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CORPORATE REPORT

NO: R246 COUNCIL DATE: December 20, 2021

REGULAR COUNCIL

TO:	**Mayor & Council**	DATE:	**December 16, 2021**
FROM:	**General Manager, Engineering**	FILE:	**5225-01**
SUBJECT:	**November 2021 Rainfall Event Summary**		

RECOMMENDATION

The Engineering Department recommends that Council receive this report for information.

INTENT

The purpose of this report is to provide information to Council with respect to the rainfall events that took place during November 2021, the effects on the City's drainage infrastructure, and actions undertaken by City staff.

BACKGROUND

Between November 13 and November 15, 2021, a severe rainfall event, known as an "atmospheric river", brought intense and sustained rainfall to southern British Columbia. The storm event resulted in extensive impacts on many communities, including extensive flooding in the Sumas Prairie in Abbotsford, landslides in multiple locations, highway and bridge failures, and tragically the loss of human life.

During the rainfall event, the Emergency Management Coordinators opened a level 1 EOC to monitor and coordinate activities for the flood response. Engineering Operations deployed approximately 150 staff to manage the City's infrastructure, address flooded areas and optimize the City's 28 drainage pump stations. The City's Emergency Management liaison attended daily coordination calls to receive information regarding current and forecasted conditions. This information was shared across departments involved in mitigation and response activities to ensure a coordinated and integrated response.

Emergency Support Services opened a reception hotline to support local individuals evacuated from their residence, as well those stranded in Surrey who were unable to return to their primary residence. To date, four individuals have been helped to find accommodation and multiple evacuees were supported to find transportation to reception centres in the City of Abbotsford.

Surrey has supported the response in Abbotsford through the following:

- Supply of 10,000 sandbags;
- Mobilizing eight staff trained in rapid damage assessment from the Parks. Recreation, & Culture and Planning & Development Departments to assess the safety of building occupancy in the flooded areas; and
- Mobilizing two firefighters to sandbag the area of Barrowtown to mitigate flooding.

Staff from the Finance department have been tracking all flooding costs that are recoverable through the provincial Disaster Financial Assistance program.

On November 17, 2021, the BC Minister of Public Safety and Solicitor General declared a provincial state of emergency to mitigate impacts on transportation networks and movement of essential goods and supplies, and to support the province-wide response and recovery efforts resulting from the widespread damage caused by the flooding and landslides.

Between November 26 and November 30, 2021, two other significant rainfall events occurred; however, the City did not experience as much rainfall accumulation as with the previous event.

While the City did not receive as much rainfall as the Fraser Valley, and due to the significant investment the City has made in drainage and flood control infrastructure over the past several decades, including most recently dyke raising and replacement of the Southern Rail bridge on the Serpentine River, the storm event had less impact on the City's agricultural community.

DISCUSSION

City's Drainage System Overview

The City's drainage system is composed of river dykes, drainage pump stations, sea dams and dykes, and back-flow preventing floodboxes as well as ditches, culverts and bridges, storm sewers, detention ponds and natural water courses.

The City's lands are drained to four rivers, the Serpentine, the Nicomekl, the Campbell and the Fraser, through a network of watercourses (creeks and ditches) and storm sewers. Surrey's extensive low-lying areas are protected through system of dykes. That system has three major parts - Fraser River dykes, the Serpentine/Nicomekl River dykes, and sea dykes protecting the Serpentine and Nicomekl areas, as illustrated in Appendix "I".

The Serpentine/Nicomekl sea dykes protect the coastal, low-lying part of Surrey from flooding due to tidal events. The Serpentine/Nicomekl River dykes protect the central, low-lying part of Surrey from flooding due to local storm events including runoff from Langley.

The Fraser River dykes protect the northern lowlands of Surrey (Bridgeview, Pattullo, Old Yale and Manson) from flooding by the Fraser River freshet.

City's Service Criteria for Upland Area

Drainage collected in upland areas is conveyed either directly to creeks or to detention areas for temporary storage prior to discharge. The upland area drainage servicing approach is centered around the following key objectives:

- Convey minor (1 in 5 year event) flows – the purpose of the City's minor drainage system (storm sewers and ditches) is to convey runoff from small, frequent storm events to minimize the inconvenience of frequent surface runoff.
- Convey major (1 in 100 year event) flows – the purpose of the City's major drainage system (storm sewers, ditches and roadways) is to convey runoff from large, infrequent storm events to provide safe conveyance and minimize damage to life and property.
- Provide stormwater detention – detention facilities (ponds, underground tanks) in upland areas of the City are used to temporarily store runoff and release it at a lower rate, in order to protect downstream systems from erosion. Many of these facilities also provide water quality treatment.

City's Service Criteria for Lowland Area

The lowlands drainage system is generally designed to provide levels of service that are in accordance with the Agricultural and Rural Development Subsidiary Agreement ("ARDSA") established by the BC Ministry of Agriculture.

The ARDSA criteria focuses on a 1 in 10 year event over a duration of five days. As indicated in the table below, the amount of rainfall received between November 13 and November 15, 2021 exceeded the ARDSA criteria. Therefore, it is expected that widespread flooding in the Serpentine and Nicomekl lowlands would occur.

November 13 – 15 Rainfall Summary

The City received a substantial amount of rainfall between Saturday, November 13, 2021 and early afternoon on Monday, November 15, 2021. The most significant rainfall accumulation was over the 24-hour period between noon on Sunday, November 14 to noon on Monday, November 15, 2021.

The following table summarizes the rainfall that was recorded at the City's three main rain gauge stations. Rainfall totals and Intensity-Duration-Frequency ("IDF") curves for each rain gauge station are provided in Appendix "II".

Rain Gauge Station	Total Rainfall (mm) during Storm Event	Rainfall Received (mm) (Max over 24-Hour Period)	Return Period
Kwantlen Park (North Surrey)	159.3	102.0	1 in 25 year
Old Municipal Hall (Central Surrey)	156.6	107.8	> 1 in 50 year
White Rock STP (South Surrey)	148.6	105.8	> 1 in 100 year

Rain Gauge Station	Actual Rainfall Received over 5 Days (mm)*	ARDSA 10-Year 5-Day Winter (mm)	Exceeded ARDSA Event?
Kwantlen Park (North Surrey)	178.9	172.3	Yes
Old Municipal Hall (Central Surrey)	177.9	143.4	Yes
White Rock STP (South Surrey)	165.7	115.6	Yes

* Includes rainfall received for the five-day period between November 11 and November 15, 2021.

Upland Drainage System Status

Overall, the City's upland drainage systems performed very well during the storm events, given the City's storm sewer network is designed for a 1 in 5 year event. The challenge with these storm events was the volume of rainfall received over a prolonged duration.

Several of the City's stormwater detention ponds activated and provided attenuation of peak flows to minimize the impact on downstream systems. Engineering Operations staff responded to grillage blockages and minor flooding issues throughout the City.

Landslides

There were two reported landslides. One landslide occurred near Old Yale Road and 125A Street within the BC Hydro/Southern Railway ("SRY") lands (see photo in Appendix "III"), and Metro Vancouver's sewer through the property may have been damaged. The landslide is being addressed by BC Hydro and SRY staff.

