AECOM

Stave Falls Aquifer Hydrogeologic Review

City of Mission

December 2023

Delivering a better world

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time..

AECOM shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. AECOM accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

AECOM agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but AECOM makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by AECOM represent AECOM's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since AECOM has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, AECOM, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by AECOM and Client; (2) as required by-law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

AECOM accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of AECOM to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

AECOM: 2015-04-13

Quality Information

Prepared by

Aspen Anderson, Ph.D., E.I.T.
Hydrogeologist

Reviewed by

Giulio Scarzella, M.Sc., P.Geo. (AB)
Senior Hydrogeologist

Reviewed / Approved by

Ryan D. Mills, M.Sc., P.Geo.
Senior Hydrogeologist

Revision History

Revision	Revision Date	Details	Authorized	Name	Position
1	December 1, 2023	Draft	RM	Ryan Mills	Senior Hydrogeologist
2	December 12, 2023	Final	RM	Ryan Mills	Senior Hydrogeologist

Distribution List

# Hard Copies	PDF Required	Association / Company Name
0	Yes	City of Mission
0	Yes	AECOM

AECOM Canada Ltd.
Permit to Practice
No. 1001307

Prepared for:

City of Mission

Prepared by:

AECOM Canada Ltd.
3292 Production Way
Suite 330
Burnaby, BC V5A 4R4
Canada

T: 604.444.6400
F: 604.608.9154
aecom.com

Table of Contents

1 Introduction 1
- 1.1 Initiation 1
- 1.2 Background 1
- 1.3 Objectives 1
- 1.4 Scope of Work 1

2 Physical Setting 2
- 2.1 Climate 2
- 2.2 Topography and Drainage 2
- 2.3 Geology 2
- 2.4 Land Use 5

3 Initial Aquifer Characterization 6
- 3.1 Mapped Aquifers 6
- 3.1.1 Mapped Bedrock Aquifers 7
- 3.1.2 Mapped Unconsolidated Aquifers 7
- 3.1.3 Other Aquifers 8
- 3.2 Hydrostratigraphic Units 9
- 3.2.1 Bedrock Aquifers 9
- 3.2.2 Unconsolidated Materials 9
- 3.2.3 Conceptual Hydrostratigraphic Cross Sections 10
- 3.2.4 Initial Geologic Modeling Framework 11
- 3.3 Hydrogeologic Properties 11
- 3.4 Hydrogeology 12
- 3.4.1 Groundwater Flow 12
- 3.4.2 Existing Groundwater Use and Well Yield 13
- 3.4.3 Water Quality 14

4 Scoping Level Water Balance 14
- 4.1 Methodology 14
- 4.2 Results 16

5 Vulnerability of Groundwater to Contamination 17
- 5.1 Methodology 17
- 5.2 Results 19

6 Private Well Policy Review 21
- 6.1 Well Policy 21
- 6.2 Form F-3 Private Well Certification 22
- 6.3 Guidance for Detailed Reports for Private Wells – Domestic Use 23

7 Conclusions 24

8 Recommendations 25

9 References 26

Figures (In-Text)

Figure A. Stave Falls Neighborhood Geology (Digitized from the GeoMap of Vancouver; NRC 1998) 3

Figure B. Land Use According to the Zoning Code Within the Stave Falls Neighborhood 5

Figure C. Stave Falls Neighborhood Bedrock Aquifers 7

Figure D. Stave Falls Neighborhood Unconsolidated Aquifers 9

Figure E. North to South Conceptual Cross Sections. 10

Figure F. East to West Conceptual Cross Sections. 11

Figure G. Groundwater Elevations in SFN 12

Figure H: Septic systems within the SFN. 19
Figure I. Interpreted Aquifer Vulnerability in the SFN 20

Figures (Back of Report)

Figure 1-1. Site Map
Figure 2-1. 1981-2010 Canadian Climate Normals Station 1107680
Figure 2-2. Ground Elevation
Figure 3-1. Aquifers and Correlated Boreholes
Figure 3-2. Top of Bedrock Elevation
Figure 3-3. Depth to Top of Bedrock
Figure 3-4. Confining Unit Thickness
Figure 3-5. Unconsolidated Aquifer Thickness
Figure 3-6. Top of Aquifer Elevation
Figure 3-7. Initial Leapfrog Geologic Modeling Framework
Figure 3-8. Well Yield
Figure 4-1. Interpreted Aquifer Thickness Along Stave and Hayward Lakes
Figure 4-2. Interpreted Groundwater Elevation
Figure 5-1. Aquifer Susceptibility
Figure 5-2. Hazard Map
Figure 5-3. Combination of Vulnerability and Development

Tables (In-Text)

Table A. Canadian Climate Normals for Station 1107680 (1981 to 2010) 2
Table B. Stave Falls Neighborhood Geology 4
Table C. Percent of Total Area Attributed to Each Land Use Category 6
Table D. Aquifer Data Summary. 6
Table E. Summary of Reported Aquifer Properties – 30782 Dewdney Trunk Road, Mission 11
Table F. Groundwater User Data Summary. 13
Table G. Runoff Coefficients for Each Zone Type 15
Table H. Scoping Level Water Balance Initial Results 16
Table I. Stratigraphy in SFN and Associated Susceptibility Rankings 18
Table J. Hazards and Associated Rankings 18

Appendices

Appendix A Data Collection and Consolidation
Appendix B 2023 Zoning Codes
Appendix C 2023 Borehole Data Simplified
Appendix D 2023 Digitized Groundwater Chemistry
Appendix E 2023 Digitized Septic Locations

1 Introduction

1.1 Initiation

The City of Mission (City) issued a Request for Proposals (RFP 2023-006) for Consulting Services for Stave Falls Aquifer Hydrological Review. The review was to consider the aquifer or aquifers underlying the Stave Falls Neighborhood (SFN). AECOM submitted a proposal dated May 23, 2023 was accepted by the City and the contract was executed on June 28, 2023.

1.2 Background

The SFN is nestled on the City's western municipal boundary, approximately 9 km northwest of city centre (**Figure 1-1**). The SFN is flanked by the City of Maple Ridge municipal boundary to the west, the Fraser River to the south, and Stave River and impoundments to the east. The northern boundary of the SFN lies between Rolley Lake Provincial Park and Devil's Lake.

There are two hydroelectric dams on Stave River along the eastern boundary of the SFN. The northern hydroelectric dam, Stave Falls Dam, separates Stave Lake to the north and Hayward Lake to the south. Hayward Lake is bounded to the south by the Ruskin Dam, with the Stave River flowing south from the dam toward the Fraser River.

1.3 Objectives

As stated in the RFP, the objective of the review is to provide a "concise understanding with respect to the limitations of the aquifer(s), whether there is potential to add users into the aquifer(s) through subdivision or rezoning, and recommended changes to current private well policies, monitoring, and management."

1.4 Scope of Work

AECOM has conducted this review based on publicly available data and information provided by the City. The scope of work included the following:

- Review of local area geology, including available maps and plans of topography, surface geology, aerial photographs.
- Review of existing groundwater supply investigation reports and published data including water well logs/reports, Provincial observation well records, aquifer mapping reports and any other publicly available relevant data. Review of the current City of Mission private well policy available at: https://www.mission.ca/wp-content/uploads/Potable-Water-Supply-Form.pdf. Documentation of available water quality data and identification of potential groundwater contamination hazards in the study area.
- Mapping of septic system locations based on information provided by the City. Preparation of this technical report which includes the following:
  - Estimation of the capacity of the aquifer(s) underlying the SFN
  - Summary of the number of current licensed allowances
  - Estimation of the safe maximum extraction capacity of the aquifer(s) and associated number of users
  - Recommended changes to the City's current private well policies.
  - Recommended further assessment and monitoring programs to ensure best management of the aquifer(s)

2 Physical Setting

2.1 Climate

Climate is characterized using the most climate normals from Environment Canada Climate Station 1107680 "STAVE FALLS" (**Table A)**. This station is located at 49°14'00.000" N and 122°22'00.000" W, at an elevation of 110.0 meters above sea level (m asl). Unfortunately, this station only operated between 1988 and 2004.

Mean precipitation is 2,359 millimetres per year (mm/yr). Annually, the daily average high temperature ranges 5.6 to 24 °C with a recorded daily maximum of 40 °C. The daily average low temperature is 0.6 to 12.7 °C with a recorded daily minimum of -26.7 °C.

Summer months (July to September) tend to be hotter and drier compared to the rest of the year (**Figure 2-1**), with a mean monthly precipitation ranging from 81.7 to 102.7 mm and average temperatures ranging from 15.9 to 18.3°C. Winter months (December to February) are the wettest and coldest months, with mean monthly precipitation ranging from 197.9 to 265.0 mm and an average daily temperature of 3.0 to 4.4 °C.

Table A. Canadian Climate Normals for Station 1107680 (1981 to 2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°C)													
Daily Average	3.1	4.4	6.6	9.8	12.8	15.5	18.1	18.3	15.9	10.5	6	3	**10.3**
Daily Maximum	5.6	8	10.6	14.7	17.8	20.5	23.7	24	21.4	14.1	8.7	5.4	**14.5**
Daily Minimum	0.6	0.9	2.5	4.9	7.8	10.4	12.4	12.7	10.3	6.9	3.3	0.7	**6.1**
Precipitation													
Rainfall (mm)	265	197.9	210.3	191.4	148.3	137.7	82	81.7	102.7	235.6	363.2	258.1	**2,273.8**
Snowfall (cm)	35.7	13.2	5.5	0.2	0	0	0	0	0	0	7.6	27.6	**89.6**
Total (mm)	300.7	211.1	215.7	191.6	148.3	137.7	82	81.7	102.7	235.6	370.8	281.6	**2,359.4**

2.2 Topography and Drainage

Topography within the SFN reaches a high of approximately 360 m asl at the pinnacle of the bedrock knob, locally known as Iron Mountain. Topography in the northwestern corner of the SFN is also elevated, at approximately 340 m asl (**Figure 2-2**). Because the SFN sits on the west bank of the river, topography generally slopes downward to the east and southeast. Topography is lowest along the eastern boundary, south of Ruskin Dam, where ground surface is only two to five meters above sea level in this area. Ground elevations along the eastern boundary of the SFN, near the Powerhouse at Stave Falls, are approximately 50 m asl.

Topography indicates that surface water falling on the SFN will generally flow overland and into water courses toward the southeast before discharging to Stave Lake or Hayward Lake. The highland areas around Iron Mountain may affect the overall overland flow direction in their immediate vicinity, funnelling water into the northcentral portion of the SFN prior to flowing toward the southeast. Water courses in the SFN are evident from aerial photo inspection. Surface water that does not run off is likely to infiltrate into the ground and will preferentially infiltrate where no fine-grained materials are present.

2.3 Geology

Geology within the SFN is primarily interpreted from the Geo Map of Vancouver (**Table A**; NRC 1998) and supported with borehole data. Geologic units within the SFN consist of granitic bedrock, till, silt and clay, and sand and gravel (**Table B**; Armstrong, 1980). Bedrock in this area generally consists of pre-Tertiary granitic rock that outcrops in the west at Iron Mountain, and in the northwest corner of the SFN.

Within the middle and eastern portions of the SFN, bedrock is overlain by overburden (**Figure A**). Overburden in the SFN mainly consists of fine-grained materials including till, silt and clay units, and gravel and sand. At ground surface, till generally covers northern half of the SFN while the south is generally composed of silt and clay. A gravel and sand unit underlies the till and silt and clay units. The gravel and sand outcrops as a band east of Iron Mountain along Wilson Street (NRC 1998).

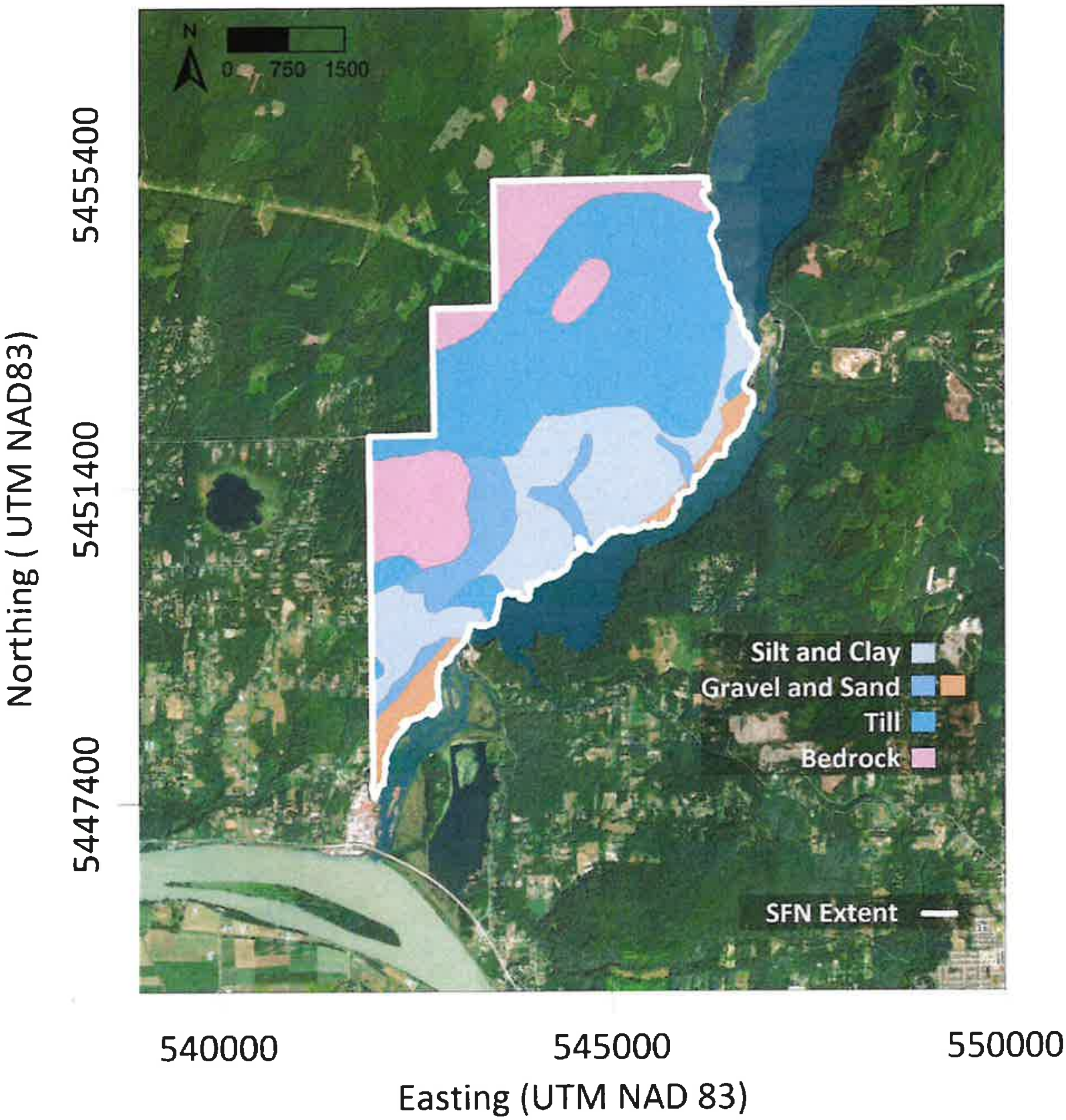


Figure A. Stave Falls Neighborhood Geology (Digitized from the GeoMap of Vancouver; NRC 1998)

Table B. Stave Falls Neighborhood Geology

Map Unit	Unit Description[1]	Surficial Geology Correlation[2]
Gravel and Sand	Deposits of gravel and sand occur along steep-gradient streams in mountain valleys (Chilliwack Valley), on alluvial fans and marine deltas at valley mouths (Capilano and Seymour rivers, North Vancouver), and on islands and bars of the Fraser River upstream of Mission. G also occur as beach deposits (Jericho, White Rock) and as debris cones and fans at the base of mountain slopes. Most areas mapped as are at risk of flooding and have a moderate to high liquefaction potential. deposits are (they transmit water) and are thus important shallow aquifers. They are also potential sources of aggregate, but shallow water tables limit their use for this purpose.	Quaternary age, mountain stream channel gravel and minor sand, up to 10 m thick
Silt and Clay	Thick silt and clay of marine origin are the most widespread surface sediments in the Surrey, White Rock, and Langley-Aldergrove uplands. This unit includes massive and bedded sediments with variable bearing capacities, depending partly on whether or not they were overridden and loaded by glaciers. In general, deposits east of Aldergrove have been loaded by ice and thus have higher bearing strengths. Water infiltration is poor because the sediments are fine grained; this can result in poor surface drainage if the land is flat. Silt and clay deposits on steep slopes (>20) are prone to land sliding. Silt and clay deposits exposed during construction activities erode easily and can be a major source of stream siltation.	Fort Langley Formation, Pleistocene age, glaciomarine stoney silt and loamy clay, interbedded with GRAVEL and SAND below
Gravel and Sand	Deposits of gravel and sand up to 40 m thick are widespread on uplands between Langley and Abbotsford, and north of the Fraser River between Pitt Meadows and Mission. Important deposits also occur on the North Shore, adjacent to the Capilano, Seymour, and Coquitlam rivers, and in the Columbia Valley south of Cultus Lake. Gravel and sand have high bearing capacity and excellent drainage. Thick gravel and sand deposits are important sources of aggregate; there are numerous gravel pits south and east of Aldergrove, and south of Langley. Gravel and sand are also important (the Abbotsford and Brookswood aquifers). Shallow aquifers are vulnerable to contamination from agricultural and industrial activities.	Fort Langley Formation, Pleistocene age, channel fill, floodplain, and ice-contact gravel and sand, in places containing clasts of till and glaciomarine sediments, 5 – 20 meters thick, interbedded with SILT and CLAY above
Till	Till is a heterogeneous glacial deposit consisting of clay, silt, sand, and stones ranging from pebble to boulder size. Till up to 25 m thick is the dominant surface and near-surface material over much of the Vancouver upland, where it is overlain by patchy marine silt and sand. Farther east, till is an important, but less extensive surface material; it is buried by thick silt and clay in the Surrey and Aldergrove areas. The lower slopes of the Coast Mountains are mantled by up to several metres of till. Some tills are compact and concrete-like, whereas others are sandy and loose. Till commonly has a high bearing capacity and thus is an excellent foundation material. Compact till is nearly impervious; for good drainage, the surface must slope. Silt- and clay-bearing tills disturbed during construction activities can be a major source of stream siltation.	Pleistocene age: 1) Fort Langley Formation, Pleistocene age, glaciomarine stoney silt and loamy clay, 8 to 100 m thick 2) Vachon Drift (lodgment till with sandy loam matrix), up to 10 m thick 3) Sumas Drift, sandy till and sub stratified drift – 0.2 to 2 m thick
Granitic Rock	Granitic rocks are a family of medium- to coarse-grained igneous rocks (granite, granodiorite, quartz diorite, diorite). They consist of interlocking light-colored grains of feldspar and quartz and dark-colored biotite and, hornblende, which give the rock a distinctive "salt-and-pepper" texture. Granitic rocks in the map area range from 165 to 95 million years old. Where not extensively fractured and faulted, granitic rock is resistant to erosion and can form steep mountain slopes. Granitic rock is locally quarried for use as building stone and crushed rock (Pitt River).	Pre-Tertiary granitic bedrock, Mesozoic to upper Paleozoic age, 1 to 5 m thick

Notes:

1 = NRC, 1998

2 = Armstrong, 1980

2.4 Land Use

According to the City of Mission's zoning codes (**Appendix B**), land use within the SFN, is 55.5% rural (**Figure B; Table C**). Institutional/Commercial Park, Open Areas, or Recreational Sites make up 35% of the land use. Residential land use that is primarily rural makes up 6.1% of the SFN, agricultural land makes up 2.7%, and commercial development makes up 1.6%. All of the agricultural and commercial development land is located south of Dewdney Trunk Road while the majority of the residential land is north of Dewdney Trunk Road. At the time of this report, the two commercial development parcels are largely undeveloped or are being utilized for residential development.

