POLICY MANUAL

Title: North East Albion Servicing Strategy Policy	**Policy No.:** 6.37
Authority: Legislative ☒ Operational ☐	**Effective Date:** July 26, 2022
Approval: Council ☒ CMT ☐ General Manager ☐	**Review Date:**

Purpose:

The North East Albion Land Use Concept Plan and Servicing Strategy, endorsed in October 2019, included a detailed Servicing Strategy for the North East Albion Area. As this level of detail does not typically become embedded in an Official Community Plan, a Council Policy encapsulating the servicing details has been developed in order to facilitate the development application process by being flexible and adaptive but also technically accurate to ensure design standards are met.

North East Albion

SERVICING STRATEGY

01 | INTRODUCTION

The North East Albion Land Use and Servicing Concept planning process involves a review of the existing infrastructure in the area and an evaluation of the existing systems to withstand buildout of North East Albion.

02 | TRANSPORTATION

The proposed transportation network is designed to foster interconnection between streets, trails, and greenways to promote cycling, walking, and horse-back riding. New roads essential to a functional street grid are identified, such as the 248 Street connection. Any new local roads required for proposed housing will be determined at the time of development. A network of high-quality trail loops will link neighbourhood parks, open spaces, commercial nodes, and other key destinations.

All drawings are considered to have the proposed 248 Street and 112 Avenue intersection moved approximately 30 to 35 meters east.

Please refer to Section 7, **Drawing 18-1022A-101 (Roadworks Master Plan)** for the proposed major road network and road classifications.

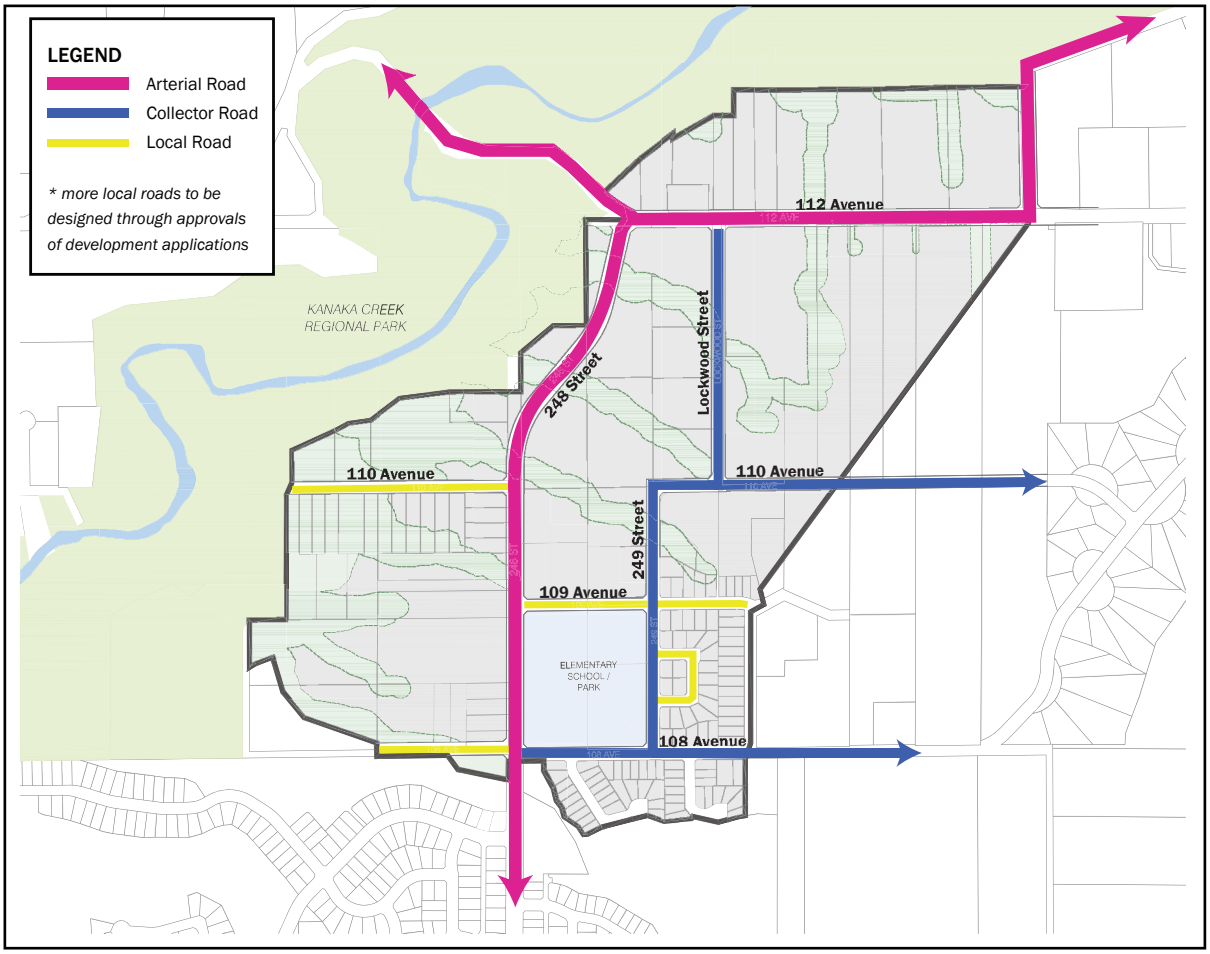


Figure 1 - Proposed Road Network

2.1 ROAD NETWORK

The North East Albion Concept Plan is currently serviced by 112 Avenue to the north and 108 Avenue to the south. New roadways shall be constructed generally in accordance with the City of Maple Ridge standards to service the proposed development of the area. A traffic signal is proposed to help traffic control and safe crossing at the 112 Avenue and 248 Street intersection, and a roundabout is proposed at the 112 Avenue and 252 Street intersection to facilitate movement as the arterial roadway turns north at 252 Street. Additional traffic improvements like roundabouts or signals may be identified as required on a development by development basis.

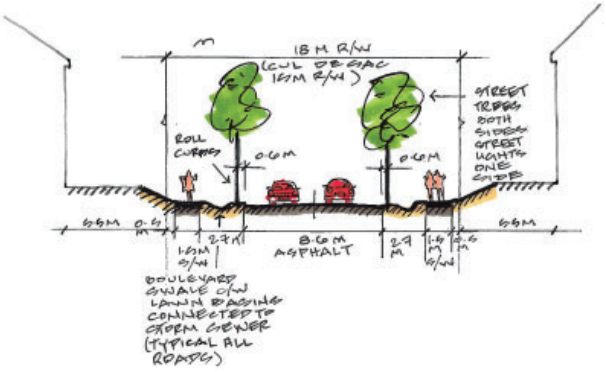
2.2 FUTURE ROAD ALIGNMENTS

As part of the 2014 Strategic Transportation Plan (STP), the City of Maple Ridge identifi ed the 108/112 Connector as a long-term east-west link. The specific alignment was not detailed in the STP but rather a notional connection is illustrated, establishing an east/west arterial grid network. As part of the North East Albion planning process, the Engineering Department at the City of Maple Ridge requested that the consultant team look at alignment options for the connector between 248 Street and 260 Street to ensure that the preferred option is not precluded by implementation of the North East Albion Plan.

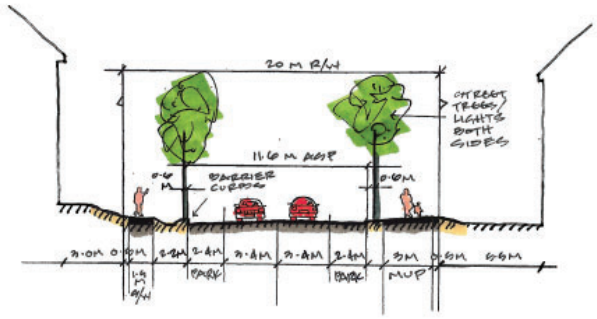
It was determined that there is the possibility for future arterial road alignments, but these would be outside the North East Albion area and would require further studies to be conducted under a separate process.

A major east-west arterial route analysis was also completed as a part of this project. As a result of that analysis, the ultimate alignment for the 112 Avenue connection from 248 Street to Grant Avenue was confirmed.

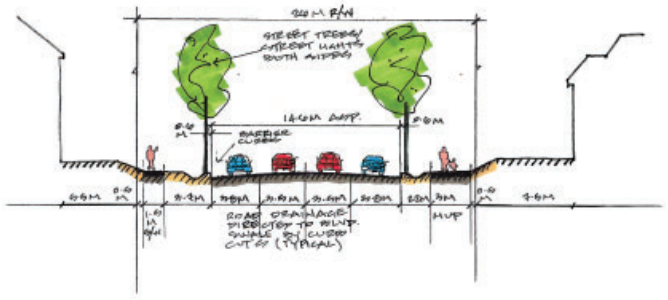
The City updates the Strategic Transportation Plan from time to time, as such, cross sections proposed for the North East Albion Area may be updated accordingly.



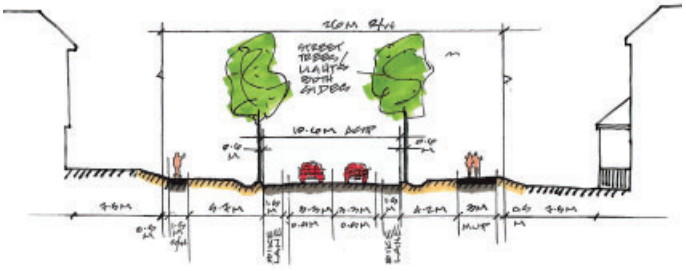
Typical Section, Local Road



Typical Section, Collector Road



Typical Section, 248 Street



Typical Section, 112 Avenue

2.3 ACTIVE TRANSPORTATION

The Concept Plan includes sidewalk or pathway access to the school site and to Cliff Falls in Kanaka Creek Regional Park. All roads include sidewalks or trails on both sides to encourage walkability through the area and to connect to the school and park.

The Maple Ridge 2014 STP identifies two corridors for a long-term bicycle network within the Concept Plan: 112 Avenue and 248 Street. The North East Albion Concept Plan provides on or off-street bicycle access to the school site and to the existing and planned municipal bike route network. 248 Street will have a multi-use path on the east side to facilitate access to the school and 112 Avenue will have on-street bike lanes consistent with the STP.

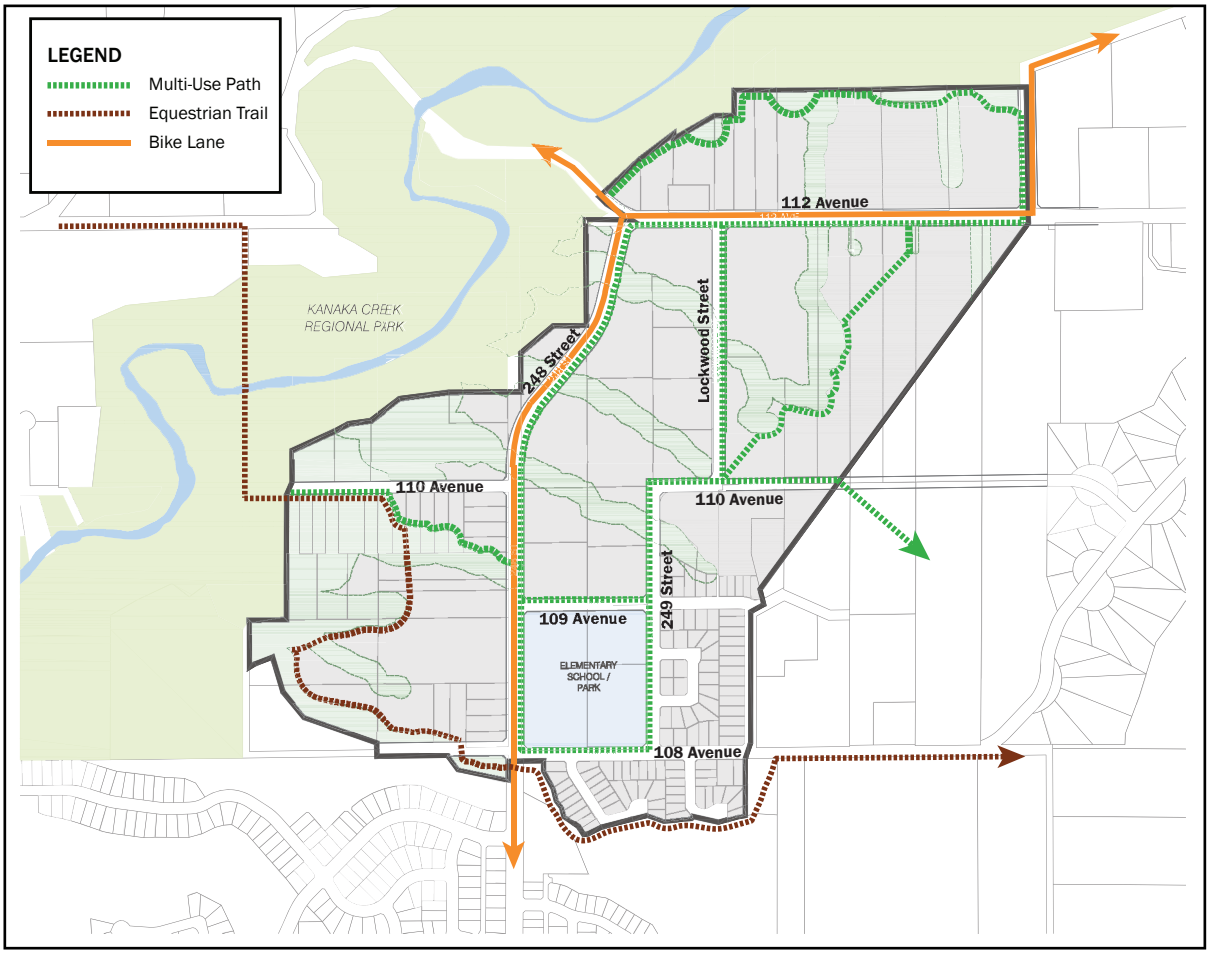


Figure 2 - Proposed Bike Lanes, Multi-Use Paths and Trails

03 | SANITARY

North East Albion is not currently serviced with sanitary sewer, except for a small portion of land near 108 Avenue that is currently serviced to the south by the existing Albion Area system. The City recently had a *Master Sanitary Plan* (MSP) completed by AECOM (November 7, 2016) that considered the existing (2016) system, anticipated 2018 loading, anticipated 2023 loading, and anticipated 2041 loading. The MSP forms the framework for integrating the localized North East Albion analysis in this Concept Plan into the overall master plan for the City.

The intent of this servicing analysis is to review the capacity of the existing system downstream of North East Albion based on the projected ultimate population proposed within the North East Albion Concept Plan.

3.1 DESIGN CRITERIA

The criteria for the evaluation of existing downstream systems is set forth in the City's current Design Criteria Manual.

3.2 SERVICING PLAN

North East Albion is proposed to be serviced primarily by a municipal pump station (PS-1) located on 112 Avenue just east of the Kanaka Creek bridge. This pump station will service the 65ha catchment within North East Albion not already being serviced to the south. Please see Section 7, **Drawing 18-1022A-201 (Sanitary Master Plan)** for the overall servicing plan and the downstream capacity calculations.

A pipe network along 112 Avenue, Lockwood Street and 110 Avenue will convey the northeast portion of the catchment to PS-1 by gravity. A gravity main along the north portion of 248 Street will convey the northwest portion of the catchment to PS-1 by gravity. Please see Section 7, **Drawing 18-1022A-202 (NE Albion Sanitary Catchment Plan)** for the local servicing plan and **Drawing 18-1022A-203 (NE Albion Sanitary Catchment Plan - Calculations)** for the local capacity calculations.

North East Albion lands south of this zone will be conveyed by gravity to PS-2 located at the west end of 110 Avenue. Flows will be pumped from PS-2 east on 110 Avenue and north on 248 Street until discharging into the gravity system on 248 Street (at MH S55). Lands at the southwest corner of North East Albion will be conveyed to PS-3 which will pump flows to 248 Street and convey them to PS-2. There is also a provision for an interim pump station to be located near the intersection of 110 Avenue and 248 Street, to permit some development within the ultimate PS-2 catchment to proceed ahead of lands for PS-2 being secured. This would also permit the school site to develop ahead of PS-2 being available, if desired.

The City can also consider allowing PS-2 to pump flows from PS-2 south on 248 Street to discharge to the gravity system on 108 Avenue subject to a separate sanitary analysis report which may require additional flow monitoring to determine actual inflow and infiltration rates. Any downstream upgrades triggered by this route would need to be addressed through the course of development.

The currently anticipated design flow and approximate total dynamic head values for the three ultimate pump stations are as below:

Pump Station	Design Flow (L/s)	Dynamic Head (m)
PS-1	40.3	16
PS-2	14.6	48
PS-3	4.4	20

North East Albion flows are proposed to be pumped west along 112 Avenue from PS-1 discharging to the existing 300mm diameter sanitary sewer on 112 Avenue just west of 244 Street (EX S1). The offsite analysis consisted of reviewing the existing 300mm diameter system from EX S1 east to EX S11 at the intersection of 112 Avenue and 240 Street, and the existing 375mm diameter system south from EX S11 to EX S17. Flows generated by this area were independently reviewed considering the latest state of development and developable areas for these catchment lands. Results were verified against the MSP and agreed very closely with the MSP predicted downstream flows for the 2041 scenario, providing a level of validation of the analysis.

With the proposed ultimate flows from North East Albion included, the downstream system meets the trunk main criteria for its entirety.

It should be noted that the MSP identifies one short section of downstream pipe for upgrade from an existing 200mm pipe size to a 375mm. However, the as-builts for this main provided by the City note that the 200mm size shown on the plan is incorrect, and that the pipe constructed is in fact a 375mm pipe.

Downstream of EX S19 (240 Street & Kanaka Creek Road) the system heads west into a major trunk line with significant excess capacity based on the MSP.

3.3 FINANCIAL BUDGET REVIEW

It is proposed to include all sanitary works located outside of the North East Albion boundary (gravity trunk main from boundary edge to PS-1, PS-1 including any road adjustments required to service PS-1, water service to PS-1, and forcemain from PS-1 to MH EXS1 including creek crossing) in an area latecomer applied over the entirety of the undeveloped North East Albion area.

