	0.25
Horton Equation	Maximum Infiltration Rate	43.94 mm/hr
	Minimum Infiltration Rate	7.62 mm/hr
	Decay Rate of Infiltration	0.00115 sec^{-1}
Percent Impervious	Existing Rail Yard	40%
	Existing Commercial	95%
	Future Commercial	70%
	Future Stadium / Parking	100%
	Future Park Space	7%

In the existing system analysis, the rail yard site was evaluated assuming a percent impervious of 40%. This is a typical value for a rail yard area and accounts for the fact that a large percent is paved (100% impervious), another large percent is gravel (approximately 13% impervious) and a very small percent is vegetated (0% impervious).

Analysis for the future development is based on the land use and layout depicted in **Figures 5.3 and 5.4.** The analysis also assumes the proposed business development is done in such a manner so as to provide a percent impervious of 70%, typical for business development in neighbourhood areas; public parks have a percent impervious of 7%, typical for parks and cemeteries; and the stadium, practice field, potential structured parking facility and bus parking area are 100% impervious.

The future development minor system was sized using the Rational Method and an in-house Rational Method spreadsheet.

5.2 Pre-Development – Existing Conditions

The existing rail yard is very flat with informal on-site detention and characteristically poor drainage, resulting in a relatively saturated yard over extended periods during wet weather events. The existing drainage patterns are depicted on **Figure 5.2.** The outcome of the existing system analysis was that the existing minor storm system in the area has very little capacity. Based on modelling, the 1 in 2 year rainfall event will cause surcharging of the pipe network and minor surface flooding. Existing upgrades to the system, including nearby storage elements, support these findings.

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Existing Conditions
Drainage Patterns
Figure - 5.2

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5.3 Post-Development – Future Conditions

Under the proposed development as shown in **Figures 5.3 and 5.4,** the overall imperviousness of the site will increase, leading to larger peak runoff rates and increased runoff volumes. In order to better manage the site runoff and required storage, it is recommended that stormwater storage be contained along the north side of the site to limit flows entering the Albert Street and Broad Street underpasses, which would put additional loading on the existing lift stations. Due to an existing 2,400 mm corrugated steel pipe stormwater storage element on the south side of Dewdney Avenue, which runs from the intersection of Dewdney Avenue and Broad Street to the intersection of Dewdney Avenue and Cornwall Street, the optimal connection points in the existing minor system are at the intersections of Dewdney Avenue and Cornwall Street and Dewdney Avenue and Lorne Street. A small catchment in the southwest of the site containing potential bus parking, which would be difficult to drain north, could tie-in at the Albert Street underpass.

Due to the minimal capacity of the minor system, a post-development release rate was determined based on 75% of the capacity of the minor system pipes at the tie-in locations. Modelling of this release rate shows some surcharging of the minor system but does not indicate surface flooding conditions under the 1 in 2 year rainfall event. Rainfall runoff in excess of the release rate will need to be detained until it can be released into the existing minor system.

Based on the limited capacity of the existing minor system in the area, and the City of Regina standard to provide a minor system capable of managing the 1 in 5 year rainfall event and a major system capable of managing the 1 in 100 year event, large amounts of on-site detention will be required. The on-site detention required to detain the 1 in 100 year event is approximately 9,400 m^3. This volume will be dependent on the level of effort put into technologies capable of decreasing site runoff.

The proposed detention facilities will provide a remedy for two problems: (1) proper collection and disposal of surface water from the site and (2) allow the site to better meet City stormwater requirements in the surrounding area during major and minor rainfall events.

We have developed two preliminary conceptual stormwater systems with on-site storage as shown in **Figures 5.3 and 5.4.** Following are some key points regarding the stormwater system.

5.3.1 Alternative 1 – Pipe Storage Elements

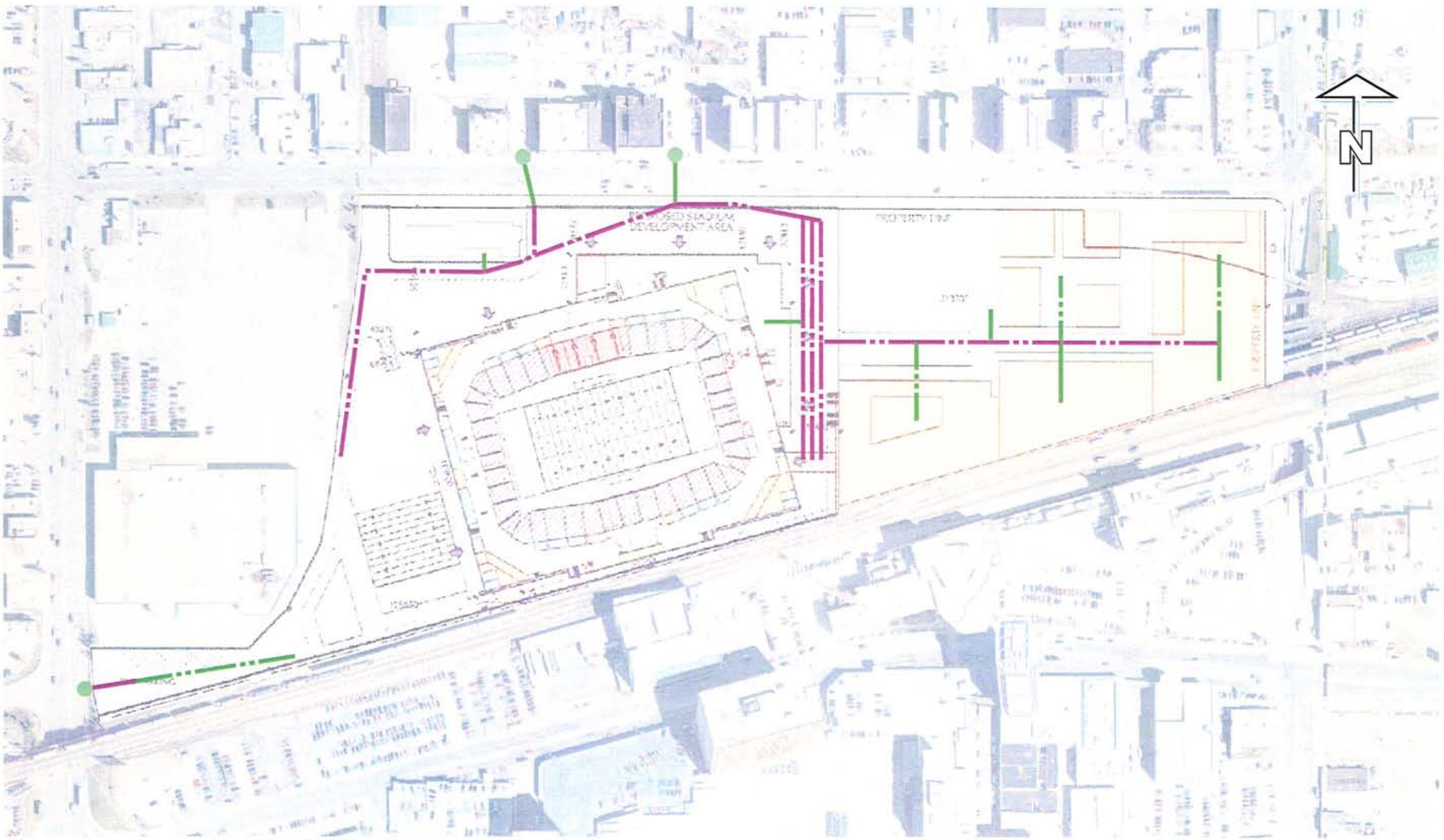
- The on-site stormwater storage in **Figure 5.3** represents a 3,000 mm oversized storm sewer. The total length of the storage pipe is approximately 1,281 m.

- The storage elements tie into the existing minor system at three locations. The east storage element ties into a 300 mm pipe at the intersection of Dewdney Avenue and Cornwall Street. The northwest storage element ties into a 300 mm pipe at the intersection of Dewdney Avenue and Lorne Street. The southwest storage element ties into a 250 mm pipe in the Albert Street underpass.

- Total storage required is approximately 9,400 m^3.

- Storage available in the storage elements accounts for 100% of the regional storage required. Potential reductions in volume and cost may be achievable if a portion of the required storage is made the responsibility of individual developers. This storage can come directly from storing the water in parking lots or other types of storage cells, or through development that reduces runoff, i.e. green roofs and porous pavers.

- The concept represented in **Figure 5.3** will require the use of stormwater lift stations at each of the tie-in points on Dewdney Avenue due to the elevation of the existing system.



LEGEND

- PROPOSED MAJOR STORM PIPE NETWORK
- PROPOSED MAJOR STORM SUBSURFACE STORAGE ELEMENTS
- EXISTING MAJOR STORM PIPE CONNECTION

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Proposed Stormwater System
Storage Pipes
Figure - 5.3

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5.3.2 Alternative 2 – Tank Storage Elements

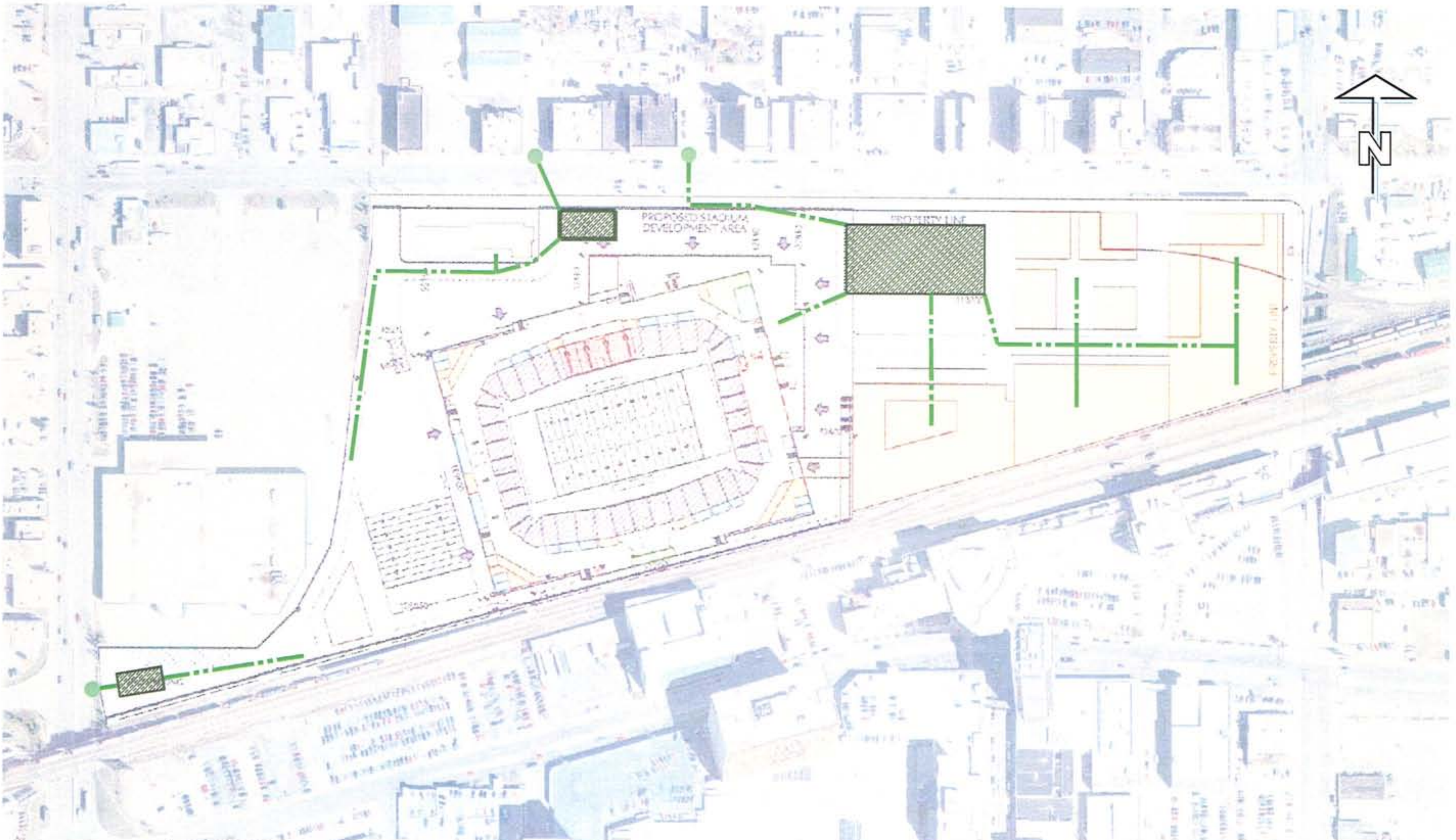
- The on-site stormwater storage in **Figure 5.4** represents storage modules such as the Brentwood Storm Tank manufactured by Brentwood Industries. The east section of storage has a volume of approximately 7,800 m^3, the northwest section is approximately 1,150 m^3 and the southwest section is approximately 400 m^3.

- The storage elements tie into the existing minor system at three locations. The east stormwater system ties into a 300 mm pipe at the intersection of Dewdney Avenue and Cornwall Street. The northwest stormwater system ties into a 300 mm pipe at the intersection of Dewdney Avenue and Lorne Street. The southwest storage element ties into a 250 mm pipe in the Albert Street underpass.

- Total storage required is approximately 9,400 m^3.

- As in Alternative 1, the storage available in the storage elements accounts for 100% of the regional storage required. Potential reductions in volume and cost may be achievable if a portion of the required storage is made the responsibility of individual developers. This storage can come directly from storing the water in parking lots or other types of storage cells, or through development that reduces runoff, i.e. green roofs and porous pavers.

- The concept represented in **Figure 5.4** will require the use of stormwater lift stations at each of the tie-in points on Dewdney Avenue due to the elevation of the existing system.



LEGEND

- PROPOSED MAJOR STORM PIPE NETWORK
- PROPOSED MAJOR STORM SUBSURFACE STORAGE ELEMENTS
- EXISTING MAJOR STORM PIPE CONNECTION

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Proposed Stormwater System

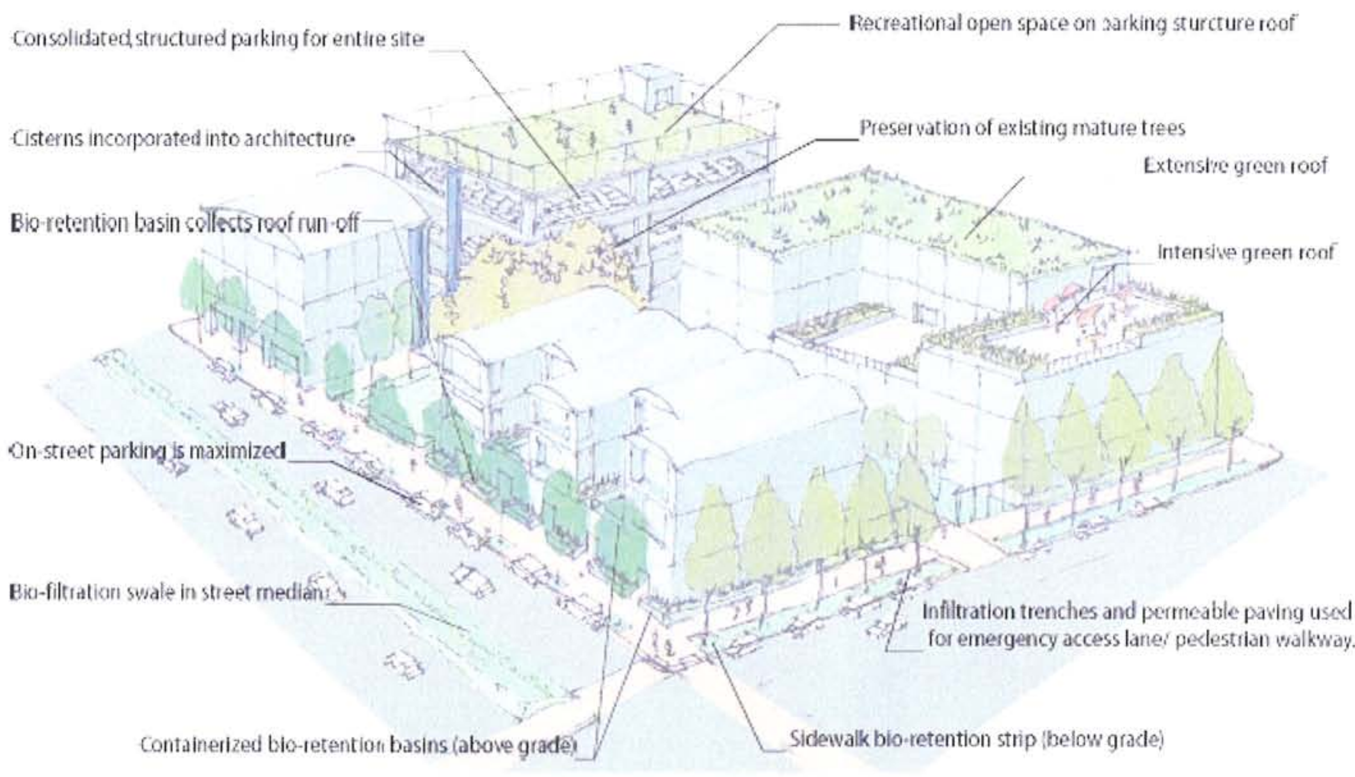
Storage Tanks

Figure - 5.4

AECOM

5.4 Regional Storage Reduction through Green Technologies

The storage volumes allotted for in Alternatives 1 and 2 account for 100% of the required storage. In order to reduce the required regional storage, the City has a number of options. Although the layout of the proposed development areas shown in **Figures 5.3 and 5.4** does not depict buildings and parking lots, it is assumed the areas will need to accommodate a large amount of traffic / parking. In order to reduce the amount of runoff from these sites, a number of stormwater Best Management Practices (BMPs) can be implemented. Based on the United States Environmental Protection Agency document, "Post-Construction Runoff Control Minimum Control Measure", these methods generally come in two forms: Non-Structural BMPs and Structural BMPs. Non-Structural BMPs consist of (i) Planning Procedures, such as master plans and zoning ordinances, which protect sensitive areas from development and (ii) Site-Based BMPs, such as riparian zone preservation, which limit disturbance and imperviousness. In essence, Non-Structural BMPs maintain pre-development conditions to limit the effect of development. Structural BMPs consist of (i) Stormwater Retention / Detention BMPs, such as dry/wet ponds, which control stormwater through detaining runoff up to the design event and releasing it at a rate, which the downstream system is capable of conveying, (ii) Infiltration BMPs, such as infiltration basins and porous pavement, which facilitate percolation of runoff into the water table and (iii) Vegetative BMPs, such as grass swales, artificial wetlands and rain gardens, which are landscaping features designed to remove pollutants and facilitate percolation of runoff into the water table.



The most applicable BMPs for the proposed multi-use facility are Structural BMPs as the site is currently developed and does not contain sensitive zones such as riparian areas. Of the Structural BMPs, the two which are most likely to be feasible for this site are Infiltration BMPs and Vegetative BMPs. Although Stormwater Detention / Retention BMPs have been in use within the City of Regina for many years now, their use in infill / redevelopment is generally discouraged due to the amount of space they require and the limitations they put on that space.

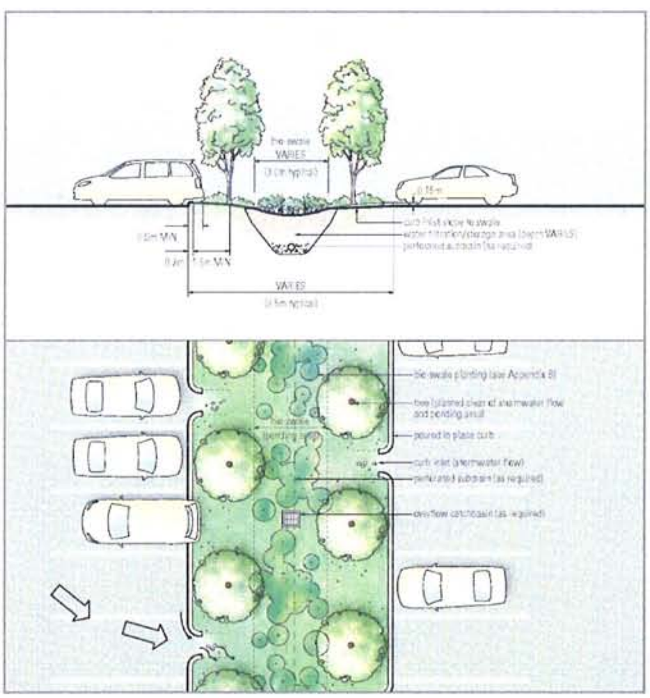
Some examples of Infiltration BMPs that could be integrated into the site include:

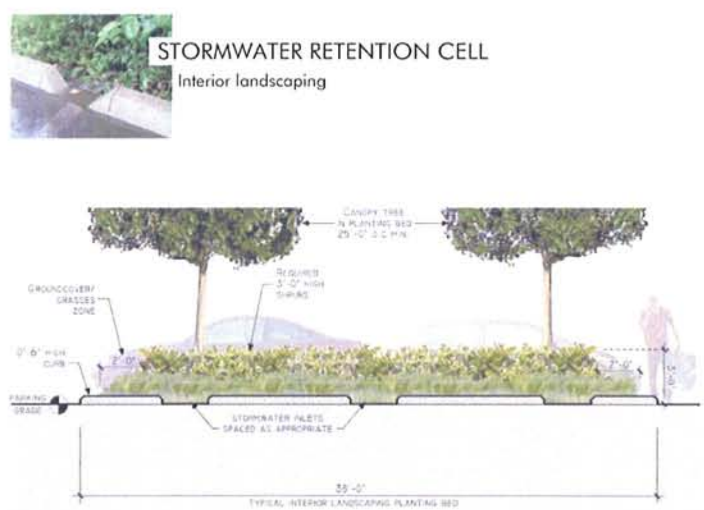
- Porous Pavement
    - Permeable / porous pavements, including open joint pavers, turf grids, porous asphalt and porous concrete allow water to pass through the paved surfaces into a specially designed subgrade gravel bed or other porous media, such as structural soil.

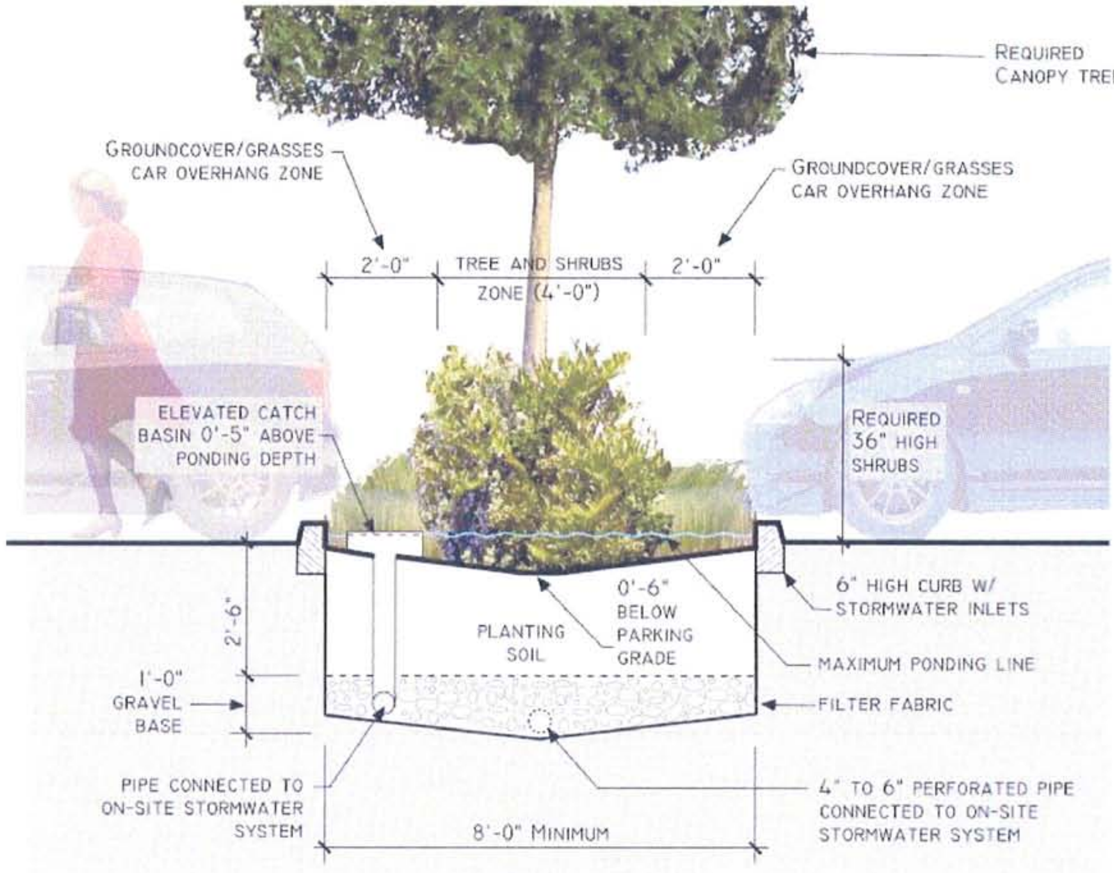
- Infiltration Trenches
    - Infiltration trenches (a.k.a. infiltration galleries and infiltration basins) are trenches filled with large granular material which store water in the void space during a rainfall event and allow it to percolate into the soil matrix.

Some examples of Vegetative BMPs that could be integrated into the site include:

- Vegetated Bio-retention Cells
    - Bio-retention cells (i.e. rain gardens, pocket parks and modified tree pits) are effectively islands or medians that have been lowered as opposed to raised, relative to the surrounding impervious surfaces. They usually incorporate curb cuts that allow the runoff to enter the retention cell area with the runoff slowly percolating into the subgrade for most rainfall events.



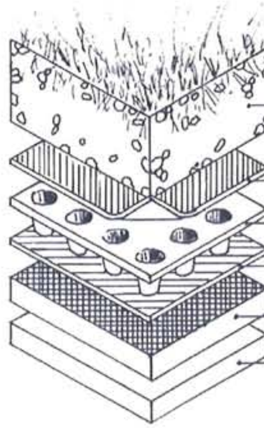




- Vegetated Swales
    - Vegetated or grassed swales are open channels generally constructed alongside roads to convey, filter and increase infiltration of stormwater runoff. Vegetated swales should be planted with erosion and flood resistant plant species. Check dams can also be installed in vegetated swales to promote infiltration and increase storage.

Grassed swales can be used along roadsides and parking lots to collect and treat stormwater runoff

- Green Roofs
  - Green roofs are building roofs partially or completely covered in vegetation. In addition to reducing building heating and cooling costs, green roofs reduce peak stormwater runoff flows and filter pollutants found in rainwater.



5.4.1 Green Technology Operation and Maintenance

5.4.1.1 Porous Pavement

Operation and maintenance associated with porous pavement includes vacuum sweeping up to four times per year in order to remove debris from the pore space. Following vacuum sweeping, the surface should be high pressure washed to remove any grit left on the surface that could cause clogging. Within the first few months after installation the surface should be inspected several times. After the initial inspections, the surface should be inspected annually and after large rainfall events when puddles could form, indicating potential clogging problems. In the event of severe clogging that cannot be remedied with vacuum sweeping, permeability can be restored by drilling 13 mm (1/2") holes every few feet in the problem area.

5.4.1.2 Infiltration Trenches

Infiltration trenches require regular maintenance including cleaning and removal of debris after large rainfall events and mowing and cleaning of the contributing areas upstream of the trench. Additional maintenance requirements include removal of accumulated sediment in any forebays if applicable every 3 to 5 years or when 50 to 60% of the original volume has been lost and removal of accumulated sediment from the main trench every 20 years or when 50% of the original volume has been lost.

5.4.1.3 Vegetative BMPs

The operation and maintenance associated with vegetative BMPs for most applications is similar to that of any other landscaped area. Areas should be inspected one to two times per year to ensure plant health and remove / replace any dead or diseased vegetation. Areas such as vegetated swales should be mowed and cleared of debris as needed and bio-retention cells should have mulch added to areas where it has been washed away. Mulch replacement may be required in bio-retention cells approximately every 3 years. Vegetative BMPs may require application of limestone or another alkaline product to counteract the effect of slightly acidic precipitation. Soil testing should be carried out in vegetative BMPs to determine if pH adjustment is required and to what degree. In the long term, bio-retention areas exposed to large amounts of pollutants may reach toxic concentrations for plant life. If this occurs, the soil will need to be removed or remediated.

5.5 Conclusions and Recommendations

As per the City of Regina Development Standards Manual, it is a requirement to provide a minor system capable of accommodating the 1 in 5 year rainfall event, as well as a major system capable of accommodating the 1 in 100 year rainfall event. In order to meet these requirements, two design alternatives were examined, each capable of detaining a volume of approximately 9,400 m^3. Alternative 1 examines the use of a stormwater system with 3,000 mm oversized mainlines used as storage elements to detain runoff in excess of the capacity of the surrounding minor system for a rainfall event up to the 1 in 100 year event. The alignment of the minor system and the 3,000 mm storage elements in respect to the stadium is shown in **Figure 5.3**. Alternative 2 examines the use of a minor system designed to accommodate the 1 in 5 year rainfall event with designated storage tanks at three locations around the site. As is the case with Alternative 1, the storage elements in Alternative 2 are sized to accommodate runoff in excess of the capacity of the surrounding minor system for a rainfall event up to the 1 in 100 year event. The alignment of the minor system and the storage tanks in respect to the stadium is shown in **Figure 5.4**.

The Class 'D' cost associated with providing a minor system capable of accommodating the 1 in 5 year rainfall event, as well as a major system capable of accommodating the 1 in 100 year rainfall event with linear storage (3,000 mm oversized sewer pipe) is approximately $9.7M. The cost to accommodate the same level of service with designated on-site storage through the use of storage tanks in park spaces is approximately $8.4M.

The difference in cost between Alternative 1 and Alternative 2 of $1.3M is significant, but needs to be balanced with the fact that these areas will become encumbered by these facilities and will no longer be available for future development, or will be limited to very specific types of development, such as parks or surface parking. This may or may not be a major consideration for the City. The other issues to consider regarding the tank alternative is the limited amount of information available for long term maintenance costs and safety constraints, i.e. confined space entry requirements. There will likely be only a limited amount of opportunity to gain access to these tanks. With the linear oversized pipe storage option, gaining access would be a simple matter of providing a sufficient number of manholes. City personnel would be more familiar with the confined space entry requirements and maintenance procedures for these types of facilities.

6. Conclusions and Recommendations

6.1 Transportation

The transportation analysis was a major component of the study. The analysis considered both day-to-day operations for the entire study area and peak event operations at the entertainment centre facility. Section 2 - Transportation provides an assembly of suggested system options that should be considered by the City to address short and long term demands related to parking, traffic management, transit, and pedestrian and bicycle access, as well as identification of proposed improvements that are deemed necessary in addressing transportation demands associated with the entertainment facility. The following is a summary of findings and listing of proposed recommendations that should be considered by the City in subsequent phases of design. Level 'D' cost estimates were only provided for those recommendations deemed necessary for successful implementation of the plan as proposed by the design consultant.

6.1.1 Parking Demand

Based on existing traffic and parking data collected at Mosaic stadium events last fall, key design criteria was developed for use on the proposed entertainment facility. It was determined that patrons on average would walk upward of 1,100 metres from a parking spot to the entertainment facility. It was also forecasted that transit ridership would increase slightly due to loss of parking availability immediately around the proposed entertainment centre facility.

Estimated parking demand for a 33,000 seat and 50,000 seat entertainment facility is approximately 10,300 vehicles and 13,700 vehicles, respectively. The availability of parking in the Old Warehouse District and Downtown areas is important in meeting peak event parking demands. It is expected that 40% of parking demand will be accommodated within the Old Warehouse District and 35% accommodated in the Downtown area. In addition, the Cathedral area will accommodate 9% and the Heritage area (formerly Core area) will accommodate 5%. There is also a desire to accommodate some on-site parking for event and staff parking and to address accessibility and safety needs. Provision has been made for an underground parking structure on the site which may address some of these needs.