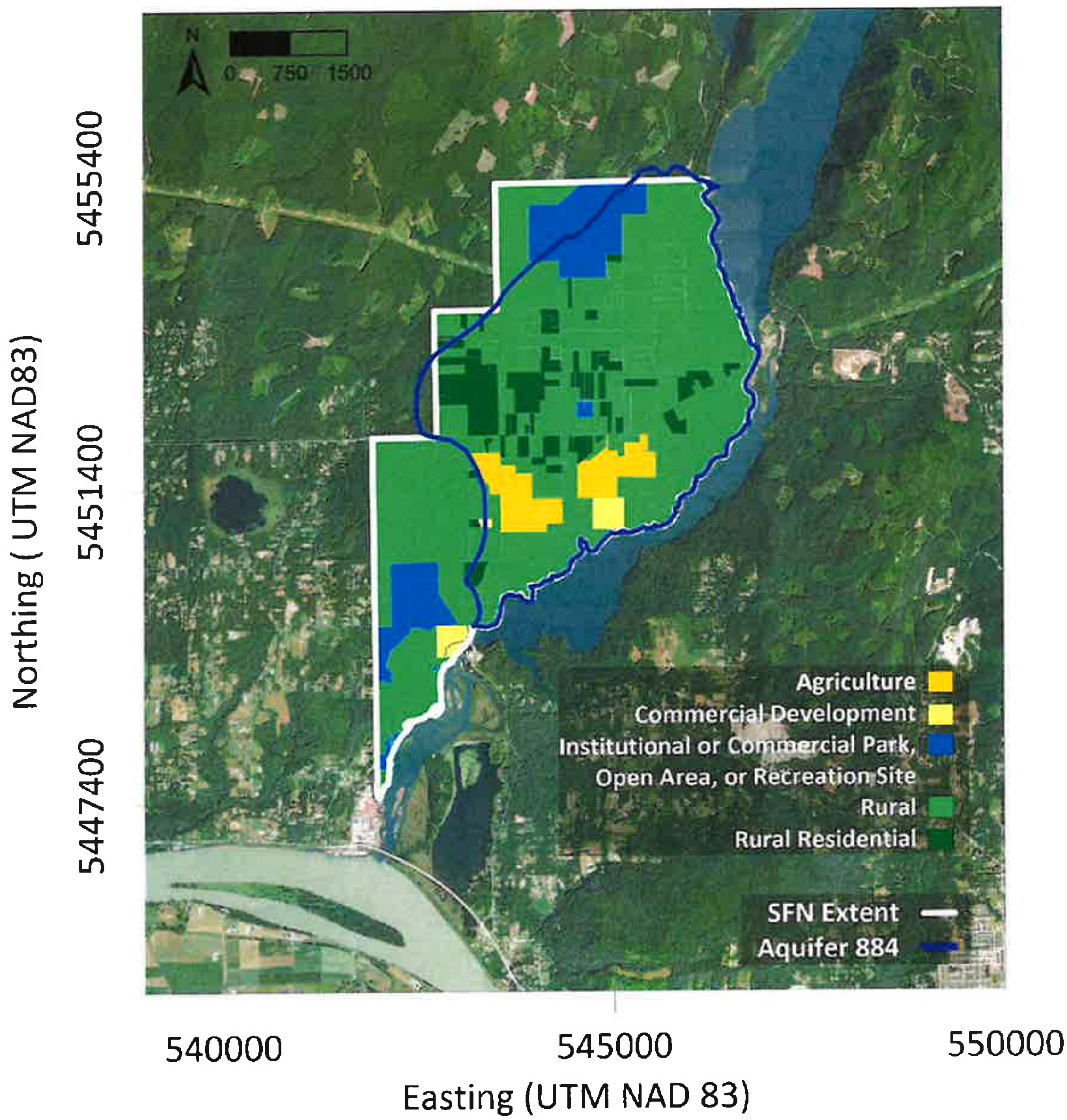


Figure B. Land Use According to the Zoning Code Within the Stave Falls Neighborhood

Table C. Percent of Total Area Attributed to Each Land Use Category

Zone Type	Percent of Total Area
Rural Residential	6.1
Rural	55.5
Institutional or Commercial Park, Open Area, or Recreation Site	34.0
Commercial Development	1.6
Agriculture	2.7

3 Initial Aquifer Characterization

The aquifers within the SFN were interpreted from past hydrogeological assessments and well tests records provided by the City of Mission. This information was supplemented with publicly accessible borehole information within the GWELLS database, and BC Aquifer Mapping Reports. Descriptions and interpretations provided herein are based on available information and professional judgment. This section presents a preliminary characterization of the identified aquifers within the SFN and should be refined in the future as additional information becomes available.

3.1 Mapped Aquifers

There are five mapped aquifers underlying the SFN according to BC Aquifer Mapping **(Table D)**, including two that are bedrock **(Figure C**; Aquifers 19 and 154), and three that are unconsolidated (**Figure D**; Aquifers 884, 26 and 971). Aquifer data for the SFN is limited and the only readily available data sources are Aquifer Fact Sheets, the associated Aquifer Mapping Reports, and the GWELLS database (**Figure 3-1**), which have all been developed by the Government of British Columbia. The Aquifer Fact Sheets and associated Aquifer Mapping Reports are typically one- to two-page summaries of available aquifer properties, if any, and statistics on groundwater use.

Ten percent of the historical well evaluation reports provided by the City were cross checked for due diligence purposes against information in GWELLS. We confirmed that much of the information within these reports was already contained within the GWELLS database. The Aquifer Fact Sheets and associated Aquifer Mapping Reports are typically one-to-two-page summaries of available aquifer properties, if any, and statistics on groundwater use. The information within **Section 3.1** of this report is primarily summarized from these documents.

Table D. Aquifer Data Summary.

Aquifer Description	Aquifer 884	Aquifer 26	Aquifer 971	Aquifer 154	Aquifer 19
Aquifer Name	884	Unnamed	971	Unnamed	Grant Hill
Aquifer Type	Unconsolida ted	Unconsolida ted	Unconsolida ted	Bedrock	Bedrock
Confinement	Confined	Confined	Unconfined	Confined	Confined
Aquifer Area	14.4	15	1.6	35.1	55.3
Number of Correlated Wells	202	353	25	73	271
Maximum Confinement Thickness	72.5	106.1	NA	NA	100.2
Minimum Confinement Thickness	0	0	NA	Outcrop	Outcrop
Median Confinement Thickness	18.6	18.0	NA	NA	6.4
Geometric Mean, Confinement Thickness	12.5	12.2	NA	NA	1.8

Notes:

1) Units: Aquifer area (km^2), Confinement thickness (m)

2) Some discrepancies were noted between data values provided in Fact Sheets and Reports. Data above is generally taken from Mapping reports.

3.1.1 Mapped Bedrock Aquifers

There are two mapped bedrock aquifers within the SFN that have identified: Aquifer 154 and Aquifer 19.

Aquifer 154

Aquifer 154 is a crystalline bedrock aquifer composed mainly of quartz diorite but can also contain granitic, volcanic, metamorphic, and sedimentary rocks. The aquifer is mapped as IIIB, which means it is lightly developed and has a moderate vulnerability (MWLAP 2002). The aquifer underlies most of the SFN except for portions of its northern and southern extents. It is generally confined except where it outcrops, which increases its vulnerability. These areas also serve as recharge zones that replenish the aquifer with direct infiltration and precipitation. The aquifer is also recharged by lateral groundwater flow from upland areas. Groundwater flow likely follows surface topography and is inferred to be to the east and southeast. No groundwater quantity or quality concerns are noted.

Aquifer 19

Aquifer 19 consists of fractured sedimentary bedrock in association with old sedimentary basins and is named the Grant Hill Aquifer. Hydrogeological information obtained from aquifer mapping reports indicates this unit is comprised of the Kitsilano Formation, which is a fractured sedimentary bedrock unit consisting mainly of sandstone and shale. The aquifer is classified as IIB which means it is moderately developed and has a moderate vulnerability (MWLAP 2002). The aquifer covers a small (approximately 1.4 km^2) portion of the study area in southern portion of the SFN. A till layer generally covers the bedrock surface, and the aquifer is generally confined but appears to outcrop in areas west of SFN near Grant Hill and another bedrock high in the region. The main recharge area is inferred to be near Grant Hill, with radially outward groundwater flow ultimately discharging to the Fraser River. The eastern portion of the aquifer may discharge into the Stave River. Minor issues associated with water quantity and water quality have been reported but are judged to be anomalies in the data set.

Information on both aquifers is limited to groundwater use (discussed below) as no aquifer properties are known. Both aquifers are identified as low productivity and serve as minor water supplies for the SFN.

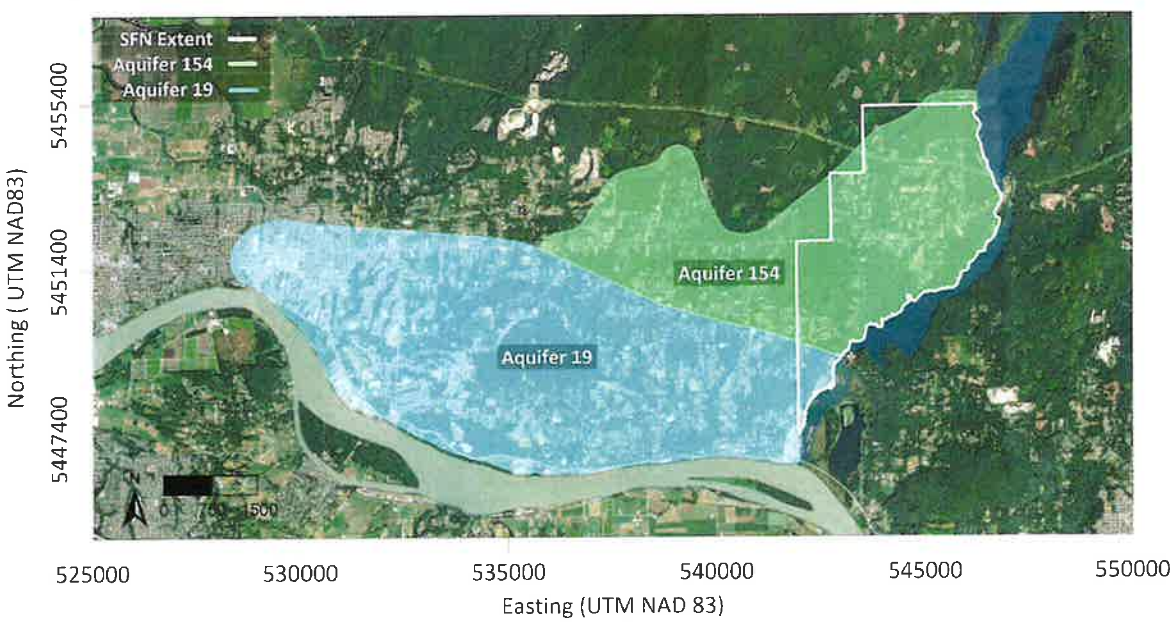


Figure C. Stave Falls Neighborhood Bedrock Aquifers

3.1.2 Mapped Unconsolidated Aquifers

There are three mapped unconsolidated aquifers within the SFN that have identified: Aquifer 884, Aquifer 26 and Aquifer 971.

Aquifer 884

Aquifer 884 covers a large portion of the SFN and is characterized as a confined sand and gravel aquifer associated with glacio-marine environments near the coast. The aquifer is classified as IIB, which means it is moderately developed and has a moderate vulnerability (MWLAP 2002). Available information indicates its northern and western extents have not been defined and are uncertain. It is generally overlain by either silt or till of unknown texture and is generally well confined with only 4 of 100 wells reporting no confinement. Recharge is from the highlands to the northwest and groundwater flow is inferred to be southeast toward Hayward Lake. The aquifer is moderately productive and appears to be the main water source for most SFN residents.

Aquifer 26

Aquifer 26 is a confined glacio-fluvial sand and gravel aquifer that may be below till, interbedded with till, or underlying glacio-lacustrine deposits (i.e. silts and clays). This aquifer is classified as IB which means it is lightly developed and has a moderate vulnerability (MWLAP 2002). It is mostly well confined with only 3 of 104 wells intersecting the sand gravel reporting no confinement. This aquifer also has numerous shallow dug wells that may utilize shallow groundwater. The aquifer is moderately productive but also highly variable. Groundwater flow is inferred to be in multiple directions with the northern part of aquifer and likely discharges to Kanaka Creek to the west, while the southern portion of the aquifer likely discharges to the southeast. Recharge is interpreted to be from bedrock highs to the west and northeast with Kanaka Creek and Whonnock Creek potentially contributing flow during the wet season or following precipitation events. There are no reported water quality or quantity concerns. One well has reported artesian flow confirming the aquifer is at least locally confined.

Aquifer 971

Aquifer 971 is a predominantly unconfined fluvial or glacio-fluvial sand and gravel aquifer typically situated along river and stream valleys bottoms with hydraulic connection to that water course. This aquifer is classified as IIB which means it is moderately developed and has a moderate vulnerability. The aquifer can also contain larger fragments like boulders and may have small interbeds of silt based on bedrock depth. Available well data indicates most wells have some degree of confinement with only a small number reporting no confinement. The aquifer is reported to have a "quasi-certain" hydraulic connection to the Stave River and is likely under the direct influence of surface water. It may also be hydraulically connected to Aquifer 26. The groundwater flow direction is inferred to be toward the Stave River or Fraser River. Recharge is interpreted to be from upland features, direct precipitation, and infiltration, and from the Stave River, Fraser River and other nearby water courses. There are no reported water quantity or quality concerns.

3.1.3 Other Aquifers

In addition to the five mapped aquifers, some borehole data included in GWELLS was associated to Aquifer 1143 which is currently an unmapped aquifer (**Figure 3-1**). It is possible that Aquifer 1143 exists within the SFN but no Aquifer Mapping Report or Fact Sheet has been published yet. Additionally, many wells with the GWELLS database are not correlated to an aquifer and some have incorrect coordinates. Correlation of these wells to an aquifer is beyond the scope of this assessment. However, when correlated, they will add to the existing data sets for mapped aquifers.

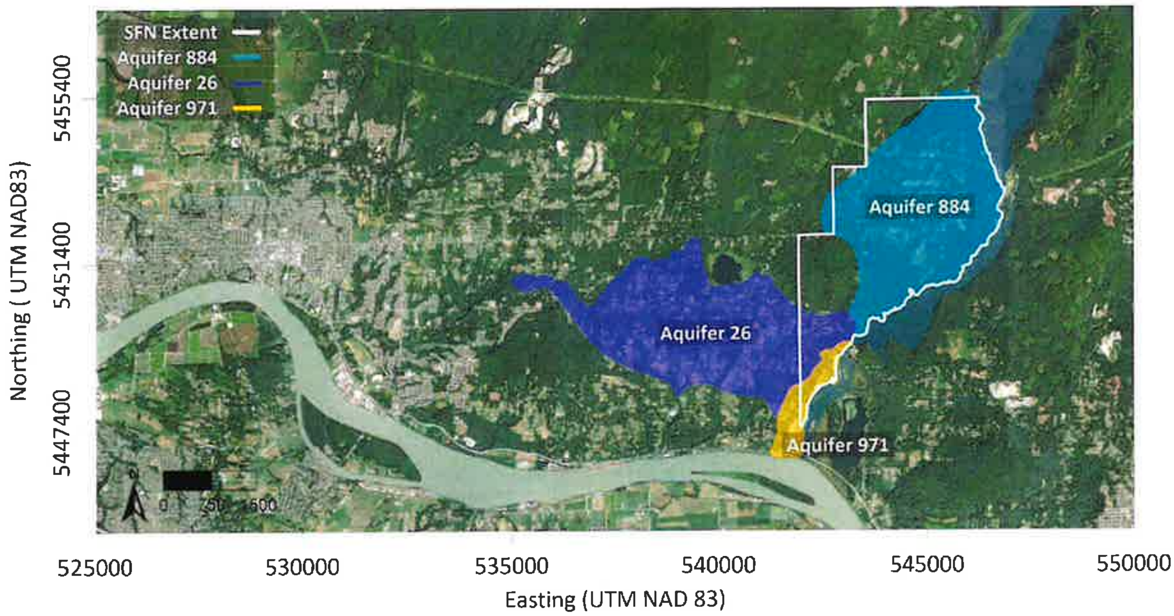


Figure D. Stave Falls Neighborhood Unconsolidated Aquifers

3.2 Hydrostratigraphic Units

Hydrostratigraphic units are defined as hydraulically continuous, mappable, and scale-independent entities. Based on available data, there are three hydrostratigraphic units within the SFN:

- Unconsolidated Materials: This unit is subdivided based on the interpreted permeability and saturated thickness into confining units (aquitards) and unconsolidated aquifers.
  - Unconsolidated Aquitards or Confining Units: These units are typically comprised of the low permeability till unit and the silt and clay unit.
  - Unconsolidated Aquifers: These units are typically comprised of the relatively permeable sand and gravel.
- Bedrock Aquifers: These units are primarily comprised of fractured crystalline bedrock and fractured sedimentary bedrock.

3.2.1 Bedrock Aquifers

The top of the bedrock hydrostratigraphic unit (**Figure 3-2**) was delineated by spatially interpolating the "depth to top of bedrock" measurements (**Figure 3-3**) included in GWELLS and subtracting the bedrock depth from the elevation of the topographic surface (**Figure 2-2**).

3.2.2 Unconsolidated Materials

The aquifer mapping reports and interpreted geology indicates that unconsolidated material in the SFN generally consists of a confining unit (comprised of till in addition to silt and clay) overlying aquifer sediment (comprised of sand and gravel). The Aquifer Mapping Report for Aquifer 884 and the accompanying Fact Sheet indicates that the aquifer is confined by fine-grained materials evident in all but four boreholes correlated to this aquifer. These resources suggest that the confining unit thickness ranges 0 to 72.5 m, with an average thickness of 21.9 m.

To develop unconsolidated material surfaces, we used GWELLS data to understand: 1) confining unit maximum depth at each well and 2) maximum thickness of unconsolidated material (i.e. depth to bedrock) at each well. We used values calculated from Equation 1 below as the basis for interpolation across the SFN and surface development:

$$\textit{Percent of Confining Unit} = \frac{\textit{Maximum Depth of Confining Unit}}{\textit{Maxmimum Thickness of Unconsolidated Material}} \qquad \textbf{Equation 1}$$

The spatially interpolated depth to bedrock map (**Figure 3-3**) suggests the maximum thickness of unconsolidated material is approximately 160 m. Additionally, the Aquifer Mapping Report for Aquifer 884 indicates that the maximum confining unit thickness is 72.5 m. Using the thickness-gradient-variation calculation presented in **Equation 1**, confining unit and aquifer sediment thicknesses are approximately 48 and 52%, respectively (**Figure 3-4** and **Figure 3-5**). Using this assumption, the elevation between the confining unit and underlying material was deduced (**Figure 3-6**).

Confining unit and aquifer thicknesses are greatest in central SFN, north of Dewdney Trunk Road. They are inferred to thin to the north and south, terminating at bedrock outcrops. Although the confining unit and aquifer thickness maps (**Figure 3-4** and **Figure 3-5**) indicate that both units are continuous, borehole data from GWELLS suggests the confining unit may not be as extensive and continuous as shown in **Figure 3-4**. It is also possible that a thin confining unit would not be observed in drill cuttings derived from the rotary drilling methods employed to install most water wells in the area.