It is expected that PS-2 and PS-3 may also require area latecomers in the future depending on how lands ultimately consolidate and develop. However, it should be noted that all undeveloped lands (including those catchment to PS-2 and/or PS-3) would be included in the PS-1 area latecomer, as all flows from these lands will eventually be serviced by PS-1 and the associated infrastructure west of 248 Street. However, if it can be proven out that routing PS-2 south is feasible then these lands would not be included in the PS-1 latecomer.

Preliminary budgets (not including land acquisition) for works associated with each pump station that would likely be eligible for an area latecomer are as below:

Pump Station	Budgetary Construction Values	Total Construction Value
PS-1	Pump Station: $3,800,000 Gravity main & Forcemain: $1,300,000	$5,100,000
PS-2	Pump Station: $1,000,000 Forcemain: $185,000	$1,185,000
PS-3	Pump Station: $950,000	$1,045,000

04 | WATER

North East Albion is not currently serviced with water, with the exception of a small portion of land at the south end that is currently serviced from the 108 Avenue system. The City recently had a *Master Water Plan (MWP)* completed by Kerr Wood Leidal (November 2016) that considered future upgrades on the City system at large. The MWP shows North East Albion being serviced by the 158m Albion pressure zone and being primarily fed by the Albion Reservoirs (158m TWL) with redundancy and some fire fl ow support provided from the Grant Mountain Reservoir (224m TWL).

PRV stations in three locations will ultimately allow for fire flow and emergency support from the Grant Mountain Zone to the Albion Zone. The stations are all existing, and are as follows:

- PRV 1: 112 Avenue at 252 Street;
- PRV 2: 108 Avenue just east of Morrisette Place; and,
- PRV 3: 112 Avenue and 256 Street (within the Grant Mountain Booster Pump Station).

The buildout of the North East Albion Concept Plan will allow for integration of the existing 158m Grant Mountain sub-zone into the 158m Albion Zone. This sub-zone services lots along 112 Avenue between 252 Street and 256 Street and was created as part of the Grant Mountain development.

Water Street Engineering Ltd. (WSE) was retained to assist in sizing the trunk infrastructure to service the area and to evaluate pressures throughout the system.

4.1 DESIGN CRITERIA

The City's Design Criteria states the following pressure requirements:

- Maximum allowable pressure: 900kPa (130 psi)
- Minimum pressure at Peak Hour Demand: 300 kPa (44 psi)
- Minimum pressure during Max Day Demand and Fire Flow: 150kPa (22 psi)
- Fire flowrequirements:
  - Single family residential: 60L/s
  - Apartments / Townhouses: 120L/s
  - Commercial / Institutional: 150L/s

It is noted that the lowest elevation areas of the existing 158m Albion Zone (53m el. west of 248 Street) have pressures up to 1035 kPa (105m WC).

The design criteria proposed by WSE as a result of their previous work on this reservoir is as follows:

- Elevation range of 53m to 110m (lower elevations to be protected with PRVs or other measures as determined with City).
- Albion reservoir total storage available = 2,489m^3;
- Grant Mountain fire storage available (cascading volume) = 409m^3;
- Density of 2.8 people per dwelling unit;
- Net lot area to gross area ratio of 64%;
- Irrigable area to net lot area ratio of 50%;
- Balancing storage amount: 25% of MDD;
- Design fire flow of 150L/s for 2 hours;
- Emergency storage amount: 25% of balancing and fire storage combined; and,
- Areas south of 108 Avenue (outside of North East Albion) retain same build-out projections as those in the 2018 memo prepared by WSE.

4.2 SERVICING PLAN

It is proposed to comply with the overall servicing concepts outlined in the MWP. Please see Section 7 **Drawing 301 (Water Master Plan)**.

Within the Concept Plan, feeder mains are proposed along 248 Street and 112 Avenue, with internal looping along 249 Street, 110 Avenue, and Lockwood Street. Local mains will connect into these feeder mains as required to service build out of the lands.

A 50mm diameter water service is proposed to the sanitary pump station PS-1 from the North East Albion system. A localized PRV is expected to be required on the PS-1 service.

4.3 SYSTEM DEMANDS

The North East Albion demands in the MWP were based on a design population of 2700 capita (ca) and a serviced lot area of 43.2ha.

The unit rates used to develop demands in the MWP were:

- Residential base demands of 250L/ca/day
- Non-revenue water of approximately 12% of base demand
- Irrigable area to lot area ratio of 50%
- Seasonal demands of 0.47L/s/ha

The above unit rates were consistent with observed system-wide consumption in Maple Ridge. The resulting demands in MWP included a buildout maximum day demand of 49L/s for the 158m Albion Area, including 19L/s for the North East Albion Concept Plan.

The revised loads for the North East Albion are:

- Residential population of 3481ca
- ICI Population equivalents of 178PE
- Total population equivalents of 3659ca
- Serviced lot area of 42.12ha

Based on the above and unit-demand rates consistent with the MWP the expected buildout demands are 21.8 L/s, i.e. an increase of approximately 3L/s.

Using the City of Maple Ridge design criteria rate of 1200L/ca/day would yield flows of 51L/s for the North East Albion Concept Plan. Given the size of the proposed development and actual observed demands, use of this value for sizing of water transmission infrastructure would be overly conservative.

4.4 HYDRAULIC ANALYSIS

As per previous recommendations, the HGL setpoints for the Grant Mountain PRVs to the Albion Zone should be lower than the Albion Reservoir operating range (i.e. less than 154m HGL). This will prevent over-commitment of the Grant Mountain Reservoir and Pump Station. Hydraulic analysis was completed on this basis.

Hydraulic analyses were completed with proposed 200mm water mains added on 248 Street, Lockwood Street, 249 Street, and 112 Avenue as indicated on Section 12 Drawing 301 (Water Master Plan). The analysis was completed without other future minor mains in the area.

An analysis completed with build-out demands of 21.8L/s for the area indicated that:

- Peak hour minimum pressures were acceptable
- Fire flows were acceptable (generally > 200L/s throughout)

A second fire flow analysis was completed with design criteria demands of 51L/s for the area, PRV station links to the 224m Grant Mountain Zone closed, and 104 Ave Pump Station off (i.e. all flow supplied from Albion Reservoir). This analysis indicated that while available fire flows were reduced, they still met design criteria (>60L/s for single family, > 120L/s for multi-family, and > 150L/s for commercial and institutional areas).

As discussed above areas with elevations less than 53m will have operating pressures slightly exceeding 1035 kPa (150psi). Special considerations should be included for these areas such as a local pressure-reduced zone or pressure-reduction on services off of 248 Street (i.e. to strata developments).

05 | STORMWATER

The North East Albion Land Use and Servicing Concept Plan provides a vision and implementation measures for sustainable water stewardship and management. The Concept Plan contains numerous watercourses that fl ow to Kanaka Creek, a fish bearing creek. Because of the degradation of fi sh habitat and water fl ows overtime, it has been recognized as one of the 15 Sensitive Streams in BC in the *Water Sustainability Act*. The creek is very sensitive to peak fl ow rate increases and water quality degradation. Primary objectives for stormwater management in the North East Albion Concept Plan have been developed as follows:

- Maintain baseflows and water quality to Kanaka Creek and its tributary watercourses to protect fish and fish habitat in these streams;
- Control peak runoff flows under frequent storm events to best mimic pre-development conditions and minimize stream erosion;
- Promote onsite infiltration to protect shallow wells, maximize groundwater infiltration and recharge and ensure groundwater flows are not to be intercepted by site development and road construction;
- Design and construct a stormwater conveyance system that includes subsurface storm sewers, detention facilities, open channels and culverts to adequately convey storm runoffs to watercourses for rain events up to a 10-year return period;
- Ensure that storm runoffs under extreme storm conditions can be conveyed via major storm conveyance systems, including major road crossings, overland flow paths and stream channels and cause no damage to life and properties; and
- Preserve or maintain existing drainage patterns essential to the overall health of Kanaka Creek, wherever possible.

5.1 STORMWATER MANAGEMENT CRITERIA

Aplin Martin identified the following design criteria to achieve the stormwater management objectives in the North East Albion Concept Plan:

Stormwater Volume Control (Achieving City's Tier A Requirements): Provide onsite infi ltration and retention to capture the 6-month 24-hour event rainfall, which equals to 72% of the Mean Annual Rainfall (MAR or the 2-year return period event rainfall) in both the development areas and the roads.

This criterion exceeds the City of Maple Ridge's Tier A design principle that requires capturing of 50% of the Mean Annual Rainfall.

Water Quality Control: Provide water quality treatment to runoff from frequent rainfall events up to a 2-year return period.

Runoff Rate Control (Achieving City's Tier B Requirements): Provide onsite or offsite storage to store runoff from design storm events up to and including the 10-year return period events and control the release rates at a forested land use condition.

This criterion exceeds the City of Maple Ridge's Tier B design principle that requires control of post-development peak flows to pre-development forested land use condition up to and including MAR (or the 2-year return period rainfall).

Groundwater Protection: Provide groundwater protection measures such as trench dams and/or groundwater flow diversions to ensure the subsurface fl ows in the shallow groundwater aquifer are not to be intercepted by development or new road construction.

Flood Control (Achieving City's Tier C Requirements): Design and construct minor and major stormwater conveyance systems to minimize surface fl ooding and flood damage to life and properties.

Minor Conveyance System: As an upland area to the Kanaka Creek system, developments will be required to adequately convey the 1:10-year return period post development flow within an engineered stormwater conveyance system that contains storm sewers, detention facilities, open ditches and culverts.

Major Conveyance System: To safely convey the 1:100-year return period post development flow within major fl ow paths, including major road crossings, overland fl ow paths and stream channels.

This criterion is same as the City of Maple Ridge's Tier C design principle.

Considering Climate Change Impacts: The stormwater conveyance system is to be designed to account for a 10% climate change impact.

2070 (assuming a 50-year design life for storm infrastructure).

The stormwater management criteria developed for the Concept Plan exceeds the City of Maple Ridge's three-tier stormwater design principles. This is to help maximize the environmental protection and minimize the impacts of development in North East Albion on the natural ecological system of the area and the overall Kanaka Creek watershed.

5.2 METHODOLOGY

Based on the above objectives, the stormwater management concept plan and Best Management Practices (BMPs) have been developed for the Concept Plan based on the following scope of work:

- Develop design storms under the existing and future 2070 moderate climate change conditions;
- Delineate existing land use condition catchment boundaries to the tributaries of Kanaka Creek;
- Determine proposed catchment boundaries and creek outfall locations based on the natural topography and practical development of lands;
- Determine pre-development forested land use design flows to the creeks;
- Determine post-development (existing and future 2070 climate condition) design flows to the creeks with and without the implementation of onsite BMPs;
- Prepare design guidelines for onsite BMPs;
- Determine onsite source control retention requirements;
- Determine unit detention requirements (m^3/ha) that are in addition to the implementation of source control retention BMPs for post-development to meet the design criteria (up to 10-year peak flow control to pre-development forested land use);
- Review potential for community stormwater pond facilities in North East Albion for any of the creek catchment;
- Review overland flow paths, culvert capacities, and creek capacities to ensure safe conveyance of the 100-year event;
- Determine applicable measures for groundwater protection;
- Develop stormwater management concepts that include:
  - Proposed stormwater minor and major drainage conveyance system;
  - Design requirements for onsite source control BMPs;
  - Design requirements for onsite and offsite detention facilities; and
  - Design requirements for groundwater protection measures.
- Develop stormwater management design guidelines for development applications; and
- Develop operation and maintenance, as well as monitoring programs to ensure effectiveness and sustainability of the stormwater management measures in the future.

5.3 EXSITING CONDITION OVERVIEW

Surface Drainage

The current state of North East Albion is generally undeveloped, with most of the land covered by natural forest and rural large parcel residential land uses. The area generally slopes west/northwest towards the Kanaka Creek ravine. Rainfall on the lands is mainly infiltrated into the ground with runoff being collected overland into ditches and tributary streams to Kanaka Creek.

Watercourses

Watercourses in North East Albion are primarily tributary to Kanaka Creek. All the tributary ravine creeks are essential sources of water and nutrients to fish population in Kanaka Creek. Most of these creeks are fed by groundwater, so they export cool temperature waters at steady rates to Kanaka Creek.

Groundwater

Based on the aquifer classification descriptions from the BC Water Resource Atlas, North East Albion is above three groundwater aquifers, the "Grant Hill" and "South of Grant Hill" aquifers, and an unnamed aquifer.

The Grant Hill Aquifer is a fractured sedimentary bedrock aquifer, underlying the entire area of North East Albion. The aquifer is approximately 6.1m to 28m below ground surface. A till layer generally covers the bedrock surface, limiting potential hydraulic connections between the shallow groundwater and fractured bedrock. However, the *Environmental Assessment*

Report – North East Albion Baseline Environmental Assessment report prepared by Phoenix Environmental Services Ltd. (April 2019), suggests that the southeast portion of North East Albion may have recharge values to this aquifer, based on background research and site investigation findings.

The South of Grant Hill Aquifer is a glacio-fluvial sand and gravel aquifer at approximately 1.2 to 1.5m below ground level. Only a small portion of the North East Albion lands on the south are underlain by this aquifer. The area near the proposed school site above this aquifer may have recharge value. In particular, the eastern side of the proposed school site consists of the well-draining soil types and this area may therefore constitute a valuable recharge area. The shallow depth of this aquifer and its proximity to Thornvale Creek suggest that it may provide valuable moderated water flows to this important salmonid-spawning stream.

The unnamed aquifer is located near the northeast portion of North East Albion. This aquifer is approximately 1.2m below ground level. Springs and streams along the toes of sloped areas in the eastern portion of North East Albion are likely fed by the aquifer.

5.4 HYDROLOGIC AND HYDRAULIC MODELLING

Modeling Scenarios

The scenarios summarized in **Table 1** were developed and assessed to defi ne the conveyance system and detention targets.

It should be noted that the conveyance system has been reviewed and sized to meet both the minor (1:10-year return period) and major (1:100-year return period) flow conveyance requirements under the future 2070 climate conditions without source control BMPs and detention storage. This is to ensure that the proposed conveyance system will adequately convey the target flows based on the design life of the system.

For source control BMPs and detention facilities, it is assumed that they will be applied to achieve the stormwater volume and rate control targets under the existing climate condition.

The source control BMPs shall be capable of retaining a minimum of 100% of the 6-month 24-hour event (72% of 2-year 24-hour rainfall volume) rainfall onsite. They are to be implemented in all development areas, including future roadway corridors.

The additional detention volumes required for the runoff fl ow rate control were estimated based on modelling a unit development site for various soil and post-development land use conditions in addition to the source control BMP measure(s) proposed for the site, to control the post-development flows to the pre-development levels for design storm events up to and including the 10-year return period events.

Table 1 – Modelling Scenarios

No.	Land Use	Climate	Onsite BMPs	Purpose
1	Future	2070	No	Define future performance under future climate conditions without source controls or detention features. This scenario is to assess and size the conveyance infrastructure.
2	Pre-development	Current	No	Define base flow control targets
3	Future	Current	Yes	Define future performance under existing climate conditions with source controls. This scenario is to size onsite BMPs and additional detention requirements.

Model Coverage

The model covers the watershed encapsulating North East Albion, including the catchment draining into the neighbourhood area and via the tributary streams to Kanaka Creek. In Section 7, **Drawing 18-1022A-401** presents the existing catchment map delineated based on the air photo, topography and the available drainage plans from existing developed areas. In Section 7, **Drawing 18-1022A-402** presents the future catchment map based on the proposed Land Use Concept Plan and the planned storm sewer system for future developments.

Design Storms

Design storms were developed under both the existing and future 2070 moderate climate change conditions based on the new design storm hyetographs developed by Aplin Martin for the City of Maple Ridge.

Land Use and Percent Imperviousness

In Section 7, **Drawings 18-1022A-401** and **18-1022A-402** also summarize the existing and future land uses based on available orthophoto, zoning and the proposed Land Use Concept Plan, respectively. **Table 2** shows the percent impervious values assigned to each land use type.

For the purpose of stormwater modelling, Cluster Residential and Multiplex land-use designations have been combined to create the category of "Multiplex".

Please note for the pre-development forested land use condition model, surface conditions of all subcatchments are assumed being the Environmentally Sensitive Areas/Metro Vancouver Regional Park (5% imperviousness).

Table 2 – Land Use Percent Imperviousness

Land Use Type	% Imperviousness
Environmentally Sensitive Areas/Metro Vancouver Regional Park	5
Single-Family Residential	55
Multiplex	60
Townhouse	65
Institutional (excluding sport field)	80
Road ROW	78

Soils and Infiltration Parameters

In Section 7, **Drawings 18-1022A-403** presents the soil map for the study catchment, showing that the study catchment area consists of three types of surfi cial soil textures, sandy loam, loam and silt loam soils. The soil map was developed based on soil information presented in *Soils of the Langley – Vancouver Map Area Volume 1* (Lutterding, 1981).The soil survey data has been interpreted into various soil texture categories and provided as an online open data source by the Ministry of Environment and Climate Change Strategy. This soil information has been commonly used for surficial drainage studies.

Soil infiltration parameters for the types of soils in the study area were selected based on the SWMM manual and typical textbook values.

Soil infiltration parameters used for modelling are summarized in **Table 3**.