The second landslide occurred in the Greenbelt near Crescent Road and 129 Street. The slide affected part of a paved pathway and fence in the park. For safety, the park gate has been locked and cones and caution tape have been erected. Staff continue to monitor the site and develop a remediation plan.

Lowland Drainage System Status

The dyke system in the Serpentine and Nicomekl lowlands also incorporates a series of spillways, as illustrated in Appendix "IV". The spillways provide relief to the dykes during times of high water levels in the rivers by providing pre-determined locations for the controlled discharge of river water, which allow for temporary detention of water in lowland areas until river levels lower and the detained water can be drained and/or pumped back in to the river. The spillways are designed to activate only during significant storm events (>1 in 15 year event) and were activated as can be seen in Appendix "V".

The main challenge with the November storm events was mainly the volume of runoff. Runoff ultimately flowed to lowland areas and triggered the following key issues:

Serpentine / Nicomekl Lowlands

During the storm event, and in the days immediately following, high ocean tide levels along Surrey's coastline were within typical ranges; however, low tides during this time were not sufficiently low enough to provide much relief in the way of gravity discharge through flood boxes and the Serpentine and Nicomekl sea dams. Therefore, water levels remained elevated in the Serpentine and Nicomekl rivers during and in the days following the storm event and flood boxes were not able to provide much drainage relief for properties behind the dykes. Water levels at key representative locations in each river system are illustrated in Appendix "V".

Lowland properties were mainly dependent on pump stations (both City owned and private) during and immediately following the storm event. When the water levels in the river are too high, the pumps do not usually run as it puts pressure on the dyke system. All pumps returned to working within normal operating levels within a few days post-event, with the exception of Fleetwood pump station which is still experiencing high water operating levels.

Key issues arising from this event that will be addressed include:

Upper Nicomekl Catchment

Significant flooding occurred in the Upper Nicomekl River catchment, particularly at 192 Street which receives most of its runoff from the City of Langley and Township of Langley to the east. Staff are documenting the extent of flooding using aerial photographs and will continue to engage the Langley's staff on the development of a broader tri-party flood management strategy for the Upper Nicomekl.

Bridgeview/South Westminster

Staff monitored water levels in the Fraser River during and following the November 13-15, 2021 event. Water levels in the Fraser River at Mission rose by 3m on Monday, November 15, 2021 as illustrated in Appendix "VI". Fraser River emergency notification procedures were not activated as the peak water levels did not reach the Provincial Phase 1 (6.0m) threshold; however, water levels in the Fraser remained elevated for some time following the storm event which exacerbated flooding issues in Bridgeview and South Westminster. All drainage pump stations in the area were operating throughout the storm events; however, as Fraser River water levels were moderate-to-high, the flood boxes did not provide much assistance in the way of gravity drainage relief.

Locations of high water levels and ditch overtopping included:

- 125A Street and 113 Avenue;
- 124 Street at 110 Ave and 112A Avenue;
- 121 Street and 103A Avenue;
- 112A Ave and Bridgeview Drive (behind Chevron gas station);
- King George Boulevard and Bridgeview Drive; and
- Tannery Road and Timberland Road.

Staff are finalizing a functional drainage assessment study for the Bridgeview area that seeks to address some of the historical and recent drainage concerns brought forward by residents and businesses in the area.

Road Closures

Due to the sustained duration of the event and the volume of rainfall received, some areas experienced flooding that impacted the road network, which resulted in several temporary road closures. Road closure locations and durations are summarized in Appendix "VII".

The longest duration road closures (24 to 36 hours) occurred at the following locations:

- 192 Street at 8 Avenue;
- 192 Street between 54 Avenue and Colebrook Road (both November 13-15 and November 26-29 events); and
- 16 Avenue at 182 Street (both November 13-15 and November 26-29 events).

Service Requests

During the November 13-15, 2021 storm event, the City received over 800 drainage-related service requests from impacted residents and businesses across the City. Neighbourhoods receiving the highest number of service requests included Bridgeview, Cloverdale and South Surrey. To date, 95% of the service requests have been completed.

Common issues that were reported include high water levels in ditches and creeks (with overtopping at some locations), blocked catch basins and grillages due to vegetation/leaf debris buildup, road flooding, surcharged manholes, and flooding of private yards and basements.

Staff attended problem locations throughout the storm event to document and address issues. Information was provided to residents and businesses, where appropriate, regarding accessing further information on financial assistance options as well as providing risk management claim forms. During these events, the City received less than 10 complaints in regards to level of service and flood control.

Metro Vancouver Sanitary Sewer Overflows

Metro Vancouver's sanitary sewers experienced sanitary sewer overflows ("SSO") due to elevated levels of rainwater inflow and infiltration ("I&I") in the sewer system, particularly the Cloverdale trunk sewer system and North Surrey Interceptor near the Port Mann bridge. Staff have completed an assessment of the City's upstream sanitary sewer catchment area and discovered three point sources of I&I and are working with Metro Vancouver on further assessment and monitoring plan for the area.

Next Steps

Staff will continue to monitor and inspect our drainage infrastructure to assess its condition and evaluate whether additional works are required to improve its resiliency.

Based on the storm events and the resultant drainage and flooding issues, staff have identified a number of infrastructure, road and bridge upgrades that will be added to the upcoming 2022 Engineering 10-Year Servicing Plan.

In addition, staff will advance discussions with the City of Langley and Township of Langley on the Upper Nicomekl River and seek joint funding opportunities, including from senior levels of government, for related capital projects to address flooding on the Nicomekl River near 192 Street and Colebrook Road.

CONCLUSION

Overall, the City's drainage and flood control systems performed quite well in response to the multiple rainfall events in November 2021, particularly the significant atmospheric river event (November 13 to 15, 2021) that saw more than 150 mm of rain fall on the City over a 48-hour period. The City has invested heavily in building and maintaining robust drainage and flood control systems over the past several decades and these investments supported the systems performance during the storm event. The City will continue to invest in drainage and flood control systems, such as the DMAF program, to ensure continued protection for our community in the years to come.