Full details of the parking demand analysis and all recommendation are found in Section 2.1 - Parking Demand. The following is an abridged version of parking demand recommendations that the City should therefore consider as the project evolves:

- Consider retention of most on-street parking restrictions in the North Central residential neighbourhood during game day.
- Consider consulting businesses and residential owners in the Old Warehouse District area to determine an appropriate parking plan during events and establish what mitigation can be provided for those impacted.
- Consider establishment of handicapped parking and taxi loading areas for the entertainment centre. These issues have not been addressed at this level of review but will need to be addressed as part of a comprehensive parking plan.
- Consider an exemption to the two hour parking limit at downtown meters for major weekend events, pending further study related to the existing on-street occupancy on Saturdays. Note that any change to the two hour limit should also be considered in consultation with the downtown businesses.
- Construction of an all-weather pedestrian connection between the downtown and the proposed entertainment centre is required at two or more locations. The estimated construction cost of an all-weather pedestrian connection over the rail lines is approximately $5M per structure.
- Consider metered parking on the south side of Dewdney Avenue between Smith Street and Hamilton Street. The four block faces would provide approximately 44 stalls in front of the facility.
- Consider development of a parking structure. This option, if established in an overall plan with the adjacent private development, could provide parking for staff as well as patrons of the adjacent development.
- Consider development of nearby surface parking lots by purchasing or leasing property within the Old Warehouse District.

- Consider implementation of shared parking with the developments immediately east of the facility. Examples include office and commercial uses where parking lots that are used during the day could then be made available for event parking in the evening.

6.1.2 Traffic Management

The proposed entertainment centre is located near the centre of the City where certain key intersections are already reaching capacity under existing during day-to-day operations, specifically the intersections of Albert Street / Dewdney Avenue and Broad Street / Dewdney Avenue. The proposed entertainment centre and adjacent developments will put further pressure on intersection capacities for certain movements. There is limited opportunity for intersection improvements and these intersections will operate at a decreased level of service. Other north / south roadways, such as Lewvan Drive, Elphinstone Street and Winnipeg Street, may see increased traffic volumes as well. Side-street traffic adjacent to the entertainment centre is also expected to increase.

The lack of on-site parking for peak event operations will push parking into the surrounding areas, thus increasing pedestrian movements before and after major events at the entertainment centre. Analysis indicates that major intersections adjacent to the entertainment facility will experience significant delay in the post-event scenario. Major changes to network operations are not justified for peak operational issues during major events. Instead, implementation of various peak event traffic management options may be warranted.

Full details of the traffic management analysis and all recommendation are found in Section 2.2 - Traffic Management. The following is an abridged version of traffic management recommendations that the City should therefore consider as the project evolves:

- Consider completion of a full Site Impact Traffic Study for the proposed development to the east of the proposed entertainment centre in order to specifically address roadway capacity issues. Any future impact assessments should include the option of installing a traffic signal at the intersection of Albert Street and 8th Avenue.

- Consider preparation of a detailed functional design for the redesign of Dewdney Avenue for the four blocks adjacent to the proposed entertainment centre as illustrated in Figure 2.6 - Dewdney Avenue Modifications. The estimated cost for retrofitting Dewdney Avenue with wider sidewalks, narrower carriageway for traffic and traffic calming measures is estimated at $1M per block. Total estimated cost for the four block length is estimated at $4M.

- Consider route / location signage to define routes for entertainment centre access/egress during major events. Wayfinding techniques may also be employed for pedestrians for such things as access to buses.

- Consider the use of traffic control officers at key intersections to override the existing traffic control devices during major events.

- Consider turn prohibitions at key intersections during major events to reduce delays caused by conflicting traffic movements.

- Consider adjustments to signal timing at major study intersections along Albert Street and Broad Street during major events to provide priority to north / south traffic.

- Consider implementation of alternate lane operations (e.g. restrict parking in curb lanes on Albert Street and Broad Street) during major events to add capacity to major access / egress routes. It may also be desirable to keep those lanes open for bus access.

- Consider implementation of transit and satellite parking (parking far from the facility and then walking or using shuttles to access the entertainment centre) during major events.

- Consider development of a comprehensive Traffic Management Plan for Major Events manual prior to the entertainment centre becoming operational.

- Consider closure of Dewdney Avenue between Smith Street and Hamilton Street during major events. This roadway is not needed from a capacity perspective and it would serve to provide a pedestrian-only zone for crossing to and from parking spots in the Old Warehouse District.

6.1.3 Transit Recommendations

Providing public and private transit services to and from the proposed entertainment centre site will help facilitate a significantly higher transit mode share, particularly during major events. Increasing transit use to the proposed entertainment centre will generate the following key benefits:

- Serve to raise the profile of Regina Transit and likely generate new customers for the City's transit system.
- Generate more economic activity in the Downtown and Warehouse District.
- Reduce the need for expensive parking spots near the facility.
- Leverage the creation of more transit priority measures.

Full details of the transit operation analysis and all recommendations are found in Section 2.3 - Transit Operation. The following is an abridged version of transit operation recommendations that the City should therefore consider as the project evolves:

- Consider increasing the number of potential pick-up points around the City that could be used to expand transit use and accessibility to the proposed entertainment centre.
- Consider establishment of standards for adequate pick-up / drop-off facilities adjacent to the entertainment centre and on Dewdney Avenue. A minimum sidewalk / platform width of 4.5 metres is recommended.
- Consider the establishment of transit priority during major events, in the form of exclusive lanes, the exclusion of regular traffic from certain roads during events, traffic signal priority and police assistance to get through key intersections ahead of other traffic.
- Consider the expanded use of buses from First Bus Group and other private bus operators when the need for buses exceeds what Regina Transit can provide with its own fleet.
- Consider simplification of fare payment by providing event ticket holders with free access to transit, including the regularly scheduled services, before and after an event. This could possibly be done by including a "transit fee" in every event ticket which would be transferred to Regina Transit or by allowing transit pass holders free access to special event transit services.
- Consider establishment of dedicated parking adjacent to the entertainment facility for para-transit and emergency vehicles.
- Consider establishment of designated pick-up / drop-off areas for major events along Dewdney Avenue, Broad Street and Albert Street.

6.1.4 Pedestrian Access

Existing sidewalks and crosswalks in the area will not adequately accommodate special event pedestrian traffic during ingress or egress from major events at the entertainment facility. Without mitigation, pedestrians will tend to cross streets at undetermined points or spill out onto streets where they may be in conflict with traffic. The CP rail line south of the proposed entertainment centre is a constraint for moving pedestrian traffic to and from the downtown area – currently there are only two crossing locations across the tracks (Broad Street and Albert Street as part of existing underpasses). The existing facilities have limited capacity for pedestrians. The rail line is secured by fencing to prevent crossing at any locations other than the two existing underpasses.

Based on analysis and review of key desire lines for pedestrians, and as was noted in the parking demand section, a significant number of pedestrians will require access to the Downtown area. A minimum of two all-weather overhead pedestrian crossings over the CP rail line will be required to meet anticipated pedestrian demands. Combined with the two existing subway crossings at Albert Street and Broad Street, an acceptable level of service (i.e. LOS = C/D) is expected for all pedestrians crossing from to and from the downtown.

A 50,000 seat entertainment facility would generate higher pedestrian volumes during peak event operations. If a 50,000 seat entertainment centre is constructed without providing additional pedestrian capacity, the pedestrian LOS will suffer during peak events. The lower LOS may be considered acceptable, as peak events are a relatively rare occurrence. The measures recommended for a 33,000 seat entertainment centre would still provide good connectivity to the proposed development areas during day-to-day operations. In order to maintain a LOS C/D for pedestrian access for a 50,000 seat entertainment centre, the width of the overhead pedestrian crosswalks would need to be increased to 7.5 metres.

Full details of the pedestrian access analysis and all recommendations are found in Section 2.4 - Pedestrian Access. The following is an abridged version of pedestrian access recommendations that the City should therefore consider as the project evolves:

- Construction of an all-weather pedestrian connection between the downtown and the proposed entertainment centre is required at two or more locations. The estimated construction cost of a 5 metre wide, all-weather pedestrian connection over the rail lines to accommodate a 33,000 seat entertainment facility is approximately $5M per structure. There are two preferred locations for the overhead pedestrian structures:

  i. Lorne Street – An overhead pedestrian crossing at Lorne Street could start at ground level just north of Saskatchewan Drive or it could also tie across Saskatchewan Drive into the Cornwall Centre at the Bay parkade.

  ii. Hamilton Street – An overhead pedestrian crossing to the entertainment centre could make use of the existing pedestrian overpass that exists across Saskatchewan Drive at Hamilton Street (i.e. from Sears over to the Casino Regina Show Lounge). This crossing could be extended from the Casino property across the rail line to the proposed entertainment facility.

- Consider redevelopment of the historic underground train-platform access leading from Casino Regina. This link exists but investigation would be necessary to determine the extent of rehabilitation required.

- Consider improving the aesthetics and lighting for pedestrians using the Broad Street and Albert Street underpasses. It will be difficult to widen the sidewalks at these locations, but attention should be paid to these key corridors for accessing the proposed entertainment centre.

- In order to maintain a LOS C/D for pedestrian access to a 50,000 seat entertainment centre, the two proposed 5.0 metre pedestrian overpasses required for a 33,000 seat facility would need to be widened to 7.5 metres. The estimated construction cost of a 7.5 metre wide, all-weather pedestrian connection over the rail lines to accommodate a 50,000 seat entertainment facility is approximately $7M per structure.

6.1.5 Bicycle Access

The new entertainment centre would be a key destination within the City of Regina and access by bicycle should be considered through a network of on-street cycling routes. In assessing the ability to service the new entertainment centre with bicycle routes, several key issues must be considered: bikeways must be designed with provisions for continuity and logical connections. In most cases, the designated route should begin and end at another proposed or existing City of Regina on-road cycling facility, off-road pathway or an attraction (i.e. Downtown, Entertainment Facility, etc.).

The preferred cycling facility for Dewdney Avenue is an on-road cycling lane. Separate cycling lanes are usually provided where it is deemed that a shared lane (i.e. the minimum requirement) would not provide adequate protection for the cyclist from high traffic volumes. Higher-than-normal volumes on Dewdney Avenue are anticipated during special events at the proposed entertainment centre.

Full details of the bicycle access analysis and all recommendation are found in Section 2.5 - Bicycle Access. The following is an abridged version of bicycle access recommendations that the City should therefore consider as the project evolves:

- Consider construction of an on-road cycling lanes along Dewdney Avenue to tie into the City's cycling network (expected to be under review in 2010). It would be practical to consider this until such time that Dewdney Avenue is reconstructed.
- Consider the extension of cycling lanes on Lorne Street and Smith Street from Victoria Avenue to Saskatchewan Drive to improve continuity and connectivity to existing and future cycling facilities.
- Consider outfitting the proposed overpass at Lorne Street with bike ramps on either side of the stairs to make it easier for cyclists to move their bikes up and down the stairs.
- Consider the construction of End-of-Trip-Facilities at the proposed entertainment facility to encourage bicycle travel by patrons and staff.

6.2 Water

The study area is well serviced by the existing water system with a 600 mm cast iron and 200 mm PVC mains on Dewdney Avenue and close proximity to the Farrell Pumping Station located east of Broad Street. Based on fixturing information provided by the design consultant, the peak water demand for a 33,000 and 50,000 seat entertainment facility, plus the adjacent commercial area, is 81.1 L/s and 134.1 L/s, respectively. A water supply of up to 200 L/s can be provided with no significant impact to water pressures in the surrounding area.

The proposed facility is located in the Downtown area and will therefore require a minimum fire flow of 250 L/s. Modelling of the City's water system indicated that hydrant leads must be connected to the existing 600 mm water main to meet fire flow requirements. Modelling results also indicated that a single 450 mm service connection to the proposed development was sufficient to comply with City standards, including peak water demand and fire flow requirements which resulted in a maximum flow velocity of 3.2 m/s.

Some entertainment centre designs have considered a scenario where all fixtures are flushed or in use simultaneously. Preliminary modelling indicates such an event would have a significant impact on the City's water distribution system. However, the probability of occurrence is considered extremely low and would result in significant overdesign of the system. Therefore as the project evolves, the City should consider installing a flow regulating valve at the service connection to restrict the flow to no more than 200 L/s to the facility.

The City should therefore consider the following recommendations as the project evolves:

- A new 450 mm water service connection for the proposed development should be connected to the existing 600 mm water main on Dewdney Avenue. The estimated cost of installing the service connection is approximately $290,000.
- A 450 mm flow regulating valve should be installed at the entertainment centre service lead to restrict incoming flow to 200 L/s. The estimated cost of installing the flow regulating valve is approximately $110,000.
- Piping for fire flow requirements including hydrants leads must be connected to the existing 600 mm water main to comply with City standards for fire flow. An allowance for five hydrant leads has been proposed at an estimated cost of approximately $100,000.
- Consider the option of using only low flow water fixtures in the development to reduce water demands.
- Consider the option to supply the proposed development using more than one service connection, to address redundancy concerns related to water supply.

- Consider the option to supply the entertainment centre using more than one service connection to provide redundancy specifically to the building.
- Consider the option of installing separate service connections for water supply and fire flow requirements to the entertainment centre building.

6.3 Wastewater

The local wastewater collection system is comprised of 375 mm to 450 mm wastewater conduits along Dewdney Avenue and Albert Street. The wastewater system near the study area is characterised by significantly high inflow and infiltration (I&I) rates which creates surcharge conditions under wet weather flow events for both 10 and 25 year storm scenarios. The other design consideration is that the peak wastewater loading that will be generated by the entertainment centre facility during a major event will be much greater than what would be generated by a typical commercial development situated on the same site. These conditions effectively limit the amount of discharge that can be added to the surrounding wastewater system from the study area without adversely affecting surrounding areas.

Based on fixturing information provided by the design consultant, the peak wastewater generated by the new entertainment centre and ancillary development at full development is estimated to be between 200 L/s and 250 L/s (calculated at 232 L/s). The total volume of wastewater for a 50,000 seat entertainment centre complex is estimated to be in the order of 900 cubic metres over a 24 hour period and roughly 350 cubic metres during the 25 minute intermission period peak.

For a 33,000 seat entertainment centre, the peak wastewater generated by the new facility is estimated to be between 100 L/s and 150 L/s (calculated at 129 L/s). The total volume of wastewater for a 33,000 seat entertainment centre complex is estimated to be in the order of 640 cubic metres over a 24 hour period and roughly 200 cubic metres during the 25 minute intermission period peak.

The entertainment centre facility will likely be configured below grade and therefore we have assumed a lift station to accommodate the facilities flows. A lift station with a firm capacity approaching the peak intermission period flow rate will have a total station capacity of roughly 300 L/s for a 50,000 seat capacity entertainment centre and 200 L/s for a 33,000 capacity facility. For the 25 minute peak intermission period, we have assumed this is the flow rate that will be pumped into the proposed wastewater collection system for the development.

Two separate configurations for servicing wastewater flows from the site were considered:

Alternative 1 – On-Site Storage Servicing Concept option effectively limits the outlet flows from the proposed development to discharges that can be accommodated by the surrounding wastewater collection system. This option consists of a 450 m^3 on-site storage element for the 50,000 seat capacity facility and 300 m^3 on-site storage element for the 33,000 seat capacity facility. It also includes a flap gate to isolate flows when the existing wastewater system is surcharged during wet weather flows. Figure 4.12 illustrates the key components of Alternative 1. Alternative 1 has the lower capital cost with an estimated construction cost of $3.8M for a 50,000 capacity entertainment centre and 2.9 M for a 33,000 capacity facility. On-site storage however, has long-term maintenance issues and costs. Because of the nature of the proposed development, i.e. a likely significant proportion of restaurants and bars, not to mention the fast food options that will be available in the entertainment centre complex itself, we are concerned about the amount of fat, oil and grease (FOG) that may find its way into the storage elements.

Alternative 2 – Conventional Pipe Servicing Concept option proposes the installation of a new 600 mm parallel wastewater sewer main from Dewdney Avenue along Albert Street to the 7th Avenue trunk. This option proposed direct discharge into the parallel sewer main, thus eliminating the need for on-site storage or flap gate. Figure 4.18 illustrates the key components and alignment of Alternative 2. The capital cost of Alternative 2 is $4.8M, for the 50,000 capacity facility and $4.2M for the 33,000 seat capacity facility. The long-term costs however, are likely significantly less than the on-site storage option. The impacts of a tie-in at 7th Avenue, as this servicing review suggests, are less than what they would have been had the system been tied in to the local sewer system but until the citywide wastewater modelling analysis is complete, we will not know the full impacts of the entertainment complex on the City's wastewater interceptor trunk system.

The City should therefore consider the following recommendations as the project evolves:

- In the interim, plan for layout of the entertainment facility based on the current SCI design and the On-Site Storage Concept, as proposed in Alternative 1, as this option presents the most restrictive scenario in regard to space requirements for placement of municipal services on the site.

- Consider the recommended alternative to be the conventional pipe servicing option, as proposed in Alternative 2, and set aside enough budget for this option. The construction value has been estimated at approximately $4.8M for the 50,000 seat complex and $4.2M for the 33,000 seat complex. Alternative 2 presents the least amount of risk in terms of long-term operation and maintenance issues and costs.

- As the citywide wastewater interceptor model is developed, revisit the conventional pipe servicing option and see if there are any changes in the potential impacts or if there are other opportunities or reasons to upgrade the 7th Avenue trunk.

6.4 Stormwater

The study area is currently a CP rail yard. The yard is relatively flat with informal on-site detention with characteristically poor drainage resulting in a relatively saturated site over extended periods during wet weather events. The outcome of the existing system analysis was that the existing minor storm system in the area has little capacity, i.e. the 1 in 2 year rainfall event will cause surcharging of the pipe network and minor surface flooding.

Proposed development of the study area will increase overall imperviousness of the site, leading to larger peak runoff rates and increased runoff volumes. Given the limited capacity of the existing minor system, a post-development release rate was determined based on 75% of the capacity of the minor system pipes at selected tie-in locations. Rainfall runoff in excess of the release rate will need to be detained on-site until it can be released into the existing minor system. The volume of on-site detention storage required to accommodate the 1 in 100 year rainfall event is approximately 9,400 m^3.

Two design alternatives for on-site detention facilities were proposed, each capable of detaining 100% of the regional storage required for a 1 in 100 year volume. Alternative 1 - Pipe Storage Elements proposed the use of a stormwater system with 3,000 mm oversized mainlines used as storage elements to detain runoff in excess of the capacity of the surrounding minor system. The alignment of the minor system and the 3,000 mm storage elements in respect to the stadium is shown in Figure 5.3. The estimated construction cost of Alternative 1 is approximately $9.7M.

Alternative 2 - Tank Storage Elements proposed the use of a minor system designed to accommodate the 1 in 5 year rainfall event with designated storage tanks at three locations around the site. As is the case with Alternative 1, the storage elements in Alternative 2 are sized to accommodate runoff in excess of the capacity of the surrounding minor system. The alignment of the minor system and the storage tanks in respect to the stadium is shown in Figure 5.4. The estimated construction cost of Alternative 2 is approximately $8.4M.

The difference in cost of $1.3M between Alternative 1 and Alternative 2 is significant but needs to be balanced with the fact that areas above the detention facilities will become encumbered and may no longer be available for future development, or will be limited to very specific types of development such as parks or surface parking. This may or may not be a major consideration for the City. The other issues to consider regarding the Alternative 2 design is the limited amount of information available on long term maintenance costs and safety constraints, i.e. confined space entry requirements. There will likely be only a limited amount of opportunity to gain access to these tanks. With the linear oversized pipe storage proposed in Alternative 1, gaining access for maintenance purposes would be a simple matter of providing a sufficient number of manholes. City personnel would also be more familiar with the confined space entry requirements and maintenance procedures for facilities proposed in Alternative 1.

As noted, both Alternatives account for 100% of the regional storage requirements for a 1 in 100 year rainfall event. Potential reductions in the total detention storage volume and associated facility costs may be achievable if a portion of the required storage is made the responsibility of individual developments, or through implementation of green technologies capable of decreasing site runoff such as vegetated bio-retention cells, infiltration trenches, porous pavements, vegetated swales or green roofs. Section 5.4 - Regional Storage Reduction through Green Technologies provides further information on green technologies and associated operation and maintenance considerations. The City may wish to incorporate some aspect of green technologies in subsequent design consideration.

The City should therefore consider the following recommendations as the project evolves:

- Plan for layout of the entertainment facility based on the current SCI design as this option presents the most restrictive scenario in regard to space requirements for placement of municipal services on the site.
- Plan for on-site pipe storage elements for stormwater as proposed in Alternative 1 - Pipe Storage Element. The construction value has been estimated at approximately $9.7M and presents the least restrictive alternative with respect to potential land use alternatives in the study area and long term operation and maintenance issues and costs.
- Consider implementation of development controls within the study area so developments are required to provide on-site storage in an attempt to decrease the amount of total detention storage requirements on the City system.
- Consider incorporation of green technologies in subsequent design phases in an attempt to decrease the amount of site runoff from development in the study area.

6.5 Cost Summary

The municipal servicing costs for the entertainment centre, as shown in **Table 6.1**, provides a summary of Level 'D' construction cost estimates for proposed infrastructure improvements discussed in this report. Level 'D' estimates are preliminary in nature indicating approximate magnitude of cost, based on the client's broad requirements and limited input parameters, and are typically intended for approvals in principle and for discussion purposes. Costs are provided in 2009 dollars and are subject to change due to the variability of input parameters associated with this report.

Table 6.1 Municipal Servicing Costs for Entertainment Centre

Municipal Component	Entertainment Centre Size	
	33,000 Seat	50,000 Seat
Transportation		
2 Pedestrian Overpasses (Lorne Street and Hamilton Street)	$10.0M	$14.0M
Dewdney Avenue Modifications	$4.0M	$4.0M
Water		
450 mm Service Connection	$0.3M	$0.3M
450 mm Regulating Valve	$0.1M	$0.1M
Hydrant Leads (Allowance of 5 Leads)	$0.1M	$0.1M
Wastewater		
Alternative 2 (Conventional Pipe System)	$4.2M	$4.8M
Stormwater		
Alternative 1 (Pipe Storage Element)	$9.7M	$9.7M
Total Cost	**$28.40M**	**$33.0M**

Technical Appendices

High Level Feasibility Study for Entertainment Centre

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Appendices

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Appendix A - Traffic Operations Model Details

High Level Feasibility Study for Entertainment Centre
Traffic Operations Model Details

Background

The development of a new Entertainment Centre on the existing Intermodal Facility site will change the way that traffic operates in the area. An analysis of the impacts to the surrounding traffic network is required to ensure that these changes are accounted for in the development plans.

Development on the lands east and west of the proposed Entertainment Centre site will be critical to the overall success the project. These developments will generate their own vehicle demands, and must be considered in the overall transportation feasibility analysis. Not all of the development facts were known at the time of this study, but some key assumptions were made to allow for a planning level investigation.

The Entertainment Centre itself is a "special generator" - it will draw a large number of vehicles during off-peak traffic hours (evenings and weekends). The surrounding development sites will have more of an impact during the peak hours of adjacent street traffic. As a result, two separate scenarios were analyzed: a day-to-day operations scenario, and a peak event scenario. Each scenario involves a comparison of existing conditions to future conditions with the Entertainment Centre and surrounding developments fully operational.

Study Area

The proposed Entertainment Centre site is in a central location in Downtown Regina. There are many roads leading to the area, but the critical roadways for the traffic operations analysis are Albert Street, Broad Street, and Dewdney Avenue. Albert Street and Broad Street are the two main arterials that will bring vehicles into the area, and Dewdney Avenue will provide the main access for the Entertainment Centre and the adjacent development lands.

The day-to-day operation of the developments will impact the Dewdney Avenue intersections with Albert Street and Broad Street. These intersections currently see a large volume of traffic in the afternoon peak period. Large events at the Entertainment Centre will bring more vehicles into the surrounding areas, and the impacts in this scenario will likely spread further from the development site. The major intersections to the north and south of the development area were included to determine the extent of these impacts.

The following intersections were included in the traffic operations analysis:

- Albert Street & 4th Avenue
- Albert Street & Dewdney Avenue
- Albert Street & Saskatchewan Drive
- Broad Street & 4th Avenue
- Broad Street & Dewdney Avenue
- Broad Street & Saskatchewan Drive

Analysis Methodology

For the purposes of the traffic model, it was assumed that the Entertainment Centre and adjacent developments will be completed in five years (2014). Traffic volumes were collected for the existing conditions analysis, and five years of background traffic growth was applied to determine how the surrounding road network will operate in the future without the added development traffic. A final analysis was conducted after the development site traffic was assigned to the network.

Synchro Studio 7, an industry standard software package, was used to analyze intersection operations. A Synchro model of the study intersections was provided by the City of Regina, which included existing afternoon peak and off-peak traffic volumes, as well as the existing signal timing plans and intersection geometries.

Synchro provides key Measures of Effectiveness (MOEs) for individual intersections, including Level of Service (LOS) and volume to capacity (v/c) ratio. Intersection LOS is a function of the average delay per vehicle. It ranges from LOS A, which provides the highest level of operational service to intersection users, to LOS F, which constitutes failure of the intersection or the turning movement being studied. The v/c ratio represents the sufficiency of an intersection to accommodate the vehicular demand for each movement.

The MOEs determined by the Synchro model for existing, future background, and full build-out conditions were used to establish the potential impacts to the surrounding road network.

Day-to-Day Operations

The day-to-day scenario involves the analysis of the study intersections during the weekday afternoon peak period. At this time adjacent street traffic is at its highest point, largely due to commuters leaving the downtown area after work. It was assumed that there would not be any events occurring at the Entertainment Centre site during this time period.

Existing traffic volumes for the Albert Street and Dewdney Avenue intersection were taken from a 2008 Site Impact Traffic Study (SITS) for the development area west of the proposed Entertainment Centre site (former Superstore site). The remaining afternoon peak volumes were obtained from the City of Regina. Background traffic growth was assumed to be 1 percent per year, which was also assumed in the existing SITS.

The west development site, east development site, and Entertainment Centre site will all generate traffic during the weekday afternoon peak period. Assumptions were made regarding the volume of traffic generated by each site, and the assignment of those trips to the adjacent road network. These assumptions are covered in the following sections.

West Development Site

The 1621 Albert Street Development Corporation is in the process of developing the site located in the southeast quadrant of the Albert Street and Dewdney Avenue intersection, immediately west of the proposed Entertainment Centre site. The west development site is approximately 4.86 hectares in size (11.4 acres), and was formerly the location of a large warehouse-style grocery store and small detached gas bar (i.e. former Superstore site). The development plans include a mix of office and retail space in the existing building, with additional developments in the existing parking lot area, including retail locations, restaurants, and a 100 room hotel.

<u>Trip Generation</u>
A Site Impact Traffic Study was completed by AECOM in 2008 which analyzed the impact of the new development on the adjacent intersections. The study involved the determination of new vehicle trips generated by the fully-developed site, and the assignment of these trips onto the existing road network.

The trip generation estimates were based on the Institute of Transportation Engineers (ITE) *7th Edition Trip Generation Manual*, and involved the determination of inbound, outbound, and pass-by trips for the afternoon peak hour of adjacent street traffic. Pass-by trips are trips attracted from traffic already passing the site on the adjacent road network.

The results of the study indicate that the west development site will generate approximately 435 inbound trips and 575 outbound trips in the weekday afternoon peak period. The pass-by trips were estimated at 135 for both inbound and outbound site traffic.

<u>Trip Distribution</u>
The trip distribution estimates were based on a combination of the existing traffic distribution at the Albert Street and Dewdney Avenue intersection, and a review of the population distribution and general destinations within Regina in the afternoon peak hour. These estimates are shown in the following table:

DISTRIBUTION	PERCENT OF SITE TRAFFIC
To the Site from:	Weekday P.M. Peak Hour
• Albert Street from the north	30%
• Albert Street from the south	40%
• Dewdney Avenue from the west	15%
• Dewdney Avenue from the east	15%
From the Site by:	
• Albert Street to the north	40%
• Albert Street to the south	15%
• Dewdney Avenue to the west	15%
• Dewdney Avenue to the east	30%

<u>Trip Assignment</u>
The existing SITS report included several assumptions about site access, including full access at the Albert Street and 9th Avenue intersection, right-in/right-out access on Albert Street between 9th Avenue and Dewdney Avenue, and two accesses from Dewdney Avenue. These assumptions were used to assign the traffic to the road network. It was also assumed that traffic would utilize right-in and right-out movements whenever possible.

The trip generation, trip distribution, and trip assignment results from the existing SITS were used in the day-to-day operations scenario.

East Development Site

Approximately 12 acres of land to the east of the proposed Entertainment Centre site will be reserved for new development. The details of the east development site were not known at the time of this study, but the total development area will be similar in size to the west development site. It was assumed, for the purpose of this traffic analysis, that the amount of site generated traffic will be similar as well.

<u>Trip Generation</u>
Using the west development site as a surrogate, it was assumed that the east development site will also generate approximately 435 inbound trips and 575 outbound trips in the weekday afternoon peak period. The pass-by trips were estimated at 135 for both inbound and outbound site traffic.

Trip Distribution

The trip distribution assumptions used for the west development site were considered applicable to the east development site as well. The distribution estimates for the east development site are shown in the following table:

DISTRIBUTION	PERCENT OF SITE TRAFFIC
To the Site from:	Weekday P.M. Peak Hour
• North Regina	30%
• South Regina	40%
• West Regina	15%
• East Regina	15%
From the Site to:	
• North Regina	40%
• South Regina	15%
• West Regina	15%
• East Regina	30%

Trip Assignment

The details of the development access points were not known at the time of this study. Once functional plans have been created for the east development site, a detailed Site Impact Traffic Study will be required to ensure that the access points work well with the surrounding road network. For the purposes of this study it was assumed that access to the east development site will be from Dewdney Avenue only.

The development site traffic was assigned to the road network according to the distribution estimates shown above. It was assumed that most vehicles will use right turns whenever possible to avoid excessive delays during the afternoon peak traffic period. Pass-by trips were assigned based on the existing distribution of vehicles entering/exiting Dewdney Avenue from Albert Street and Broad Street.

All of the site traffic was routed through the Albert/Dewdney and Broad/Dewdney intersections, for a worst-case scenario.

Entertainment Centre Site

The day-to-day operations scenario assumes that no events are taking place on the Entertainment Centre grounds during weekday afternoon peak traffic periods. Site use is restricted to Saskatchewan Roughriders Football Club (SRFC) administrative staff, football operations staff, players, and building management staff. Additional site traffic may be the result of ticket purchase/pick-up, and visits to the Roughriders Retail Store and Hall of Fame.

Trip Generation

The analysis was performed under the assumption that regular football operations are in effect (day-today operations during the football season). Considering the current operations at the Mosaic Stadium site, and the space devoted to the SRFC at the new Entertainment Centre, it is possible that 150 people will be at the new Entertainment Centre on a typical day. Under a worst-case scenario, all of these people will leave the Entertainment Centre site during the afternoon peak hour.

It is assumed that the majority of the ticket purchase/pick-up, Retail Store, and Hall of Fame visits will occur during regular weekday business hours or on weekends. A small amount of additional inbound/outbound site traffic was added to account for minimal use during the weekday afternoon peak.

Trip Distribution

Since the majority of the day-to-day Entertainment Centre site traffic is generated by people working at the Centre, the vehicle distribution was based on population distribution. The following table shows the trip distribution estimate:

DISTRIBUTION	PERCENT OF SITE TRAFFIC
From the Site to:	
• North Regina	25%
• South Regina	25%
• West Regina	20%
• East Regina	30%

Any traffic added for other site uses assumed the same distribution as the east and west development sites.