Table 3 – Hydrological Modelling Parameters

Hydrological Model Parameters – North East Albion Neighbourhood		
Global Parameters	**Depression Storage, mm**	
	Impervious	2
	Pervious	7
	Manning's n	
	Impervious	0.015
	Pervious	0.25
Green-Ampt Infiltration Parameters	**Sandy Loam**	
	- Average Capillary Suction, mm (Wet)	110.1
	- Initial Moisture Deficit (Saturated)	0
	- Saturated Hydraulic Conductivity, mm/hr	25
	Loam	
	- Average Capillary Suction, mm (Wet)	88.9
	- Initial Moisture Deficit (Saturated)	0
	- Saturated Hydraulic Conductivity, mm/hr	13
	Silt Loam	
	- Average Capillary Suction, mm (Wet)	166.8
	- Initial Moisture Deficit (Saturated)	0
	- Saturated Hydraulic Conductivity, mm/hr	6.6

Subsurface Flow Modelling

Geotechnical investigations performed in North East Albion indicated that the groundwater table is at approximately 1.0m below the ground surface during the winter months. Likely, rainfall infiltrated to the ground would slowly drain back to the stormwater system or downstream watercourses. We have therefore included the groundwater module in our model that simulates the subsurface flows. The parameters used for the groundwater module were based on the subsurface soil characteristics and our past groundwater model calibration experience, as shown in **Table 4**.

Model Network

The stormwater network for existing developments was modeled based on the City's GIS data and available field verification data. The proposed future pipe network was modeled based on future land use and development plans, and the proposed future catchment plan. The modeled creek transects were approximated from the City's DEM data.

Downstream Boundary Conditions

The hydraulic model developed covers the tributary streams to Kanaka Creek to which North East Albion drains. Based on the topography, it does not appear that there would be backwater effects from Kanaka Creek impacting the drainage in our study catchments. Therefore, we have assumed free outfall conditions for the tributary streams to Kanaka Creek in the model.

However, it may be prudent to review the modelled Kanaka Creek peak water level profiles from the Kanaka Creek ISMP study to assess whether backwater/downstream water levels should be considered in the modelling of the boundary conditions when the ISMP becomes available.

Table 4 – Subsurface Modelling Parameters

Subsurface Model Parameters – North East Albion Neighbourhood		
Groundwater Aquifer Parameters	Porosity (/)	0.453
	Wilting Point (/)	0.085
	Field Capacity (/)	0.19
	Conductivity (mm/hr)	10.9
	Lower GW Loss Rate (mm/hr)	0.002
	Bottom Elevation (m)	0
	Initial Water Table Elevation (m)	1.0
Groundwater Parameters	Surface Elevation (m)	2
	Groundwater Flow Coefficient (A1)	0.1
	Groundwater Flow Exponent (B1)	2
	Groundwater Flow Coefficient (A2)	0
	Groundwater Flow Exponent (B2)	0
	Surface Water Depth (m)	Depth from flow routing
	Threshold Water Table Elevation (m)	1.0

5.5 STORMWATER MANAGEMENT CONCEPTS

Stormwater management concepts have been developed for North East Albion Concept Plan based on the modelling results and are as follows:

- Proposed trunk storm sewer network and major flow paths;
- Onsite source volume and Water Quality control BMPs;
- Additional detention requirements;
- Regional stormwater management features; and
- Groundwater protection measures.

Proposed Trunk Storm Sewer Network and Major Flow Paths

The proposed trunk storm mains were sized in compliance with the design criteria under Scenario 1, which simulates the peak fl ow in the system during future land use and future climate conditions, assuming 2070 climate condition and no source controls and detention features are functional. In Section 7, **Drawing 18-1022A-404** presents the proposed storm main sizes and upgrades to the existing system. The underground storm sewers are to be designed to convey 1:10-year return period peak design flows while the major road crossings are to convey 1:100-year return period peak design flows.

Major storm conveyance systems for safely conveying 1:100-year return period post-development fl ows also include overland fl ow paths and stream channels, in addition to major road crossings, to ensure no fl ood damage to life and properties. The major storm conveyance system under the post-development 2070 climate condition has been reviewed with major fl ow paths identifi ed as shown in Section 7, **Drawing 18-1022A-405**. Stream channels' adequacy to convey extreme flows has been confi rmed, with the exception of approximately 150m of an existing drainage ditch north of 112 Avenue that discharges to the tributary channel KA6 west (see Section 7, **Drawing 18-1022A-405)**.The modelling results show that this ditch would be flooded and should be upgraded to a minimum 1m bottom width with 2:1 side slope channel to provide a suitable 100-year fl ow path under the assumed design condition.

Onsite Source Volume and Water Quality Control BMPs

The objectives for onsite source volume and water quality control BMPs include:

- Retain 90% of the total annual rainfall volume onsite as that typically occurs under the natural forested land use conditions; and
- Control rainfall runoff quality.

Past hydrologic analyses indicate that capturing 100% of the 6-month 24-hour rainfall volume would roughly achieve the 90% annual rainfall volume retention in the Metro Vancouver region. The 6-month 24-hour rainfall depth for the study area is estimated to be 53.6mm, that equals to 72% of the 2-year 24-hour rainfall depth.

Types of source control BMPs recommended in North East Albion for developments with different land uses are summarized in **Table 5**. These BMPs were identified based on Aplin Martin's experience with past common BMP applications within the Greater Vancouver Lower Mainland area.

Detailed design of these BMPs shall follow the design guidelines provided in the *Metro Vancouver's Stormwater Source Control Design Guidelines 2012*. A general overview of each the recommended BMPs and their application in the North East Albion Concept Plan are provided below.

ABSORBENT LANDSCAPE

Applying amended topsoil on pervious areas is the most commonly used stormwater source control BMP measure. It creates an absorbent landscape layer that acts like a sponge to soak up, store and slowly release rainfall. It also provides bio-infiltration or water quality control to the runoff draining into the absorbent landscape areas. This type of the BMP is generally suitable to use for all type of development applications. Runoff from impervious areas would need to be routed to the pervious areas.

Based on the native soil condition and percent imperviousness of the site, absorbent landscape alone or combined with other ground-infiltration measures would achieve the target volume and water quality controls in North East Albion.

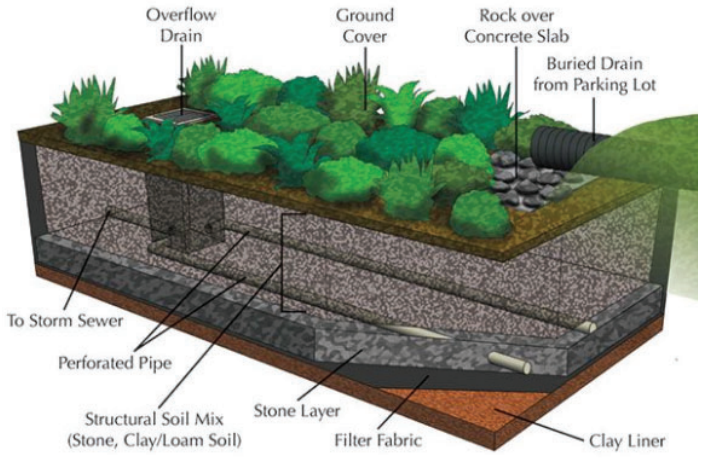
Materials and application methods for absorbent landscape shall meet MMCD 2009 requirements for Topsoil and Finish Grading (Section 32-91-21), **Table 2** specifications for Growing Medium, with organic matter requirements amended to minimum of 8% for lawn areas and 15% for planting areas. The minimum amended topsoil depth is 300mm in grassed areas and 450mm in planted areas.

Absorbent Landscape

INFILTRATION CHAMBERS

Infiltration chambers such as rock pits are a type of BMP that can be easily implemented, and they are cost effective for onsite stormwater volume control. Infiltration chambers are commonly used for residential development areas for rainfall infiltration and capture. They can be applied in combination with the absorbent landscape BMP to achieve the target volume and water quality controls for future single-family developments in North East Albion.

Infiltration chambers are typically located below the ground surface and consist of either prefabricated storage cells or drain rock wrapped in geotextile, with a perforated underdrain pipe connected to the municipal stormwater system.



Infiltration Chambers

BIO-RETENTION

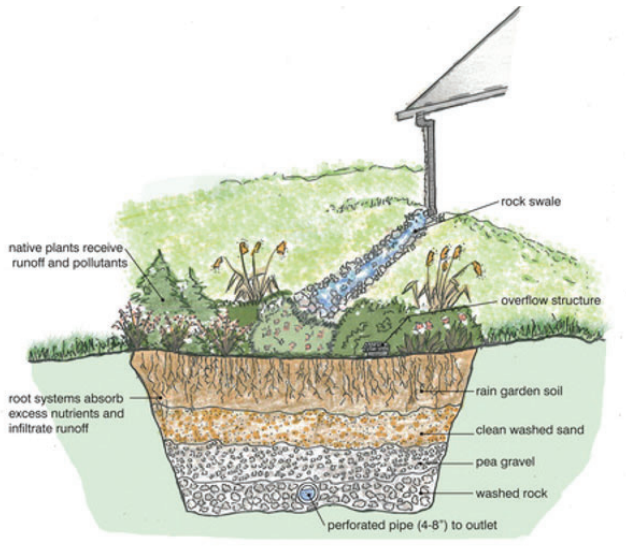
Bio-retention BMPs, such as rain gardens and infiltration swale systems, combine aspects of a green medium layer for water quality control and an infiltration trench/reservoir for runoff to store and/or infiltrate to achieve volume control. Bio-retention cells would require more maintenance than infiltration chambers and they are typically more applicable to high density residential, industrial, commercial and institutional land use development. For the North East Albion Concept Plan, it is proposed that bio-retention BMPs are to be applied for the proposed townhouse sites and institutional lands in combination with the absorbent landscape BMP measure.

Bio-retention facilities are typically designed with a minimum 450mm thick growing medium layer with amended topsoil overlaid on a rock reservoir layer. Drain rock fills the rock reservoir layer with a perforated pipe installed near the top of the rock reservoir and connected to the municipal stormwater system.

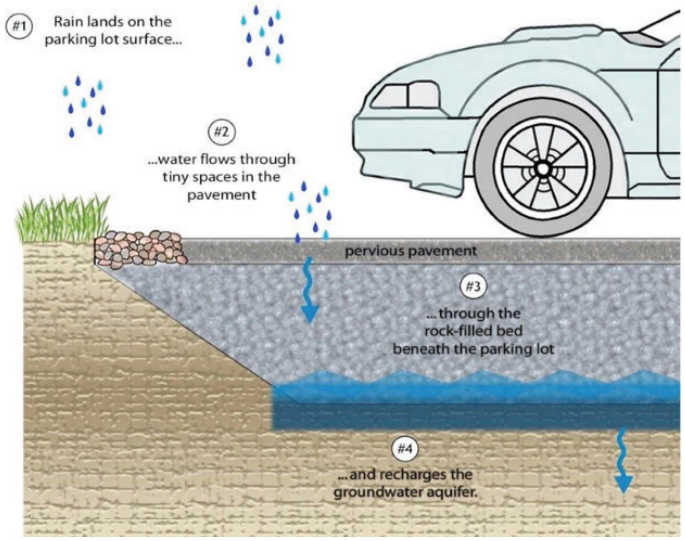
PERVIOUS PAVING

Pervious paving is a surface layer of paving systems which allow rainfall to percolate into an underlying reservoir base, where rainfall is stored and either infiltrated to underlying subgrade or discharged via a sub-drain. The surface component of pervious paving can be porous asphalt or porous concrete, concrete or plastic grid pavers, or permeable unit pavers.

Pervious paving does not have a soil layer that treats runoff and is subject to clogging from surface pollutants. It should not be used to infiltrate runoff from city roads. They may be used for driveways, walkways, patio areas, or visitor parking areas for various land use developments in North East Albion. In addition, grades are to be considered when evaluating locations to implement pervious pavings.



Bio-Retention



Pervious Paving

BIO-SWALE AND INFILTRATION TRENCH

Source control BMPs with a combined bio-swale and infiltration trench system is proposed for the roads in the North East Albion Concept Plan. Bio-swales provide water quality improvement of captured road runoff prior to discharge to infiltration trenches for infiltration and temporary storage to achieve rainfall volume control. Infiltration trenches are similar to infiltration chambers and have similar design requirements.

Amended topsoil shall also be used in the pervious areas in road rights-of-way and the surface of bio-swales. The minimum amended topsoil depth is 300mm in grassed areas and 450mm in planted areas.

Retention storage volumes for the source volume control BMPs are calculated based on the following mass balance equation:

Total 24-hour Rainfall = 24-hour Infiltration to native soil in pervious area + Water Storage in topsoil and rock reservoir

Several basic assumptions have been made to the calculation, as follows:

- Native Ground Infiltration Rate:
  Sandy Loam: 25mm/hr
  Loam: 13mm/hr
  Silt Loam: 6.6mm/hr
- 50% effective pervious area, accounting for possible pervious area coverage to be reduced after development or during redevelopment;
- 300mm minimum depth of amended topsoil on pervious areas;
- 450mm standard soil depth in bio-retention facilities;
- 30mm water storage in amended soil layer (based on the typical 20% of the topsoil thickness as the water storage volume with 50% reduction accounting for topsoil loss over time);
- 100% impervious area will be routed via effective pervious area for all land use types except road right-of-way;
- Impervious areas in the road right-of-way will be drained to bio-swales then to infiltration trenches, assuming no retention storage in the amended topsoil.
- Assume 5% of the total development land area will be designated for source volume retention storage use for all land use types, except road rights-of-way;
- Infiltration trenches will be installed within all road rights-of-way and cover minimum 10% of the total ROW area with minimum 200mm depth; and
- Detention storage area will be filled with drain rocks with 35% porosity.

Table 6 below provides the estimated BMP retention storage requirements (in addition to the onsite infi ltration and retention storage provided in the amended topsoil) based on the mass balance calculation.

Please refer to Section 7, **Drawing 18-1022A-403** for the soil map showing areas with different soil types in North East Albion.

In addition to the above recommended BMPs, other types of source volume and water quality control BMPs, such as rainwater harvesting facilities, soak-away pits, green-roofs, tree clusters, and/or other special bio-retention facilities can also be considered in the design to achieve the stormwater retention and quality control targets, subject to approval by the City of Maple Ridge Engineering Department.

Bio-Swale and Infiltration Trench

Structural water quality treatment devices, such as oil/grit separators and stormceptors, may also be considered in the design to treat urban runoff from areas with high pollutant loadings, prior to discharge into infiltration facilities or storm sewers. These devices are used in urban environments where space is limited. They therefore may be retrofitted into the storm systems. They are to be specified to target treatment for oils and hydrocarbons, and sand and sediment trapping.

Table 5 – Recommended Source Volume Control BMPs

Land Use Type	Applicable BMP Types				
	Absorbent Landscape	Infiltration Chamber	Bio-retention	Pervious Paving	Bioswale + Infiltration Trench
Single Family Residential	X	X		X	
Multiplex	X		X	X	
Townhouse	X		X	X	
Institutional	X		X	X	
Road ROW					X

Table 6 – Onsite Source Volume Control BMP Storage Requirements

Land Use Type	% Imp	Required Rock Reservoir Storage Depth, mm			Rock Reservoir Area
		Sandy Loam	Loam	Silt Loam	
Single Family	55%	-	-	641	5% of the Total Development Area
Multiplex	60%	-	-	910	
Townhouse	65%	-	-	1,179	
Institutional	80%	-	1,109	1,987	
Road ROW	78%	200	456	1,045	10% of Road ROW Area

Note: For land use types with soil types showing no storage depth requirement, the onsite infiltration and retention in the amended topsoil would adequately provide the 6-month 24-hour rainfall capture.

Detention Requirements

In addition to the BMP storages provided for 90% rainfall volume capture, additional detention may also be required to control runoff rates under the post-development condition to that of the pre-development forested condition for design storm events up to and including the 10-year return period events.This is to aim to provide erosion protection to the tributary and main channels of Kanaka Creek. To estimate the detention requirements, a unit development site of 1ha was modelled to estimate the flow hydrographs for the three soil types under pre-development forested land use and various post-development land use conditions. Onsite source volume control BMPs determined in Section 10.5 were modelled to estimate the additional detention requirements under various soil type and land use conditions. **Table 7** presents a summary of the unit detention volume required for each soil and post-development land use type according to the modelling results. Discharge rates of the detention facilities should be controlled to the pre-development forested condition rates, relative to the underlying soil stratigraphy, as shown in **Table 7**.

Detention and controlled discharge required for each development site shall be estimated based on pro-rating storage and discharge rates required for areas with multiple land uses and/or soil types according to **Table 7**. Please refer to Section 7, **Drawing 18-1022A-403** for the soil map showing areas with different soil types in North East Albion.

Based on the topography of North East Albion, limited sites would be available for community detention facilities. The required detention volumes are therefore to be provided at individual development sites and subdivisions, roadways and/or at locations suitable for community stormwater management features. Detention storage can be provided with the following measures:

- Adding extra storage and flow controls to the onsite BMPs;
- Oversized pipes;
- Underground tanks; or
- Wet or dry open detention facilities.

Open water detention volumes integrated into the source volume and water quality control devices would be preferred in the design, instead of oversized pipes and underground tanks.

Table 7 – Summary of Detention Requirements

Soil Type	Forested Condition Peak Unit Discharge	Proposed Post-Development Land Use Type	Additional Detention, m^3/ha
Sandy Loam	$Q_{2\text{-year}}$ = 3.7 L/s/ha $Q_{5\text{-year}}$ = 5.0 L/s/ha $Q_{10\text{-year}}$ = 5.9 L/s/ha	Single Family (55% Imp)	0
		Multiplex (60% Imp)	0
		Townhouse (65% Imp)	13.3
		Institutional (80% Imp)	196.0
		Road ROW (78% Imp)	167.4
Loam	$Q_{2\text{-year}}$ = 3.7 L/s/ha $Q_{5\text{-year}}$ = 5.0 L/s/ha $Q_{10\text{-year}}$ = 5.9 L/s/ha	Single Family (55% Imp)	18.3
		Multiplex (60% Imp)	65.7
		Townhouse (65% Imp)	119.6
		Institutional (80% Imp)	271.1
		Road ROW (78% Imp)	267.5
Silt Loam	$Q_{2\text{-year}}$ = 3.7 L/s/ha $Q_{5\text{-year}}$ = 9.0 L/s/ha $Q_{10\text{-year}}$ = 16.3 L/s/ha	Single Family (55% Imp)	41.3
		Multiplex (60% Imp)	64.5
		Townhouse (65% Imp)	58.6
		Institutional (80% Imp)	35.3
		Road ROW (78% Imp)	42.5

Community Stormwater Management Features

In addition to the proposed stormwater onsite source control BMP and detention measures described above, community stormwater management features may be implemented in select areas as shown on Section 7, **Drawing 18-1022A-404**. These community stormwater features have been proposed adjacent to park trails and underutilized open spaces primarily to maximize water quality control opportunities from the trails prior to discharging into the downstream watercourses. These features may also create local detention opportunities for its adjacent properties.