Scott Neuman, P. Eng.
General Manager, Engineering

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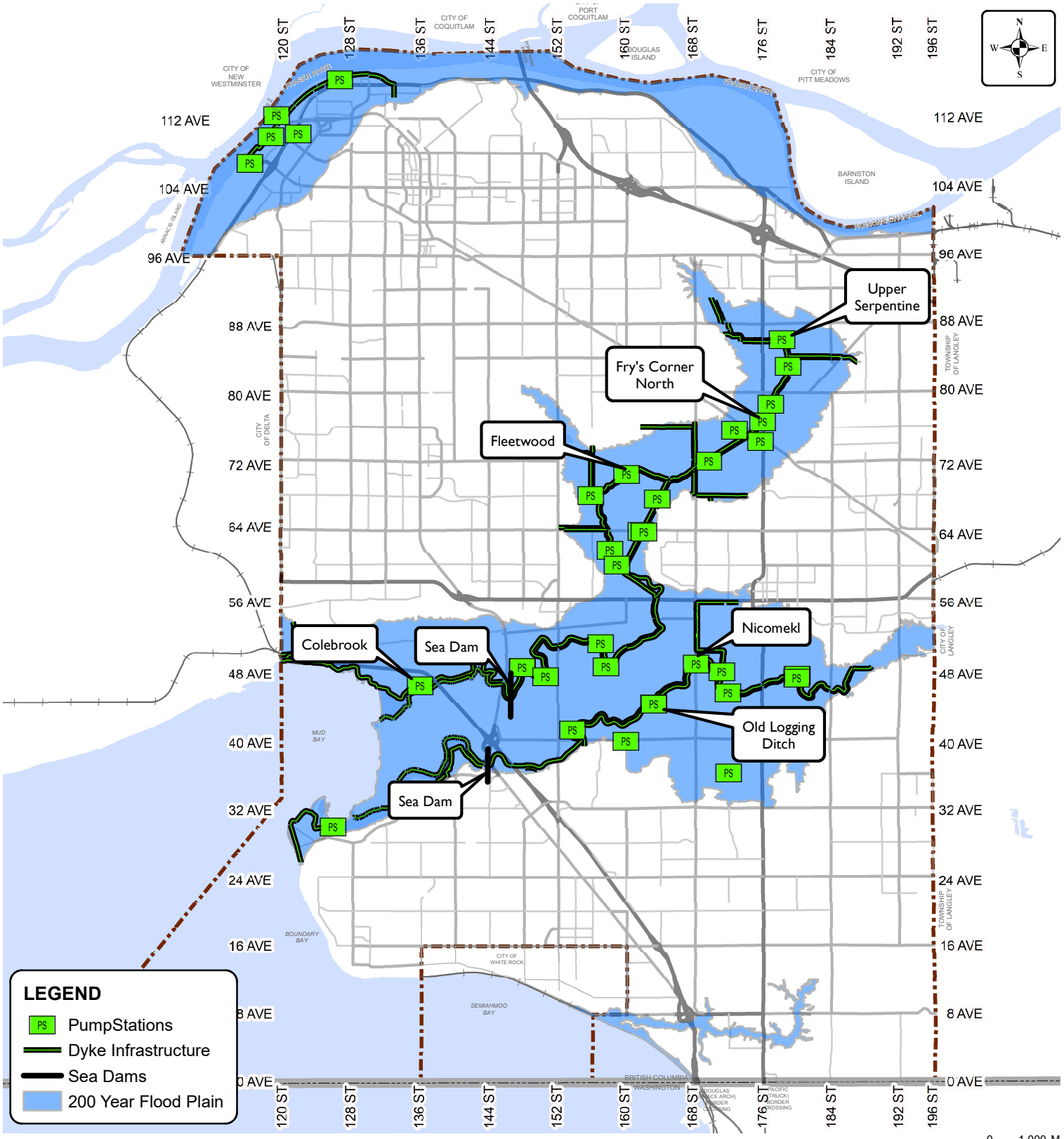
Appendix "I": City's Drainage System Overview
Appendix "II": Rainfall Amounts and IDF Curves
Appendix "III": Photos of November 2021 Rainfall Event
Appendix "IV": Serpentine and Nicomekl River Spillway Locations
Appendix "V": Serpentine and Nicomekl River Levels during November Rainfall Event
Appendix "VI": Fraser River Levels at Mission
Appendix "VII": Road Closure Map

APPENDIX "I"



Produced by GIS Section: 13-Dec-2021, P208082

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City of Surrey Drainage Network

ENGINEERING DEPARTMENT

Source:
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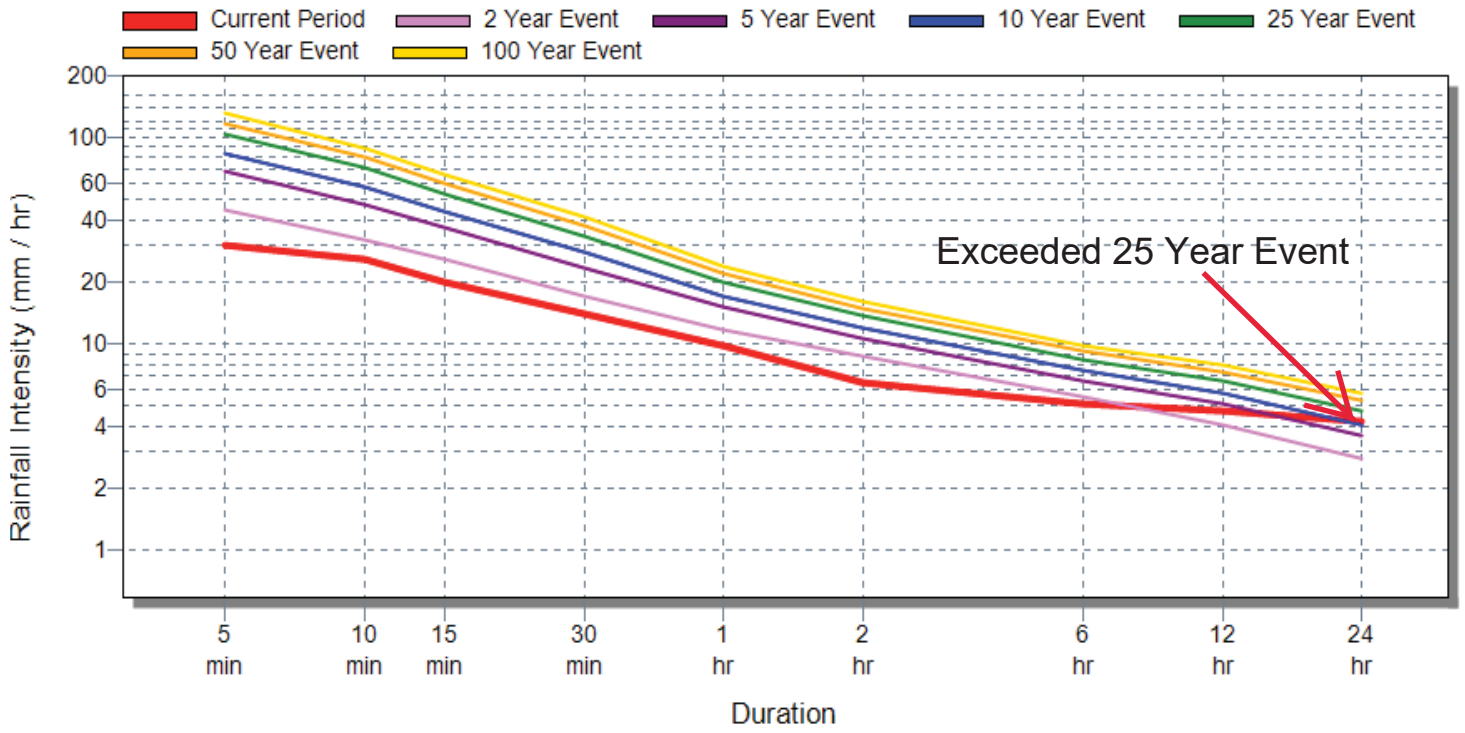
APPENDIX "II"