3.2.3 Conceptual Hydrostratigraphic Cross Sections

Simplified conceptual hydrogeologic cross sections (**Figure E** and **Figure F**) show the confining unit and aquifer are thickest within the middle of the SFN, north of Dewdney Trunk Road. Data limitations, scoping level thickness-gradient-variation calculations, and spatial interpolation software used to develop hydrostratigraphic surfaces all contribute to the uncertainty in the accuracy of the surfaces and cross sections. Uncertainty regarding confining unit thickness is enhanced where erosion has cut through the confining unit to expose the underlying aquifer at ground surface such as water courses. Only drilling, geophysical surveys and geological mapping can reduce uncertainty and determine the stratigraphy to guide interpolation between boreholes or outcrop locations.

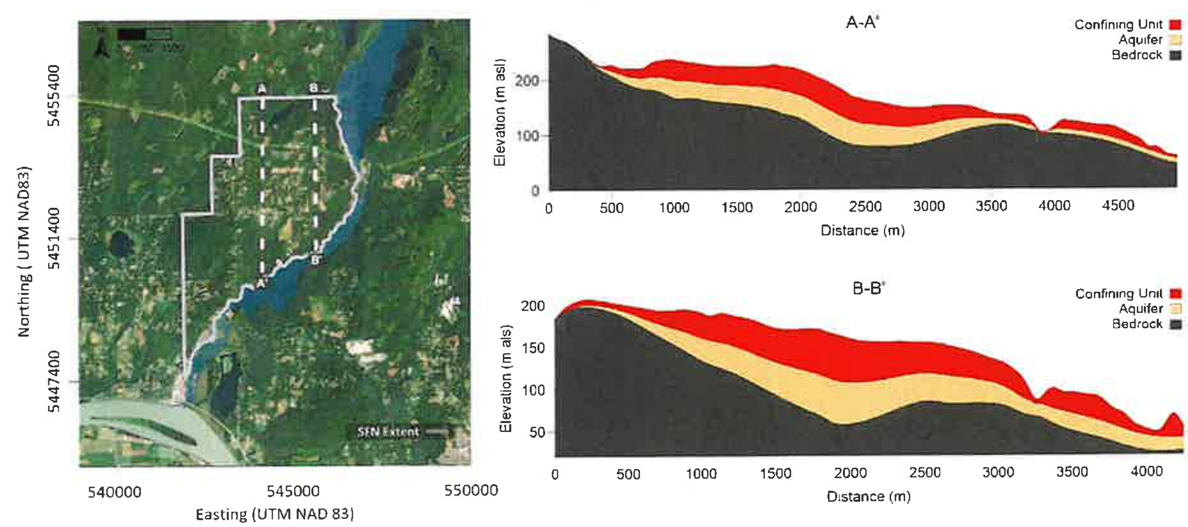


Figure E. North to South Conceptual Cross Sections.

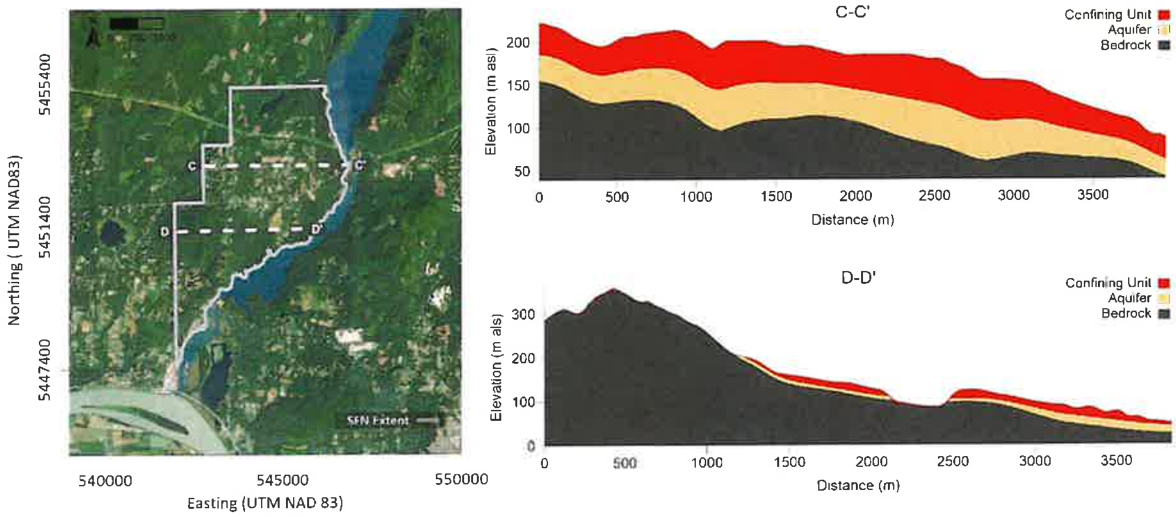


Figure F. East to West Conceptual Cross Sections.

3.2.4 Initial Geologic Modeling Framework

As a value-added service, an initial geological modeling framework was developed within Leapfrog™ to refine the SFN conceptual geologic model. Leapfrog™ is a geological modeling software that aids in the visualization of 3D geologic and hydrogeologic data. The software is the industry standard for analysing spatial data and creating 3D geologic models.

The initial geologic modeling framework included the compilation of GWELLS lithology data, topographic elevations, bedrock elevations, confining unit-aquifer contact surfaces, and satellite imagery (**Figure 3-7**). Lithology data contained in the GWELLS database is highly variable and does not follow a unified logging protocols, making it difficult to interpolate lithological or hydrostratigraphic units without extensive pre-processing. GWELLS data was simplified using a Python code developed for the SFN to recharacterize the drilling descriptions in GWELLS into common lithological terms and the associated hydrostratigraphic unit (**Appendix C**).

Results from this recharacterization of drilling data identified questions about the extent and continuity of the confining unit throughout the SFN. The geologic model may be advanced in the future to refine the geologic interpretation and resolve uncertainties surrounding the confining unit and aquifer outcrops.

3.3 Hydrogeologic Properties

Aquifer depth and thickness were discussed in earlier sections of this report. Other hydrogeologic property data including hydraulic conductivity, transmissivity, and storativity, were limited to one report for a new subdivision at 30782 Dewdney Trunk Road. Well data from GWELLS in the SFN were devoid of aquifer property data.

Several single-well pumping tests in well IDs 51761, 63652, 63687, 40652, and 63686 are assumed to have been completed in Aquifer 884 (**Table E**). The tests were conducted and analyzed by Active Earth Engineering Ltd. in 2021 (AEE 2021). While results were provided in the report, no analysis was provided to indicate the basis for testing and aquifer property determination. This information may have been included in a separate appendix or may not have been reported.

Table E. Summary of Reported Aquifer Properties – 30782 Dewdney Trunk Road, Mission

Aquifer Property	Units	Estimated Range
Transmissivity	m^2/s	$1.2 \times 10^{-4} - 3.5 \times 10^{-3}$
Hydraulic Conductivity	m/s	$2.3 \times 10^{-5} - 6.9 \times 10^{-5}$
Storage Coefficient	unitless	$4.2 \times 10^{-8} - 5.9 \times 10^{-6}$

Overall, these results indicate the aquifer has a moderate hydraulic conductivity. It also indicates the aquifer has a relatively low storage coefficient compared to values typically observed in confined sand and gravel aquifers. It is possible that storage parameters were limited by the testing method, test duration, availability of observation wells or the method used to analyze the results.

3.4 Hydrogeology

3.4.1 Groundwater Flow

Groundwater elevations within the SFN range from approximately 340 m asl near the bedrock outcrops to 60 m asl along the eastern boundary, south of Ruskin Dam (**Figure G**). Groundwater flow generally follows topography, moving from groundwater elevation highs near the bedrock highs in the north and around Iron Mountain toward low (around Stave and Hayward lakes) elevations. Therefore, the principal groundwater flow direction is interpreted to be from northwest to southeast.

Groundwater elevation data (**Figure G**) was calculated from depth to water data reported in the GWELLS database. These measurements typically reference ground surface elevation, but some records may reference top of casing elevation which may contribute to local uncertainty of approximately one metre magnitude. However, the interpreted groundwater flow direction is likely not impacted.

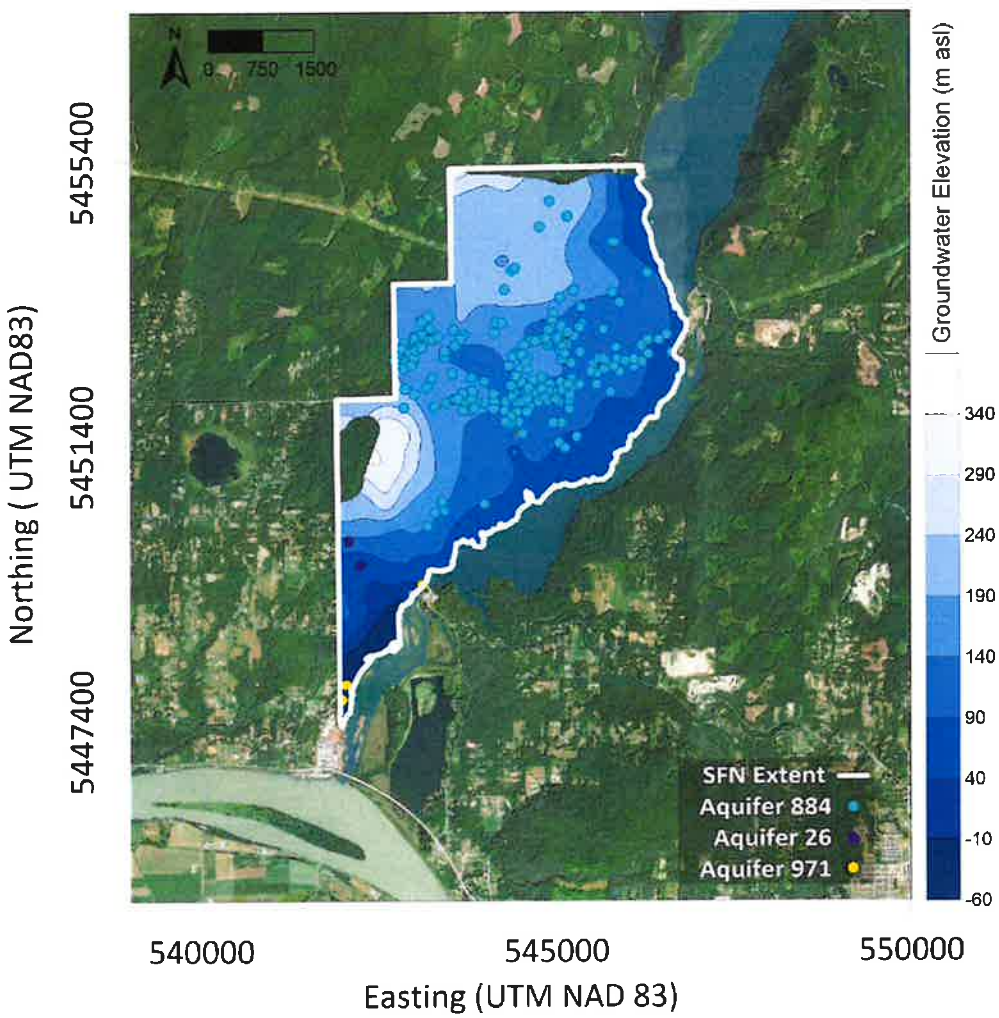


Figure G. Groundwater Elevations in SFN

3.4.2 Existing Groundwater Use and Well Yield

Hydrogeologic information for each aquifer is derived from GWELLS and summarized in the Aquifer Mapping Reports and Fact Sheets. Data from these sources are summarized for mapped aquifers within the SFN below. Some of the values are approximated as described in the notes (**Table F**).

There is only one water use license in this area issued for domestic water supply use at 30259 Dewdney Trunk Road, Mission. The well was finished in Aquifer 884 with well diameter of 6", finished depth of 26 m, and reported well yield of 50 U.S. gallons per minute (GPM).

Table F. Groundwater User Data Summary.

Aquifer Property	**Aquifer 884**	**Aquifer 26**	**Aquifer 971**	**Aquifer 154**	**Aquifer 19**
Aquifer Type	Surficial	Surficial	Surficial	Bedrock	Bedrock
Confinement	Confined	Confined	Unconfined	Confined	Confined
Maximum Well Yield	3.8	18.3	1.9	≈ 0.08	≈ 0.03
Minimum Well Yield	0.03	0.06	0	≈ 0.6	≈ 0.6
Median Well Yield	0.9	0.6	0.6	0.2	0.2
Geometric Mean, Well Yield	0.8	0.6	0.3	0.2	0.2
Maximum Water Depth	97.5	95.4	24.4	88.1	182.9
Minimum Water Depth	0.3	0.3	1.5	Artesian	0.9
Median Water Depth	9.1	9.1	7.0	20.7	19.8
Geometric Mean, Water Depth	9.1	6.1	7.0	14.9	18.3
Maximum Well depth	131.7	106.4	≈ 24.5	194.8	286.5
Minimum Well depth	1.5	0.6	≈ 12.0	31.1	2.7
Median Well depth	21.3	23.2	19.2	97.5	93.3
Geometric Mean, Well Depth	20.1	14.0	NA	94.5	86.0

Notes:

1) Units: Aquifer area (km^2), Well yield (L/s), Well and water depth (m bgs)

2) Some discrepancies were noted between data values provided in Fact Sheets and Reports. Data above is generally taken from Aquifer Mapping reports. Values with ≈ indicate estimated values from Fact Sheets.

Aquifers underlying the SFN are utilized for a range of purposes but are predominantly for domestic use (**Figure 3-1**). Reported well yields in the SFN (**Figure 3-8**) are summarized in **Table F**, which shows a wide range of reported values for each aquifer.

Available but limited groundwater user distribution data in SFN aquifers is described below:

- **Aquifer 884:**
  - 98 wells are installed in Aquifer 884, with finished depths between 3.8 to 129 m.
  - 40 wells are reported as domestic, 1 as commercial / industrial and 5 wells belong to a water supply system. One of them is referenced as "Rolley Lake Water Supply System".
- **Aquifer 26:**
  - Two (2) wells are installed within Aquifer 26, one of which has the finished depth of 106 m bgs and a well yield of 10 US GPM for domestic water use while the other well was finished with depth of 41 m bgs and a well yield of 3 US GPM for unidentified water use.
- **Aquifer 971:**
  - Two (2) wells are installed within Aquifer 971, one of which had a finished depth of 13.7 m bgs for unidentified water use but was abandoned. The other well was finished with unidentified well construction for domestic water supply.

- **Aquifer 154:**
  - 31 wells are installed within Aquifer 154 to finished depths ranging 31 to 194 m bgs. 15 wells are reported as domestic, 1 as DWS and 15 as unknown water use. Static water levels ranged 15 to 76 m below top of casing (btoc) and well yields ranged 0.5 to 25 US GPM.
- **Aquifer 19:**
  - No wells are installed within Aquifer 19 in the SFN.
- **Aquifer 1143:**
  - Three (3) wells installed are installed in Aquifer 1143, but it is not clear if that aquifer lies within the SFN. One well reports a finished depth of 104 m bgs. No additional information available.
- **Aquifer 887:**
  - One (1) well installed with a finished depth of 139 m bgs for domestic water use. Well yield is 2 USGPM with a static water level of 76 m btoc.
- **Unidentified:**
  - 85 wells are installed in unidentified aquifers with finished depths ranging 8.5 to 231 m bgs, static water levels ranging 0.9 to 97 m btoc, and well yields ranging 0.6 to 40 USGPM. Most of these wells are assumed to correlate with Aquifer 884.

3.4.3 Water Quality

Water quality data was digitized from the City of Mission Well Evaluation Reports (**Appendix D**). Generally, exceedances of Maximum Acceptable Guidelines or Aesthetic Objectives guidelines were reported for turbidity, pH, total coliforms, E. coli, arsenic, iron, lead, and manganese. None are surprising, as pH and manganese are naturally variable and are often elevated in deep confined aquifers. When water samples are collected in an appropriate manner, E. coli and total coliforms are indicative of surface water influences. Naturally occurring arsenic is commonly found in the marine and glaciomarine deposits in the lower Fraser Valley (Wilson et al. 2008). Iron and lead can be derived from household plumbing and other water conveyance infrastructure.

However, results should not be interpreted as fully indicative of groundwater quality in the SFN as groundwater for the following reasons:

1. Data entry/translation uncertainty.
2. Sample collection methods are unknown. Most reports do not clearly indicate where and how water quality samples are obtained and generally indicate the sample was "raw" with no further information provided.
3. Circumstances under which water samples were collected and resulting influence on water chemistry is unknown. Samples from household taps are prone to influence from varied and incorrect sampling methods and household plumbing and water treatment systems, which can lead to lead to false positives for bacteria, metals and other constituents.

4 Scoping Level Water Balance

4.1 Methodology

The goal of a water balance is to account for water entering and leaving the SFN. A total area of 20.2 km^2 is considered to represent the extent of the SFN neighborhood. For the water supply to be sustainable, the total amount of water leaving the system must not exceed water entering the system:

$$\boldsymbol{Inflow = Outflow} \quad \textbf{Equation 2}$$

Both the surface water balance and groundwater balance are accounted for within the analysis. Surface water balance components include precipitation (P), runoff (Ro), evapotranspiration (ET), and recharge (R):

$$P = Ro + ET + R$$ **Equation 3**

In this equation, precipitation is the primary water input into the surface water system while runoff, evapotranspiration, and recharge are outputs leaving the surface water system. The groundwater balance considers recharge as the primary input into the groundwater system and groundwater discharge (Gd) leaving the system.

$$R = Gd$$ **Equation 4**

Combining the surface water and groundwater balance equations, **Equation 5** shows the scoping level water balance considered in this analysis:

$$P = Ro + ET + Gd$$ **Equation 5**

Precipitation

Precipitation (P) data was obtained from the Canadian Climate Normals **(Table A**). Canadian Climate Normals up to 2010 were retrieved from Station 1107680 ("STAVE FALLS") as discussed in **Section 1.2**.

Runoff

Runoff (RO) is approximated monthly using a runoff coefficient method based on land cover to reflect the ratio of rainfall that results in surface runoff. Runoff coefficients were assigned to each zoning category (Table C) as a proxy for land cover within the SFN **(Figure B**). Overall, runoff coefficients assigned to the SFN are low, signifying the relatively high proportion of infiltration compared to runoff and reflecting the rural landscape within the SFN. Increased runoff coefficients representing lower infiltration and higher runoff were assigned to a commercial development zone due to the higher likelihood for pavement and other non-permeable material. A runoff coefficient of 0.19 for the SFN was developed by considering area weighted coefficients for each land use in **Table G**. This method does not consider topographic variability throughout the SFN, but this represents for future refinements to the runoff estimation and water balance.

Table G. Runoff Coefficients for Each Zone Type

Zone Type	Percent of Total SFN Area (%)	Runoff Coefficient Range	Assigned Runoff Coefficient
Rural Residential	6.1	0.3 - 0.5	0.3
Rural	55.5	0.1 - 0.25	0.17
Institutional or Commercial Park, Open Area, or Recreation Site	34.0	0.1 - 0.25	0.17
Commercial Development	1.6	0.5 - 0.9	0.7
Agriculture	2.7	0.2 - 0.5	0.35
Weighted Average	**100**	**0.1 – 0.9**	**0.19**

Evapotranspiration

Potential Evapotranspiration (ET) was estimated using a well-known analytical equation (following the Thornthwaite, 1948 methodology). The original Thornthwaite method calculated monthly PET based on average daily temperature, the number of days within the month, the average number of sunshine hours, and a heat index, which is dependant on the 12 monthly mean temperature. Day length data were not available directly from Environment Canada climate stations, so a latitude correction (of 49.2 degrees N) to the Thornthwaite method was applied instead.