The proposed offsite community stormwater features utilize a series of interconnected bio-retention cells, wetted habitat channels, and ponds/wetlands which convey surface water runoff collected from the adjacent lots towards the downstream watercourses.

In addition to the areas identifi ed above, these community stormwater management features may also be applied to areas near stream setback boundaries or other conservation area boundaries onsite or offsite.

Groundwater Protection

Groundwater is recognized as a valuable resource in North East Albion. Groundwater protection is key for stormwater management in the area. Such groundwater protection measures may include, but are not limited to:

- Promoting rainwater infiltration to recharge to groundwater. Implementing source volume control BMP measures as described in Section 10.5 would ensure capture of the 6-month 24-hour rainfall; equivalent to 90% of the annual rainfall in ground for groundwater recharge.

- Groundwater flows could be interrupted and/or redirected due to land development and road constructions. In order to ensure groundwater conservation, a groundwater impact assessment should be conducted by a qualified Hydrogeologist for each future application in North East Albion. The groundwater investigation should be focused on groundwater characterization regarding aquifer presence at a site (e.g. groundwater-bearing soil formation, depth, flow direction) and impact mitigation measures (e.g. intercept and redirect to nearby streams, supplement with stormwater infiltration) to protect stream base flows and local use as a drinking water resource.

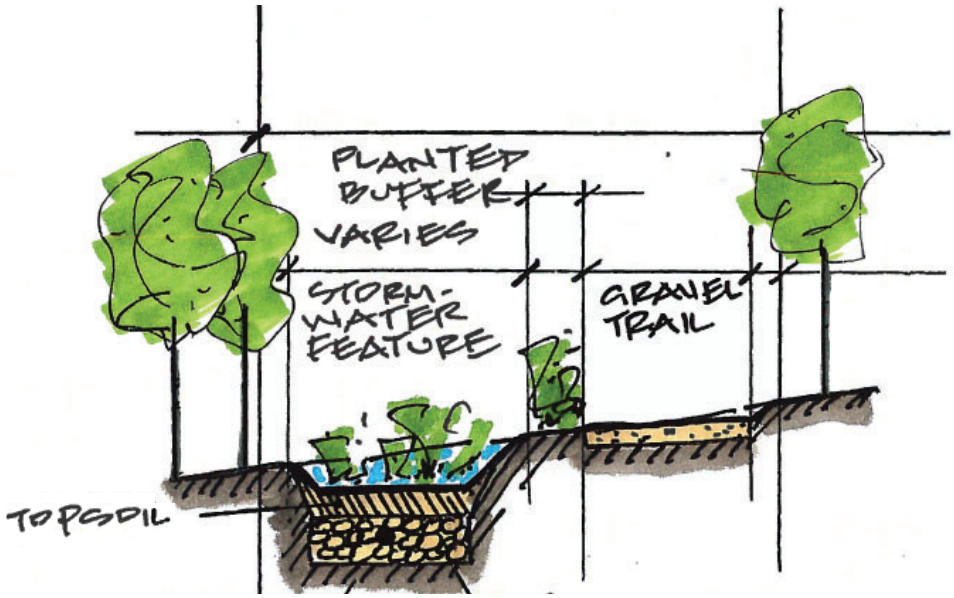


Figure 3 - Trail and Stormwater Feature Typical Section

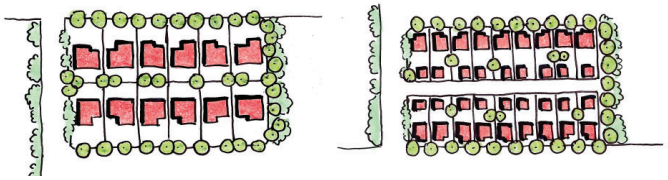
5.6 STORMWATER MANAGEMENT DESIGN GUIDELINES

Stormwater management designs for development applications in the North East Albion area are recommended to follow source control design guidelines developed for various land uses.

These design guidelines were prepared based on stormwater management concepts developed in Section 10.5

Single Family

Maximum allowed imperviousness: 55%

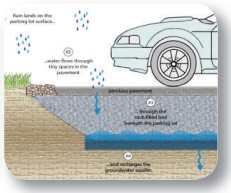


Stormwater Management

- Flood Protection
- Climate Change
- Rate Control
  - Volume/Water Quality Control
    - Absorbent Landscape
    - Rock pit
    - Pervious Paving
  - Detention Pond
  - Storage Pipe
  - Underground Tank
- Groundwater Protection

Absorbent Landscape

Rock Pit

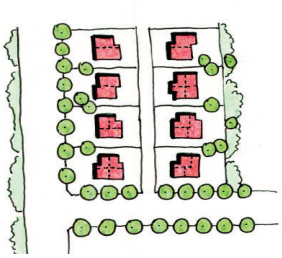


Pervious Paving

Criteria	Recommendations
Water Quality/ Volume Control (6 month 24 hour rainfall Capture)	• Minimum 300mm amended topsoil in grassed and 450mm in planted areas • Disconnected roof leaders to pervious area • Pervious paving for driveways, walkways and patio areas • Rock pit installation in silt loam soils, but not required in sandy loam and loam soils Rock pit area = 5% development area Rock reservoir storage depth = 641mm *Note: Required rock reservoir storage depth shall be verified based on the site specific geotechnical investigation for the subsurface soils and soil infiltration rates.*
Rate Control (Up to 10-year post-development flow to pre-development flow)	• Additional detention storage requirements Sandy Loam Soil Area: None Loam Soil Area: 18.3 m3/ha Silt Loam Soil Area: 41.3 m3/ha
Groundwater Protection	• Groundwater impact assessment be conducted by a Hydro-geotechnical professional to determine groundwater protection measures
Supplementary Stormwater Management Measures	• Maintenance (or retention) of high tree cover densities • Maintenance of riparian setback as per the environmental requirements if applicable. • Installation of daisy-chained stormwater management features (combination of bio-retention cells, wetted habitat channels and detention ponds/wetlands) if possible along the edge of the riparian setback boundaries • Other source control measures that can achieve water quality, volume and rate controls in combination with, or in replacement of replacing rock pits

Cluster Residential/Multiplex

Maximum allowed imperviousness: 60%



Stormwater Management

Flood Protection | Climate Change

Rate Control

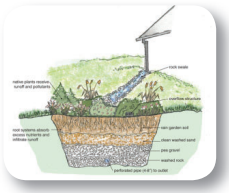
Volume/Water Quality Control

- Absorbent Landscape
- Bio-Retention
- Pervious Paving

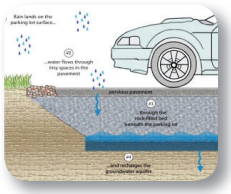
- Detention Pond
- Storage Pipe
- Underground Tank

Groundwater Protection

Absorbent Landscape



Bio-Retention

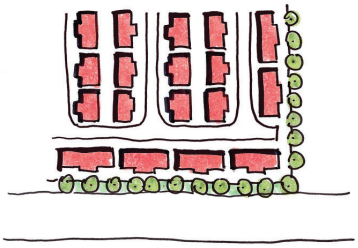


Pervious Paving

Criteria	Recommendations
Water Quality/ Volume Control (6 month 24 hour rainfall Capture)	• Minimum 300mm amended topsoil in grassed and 450mm in planted areas • Disconnected roof leaders to pervious area • Pervious paving for driveways, walkways, visitor parking areas • Bio-retention devices installation in silt loam soils, but not required in sandy loam and loam soils Bio-retention bottom area = 5% development area Rock reservoir storage depth = 910mm *Note: Required rock reservoir storage depth shall be verified based on the site specific geotechnical investigation for the subsurface soils and soil infiltration rates.*
Rate Control (Up to 10-year post-development flow to pre-development flow)	• Additional detention storage requirements Sandy Loam Soil Area: None Loam Soil Area: 65.7m3/ha Silt Loam Soil Area: 64.5m3/ha
Groundwater Protection	• Groundwater impact assessment be conducted by a Hydro-geotechnical professional to determine groundwater protection measures
Supplementary Stormwater Management Measures	• Maintenance (or retention) of high tree cover densities • Maintenance of riparian setback as per the environmental requirements if applicable • Installation of daisy-chained stormwater management features (combination of bio-retention cells, wetted habitat channels and detention ponds/wetlands) if possible along the edge of the riparian setback boundaries • Other source control measures that can achieve water quality, volume and rate controls in combination with, or in replacement of bio-retention devices

Townhouse

Maximum allowed imperviousness: 65%



Stormwater Management

Flood Protection | Climate Change

Rate Control

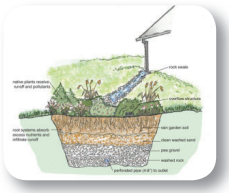
Volume/Water Quality Control

Absorbent Landscape | Bio-Retention | Pervious Paving

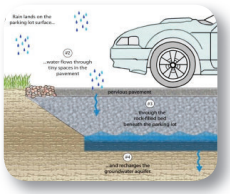
Detention Pond | Storage Pipe | Underground Tank

Groundwater Protection

Absorbent Landscape



Bio-Retention

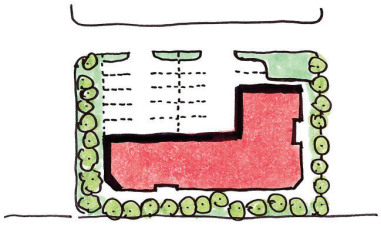


Pervious Paving

Criteria	Recommendations
Water Quality/ Volume Control (6 month 24 hour rainfall Capture)	• Minimum 300mm amended topsoil in grassed and 450mm in planted areas • Disconnected roof leaders to pervious area • Pervious paving for driveways, walkways and visitor parking areas • Bio-retention devices installation in silt loam soils, but not required in sandy loam and loam soils Bio-retention bottom area = 5% development area Rock reservoir storage depth = 1,179mm *Note: Required rock reservoir storage depth shall be verified based on the site specific geotechnical investigation for the subsurface soils and soil infiltration rates.*
Rate Control (Up to 10-year post-development flow to pre-development flow)	• Additional detention storage requirements Sandy Loam Soil Area: 13.3m3/ha Loam Soil Area: 119.6m3/ha Silt Loam Soil Area: 58.5m3/ha
Groundwater Protection	• Groundwater impact assessment be conducted by a Hydro-geotechnical professional to determine groundwater protection measures
Supplementary Stormwater Management Measures	• Maintenance (or retention) of high tree cover densities • Maintenance of riparian setback as per the environmental requirements if applicable • Installation of daisy-chained stormwater management features (combination of bio-retention cells, wetted habitat channels and detention ponds/wetlands) if possible along the edge of the riparian setback boundaries • Other source control measures that can achieve water quality, volume and rate controls in combination with, or in replacement of bio-retention devices

Institutional

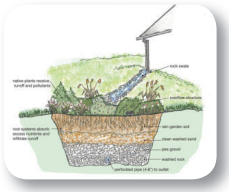
Maximum allowed imperviousness: 80%
(excluding fields)



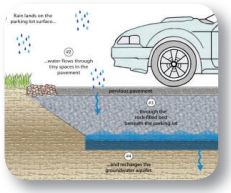
Stormwater Management

- Flood Protection
- Climate Change
- Rate Control
  - Volume/Water Quality Control
    - Absorbent Landscape
    - Bio-Retention
    - Pervious Paving
  - Detention Pond
  - Storage Pipe
  - Underground Tank
- Groundwater Protection

Absorbent Landscape



Bio-Retention

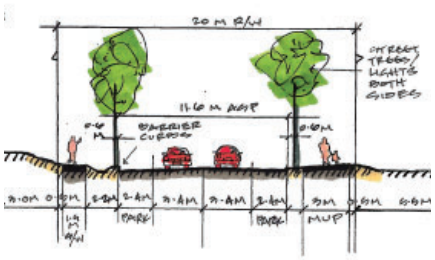


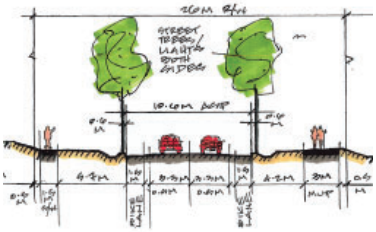
Pervious Paving

Criteria	Recommendations
Water Quality/ Volume Control (6 month 24 hour rainfall Capture)	• Minimum 300mm amended topsoil in grassed and 450mm in planted areas • Disconnected roof leaders to pervious area • Pervious paving for walkways and parking areas • Bio-retention devices installation in loam and silt loam soils, but not required in sandy loam soils Bio-retention bottom area = 5% development area Rock reservoir storage depth = 1,109mm (Loam)/1,987mm (Silt Loam) *Note: Required rock reservoir storage depth shall be verified based on the site specific geotechnical investigation for the subsurface soils and soil infiltration rates.*
Rate Control (Up to 10-year post-development flow to pre-development flow)	• Additional detention storage requirements Sandy Loam Soil Area: 196.0m3/ha Loam Soil Area: 271.1m3/ha Silt Loam Soil Area: 35.3m3/ha
Groundwater Protection	• Groundwater impact assessment be conducted by a Hydro-geotechnical professional to determine groundwater protection measures • Plan for the school sport field in the eastern portion of the school site and install perforated subsurface drainage system to allow for maximum ground infiltration and groundwater recharge in this area
Supplementary Stormwater Management Measures	• Maintenance (or retention) of high tree cover densities • Other source control measures that can achieve water quality, volume and rate controls in combination with, or in replacement of bio-retention devices

Road Right-of-Way

Maximum Design imperviousness: 78%





Stormwater Management

- Flood Protection
- Climate Change
- Rate Control
  - Volume/Water Quality Control
    - Absorbent Landscape
    - Bioswale + Infiltration Trench
  - Storage Pipe
  - Underground Tank
- Groundwater Protection

Absorbent Landscape

Bioswale + Infiltration Trench

Criteria	Recommendations
Water Quality/ Volume Control (6 month 24 hour rainfall Capture)	• Minimum 300mm amended topsoil in grassed and 450mm in planted areas • Bioswale in combination with infiltration trench system installation Infiltration trench bottom width = 10% road ROW width Rock reservoir storage depth = 200mm (Sandy Loam) = 456mm (Loam) = 1,045mm (Silt Loam) *Note: Required rock reservoir storage depth shall be verified based on the site specific geotechnical investigation for the subsurface soils and soil infiltration rates.*
Rate Control (Up to 10-year post-development flow to pre-development flow)	• Additional detention storage requirements Sandy Loam Sand Area: 167.4m3/ha Loam Sand Area: 267.5m3/ha Silt Loam Sand Area: 42.5m3/ha
Groundwater Protection	• Groundwater impact assessment be conducted by a Hydro-geotechnical professional to determine groundwater protection measures
Supplementary Stormwater Management Measures	• Tree planting in boulevard • Installation of trench dams at stream crossing locations • Other source control measures that can achieve water quality, volume and rate controls in combination with, or in replacement of the proposed source control devices

In addition to the source control design guidelines provided above, onsite and offsite storm sewer systems shall be designed to convey the peak 10-year flows and the major flow paths including major road crossings, designated overland flow paths and open channels shall be designed to convey the peak 100-year flows assuming no onsite source control measures with 2070 climate condition.

5.7 STORMWATER MANAGEMENT SYSTEM OPERATION, MAINTENANCE AND PERFORMANCE MONITORING

Operation and Maintenance

Stormwater management source controls rely on appropriate operation and maintenance for performance and longevity. The lifespan of source controls will vary with the type, design and maintenance provided. **Table 8** provides the operation and maintenance requirements for various BMP devices for use by landowners and subdivision strata management groups during and after construction and implementation of these stormwater management BMP features.

Table 8 – Stormwater BMP Operation and Maintenance Requirements

BMP Type	Required Operation and Maintenance Actions
Absorbent Landscape	**Construction Phase:** - Inspection to ensure required depths and areas are constructed - Ensure topsoil installation area is properly scarified and prepared **Operation Phase:** - Hydro-seeding in areas where topsoil is exposed and eroded (on-going) - Minimum water supply to absorbent landscape areas during dry season (on-going) - Seeding and soil maintenance (bi-annual)
Rock Pit	**Construction Phase:** - Ensure rock infiltration area is protected from sediment **Operation Phase:** - Ensure vehicles are not driven or parked on the trenches unless proper support with pavement constructed on the top of the rock pit area for vehicle access is provided (on-going) - Avoid excessive compaction from equipment, vehicles and mowers (on-going) - Remove trash, leaves and other debris collected on the surface (on-going) - Inspect cleanouts of perforated drains (quarterly) - Remove debris from surfaces (quarterly) - Catch basins and inlets to be inspected and cleaned (annually) - Check and repair damages (e.g. sink holes) (as needed) - Check for signs of failure such as standing water in the observation well for more than 48 hours after a rain event, insects and/or odour, and clean and reinstall filter fabric and rock reservoir, as needed - Redirect drainage if runoff is conveyed over and across the trench but not into the facility (as needed)

Bio-Retention (e.g. rain gardens)	**Construction Phase:** - Inspection to ensure required amended topsoil depths being constructed - Ensure topsoil installation area is properly scarified and prepared - Ensure rock infiltration area is protected from sediments **Operation Phase:** - Plan in place for watering until plantings established (first year) - Plant and soil maintenance and weed control (bi-annual) - Inspection of surface conditions for uneven settling, water ponding, or potholes to determine if any remedial work is needed (bi-annual)
Pervious Paving	**Construction Phase:** - Ensure rock infiltration area is protected from sediments **Operation Phase:** - Provide remedial work when ponding of water is visible on the surface 48 hours after a rain event (on-going) - Avoid loading or placement of landscaping materials such as mulch, sand or topsoil on pervious paving (on-going) - Surface sweeping with a commercial vacuum sweeping unit or pressure washing of clogged surface (bi-annual or when accumulated sediment is found in between pavers) - Inspection of surface conditions for uneven settling, water ponding, or potholes to determine if any remedial work is needed (bi-annual) - Restrict use of de-icing chemicals and sand on pervious paving areas (winter)
Bioswale and Infiltration Trench in Road Right-of-Way	**Construction Phase:** - Inspection to ensure required amended topsoil depths being constructed within bioswale areas - Ensure topsoil installation area is properly scarified and prepared - Ensure infiltration trench area is protected from sediments **Operation Phase:** - Inspect cleanouts of perforated drains (quarterly) - Remove debris from surface to maintain proper function (quarterly or as needed) - Avoid excessive compaction from equipment and mowers (on-going) - Ensure vehicles are not driven or parked on trenches unless proper support with pavement constructed on the top of the infiltration area for vehicle access (on-going) - Catch basins and inlets to be inspected and cleaned (annual) - Repair when there is visible damage to the trench, e.g. sink holes (as needed) - Redirect drainage if runoff is conveyed over and across the trench but not into the facility (as needed)

Stormwater Performance Monitoring Program

A performance monitoring program will assist the City in answering the following two questions:

- If the development is negatively impacting the ecological health of creeks; and
- If stormwater management activities are resulting in no-net-loss of the overall health of the creeks.