Surrey Kwantlen Park

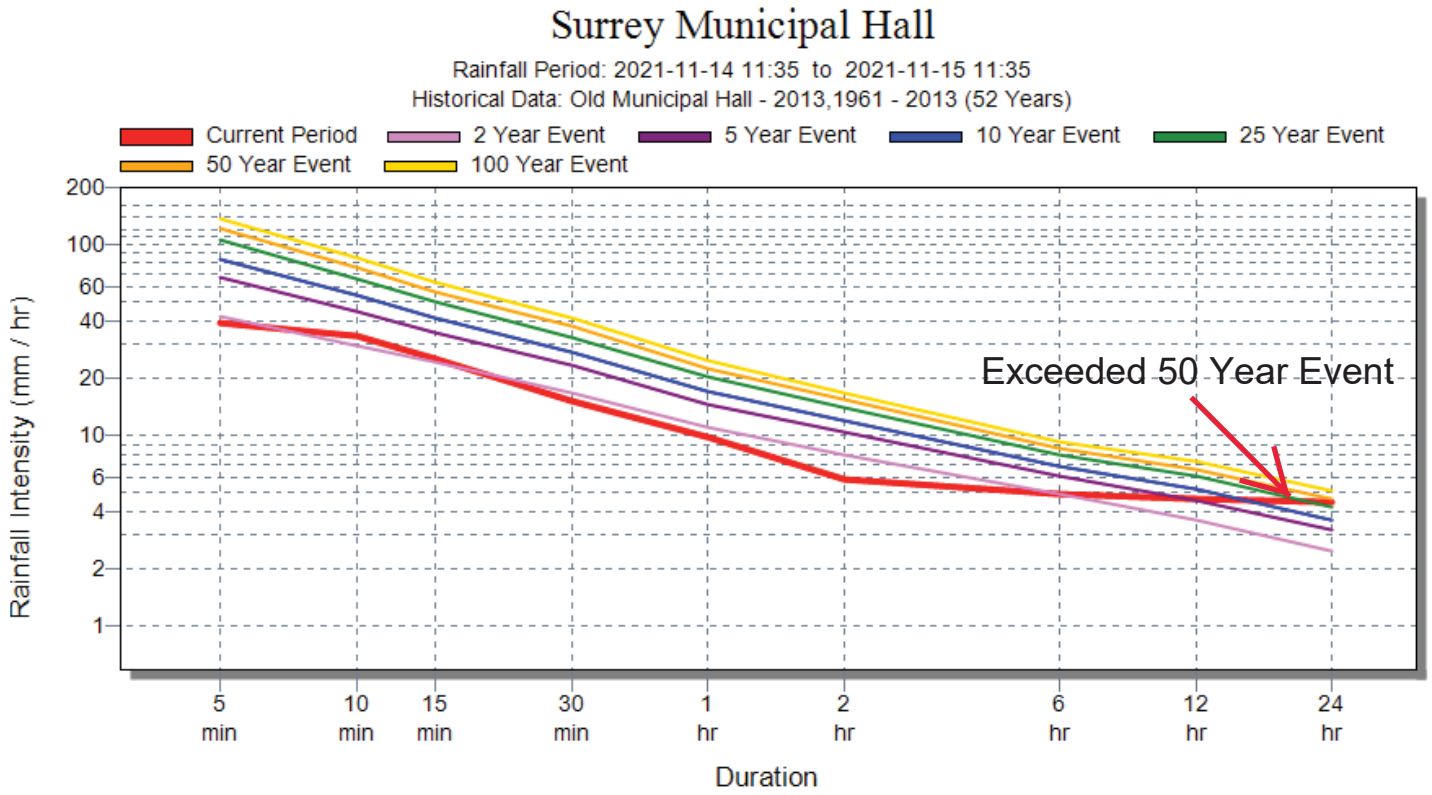
Rainfall Period: 2021-11-14 12:00 to 2021-11-15 12:00
Historical Data: Kwantlen Park - 2013,1961 - 2013 (52 Years)



Total Rainfall During Period	102 mm
Hours in Period	24.0 hrs

	5 min	10 min	15 min	30 min	1 hr	2 hrs	6 hrs	12 hrs	24 hrs
Current Period	30	25.5	20	14	9.8	6.5	5.1	4.8	4.2
2 Year Event	44.4	31.8	25.6	17	11.8	8.7	5.6	4.1	2.8
5 Year Event	68.4	47.4	36.4	23.4	15	10.6	6.7	5.1	3.6
10 Year Event	84	57.6	43.6	27.6	17.2	11.9	7.5	5.8	4.1
25 Year Event	103.2	70.8	52.8	33	19.9	13.6	8.4	6.6	4.8
50 Year Event	117.6	80.4	59.6	37.2	21.9	14.8	9.2	7.3	5.3
100 Year Event	132	89.4	66.4	41	23.9	16	9.9	7.9	5.8