Groundwater Discharge

Groundwater discharge (Q) from the surficial aquifers underlying the SFN to Stave Lake and Hayward Lake was approximated using the Darcy equation (**Equation 6**):

$$Q = -A\,Kh\,(dh/dl)$$ **Equation 6**

In this equation, A is the cross-sectional area of the aquifer that overlaps and interacts with the surface water bodies (Stave and Hayward lakes), K_h is the horizontal hydraulic conductivity, and dh/dl is the hydraulic gradient.

The cross-sectional area of the aquifer was computed using an average thickness of the interpreted aquifer hydrostratigraphic unit along cross-sections E-E' (**Figure 4-1**). The average thickness along this cross-section was interpreted to be 13 m. Using the cross-sectional area illustrated in **Figure 4-1** to calculate groundwater discharge requires that we assume surficial aquifers overlap and interact with Stave Lake and Hayward Lake along this boundary. Additionally, we assume that water is discharging from the aquifer into the lakes based on the interpreted groundwater flow direction (**Figure G**).

Hydraulic gradient is calculated by approximating the groundwater elevation along the western boundary of the surficial aquifer (**Figure 4-2, Cross-Section F-F'**) and along the eastern boundary of the surficial aquifer (**Figure 4-2, Cross-Section G-G'**). The average groundwater elevation along cross-section F-F' was 220 m asl and the average groundwater elevation along cross-section G-G' was 63 m asl (**Figure 4-2**). The lateral distance between cross-sections F-F' and G-G' was measured along five locations (shown as black lines in **Figure 4-2**) and was averaged to obtain a mean distance of 2,195 m. The resulting horizontal hydraulic gradient was 0.072 m/m.

Horizontal hydraulic conductivity (K_h) used in **Equation 6** was $4x10^{-5}$ m/s, the geometric mean of the hydraulic conductivity range suggested by Active Earth (2021) and presented in **Table E.** The overall approximated groundwater discharge from aquifer(s) to Stave Lake and Hayward Lake is 0.03 m^3/s. This approximation does not account for variability in the aquifer and confining unit along the cross-section in addition to spatial and temporal variability in the direction and magnitude of groundwater discharge. The assumptions made during this analysis represent a conservative approach to calculating the groundwater discharge and will need refinement to achieve a more robust water balance in the future. It will be important to understand the relationship between the aquifers and adjacent surface water features, and the spatial extent of the aquifer outcrop at surface, where increased lateral and vertical recharge to the aquifer may occur.

4.2 Results

The scoping level water balance components included in **Equation 5** are constrained due to limitations on data availability. As additional data becomes available in the future, this water balance may be improved with quantification of groundwater abstraction, groundwater recharge entering/leaving the aquifer through interactions with surface water features, and groundwater inflow from upgradient groundwater sources.

The scoping level water balance results for SFN (**Table H**) indicated an overall surplus of water annually. However, two summer months (July and August) indicate a deficit in the water balance. Potential evaporation in July and August exceeds incoming precipitation, resulting in no groundwater recharge to the system in these months. The surplus of water in June and September is low compared to the winter months (December through February), suggesting that these months may also experience a deficit in years with hot and dry summers.

Table H. Scoping Level Water Balance Initial Results

	Water Balance Components				Summary
Month	**Precipitation (m^3)**	**Potential ET (m^3)**	**Runoff (m^3)**	**Groundwater Discharge (m^3)**	**Inflow - Outflow (m^3)**
January	6,065,329	173,187	1,119,507	88,553	4,684,082
February	4,258,035	302,803	751,494	88,553	3,115,184
March	4,350,820	556,460	720,928	88,553	2,984,878
April	3,864,706	1,008,291	542,719	88,553	2,225,143
May	2,991,315	1,527,652	278,096	88,553	1,097,014
June	2,777,505	2,012,133	145,421	88,553	531,399

	Water Balance Components				Summary
Month	Precipitation (m^3)	Potential ET (m^3)	Runoff (m^3)	Groundwater Discharge (m^3)	Inflow - Outflow (m^3)
July	1,653,997	2,345,605	0	88,553	-780,161
August	1,647,946	2,164,899	0	88,553	-605,506
September	2,071,531	1,621,807	85,448	88,553	275,723
October	4,752,217	865,082	738,556	88,553	3,060,026
November	7,479,296	389,914	1,346,983	88,553	5,653,846
December	5,680,069	160,083	1,048,797	88,553	4,382,636
Year	**47,592,767**	**13,127,917**	**6,777,948**	**25,859,520**	**26,624,264**

The current scoping level water balance does not account for any change in water storage throughout the SFN and should be considered an order-of-magnitude estimate that requires confirmation with additional field investigation, testing, desktop analysis and monitoring.

Specific considerations for improving this scoping level water balance include:

- Climate Data: Climate normals used in this water balance were developed for 1981-2010 and have not recently been updated. More recent climate normals combined with local climate station measurements are needed to assess the current inflows and outflows within the SFN.
- Interactions with Surface Water Features: The degree of aquifer interaction with the surrounding water bodies, including Stave Lake, Hayward Lake, and the Fraser River, is uncertain. These water bodies may significantly interact with SFN aquifers and affect the overall water balance calculation. This interaction needs to be quantified through drilling, monitoring, and testing to support further analysis.
- Extent and Continuity of the Confining Unit: Recharge entering the groundwater system through infiltration from ground surface is expected to be reduced or delayed in areas where the confining unit is present and thick.
- Spatial Extent of Recharge Areas: Identification, coverage extent and distribution of recharge areas within the SFN would benefit this analysis by leading to more accurate recharge estimates.
- Groundwater Withdrawal: Groundwater withdrawal data in the SFN is incomplete and/or limited. Detailed accounting of groundwater abstraction within the SFN to refine water balance estimates.
- Climate Factored Analysis: To be best prepared for future water management decisions, a climate-factored water balance is required. Climate factored precipitation and temperature data can be obtained from the Pacific Climate Impacts Consortium and NASA and should be applied in future water balance updates to ensure conclusions and recommendations are climate resilient.

5 Vulnerability of Groundwater to Contamination

5.1 Methodology

Vulnerability is defined in this report as a combination of the physical susceptibility of an aquifer(s) to groundwater contamination in the presence of a hazard or hazard threat, which is any stressor (natural or anthropogenic) that may act to adversely impact groundwater resources.

Similar definitions of vulnerability within integrated risk frameworks have been used in groundwater applications (Simpson et al. 2014 Holding and Allen 2016; Klassen and Allen 2017). Several of these studies were completed locally within southern British Columbia. We chose this definition of vulnerability over the DRASTIC method, which is commonly used, as it can account for many specific and known hazards within the SFN. The method employed in this study may be refined in the future upon further data availability to include some DRASTIC method components (such as topography, soil media, and vadose zone impact) within the calculation of aquifer susceptibility, where susceptibility in this report is analogous to intrinsic vulnerability defined within the DRASTIC method.

Susceptibility

Aquifer susceptibility is an intrinsic property that describes how susceptible the aquifer is to contamination. Aquifers are most susceptible to contamination where permeable material is exposed at ground surface and no barrier between the aquifer and the contamination source exists. In the SFN, areas where unconsolidated aquifers are overlain by fine grained material may provide a natural barrier between contamination at ground surface and the aquifer. The degree of protection the confining unit provides to the aquifer generally increases as the confining unit thickness increases; a thick confining unit will result in less susceptibility.

Within the SFN, susceptibility was assigned based on the geologic material exposed at ground surface **(Figure A)** and confining unit thickness (**Figure 3-4**). Susceptibility was assigned "low" if the confining unit was interpreted to be greater than 10 m thick (**Table I**). Susceptibility was assigned "moderate" if the confining unit is present but was less than 10 m thick. Susceptibility was also assigned "moderate" where bedrock aquifers outcrop at surface. A moderate ranking was applied to the bedrock aquifer as a conservative approach since fracture frequency, aperture, orientation etc. and associated effective hydraulic conductivity are unknown. Susceptibility was assigned "high" where unconsolidated aquifer(s) are interpolated to be exposed at ground surface. The resulting susceptibility map (**Figure 5-1**) indicates higher susceptibility in the southern half of SFN where the surficial aquifer is interpreted to outcrop, primarily along Wilson Street. Low susceptibility within the middle of SFN is dependent on the extent and continuity of the confining unit.

Table I. Stratigraphy in SFN and Associated Susceptibility Rankings

Stratigraphy	Susceptibility Ranking
Gravel and Sand, outcrop	High
Bedrock	Moderate
Till	Moderate
Silt and Clay, < 10 m thick	Moderate
Silt and Clay, > 10 m thick	Low

Hazard

Hazard is defined as any stressor (natural or anthropogenic) that may act to contaminate groundwater resources. Based on available data, primary hazards identified within the SFN were related to septic systems and land use. Septic system locations were identified and digitized (**Figure H**, **Appendix E**); a "high" hazard ranking was assigned to a 30 m perimeter around any septic system boundaries (**Table J**) in accordance with the well setback policy (Government of British Columbia 2011). Hazard rankings were also assigned based on land use/land cover (**Figure B**). Agricultural land was interpreted to have the highest hazard ranking (**Table J**) due to potential contamination from fertilizer, manure, and livestock grazing, which can lead to nitrate and bacteriological groundwater impacts. Commercial development zoning codes were used to assign a "moderate" hazard ranking as understood activities in this zone (e.g. gas stations, etc.) suggest a higher hazard ranking than rural and park zones. Remaining rural, rural residential, and parks/recreational zone codes were assigned "low" hazard rankings.

Table J. Hazards and Associated Rankings

Criteria/Land Use	Hazard Ranking
Within 30 m of known septic system	High
Agriculture	High
Commercial Development	Moderate
Institutional or Commercial Park, Open Area, or Recreation Site	Low
Rural	Low
Rural Residential	Low

The resulting hazard map (**Figure 5-2**) is limited by available data sets and in this case any hazards present in SFN not identified or accounted for in **Table J** remain as data gaps. Other prominent hazards may include dry cleaners, gas stations, and unidentified industrial lands. In some cases, specific property activities may represent certain hazards (e.g. a homeowner has a large "shop" where mechanical work is completed). Due to data and scope limitations, our hazard analysis does not consider groundwater flow direction, the potential for downgradient impacts from upgradient sources and impacts from surface water - groundwater interactions.

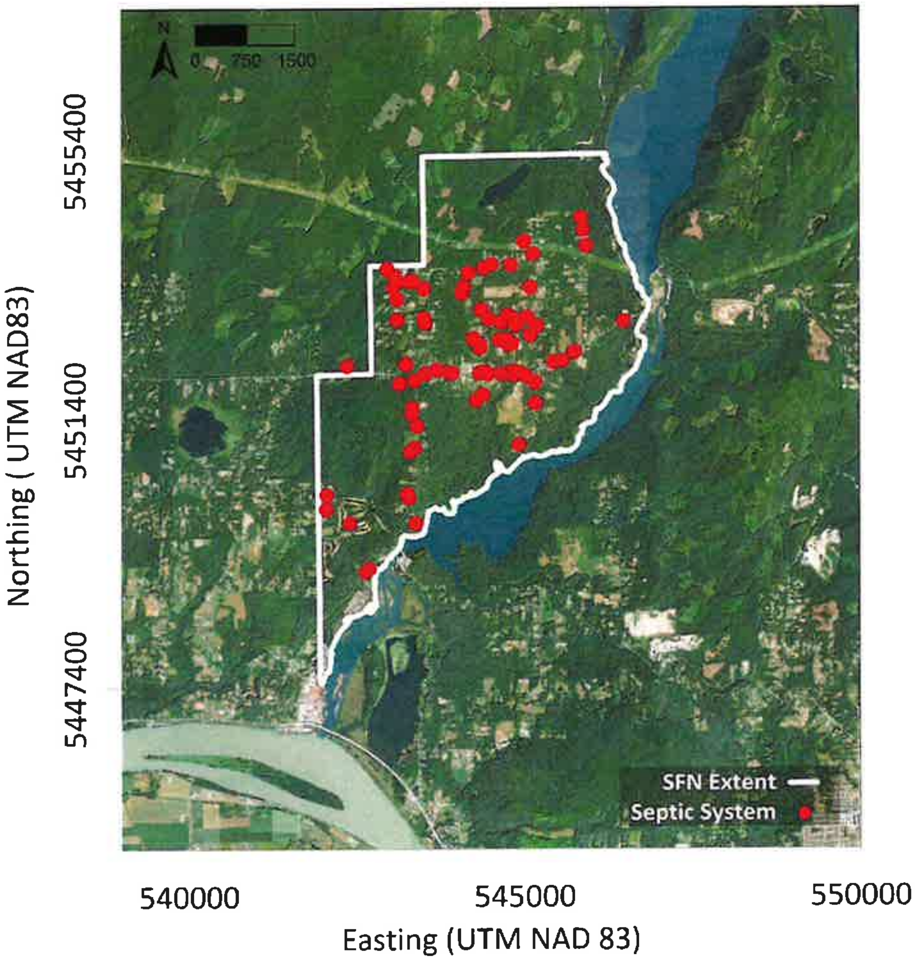


Figure H: Septic systems within the SFN.

5.2 Results

Vulnerability to groundwater contamination (**Figure I**) is highest within the southern part of the SFN where susceptibility is high due to interpreted aquifer outcropping collocated with agricultural land or septic systems. The highest vulnerability within the SFN was interpreted along Dewdney Trunk Road where residents and agricultural lands are dispersed, along the northern part of Wilson Street where Aquifer 884 is expected to outcrop at ground surface, and along Wilson Street south of Ruskin Dam where Aquifer 971 is exposed at surface.

Comparing vulnerability to existing groundwater development indicates that there is already groundwater development within interpreted vulnerable areas along Dewdney Truck Road (**Figure 5-3**). High vulnerability areas may be used to identify future groundwater monitoring locations and/or inform policy decisions regarding zoning codes and development in highly vulnerable areas.

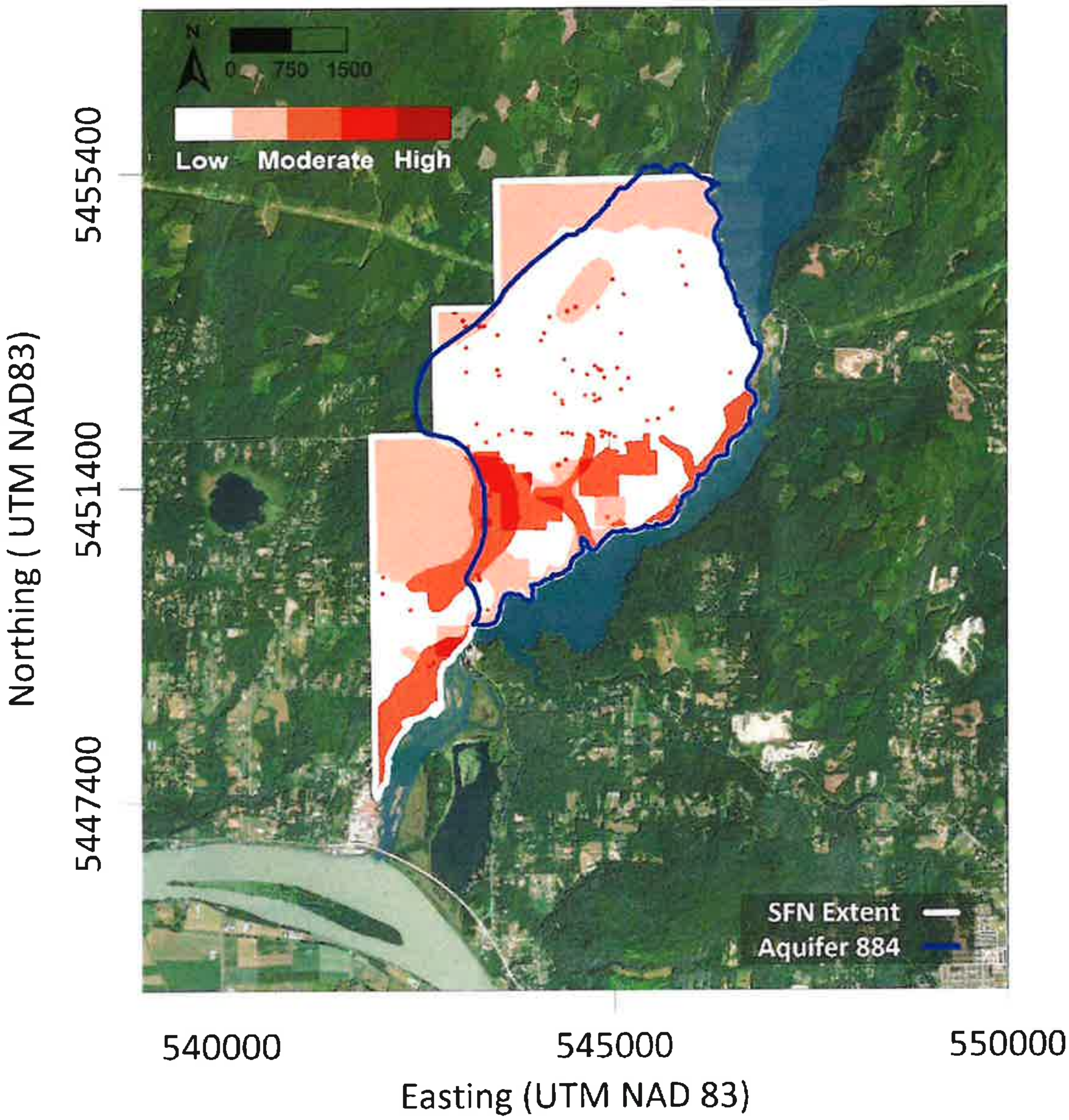


Figure I. Interpreted Aquifer Vulnerability in the SFN

The vulnerability analysis herein is constrained by data limitations and these results should be considered preliminary. This analysis would benefit from:

- More Detailed Geologic Mapping: More detailed geologic information is needed to delineate and ground truth subsurface stratigraphy including aquifer outcrops as well as confining unit thickness and extent.
- Other Hazards: Hazards included within this study include land use and septic systems. This analysis will benefit from a site visit to identify additional hazards including dry cleaners, gas stations, etc. in addition to confirming previously identified hazards and establishing the relationship between the aquifer and nearby surface water sources that could introduce pathogens and other contaminants to the aquifer.
- Septic System Details: Within this analysis, septic systems are identified as single point locations tied to the associated address. It would be beneficial to identify and digitize the location of each septic field and the spatial extent that is covers more precisely. We note that many of the files provided by the City of Mission include engineered septic system design drawings and locations.

- More Comprehensive Water Level And Aquifer Property Data Sets: To account for potential downgradient impacts from upgradient sources, more detailed and current groundwater elevation information is needed in addition to larger aquifer property data sets. With strong data sets, the accuracy of groundwater discharge, infiltration rates and gradients can be improved. Further, a three-dimensional numerical groundwater flow model may also be used to identify source-receptor pathways, establish a robust water balance for the aquifer and identify areas that should be protected to avoid contamination of a wellfield or the aquifer.

6 Private Well Policy Review

We have reviewed the *Potable Water Supply – Rural Subdivisions & Building Permit Application* document issued by City of Mission Development Services and the associated documents. While the document is generally clear, it is also highly focused. As the SFN and the City of Mission continues development, refinements to the Well Policy may be required.

6.1 Well Policy

Our comments are summarized below on a section-by-section basis together with key recommendations for modifications to the document. It is recommended that the City's in-house legal council also review the document before it is updated and issued.