Aplin Martin recommends that the City of Maple Ridge consider implementing a Stormwater Performance Monitoring Program for the North East Albion Concept Plan area according to the Monitoring and Adaptive Management Framework for Stormwater (MAMF) developed by Metro Vancouver in 2014. The proposed monitoring program should follow the MAMF protocols and includes the following:

- Conduct continuous flow monitoring in the selected ravine watercourses, e.g. KA2, KA3 and KA6 west;
- Water quality grab sampling to measure dissolved oxygen, water temperature, turbidity, pH, conductivity, nitrate, e. coli, fecal coliform, total iron, total copper, total lead, total zinc and total cadmium, once every five years;
- Annual erosion monitoring for all tributary ravine areas; and
- Desktop monitoring of changes in total impervious area, effective impervious area (EIA) and riparian forest integrity (RFI) using aerial photos and GIS, every five years.

06 | BC HYDRO, TELECOMM, CABLE & GAS

The area is generally currently serviced with BC Hydro, Telus and Fortis BC natural gas services. The existing subdivisions to the south and east of North East Albion are currently serviced with underground BC Hydro and Telus distribution systems.

It is proposed to extend the existing underground systems as required to service each individual development application within North East Albion.

Three phase BC Hydro servicing appears to currently terminate at the intersection of 112 Avenue and Lockwood Street. It is anticipated that three phase BC Hydro servicing will need to be extended via overhead service along 112 Avenue to service sanitary pump station PS-1.

07 | LARGE FORMAT DRAWING

The drawings referenced above are provided in the following section.

Roadworks drawings include:
- Drawing 101 – Roadworks Master Plan

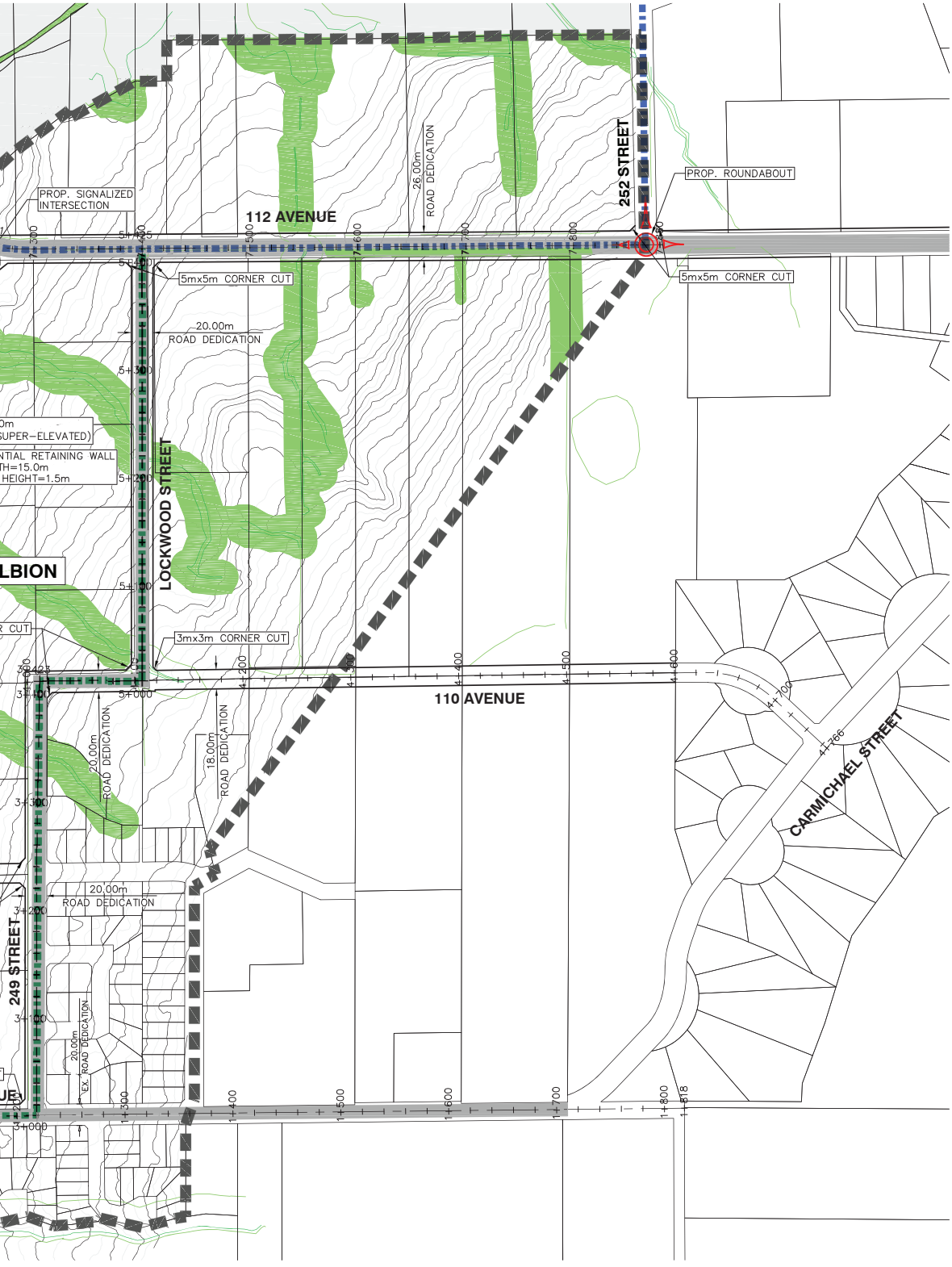
Sanitary drawings include:
- Drawing 201 – Sanitary Master Plan
- Drawing 202 – North East Albion Sanitary Catchment Plan
- Drawing 203 – North East Albion Sanitary Catchment Plan - Calculations

Water drawings include:
- Drawing 301 – Water Master Plan

Stormwater drawings include:
- Drawing 401 – Land Use and Stormwater Catchment Plan - Existing
- Drawing 402 – Land Use and Stormwater Catchment Plan - Post Development
- Drawing 403 – Soil Map
- Drawing 404 – Stormwater Master Plan
- Drawing 405 – 100 Year Flow Paths

Drawing 101 – Roadworks Master Plan

Noting that 248 Street at 112 Avenue intersection is approximately 30 to 35 meters east



& SERVICING PLAN

The location of existing underground utilities are shown in an approximate way only & have not been independently verified by the owner or its representative. The contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the contractor's failure to exactly locate and preserve any and all underground utilities.

TITLE: **ROADWORKS MASTER PLAN**

DESIGN: YK CHECK: DB
DRAWN: KAL APPR: DB

A & M FILE: **18-1022A**

PROJECT NO. .

SCALE : HORZ. 1:2500 VERT. N/A

DRAWING DATE: **FEBRUARY, 2019**

DRAWING NO. .

A & M DRAWING NO. **18-1022A - 101**

SHEET NO. **101**

REV.

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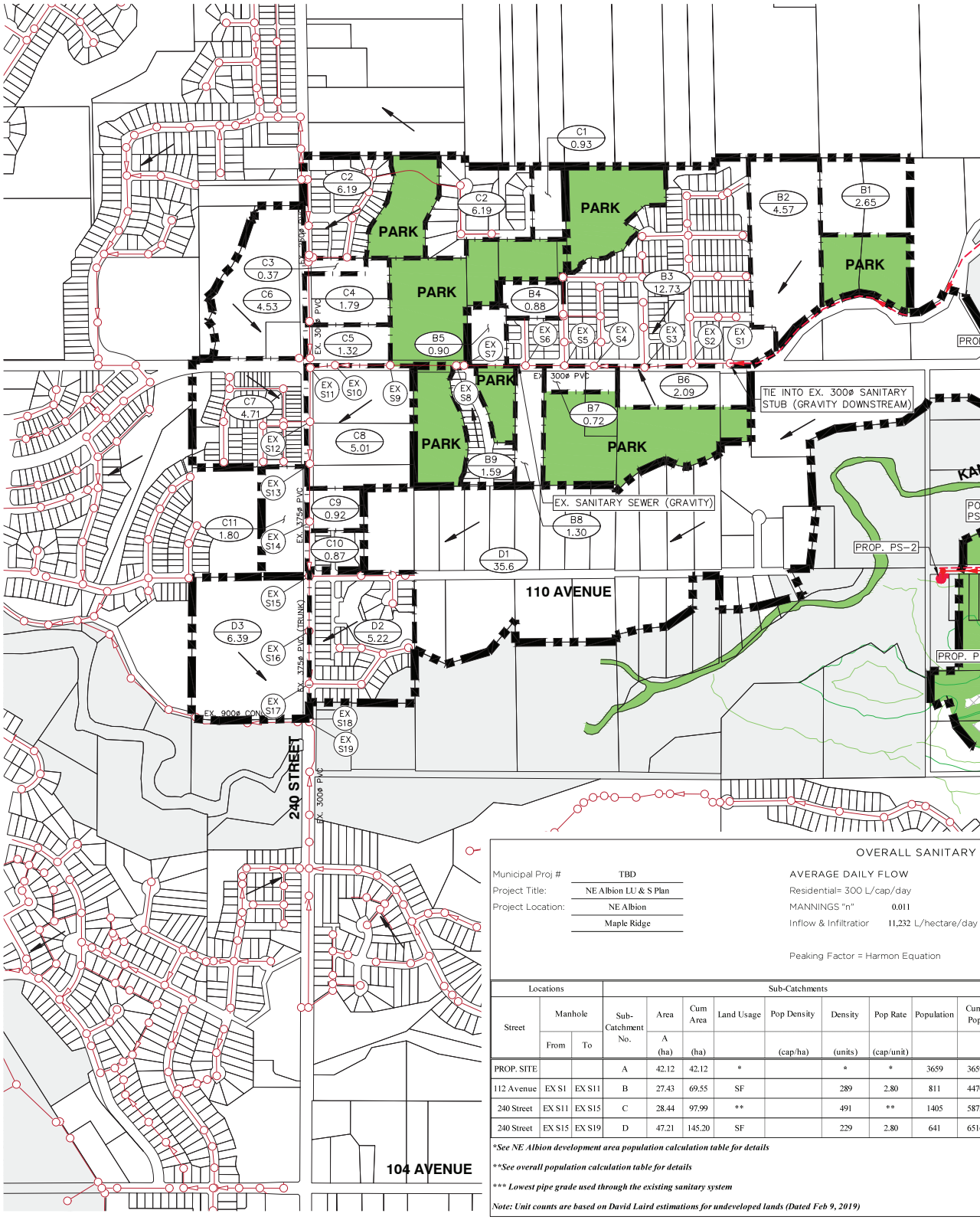
Sep 24 2019 - 10:26am M:\2018\18-1022A\DWG\PRELIMINARY MASTER PLANS\18-1022A-101 - Roadworks Master Plan.dwg/101 Preliminary Roadworks Master Plan YKim



OVERALL SANITARY

Municipal Proj #	TBD
Project Title:	NE Albion LU & S Plan
Project Location:	NE Albion
	Maple Ridge

AVERAGE DAILY FLOW
Residential= 300 L/cap/day
MANNINGS "n" 0.011
Inflow & Infiltration 11,232 L/hectare/day

Peaking Factor = Harmon Equation

Locations			Sub-Catchments								
Street	Manhole From	Manhole To	Sub-Catchment No.	Area A (ha)	Cum Area (ha)	Land Usage	Pop Density (cap/ha)	Density (units)	Pop Rate (cap/unit)	Population	Cum Pop
PROP. SITE			A	42.12	42.12	*		*	*	3659	365
112 Avenue	EX S1	EX S11	B	27.43	69.55	SF		289	2.80	811	447
240 Street	EX S11	EX S15	C	28.44	97.99	**		491	**	1405	587
240 Street	EX S15	EX S19	D	47.21	145.20	SF		229	2.80	641	651

**See NE Albion development area population calculation table for details*

***See overall population calculation table for details*

**** Lowest pipe grade used through the existing sanitary system*

Note: Unit counts are based on David Laird estimations for undeveloped lands (Dated Feb 9, 2019)

LEGAL DESCRIPTION: .

B.M. MONUMENT NO. . ELEVATION: .
LOCATED AT . STREET & . AVENUE

REV. NO.	DESCRIPTION	DR	CH	DATE	APP

APLIN MARTIN
ENGINEERING ARCHITECTURE PLANNING SURVEYING

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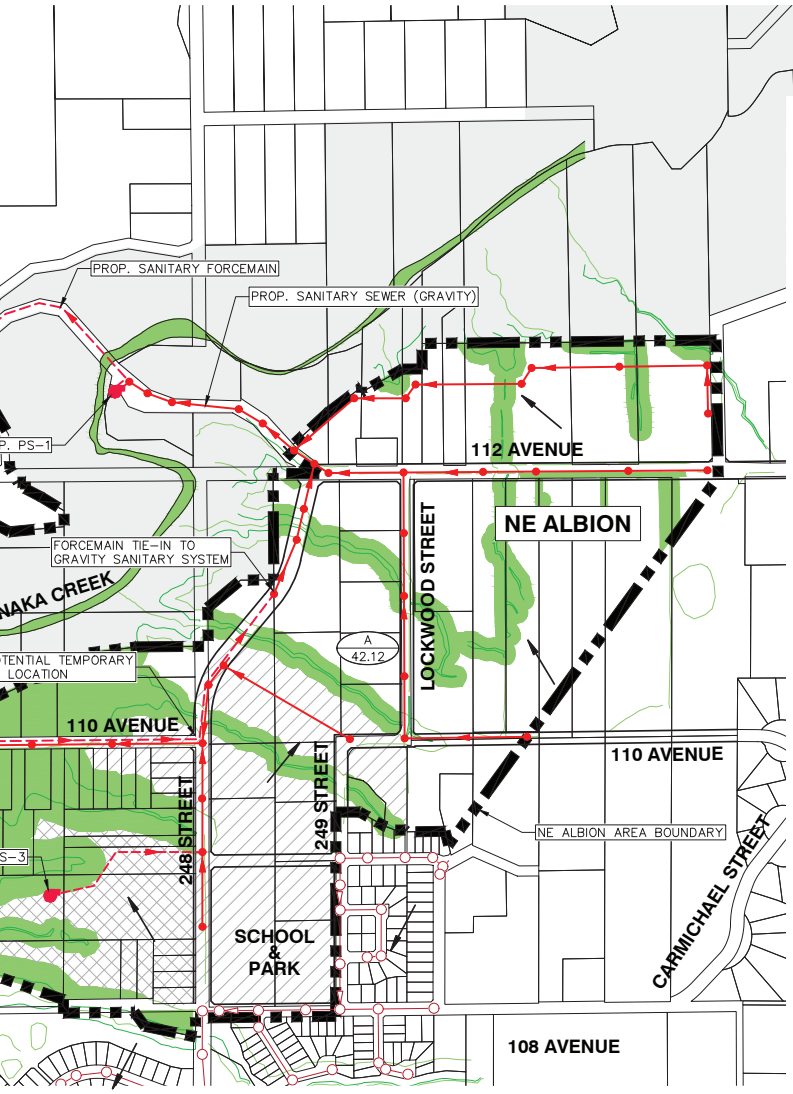
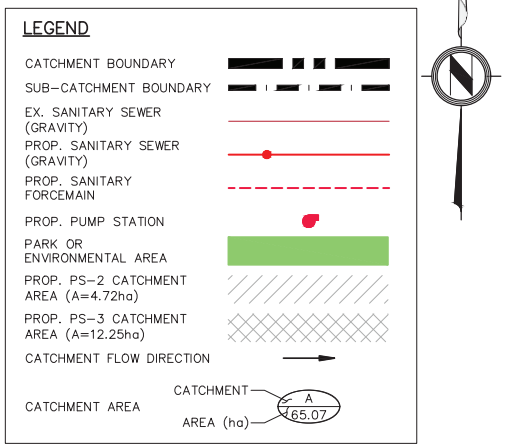
PROJECT:

NE ALBION LAND USE &

MAPLE RIDGE, B.C.