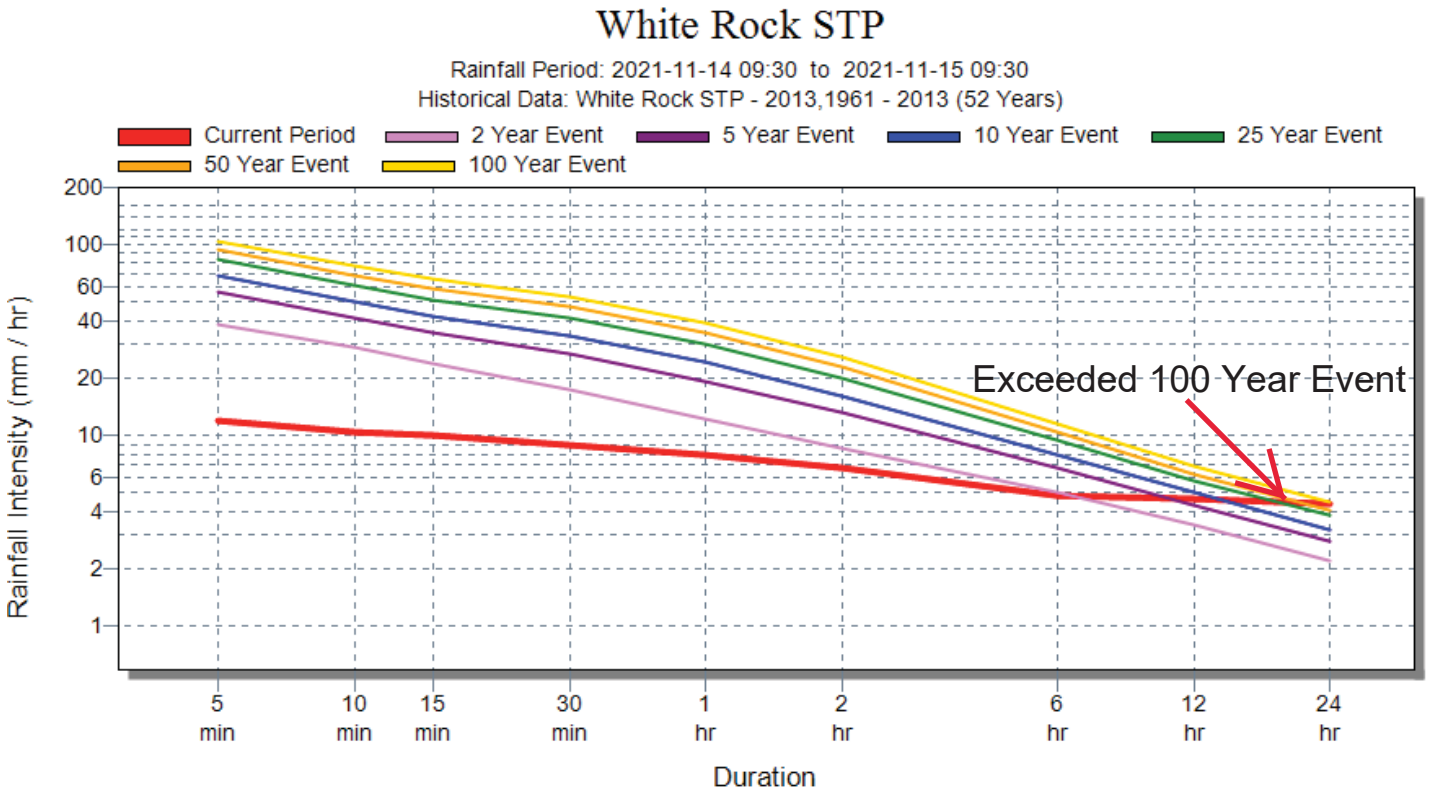
Intensity Duration Frequency Analysis



Total Rainfall During Period	107.8 mm
Hours in Period	24.0 hrs

	5 min	10 min	15 min	30 min	1 hr	2 hrs	6 hrs	12 hrs	24 hrs
Current Period	39	33	25	15	9.8	5.9	4.9	4.7	4.5
2 Year Event	42	29.4	24.4	16.6	11	8	4.9	3.6	2.5
5 Year Event	67.2	44.4	34.8	23.2	14.7	10.4	6.1	4.6	3.2
10 Year Event	84	54	41.6	27.4	17.1	11.9	6.9	5.2	3.6
25 Year Event	105.6	66.6	50.4	32.8	20.2	13.9	7.9	6.1	4.2
50 Year Event	121.2	75.6	56.8	37	22.5	15.3	8.6	6.7	4.7
100 Year Event	136.8	84.6	63.2	41	24.8	16.8	9.3	7.3	5.1

Intensity Duration Frequency Analysis



Total Rainfall During Period	105.8 mm
Hours in Period	24.0 hrs

	5 min	10 min	15 min	30 min	1 hr	2 hrs	6 hrs	12 hrs	24 hrs
Current Period	12	10.5	10	9	8	6.8	4.9	4.6	4.4
2 Year Event	38.4	28.8	23.6	17.4	12.2	8.6	5	3.4	2.2
5 Year Event	56.4	41.4	34.8	27	19.3	13.2	6.8	4.3	2.8
10 Year Event	68.4	50.4	42.4	33.4	24.1	16.2	8	5	3.2
25 Year Event	82.8	61.2	51.6	41.4	30.1	20.1	9.4	5.8	3.8
50 Year Event	93.6	69	58.4	47.4	34.5	23	10.5	6.3	4.1
100 Year Event	104.4	76.8	65.6	53.2	38.9	25.8	11.6	6.9	4.5

Flooding on Old Yale Road near 124 Street; Looking South East on Old Yale Rd

Bank Failure near Old Yale Rd and 125A St; Looking North on Old Yale Rd

Flooding on 112A Ave near 126A St; Looking East on 126 A St

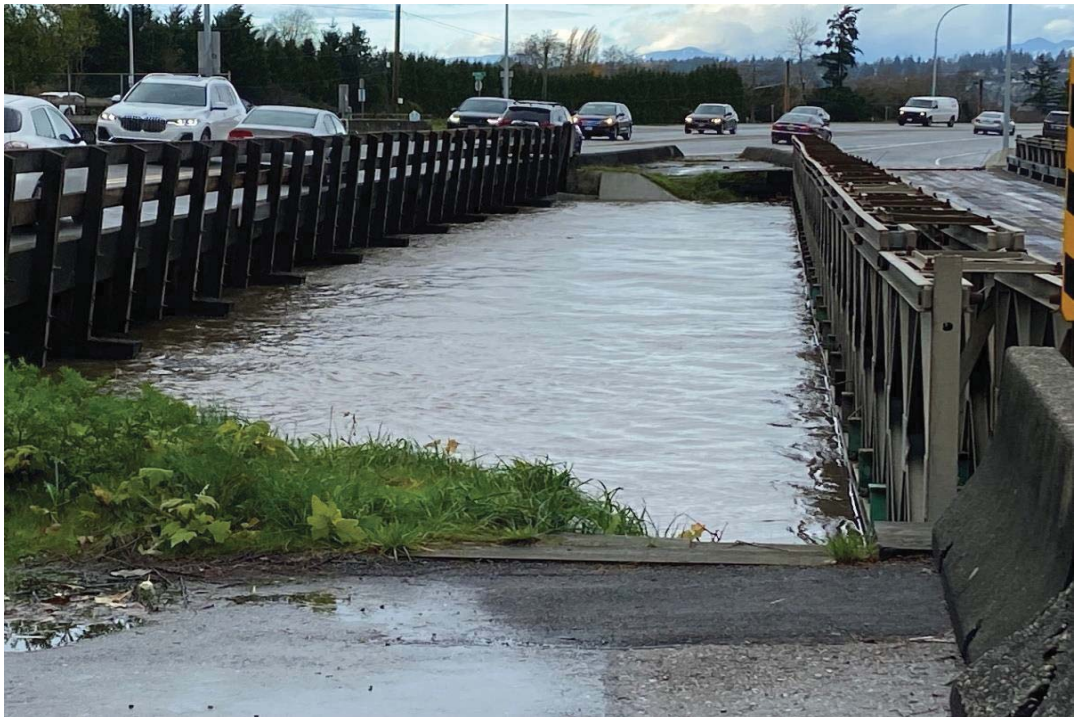
Flooding at King George Blvd and Bridgeview Dr; Looking West on King George Blvd

Surrey Lake Parking Lot on 152 St; Looking East on 152 St

Bear Creek at 152 Street; Looking South on 152 St

Nicomekl River @ 40 Ave Bridge; Looking West on 40 Ave

Nicomekl River at King George Blvd (Bailey Bridge); Looking NW on King George Blvd



Fraser Highway at 176 St (Northbound)

Spillway Activation on South Bank of Nicomekl River near 184 St; Looking NW off 184 St