General:

The objective of the Well Policy is clearly stated. There is a mandatory requirement for the owner of a subdivision to prove a potable water supply by way of a private well for each lot prior to approval of a subdivision. The third paragraph could be shortened for conciseness. The end of the paragraph contains verbiage from Bylaw 56509-2017 Section 3.15.2, which is redundant as the previous sentence indicates that conformance with all requirements outlined in Section 3.15 is required.

> **Policy Recommendation #1:** Change this paragraph to the following: "All new lots must be serviced by drilled or dug wells and must be tested and certified in accordance with the City of Mission Development and Subdivision Control Bylaw 5650-2017 (as amended), Section 3.0–Water Distribution, 3.15 Private Water Systems. Groundwater use is governed by the provincial government and an additional reference to the provincial acts and regulations governing groundwater use and licensing should be added as follows: "The use of groundwater is governed by the *Water Sustainability Act*, Water Sustainability Regulation, and the Groundwater Protection Regulation, which establish the requirements for groundwater investigations, analysis and licensing in the Province of British Columbia. It is recommended that all developers and groundwater users consult these documents for additional information in advance of investigating a groundwater and/or surface water supply".

Building Permits:

This section clearly states a completed private well certification form is required at application stage for any property without municipal water, and appropriately describes the relationship to other municipal approval processes.

> **Policy Recommendation #2:** Consider providing a flowchart or table that lists all required approvals and the sequencing of document submission, municipal reviews and approvals.

Detailed Report on Water Quantity, Water Quality, and Hydrogeological Impact Assessment and Form F-3:

Clearly states requirements that a report and F-3 Form are required and who must prepare the report. However, the Association of Engineers and Geoscientists of British Columbia (APEGBC) was renamed as Engineers and Geoscientists of British Columbia (EGBC) several years ago. Furthermore, the *Professional Governance Act* was implemented and requires firms to have a Professional Practice Management Plan (PPMP) in place as of September 30, 2021. The document is to assign Responsible Registrants that are able to apply the firm's Permit to Practice to all technical documents.

> **Policy Recommendation #3:** Update the reference to the professional association to be Engineers and Geoscientists of British Columbia (EGBC), and require the firms meet the requirements of the *Professional Governance Act* and all applicable EGBC Bylaws.

Firms Known to Have Expertise in The Area:

Providing a list of firms is subjective and may be seen to indicate preference. It may also expose the City of Mission by suggesting that the list of firms have been vetted and approved by the City of Mission. While we acknowledge that some of these firms have worked within the City of Mission, the list is not exhaustive and many other firms also have this expertise. Furthermore, it is very challenging to maintain a current database and the needs of prospective developers and landowners may be diverse. The British Columbia Groundwater Association (BCGWA) maintains a database of members that are active in the groundwater supply development and management industry in British Columbia. The database includes a list of:

- Well Drilling Contractors (https://www.bcgwa.org/type/drilling-contractor/)
- Well Pump Suppliers and Installers (https://www.bcgwa.org/type/pump-contractors/)
- Manufacturers and Suppliers (https://www.bcgwa.org/type/m-s-members/)
- Geotechnical / Environmental Drilling Contractors (https://www.bcgwa.org/type/geoenvironmental-driller/)
- Professional / Technical Consultants (https://www.bcgwa.org/type/professionaltechnical/)
- Associate Members (https://www.bcgwa.org/type/associate-members/)

Policy Recommendation #4: Given the frequent changes (mergers, acquisitions, retirements, etc.) in the industry, it is recommended that the City of Mission avoid directly referencing individual firms that have experience in the area, but rather direct them to the BCGWA website and list of consultants and contractors that may be able to assist them with groundwater exploration, technical evaluation, and any licensing required under the *Water Sustainability Act*. Another alternative would be for the City of Mission to develop and maintain a formal roster of approved firms qualified to conduct hydrogeological impact assessments on behalf of the City of Mission through a formal solicitation process. The level of rigor for evaluation and submission requirements would be at the City of Mission's discretion and the roster could be subdivided based on the complexity of the Hydrogeological Impact Assessment and the firm's required expertise. Developers requiring approvals could be required to use these firms. However, this would also open the City of Mission to possible legal implications as you would essentially be directing individuals or corporations to use a pre-selected list of consultants and contractors. Furthermore, this would require time and cost to maintain the list of firms. Water use conflicts (e.g. well interference, dry wells, etc.) may increase over time with increased development and climate change. For this reason, it is recommended that the City of Mission reference a list of vendors provided by others.

6.2 Form F-3 Private Well Certification

This document requires that a professional engineer or geoscientist licensed with EGBC agree to several certifying statements prior to signing the form. Two of the certifying statements clearly indicate the certification requirements regarding wells without any ambiguity, and are judged to be reasonable and based on quantitative measurements:

- "a quantity of not less than at 2,500 litres per day has been proven for each existing or proposed lot the subdivision"
- "each well within the subdivision has been tested and is capable of continuously providing water at a rate of 9 liters/minute for a period of four consecutive hours".

However, the following two certifications are very challenging for a licensed professional to accept as written:

- "*the withdrawal of the above daily quantities of water will not adversely affect the long term stability of the aquifer and that each well will be capable of delivering those quantities of water at all times of the year*"
- "*none of the wells within the subdivision will have an adverse impact on any other wells within or in the vicinity of the subdivision*".

These certifications are particularly onerous without further guidance in the context of ongoing development within the SFN, the lack of a defined water balance and sustainable yield for the aquifer, and the effects of climate change that will increase over time. The term "stability of the aquifer" should be clearly defined in hydrogeological terms or removed. The professional will not likely have knowledge of all wells within the subdivision and may have only been requested to comment on the viability of a single well. It is also important to recognize that one or several wells installed for a subdivision may not be the sole cause of unsustainable withdrawals from an aquifer or provide evidence of adverse impacts on their own. It may be the large number of wells in numerous subdivisions spread across the aquifer that may cause issues such as over pumping or water quality degradation, and these impacts are best evaluated with area-wide assessments conducted by government agencies. Anthropogenic activities and hazards may also harm aquifers following completion of documentation.

Many technical guidance documents have been developed by the provincial government to guide evaluation of the sustainability of groundwater supplies, including "*Guidance for Technical Assessments in Support of an Application for Groundwater Use in British Columbia*", with specific reference to Section 2.1: Assessing Adequacy of Supply, Section 2.2: Assessing Likelihood of Hydraulic Connection to Streams and Other Aquifers, Section 2.3: Assessing Potential Impacts on Nearby Groundwater Users, Section 3.5: Methodology for Assessing the Adequacy of the Supply, Section 3.6: Results Used for Assessing the Adequacy of the Supply, and Section 3.7.3: Assessment of Potential Impacts. While domestic groundwater use evaluations are exempt from many of the requirements,

> **Policy Recommendation #5:** It is recommended that the City of Mission add the following phrase: "The withdrawal of the above daily quantities of water has been conducted in a manner that meets the requirements of the Technical Assessment Guidelines (Todd et al., 2020), and is judged to be able to provide those quantities of water at all times of the year without impacts to existing groundwater and/or surface water users. Furthermore, the impact of climate change on the long-term groundwater extraction has been evaluated in accordance with the requirements of EGBC and all applicable provincial acts and regulations, and the above quantity of water is judged to be sustainable in the context of known existing groundwater users".

The remaining certifying statements regarding water quality are judged to be reasonable and clear.

6.3 Guidance for Detailed Reports for Private Wells – Domestic Use

As stated, "*This guidance is intended for professional engineers and geoscientists in the preparation of detailed reports for submission to the City of Mission so as to meet the minimum information requirements of a "detailed report" as referenced in Section 3.15 of Schedule C of the City of Mission Development and Subdivision Control Bylaw 5650-2017 (as amended).The detailed report must be for one well only, and each report must be signed and sealed by a registered Professional Engineer or Geoscientist with experience in hydrogeology. To meet the definition of "experience in hydrogeology", the professional must be registered with Engineers and Geoscientists BC as having a primary or secondary field of expertise in hydrogeology or as a hydrogeologist*".

This document contains many statements that duplicate and may contradict some of the statements made in provincial guidance documents. Professional engineers and geoscientists licensed with EGBC having expertise in hydrogeology and groundwater supply evaluations should be very familiar with provincial acts, regulations and the technical; requirements outlined in provincial guidance documents and policy. In aggregate, these documents establish industry standard in British Columbia. There are opportunities to simplify the guidance document by referencing provincial guidance documents, and focus on supplementary requirements of the City of Mission, and the noted exemptions.

> **Policy Recommendation #6:** It is recommended that the City of Mission reference the requirements of the Technical Assessment Guidelines (Todd et al., 2020) for a list of technical assessment and reporting requirements. To recognize the full value of the analysis and reporting, the City of Mission should:
>
> - Require that professionals provide a copy of pumping test analysis reports and an estimated hydraulic conductivity value for the aquifer.
> - Require that professionals specify how, where and when the water quality samples were collected.
> - Require that professionals provide justification for the methodologies employed in the analysis.

7 Conclusions

Based on the data compilation and desktop analysis undertaken as part of this assignment, we conclude the following:

1. Adequacy of Information: The information used to conduct analysis for this report were limited to publicly available data and information provided by the City of Mission. This information included reports and drawings, which required digitization, and were mainly to identify septic system locations. Consultant reports were focused on a very limited area of the Stave Falls Neighbourhood, and most of the area was not characterized. Publicly available data was generally limited to the British Columbia government well database, and associated aquifer mapping reports and fact sheets, which also had their own limitations in terms of accuracy and completeness. Although this information is judged to be sufficient for a scoping level (preliminary) hydrogeological assessment of the Stave Falls Neighbourhood, there is significant missing information that is required to confirm many of the assumptions adopted during this evaluation and produce an improved conceptual model of the aquifer system and a reliable water balance that can be used for planning purposes. Future assessments would benefit significantly from additional characterization to confirm connectivity with surface water features, aquifer properties, seasonal water level fluctuations and water quality.
2. State of GWELLS Database for Stave Falls Neighbourhood: Based on a limited Quality Assurance and Quality Control (QA/QC) evaluation of ten percent of the historical well evaluation report provided by the City of Mission, the GWELLS database contains the majority of the pertinent information within these reports and is judged to be a reasonably good source of information for the purposes of aquifer characterization and distribution of groundwater users within the Stave Falls Neighbourhood.
3. Mapped Aquifers: Five mapped aquifers underly the Stave Falls Neighborhood including two bedrock aquifers (19 and 154) and three unconsolidated aquifers (884, 26 and 971). Aquifer 884 is the primary domestic water supply source for the Stave Falls Neighborhood. Many of the aquifers appear to be partially to fully confined by a surficial unit consisting of fine-grained (silt and clay) glacially derived sediments. Sand and gravel aquifers provide meaningful quantities of water to groundwater well users. Bedrock outcrops at higher elevations and also provides adequate water supply to some well users.
4. Scoping Level Water Balance: The scoping level water balance indicated an overall surplus of water on an annual basis. However, two summer months (July and August) show a deficit which coincides with the period of time when groundwater use is typically greatest. Potential evaporation in July and August exceeds incoming precipitation, resulting in no groundwater recharge to the system in these months. Surplus water in June and September is low compared to winter months (December through February), suggesting that these months may also experience a deficit in years with hot and dry summers.
5. Vulnerability to Surface Contamination: Vulnerability to groundwater contamination is highest within the southern part of the Stave Falls Neighbourhood where susceptibility is interpreted to be high due to the interpreted outcropping of the aquifer that is collocated with agricultural land or septic systems. The highest vulnerability within the Stave Falls Neighbourhood lies along Dewdney Trunk Road where residents and agricultural lands are dispersed, along the northern part of Wilson Street where Aquifer 884 is expected to outcrop at ground surface, and along Wilson Street south of Ruskin Dam where Aquifer 971 is exposed at surface. Comparing vulnerability mapping to existing groundwater development indicates groundwater development within interpreted vulnerable areas along Dewdney Trunk Road. However, the interconnection between the aquifers and surface water features, notably Stave Lake, Hayward Lake is not known.
6. Review of Well Policy: The City of Mission's private well policy is generally suitable for the Stave Falls Neighbourhood in that it aims to collect important information for a rural groundwater-dependent area that is not otherwise required by provincial government agencies for domestic well users. However, the policy documents contain a significant volume of information that is duplicated or inconsistent with other British Columbia provincial government technical guidance documents. The policy documents provide good information on how the City of Mission intends to utilize this information during the land development process. Overall, these policy documents could be enhanced by specifically referencing the technical requirements established by the provincial government and providing references to protocols and procedures implemented to meet the objectives of the well policy documents rather than restating them.

8 Recommendations

Detailed context for recommendations is interspersed through the document in relevant sections. The following recommendations are made to improve the overall hydrogeologic understanding in the Stave Falls Neighborhood to inform future policy decisions and ensure sustainable use of groundwater resources for the community:

1. **Establish a Digital Database** to house hydrogeologic data including well locations, water use/groundwater pumping data, groundwater level measurements, well evaluation reports, septic system locations, borehole logs/lithologies, groundwater chemistry, etc. Many hydrogeological analyses utilize geospatial and subsurface data that must be in digital format to be useful. Prospective developers and groundwater users should be required to provide digital data for upload of any new information into this database to streamline digitization and record keeping. Data can be expensive to digitize, so preservation of digital data when available is recommended.
2. **Characterize Aquifer Properties and the Hydrogeologic Connection to Hayward Lake and Stave Lake** to determine the sustainable yield of the unconsolidated aquifers underlying the SFN. Pumping tests are required to confirm aquifer properties (such as hydraulic conductivity) at a scale that is appropriate for a regional assessment. Completing pumping tests in targeted locations near Hayward Lake and Stave Lake would allow for quantification of groundwater/surface water interactions along the eastern boundary of the SFN, which is critical for future water balance evaluations and vulnerability assessments. This information is critical for ultimately determining how much groundwater resources are available for consumption.
3. **Implement a Groundwater Monitoring Program** to monitor the current state of the aquifer systems and how they behave throughout the year in response to meteoric inputs and outputs, groundwater use and fluctuations in the elevation of Stave Lake and Hayward Lake. The monitoring system should include a series of monitoring wells in upland and lowland environments that are initially focused on Aquifer 884 and be monitored for water levels and water quality. Considering some residents within the SFN have experienced dry wells during some summer months, it is critical to create a monitoring program for regular data collection to diagnose these types of problems and monitor for any future issues that arise. Furthermore, the current understanding of groundwater quality is focused on point of use (tap water) data that may be influenced by household plumbing and water treatment systems. Monitoring programs produce the most reliable information when monitoring is conducted at the same locations by the same staff over a prolonged period. This is best completed in municipally owned wells.
4. **Improve the Hydrogeological Conceptual Model** to understand where the aquifer outcrops, characterize the extent and continuity of the confining unit, and determine the connection between the aquifers and Hayward Lake and Stave Lake. Data in the GWELLS database has been utilized to develop a preliminary geological model, but it is critical to ground truth the geological mapping through field investigation. Additional drilling is required to fill data gaps in targeted locations. Having a detailed geologic model is critical for all future hydrogeologic investigations and will support refinements of the initial water balance and vulnerability analysis.
5. **Establish a Local Meteorological** Station to monitor precipitation, temperature, relative humidity, net radiation, wind speed and wind direction within the Stave Falls Neighborhood. This is important information for establishment of the inputs (groundwater recharge) and outputs (evapotranspiration) from the water balance and is known to be highly variable in mountainous environments.
6. **Consider the Impacts of Climate Change** in future water balance evaluations to ensure the long-term sustainable aquifer yield is climate resilient. The Pacific Climate Impacts Consortium (PCIC) Climate Explorer can be used to develop future climate scenarios for the Stave Falls Neighborhood. Data from the proposed meteorological stating within the Stave Falls Neighborhood should also be used to validate model outputs. The Lower Mainland is forecast to experience longer and drier summers in conjunction with more intense fall precipitation events. Short duration extreme weather events like Atmospheric Rivers have already resulted in major flooding within the Lower Mainland and drier summers are resulting in water shortages and more intense forest fire seasons. It is critical to validate these predictions with climate analysis and prepare for future changes in water resources.
7. **Update the Private Well Policy** to minimize duplicity and contradictions with established technical guidance documents and focus on information that is important to the City of Mission.

9 References

Armstrong, J.E., 1980. Surficial Geology, Mission, British Columbia, Geological Survey of Canada Map 1485A.

BC MOE (British Columbia Ministry of Environment), 2012. Guidelines for Groundwater Modeling to Assess Impacts of Proposed Natural Resource Development Activities, Report No. 194001, 385 pages.

Government of British Columbia, 2011. Public Health Act, Health Hazards Regulation. B.C. Reg. 216/2011.

Holding, S., and Allen, D.M., 2016, Risk to water security for small islands: an assessment framework and application: Regional Environmental Change, v. 16, p. 827–839, doi:10.1007/s10113-015-0794-1.

Klassen, J., and Allen, D.M., 2017, Assessing the risk of saltwater intrusion in coastal aquifers: Journal of hydrology, v. 551, p. 730–745, doi:10.1016/j.jhydrol.2017.02.044.

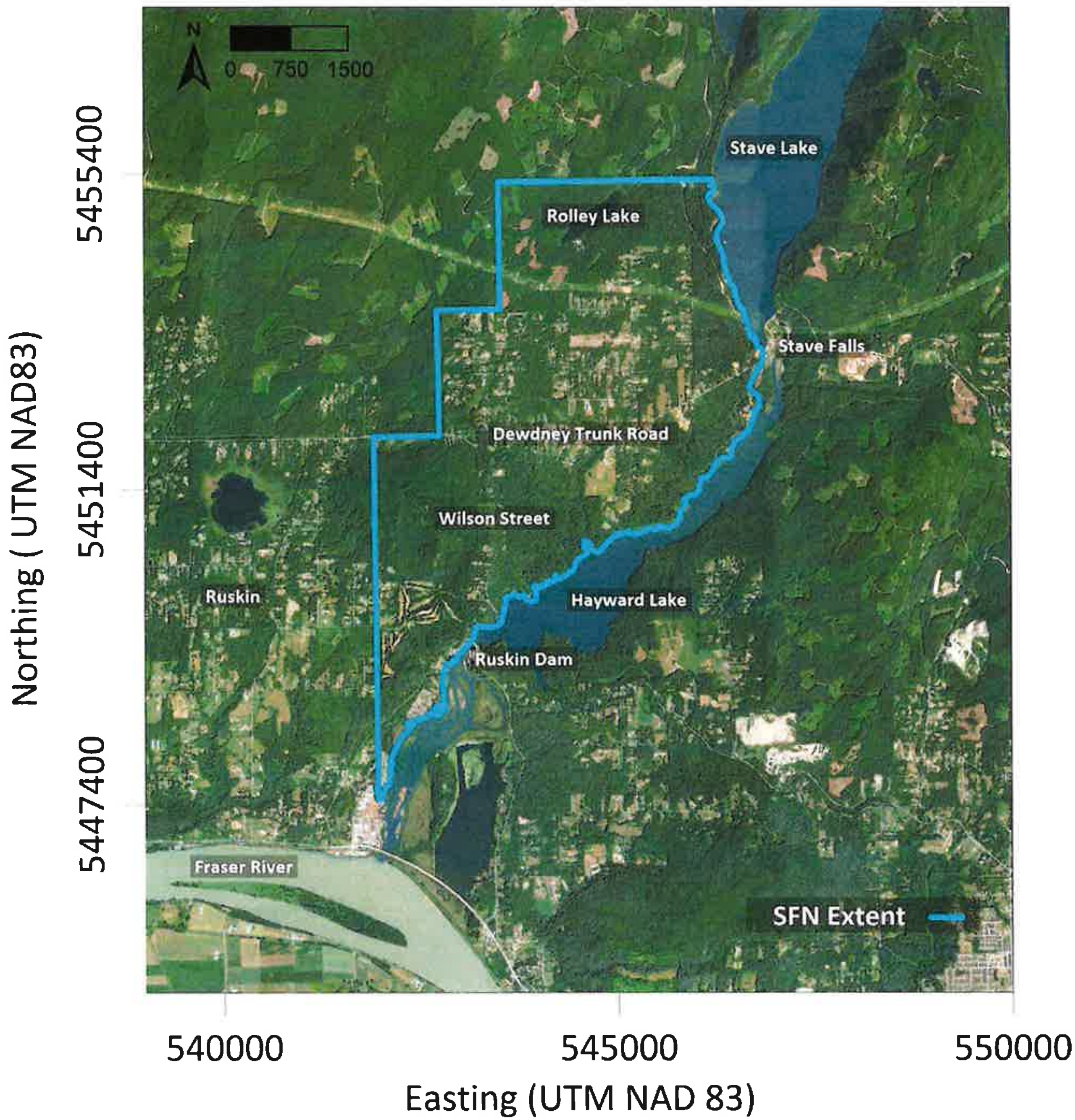
Ministry of Water, Land and Air Pollution, 2002. Guide to Using the BC Aquifer Classification Maps, 61 pages.