Trip Assignment

The details of the Entertainment Centre access points were not known at the time of this study. Once functional plans have been created for the Entertainment Centre site, a detailed Site Impact Traffic Study will be required to ensure that the access points work well with the surrounding road network. For the purposes of this study it was assumed that access to the Entertainment Centre site will be from Dewdney Avenue only.

All Entertainment Centre site traffic for the day-to-day scenario was routed through the Albert/Dewdney and Broad/Dewdney intersections. Some vehicles may avoid these intersections by travelling north through the warehouse district, but this model considers a worst-case scenario for the study intersections.

Day-to-Day Model

The weekday afternoon peak traffic volumes generated by the west development site, east development site, and the Entertainment Centre site were combined to form an estimate of the overall site generated traffic volumes. These volumes were added to background traffic volumes to form the future day-to-day traffic scenario. This scenario was tested using Synchro, and the results were compared to the existing and background conditions.

The day-to-day model was created for an Entertainment Centre with approximately 33,000 seats. An expansion of the Entertainment Centre to a capacity of 50,000 would not have a large impact on the day-to-day scenario, since it was assumed that there would not be any events occurring at the Entertainment Centre site during the peak weekday afternoon period.

Peak Event Operations

The peak event scenario involves the analysis of the study intersections after a large event at the Entertainment Centre. A post-event scenario is considered to be worst-case, as the majority of the spectators will be leaving the site in a short period of time.

Large events generally occur during off-peak traffic hours (evenings and weekends). Existing off-peak traffic volumes for each of the study intersections were provided by the City of Regina. As with the day-to-day analysis, background traffic growth was assumed to be 1 percent per year.

The Entertainment Centre site will generate most of the traffic in the area during peak event operations. The adjacent development sites will generate some traffic as well, though it is assumed that this will be significantly less than during non-event operations. The assumptions made regarding the volume of traffic generated by each site, and the assignment of those trips to the adjacent road network, are covered in the following sections.

Entertainment Centre Site

According to initial site plans, very little parking will be provided on the Entertainment Centre site. Peak event parking will be spread out into the areas surrounding the Entertainment Centre. A post-event scenario assumes that most of the event patrons will attempt to leave the site in a short period of time. For the purposes of this model, it was assumed that 80 percent of the patrons will reach their vehicles and enter the road network within half an hour.

<u>Trip Generation</u>
Initial site plans for the proposed Entertainment Centre indicated that seating would be provided for approximately 33,000 spectators. Parking demand estimates were developed based on a facility of this size, which included a breakdown of the number of vehicles that would park in the various areas surrounding the Entertainment Centre. These estimates were used to develop the peak event traffic operations model.

<u>Trip Distribution</u>
Trip distribution for a peak event was based on Regina's population distribution. Since the proposed Entertainment Centre site is centrally located, it was assumed that out-of-town patrons would access the site from all directions. The distribution estimate is shown below:

DISTRIBUTION	**PERCENT OF SITE TRAFFIC**
From the Site to:	
• North Regina	25%
• South Regina	25%
• West Regina	20%
• East Regina	30%

<u>Trip Assignment</u>
The roadways in the areas immediately adjacent to the Entertainment Centre site are laid out in a grid pattern, which provides many access/egress points. The peak event model focussed on the traffic passing through the major signalized intersections. It was assumed that vehicles would avoid delays where possible by using side streets, and choosing right turns. It was assumed that a large percentage of

the event traffic would eventually make its way to Albert Street and Broad Street, since these are the major arterial roadways running north/south alongside the Entertainment Centre.

East/West Development Sites

It was assumed that during peak events, parking and traffic operations in the areas adjacent to the Entertainment Centre site will be dominated by event traffic. There will likely be a limited number of trips bound for the east and west development sites that is not event related. To account for these trips, a percentage (20%) of the day-to-day development site traffic was added to the peak event scenario using the same distribution and assignment assumptions.

Peak Event Model

The peak event traffic volumes generated by the west development site, east development site, and the Entertainment Centre site were combined to form an estimate of the overall site generated traffic volumes. These volumes were added to background traffic volumes to form the future peak event traffic scenario. This scenario was tested using Synchro, and the results were compared to the existing and background conditions.

The peak event model was created for an Entertainment Centre with approximately 33,000 seats. An expansion of the Entertainment Centre to a capacity of 50,000 spectators would increase parking demand during peak events. The model already predicts the failure of the major intersections around the proposed Entertainment Centre for a post-event scenario. The additional vehicles will result in even longer post-event delays.

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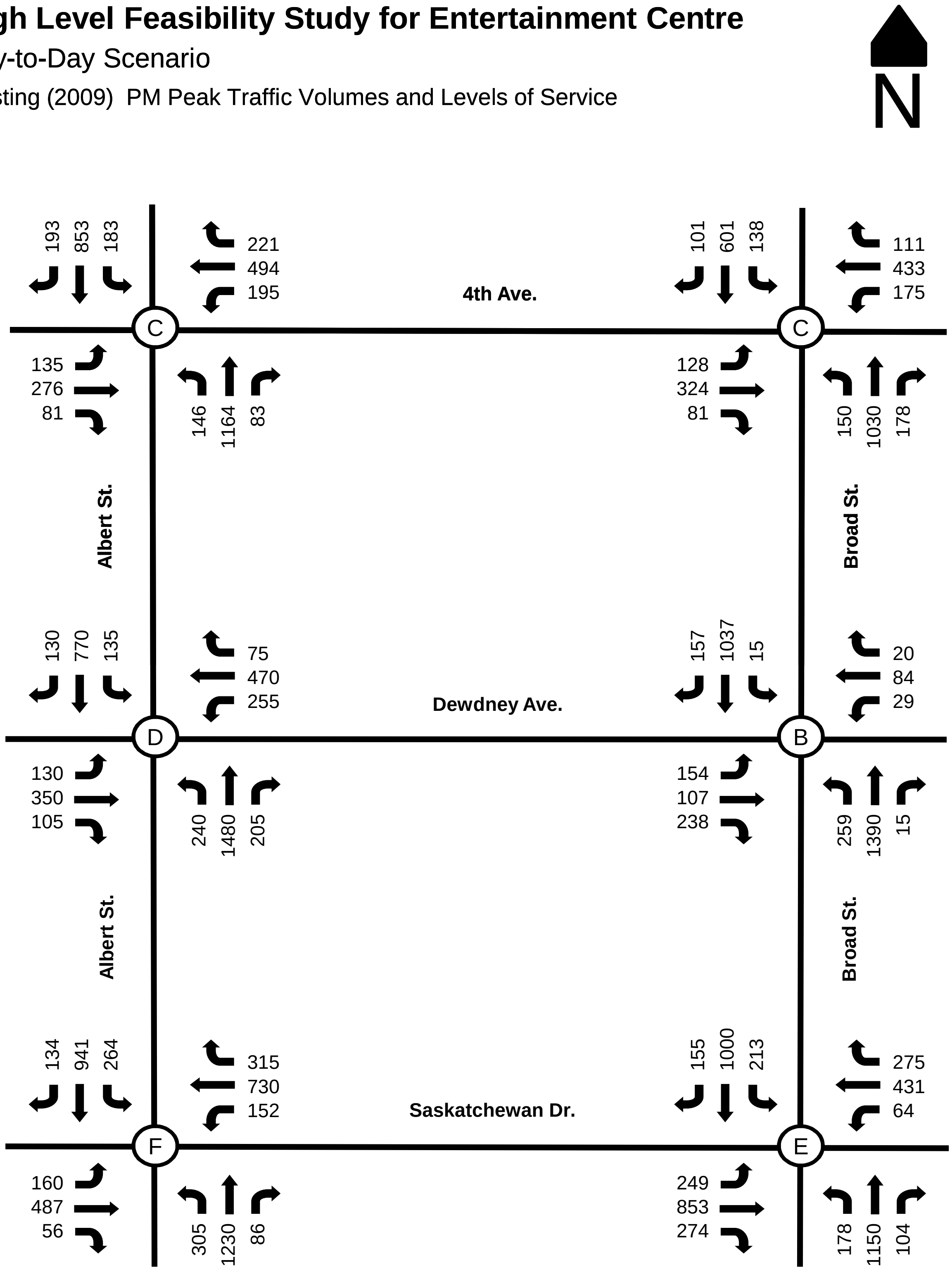
Appendix B - Day-to-Day Scenario Traffic Volumes

High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

Existing (2009) PM Peak Traffic Volumes and Levels of Service



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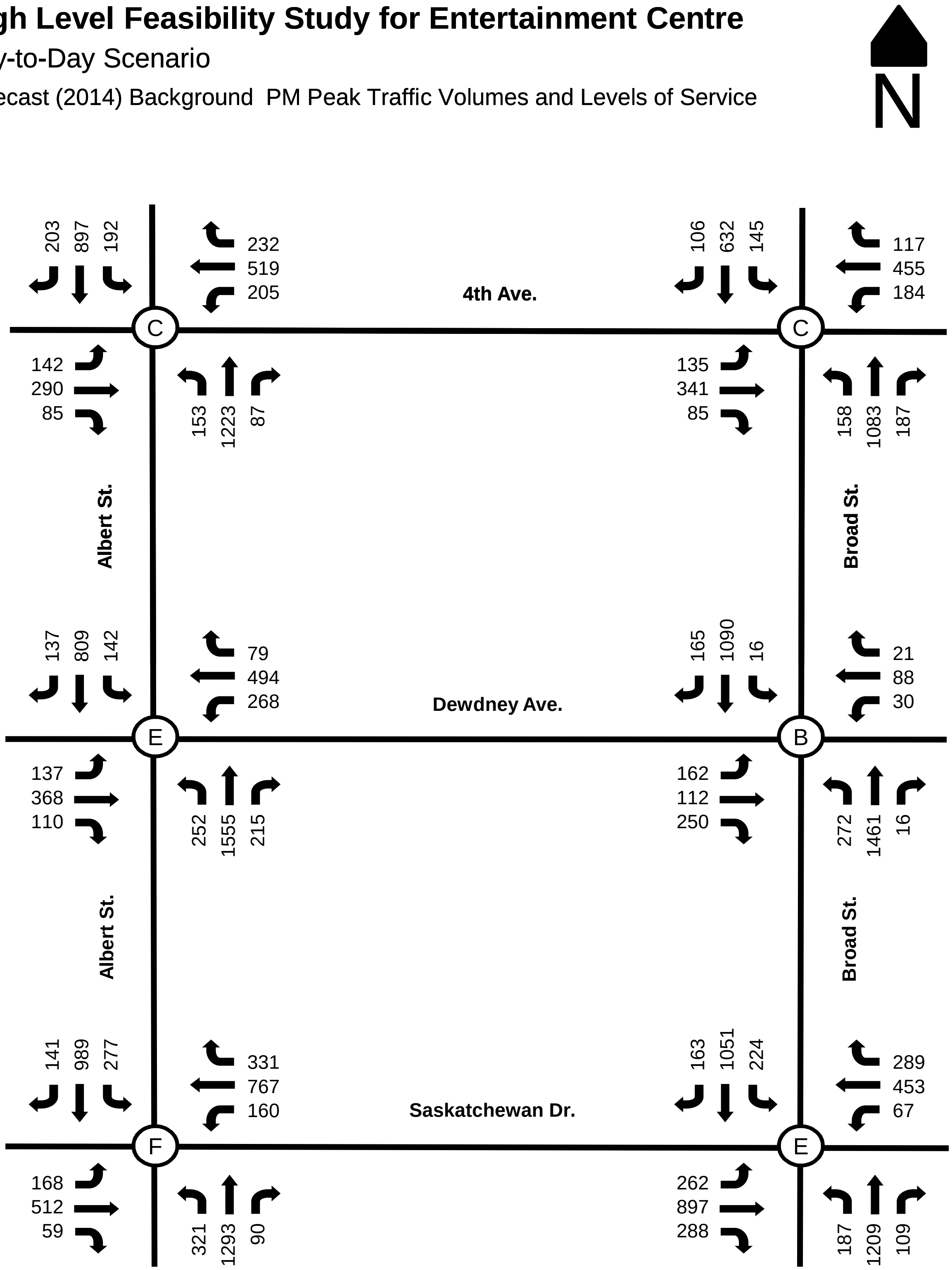
High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

Forecast (2014) Background PM Peak Traffic Volumes and Levels of Service



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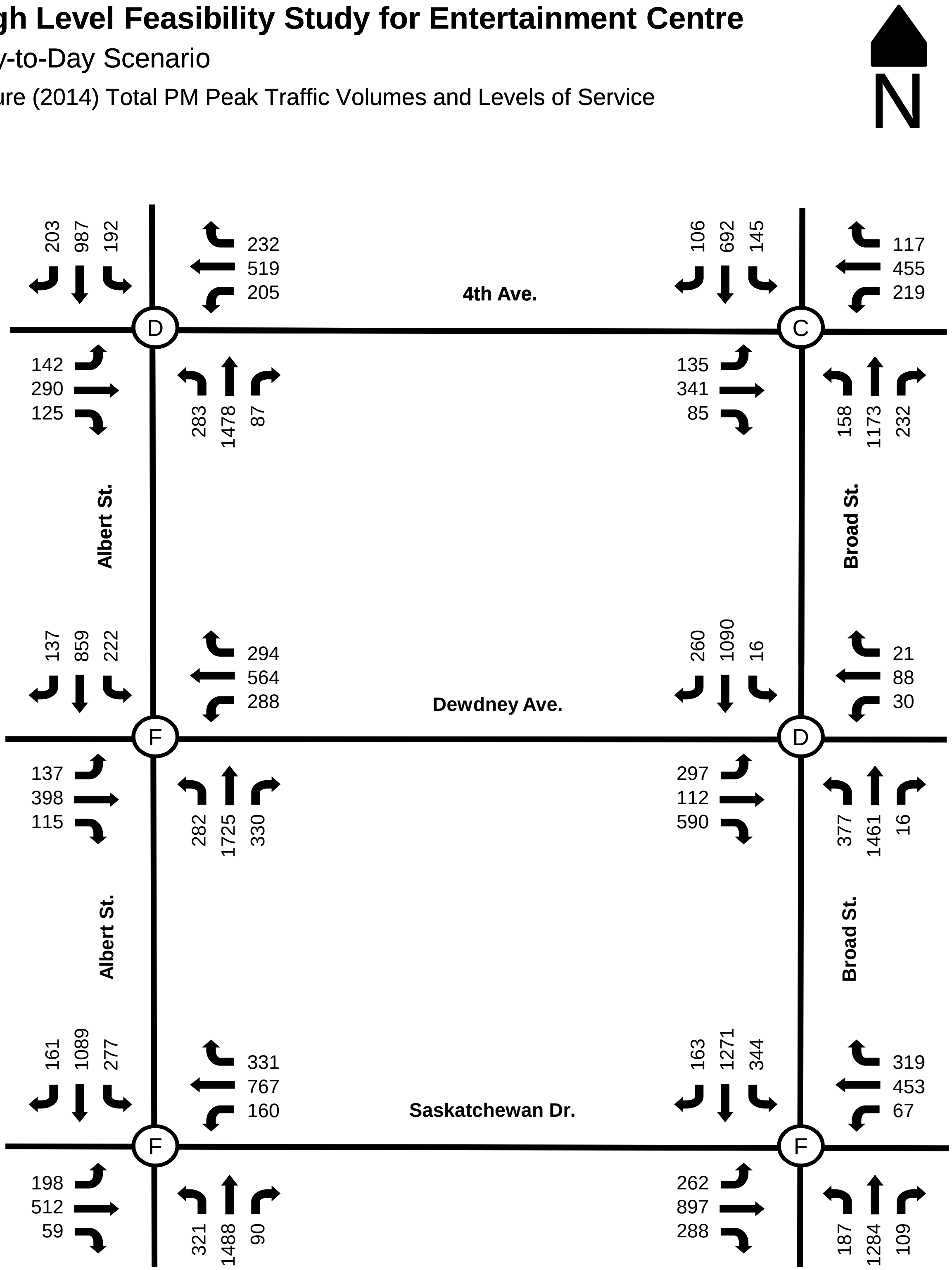
High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

Future (2014) Total PM Peak Traffic Volumes and Levels of Service



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Appendix C - Day-to-Day Analysis Results

High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Day-to-Day
Intersection: Albert Street & 4th Avenue

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	54.9	42.4	42.4	**45.8**	43.1	33.8	3.7	**28.5**	10.5	17.1	6.4	**15.8**	41.2	23.5	14.1	**24.7**	Intersection Delay (s)	**25.0**
Level of Service	D	D	D	**D**	D	C	A	**C**	B	B	A	**B**	D	C	B	**C**	Level of Service	**C**
v/c Ratio	0.73	0.55	0.55	**-**	0.79	0.70	0.46	**-**	0.46	0.75	0.12	**-**	0.79	0.53	0.27	**-**	Max v/c Ratio	**0.79**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	59.6	42.1	42.1	**46.9**	46.8	33.4	4.1	**29.1**	12.5	20.4	7.4	**18.8**	62.4	24.9	14.9	**29.0**	Intersection Delay (s)	**27.7**
Level of Service	E	D	D	**D**	D	C	A	**C**	B	C	A	**B**	E	C	B	**C**	Level of Service	**C**
v/c Ratio	0.78	0.56	0.56	**-**	0.82	0.71	0.48	**-**	0.52	0.80	0.13	**-**	0.89	0.57	0.29	**-**	Max v/c Ratio	**0.89**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	59.6	41.2	41.2	**45.9**	60.0	33.5	4.4	**32.1**	75.8	46.3	8.1	**49.1**	86.6	27.3	15.9	**33.9**	Intersection Delay (s)	**40.9**
Level of Service	E	D	D	**D**	E	C	A	**C**	E	D	A	**D**	F	C	B	**C**	Level of Service	**D**
v/c Ratio	0.78	0.61	0.61	**-**	0.89	0.71	0.48	**-**	1.01	0.97	0.13	**-**	0.97	0.65	0.30	**-**	Max v/c Ratio	**1.01**

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High Level Feasibility Study for Entertainment Centre

Intersection Analysis Findings

Scenario: Day-to-Day
Intersection: Broad Street & 4th Avenue

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	42.6	34.0	34.0	**36.1**	41.8	47.2	47.2	**45.9**	9.6	20.0	2.3	**16.5**	35.8	26.3	5.2	**25.3**	Intersection Delay (s)	**27.8**
Level of Service	D	C	C	**D**	D	D	D	**D**	A	B	A	**B**	D	C	A	**C**	Level of Service	**C**
v/c Ratio	0.66	0.59	0.59	**-**	0.70	0.76	0.76	**-**	0.44	0.77	0.26	**-**	0.70	0.45	0.16	**-**	Max v/c Ratio	**0.77**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	47.5	34.6	34.6	**37.7**	44.2	47.5	47.5	**46.7**	10.6	22.2	2.6	**18.4**	51.8	27.6	5.2	**28.9**	Intersection Delay (s)	**29.8**
Level of Service	D	C	C	**D**	D	D	D	**D**	B	C	A	**B**	D	C	A	**C**	Level of Service	**C**
v/c Ratio	0.70	0.60	0.60	**-**	0.74	0.78	0.78	**-**	0.49	0.83	0.28	**-**	0.80	0.48	0.17	**-**	Max v/c Ratio	**0.83**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	46.3	36.3	36.3	**38.7**	59.9	47.5	47.5	**51.0**	13.7	28.5	3.0	**23.2**	56.1	28.5	5.2	**30.1**	Intersection Delay (s)	**32.8**
Level of Service	D	D	D	**D**	E	D	D	**D**	B	C	A	**C**	E	C	A	**C**	Level of Service	**C**
v/c Ratio	0.70	0.61	0.61	**-**	0.87	0.78	0.78	**-**	0.53	0.90	0.35	**-**	0.81	0.53	0.17	**-**	Max v/c Ratio	**0.90**

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High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Day-to-Day
Intersection: Albert Street & Dewdney Avenue

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	33.2	36.1	7.2	**30.3**	57.7	44.3	14.5	**45.8**	25.4	87.0	11.9	**71.3**	70.7	23.8	10.1	**28.2**	Intersection Delay (s)	**50.8**
Level of Service	C	D	A	**C**	E	D	B	**D**	C	F	B	**E**	E	C	B	**C**	Level of Service	**D**
v/c Ratio	0.50	0.38	0.22	**-**	0.81	0.50	0.17	**-**	0.74	1.04	0.31	**-**	0.86	0.61	0.22	**-**	Max v/c Ratio	**1.04**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	35.0	36.3	7.1	**30.8**	66.3	45.5	15.2	**49.2**	29.0	109.9	12.2	**89.4**	77.2	26.6	11.7	**31.4**	Intersection Delay (s)	**60.3**
Level of Service	D	D	A	**C**	E	D	B	**D**	C	F	B	**F**	E	C	B	**C**	Level of Service	**E**
v/c Ratio	0.55	0.39	0.23	**-**	0.87	0.53	0.17	**-**	0.80	1.10	0.33	**-**	0.90	0.65	0.23	**-**	Max v/c Ratio	**1.10**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	39.0	36.7	7.0	**32.0**	88.9	52.5	29.0	**55.6**	44.3	161.1	14.3	**126.3**	244.0	28.1	12.3	**65.7**	Intersection Delay (s)	**85.9**
Level of Service	D	D	A	**C**	F	D	C	**E**	D	F	B	**F**	F	C	B	**E**	Level of Service	**F**
v/c Ratio	0.61	0.43	0.23	**-**	0.98	0.60	0.55	**-**	0.92	1.22	0.49	**-**	1.41	0.72	0.24	**-**	Max v/c Ratio	**1.41**

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High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Day-to-Day
Intersection: Broad Street & Dewdney Avenue

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	65.9	33.6	7.8	**26.4**	45.6	45.6	14.3	**40.9**	27.9	5.6	5.6	**9.1**	12.8	16.3	4.3	**14.7**	Intersection Delay (s)	**15.4**
Level of Service	E	C	A	**C**	D	D	B	**D**	C	A	A	**A**	B	B	A	**B**	Level of Service	**B**
v/c Ratio	0.84	0.39	0.57	**-**	0.46	0.46	0.08	**-**	0.83	0.73	0.73	**-**	0.12	0.74	0.26	**-**	Max v/c Ratio	**0.84**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	68.5	33.4	7.6	**32.0**	45.1	45.1	15.1	**40.6**	35.8	7.2	7.2	**11.7**	13.8	19.3	4.8	**17.4**	Intersection Delay (s)	**17.6**
Level of Service	E	C	A	**C**	D	D	B	**D**	D	A	A	**B**	B	B	A	**B**	Level of Service	**B**
v/c Ratio	0.86	0.39	0.57	**-**	0.46	0.46	0.08	**-**	0.88	0.77	0.77	**-**	0.15	0.81	0.29	**-**	Max v/c Ratio	**0.88**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	193.3	36.0	88.1	**113.5**	41.0	41.0	15.0	**37.1**	149.5	10.2	10.2	**38.6**	15.9	30.2	7.0	**25.6**	Intersection Delay (s)	**51.6**
Level of Service	F	D	F	**F**	D	D	B	**D**	F	B	B	**D**	B	C	A	**C**	Level of Service	**D**
v/c Ratio	1.30	0.33	1.11	**-**	0.39	0.39	0.07	**-**	1.25	0.82	0.82	**-**	0.18	0.92	0.48	**-**	Max v/c Ratio	**1.30**

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High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Day-to-Day
Intersection: Albert Street & Saskatchewan Drive

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	117.3	45.8	45.8	**100.1**	420.6	73.5	37.8	**108.2**	191.1	208.9	3.4	**194.6**	110.2	53.6	12.3	**60.6**	Intersection Delay (s)	**122.7**
Level of Service	F	F	F	**F**	F	E	D	**F**	F	F	A	**F**	F	D	B	**E**	Level of Service	**F**
v/c Ratio	1.04	0.72	0.72	**-**	0.84	0.98	0.76	**-**	1.02	1.06	0.17	**-**	1.09	0.89	0.25	**-**	Max v/c Ratio	**1.09**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	129.9	220.4	220.4	**199.9**	737.4	85.1	41.7	**156.5**	246.3	239.1	3.5	**228.0**	127.6	59.8	12.4	**68.4**	Intersection Delay (s)	**162.4**
Level of Service	F	F	F	**F**	F	F	D	**F**	F	F	A	**F**	F	E	B	**E**	Level of Service	**F**
v/c Ratio	1.09	0.75	0.75	**-**	0.92	1.03	0.80	**-**	1.10	1.12	0.18	**-**	1.15	0.93	0.26	**-**	Max v/c Ratio	**1.15**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	197.8	220.4	220.4	**214.6**	737.6	85.1	41.7	**156.5**	243.5	270.7	3.6	**253.5**	127.0	92.4	14.5	**90.5**	Intersection Delay (s)	**180.0**
Level of Service	F	F	F	**F**	F	F	D	**F**	F	F	A	**F**	F	F	B	**F**	Level of Service	**F**
v/c Ratio	1.29	0.75	0.75	**-**	0.92	1.03	0.80	**-**	1.10	1.29	0.18	**-**	1.15	1.03	0.29	**-**	Max v/c Ratio	**1.29**

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High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Day-to-Day
Intersection: Broad Street & Saskatchewan Drive

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	147.5	62.4	9.3	**67.2**	106.4	42.2	11.7	**36.6**	79.9	93.0	18.5	**85.9**	70.1	48.0	18.3	**48.1**	Intersection Delay (s)	**62.6**
Level of Service	F	E	A	**E**	F	D	B	**D**	E	F	B	**F**	E	D	B	**D**	Level of Service	**E**
v/c Ratio	1.18	0.84	0.44	**-**	0.84	0.61	0.56	**-**	0.93	1.10	0.21	**-**	0.98	0.90	0.29	**-**	Max v/c Ratio	**1.18**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	168.0	74.2	9.7	**78.4**	135.6	41.6	13.4	**39.4**	104.7	127.8	19.2	**117.1**	80.0	55.5	18.3	**55.1**	Intersection Delay (s)	**77.1**
Level of Service	F	E	A	**E**	F	D	B	**D**	F	F	B	**F**	F	E	B	**E**	Level of Service	**E**
v/c Ratio	1.24	0.86	0.46	**-**	0.96	0.61	0.58	**-**	1.01	1.19	0.23	**-**	1.03	0.97	0.31	**-**	Max v/c Ratio	**1.24**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	168.0	74.2	10.0	**78.4**	135.6	41.6	17.2	**39.9**	101.9	157.9	19.7	**141.7**	292.0	137.8	14.1	**156.3**	Intersection Delay (s)	**114.9**
Level of Service	F	E	B	**E**	F	D	B	**D**	F	F	B	**F**	F	F	B	**F**	Level of Service	**F**
v/c Ratio	1.24	0.86	0.46	**-**	0.96	0.61	0.64	**-**	1.01	1.26	0.23	**-**	1.58	1.17	0.31	**-**	Max v/c Ratio	**1.58**

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High Level Feasibility Study for Entertainment Centre
Level of Service Results

Day-to-Day Scenario

INTERSECTION	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	
Albert Street & 4th Avenue																	
Existing 2009	D	D	D	**D**	D	C	A	**C**	B	B	A	**B**	D	C	B	**C**	**C**
Forecast Background 2014	E	D	D	**D**	D	C	A	**C**	B	C	A	**B**	E	C	B	**C**	**C**
Forecast Total 2014	E	D	D	**D**	E	C	A	**C**	E	D	A	**D**	F	C	B	**C**	**D**
Broad Street & 4th Avenue																	
Existing 2009	D	C	C	**D**	D	D	D	**D**	A	B	A	**B**	D	C	A	**C**	**C**
Forecast Background 2014	D	C	C	**D**	D	D	D	**D**	B	C	A	**B**	D	C	A	**C**	**C**
Forecast Total 2014	D	D	D	**D**	E	D	D	**D**	B	C	A	**C**	E	C	A	**C**	**C**
Albert Street & Dewdney Avenue																	
Existing 2009	C	D	A	**C**	E	D	B	**D**	C	F	B	**E**	E	C	B	**C**	**D**
Forecast Background 2014	D	D	A	**C**	E	D	B	**D**	C	F	B	**F**	E	C	B	**C**	**E**
Forecast Total 2014	D	D	A	**C**	F	D	C	**E**	D	F	B	**F**	F	C	B	**E**	**F**
Broad Street & Dewdney Avenue																	
Existing 2009	E	C	A	**C**	D	D	B	**D**	C	A	A	**A**	B	B	A	**B**	**B**
Forecast Background 2014	E	C	A	**C**	D	D	B	**D**	D	A	A	**B**	B	B	A	**B**	**B**
Forecast Total 2014	F	D	F	**F**	D	D	B	**D**	F	B	B	**D**	B	C	A	**C**	**D**
Albert Street & Saskatchewan Drive																	
Existing 2009	F	F	F	**F**	F	E	D	**F**	F	F	A	**F**	F	D	B	**E**	**F**
Forecast Background 2014	F	F	F	**F**	F	F	D	**F**	F	F	A	**F**	F	E	B	**E**	**F**
Forecast Total 2014	F	F	F	**F**	F	F	D	**F**	F	F	A	**F**	F	F	B	**F**	**F**
Broad Street & Saskatchewan Drive																	
Existing 2009	F	E	A	**E**	F	D	B	**D**	E	F	B	**F**	E	D	B	**D**	**E**
Forecast Background 2014	F	E	A	**E**	F	D	B	**D**	F	F	B	**F**	F	E	B	**E**	**E**
Forecast Total 2014	F	E	B	**E**	F	D	B	**D**	F	F	B	**F**	F	F	B	**F**	**F**

High Level Feasibility Study for Entertainment Centre

Summary of Intersection Operations and Critical Movements by Timeframe

Day-to-Day Scenario

INTERSECTION / TIMEFRAME	Overall Intersection		Critical Movements		
	LOS	Delay (s)	Max v/c Ratios	Movement	LOS
Albert Street & 4th Avenue					
Existing 2009	C	25.0	0.79	SB LT	D
Forecast Background 2014	C	27.7	0.89	SB LT	D
Forecast Total 2014	D	40.9	1.01	NB LT	E
			0.97	SB LT	F
			0.97	NB TH	D
Broad Street & 4th Avenue					
Existing 2009	C	27.8	0.77	NB TH	B
Forecast Background 2014	C	29.8	0.83	NB TH	C
Forecast Total 2014	C	32.8	0.90	NB TH	C
			0.87	WB LT	E
			0.81	SB LT	E
Albert Street & Dewdney Avenue					
Existing 2009	D	50.8	1.04	NB TH	F
Forecast Background 2014	E	60.3	1.10	NB TH	F
Forecast Total 2014	F	85.9	1.41	SB LT	F
			1.22	NB TH	F
			0.98	WB LT	F
Broad Street & Dewdney Avenue					
Existing 2009	B	15.4	0.84	EB LT	E
Forecast Background 2014	B	17.6	0.88	NB LT	D
Forecast Total 2014	D	51.6	1.30	EB LT	F
			1.25	NB LT	F
			1.11	EB RT	F
Albert Street & Saskatchewan Drive					
Existing 2009	F	122.7	1.09	SB LT	F
			1.06	NB TH	F
			1.04	EB LT	F
Forecast Background 2014	F	162.4	1.15	SB LT	F
			1.12	NB TH	F
			1.10	NB LT	F
Forecast Total 2014	F	180.0	1.29	NB TH	F
			1.29	EB LT	F
			1.15	SB LT	F
			1.10	NB LT	F
Broad Street & Saskatchewan Drive					
Existing 2009	E	62.6	1.18	EB LT	F
			1.10	NB TH	F
			0.98	SB LT	E
Forecast Background 2014	E	77.1	1.24	EB LT	F
			1.19	NB TH	F
			1.03	SB LT	F
Forecast Total 2014	F	114.9	1.58	SB LT	F
			1.26	NB TH	F
			1.24	EB LT	F
			1.17	SB TH	F