South Surrey Athletic Field; Looking South off 20 Ave

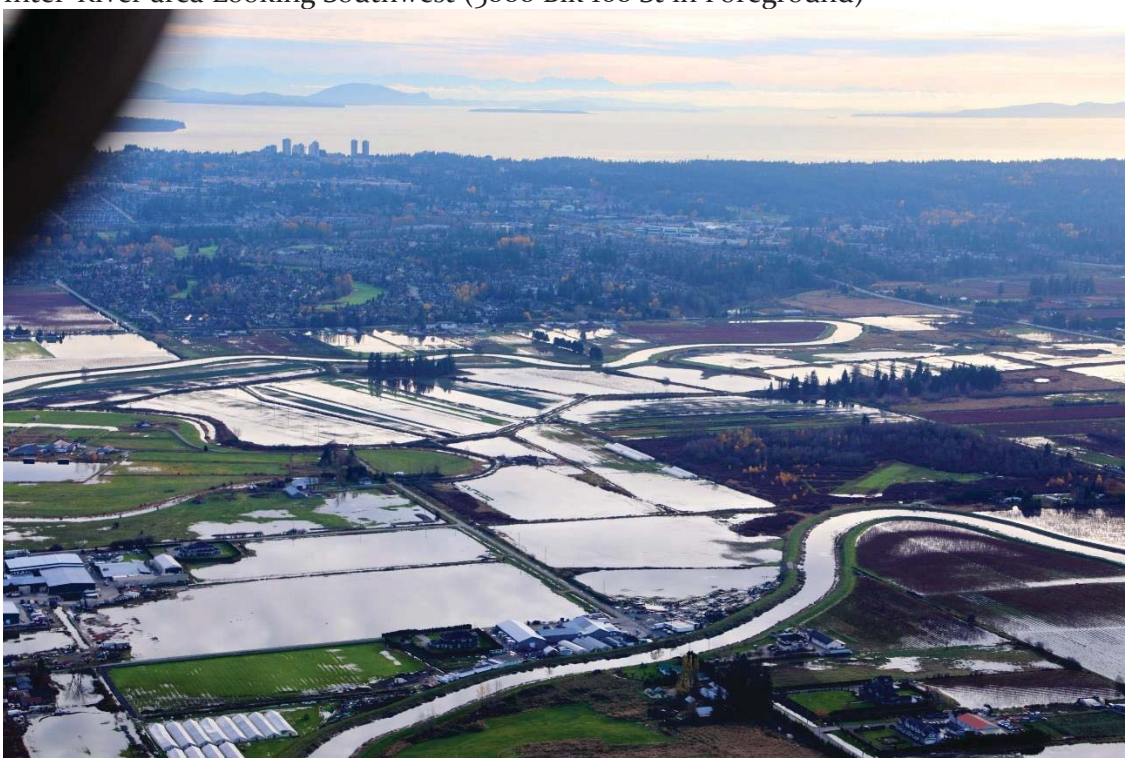
Wickson Pier at Crescent Beach; Looking NE along Dyke

November 17th Aerial Images of Serpentine and Nicomekl Lowlands

Inter-River area Looking West (Southwest Cloverdale Canal in Foreground)

Inter-River area Looking Southwest (168 St and Hwy 10 in Foreground)

Inter-River area Looking Southwest (5000 Blk 160 St in Foreground)

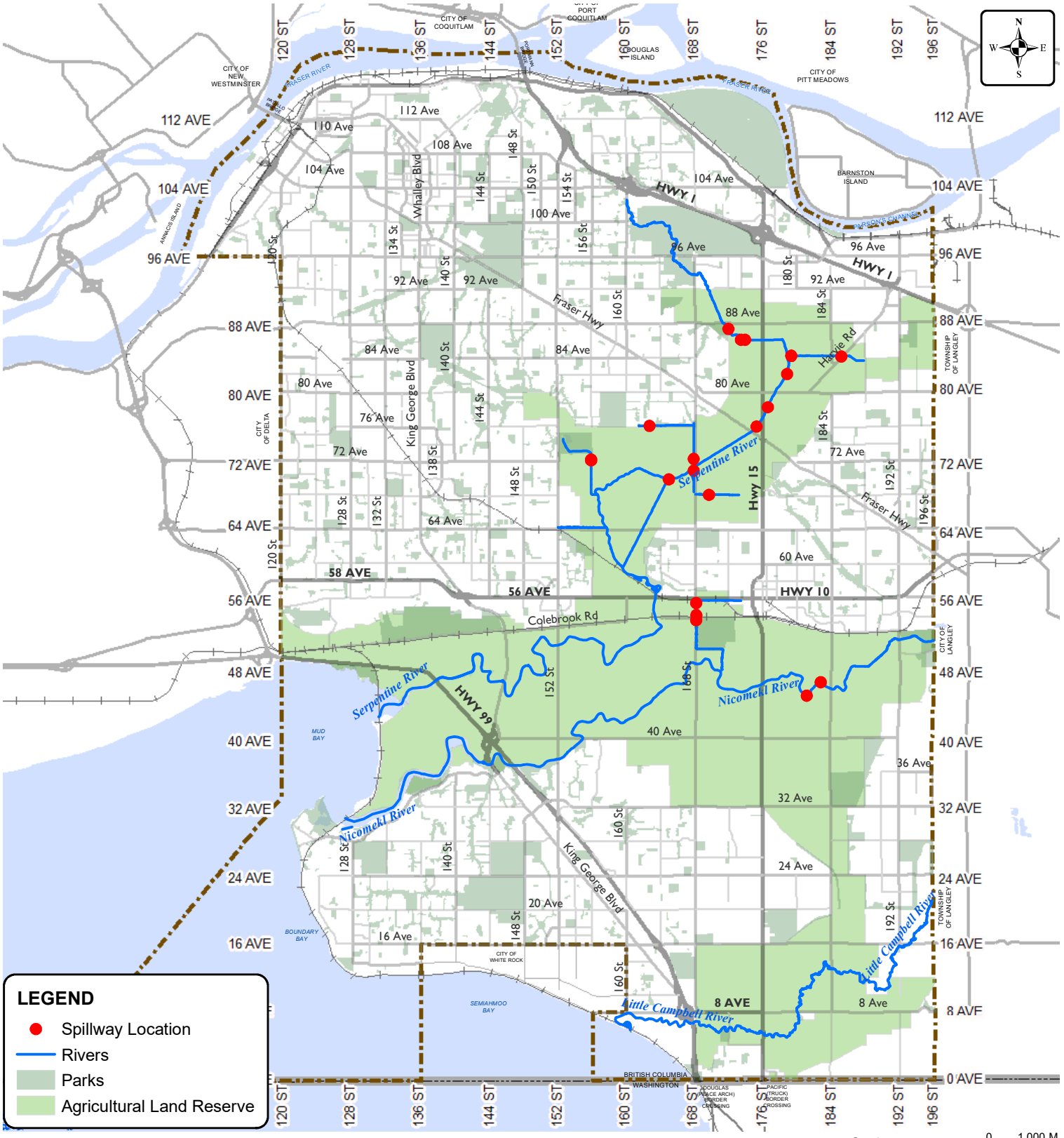


40 Ave looking East of 160 St (Old Logging Ditch area)

Nicomekl River looking East (Remnant Oxbow Channel of Inter-River area in Foreground)