Natural Resources Canada, 1998. Geological Survey of Canada Open File 3511, Vancouver Geomap, Geological Map of the Vancouver Metropolitan Area.

Simpson, M.W.M., Allen, D.M., and Journeay, M.M., 2014, Assessing risk to groundwater quality using an integrated risk framework: Environmental Earth Sciences, v. 71, p. 4939–4956, doi:10.1007/s12665-013-2886-x.

J.E. Wilson, S. Brown, H. Schreier, D. Scovill and M. Zubel. Arsenic in Groundwater Wells in Quaternary Deposits in the Lower Fraser Valley of British Columbia, Canadian Water Resources Journal, Vol. 33(4): 397–412.

Figures



STAVE FALLS AQUIFER HYDROGEOLOGIC REVIEW

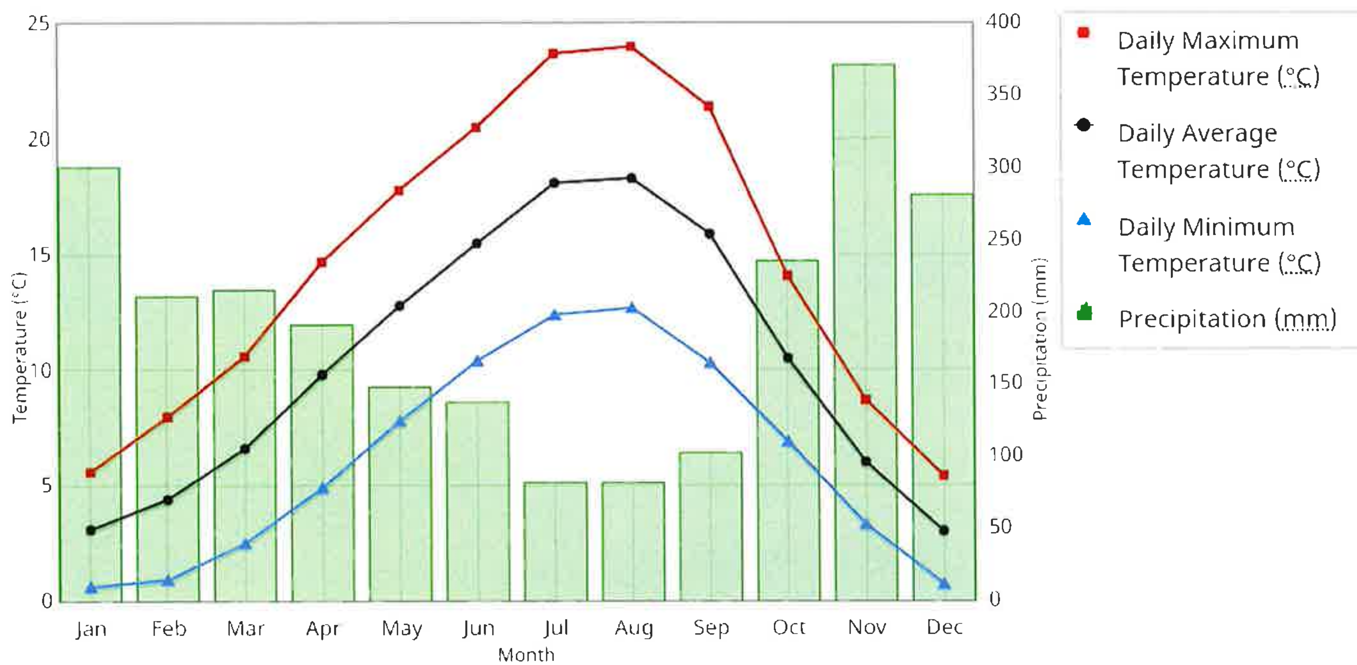
Site Map

CITY OF MISSION

Dec 1, 2023	60712246

Figure 1-1

AECOM



STAVE FALLS AQUIFER HYDROGEOLOGIC REVIEW

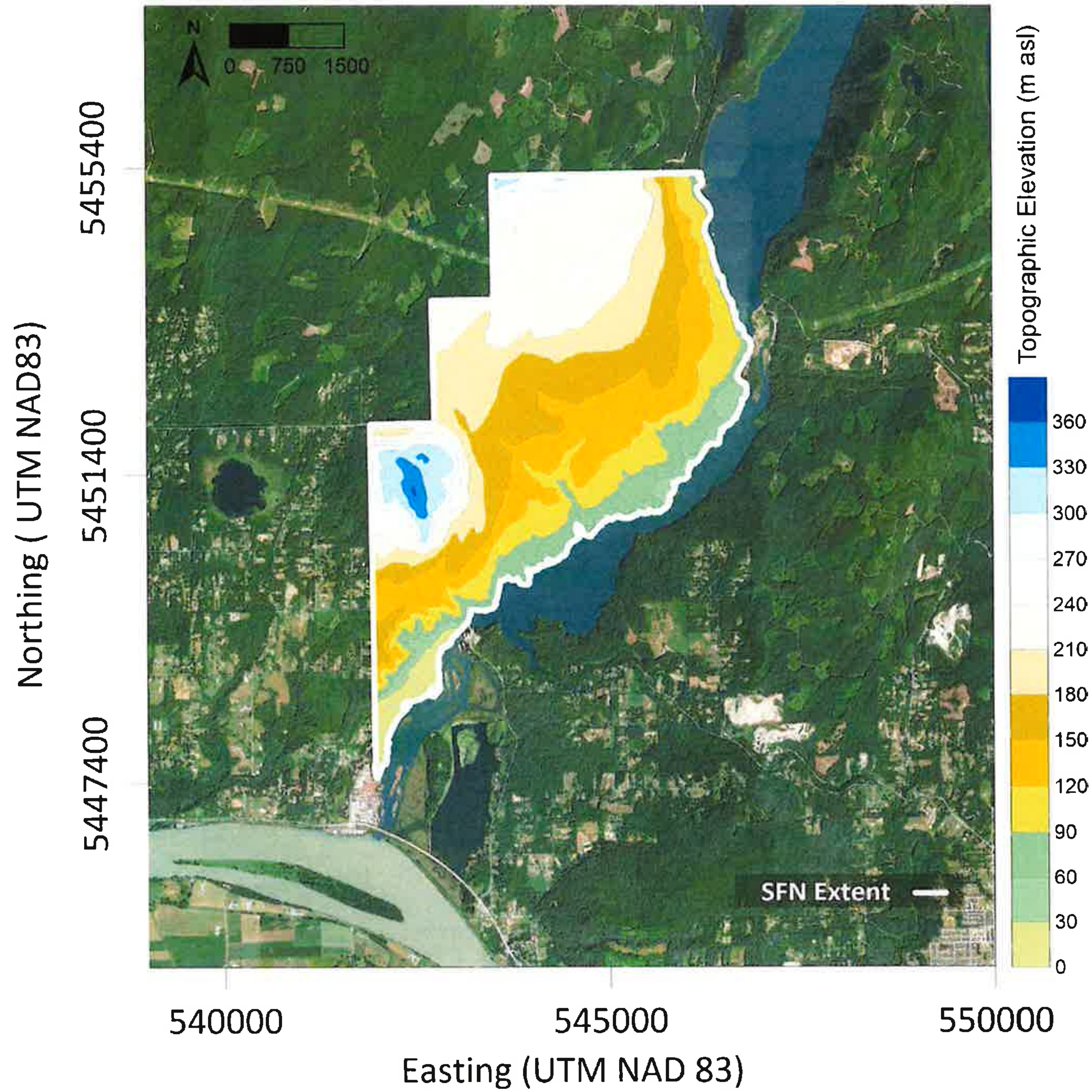
1981-2020 Canadian Climate Normals Station 1107680