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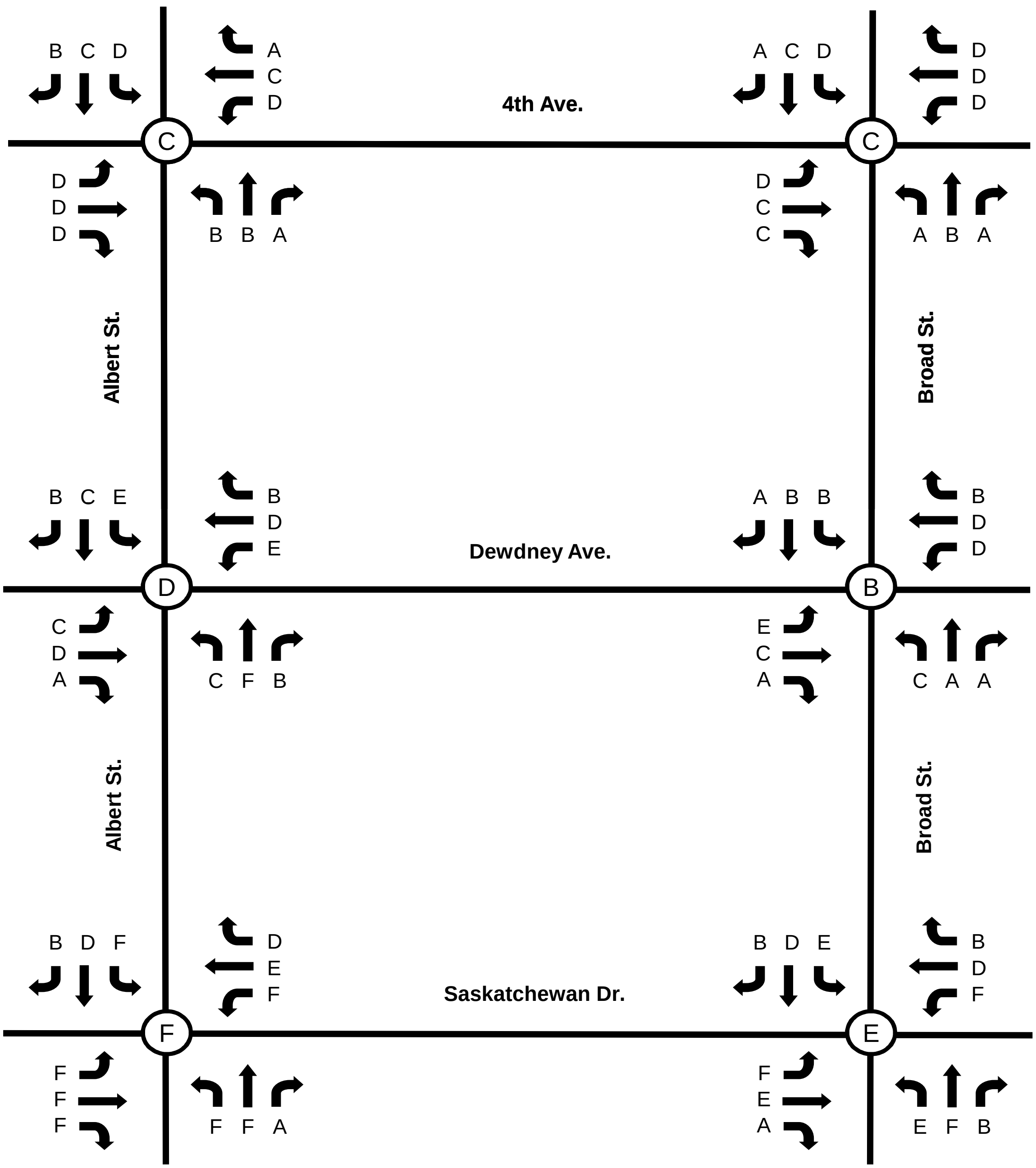
Appendix D - Day-to-Day LOS Results

High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

Existing (2009) PM Peak Levels of Service - By Movement



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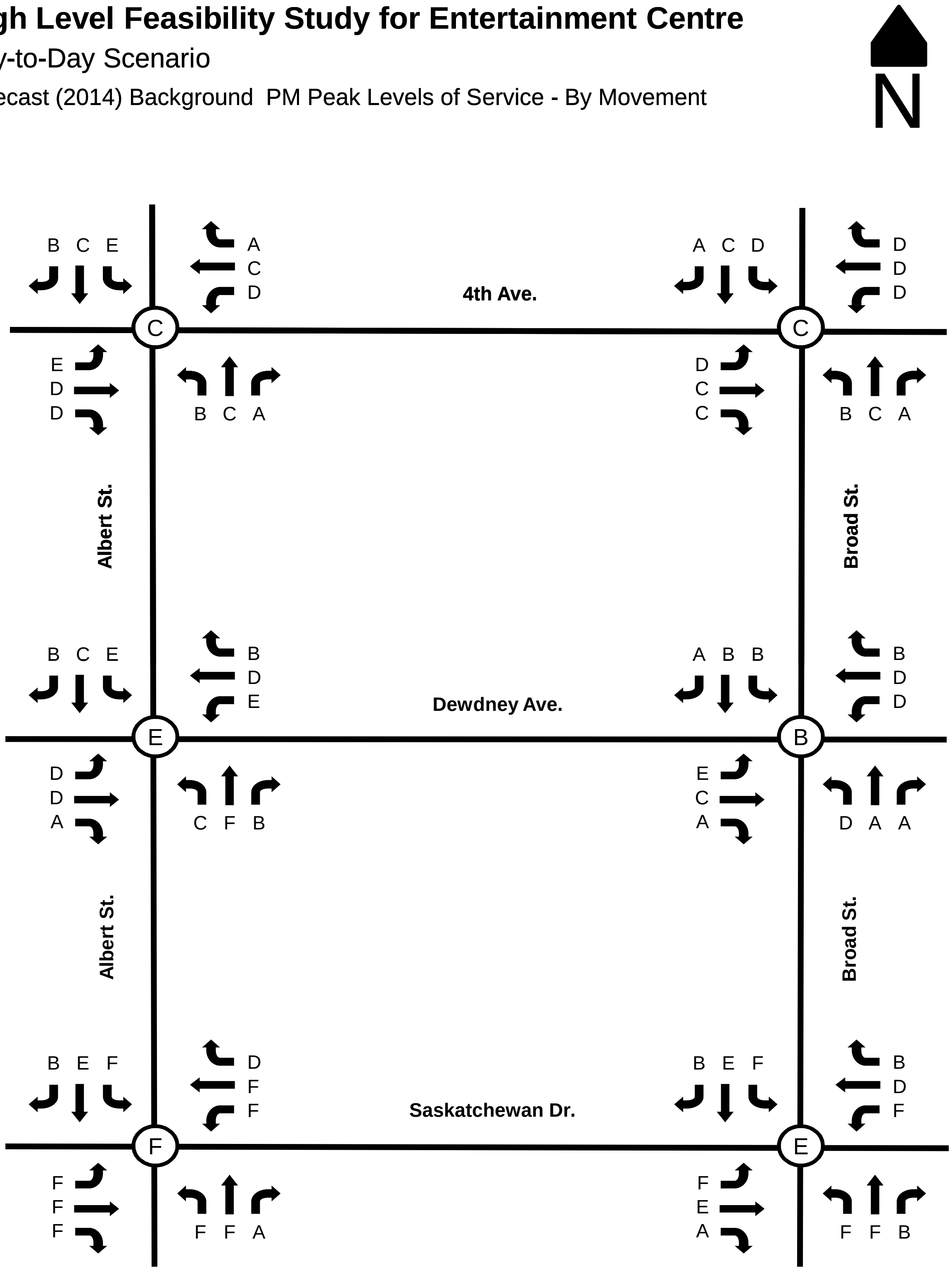
High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

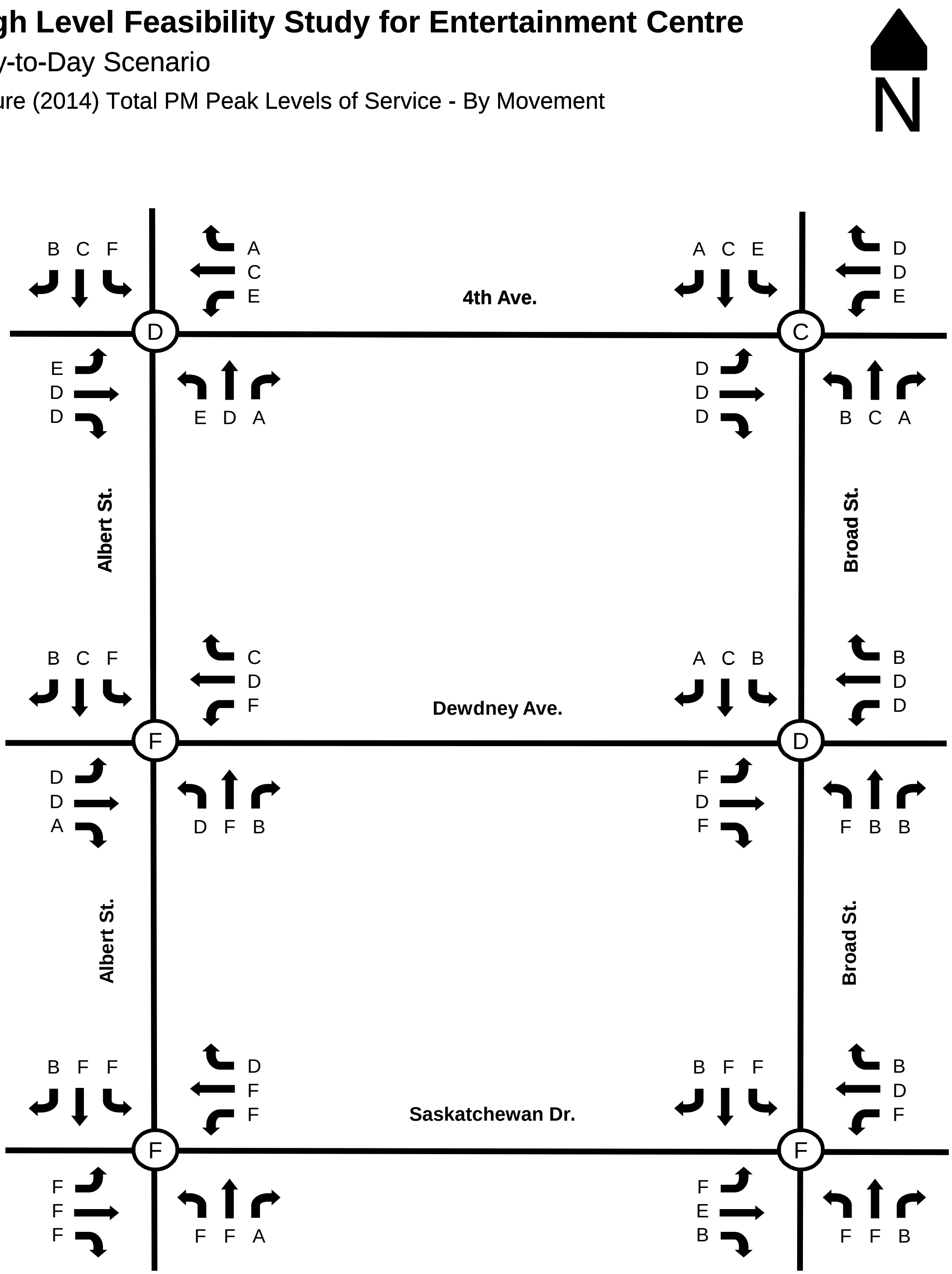
Forecast (2014) Background PM Peak Levels of Service - By Movement



High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

Future (2014) Total PM Peak Levels of Service - By Movement



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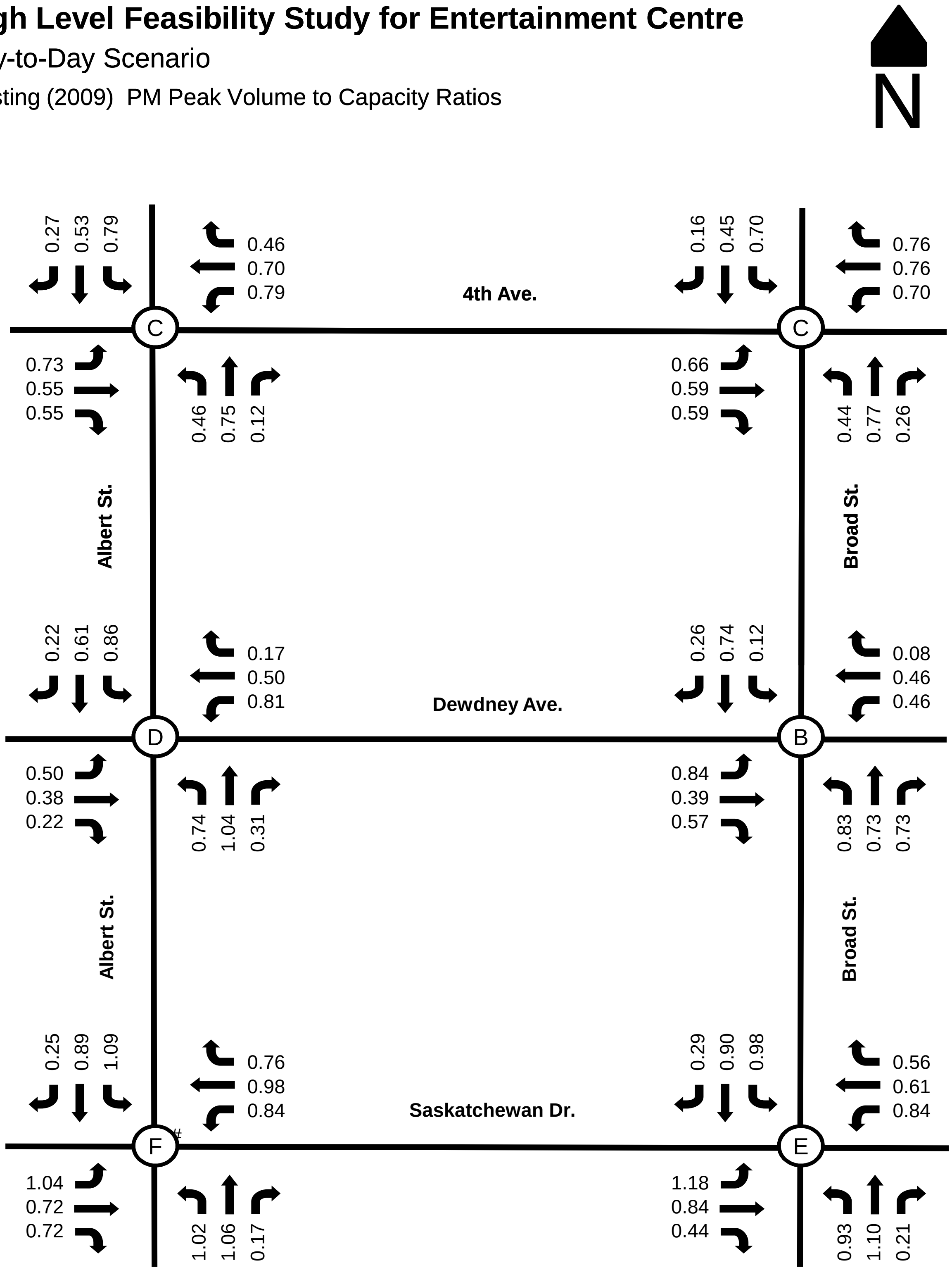
Appendix E - Day-to-Day Volume to Capacity Ratios

High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

Existing (2009) PM Peak Volume to Capacity Ratios



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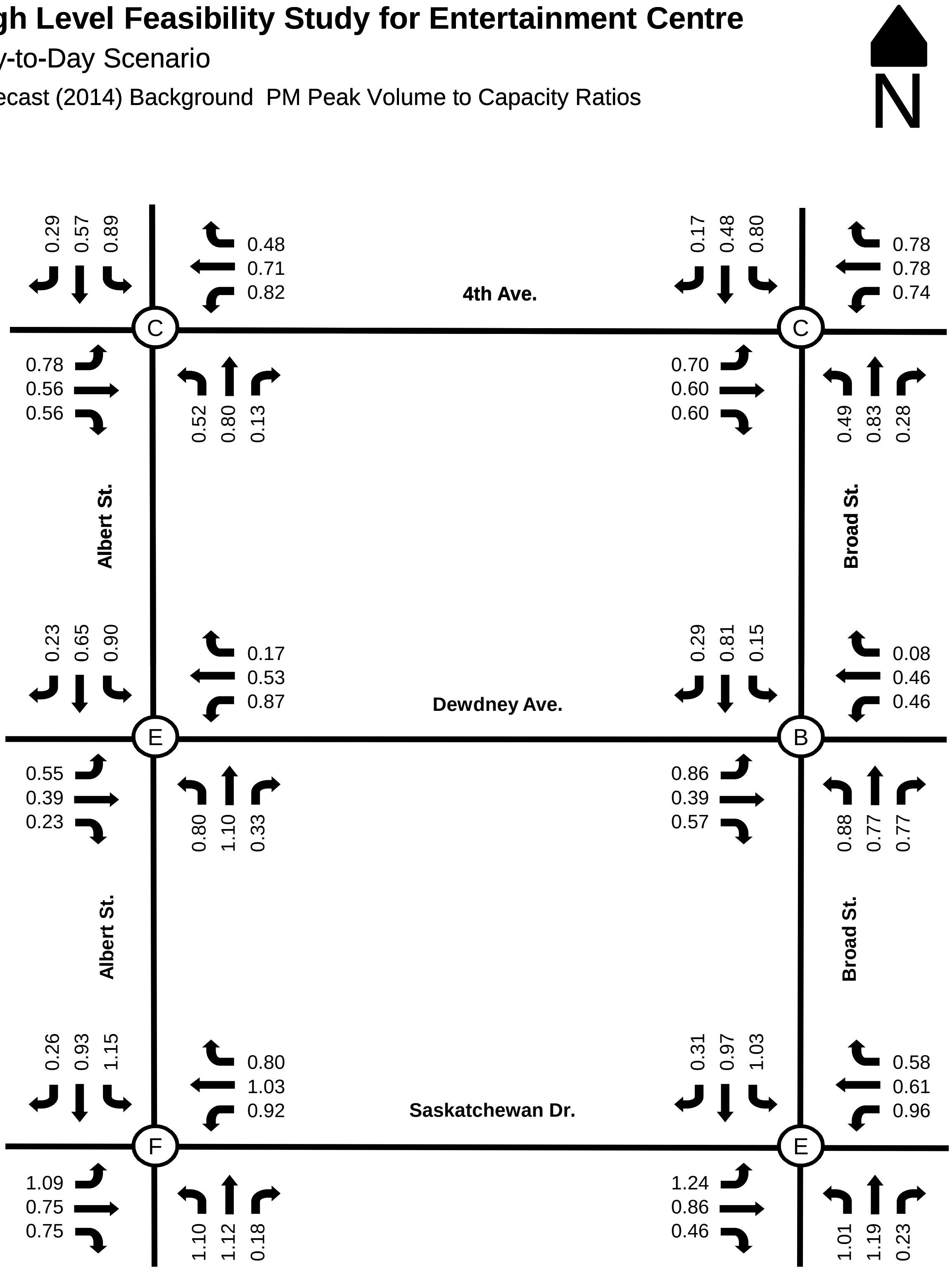
High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

Forecast (2014) Background PM Peak Volume to Capacity Ratios

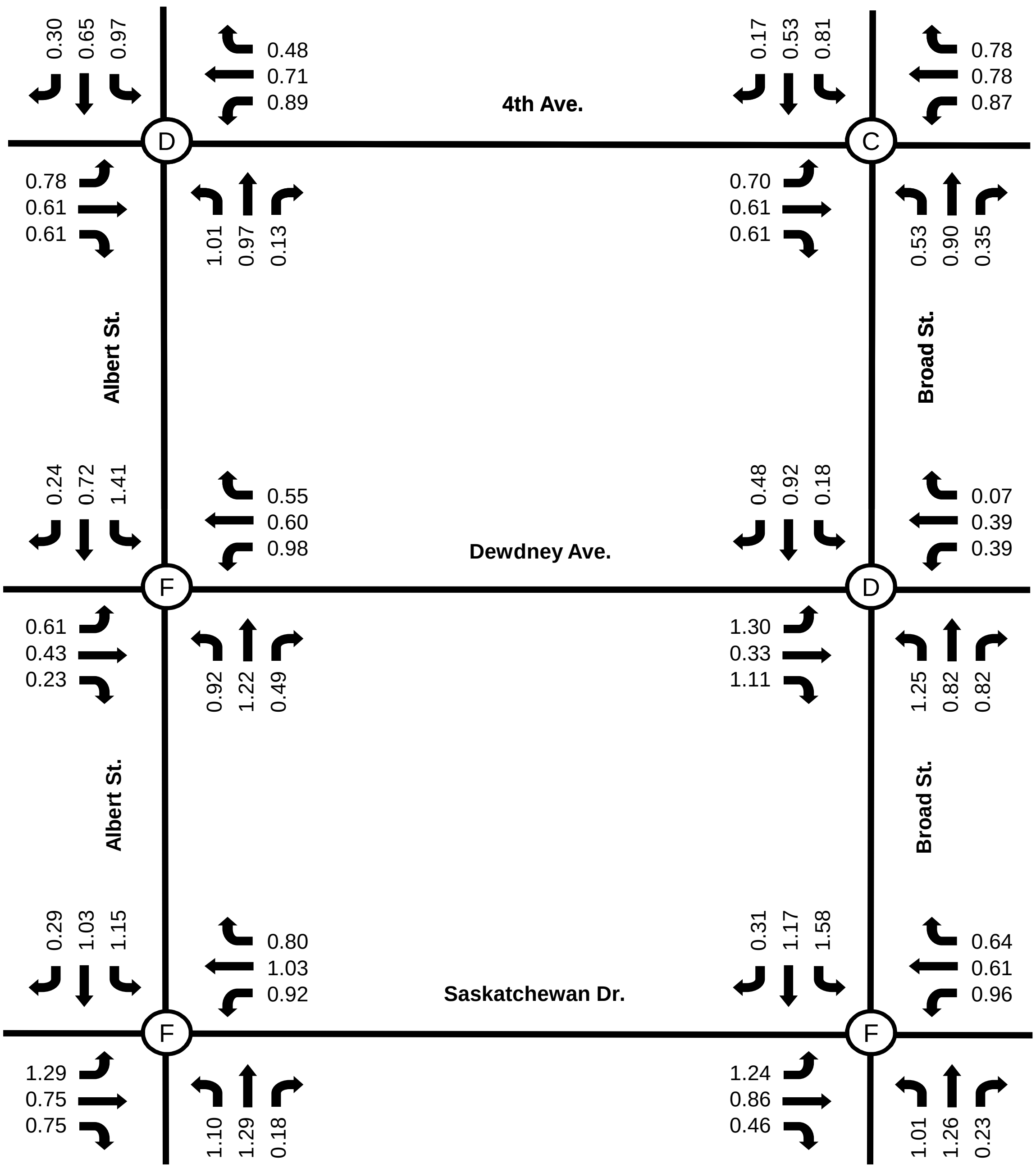


High Level Feasibility Study for Entertainment Centre

Day-to-Day Scenario

Future (2014) Total PM Peak Volume to Capacity Ratios

N



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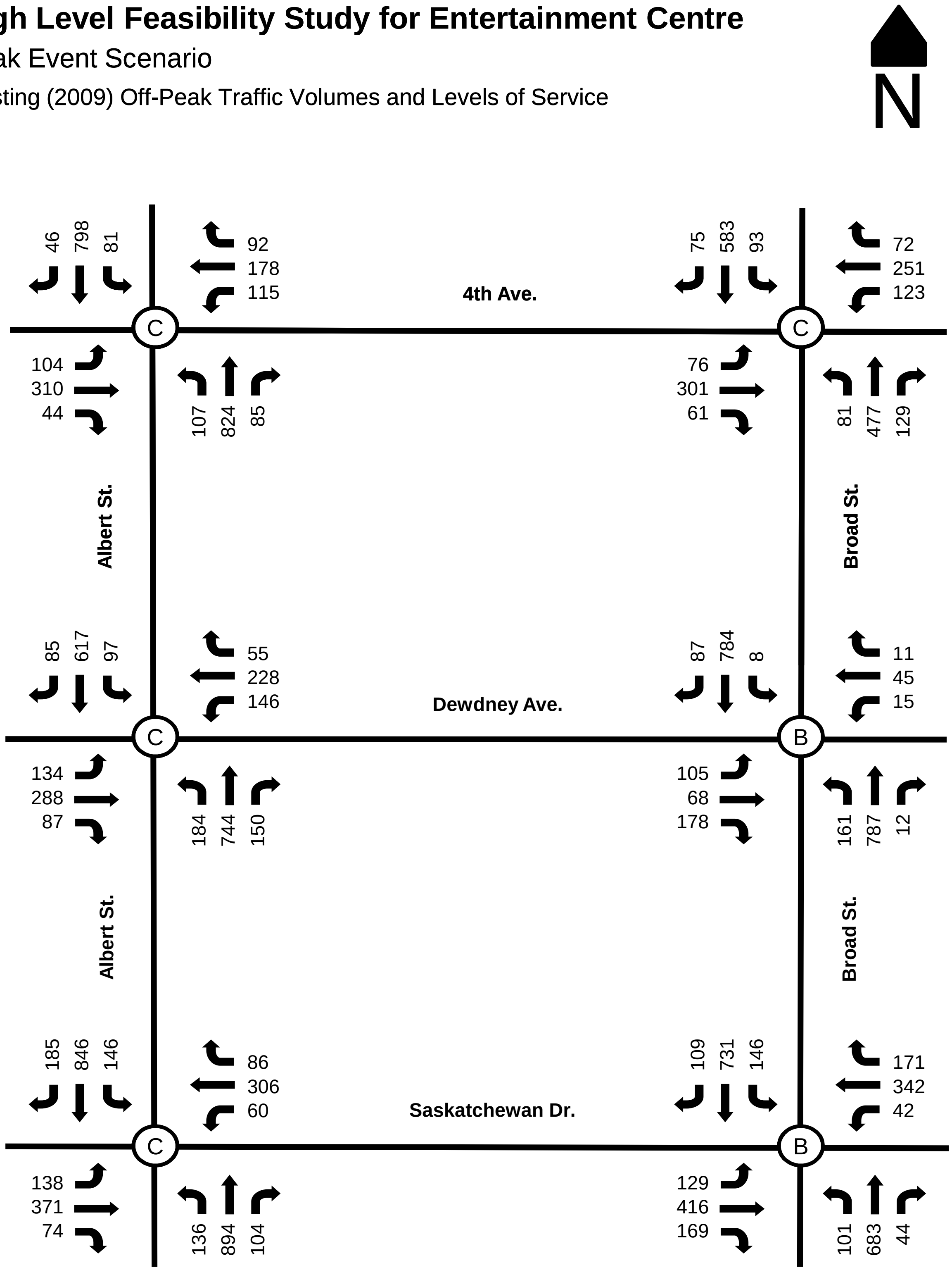
Appendix F - Peak Event Traffic Volumes

High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

Existing (2009) Off-Peak Traffic Volumes and Levels of Service



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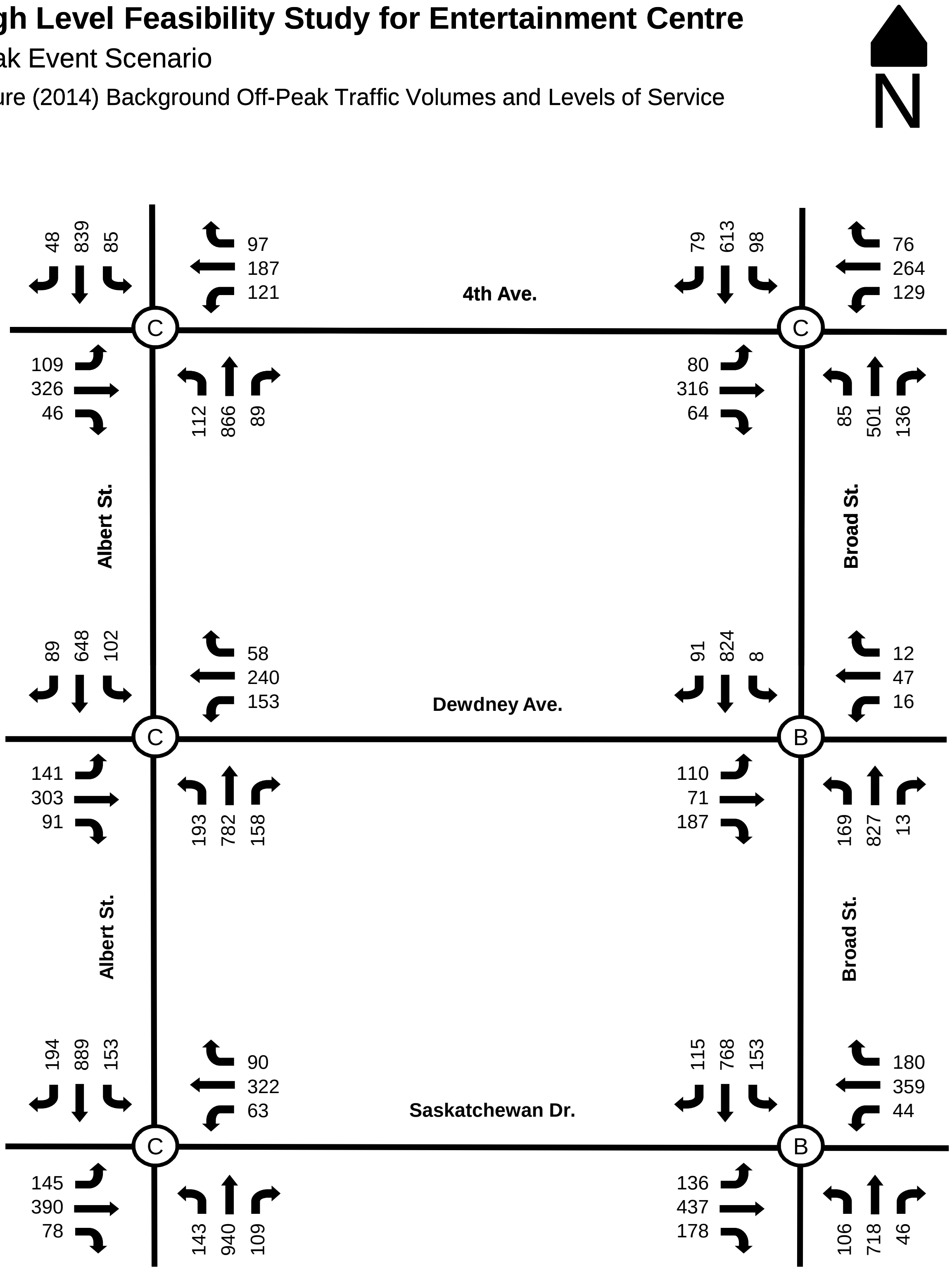
High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