Drawing 201 – Sanitary Master Plan





OVERALL POPULATION CALCULATION TABLE

Area	Land Usage	Unit Count	Area (ha)	Pop Rate	Population
A	*	*	42.12	*	3659 *
B1	Fut. Single Family	15	2.65	2.8 (Cap/unit)	42
B2	Fut. Single Family	31	4.57	2.8 (Cap/unit)	87
B3	Ex. Single Family	172	12.73	2.8 (Cap/unit)	482
B4	Fut. Single Family	16	0.88	2.8 (Cap/unit)	45
B5	Fut. Single Family	2	0.90	2.8 (Cap/unit)	6
B6	Fut. Single Family	16	2.09	2.8 (Cap/unit)	45
B7	Fut. Single Family	2	0.72	2.8 (Cap/unit)	6
B8	Fut. Single Family	10	1.30	2.8 (Cap/unit)	28
B9	Ex. Single Family	25	1.59	2.8 (Cap/unit)	70
C1	Fut. Single Family	4	0.93	2.8 (Cap/unit)	12
C2	Ex. Single Family	58	6.19	2.8 (Cap/unit)	163
C3	Fut. Single Family	3	0.37	2.8 (Cap/unit)	9
C4	Fut. Single Family	5	1.79	2.8 (Cap/unit)	14
C5	Fut. Single Family	20	1.32	2.8 (Cap/unit)	56
C6	Ex. Townhouse (RM-1)	167	3.98	2.8 (Cap/unit)	468
	Fut. Commercial		0.55	50 (Cap/ha)	28 (2)
C7	Ex. Single Family	70	4.71	2.8 (Cap/unit)	196
C8	Fut. Townhouse (RM-1)	130	5.01	2.8 (Cap/unit)	364
C9	Fut. Single Family	5	0.92	2.8 (Cap/unit)	14
C10	Fut. Single Family	9	0.87	2.8 (Cap/unit)	25
C11	Fut. Single Family	20	1.80	2.8 (Cap/unit)	56
D1	Fut. Single Family	129	35.60	2.8 (Cap/unit)	361
D2	Ex. Single Family	50	5.22	2.8 (Cap/unit)	140
D3	Fut. Single Family	50	6.39	2.8 (Cap/unit)	140

(1) See NE Albion development area population calculation table for details
(2) Population density of 50 (cap/ha) used to determine future commercial population

SYSTEM DESIGN - CALCULATION SHEET

PIPE CAPACITY DESIGN CRITERIA
70% for Ex. Local (<40 L/s PWWF) Sewers (q/Q)
83.5% for Ex. Trunk (>40 L/s PWWF) Sewers (q/Q)
75% for New Sewers (d/D)

Consultant: APLIN MARTIN

APLIN MARTIN
ENGINEERING ARCHITECTURE PLANNING SURVEYING

A&M Proj #: 18-1022A
Page: 1 of 1
Designed by: YK
Checked by: DB / DDH
Date: August-07-19

		Flow Calculations					Pipe Parameters					Results			
	Usage Level	Avg Flow	Peaking Factor	Peak Flow	Inflow & Infiltration	PWWF (Design Flow)	Sewer Design					Flow Ratio	Partial Velocity	Velocity Check	Depth of Flow
	L/cap/day	ADWF (L/s)	Pf	PDWF (L/s)	I&I (L/s)	Q (L/s)	S %	DIA mm	L m	Vcap m/s	Qcap (L/s)	Q/Qcap %	Vact (m/s)	Vact ≥ 0.75 (m/s)	d/D %
9	300	12.70	2.74	34.78	5.48	40.25									
0	300	15.52	2.68	41.56	9.04	50.60	0.59***	300	820.00	1.24	87.78	57.6%	1.29	OK	54%
5	300	20.40	2.60	53.01	12.74	65.75	1.10***	375	410.00	1.97	217.32	30.3%	1.72	OK	38%
5	300	22.63	2.57	58.12	18.88	77.00	0.50***	375	280.00	1.33	146.52	52.6%	1.34	OK	51%

& SERVICING PLAN

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TITLE: **SANITARY MASTER PLAN**

DESIGN: YK CHECK: DB
DRAWN: KAL APPR: DB

A & M FILE: **18-1022A**

PROJECT NO. -

SCALE : HORZ. 1:5000 VERT. N/A

DRAWING DATE: **FEBRUARY, 2019**

DRAWING NO. -

A & M DRAWING NO. **18-1022A - 201**

SHEET NO. **201** REV.

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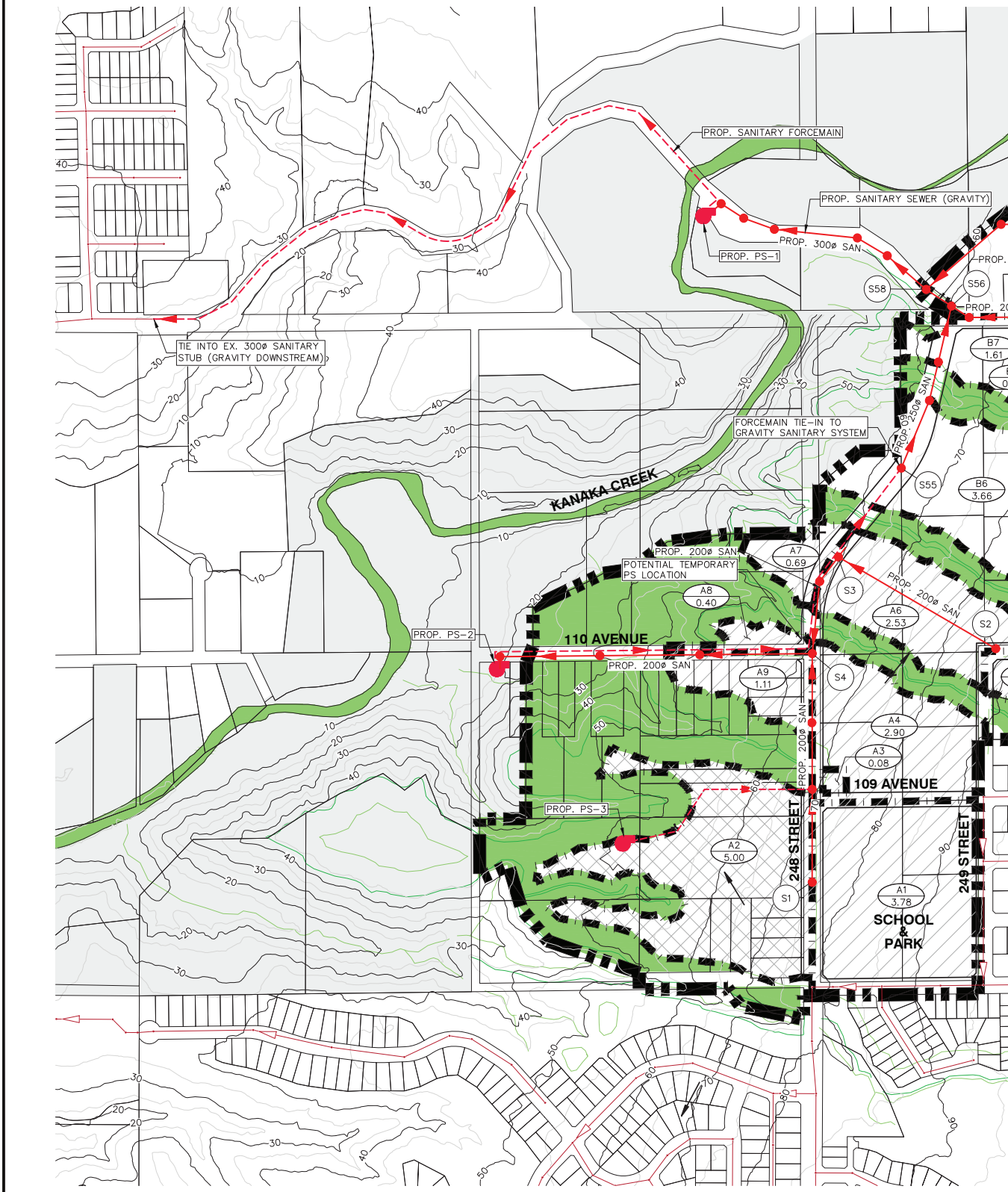

LEGAL DESCRIPTION: .

B.M. MONUMENT NO. . ELEVATION: .
LOCATED AT . STREET & . AVENUE

REV. NO.	DESCRIPTION	DR	CH	DATE	APP

APLIN MARTIN
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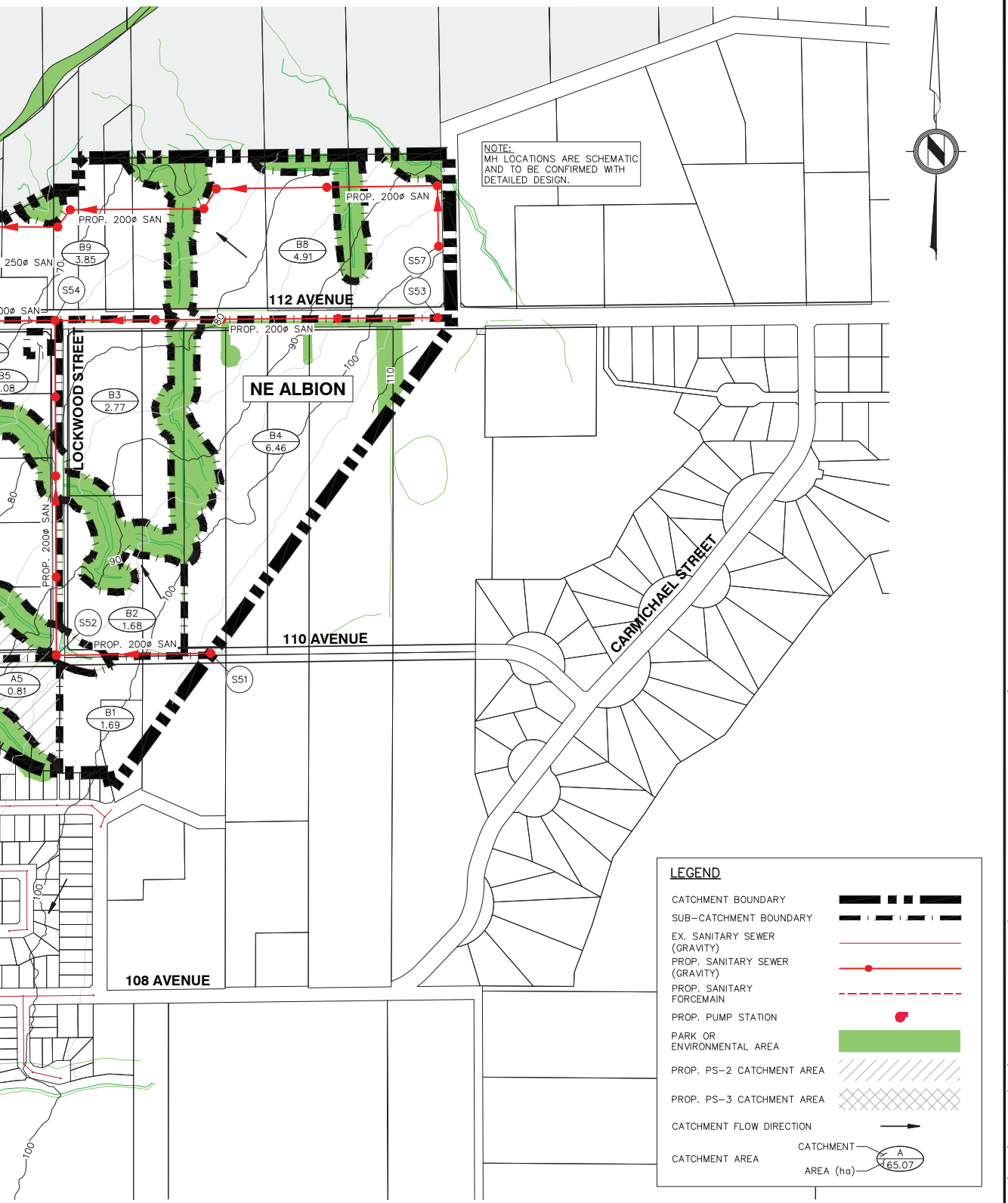
PROJECT:

NE ALBION LAND USE &

MAPLE RIDGE, B.C.

Drawing 202 – North East Albion Sanitary Catchment Plan



& SERVICING PLAN

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TITLE: **NE ALBION SANITARY CATCHMENT PLAN**

DESIGN: YK CHECK: DB
DRAWN: KAL APPR: DB

A & M FILE: **18-1022A**

PROJECT NO. .

SCALE : HORZ. 1:3000 VERT. N/A

DRAWING DATE: **FEBRUARY, 2019**

DRAWING NO. .

A & M DRAWING NO. **18-1022A - 202**

SHEET NO. **202**

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NE ALBION SANITARY SYSTEM DESIGN - CALCULATION SHEET

Municipal Proj # TBD
Project Title: NE Albion LU & S Plan
Project Location: NE Albion
Maple Ridge

AVERAGE DAILY FLOW
Residential= 300 L/cap/day
MANNINGS "n" 0.011
Inflow & Infiltratior 11,232 L/hectare/day

PIPE CAPACITY DESIGN CRITERIA
70% for Ex. Local (<40 L/s PWWF) Sewers (q/Q)
83.5% for Ex. Trunk (>40 L/s PWWF) Sewers (q/Q)
75% for New Sewers (d/D)

Consultant: A

Peaking Factor = Harmon Equation

Locations			Sub-Catchments									Flow Calculations					Pipe Parar		
Street	Manhole		Sub-Catchment No.	Area	Cum Area	Land Usage	Pop Density	Density	Pop Rate	Population	Cum. Pop	Usage Level	Avg Flow	Peaking Factor	Peak Flow	Inflow & Infiltration	PWWF (Design Flow)	Sewer De		
	From	To		A (ha)	(ha)		(cap/ha)	(units)	(cap/unit)			L/cap/ day	ADWF (L/s)	Pr	PDWF (L/s)	I&I (L/s)	Q (L/s)	S %	DIA mm	L m
248 Street	S1	S4	A1, A2, A3 & A4	9.87	9.87	*		183	*	685	685	300	2.38	3.29	7.83	1.28	9.11	4.50	200	458.0
	S2	S3	A5 & A6	3.34	3.34	SF/TH		95	*	265	265	300	0.92	3.65	3.36	0.43	3.80	12.00	200	370.0
248 Street	S3	S4	A7	0.69	4.03	Townhouse		35	2.80	97	362	300	1.26	3.53	4.44	0.52	4.96	2.80	200	210.0
110 Avenue	S4	PS-2	A8 & A9	1.51	15.41	SF/TH		70	*	118	1165	300	4.05	3.10	12.56	2.00	14.56	8.00	200	630.0
110 Avenue	S51	S52	B1	1.69	1.69	SF		34	2.80	95	95	300	0.33	4.09	1.35	0.22	1.57	7.00	200	310.0
Lockwood	S52	S54	B2 & B3	4.45	6.14	SF/TH		172	*	482	577	300	2.00	3.35	6.72	0.80	7.52	4.00	200	660.0
112 Avenue	S53	S54	B4	6.46	6.46	SF		129	2.80	362	362	300	1.26	3.53	4.44	0.84	5.28	2.00	200	760.0
112 Avenue	S54	S56	B5	0.08	12.68	Commercial				4	943	300	3.27	3.18	10.40	1.65	12.05	8.50	200	230.0
248 Street	S55	S56	A, B6 & B7	5.27	20.68	*		264	2.50	737	1902	300	6.60	2.94	19.43	2.69	22.12	0.50	250	340.0
112 Avenue	S56	S58			33.36						2845	300	9.88	2.81	27.80	4.34	32.14	9.40	250	65.0
	S57	S58	B8 & B9	8.76	8.76	SF/TH		291	*	814	814	300	2.83	3.23	9.13	1.14	10.27	1.00	200	1100.0
112 Avenue	S58	PS-1			42.12				*		3659	300	12.70	2.74	34.78	5.48	40.25	1.00	300	470.0

** See NE Albion population calculation table for details*

LEGAL DESCRIPTION: .
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B.M. MONUMENT NO. . ELEVATION: .
LOCATED AT . STREET & . AVENUE

REV. NO.	DESCRIPTION	DR	CH	DATE	APP

APLIN MARTIN
ENGINEERING ARCHITECTURE PLANNING SURVEYING

Aplin & Martin Consultants Ltd.
201 - 12448 82 Avenue, Surrey, B.C. Canada V3W 3E9
Tel: (604) 597-9058, Fax: (604) 597-9061, Email: general@aplinmartin.com

PROJECT:
NE ALBION LAND USE &
MAPLE RIDGE, B.C.

Drawing 203 – North East Albion Sanitary Catchment Plan - Calculations

A&M Proj # 18-1022A

APLIN MARTIN Page: 1 of 1

N MARTIN Designed by: YK

CHITECTURE PLANNING SURVEYING Checked by: DB / DDH

Date: August-07-19

meters			Results			
esign			Flow Ratio	Partial Velocity	Velocity Check	Depth of Flow
	V_{cap} m/s	Q_{cap} (L/s)	Q/Q_{cap} %	V_{act} (m/s)	$V_{act} \geq$ 0.75 (m/s)	d/D %
0	2.62	82.23	11.1%	1.72	OK	22%
0	4.27	134.28	2.8%	1.88	OK	12%
0	2.06	64.86	7.6%	1.22	OK	19%
0	3.49	109.64	13.3%	2.42	OK	25%
0	3.26	102.55	1.5%	1.19	OK	9%
0	2.47	77.52	9.7%	1.56	OK	21%
0	1.74	54.82	9.6%	1.10	OK	21%
0	3.60	113.01	10.7%	2.34	OK	22%
0	1.01	49.70	44.5%	0.98	OK	47%
0	4.39	215.47	14.9%	3.15	OK	26%
00	1.23	38.76	26.5%	1.04	OK	35%
0	1.62	114.28	35.2%	1.48	OK	41%

NE ALBION POPULATION CALCULATION TABLE

Area	Land Usage	unit/ha	Area (ha)	Units	Pop Rate	Population
A1	Institutional		1.89		90 (Cap/ha)	170 (1)
A2	Single Family	20	5.00	100	2.8 (Cap/unit)	280
A3	Commercial		0.08		50 (Cap/ha)	4 (2)
A4	Duplex	28.5	2.90	83	2.8 (Cap/unit)	231
A5	Single Family	20	0.81	16	2.8 (Cap/unit)	45
A6	Cluster TH	31	2.53	78	2.8 (Cap/unit)	220
A7	Townhouse	50	0.69	35	2.8 (Cap/unit)	97
A8	Townhouse	50	0.40	20	2.8 (Cap/unit)	56
A9	Single Family	20	1.11	22	2.8 (Cap/unit)	62
B1	Single Family	20	1.69	34	2.8 (Cap/unit)	95
B2	Single Family	20	1.68	34	2.8 (Cap/unit)	94
B3	Townhouse	50	2.77	139	2.8 (Cap/unit)	388
B4	Single Family	20	6.46	129	2.8 (Cap/unit)	362
B5	Commercial		0.08		50 (Cap/ha)	4 (2)
B6	Townhouse	50	3.66	183	2.8 (Cap/unit)	512
B7	Townhouse	50	1.61	81	2.8 (Cap/unit)	225
B8	Single Family	20	4.91	98	2.8 (Cap/unit)	275
B9	Townhouse	50	3.85	193	2.8 (Cap/unit)	539

(1) Population density of 90 (cap/ha) used to determine institutional population

(2) Population density of 50 (cap/ha) used to determine future commercial population

& SERVICING PLAN

The location of existing underground utilities are shown in an approximate way only & have not been independently verified by the owner or its representative. The contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the contractor's failure to exactly locate and preserve any and all underground utilities.