CITY OF MISSION

Dec 1, 2023	60712246

Figure 2-1

AECOM



STAVE FALLS AQUIFER HYDROGEOLOGIC REVIEW

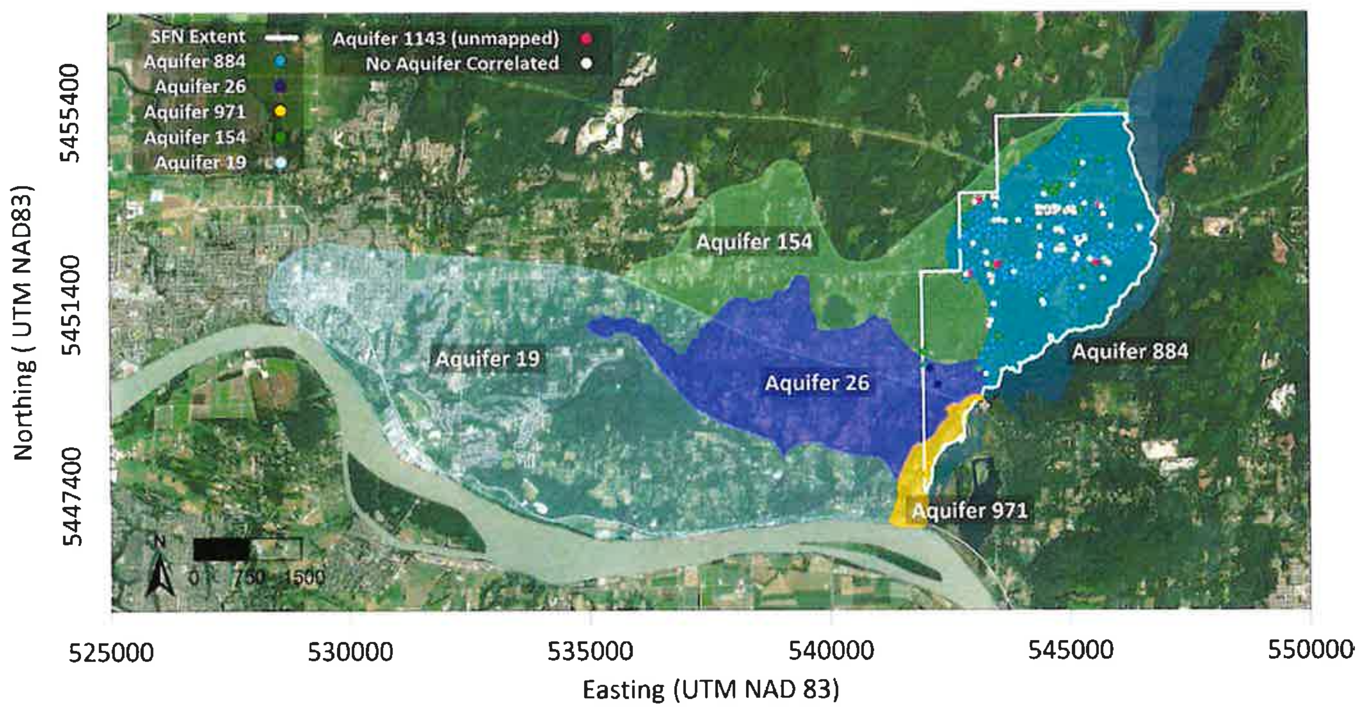
Ground Elevation

CITY OF MISSION

Dec 1, 2023	60712246

Figure 2-2

AECOM



STAVE FALLS AQUIFER HYDROGEOLOGIC REVIEW

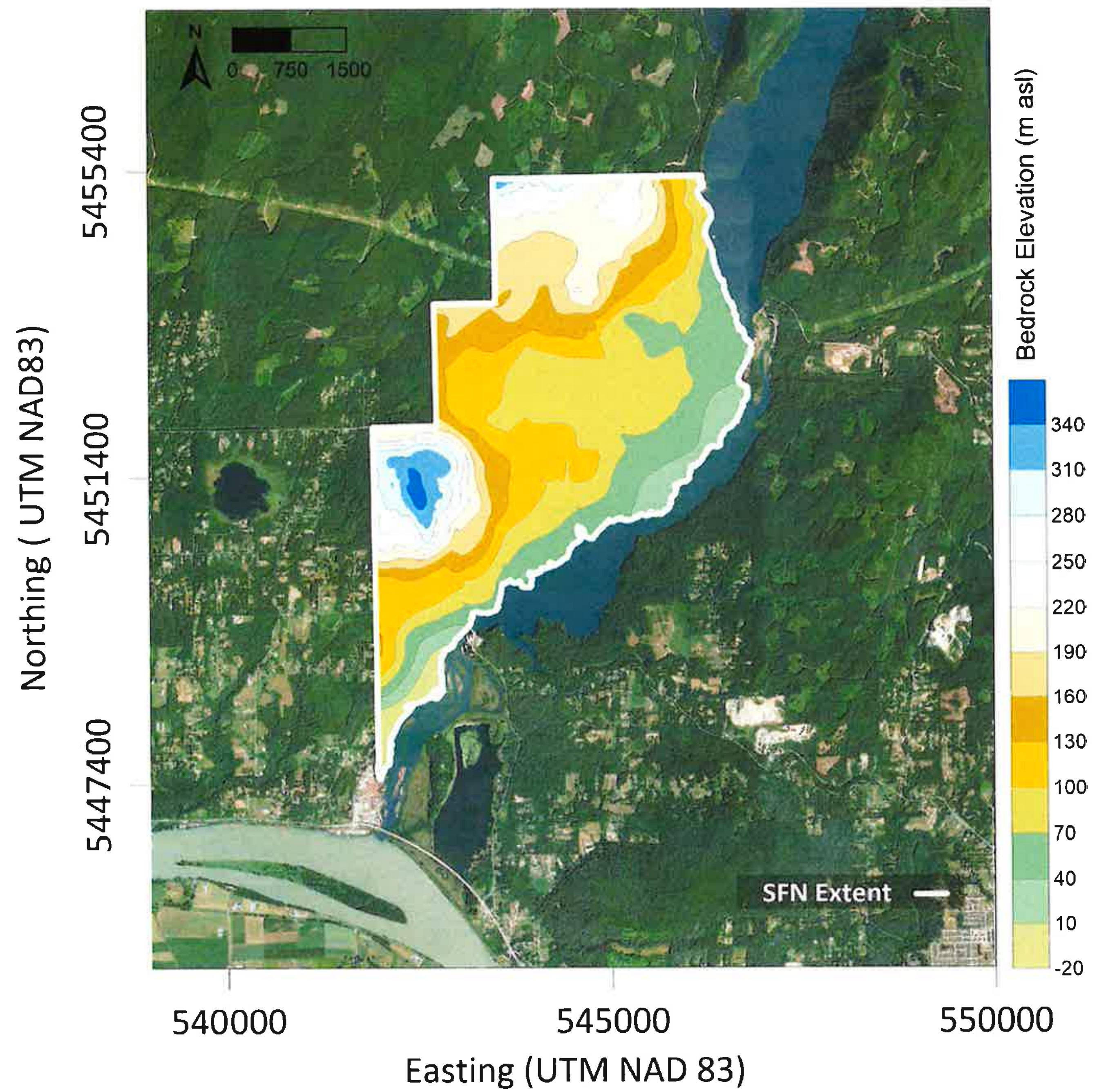
Aquifers and Correlated Boreholes

CITY OF MISSION

Dec 1, 2023	60712246

Figure 3-1

AECOM



STAVE FALLS AQUIFER
HYDROGEOLOGIC REVIEW

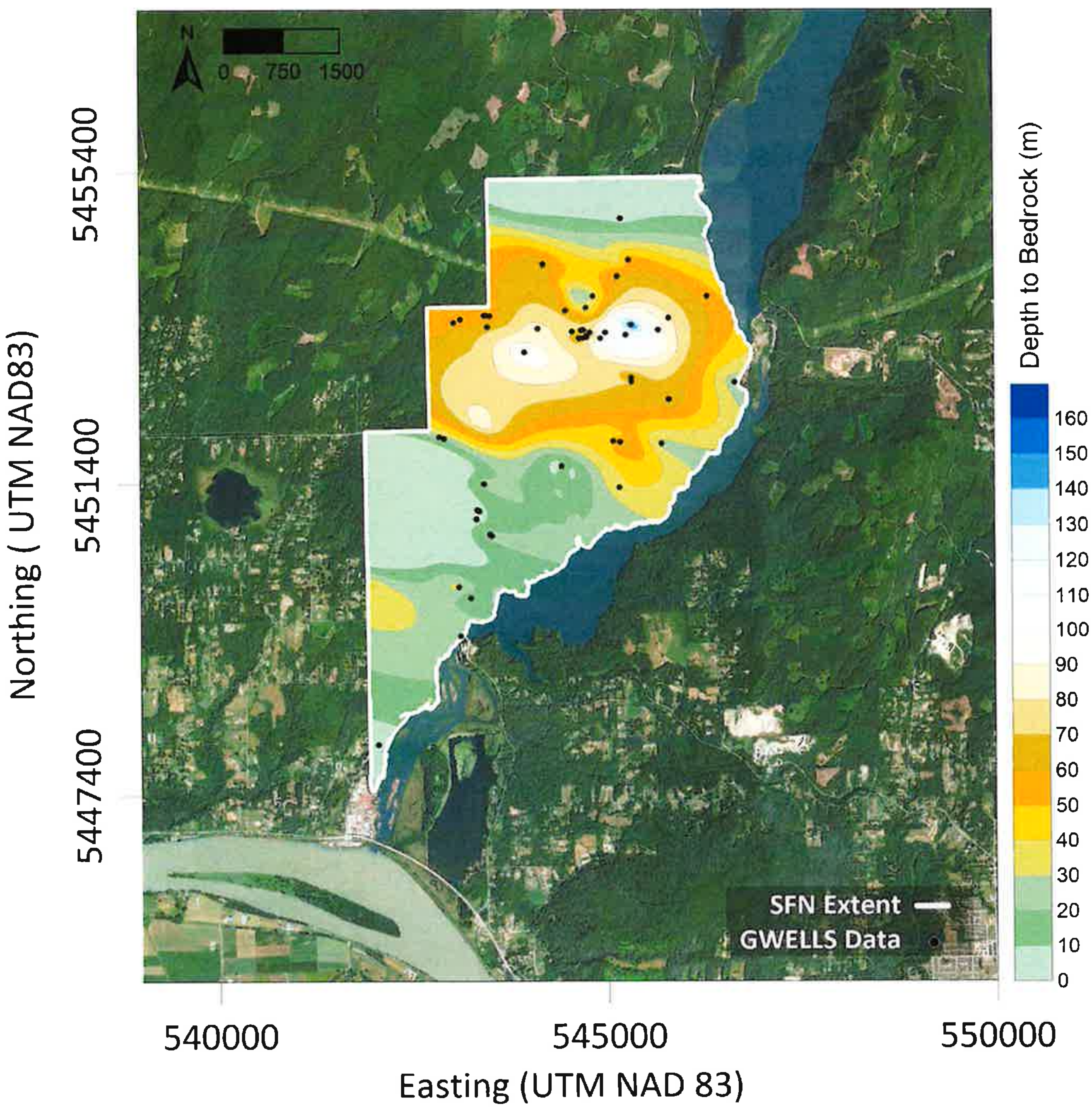
Top of Bedrock Elevation

CITY OF MISSION

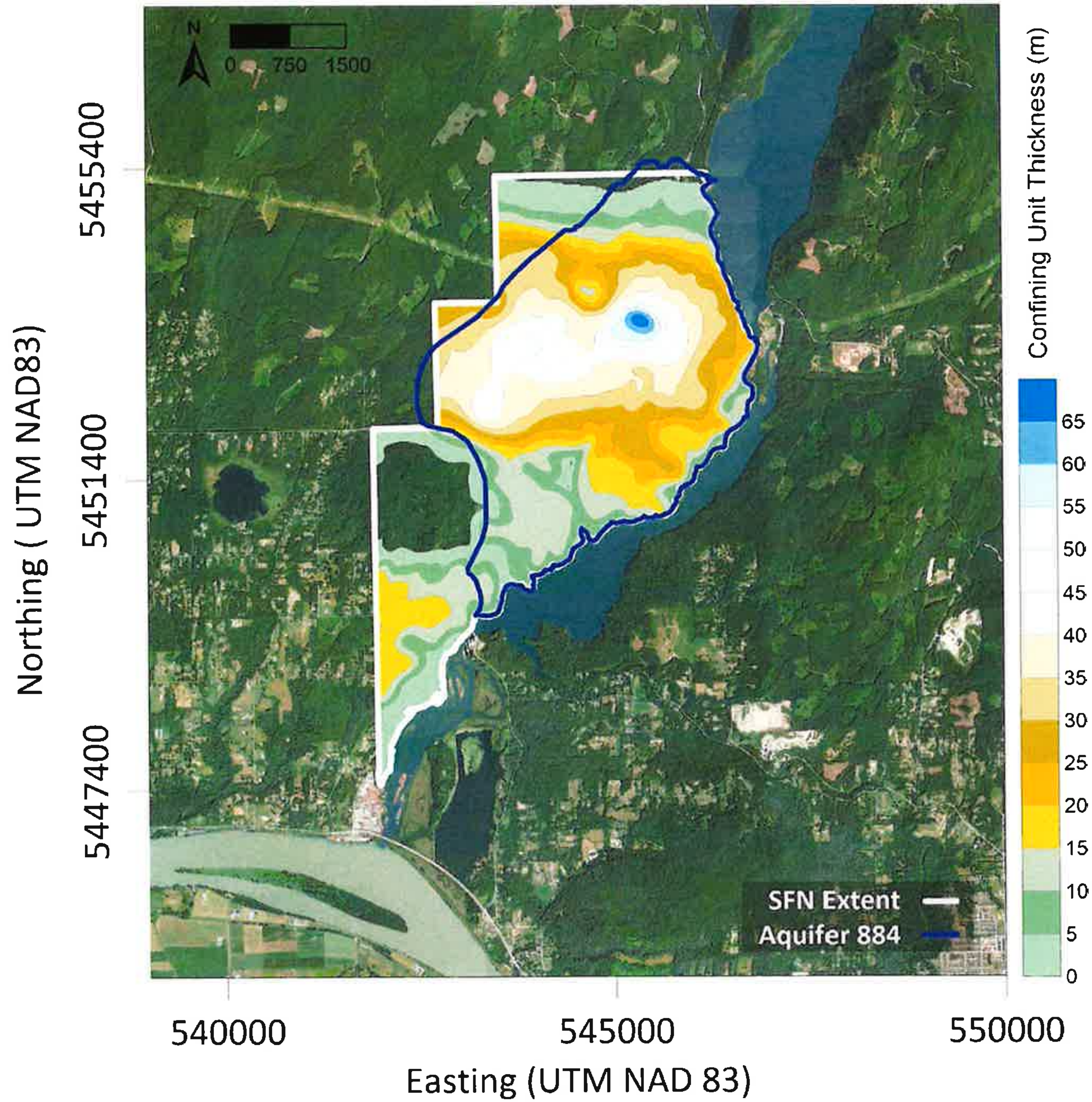
Dec 1, 2023 | 60712246

Figure 3-2

AECOM



STAVE FALLS AQUIFER HYDROGEOLOGIC REVIEW	
Depth to Top of Bedrock	
CITY OF MISSION	
Dec 1, 2023	60712246
Figure 3-3	
AECOM	



STAVE FALLS AQUIFER HYDROGEOLOGIC REVIEW

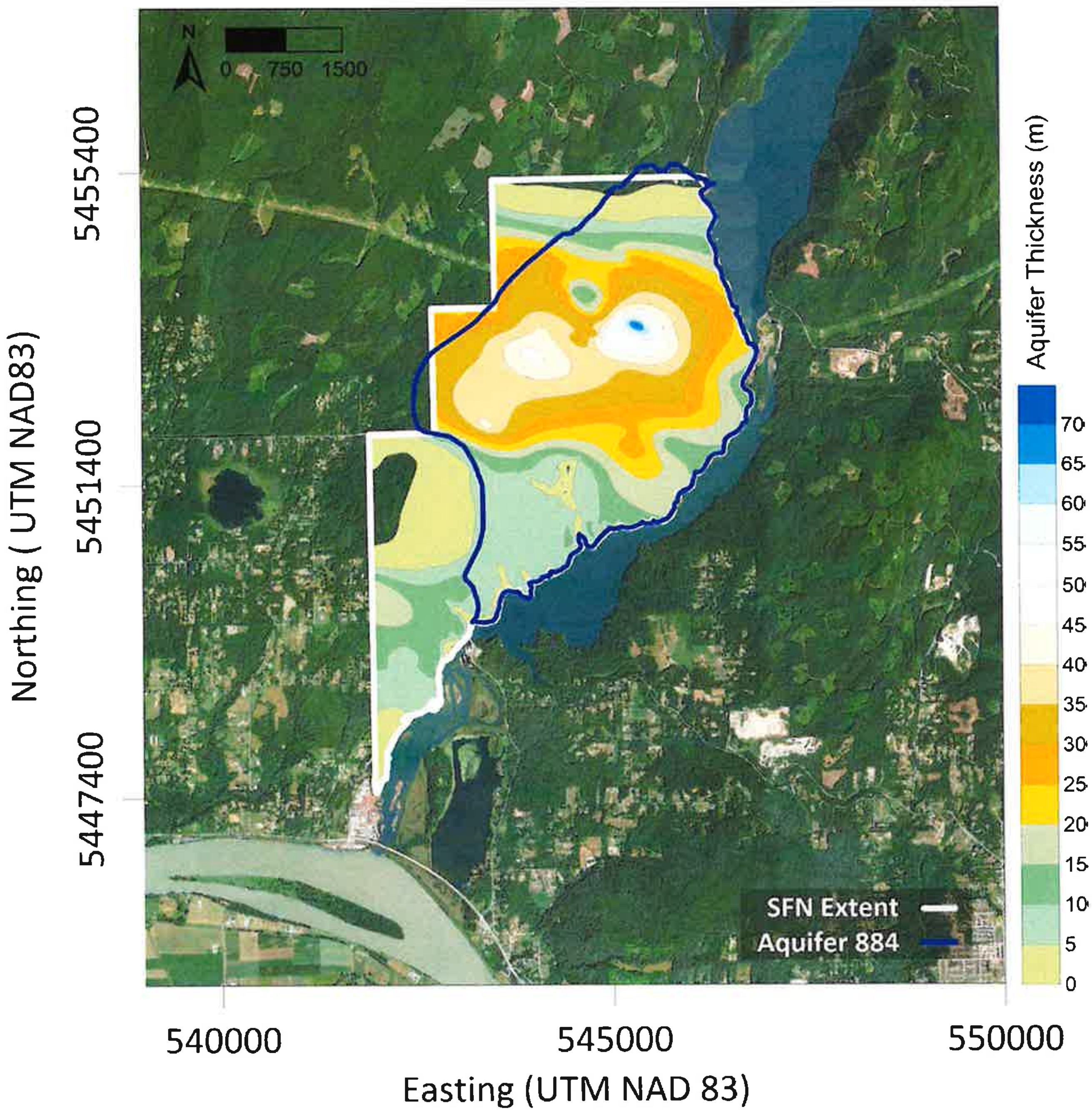
Confining Unit Thickness

CITY OF MISSION

Dec 1, 2023	60712246

Figure 3-4

AECOM



STAVE FALLS AQUIFER
HYDROGEOLOGIC REVIEW

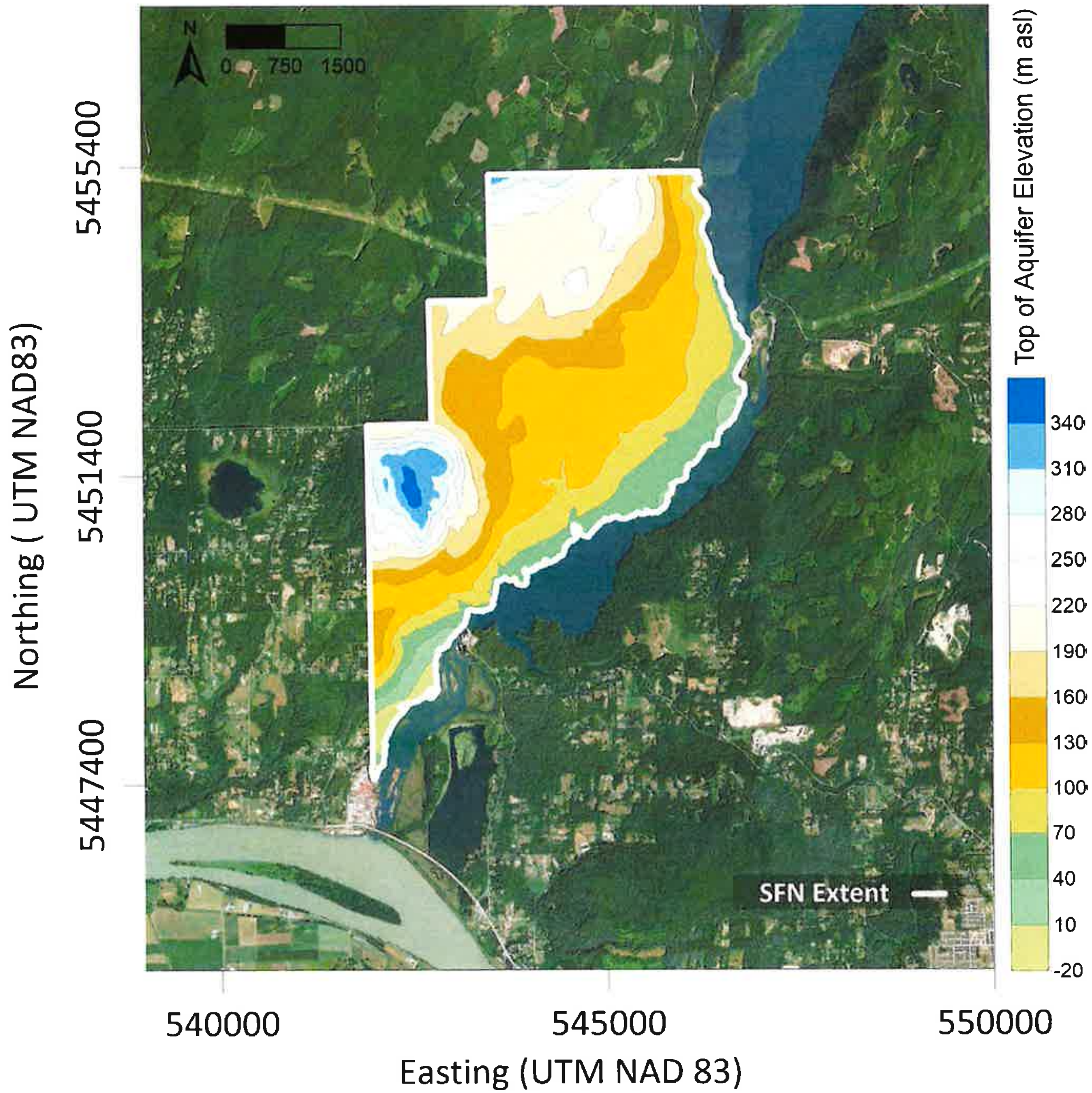
Unconsolidated Aquifer Thickness

CITY OF MISSION

Dec 1, 2023	60712246

Figure 3-5

AECOM



STAVE FALLS AQUIFER HYDROGEOLOGIC REVIEW

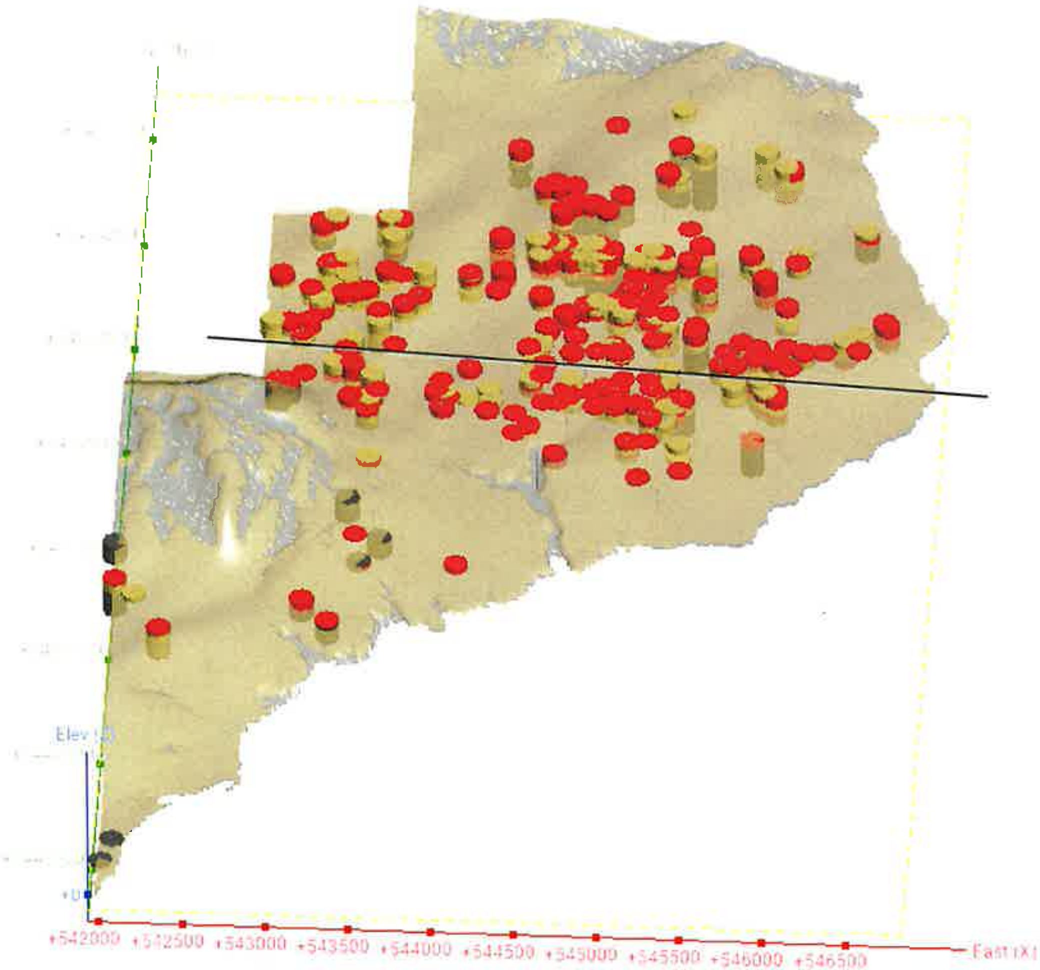
Top of Aquifer Elevation

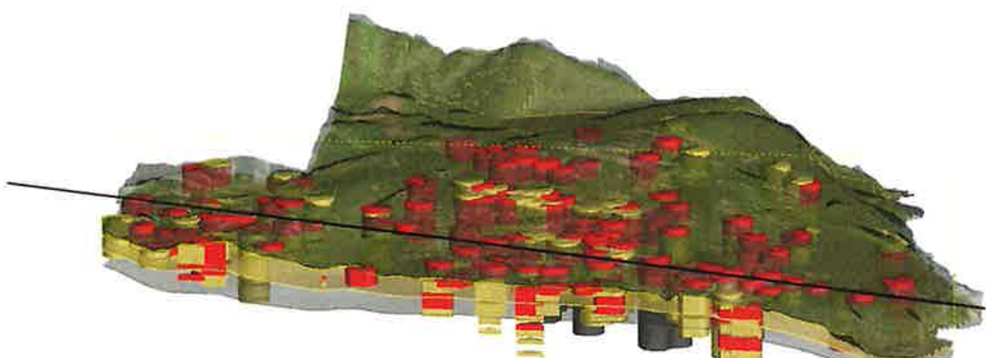
CITY OF MISSION

Dec 1, 2023 | 60712246

Figure 3-6

AECOM





STAVE FALLS AQUIFER
HYDROGEOLOGIC REVIEW

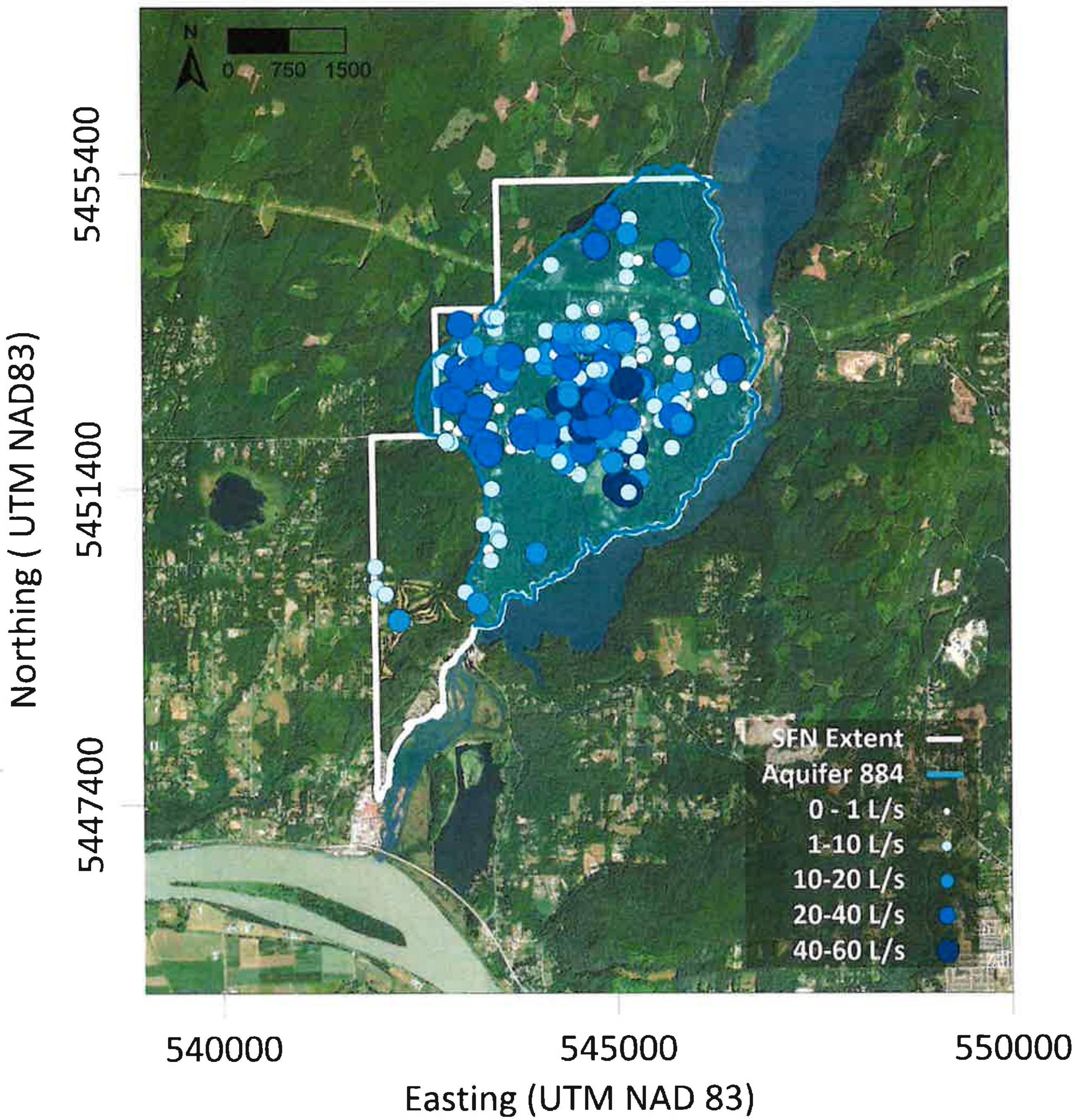
Initial Leapfrog Geologic Modeling Framework