Future (2014) Background Off-Peak Traffic Volumes and Levels of Service



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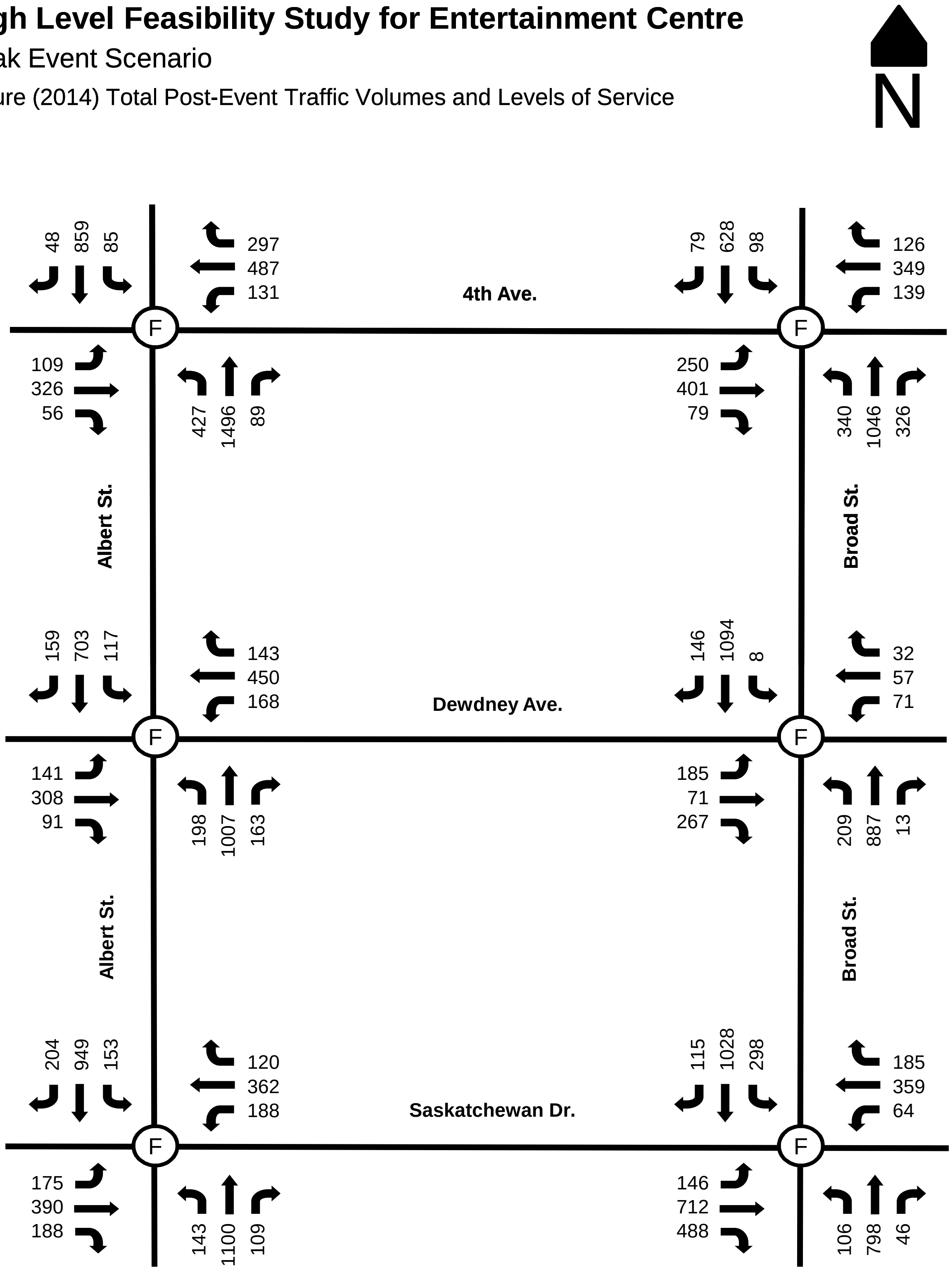
High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

Future (2014) Total Post-Event Traffic Volumes and Levels of Service



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Appendix G - Peak Event Analysis Results

High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Peak Event
Intersection: Albert Street & 4th Avenue

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	33.6	45.9	45.9	**43.1**	42.9	40.9	20.7	**36.7**	12.9	9.6	2.2	**9.3**	13.9	24.6	13.9	**23.1**	Intersection Delay (s)	**23.2**
Level of Service	C	D	D	**D**	D	D	C	**D**	B	A	A	**A**	B	C	B	**C**	Level of Service	**C**
v/c Ratio	0.42	0.68	0.68	**-**	0.61	0.30	0.28	**-**	0.39	0.59	0.13	**-**	0.33	0.60	0.08	**-**	Max v/c Ratio	**0.68**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	33.5	45.9	45.9	**43.1**	44.8	40.7	20.4	**37.0**	16.5	10.5	2.4	**10.5**	15.3	26.0	14.6	**24.5**	Intersection Delay (s)	**24.2**
Level of Service	C	D	D	**D**	D	D	C	**D**	B	B	A	**B**	B	C	B	**C**	Level of Service	**C**
v/c Ratio	0.43	0.69	0.69	**-**	0.65	0.31	0.28	**-**	0.44	0.63	0.14	**-**	0.38	0.64	0.08	**-**	Max v/c Ratio	**0.69**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	57.9	36.2	36.2	**41.0**	37.3	43.1	35.1	**39.7**	850.4	346.2	13.4	**443.4**	29.5	34.7	17.3	**33.5**	Intersection Delay (s)	**239.3**
Level of Service	E	D	D	**D**	D	D	D	**D**	F	F	B	**F**	C	C	B	**C**	Level of Service	**F**
v/c Ratio	0.79	0.53	0.53	**-**	0.71	0.81	0.85	**-**	2.83	1.71	0.17	**-**	0.57	0.78	0.10	**-**	Max v/c Ratio	**2.83**

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High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Peak Event
Intersection: Broad Street & 4th Avenue

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	25.8	41.3	41.3	**38.6**	33.4	34.4	34.4	**34.1**	8.9	17.1	5.9	**14.7**	13.5	20.5	5.1	**18.1**	Intersection Delay (s)	**24.0**
Level of Service	C	D	D	**D**	C	C	C	**C**	A	B	A	**B**	B	C	A	**B**	Level of Service	**C**
v/c Ratio	0.29	0.59	0.59	**-**	0.53	0.46	0.46	**-**	0.22	0.33	0.18	**-**	0.23	0.39	0.11	**-**	Max v/c Ratio	**0.59**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	25.9	41.8	41.8	**39.0**	34.6	34.7	34.7	**34.7**	9.1	18.1	5.6	**14.7**	13.9	21.1	5.1	**18.6**	Intersection Delay (s)	**24.4**
Level of Service	C	D	D	**D**	C	C	C	**C**	A	B	A	**B**	B	C	A	**B**	Level of Service	**C**
v/c Ratio	0.31	0.62	0.62	**-**	0.56	0.48	0.48	**-**	0.24	0.35	0.19	**-**	0.25	0.41	0.11	**-**	Max v/c Ratio	**0.62**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	213.5	47.8	47.8	**104.6**	41.6	34.1	34.1	**35.8**	146.4	158.2	15.3	**127.5**	32.9	28.6	5.7	**26.9**	Intersection Delay (s)	**94.0**
Level of Service	F	D	D	**F**	D	C	C	**D**	F	F	B	**F**	C	C	A	**C**	Level of Service	**F**
v/c Ratio	1.37	0.85	0.85	**-**	0.72	0.58	0.58	**-**	1.21	1.27	0.66	**-**	0.61	0.53	0.14	**-**	Max v/c Ratio	**1.37**

High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Peak Event
Intersection: Albert Street & Dewdney Avenue

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	23.9	30.7	6.5	**24.8**	23.2	27.9	6.8	**23.6**	30.6	33.2	14.7	**30.2**	19.7	18.4	3.7	**17.0**	Intersection Delay (s)	**24.5**
Level of Service	C	C	A	**C**	C	C	A	**C**	C	C	B	**C**	B	B	A	**B**	Level of Service	**C**
v/c Ratio	0.38	0.33	0.20	**-**	0.45	0.26	0.13	**-**	0.70	0.70	0.28	**-**	0.50	0.64	0.19	**-**	Max v/c Ratio	**0.70**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	24.4	30.9	6.5	**25.0**	24.0	28.0	6.8	**23.9**	36.6	33.7	15.0	**31.6**	26.0	20.0	4.9	**19.1**	Intersection Delay (s)	**25.7**
Level of Service	C	C	A	**C**	C	C	A	**C**	D	C	B	**C**	C	C	A	**B**	Level of Service	**C**
v/c Ratio	0.41	0.35	0.20	**-**	0.48	0.27	0.14	**-**	0.76	0.74	0.30	**-**	0.56	0.69	0.20	**-**	Max v/c Ratio	**0.76**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	41.8	30.8	6.4	**29.5**	33.0	34.2	5.4	**28.5**	135.8	172.4	15.9	**152.6**	48.1	66.6	10.1	**55.4**	Intersection Delay (s)	**84.0**
Level of Service	D	C	A	**C**	C	C	A	**C**	F	F	B	**F**	D	E	B	**E**	Level of Service	**F**
v/c Ratio	0.73	0.35	0.20	**-**	0.71	0.68	0.38	**-**	1.17	1.30	0.33	**-**	0.74	1.05	0.46	**-**	Max v/c Ratio	**1.30**

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High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Peak Event
Intersection: Broad Street & Dewdney Avenue

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	51.0	38.4	18.7	**32.2**	41.0	41.0	16.3	**37.1**	12.5	13.2	13.2	**13.1**	6.5	7.4	2.0	**6.9**	Intersection Delay (s)	**14.4**
Level of Service	D	D	B	**C**	D	D	B	**D**	B	B	B	**B**	A	A	A	**A**	Level of Service	**B**
v/c Ratio	0.60	0.30	0.52	**-**	0.28	0.28	0.06	**-**	0.47	0.40	0.40	**-**	0.03	0.46	0.12	**-**	Max v/c Ratio	**0.60**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	51.9	38.1	18.6	**32.4**	40.9	40.9	16.2	**36.9**	13.2	13.7	13.7	**13.6**	6.8	7.9	2.2	**7.3**	Intersection Delay (s)	**14.8**
Level of Service	D	D	B	**C**	D	D	B	**D**	B	B	B	**B**	A	A	A	**A**	Level of Service	**B**
v/c Ratio	0.62	0.31	0.53	**-**	0.29	0.29	0.06	**-**	0.51	0.42	0.42	**-**	0.03	0.49	0.13	**-**	Max v/c Ratio	**0.62**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	117.5	33.1	21.9	**57.3**	38.0	38.0	11.3	**32.6**	17.1	22.7	22.7	**21.9**	16.5	167.2	11.3	**153.5**	Intersection Delay (s)	**83.8**
Level of Service	F	C	C	**E**	D	D	B	**C**	B	C	C	**C**	B	F	B	**F**	Level of Service	**F**
v/c Ratio	1.08	0.28	0.72	**-**	0.45	0.45	0.10	**-**	0.89	0.76	0.76	**-**	0.08	1.30	0.28	**-**	Max v/c Ratio	**1.30**

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High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Peak Event
Intersection: Albert Street & Saskatchewan Drive

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	56.9	42.3	42.3	**45.8**	30.6	33.8	15.5	**29.9**	26.4	21.8	2.8	**20.6**	42.2	16.4	1.3	**17.3**	Intersection Delay (s)	**25.1**
Level of Service	E	D	D	**D**	C	C	B	**C**	C	C	A	**C**	D	B	A	**B**	Level of Service	**C**
v/c Ratio	0.78	0.71	0.71	**-**	0.43	0.52	0.28	**-**	0.63	0.77	0.20	**-**	0.70	0.71	0.30	**-**	Max v/c Ratio	**0.78**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	62.6	42.6	42.6	**47.4**	31.6	34.0	16.3	**30.3**	35.0	27.2	3.1	**25.9**	56.2	18.9	1.4	**20.8**	Intersection Delay (s)	**28.5**
Level of Service	E	D	D	**D**	C	C	B	**C**	D	C	A	**C**	E	B	A	**C**	Level of Service	**C**
v/c Ratio	0.82	0.73	0.73	**-**	0.46	0.53	0.28	**-**	0.70	0.82	0.21	**-**	0.79	0.77	0.32	**-**	Max v/c Ratio	**0.82**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	155.2	43.5	43.5	**69.5**	538.1	37.6	17.2	**174.3**	60.3	348.3	8.8	**303.3**	72.2	131.5	3.2	**105.5**	Intersection Delay (s)	**179.7**
Level of Service	F	D	D	**E**	F	D	B	**F**	E	F	A	**F**	E	F	A	**F**	Level of Service	**F**
v/c Ratio	1.18	0.83	0.83	**-**	2.10	0.69	0.44	**-**	0.84	1.43	0.24	**-**	0.87	1.22	0.48	**-**	Max v/c Ratio	**2.10**

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High Level Feasibility Study for Entertainment Centre
Intersection Analysis Findings

Scenario: Peak Event
Intersection: Broad Street & Saskatchewan Drive

Time Frame: Existing 2009

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	25.9	14.9	2.7	**14.0**	39.5	43.3	8.1	**32.2**	14.8	20.9	7.6	**19.5**	10.2	16.7	4.5	**14.4**	Intersection Delay (s)	**18.9**
Level of Service	C	B	A	**B**	D	D	A	**C**	B	C	A	**B**	B	B	A	**B**	Level of Service	**B**
v/c Ratio	0.65	0.48	0.33	**-**	0.29	0.61	0.44	**-**	0.37	0.53	0.07	**-**	0.48	0.54	0.17	**-**	Max v/c Ratio	**0.65**

Time Frame: Forecast Background 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	29.5	14.9	2.8	**14.7**	40.0	43.7	8.1	**32.4**	16.2	22.2	7.8	**20.7**	11.7	17.0	4.3	**14.8**	Intersection Delay (s)	**19.5**
Level of Service	C	B	A	**B**	D	D	A	**C**	B	C	A	**C**	B	B	A	**B**	Level of Service	**B**
v/c Ratio	0.70	0.50	0.34	**-**	0.31	0.63	0.45	**-**	0.41	0.56	0.08	**-**	0.52	0.57	0.18	**-**	Max v/c Ratio	**0.70**

Time Frame: Forecast Total 2014

MEASURE	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL	
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total		
Delay (s)	40.0	80.0	103.5	**84.2**	149.9	31.9	6.0	**36.5**	56.7	167.3	13.5	**153.1**	485.0	208.4	3.8	**255.6**	Intersection Delay (s)	**153.8**
Level of Service	D	F	F	**F**	F	C	A	**D**	E	F	B	**F**	F	F	A	**F**	Level of Service	**F**
v/c Ratio	0.75	0.90	1.12	**-**	1.00	0.42	0.36	**-**	0.76	1.28	0.11	**-**	2.02	1.41	0.23	**-**	Max v/c Ratio	**2.02**

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High Level Feasibility Study for Entertainment Centre
Level of Service Results

Peak Event Scenario

INTERSECTION	EASTBOUND				WESTBOUND				NORTHBOUND				SOUTHBOUND				OVERALL
	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	LT	TH	RT	Total	
Albert Street & 4th Ave																	
Existing 2009	C	D	D	**D**	D	D	C	**D**	B	A	A	**A**	B	C	B	**C**	**C**
Forecast Background 2014	C	D	D	**D**	D	D	C	**D**	B	B	A	**B**	B	C	B	**C**	**C**
Forecast Total 2014	E	D	D	**D**	D	D	D	**D**	F	F	B	**F**	C	C	B	**C**	**F**
Broad Street & 4th Ave																	
Existing 2009	C	D	D	**D**	C	C	C	**C**	A	B	A	**B**	B	C	A	**B**	**C**
Forecast Background 2014	C	D	D	**D**	C	C	C	**C**	A	B	A	**B**	B	C	A	**B**	**C**
Forecast Total 2014	F	D	D	**F**	D	C	C	**D**	F	F	B	**F**	C	C	A	**C**	**F**
Albert Street & Dewdney Avenue																	
Existing 2009	C	C	A	**C**	C	C	A	**C**	C	C	B	**C**	B	B	A	**B**	**C**
Forecast Background 2014	C	C	A	**C**	C	C	A	**C**	D	C	B	**C**	C	C	A	**B**	**C**
Forecast Total 2014	D	C	A	**C**	C	C	A	**C**	F	F	B	**F**	D	E	B	**E**	**F**
Broad Street & Dewdney Ave																	
Existing 2009	D	D	B	**C**	-	D	B	**D**	B	B	B	**B**	A	A	A	**A**	**B**
Forecast Background 2014	D	D	B	**C**	-	D	B	**D**	B	B	B	**B**	A	A	A	**A**	**B**
Forecast Total 2014	F	C	C	**E**	-	D	B	**C**	B	C	C	**C**	B	F	B	**F**	**F**
Albert Street & Saskatchewan Drive																	
Existing 2009	E	D	D	**D**	C	C	B	**C**	C	C	A	**C**	D	B	A	**B**	**C**
Forecast Background 2014	E	D	D	**D**	C	C	B	**C**	D	C	A	**C**	E	B	A	**C**	**C**
Forecast Total 2014	F	D	D	**E**	F	D	B	**F**	E	F	A	**F**	E	F	A	**F**	**F**
Broad Street & Saskatchewan Drive																	
Existing 2009	C	B	A	**B**	D	D	A	**C**	B	C	A	**B**	B	B	A	**B**	**B**
Forecast Background 2014	C	B	A	**B**	D	D	A	**C**	B	C	A	**C**	B	B	A	**B**	**B**
Forecast Total 2014	D	F	F	**F**	F	C	A	**D**	E	F	B	**F**	F	F	A	**F**	**F**

High Level Feasibility Study for Entertainment Centre

Summary of Intersection Operations and Critical Movements by Timeframe

Peak Event Scenario

INTERSECTION / TIMEFRAME	Overall Intersection		Critical Movements		
	LOS	Delay (s)	Max v/c Ratios	Movement	LOS
Albert Street & 4th Ave					
Existing 2009	C	23.2	0.68	EB TH	D
Forecast Background 2014	C	24.2	0.69	EB TH	D
Forecast Total 2014	F	239.3	2.83	NB LT	F
			1.71	NB TH	F
			0.85	WB RT	D
Broad Street & 4th Ave					
Existing 2009	C	24.0	0.59	EB TH/RT	D
Forecast Background 2014	C	24.4	0.62	EB TH/RT	D
Forecast Total 2014	F	94.0	1.37	EB LT	F
			1.27	NB TH	F
			1.21	NB LT	F
Albert Street & Dewdney Avenue					
Existing 2009	C	24.5	0.70	NB LT	C
Forecast Background 2014	C	25.7	0.76	NB LT	D
Forecast Total 2014	F	84.0	1.30	NB TH	F
			1.17	NB LT	F
			1.05	SB TH	E
Broad Street & Dewdney Avenue					
Existing 2009	B	14.4	0.60	EB LT	D
Forecast Background 2014	B	14.8	0.62	EB LT	D
Forecast Total 2014	F	83.8	1.30	SB TH	F
			1.08	EB LT	F
			0.89	NB LT	B
Albert Street & Saskatchewan Drive					
Existing 2009	C	25.1	0.78	EB LT	E
Forecast Background 2014	C	28.5	0.82	EB LT	E
Forecast Total 2014	F	179.7	2.10	WB LT	F
			1.43	NB TH	F
			1.22	SB TH	F
Broad Street & Saskatchewan Drive					
Existing 2009	B	18.9	0.65	EB LT	C
Forecast Background 2014	B	19.5	0.70	EB LT	C
Forecast Total 2014	F	153.8	2.02	SB LT	F
			1.41	SB TH	F
			1.28	NB TH	F

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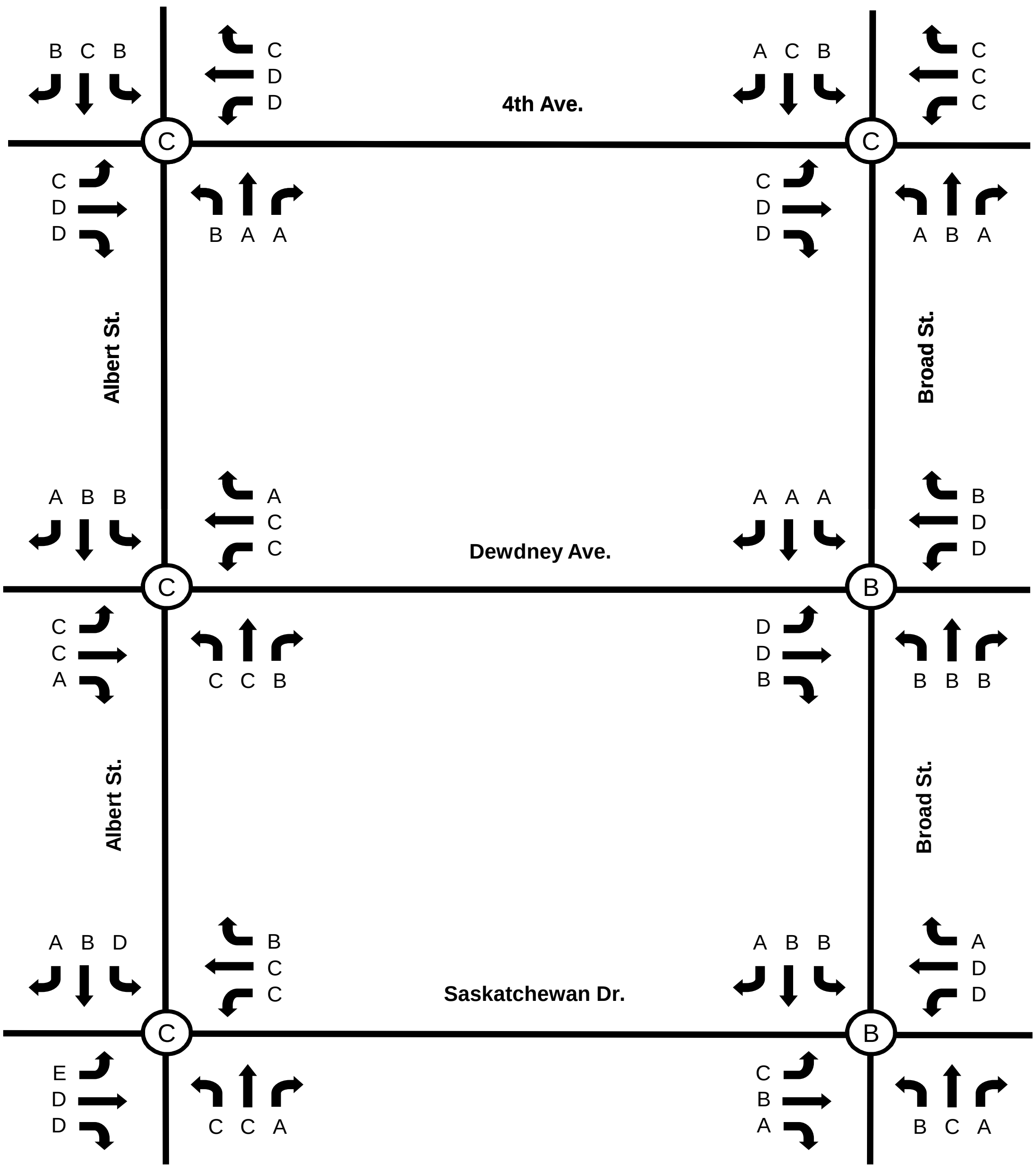
Appendix H - Peak Event LOS Results

High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

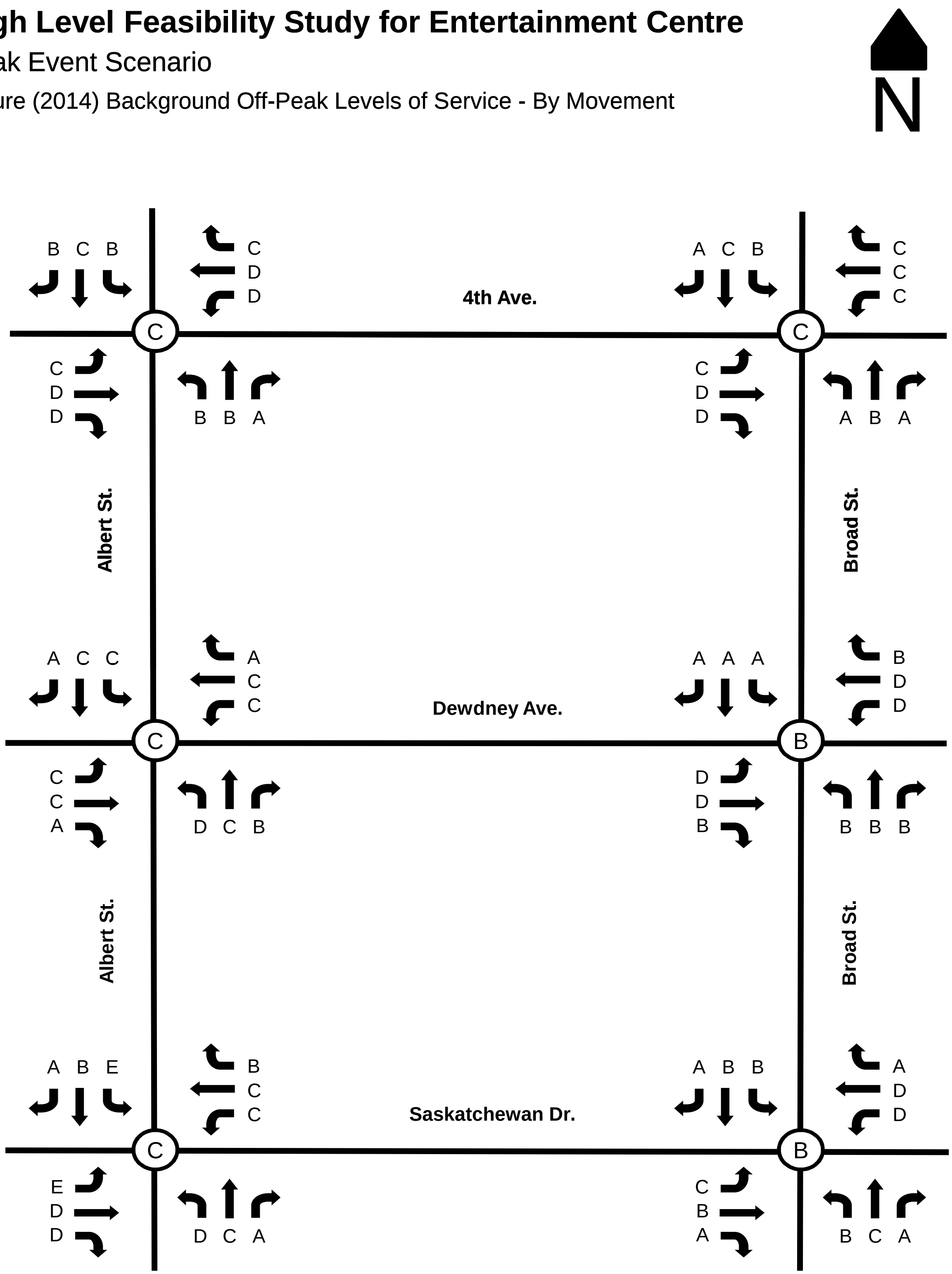
Existing (2009) Off-Peak Levels of Service - By Movement



High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

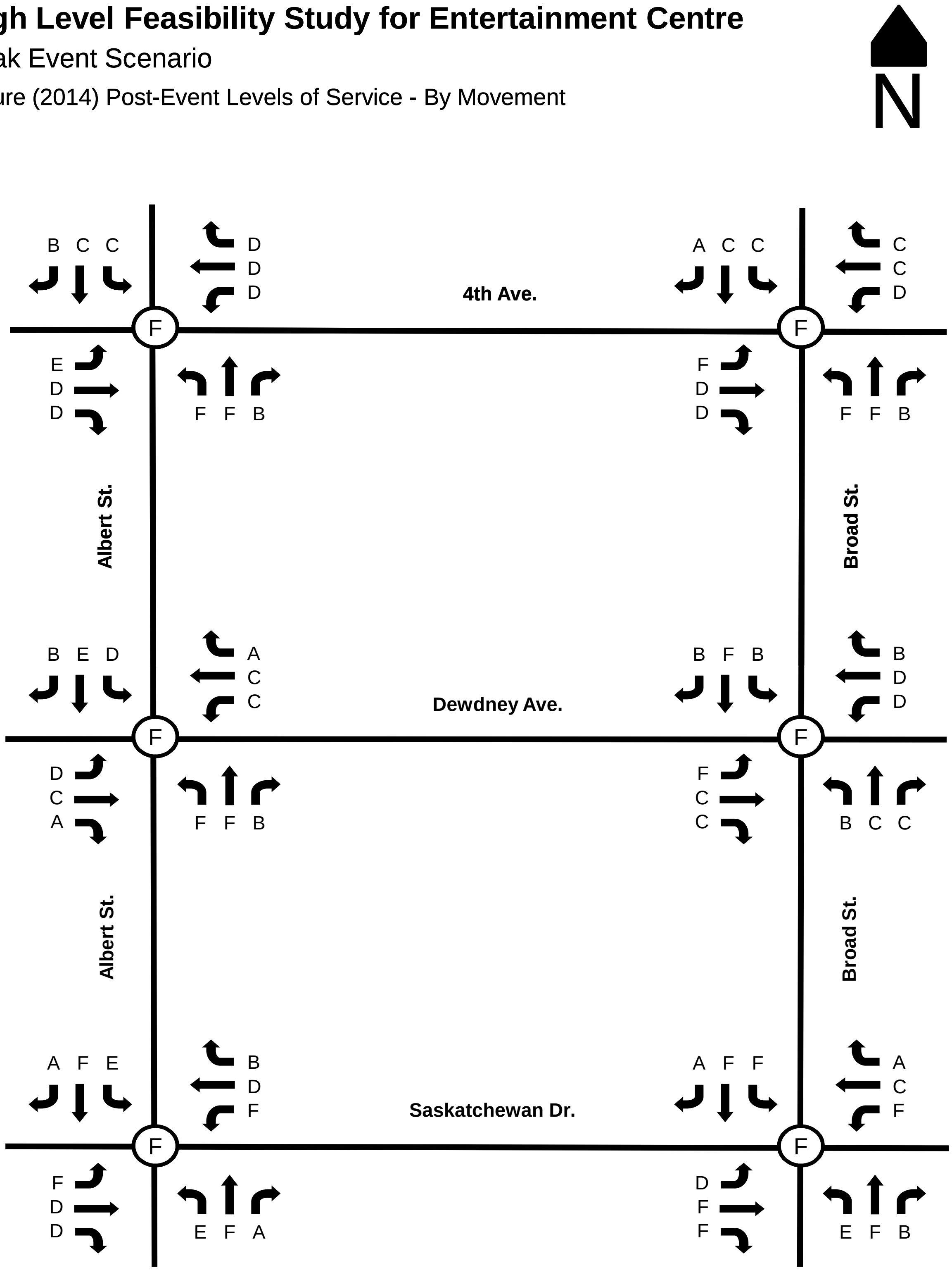
Future (2014) Background Off-Peak Levels of Service - By Movement