TITLE: **NE ALBION SANITARY CATCHMENT PLAN - CALCULATIONS**

DESIGN: YK CHECK: DB
DRAWN: KAL APPR: DB

A & M FILE: **18-1022A**

PROJECT NO. -

SCALE : HORZ. N/A VERT. N/A

DRAWING DATE: **FEBRUARY, 2019**

DRAWING NO. -

A & M DRAWING NO. **18-1022A - 203**

SHEET NO. **203**

REV.

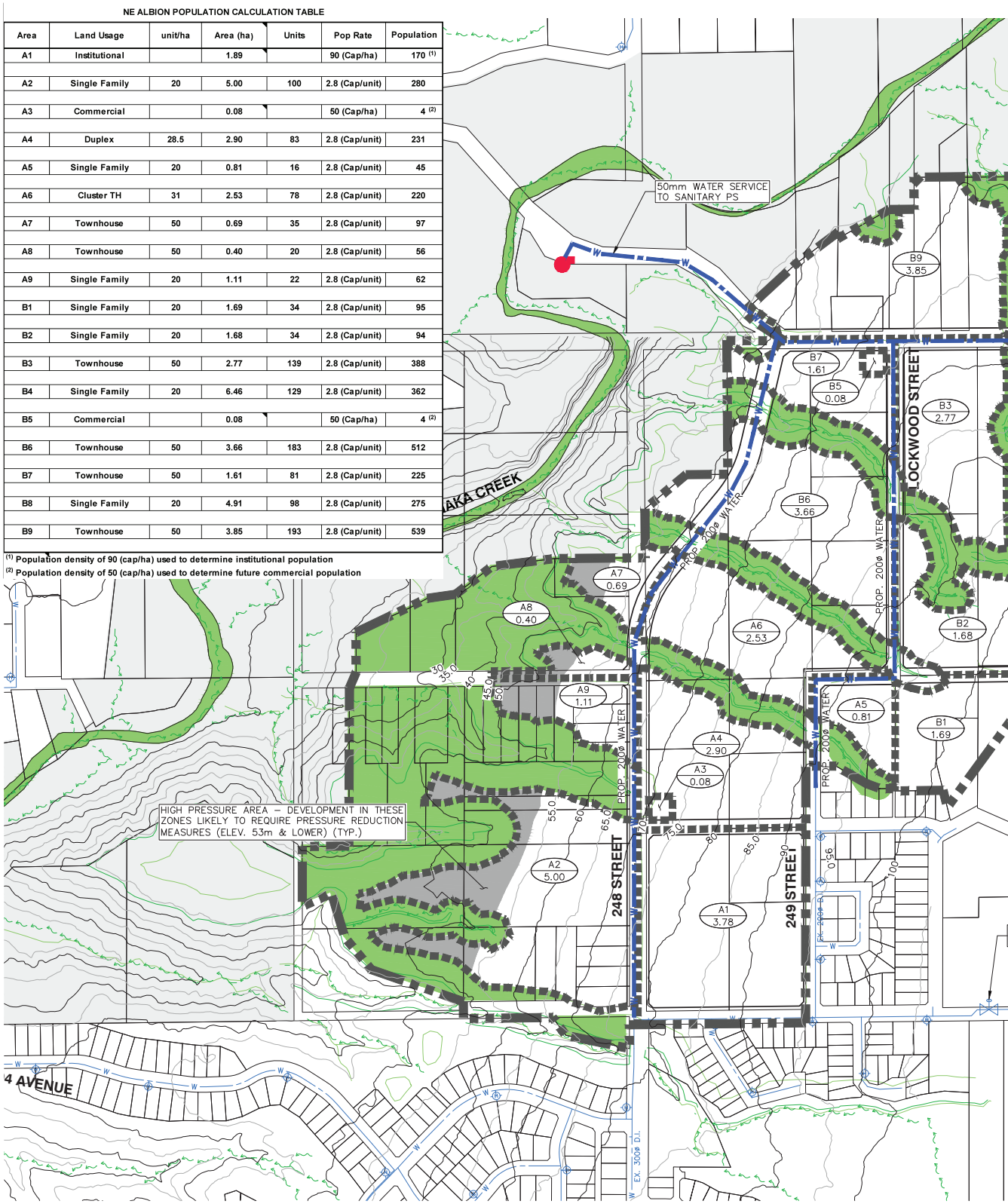
Sep 24 2019 - 9:29am M:\2018\18-1022A\DWG\PRELIMINARY MASTER PLANS\18-1022A-202 - Sanitary Master Plan.dwg/03 SCP CALCS YKim

NE ALBION POPULATION CALCULATION TABLE

Area	Land Usage	unit/ha	Area (ha)	Units	Pop Rate	Population
A1	Institutional		1.89		90 (Cap/ha)	170 (1)
A2	Single Family	20	5.00	100	2.8 (Cap/unit)	280
A3	Commercial		0.08		50 (Cap/ha)	4 (2)
A4	Duplex	28.5	2.90	83	2.8 (Cap/unit)	231
A5	Single Family	20	0.81	16	2.8 (Cap/unit)	45
A6	Cluster TH	31	2.53	78	2.8 (Cap/unit)	220
A7	Townhouse	50	0.69	35	2.8 (Cap/unit)	97
A8	Townhouse	50	0.40	20	2.8 (Cap/unit)	56
A9	Single Family	20	1.11	22	2.8 (Cap/unit)	62
B1	Single Family	20	1.69	34	2.8 (Cap/unit)	95
B2	Single Family	20	1.68	34	2.8 (Cap/unit)	94
B3	Townhouse	50	2.77	139	2.8 (Cap/unit)	388
B4	Single Family	20	6.46	129	2.8 (Cap/unit)	362
B5	Commercial		0.08		50 (Cap/ha)	4 (2)
B6	Townhouse	50	3.66	183	2.8 (Cap/unit)	512
B7	Townhouse	50	1.61	81	2.8 (Cap/unit)	225
B8	Single Family	20	4.91	98	2.8 (Cap/unit)	275
B9	Townhouse	50	3.85	193	2.8 (Cap/unit)	539

(1) Population density of 90 (cap/ha) used to determine institutional population

(2) Population density of 50 (cap/ha) used to determine future commercial population



LEGAL DESCRIPTION: .

B.M. MONUMENT NO. . ELEVATION: .
LOCATED AT . STREET & . AVENUE

REV. NO.	DESCRIPTION	DR	CH	DATE	APP

APLIN MARTIN
ENGINEERING ARCHITECTURE PLANNING SURVEYING

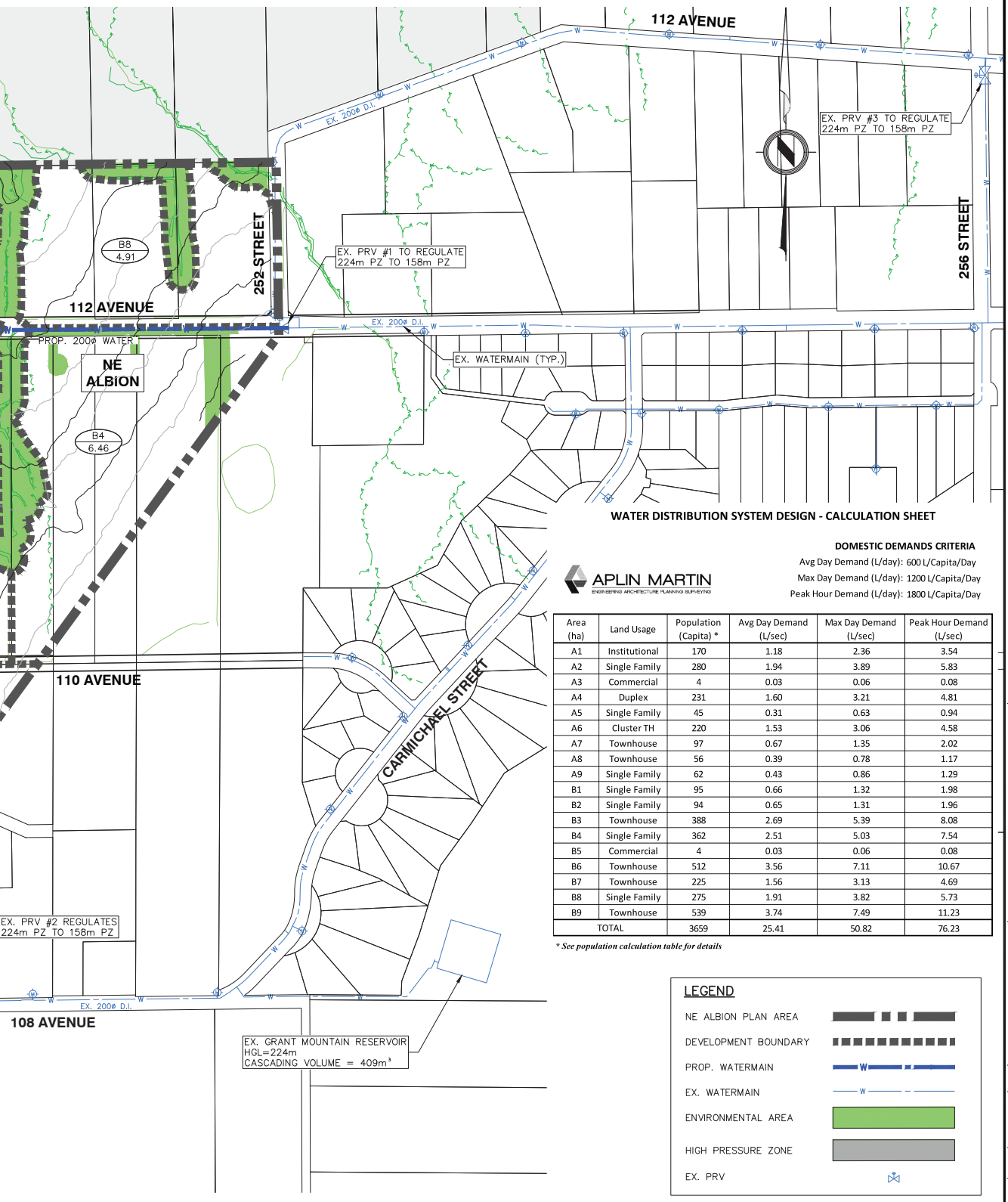
Aplin & Martin Consultants Ltd.
201 - 12448 82 Avenue, Surrey, B.C. Canada V3W 3E9
Tel: (604) 597-9058, Fax: (604) 597-9061, Email: general@aplinmartin.com

PROJECT:

NE ALBION LAND USE &

MAPLE RIDGE, B.C.

Drawing 301 – Water Master Plan



WATER DISTRIBUTION SYSTEM DESIGN - CALCULATION SHEET

APLIN MARTIN
ENGINEERING ARCHITECTURE PLANNING SURVEYING

DOMESTIC DEMANDS CRITERIA

Avg Day Demand (L/day): 600 L/Capita/Day
Max Day Demand (L/day): 1200 L/Capita/Day
Peak Hour Demand (L/day): 1800 L/Capita/Day

Area (ha)	Land Usage	Population (Capita) *	Avg Day Demand (L/sec)	Max Day Demand (L/sec)	Peak Hour Demand (L/sec)
A1	Institutional	170	1.18	2.36	3.54
A2	Single Family	280	1.94	3.89	5.83
A3	Commercial	4	0.03	0.06	0.08
A4	Duplex	231	1.60	3.21	4.81
A5	Single Family	45	0.31	0.63	0.94
A6	Cluster TH	220	1.53	3.06	4.58
A7	Townhouse	97	0.67	1.35	2.02
A8	Townhouse	56	0.39	0.78	1.17
A9	Single Family	62	0.43	0.86	1.29
B1	Single Family	95	0.66	1.32	1.98
B2	Single Family	94	0.65	1.31	1.96
B3	Townhouse	388	2.69	5.39	8.08
B4	Single Family	362	2.51	5.03	7.54
B5	Commercial	4	0.03	0.06	0.08
B6	Townhouse	512	3.56	7.11	10.67
B7	Townhouse	225	1.56	3.13	4.69
B8	Single Family	275	1.91	3.82	5.73
B9	Townhouse	539	3.74	7.49	11.23
TOTAL		3659	25.41	50.82	76.23

** See population calculation table for details*

LEGEND

- NE ALBION PLAN AREA
- DEVELOPMENT BOUNDARY
- PROP. WATERMAIN
- EX. WATERMAIN
- ENVIRONMENTAL AREA
- HIGH PRESSURE ZONE
- EX. PRV

& SERVICING PLAN

The location of existing underground utilities are shown in an approximate way only & have not been independently verified by the owner or its representative. The contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the contractor's failure to exactly locate and preserve any and all underground utilities.

TITLE: **WATER MASTER PLAN**

DESIGN: YK CHECK: DB
DRAWN: KAL APPR: DB

A & M FILE: **18-1022A**

PROJECT NO. -

SCALE : HORZ. 1:3000 VERT. N/A

DRAWING DATE: **FEBRUARY, 2019**

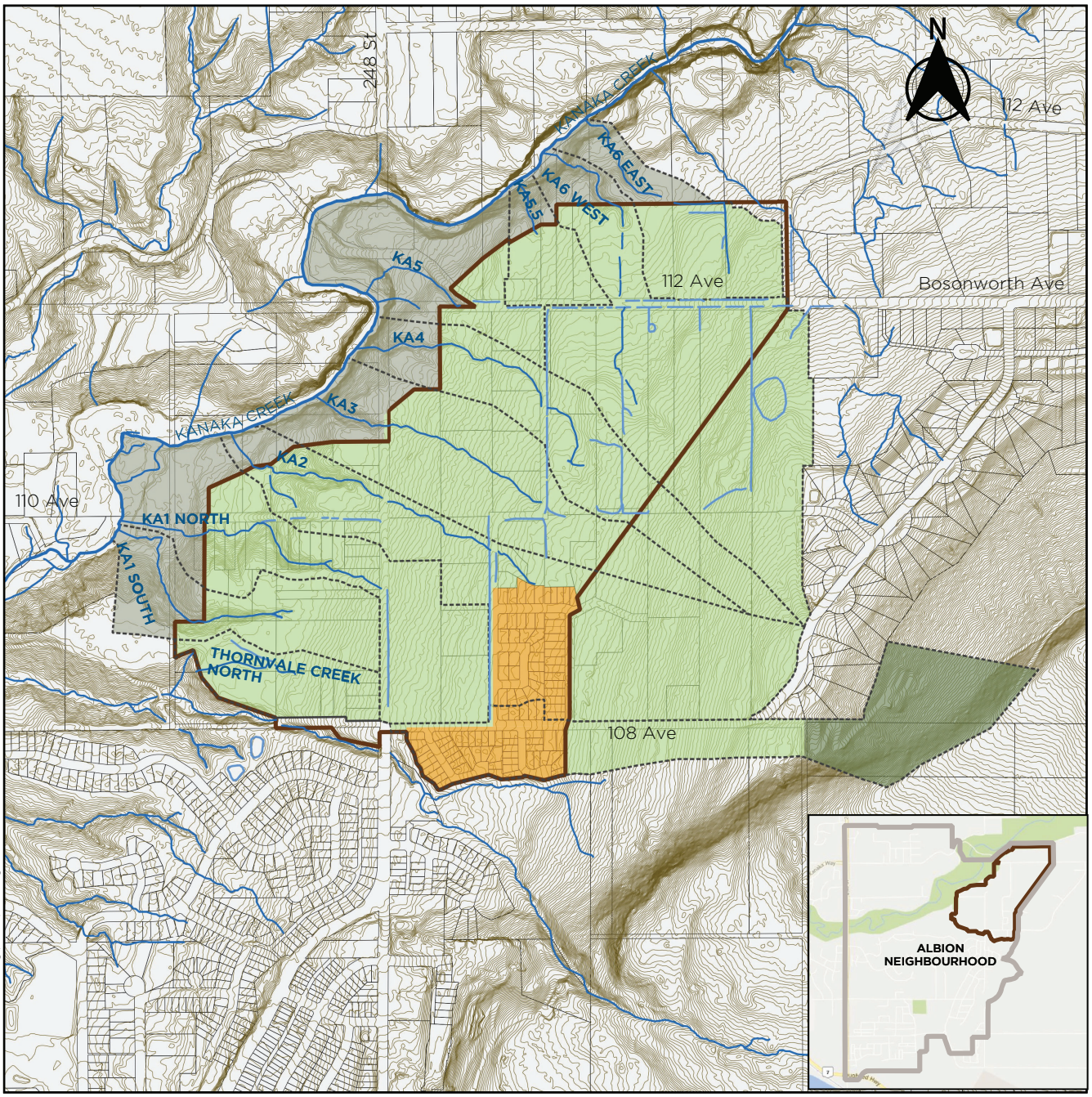
DRAWING NO. -

A & M DRAWING NO. **18-1022A - 301**

SHEET NO. **301** REV.