Inter River area Looking South along 160 St (Remnant Oxbow Channel in Centre)

APPENDIX "IV"



Serpentine and Nicomekl River Spillways

ENGINEERING DEPARTMENT

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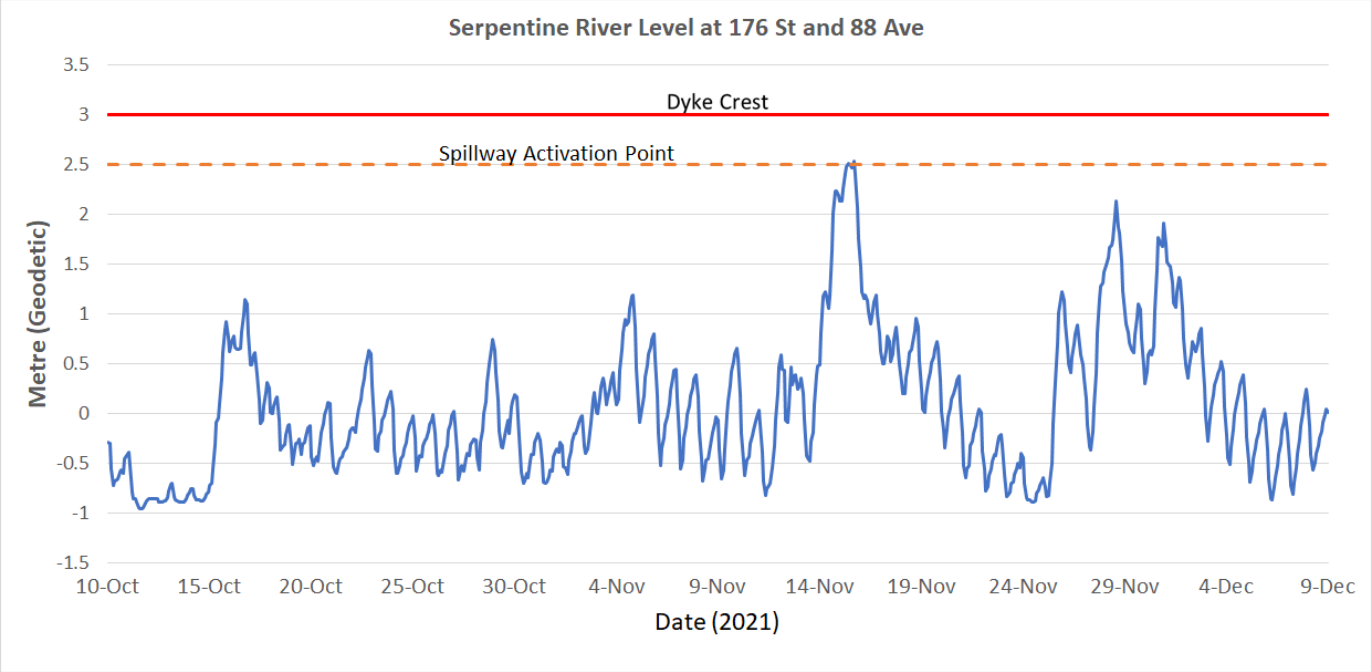
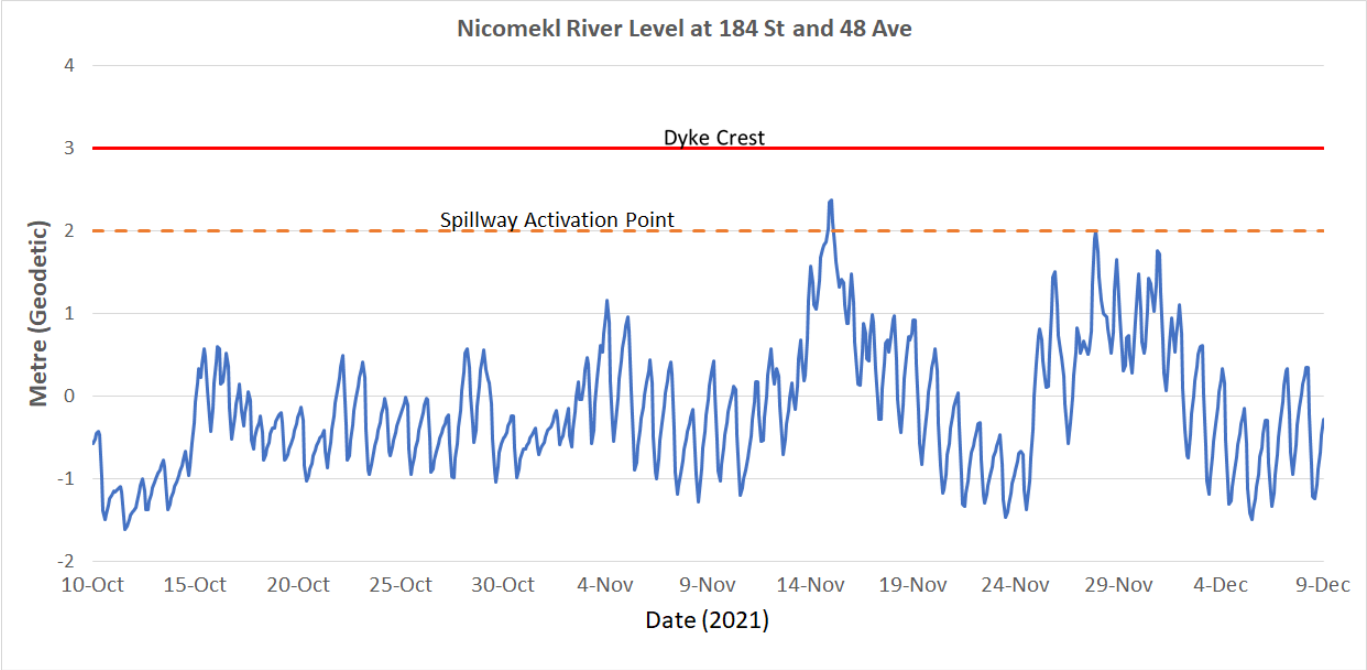
APPENDIX "V"