High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

Future (2014) Post-Event Levels of Service - By Movement



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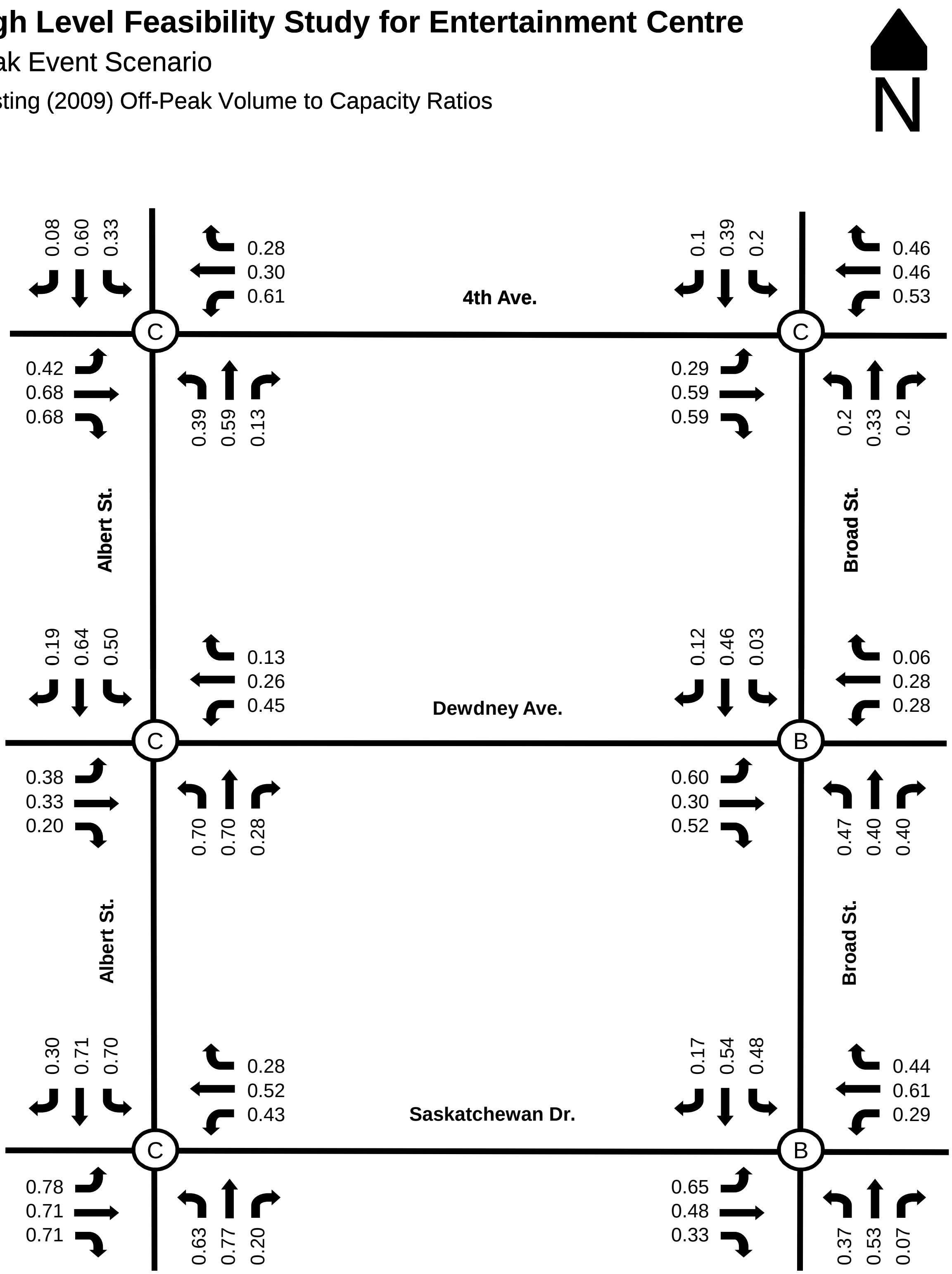
Appendix I - Peak Event Volume to Capacity Ratios

High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

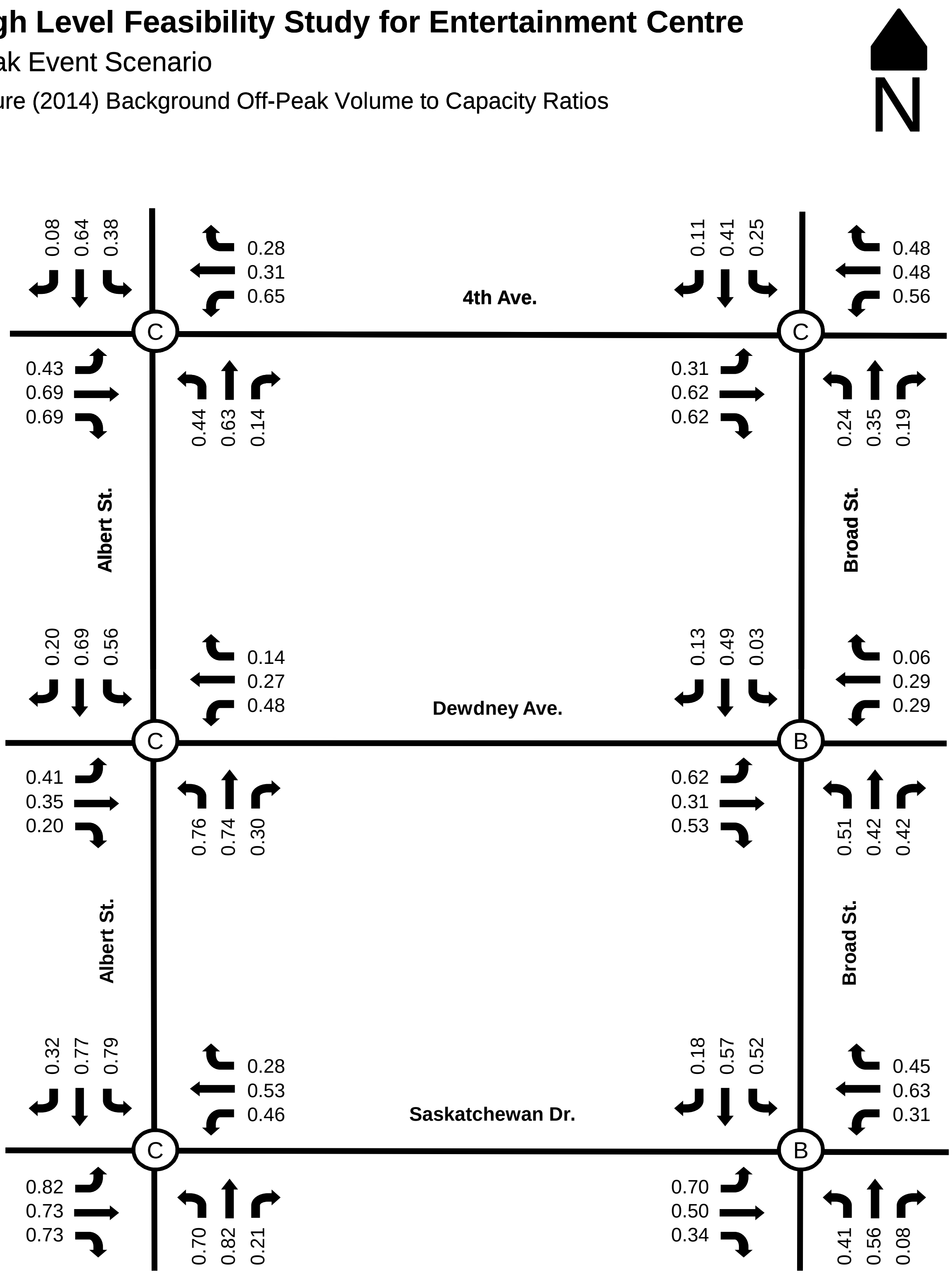
Existing (2009) Off-Peak Volume to Capacity Ratios



High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

Future (2014) Background Off-Peak Volume to Capacity Ratios



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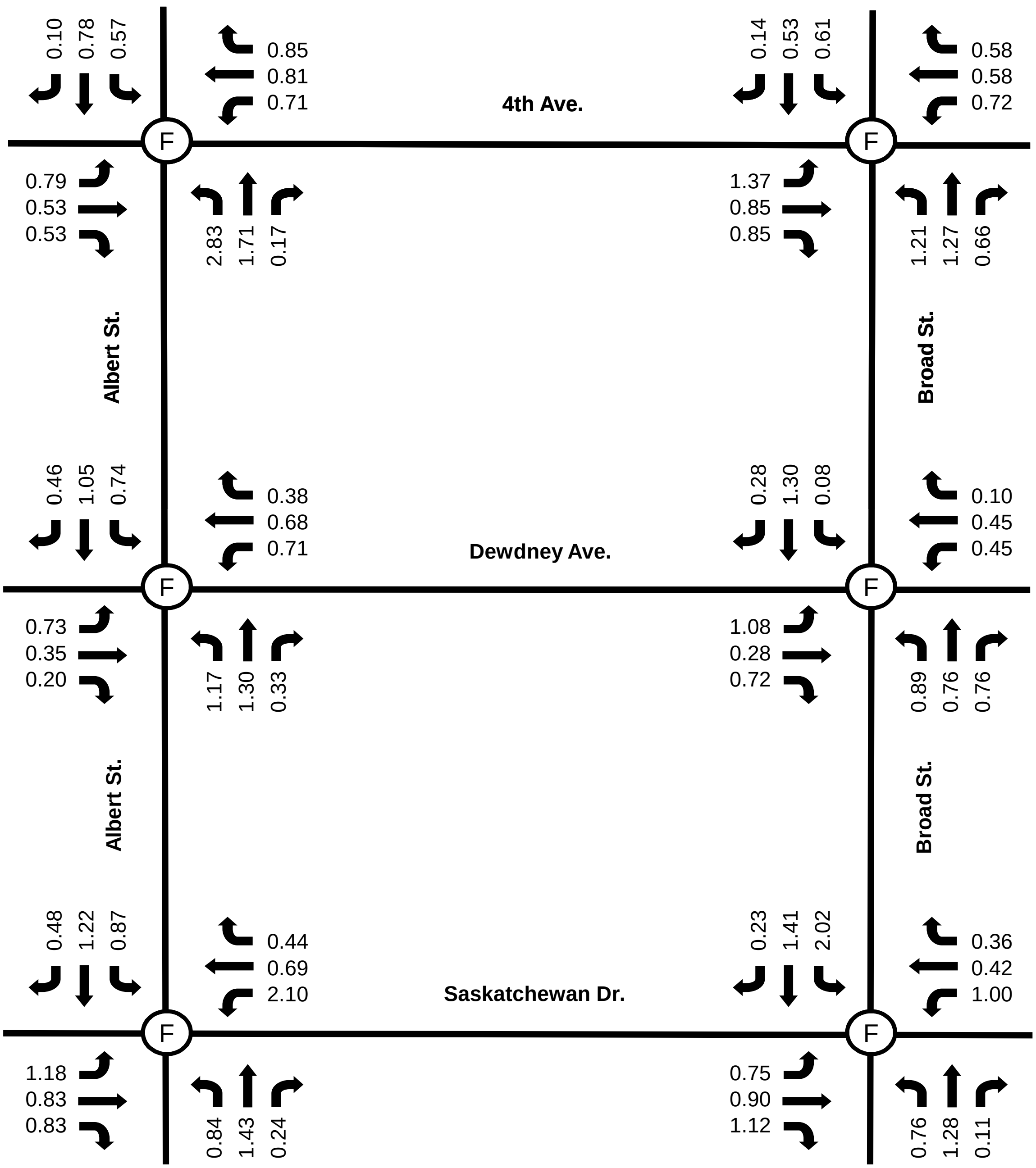
High Level Feasibility Study for Entertainment Centre

Peak Event Scenario

Future (2014) Total Post-Event Volume to Capacity Ratios



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Appendix J - Water Servicing

New Stadium - 1st phase - 33,000

BP Code	Unit Description	Quantity	Fixtures per Unit					Total Fixtures				
			Sinks	Showers	Urinals	Toilets	Washer M	Sinks	Showers	Urinals	Toilets	Wash M.
2	Public Areas											
2.1.2	Suites	40	1					40	0	0	0	
2.1.2	Group sales suites	4	1					4	0	0	0	
2.3.2	Public Washrooms - Men General Concourse	1	68		152	51		68	0	152	51	
	Public Washrooms - Women General Concourse	1	81			203		81	0	0	203	
2.3.3	Public Washrooms - Men Suite Level	1	7		15	5		7	0	15	5	
	Public Washrooms - Women Suite Level	1	8			20		8	0	0	20	
2.3.4	Public Washrooms - Men Club Concourse	1	2		5	2		2	0	5	2	
	Public Washrooms - Women Club concurse	1	2			7		2	0	0	7	
2.3.5	Family Washrroms	8	1			1		8	0	0	8	
2.3.6	Public Washrooms - Men Event Level	1	21		34	11		21	0	34	11	
	Public Washrooms - Women Event Level	1	42			85		42	0	0	85	
2.4	Concessions -							0	0	0	0	
2.4.2	Points of sale - General & Club Concourse	152	1					152	0	0	0	
2.4.3	Points of sale - Hawkers room	8	1					8	0	0	0	
	Subtotal							443	0	206	392	
3	Services Areas											
3.1.5	Media Washrooms	2	1			1		2	0	0	2	
3.2.1	Central storage	1	1					1	0	0	0	
3.2.2	Pantries	2	1					2	0	0	0	
3.2.3	Break rooms	2	1			1		2	0	0	2	
3.2.4	Staff change rooms	2	1	1		1		2	2	0	2	
3.3.1	Security building control	1	1			1		1	0	0	1	
3.3.2	Ticket offices - washroom	1	1			1		1	0	0	1	
3.3.3	Event Staff change room	1	1	1		1		1	1	0	1	
3.3.4	Operations/staff - Laundry room	1					6	0	0	0	0	6
3.3.5	Staff Breaks Room	1	1			1		1	0	0	1	
3.3.6	Police Office	1	1			1		1	0	0	1	
3.3.7	Janitor Closets	8	1					8	0	0	0	
3.3.8	First Aid facility	1	1			1		1	0	0	1	
3.4.1	Office lobby							0	0	0	0	
3.5.3	Garbage room	3	1					3	0	0	0	
3.5.5	Compactor recycling	1	1					1	0	0	0	
3.5.7	Workshop	1	1					1	0	0	0	
	Subtotal							28	3	0	12	
4	Team and performer area											
4.1.2	Std. Dressing room - community use	2	7	10	3	3		14	20	6	6	
	Std. Dressing room - coaches room	2	1	1		1		2	2	0	2	
4.1.3	Visiting CFL dressing room	1	3	8	3	3		3	8	3	3	
4.1.5	Medical examination room	1	1	1		1		1	1	0	1	
4.2.2	Riders's dressing room	1	5	12	5	3		5	12	5	3	
	Subtotal							25	43	14	15	
							Totals:	496	46	220	419	6

Later Expansion - 2nd Phase - 17,000 Additional Seats - For a Total of 50,000 Seats.

BP Code	Unit Description	Quantity	Fixtures per Unit					Total Fixtures				
			Sinks	Showers	Urinals	Toilets	Washer M	Sinks	Showers	Urinals	Toilets	Wash M.
5	Additional 17,000 seats for a total of 50,000											
5.1	*Public Washrooms - Men 50% = 8,500	1	85			57		85	0	0	57	
5.1	*Public Washrooms - Women 50% = 8,500	1	170			340		170	0	0	340	
							Totals:	255			397	

* Washroom ratio as per proposal. (Table 1)

Assumed fixtures (shaded)

Appendix K - Wastewater Servicing

Wastewater Servicing Costing

Alternative 1 – On-site Storage Servicing Concept

The Class 'D' cost associated with providing a system capable of accommodating the wastewater loadings described in this section and depicted in **Figure 6.1 and Table 6.1** below is approximately $3.45 M. The cost to accommodate the same level of service with designated on-site storage through the use of storage tanks in park spaces has not been estimated since it is assumed these areas will not be available for wastewater storage due to the need for on-site storage for stormwater management.

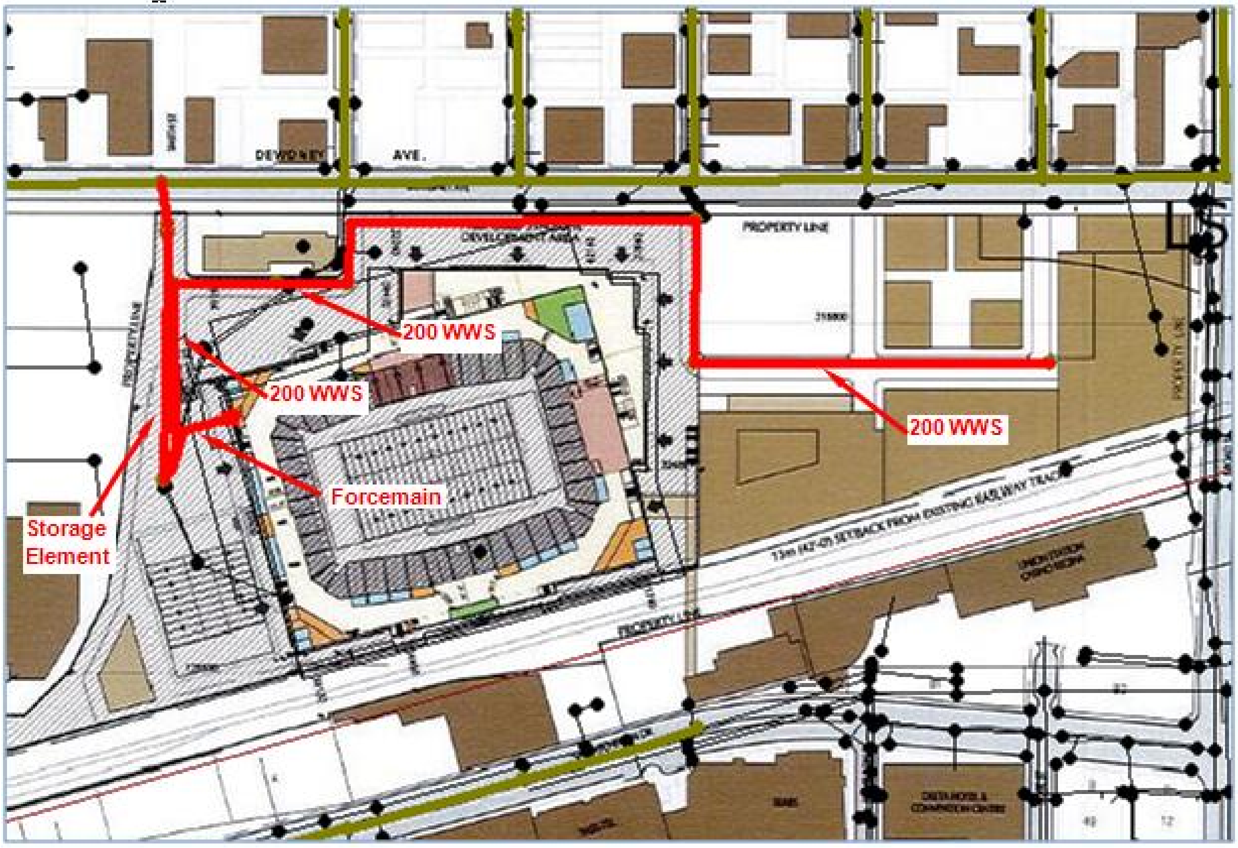


Figure 6.1 Alternative 1 Depiction - On-Site Storage Servicing Concept

Table 6.1 Alternative 1 - On-Site Storage Servicing Concept (50,000 capacity)

Item	Qty	Units	Unit Price	Item Cost
Mob/Demob	%	10	$265,885	$265,885
WWS Piping				
200 mm WWS (Internal Site Piping)	646	m	$300	$193,800
250 mm WWS (Connection to Dewdney Avenue)	30	m	$400	$12,000
2,000 mm WWS Storage Element				
Common Excavation	147	m	$870	$127,890
Pipe Supply	147	m	$1,025	$150,675
Bedding	147	m	$745	$109,515
Pipe Install & Backfill	147	m	$510	$74,970
Special Access Manholes Weholite	3	l.s.	$35,000	$105,000
300 mm WWS Forcemain	20	m	$1,000	$20,000
250 mm Flap Gate	1	l.s.	$75,000	$75,000
Standard Manholes	60	m	$2,000	$120,000
Subtotal of WWS Piping				**$988,850**
Pump Station 300 Lps	1	l.s.	$1,670,000	$1,670,000
Total Cost				**$2,920,000**
Contingency	%	30		$876,000
Grand Total				**$3,800,000**

Table 6.2 Alternative 1 - On-Site Storage Servicing Concept (33,000 capacity)

Item	Qty	Units	Unit Price	Item Cost
Mob/Demob	%	10	$198,420	$198,420
WWS Piping				
200 mm WWS (Internal Site Piping)	695	m	$300	$208,500
250 mm WWS (Connection to Dewdney Avenue)	30	m	$400	$12,000
2,000 mm WWS Storage Element				
Common Excavation	98	m	$870	$85,260
Pipe Supply	98	m	$1,025	$100,450
Bedding	98	m	$745	$73,010
Pipe Install & Backfill	98	m	$510	$49,980
Special Access Manholes Weholite	2	l.s.	$35,000	$70,000
300 mm WWS Forcemain	20	m	$1,000	$20,000
250 mm Flap Gate	1	l.s.	$75,000	$75,000
Standard Manholes	60	m	$2,000	$120,000
Subtotal of WWS Piping				**$814,200**
Pump Station 300 Lps	1	l.s.	$1,170,000	$1,170,000
Total Cost				**$2,180,000**
Contingency	%	30		$654,000
Grand Total				**$2,850,000**

Alternative 2 – Conventional Pipe Servicing Concept

The Class 'D' cost associated with providing a system capable of accommodating the wastewater loadings described in this section and depicted in **Figure 6.2 and Table 6.2** below is approximately $4.4 M.

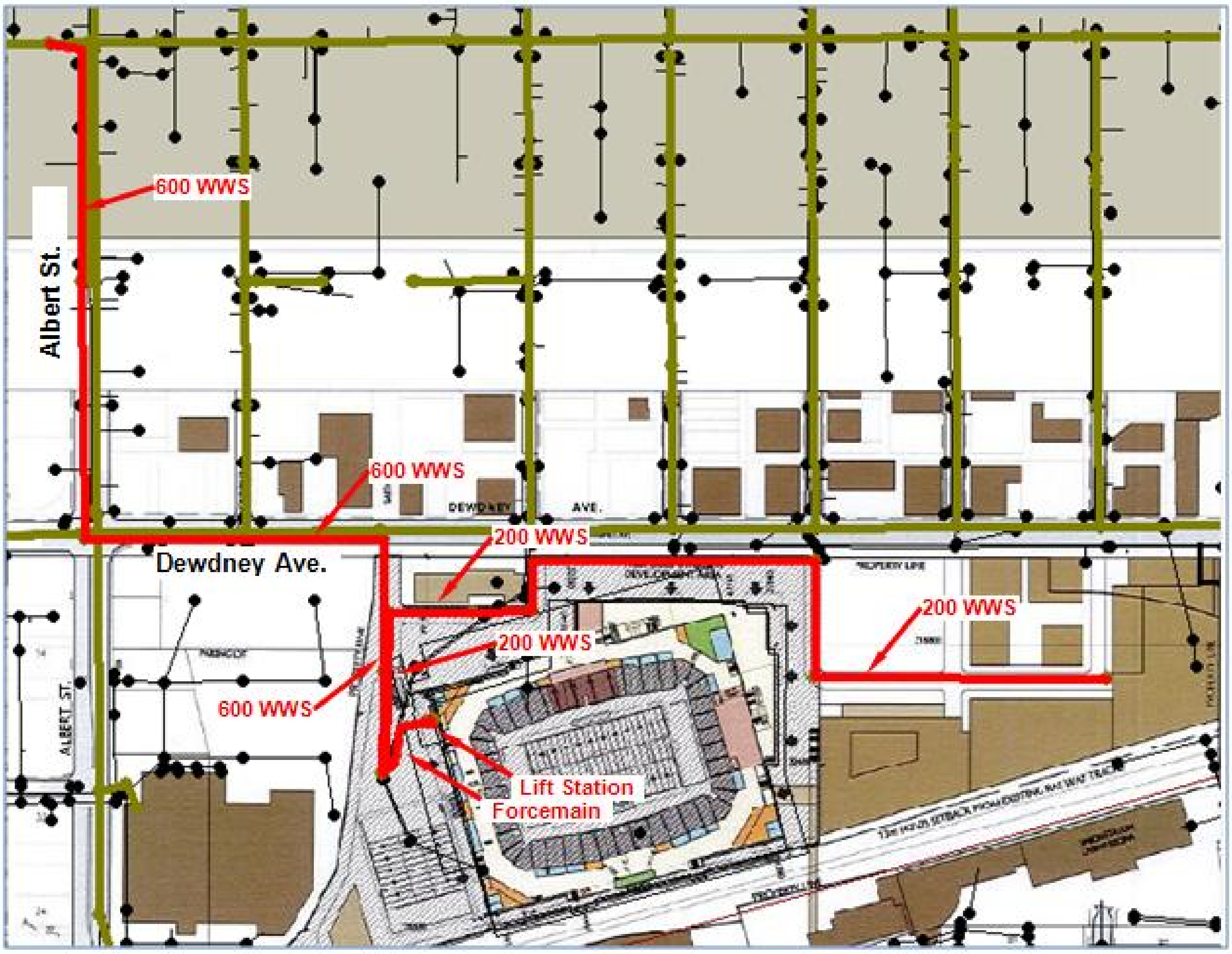


Figure 6.2 Alternative 2 Depiction - On-Site Storage Servicing Concept

Table 6.3 Alternative 2 – Conventional Piping Servicing Concept (50,000 capacity)

Item	Qty	Units	Unit Price	Item Cost
Mob/Demob	%	10	$339,920	$339,920
WWS Piping				
200 mm WWS (Internal Site Piping)	754	m	$300	$226,200
600 mm WWS (External Site Piping)	762	m	$1,500	$1,143,000
300 mm WWS Forcemain	20	m	$1,000	$20,000
Connection to 7th Avenue Trunk	1	l.s.	$100,000	$100,000
Standard Manholes (6 m per 100 m of Sewer)	120	m	$2,000	$240,000
Subtotal of WWS Piping				**$1,729,200**
Pump Station 300 Lps	1	l.s.	$1,670,000	$1,670,000
Total Cost				**$3,740,000**
Contingency	%	30		$1,122,000
Grand Total				**$4,485,000**

Table 6.4 Alternative 2 – Conventional Piping Servicing Concept (33,000 capacity)

Item	Qty	Units	Unit Price	Item Cost
Mob/Demob	%	10	$289,200	$289,200
WWS Piping				
200 mm WWS (Internal Site Piping)	754	m	$300	$226,200
600 mm WWS (External Site Piping)	762	m	$1,500	$1,143,000
300 mm WWS Forcemain	20	m	$1,000	$20,000
Connection to 7th Avenue Trunk	1	l.s.	$100,000	$100,000
Standard Manholes (6 m per 100 m of Sewer)	120	m	$2,000	$240,000
Subtotal of WWS Piping				**$1,729,200**
Pump Station 200 Lps	1	l.s.	$1,170,000	$1,170,000
Total Cost				**$3,190,000**
Contingency	%	30		$957,000
Grand Total				**$4,150,000**

Check of Wastewater Loadings

The table below is a design guideline used for a number of recent North American stadium developments. The table below appears to be based on the UK Sport Council Guidelines[1], however, the number of toilets and washbasins has been increased by factors of 4 and 3, respectively for males and by a factor of 1.4 for females.

	Urinals	Toilets	Wash Basins
Male	1 per 70 males	1 for every 150 males but not less than 2 per toilet area	1 for every 100 males, but not less than 2 per toilet area
Female	N/A	1 for every 25 females, but not less than 2 per toilet area	1 for every 50 females, but not less than 2 per toilet area
Note: Peak demand occurs in the 10-15 minute period at half time. The following ratios of toilets and wash basins relative to spectators noted above will be based on a male:female ratio of 70:30.			

A comparison of the estimated fixture quantities based on the estimates by the Stadium Developer and the design guidelines used in other stadium developments is shown below.

	Stadium Developer Estimates		Design Guideline Estimates Male:Female ratio of 70:30	
Fixture Type	Proposed 33,000 Seat Stadium	Proposed 50,000 Seat Stadium	Proposed 33,000 Seat Stadium	Proposed 50,000 Seat Stadium
Sinks	498	753	429	650
Showers	46	46	N/A	N/A
Urinals	220	341	330	500
Toilets	421	818	550	833

Based on the table above, it can be seen that the numbers of fixtures estimated by the Stadium Developer are comparable to the design guideline example used for another stadium development.

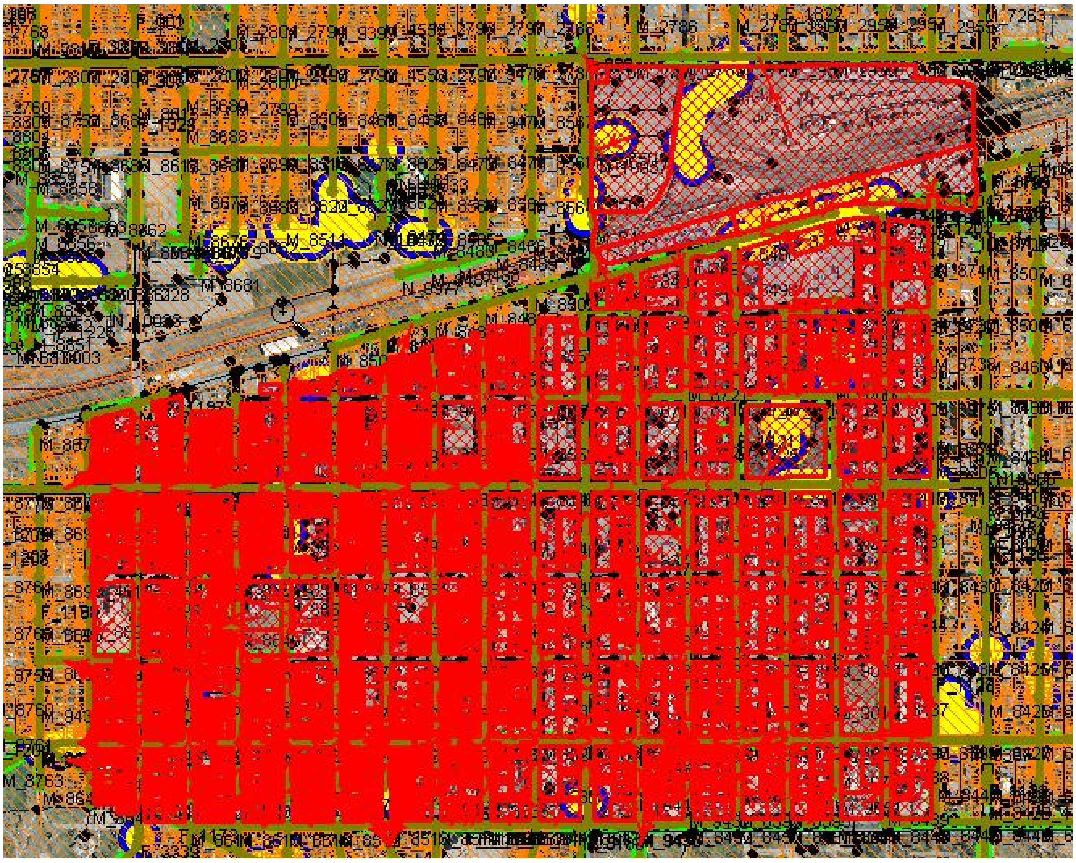
[1] *John Geraint, Richard Sheaard, Ben Vicery. (2007). "Stadia: A Design Development Guide" 4th Edition, Architectural Press.*

I & I Improvements

Inflow & Infiltration Improvements

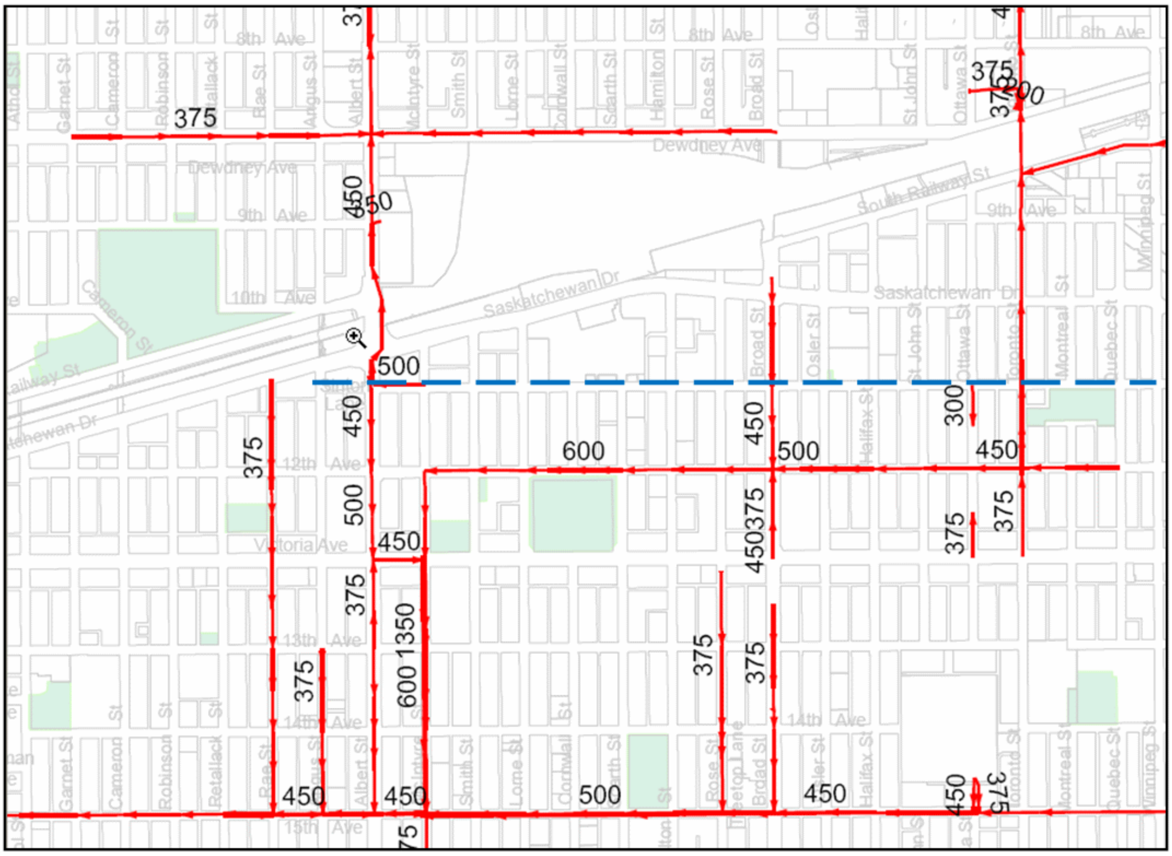
In an effort to acknowledge the anticipated improvement in the I & I for the development of the stadium site a reduction of the contributing infiltration was made.