0 30 1:3000 150m

Sep 24 2019 - 10:28am M:\2018\18-1022A\DWG\PRELIMINARY MASTER PLANS\18-1022A-301 - Water Master Plan.dwg/301 DOMESTIC WATER LOADING DISTRIBUTION PLAN YKim



Legend

- North-East Albion
- Existing Drainage Boundaries
- Contour (1m Interval)
- Watercourse
- Ditches/Unconfirmed Streams

Existing Land Use

- Metro Vancouver Park
- Agricultural
- Rural
- Low Density Residential
- Low/Medium Density Residential
- Medium Density Residential

150 0 150 300 450 m

Scale 1:8,000

NE Albion
Land Use and Stormwater
Catchment Plan - Existing

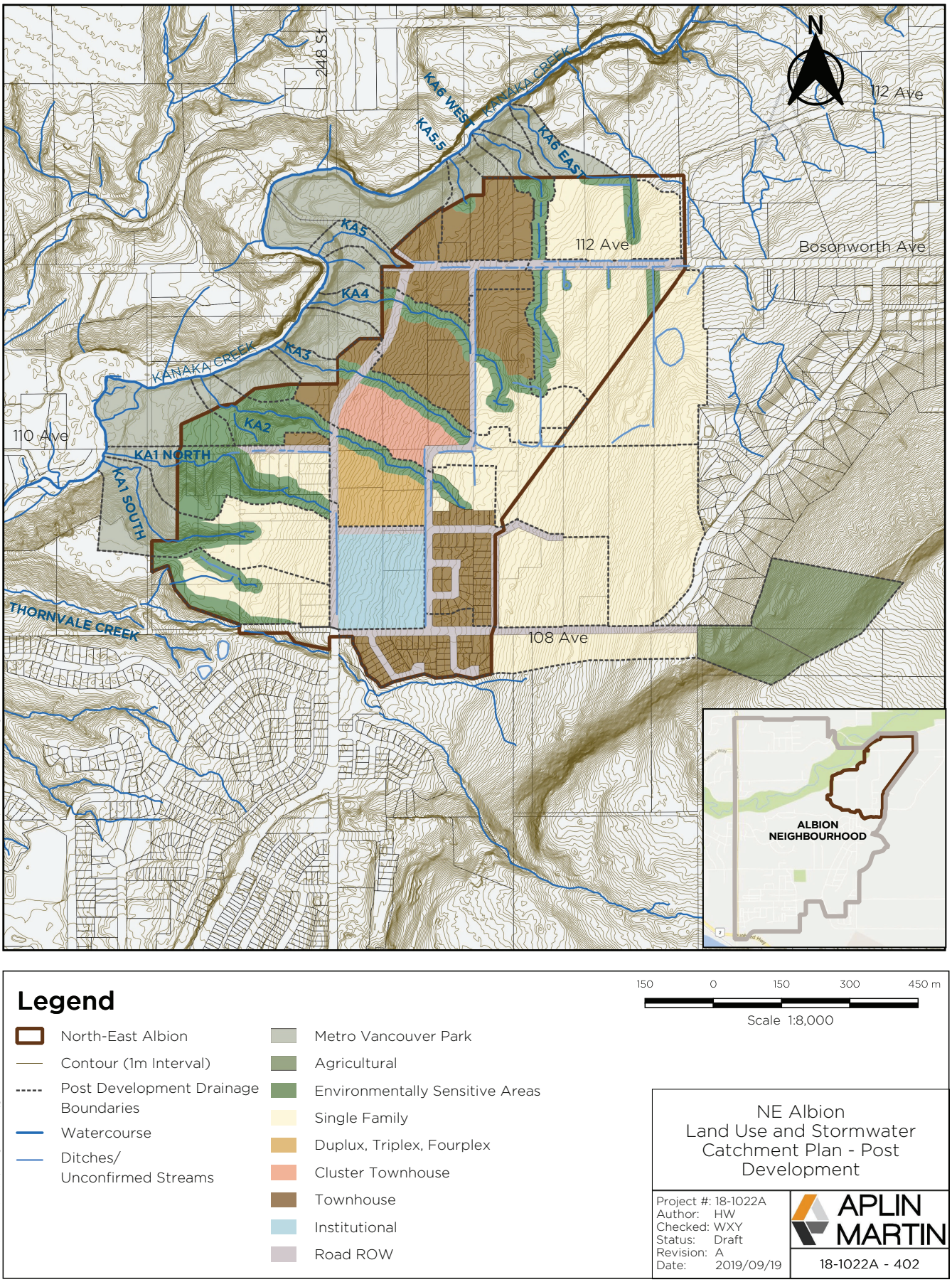
Project #:	18-1022A
Author:	HW
Checked:	WXY
Status:	Draft
Revision:	A
Date:	2019/09/19

APLIN MARTIN

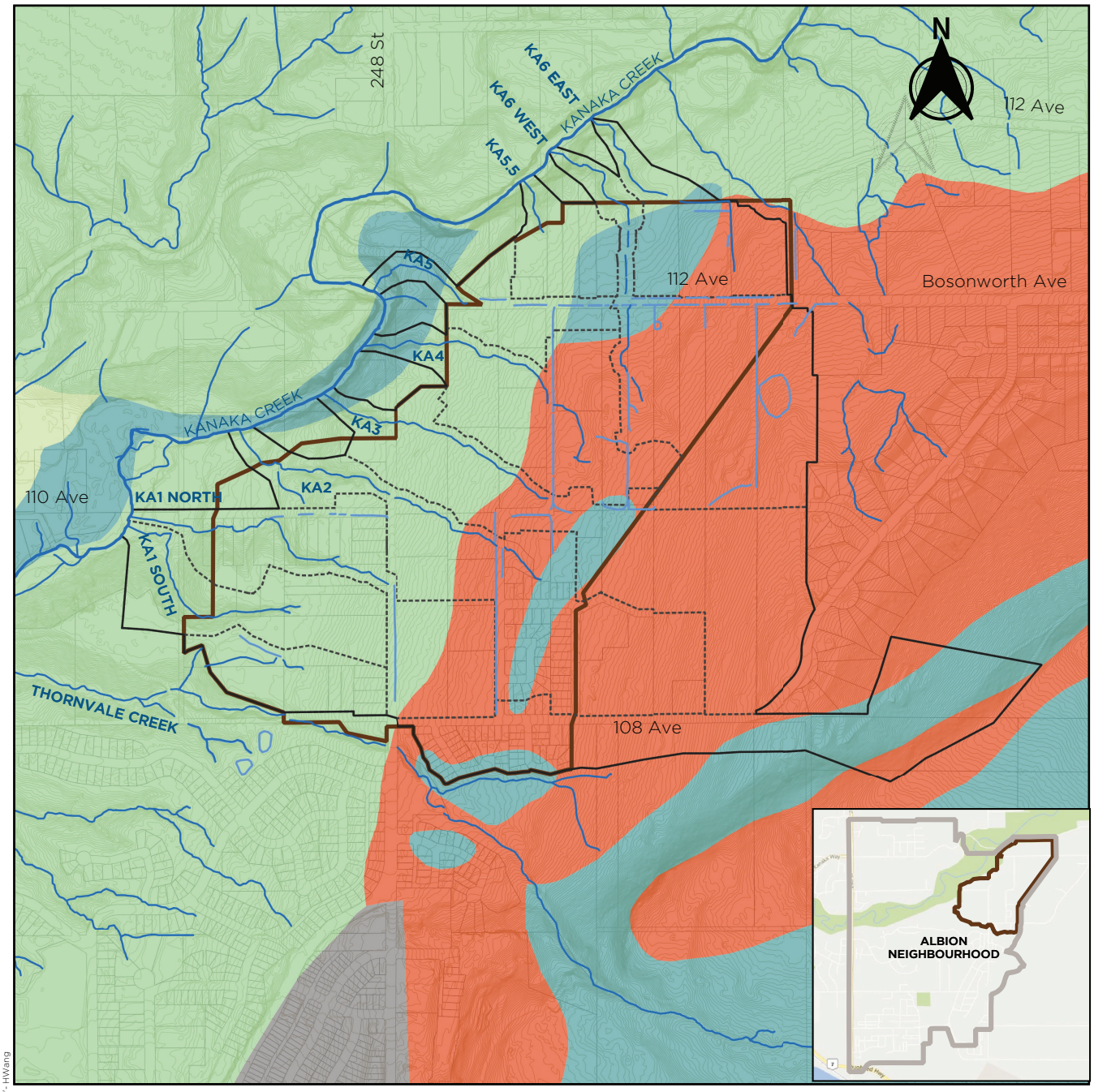
18-1022A - 401

M:\2018\18-1022A\GIS\Map1 - Figures-CYC.qgz "18-1022A - 401 - Land Use and Stormwater Catchment Plan - Existing (Portrait)" - H Wang

Drawing 401 – Land Use and Stormwater Catchment Plan - Existing



Drawing 402 – Land Use and Stormwater Catchment Plan - Post Development



Legend

- North-East Albion
- Contour (1m Interval)
- Extent of Drainage Boundaries
- Post Development Drainage Boundaries
- Watercourse
- Ditches/ Unconfirmed Streams

Surficial Soil Types

- L - Loam
- SL - Sandy Loam
- SIL - Silt Loam
- SICL - Silty Clay Loam
- Gravel Pit

150 0 150 300 450 m

Scale 1:8,000

Surficial Geology Information Source: Soils of the Langley - Vancouver Map Area - British Columbia Soil Survey (Luttmerding, 1981); FGDB published 2016-06-23 by British Columbia - Data Catalogue

NE Albion
Soil Map

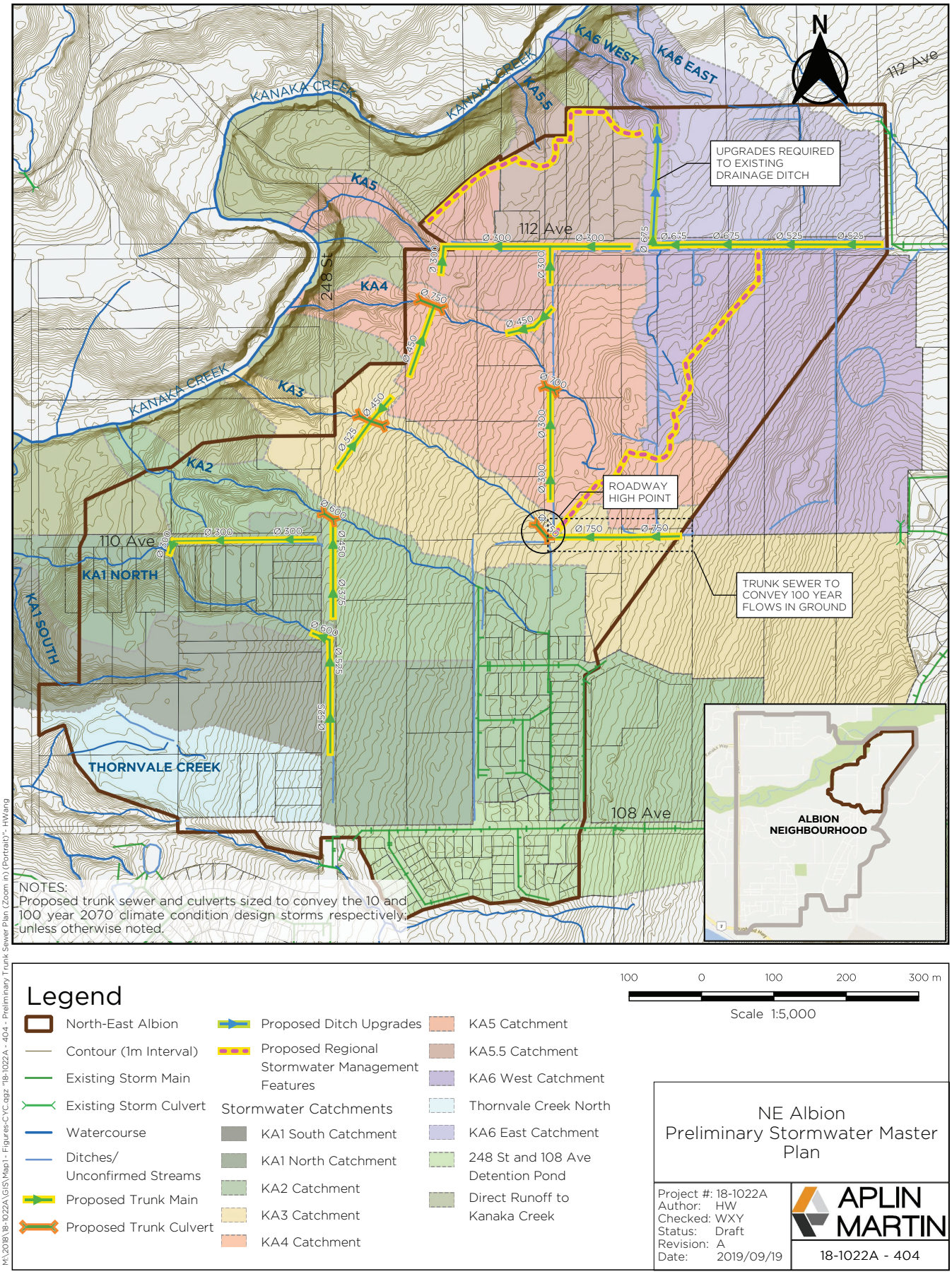
Project #: 18-1022A
Author: HW
Checked: WXY
Status: Draft
Revision: A
Date: 2019/09/13

APLIN MARTIN

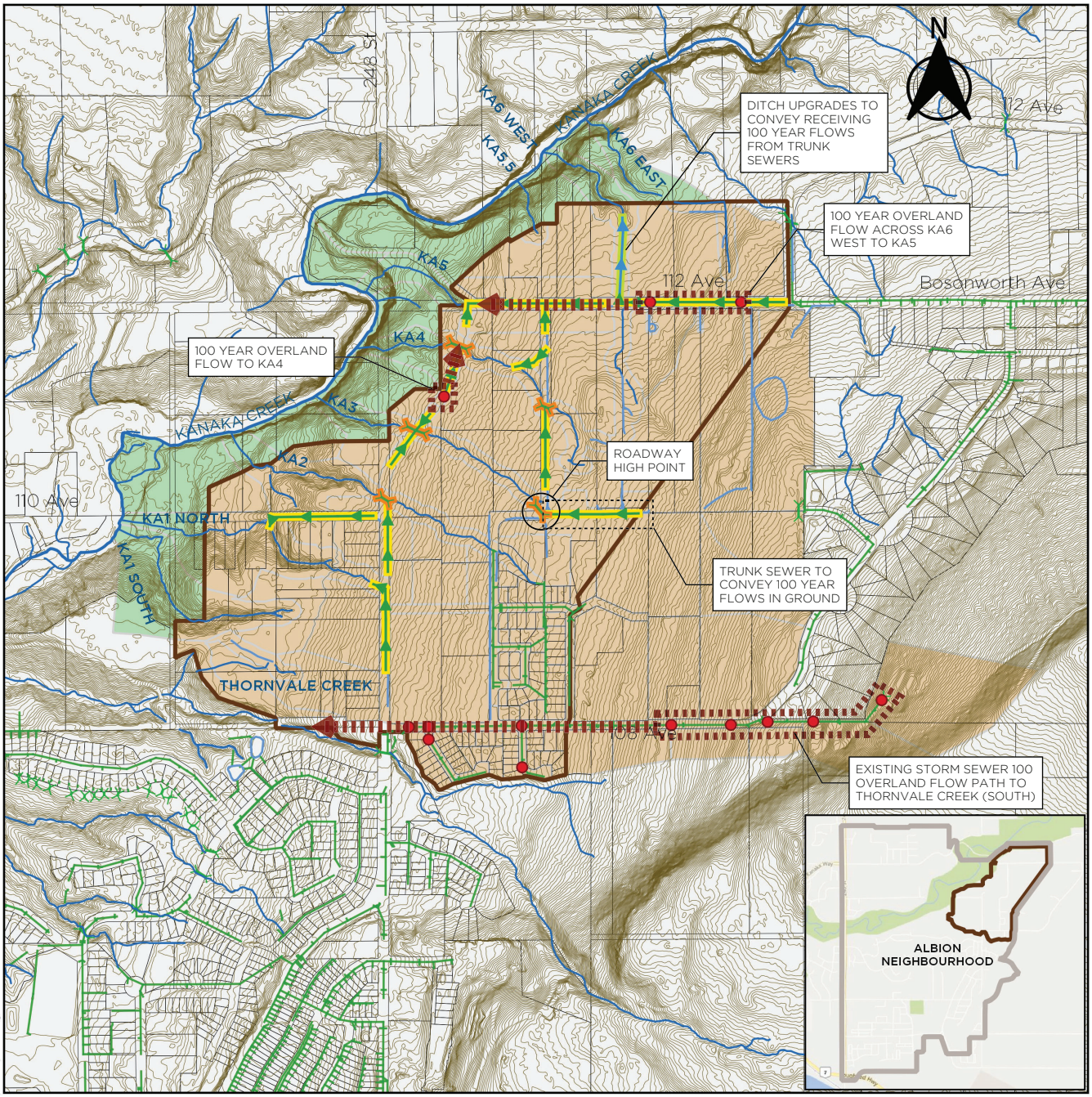
18-1022A - 403

M:\2018\18-1022A\GIS\Map1 - Figures-CYC.qgz "18-1022A - 403 - Soil Map (Portrait)" - HWang

Drawing 403 – Soil Map



Drawing 404 – Stormwater Master Plan



Legend

- North-East Albion
- Contour (1m Interval)
- Watercourse
- Ditches/ Unconfirmed Streams
- Existing Storm Main
- Existing Storm Culvert
- Proposed Trunk Main
- Proposed Trunk Culvert
- Proposed Ditch Upgrades
- Flooded Manhole under 100-year conditions
- Overland Flow Path

150 0 150 300 450 m

Scale 1:8,000

NE Albion
100 Year Flow Paths

Project #:	18-1022A
Author:	HW
Checked:	WXY
Status:	Draft
Revision:	A
Date:	2019/09/19

APLIN MARTIN

18-1022A - 405

M:\2018\18-1022A\GIS\Map1 - Figures-CYC.mxd "18-1022A - 405 -100 Year Flow Path (Portrait)" HWang

Drawing 405 – 100 Year Flow Paths