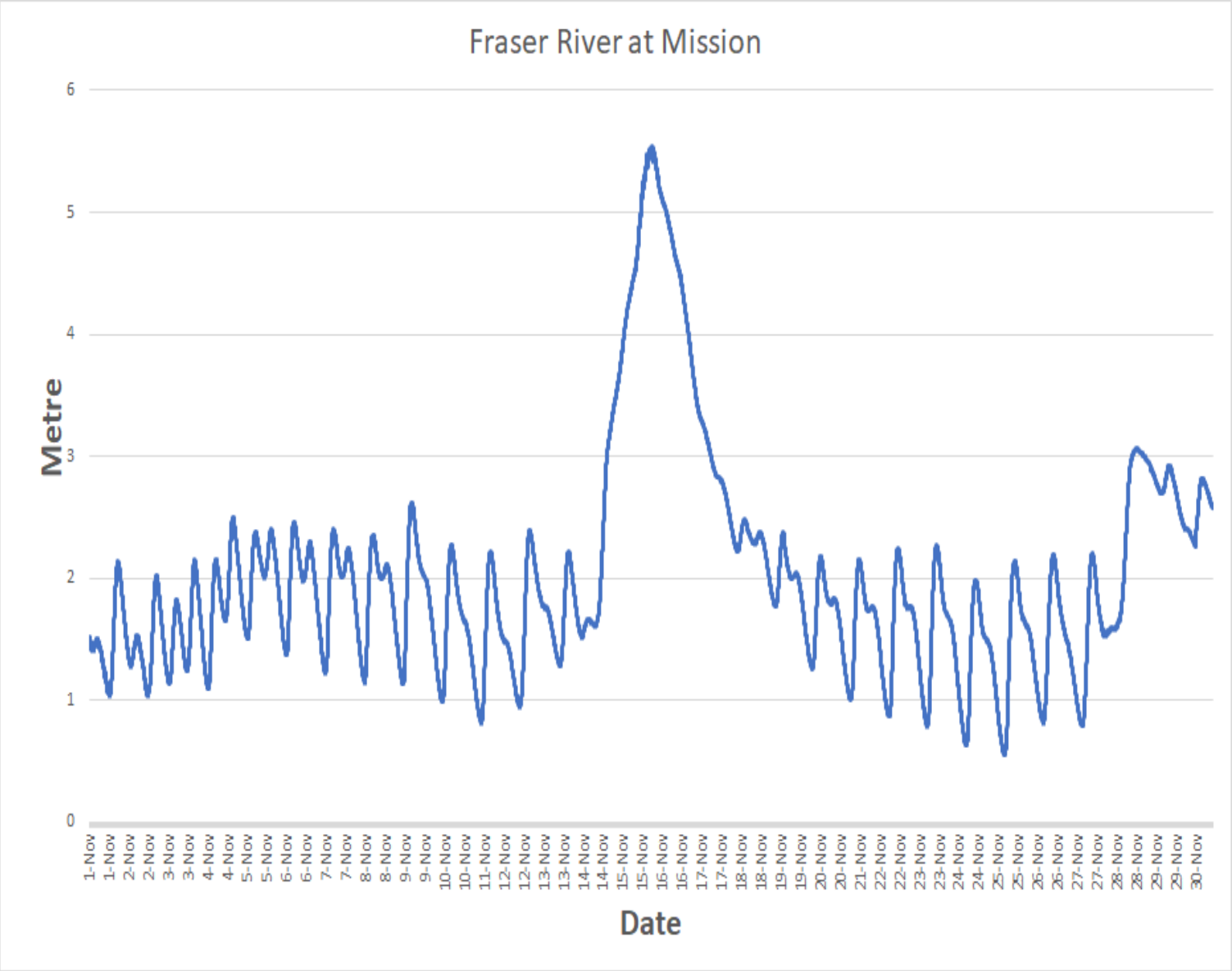
Serpentine and Nicomekl River Levels
2021 Rainfall Event

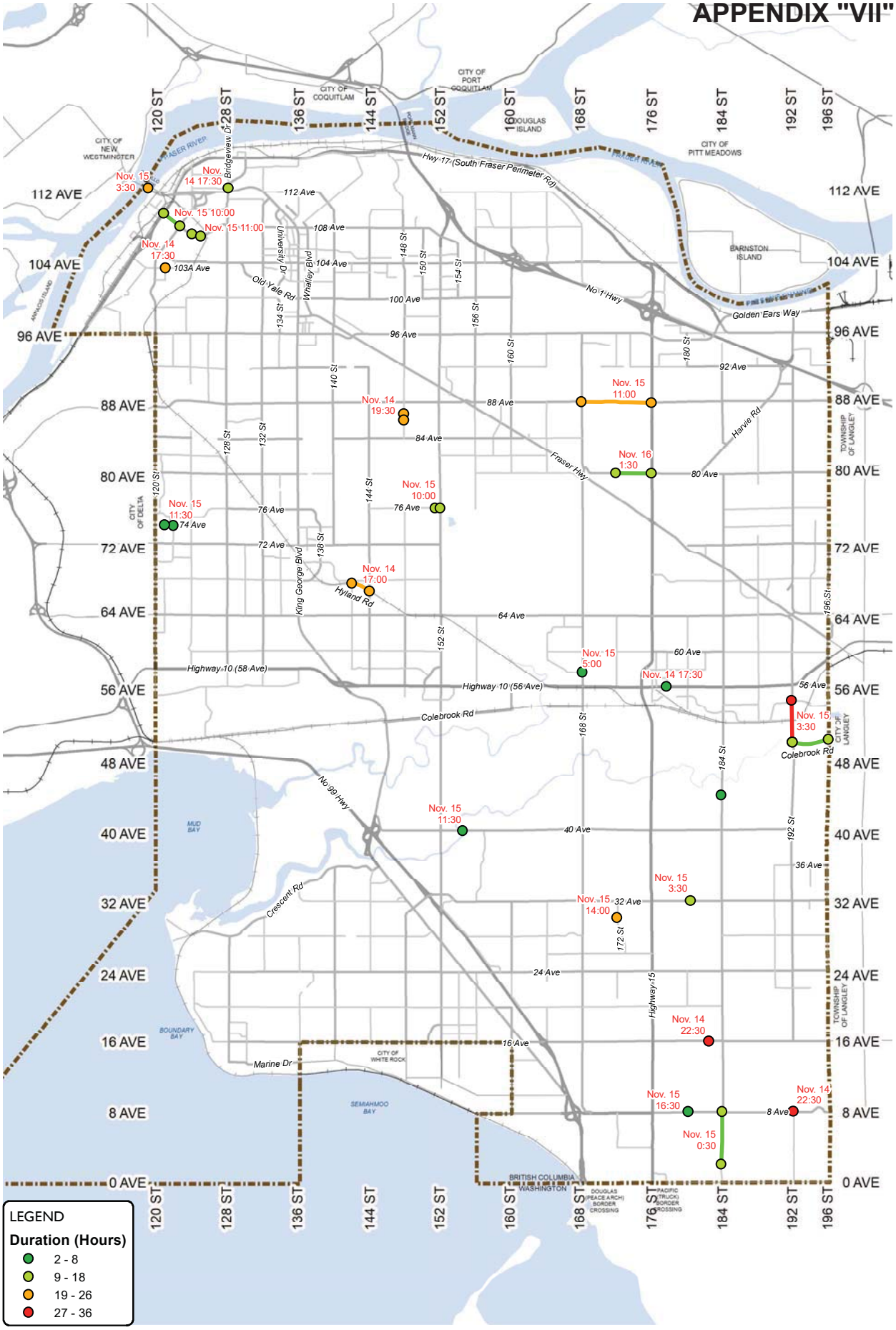




APPENDIX "VI"

Fraser River Level at Mission





November 13-15 2021

Storm Event Road Closures

SCALE: 1:80,000

GIS SECTION ENGINEERING

CITY OF SURREY

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