The original HYDRA model identified a large portion of the downtown core area with a high I & I value which was modeled as a percent impervious value of 13.1% (RunoffArea2). Generally most other areas contribute much lower values in the range of 1%. The following figure illustrate the estimated area with above average I & I contribution.



Location of catchments included by 13% Impervious (Runoff Area 2) [145.8 ha]

The figure shows the CPR rail yard on the outer fringe of this area. It appears that this I & I value was applied to the model on a coarse basis over the general area. The following figure shows a more localized portion of this area that might be considered to impact the wastewater flows toward the 7th Avenue trunk. The area above the dashed line would represent this area.



Determination of Contributing Area for reduction of RUNOFF AREA 2

The figure below shows the assumed model area with a high I & I potentially contributing to the 7th Avenue trunk.

Location of catchments North of 12th AVE included by 13% Impervious (Runoff Area 2) [46.16 ha]

The reduction of I & I on the CPR rail yard with the new stadium development was applied by removing the improved area from the overall contributing area shown above. The method is shown below:

Determination of reduction of infiltration resulting from the development of the Regina Stadium Site

Existing model catchment 30060 contributing area = 16.135 ha

Area north of 12th Ave. that has a Runoff Area2 value of 13.1% of impervious for infiltration = 46.16 ha

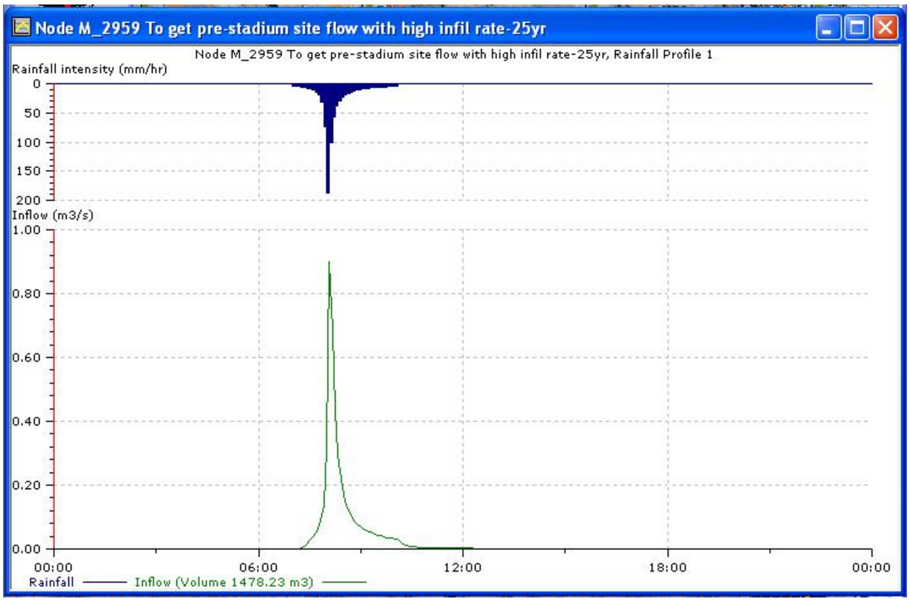
Reduction of infiltration in the Stadium Site represents [16.135 / 46.16] 0.35 of the entire area north of 12th Ave.

This 35% improvement [0.35] translates to a reduction in the Runoff Area 2 value from 13.1 to:

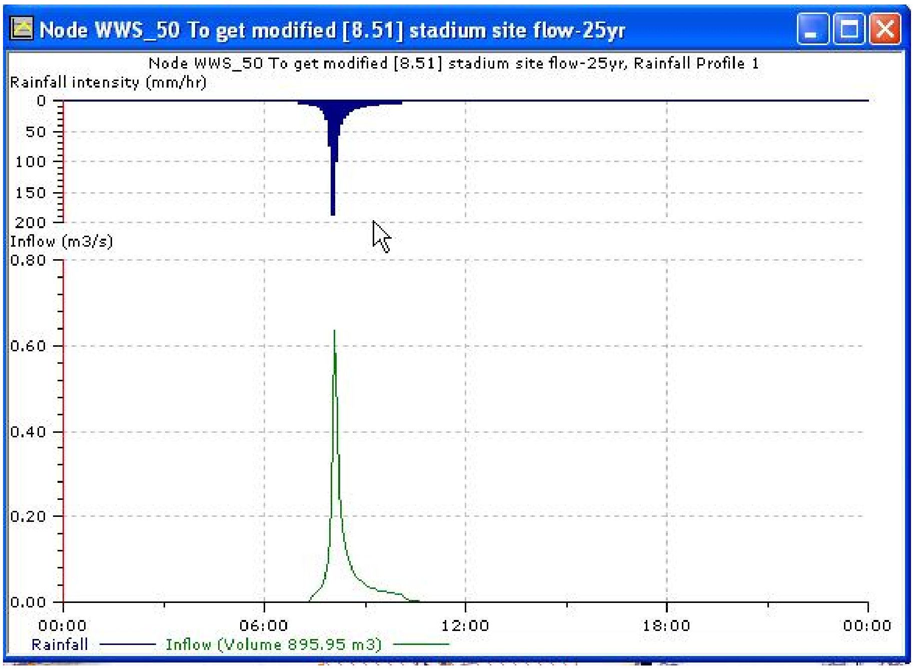
[0.35 x 13.1] = 4.59% ……………..therefore reduce Runoff Area2 from 13.1 – 4.59 = **8.51%**

The new I & I applied on the general area would be reduced from 13.1% to 8.51%.

The following hydrograph illustrates the original flow rate from the CPR rail yard assuming the high infiltration rate of 13.1%.



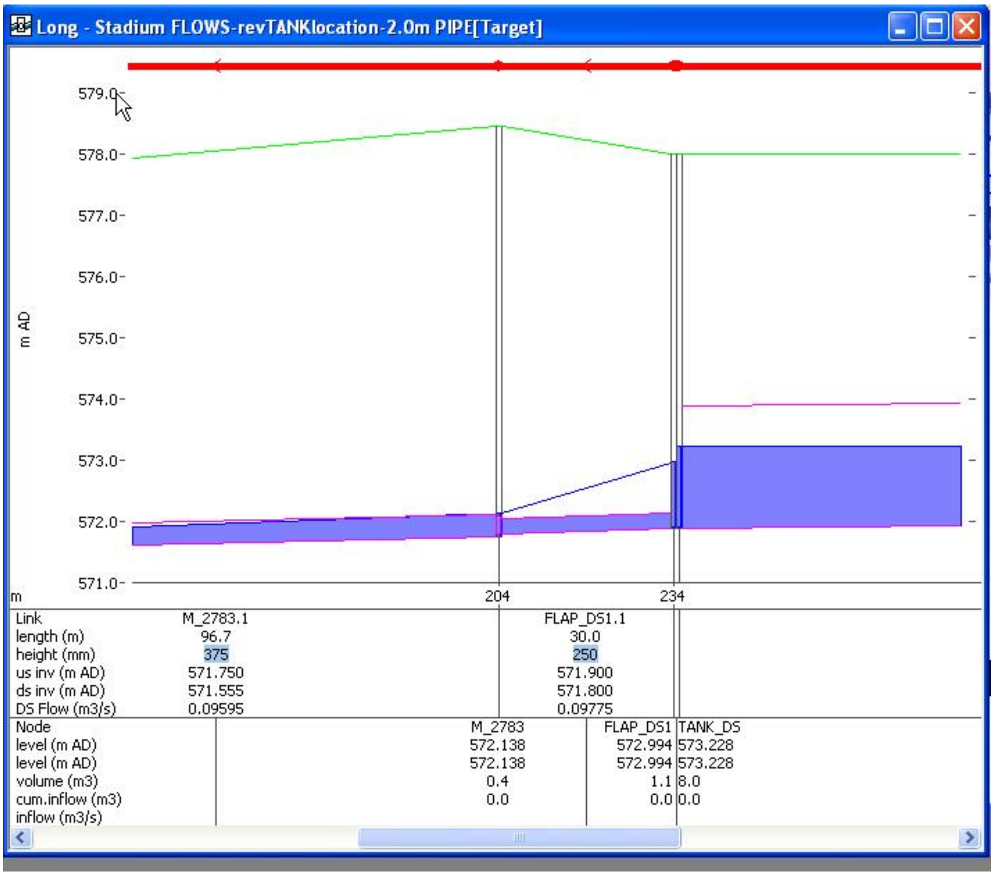
Existing Rail Yard: (high infiltration rate)



Improvement to General Area with Stadium I & I Reduction

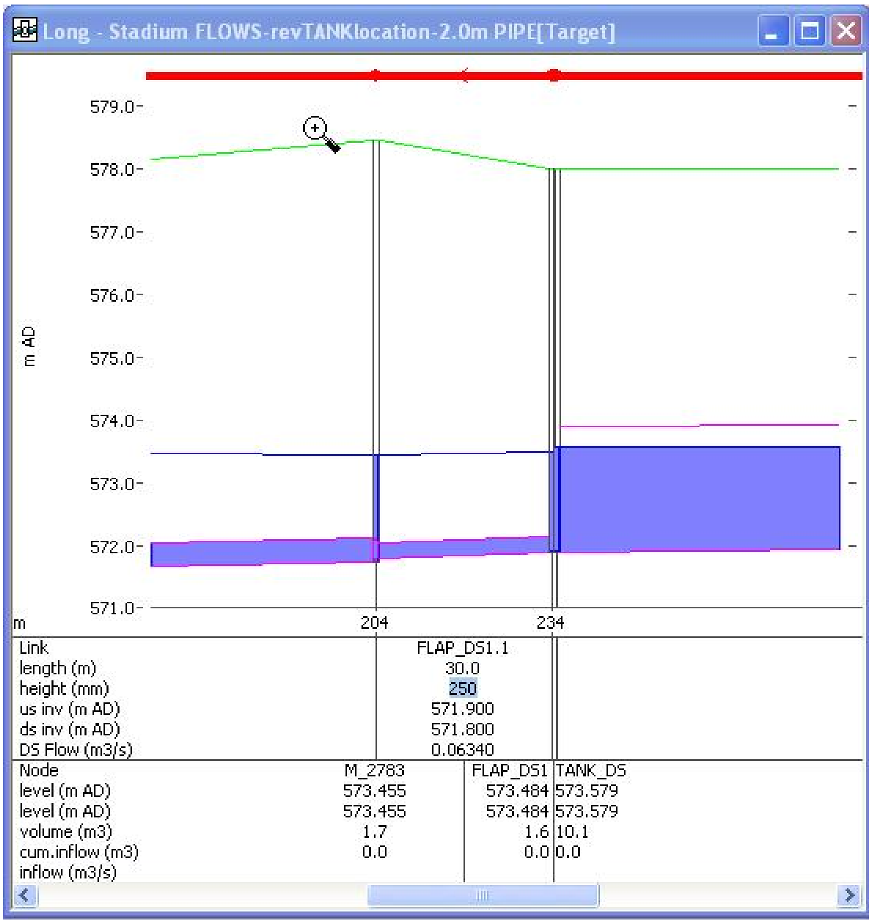
On-Site Storage Tank Performance

The following profiles show the proposed discharge from the stadium site and connection to the existing 375 mm sewer on Dewdney Avenue for the DWF condition and the 10 year and 25 year wet weather events.



2.0m dia PIPE STORAGE with 250mm DISCHARGE [Peak DWF + Stadium Inflow]

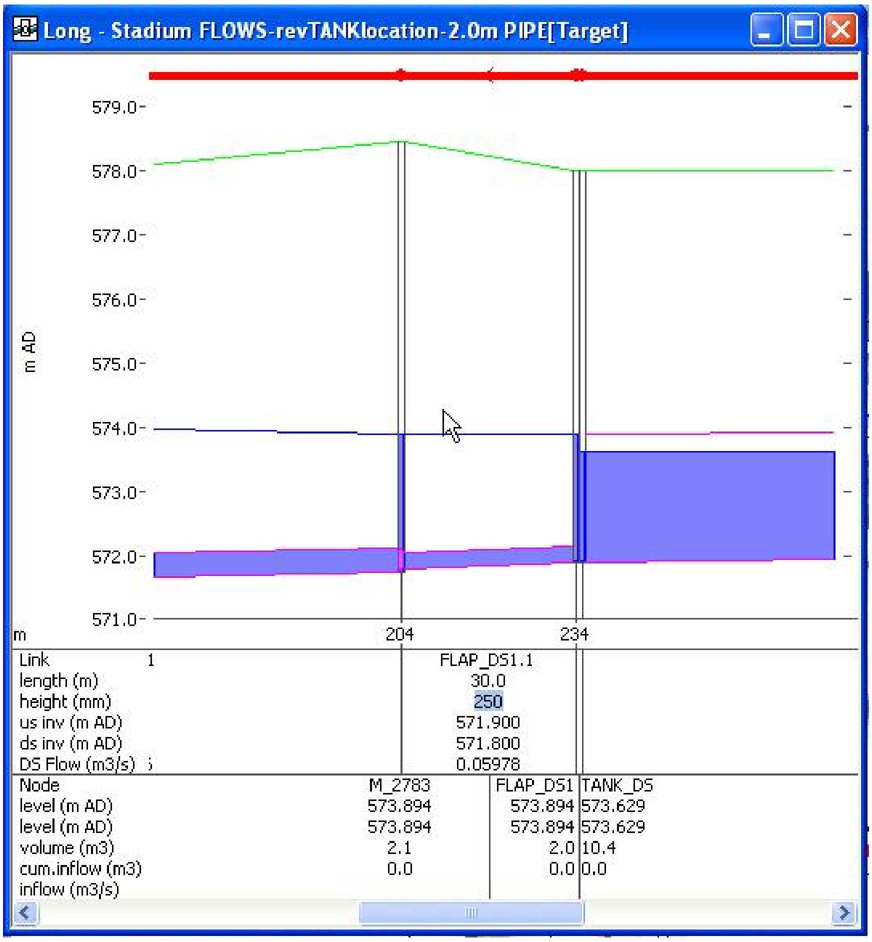
For the DWF condition, the 250 mm outlet pipe connecting to the existing wastewater collection system as well as the tank reduces the flow entering the Dewdney Avenue wastewater system during the peak half-time flow. We can see from the profile that the peak inflow of 300 L/s into the tank from the lift station is reduced to roughly 100 L/s (97.75 L/s in the model) at the peak flow into the surrounding sewer system and the downstream wastewater collection system is able to accommodate this amount of discharge without causing surcharge in the downstream system.



2.0m dia PIPE STORAGE with 250mm DISCHARGE [Peaks - 10 yr storm + Stadium Inflow]

Under the 10 year wet weather flow condition the tank and surrounding maximum surcharge levels are roughly equivalent in elevation during the peak hydraulic grade line period (573.46 m in the wastewater collection system and 573.58 m in the tank) meaning that some flow would still be discharging from the tank to the collection system but it would be minimal.

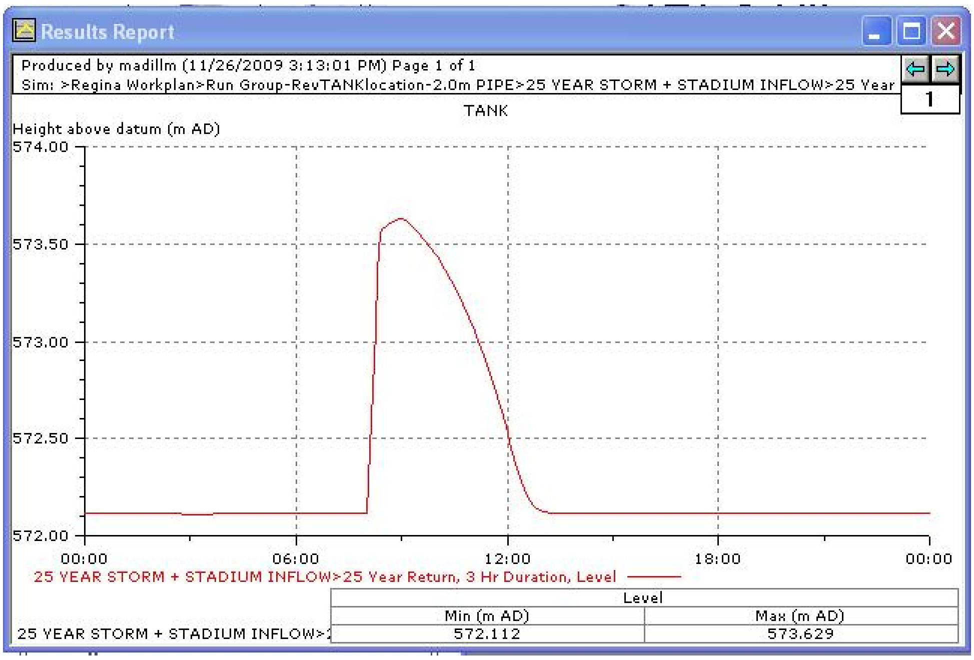
The 250 mm discharge pipe would also deliver a maximum of roughly 63 L/s at its peak to the surrounding wastewater collection system under the 10 year wet weather flow condition compared to the peak inflow from the lift station of 300 L/s (note that the peak outflow of 63 L/s does not coincide with the peak HGLs. The figure above shows peak HGLs and peak flows during the entire simulation).



2.0m dia PIPE STORAGE with 250mm DISCHARGE [Peaks - 25 yr storm + Stadium Inflow]

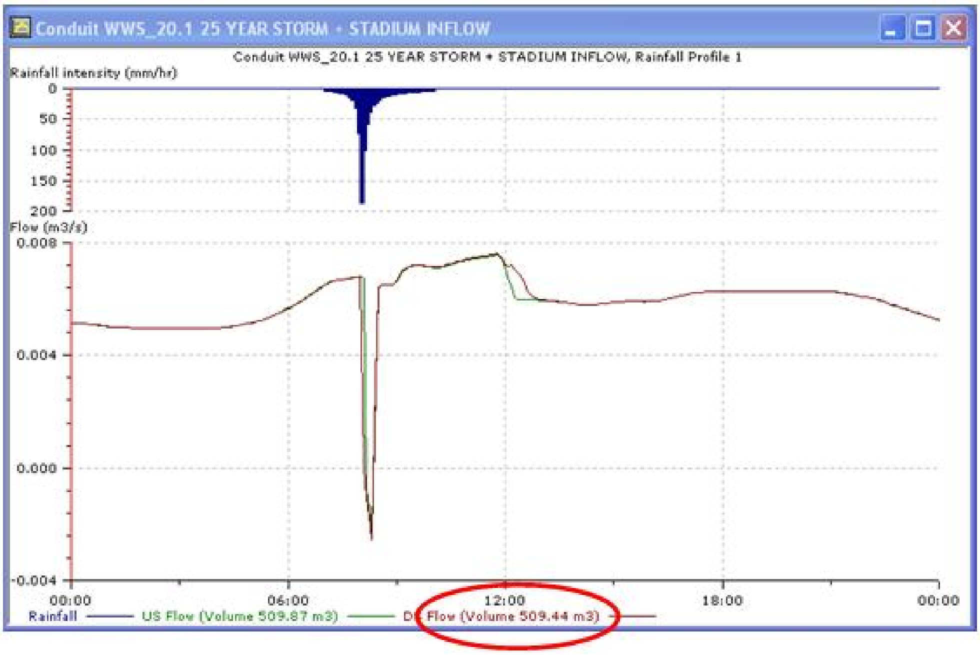
Under the 25 year wet weather flow condition the tank is now below the surrounding hydraulic grade line and therefore no flow would be coming out of the tank under these conditions. The peak discharge from the 250 mm outlet pipe would also have a peak discharge of roughly 60 L/s compared to the peak inflow from the lift station of 300 L/s.

The following figure illustrates the water levels in the storage element for the 25 year event. We see that the maximum attained level in the tank is roughly 573.63 m.



Storage Element Water Levels - 25 yr storm + Stadium Inflow

The following hydrograph represents the inflow into the upstream end of the storage element from the proposed commercial development on the stadium site. This represents the domestic and I & I flow over a 24 hour duration coinciding with the 25 year rainfall event. Total volume over a 24 hour period is just over 500 m3.



On-site Commercial Wastewater Hydrograph + 25 yr Storm (24 hour duration)

Appendix L - Stormwater Servicing

ENTERTAINMENT CENTRE - STORM SEWER DESIGN CALCULATIONS - ALTERNATIVE 1 - PIPE STORAGE ELEMENTS

JOB #: 0037-099-00   REVISED: RSJ   Frequency = 5 Years   IDF Curve Information
SYSTEM: n_{CONC}= 0.013   a = 1080.652
n_{PVC}= 0.010   b = 8.418
Minimum cover is 1.8 m to the top of pipe   c = 0.827
V_{full} = 0.9 m/s or greater

Pipe Grand Total = $ 53,972.77

Location		Drainage Area				Runoff			Sewer Design										Profile	Upstream				Downstream						Pricing				
From MH or CBMH No.	To MH or CBMH No.	A (ha.)	C	AC	Cumul. AC	Cumul T_c (T_i = 15 min)	i (mm/hr)	Q (m^3/s)	D (Actual) (m)	Pipe So (m/m)	Q_{full} (m^3/s)	V (full) (m/s)	% Diff (Q/Q_{full})	y/D	V/V_{full}	V (design) (m/s)	Pipe L (m)	Time of Flow (min)	Fall in Sewer (m)	Surface Elev. (m)	T.O.P Elev (m)	INVEL (m)	Cover (m)	Surface Elev. (m)	T.O.P Elev (m)	INVEL (m)	Cover (m)	Average Pipe Depth (m)	Rounded Pipe Depth	Pipe Price $/m	Install $/m	Compaction $/m	Total $/m	Total Cost
S1	S2	0.90	0.65	0.585	0.585	15.00	79.63	0.130	0.375	0.45%	0.153	1.38	85%	0.7080	1.122	1.55	60.000	0.723	0.27	577.250	575.450	575.075	1.800	578.000	575.180	574.805	2.820	2.68	3.00	$ 45.05	$ 55.76	$ 16.46	$ 117.27	$ 7,036.20
S2	S5			0.000	0.903	15.72	77.65	0.196	3.000	0.15%	22.599	2.46	1%	0.0700	0.319	1.02	107.000	0.725	0.16	578.000	575.180	572.180	2.820	578.250	575.020	572.020	3.230	6.03	6.50					
S5	S8			0.000	2.133	16.45	75.77	0.453	3.000	0.15%	22.599	2.46	2%	0.0970	0.393	1.26	97.000	0.657	0.15	578.250	574.995	571.995	3.255	578.350	574.849	571.849	3.501	6.38	6.50					
S8	S13			0.000	2.822	17.11	74.16	0.586	3.000	0.15%	22.599	2.46	3%	0.1180	0.445	1.42	140.000	0.949	0.21	578.350	574.824	571.824	3.526	578.000	574.614	571.614	3.386	6.46	6.50					
S13	S14			0.000	3.029	18.05	71.95	0.610	3.000	0.15%	22.599	2.46	3%	0.1180	0.445	1.42	18.000	0.122	0.03	578.000	574.589	571.589	3.411	577.850	574.562	571.562	3.288	6.35	6.50					
S14	S15			0.000	7.441	18.18	71.68	1.493	3.000	0.15%	22.599	2.46	7%	0.1790	0.576	1.84	87.000	0.590	0.13	577.850	574.537	571.537	3.313	577.750	574.407	571.407	3.343	6.33	6.50					
S15	S16							0.070	0.300	0.31%	0.070	0.99	100%	0.8200	1.140	1.13	34.000	0.573	0.11	577.750	574.407	574.107	3.343	577.200	574.301	574.001	2.899	3.42	3.50					
S3	S2	0.49	0.65	0.318	0.318	15.00	79.63	0.071	0.300	0.65%	0.101	1.43	70%	0.6165	1.082	1.55	26.000	0.302	0.17	578.000	576.200	575.900	1.800	578.000	576.031	575.731	1.969	2.18	2.50	$ 32.12	$ 50.07	$ 14.32	$ 96.51	$ 2,509.26
S4	S5	1.04	0.65	0.675	0.675	15.00	79.63	0.151	0.375	0.55%	0.169	1.53	89%	0.7345	1.130	1.73	45.000	0.490	0.25	577.500	575.700	575.325	1.800	578.250	575.453	575.078	2.797	2.67	3.00	$ 45.05	$ 55.76	$ 16.46	$ 117.27	$ 5,277.15
S6	S5	0.85	0.65	0.555	0.555	15.00	79.63	0.124	0.375	0.40%	0.144	1.30	86%	0.7150	1.125	1.47	41.000	0.524	0.16	578.250	576.450	576.075	1.800	578.250	576.286	575.911	1.964	2.26	2.50	$ 45.05	$ 53.02	$ 14.32	$ 112.39	$ 4,607.99
S9	S8	1.06	0.65	0.689	0.689	15.00	79.63	0.154	0.375	0.60%	0.177	1.60	87%	0.7215	1.127	1.80	54.000	0.563	0.32	578.350	576.275	575.900	2.075	578.350	575.951	575.576	2.399	2.61	3.00	$ 45.05	$ 55.76	$ 16.46	$ 117.27	$ 6,332.58
S10	S13	2.07	0.10	0.207	0.207	15.00	79.63	0.046	0.250	0.50%	0.055	1.11	84%	0.7020	1.120	1.25	44.000	0.659	0.22	577.500	575.690	575.440	1.810	578.000	575.470	575.220	2.530	2.42	2.50	$ 23.54	$ 50.07	$ 14.32	$ 87.93	$ 3,868.92
S11	S12	5.01	0.88	4.411	4.411	15.00	79.63	0.984	0.750	1.00%	1.113	2.52	88%	0.7280	1.128	2.84	26.000	0.172	0.26	578.500	576.700	575.950	1.800	578.250	576.440	575.690	1.810	2.55	3.00	$ 203.03	$ 83.19	$ 16.46	$ 302.68	$ 7,869.68
S12	S14			0.000	4.411	15.17	79.15	0.978	3.000	0.60%	45.197	4.92	2%	0.0970	0.393	2.52	70.000	0.237	0.42	578.250	576.440	573.440	1.810	577.850	576.020	573.020	1.830	4.82	5.00					

Location		Drainage Area				Runoff			Sewer Design										Profile	Upstream				Downstream						Pricing				
From MH or CBMH No.	To MH or CBMH No.	A (ha.)	C	AC	Cumul. AC	Cumul T_c (T_i = 15 min)	i (mm/hr)	Q (m^3/s)	D (Actual) (m)	Pipe So (m/m)	Q_{full} (m^3/s)	V (full) (m/s)	% Diff (Q/Q_{full})	y/D	V/V_{full}	V (design) (m/s)	Pipe L (m)	Time of Flow (min)	Fall in Sewer (m)	Surface Elev. (m)	T.O.P Elev (m)	INVEL (m)	Cover (m)	Surface Elev. (m)	T.O.P Elev (m)	INVEL (m)	Cover (m)	Average Pipe Depth (m)	Rounded Pipe Depth	Pipe Price $/m	Install $/m	Compaction $/m	Total $/m	Total Cost
S17	S18	1.02	0.88	0.901	0.901	15.00	79.63	0.201	3.000	0.30%	31.959	3.48	1%	0.0700	0.319	1.44	207.000	0.992	0.62	578.000	576.200	573.200	1.800	578.000	575.579	572.579	2.421	5.11	5.50					
S18	S20	0.90	0.10	0.090	1.367	15.99	76.94	0.295	3.000	0.20%	26.095	2.84	1%	0.0700	0.319	1.18	70.000	0.411	0.14	578.000	575.554	572.554	2.446	577.750	575.414	572.414	2.336	5.39	5.50					
S20	S21							0.054	0.300	0.26%	0.064	0.91	84%	0.7020	1.120	1.02	24.000	0.441	0.06	577.750	575.105	574.805	2.645	578.000	575.043	574.743	2.957	3.10	3.50	$ 32.12	$ 55.32	$ 18.86	$ 106.30	$ 2,551.20
S19	S18	0.58	0.65	0.376	0.376	15.00	79.63	0.084	0.300	0.60%	0.097	1.38	86%	0.7150	1.125	1.55	13.000	0.157	0.08	578.000	576.200	575.900	1.800	578.000	576.122	575.822	1.878	2.14	2.50	$ 32.12	$ 50.07	$ 14.32	$ 96.51	$ 1,254.63

Location		Drainage Area				Runoff			Sewer Design										Profile	Upstream				Downstream						Pricing				
From MH or CBMH No.	To MH or CBMH No.	A (ha.)	C	AC	Cumul. AC	Cumul T_c (T_i = 15 min)	i (mm/hr)	Q (m^3/s)	D (Actual) (m)	Pipe So (m/m)	Q_{full} (m^3/s)	V (full) (m/s)	% Diff (Q/Q_{full})	y/D	V/V_{full}	V (design) (m/s)	Pipe L (m)	Time of Flow (min)	Fall in Sewer (m)	Surface Elev. (m)	T.O.P Elev (m)	INVEL (m)	Cover (m)	Surface Elev. (m)	T.O.P Elev (m)	INVEL (m)	Cover (m)	Average Pipe Depth (m)	Rounded Pipe Depth	Pipe Price $/m	Install $/m	Compaction $/m	Total $/m	Total Cost
S22	S23	1.07	0.88	0.944	0.944	15.00	79.63	0.211	0.375	2.00%	0.322	2.92	65%	0.5870	1.064	3.11	108.000	0.617	2.16	577.750	575.950	575.575	1.800	577.000	573.790	573.415	3.210	2.88	3.00	$ 45.05	$ 55.76	$ 16.46	$ 117.27	$ 12,665.16
S23	S24							0.159	3.000	0.30%	31.959	3.48	0%	0.0000	0.000	0.00	35.000	0.168	0.11	577.000	573.790	570.790	3.210	576.240	573.685	570.685	2.555	5.88	6.00					

ENTERTAINMENT CENTRE - STORM SEWER DESIGN CALCULATIONS - ALTERNATIVE 2 - TANK STORAGE ELEMENTS

JOB #: 0037-099-00
SYSTEM:

REVISED: RSJ

Frequency = 5 Years
n_{CONC} = 0.013
n_{PVC} = 0.010

IDF Curve Information
a = 1080.652
b = 8.418
c = 0.827

Minimum cover is 1.8 m to the top of pipe
V_{full} = 0.9 m/s or greater

Pipe Grand Total = $ 187,743.80

Location: From (MH or CBMH No.)	Location: To (MH or CBMH No.)	Drainage Area: A (ha.)	C	AC	Cumul. AC	Runoff: Cumul T_c (T_i = 15 min)	i (mm/hr)	Q (m^3/s)	Sewer Design: D (Actual) (m)	Pipe So (m/m)	Q_{full} (m^3/s)	V (full) (m/s)	% Diff (Q/Q_{full})	y/D	V/V_{full}	V (design) (m/s)	Pipe L (m)	Time of Flow (min)
S1	S2	0.90	0.65	0.585	0.585	15.00	79.63	0.130	0.450	0.16%	0.148	0.93	88%	0.7280	1.128	1.05	60.000	1.074
S2	S5			0.000	0.903	16.07	76.73	0.194	0.525	0.15%	0.217	1.00	90%	0.7420	1.132	1.13	107.000	1.784
S5	S10			0.000	2.133	17.86	72.40	0.432	0.750	0.13%	0.522	0.91	83%	0.6956	1.118	1.32	88.000	1.615
S3	S2	0.49	0.65	0.318	0.318	15.00	79.63	0.071	0.300	0.65%	0.101	1.43	70%	0.6165	1.082	1.55	26.000	0.302
S4	S5	1.04	0.65	0.675	0.675	15.00	79.63	0.151	0.450	0.40%	0.234	1.47	64%	0.5815	1.061	1.56	45.000	0.509
S6	S5	0.85	0.65	0.555	0.555	15.00	79.63	0.124	0.375	0.40%	0.144	1.30	86%	0.7150	1.125	1.47	42.000	0.537
S9	S10	1.06	0.65	0.689	0.689	15.00	79.63	0.154	0.375	1.00%	0.228	2.06	67%	0.5990	1.072	2.21	88.000	0.711
S11	S10	5.01	0.88	4.411	4.411	15.00	79.63	0.984	0.750	1.10%	1.168	2.64	84%	0.7020	1.120	2.96	50.000	0.315
S10	S16							0.070	0.375	0.25%	0.114	1.03	61%	0.5640	1.049	1.08	140.000	2.263

From	To	Fall in Sewer (m)	Profile: Upstream Surface Elev. (m)	Upstream T.O.P Elev (m)	Upstream INVEL (m)	Upstream Cover (m)	Downstream Surface Elev. (m)	Downstream T.O.P Elev (m)	Downstream INVEL (m)	Downstream Cover (m)	Average Pipe Depth (m)	Rounded Pipe Depth	Pricing: Pipe Price $/m	Install $/m	Compaction $/m	Total $/m	Total Cost
S1	S2	0.10	577.250	575.450	575.000	1.800	578.000	575.354	574.904	2.646	2.67	3.00	$ 71.22	$ 62.36	$ 16.46	$ 150.04	$ 9,002.40
S2	S5	0.16	578.000	575.354	574.829	2.646	578.250	575.194	574.669	3.057	3.38	3.50	$ 99.86	$ 71.48	$ 18.86	$ 190.20	$ 20,351.40
S5	S10	0.11	578.250	575.194	574.444	3.057	577.500	575.079	574.329	2.421	3.49	3.50	$ 203.03	$ 87.82	$ 18.86	$ 309.71	$ 27,254.48
S3	S2	0.17	578.000	576.200	575.900	1.800	578.000	576.031	575.731	1.969	2.18	2.50	$ 32.12	$ 50.07	$ 14.32	$ 96.51	$ 2,509.26
S4	S5	0.18	577.500	575.700	575.250	1.800	578.250	575.520	575.070	2.730	2.71	3.00	$ 71.22	$ 62.36	$ 16.46	$ 150.04	$ 6,751.80
S6	S5	0.17	578.250	576.450	576.075	1.800	578.250	576.282	575.907	1.968	2.26	2.50	$ 45.05	$ 53.02	$ 14.32	$ 112.39	$ 4,720.38
S9	S10	0.88	578.350	576.550	576.175	1.800	577.500	575.670	575.295	1.830	2.19	2.50	$ 45.05	$ 53.02	$ 14.32	$ 112.39	$ 9,890.32
S11	S10	0.55	578.500	576.250	575.500	2.250	577.500	575.700	574.950	1.800	2.77	3.00	$ 203.03	$ 83.19	$ 16.46	$ 302.68	$ 15,134.00
S10	S16	0.35	577.500	574.960	574.585	2.540	577.200	574.610	574.235	2.590	2.94	3.00	$ 45.05	$ 55.76	$ 16.46	$ 117.27	$ 16,417.80

$ 112,031.84

Location: From (MH or CBMH No.)	Location: To (MH or CBMH No.)	Drainage Area: A (ha.)	C	AC	Cumul. AC	Runoff: Cumul T_c (T_i = 15 min)	i (mm/hr)	Q (m^3/s)	Sewer Design: D (Actual) (m)	Pipe So (m/m)	Q_{full} (m^3/s)	V (full) (m/s)	% Diff (Q/Q_{full})	y/D	V/V_{full}	V (design) (m/s)	Pipe L (m)	Time of Flow (min)
S17	S18	1.02	0.88	0.901	0.901	15.00	79.63	0.201	0.525	0.30%	0.306	1.41	66%	0.5930	1.068	1.51	241.000	2.841
S18	S20	0.90	0.10	0.090	1.367	17.84	72.43	0.277	0.525	0.35%	0.331	1.53	84%	0.7020	1.120	1.71	50.000	0.546
S20	S21							0.054	0.300	0.26%	0.064	0.91	84%	0.7020	1.120	1.02	40.000	0.736
S19	S18	0.58	0.65	0.376	0.376	15.00	79.63	0.084	0.300	0.60%	0.097	1.38	86%	0.7150	1.125	1.55	13.000	0.157

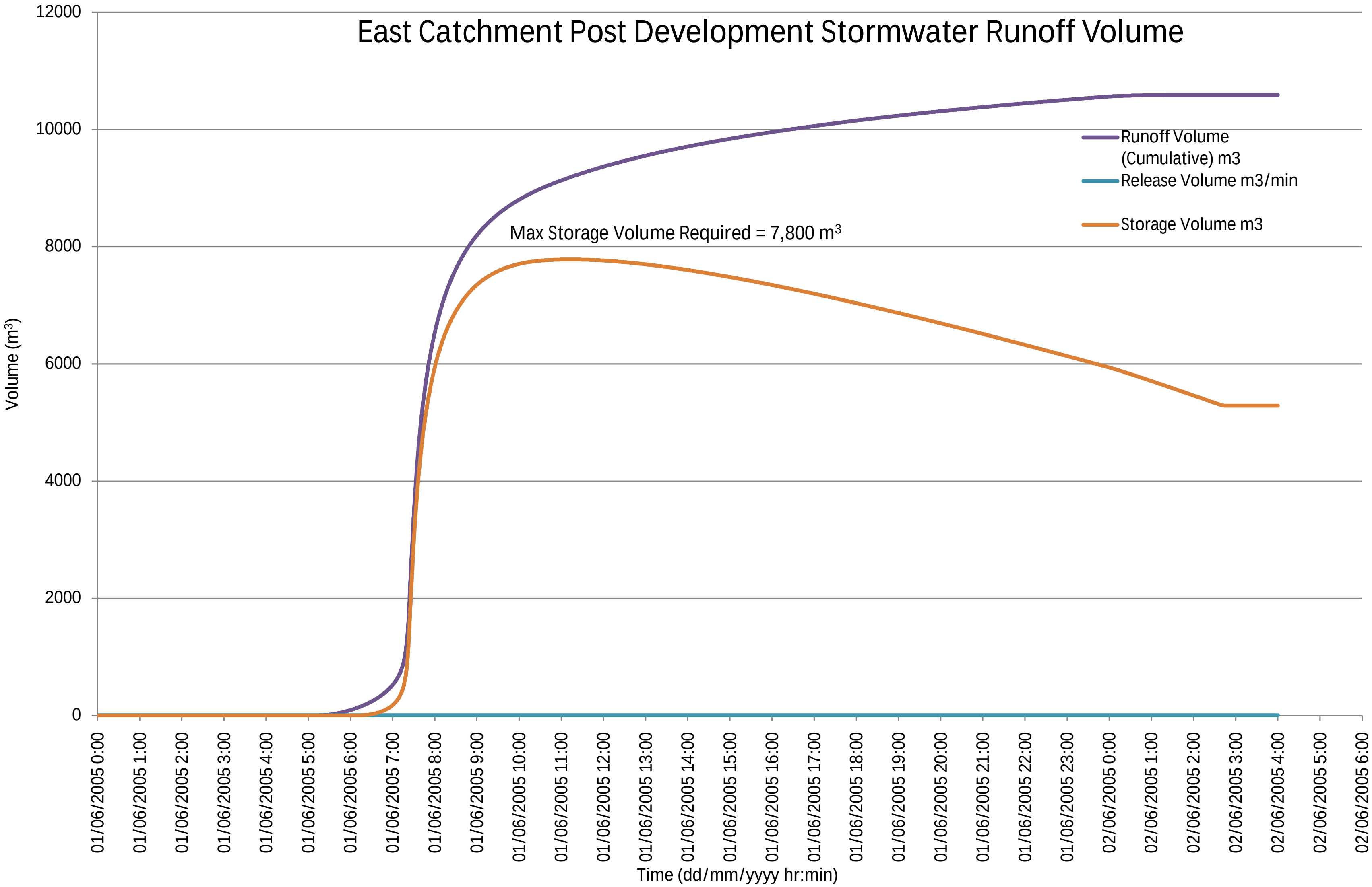
From	To	Fall in Sewer (m)	Profile: Upstream Surface Elev. (m)	Upstream T.O.P Elev (m)	Upstream INVEL (m)	Upstream Cover (m)	Downstream Surface Elev. (m)	Downstream T.O.P Elev (m)	Downstream INVEL (m)	Downstream Cover (m)	Average Pipe Depth (m)	Rounded Pipe Depth	Pricing: Pipe Price $/m	Install $/m	Compaction $/m	Total $/m	Total Cost
S17	S18	0.72	578.000	576.200	575.675	1.800	578.000	575.477	574.952	2.523	2.69	3.00	$ 99.86	$ 68.84	$ 16.46	$ 185.16	$ 44,623.56
S18	S20	0.18	578.000	575.452	574.927	2.548	577.750	575.277	574.752	2.473	3.04	3.50	$ 99.86	$ 71.48	$ 18.86	$ 190.20	$ 9,510.00
S20	S21	0.10	577.750	575.006	574.706	2.744	578.000	574.902	574.602	3.098	3.22	3.50	$ 32.12	$ 55.32	$ 18.86	$ 106.30	$ 4,252.00
S19	S18	0.08	578.000	576.200	575.900	1.800	578.000	576.122	575.822	1.878	2.14	2.50	$ 32.12	$ 50.07	$ 14.32	$ 96.51	$ 1,254.63

$ 59,640.19

Location: From (MH or CBMH No.)	Location: To (MH or CBMH No.)	Drainage Area: A (ha.)	C	AC	Cumul. AC	Runoff: Cumul T_c (T_i = 15 min)	i (mm/hr)	Q (m^3/s)	Sewer Design: D (Actual) (m)	Pipe So (m/m)	Q_{full} (m^3/s)	V (full) (m/s)	% Diff (Q/Q_{full})	y/D	V/V_{full}	V (design) (m/s)	Pipe L (m)	Time of Flow (min)
S22	S24	1.07	0.88	0.944	0.944	15.00	79.63	0.211	0.375	1.10%	0.239	2.16	88%	0.7280	1.128	2.44	143.000	1.102

From	To	Fall in Sewer (m)	Profile: Upstream Surface Elev. (m)	Upstream T.O.P Elev (m)	Upstream INVEL (m)	Upstream Cover (m)	Downstream Surface Elev. (m)	Downstream T.O.P Elev (m)	Downstream INVEL (m)	Downstream Cover (m)	Average Pipe Depth (m)	Rounded Pipe Depth	Pricing: Pipe Price $/m	Install $/m	Compaction $/m	Total $/m	Total Cost
S22	S24	1.57	577.750	575.950	575.575	1.800	576.240	574.377	574.002	1.863	2.21	2.50	$ 45.05	$ 53.02	$ 14.32	$ 112.39	$ 16,071.77

$ 16,071.77


East Catchment Post Development Stormwater Runoff Volume
Max Storage Volume Required = 7,800 m3
Runoff Volume (Cumulative) m3
Release Volume m3/min
Storage Volume m3
Volume (m3)
Time (dd/mm/yyyy hr:min)
12000
10000
8000
6000
4000
2000
0
01/06/2005 0:00
01/06/2005 1:00
01/06/2005 2:00
01/06/2005 3:00
01/06/2005 4:00
01/06/2005 5:00
01/06/2005 6:00
01/06/2005 7:00
01/06/2005 8:00
01/06/2005 9:00
01/06/2005 10:00
01/06/2005 11:00
01/06/2005 12:00
01/06/2005 13:00
01/06/2005 14:00
01/06/2005 15:00
01/06/2005 16:00
01/06/2005 17:00
01/06/2005 18:00
01/06/2005 19:00
01/06/2005 20:00
01/06/2005 21:00
01/06/2005 22:00
01/06/2005 23:00
02/06/2005 0:00
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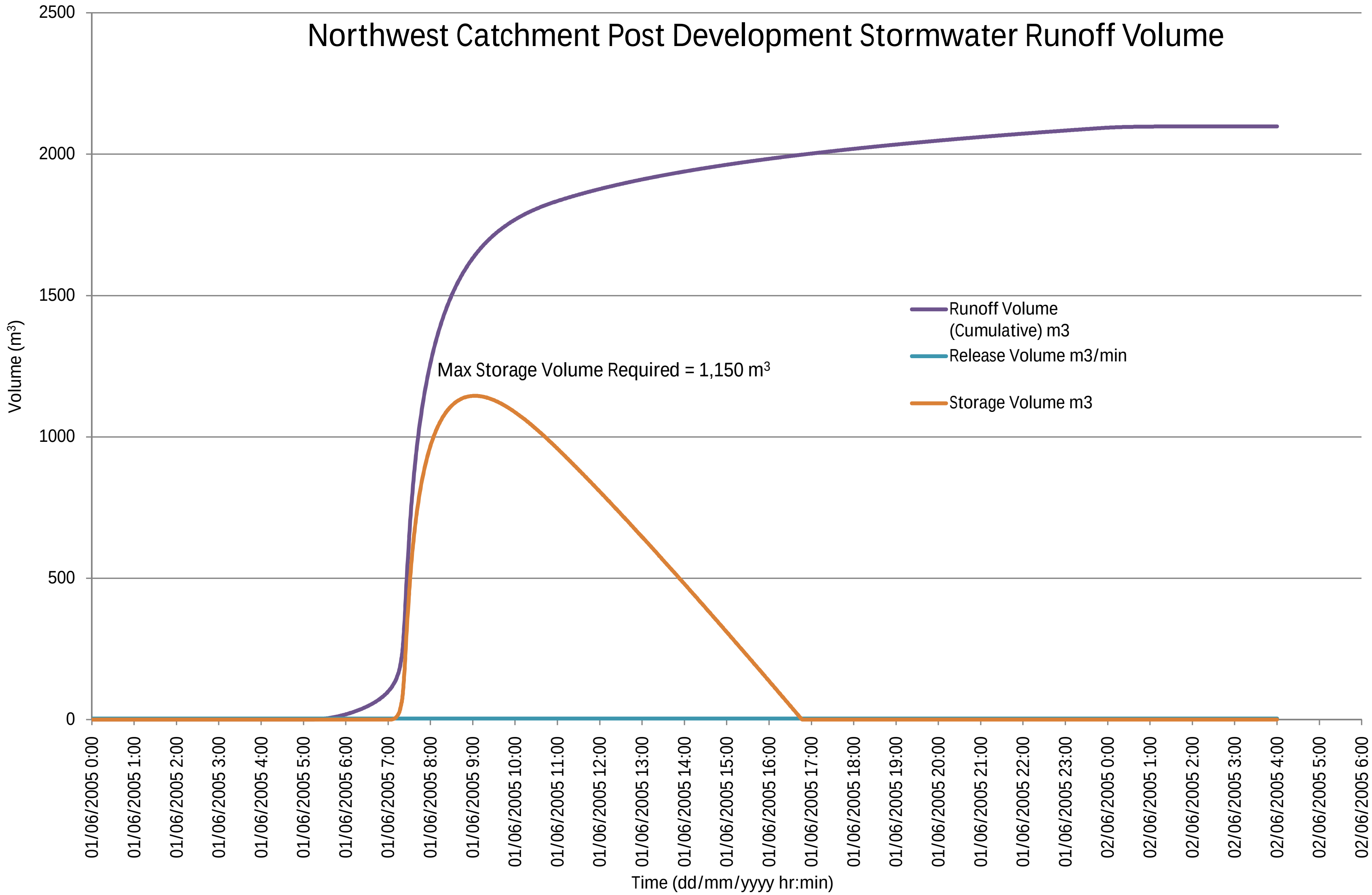
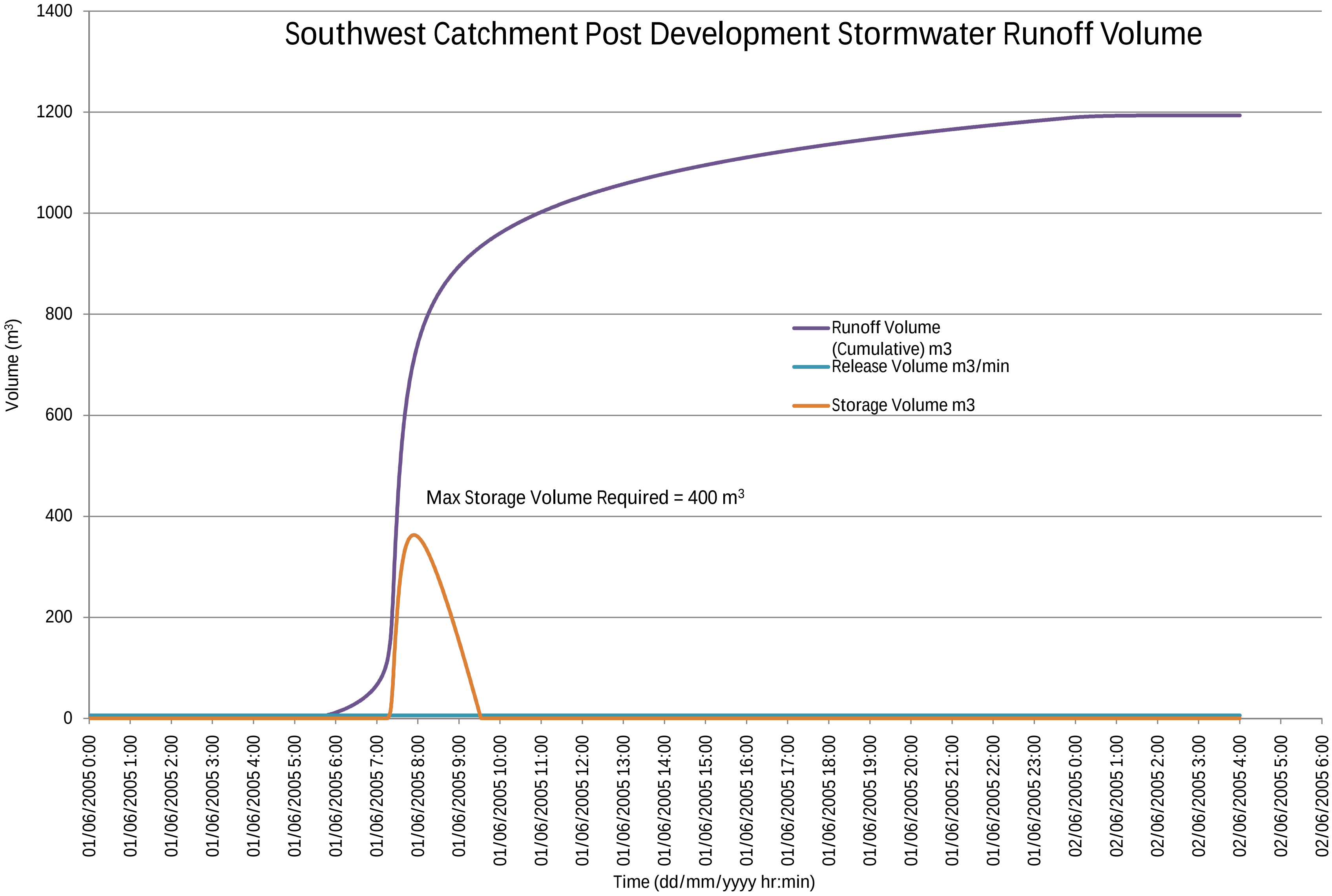
02/06/2005 6:00



Northwest Catchment Post Development Stormwater Runoff Volume
Volume (m³)
2500
2000
1500
1000
500
0
Max Storage Volume Required = 1,150 m³
Runoff Volume (Cumulative) m3
Release Volume m3/min
Storage Volume m3
01/06/2005 0:00
01/06/2005 1:00
01/06/2005 2:00
01/06/2005 3:00
01/06/2005 4:00
01/06/2005 5:00
01/06/2005 6:00
01/06/2005 7:00
01/06/2005 8:00
01/06/2005 9:00
01/06/2005 10:00
01/06/2005 11:00
01/06/2005 12:00
01/06/2005 13:00
01/06/2005 14:00
01/06/2005 15:00
01/06/2005 16:00
01/06/2005 17:00
01/06/2005 18:00
01/06/2005 19:00
01/06/2005 20:00
01/06/2005 21:00
01/06/2005 22:00
01/06/2005 23:00
02/06/2005 0:00
02/06/2005 1:00
02/06/2005 2:00
02/06/2005 3:00
02/06/2005 4:00
02/06/2005 5:00
02/06/2005 6:00
Time (dd/mm/yyyy hr:min)


Southwest Catchment Post Development Stormwater Runoff Volume
Volume (m³)
1400
1200
1000
800
600
400
200
0
Runoff Volume (Cumulative) m3
Release Volume m3/min
Storage Volume m3
Max Storage Volume Required = 400 m³
01/06/2005 0:00
01/06/2005 1:00
01/06/2005 2:00
01/06/2005 3:00
01/06/2005 4:00
01/06/2005 5:00
01/06/2005 6:00
01/06/2005 7:00
01/06/2005 8:00
01/06/2005 9:00
01/06/2005 10:00
01/06/2005 11:00
01/06/2005 12:00
01/06/2005 13:00
01/06/2005 14:00
01/06/2005 15:00
01/06/2005 16:00
01/06/2005 17:00
01/06/2005 18:00
01/06/2005 19:00
01/06/2005 20:00
01/06/2005 21:00
01/06/2005 22:00
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02/06/2005 1:00
02/06/2005 2:00
02/06/2005 3:00
02/06/2005 4:00
02/06/2005 5:00
02/06/2005 6:00
Time (dd/mm/yyyy hr:min)

High Level Feasibility Study - Entertainment Centre
Stormwater Serviceability Review
Alternative 1 - Pipe Storage Elements
1 in 100 Year Storage Capability Class "D" Cost Estimate

3000mm HDPE Pipe

Item	Unit	Quantity	Unit Cost	Cost
Mob/Demob	%	10%	$6,747,000	$675,000
Common Excavation	m	1281	$987.00	$1,265,000
Pipe Supply	m	1281	$2,385.00	$3,056,000
Bedding	m	1281	$849.00	$1,088,000
Pipe Install & Backfill	m	1281	$600.00	$769,000
Inlet & Outlet Connections/Tees	Each	13	$5,000.00	$65,000
Lift Stations	Each	2	$225,000.00	$450,000
Minor System Piping	Lump Sum	1	$54,000.00	$54,000
Construction Subtotal				**$7,422,000**
Contingency	%	30%	$7,422,000	$2,227,000
Construction Total				**$9,649,000**

High Level Feasibility Study - Entertainment Centre
Stormwater Serviceability Review
Alternative 2 - Tank Storage Elements
1 in 100 Year Storage Capability Class "D" Cost Estimate

Storage Volume =	7868	m^3
Man minutes to assemble each tank module =	3	minutes
# of modules =	21,218	
assembly time =	1060.9	hours
Laborer Rate =	$45.00	/hr
Assembly Labor Cost =	$47,740.50	
Foreman Rate =	$80.00	/hr
Assembly Foreman Cost (@1 Foreman/3 Laborers) =	$28,290.67	
Install Cost is approx = Assembly Cost =	$76,031.17	
Assemble & Install Cost =	$152,062.33	
Assemble & Install Cost =	$20.00	/m

Brentwood StormTank Dimension Calculator

Enter Values in [ ] boxes, the rest is calculated

Project Name : Saskatchewan Multi Use Facility

modules wide	modules long	height (ft)
103	103	6.0

width (m)	length (m)	height (m)
47.092	94.183	1.829

width (ft)	length (ft)	height (ft)
154.50	309.00	6.00

Area (m^2)
4,435.2

Area (ft^2)
47,740.5

tank volume (m^3)	storage volume (m^3)
8111.162	7867.828

tank volume (ft^3)	storage volume (ft^3)
286,443.0	277,849.7

tank volume (imp gal)	storage volume (imp gal)
1,784,455.7	1,730,922.1

# modules/level	10,609
# levels	2
total # modules	21,218

	module height
Level 1	3
Level 2	3

* heights are configured in 1.5' to 6' in 6" increments only

Note: this calculator is for reference only.
Brentwood Industries and its distributors are not responsible for any errors made in determining StormTank dimensions and volumes.

Storage Volume =	1187	m^3
Man minutes to assemble each tank module =	3	minutes
# of modules =	3,200	
assembly time =	160	hours
Laborer Rate =	$45.00	/hr
Assembly Labor Cost =	$7,200.00	
Foreman Rate =	$80.00	/hr
Assembly Foreman Cost (@1 Foreman/3 Laborers) =	$4,266.67	
Install Cost is approx = Assembly Cost =	$11,466.67	
Assemble & Install Cost =	$22,933.33	
Assemble & Install Cost =	$20.00	/m

Brentwood StormTank Dimension Calculator

Enter Values in [ ] boxes, the rest is calculated

Project Name : Saskatchewan Multi Use Facility

modules wide	modules long	height (ft)
40	40	6.0

width (m)	length (m)	height (m)
18.288	36.576	1.829

width (ft)	length (ft)	height (ft)
60.00	120.00	6.00

Area (m^2)
668.9

Area (ft^2)
7,200.0

tank volume (m^3)	storage volume (m^3)
1223.288	1186.589

tank volume (ft^3)	storage volume (ft^3)
43,200.0	41,904.0

tank volume (imp gal)	storage volume (imp gal)
269,123.3	261,049.6

# modules/level	1,600
# levels	2
total # modules	3,200

	module height
Level 1	3
Level 2	3

* heights are configured in 1.5' to 6' in 6" increments only

Note: this calculator is for reference only.
Brentwood Industries and its distributors are not responsible for any errors made in determining StormTank dimensions and volumes.

Storage Volume =	404	m^3
Man minutes to assemble each tank module =	3	minutes
# of modules =	1,089	
assembly time =	54.45	hours
Laborer Rate =	$45.00	/hr
Assembly Labor Cost =	$2,450.25	
Foreman Rate =	$80.00	/hr
Assembly Foreman Cost (@1 Foreman/3 Laborers) =	$1,452.00	
Install Cost is approx = Assembly Cost =	$3,902.25	
Assemble & Install Cost =	$7,804.50	
Assemble & Install Cost =	$20.00	/m

Brentwood StormTank Dimension Calculator

Enter Values in [green] boxes, the rest is calculated

Project Name : Saskatchewan Multi Use Facility

modules wide	modules long	height (ft)
33	33	3.0

width (m)	length (m)	height (m)
15.088	30.175	0.914

width (ft)	length (ft)	height (ft)
49.50	99.00	3.00

Area (m^2)
455.3

Area (ft^2)
4,900.5

tank volume (m^3)	storage volume (m^3)
416.300	403.811

tank volume (ft^3)	storage volume (ft^3)
14,701.5	14,260.5

tank volume (imp gal)	storage volume (imp gal)
91,586.0	88,838.4

# modules/level	1,089
# levels	1
total # modules	1,089

	module height
Level 1	3
Level 2	N/A

* heights are configured in 1.5' to 6' in 6" increments only

Note: this calculator is for reference only.
Brentwood Industries and its distributors are not responsible for any errors made in determining StormTank dimensions and volumes.

High Level Feasibility Study - Entertainment Centre
Stormwater Serviceability Review
Alternative 2 - Tank Storage Elements
1 in 100 Year Storage Capability Class "D" Cost Estimate

Stormtank Modules - East Storage

Item	Unit	Quantity	Unit Cost	Cost
Mob/Demob	%	10%	$4,524,000	$453,000
Common Excavation	m^3	20000	$18.00	$360,000
Tank Supply	m^3	7868	$320.00	$2,518,000
Tank Install	m^3	7868	$20.00	$158,000
Clean Stone Bedding/Backfill/Cover	m^3	12140	$70.00	$850,000
Haul Excess Fill Offsite	m^3	20000	$14.00	$280,000
Inlet & Outlet Tie in	Each	4	$5,000.00	$20,000
Minor System Piping	Lump Sum	1	$113,000.00	$113,000
Lift Stations	Each	1	$225,000.00	$225,000
Construction Subtotal				**$4,977,000**
Contingency	%	30%	$4,977,000	$1,494,000
Construction Total				**$6,471,000**

Stormtank Modules - NW Storage

Item	Unit	Quantity	Unit Cost	Cost
Mob/Demob	%	10%	$1,011,000	$102,000
Common Excavation	m^3	3800	$18.00	$69,000
Tank Supply	m^3	1187	$320.00	$380,000
Tank Install	m^3	1187	$20.00	$24,000
Clean Stone Bedding/Backfill/Cover	m^3	2620	$70.00	$184,000
Haul Excess Fill Offsite	m^3	3800	$14.00	$54,000
Inlet & Outlet Tie in	Each	3	$5,000.00	$15,000
Minor System Piping	Lump Sum	1	$60,000.00	$60,000
Lift Stations	Each	1	$225,000.00	$225,000
Construction Subtotal				**$1,113,000**
Contingency	%	30%	$1,113,000	$334,000
Construction Total				**$1,447,000**

Stormtank Modules - SW Storage

Item	Unit	Quantity	Unit Cost	Cost
Mob/Demob	%	10%	$328,000	$33,000
Common Excavation	m^3	1800	$18.00	$33,000
Tank Supply	m^3	404	$320.00	$130,000
Tank Install	m^3	404	$20.00	$9,000
Clean Stone Bedding/Backfill/Cover	m^3	1400	$70.00	$98,000
Haul Excess Fill Offsite	m^3	1800	$14.00	$26,000
Inlet & Outlet Tie in	Each	3	$5,000.00	$15,000
Minor System Piping	Lump Sum	1	$17,000.00	$17,000
Construction Subtotal				**$361,000**
Contingency	%	30%	$361,000	$109,000
Construction Total				**$470,000**

Total Cost = $8,388,000