CITY OF MISSION

Dec 1, 2023	60712246

Figure 3-7

AECOM



STAVE FALLS AQUIFER
HYDROGEOLOGIC REVIEW

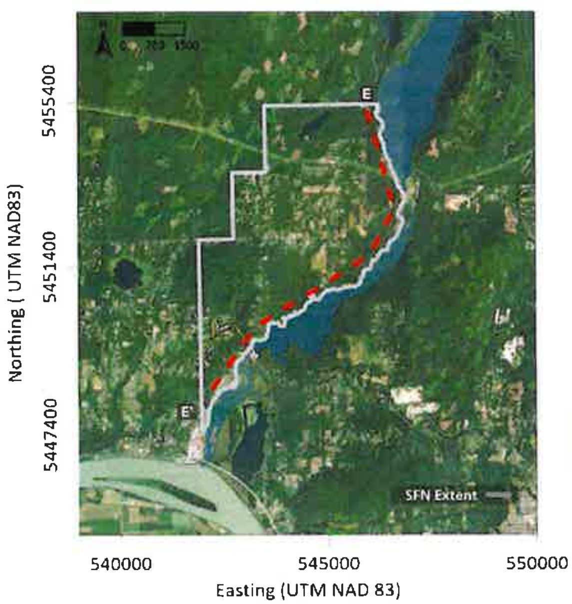
Well Yield

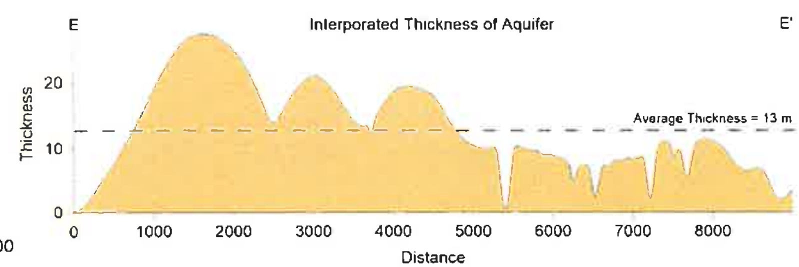
CITY OF MISSION

Dec 1, 2023	60712246

Figure 3-8

AECOM





STAVE FALLS AQUIFER
HYDROGEOLOGIC REVIEW

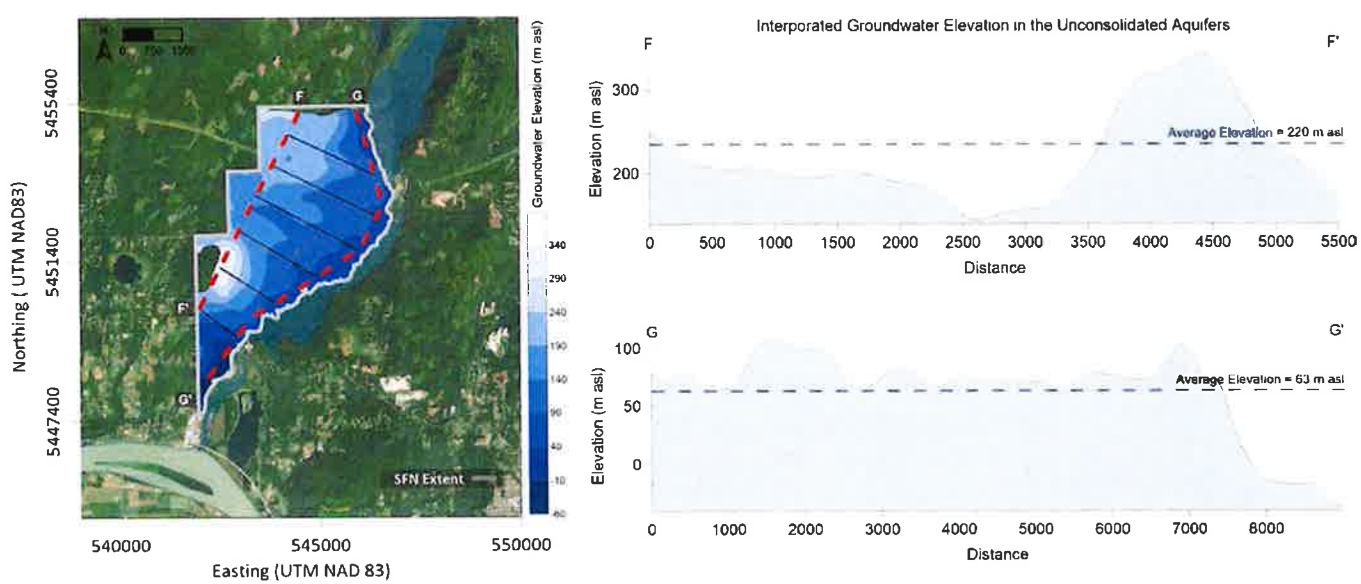
Interpreted Aquifer Thickness
Along Stave and Hayward Lakes

CITY OF MISSION

Dec 1, 2023	60712246

Figure 4-1

AECOM



STAVE FALLS AQUIFER
HYDROGEOLOGIC REVIEW

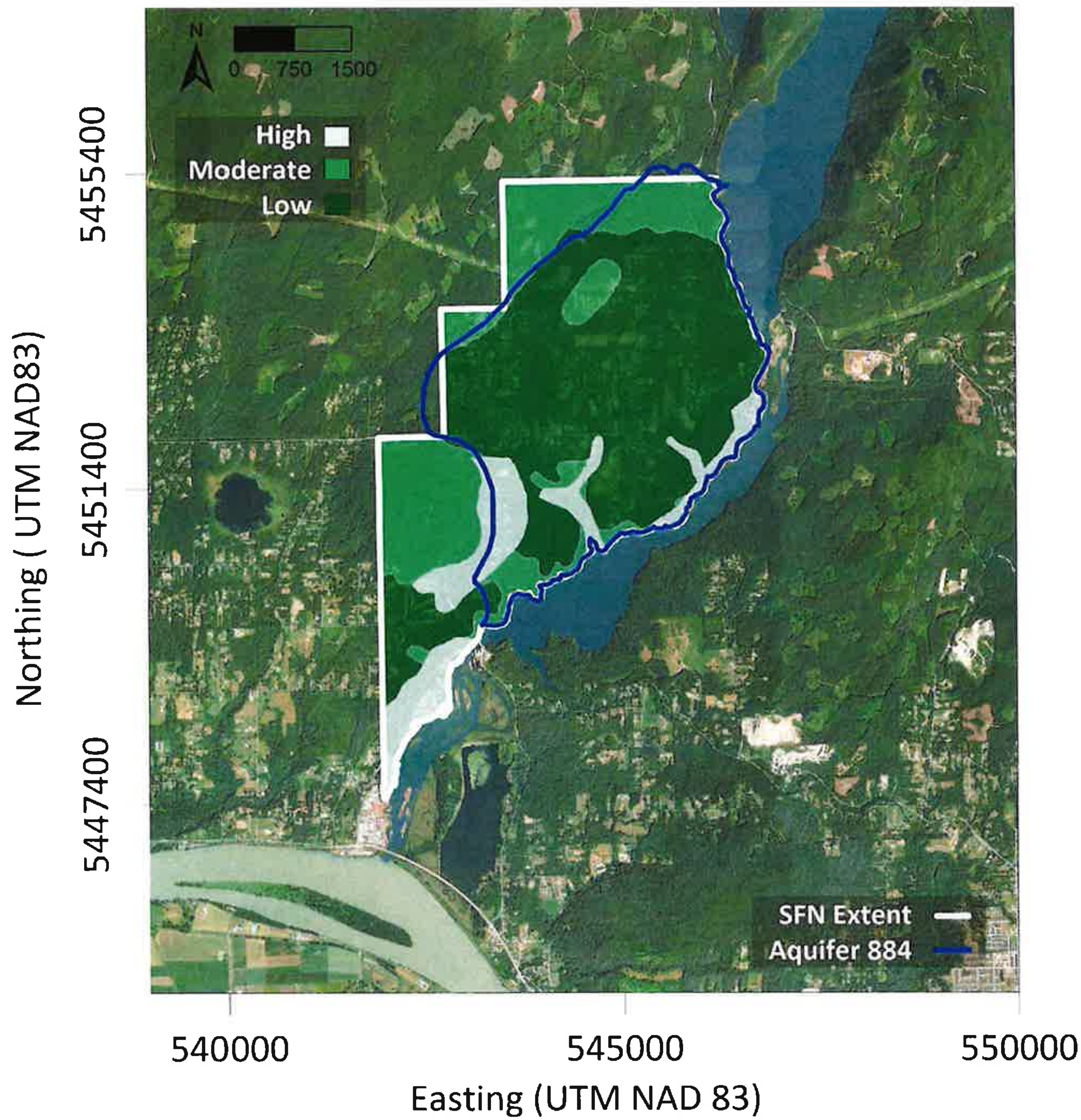
Interpreted Groundwater Elevation

CITY OF MISSION

Dec 1, 2023	60712246

Figure 4-2

AECOM



STAVE FALLS AQUIFER
HYDROGEOLOGIC REVIEW

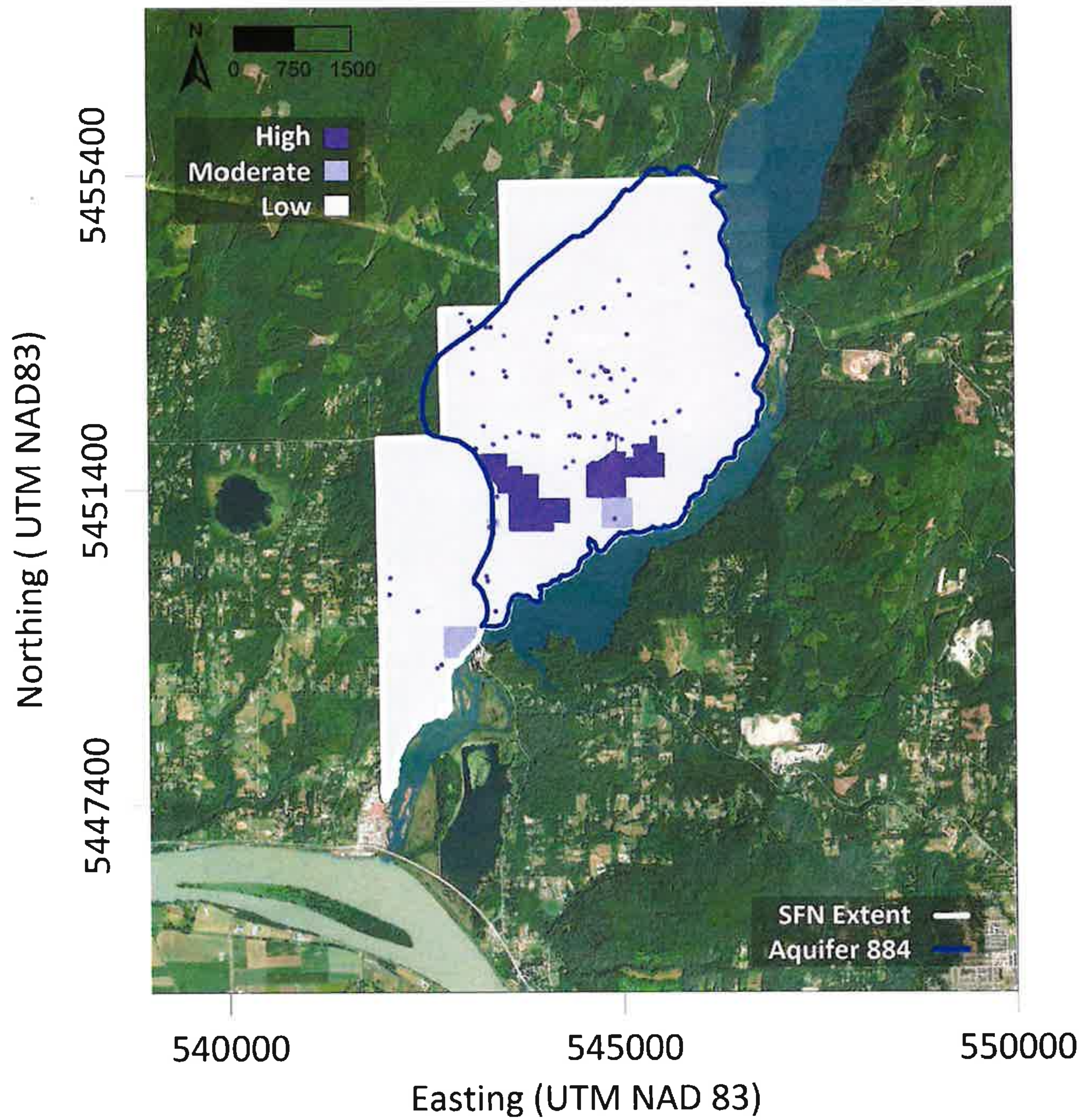
Aquifer Suseptibility

CITY OF MISSION

Dec 1, 2023	60712246

Figure 5-1

AECOM



STAVE FALLS AQUIFER HYDROGEOLOGIC REVIEW

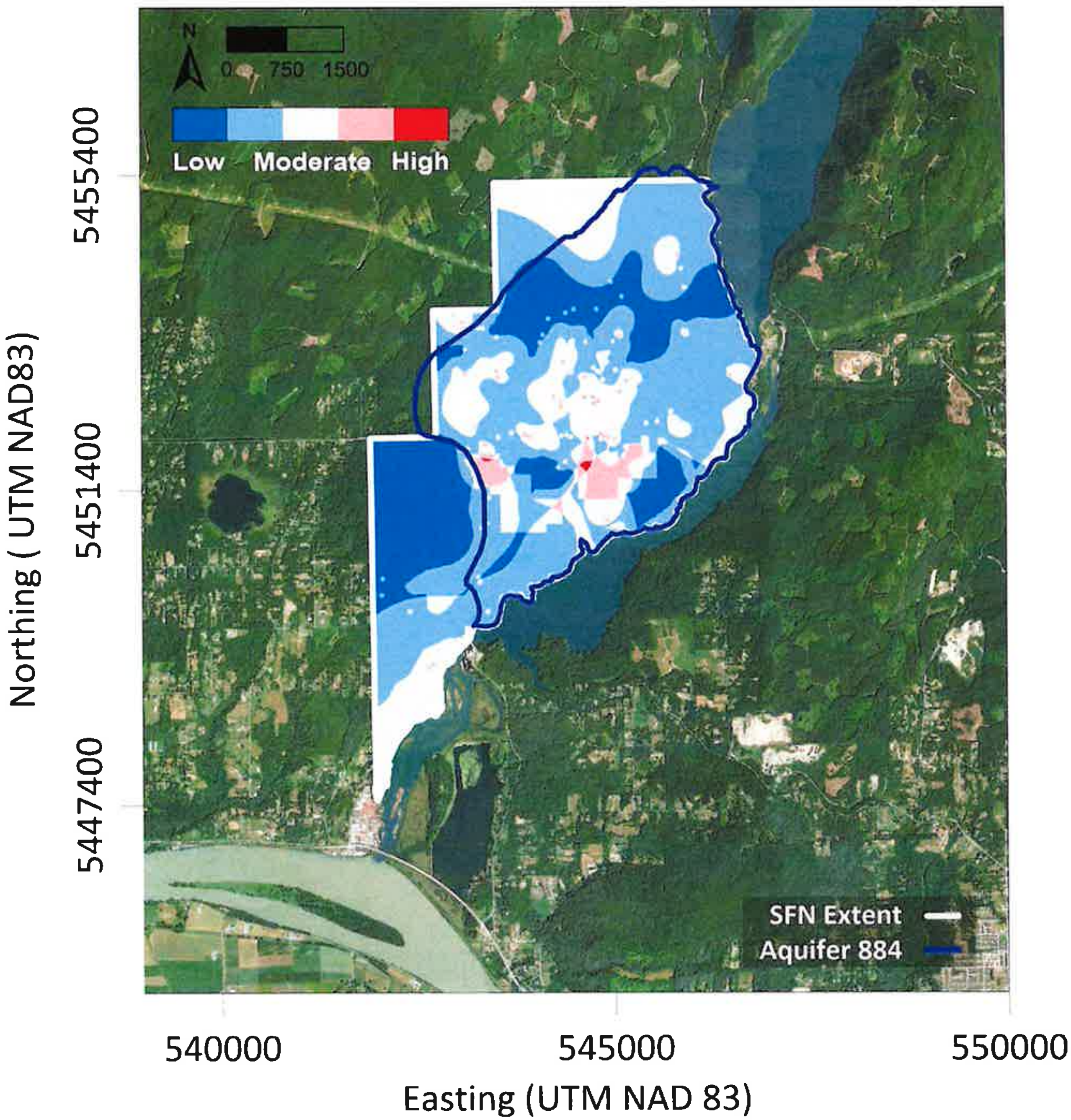
Hazard Map

CITY OF MISSION

Dec 1, 2023	60712246

Figure 5-2

AECOM



STAVE FALLS AQUIFER
HYDROGEOLOGIC REVIEW

Combination of Vulnerability and Development

CITY OF MISSION

Dec 1, 2023	60712246

Figure 5-3

AECOM

Appendix A

Data Collection and Consolidation

Data Type	Data Format	Data Source(s)
Maps and Geospatial Data	Digital Elevation Model	Government of Canada LiDAR
	SFN Extent Shapefile	City of Mission WebMap
	Zoning Codes/Land Use Shapefile	City of Mission WebMap
	Septic System Locations	City of Mission, digitized by AECOM
Geologic and Hydrostratigraphic	Geologic Maps	Vancouver Geomap
	Borehole Lithology	GWELLS
	Hydrostratigraphic Unit Average Thicknesses	Aquifer Mapping Reports and Fact Sheets
Hydrogeologic	Aquifer Description, Extent/Location	GWELLS, Aquifer Mapping Reports and Fact Sheets
	Aquifer properties	GWELLS, Aquifer Mapping Reports and Fact Sheets, City of Mission Well Evaluation and Pumping Test Analysis
	Water Level	GWELLS
	Water Chemistry	City of Mission Well Evaluation and Pumping Test Analysis, digitized by AECOM
	Well Yield	GWELLS
	Groundwater users and licenses	GWELLS
Climate	Precipitation	Canadian Climate Normals for the Stave Falls station
	Temperature	Canadian Climate Normals for the Stave Falls station

Internet resources listed in the table above include:

- Aquifer Mapping Reports and Fact Sheets:

  https://catalogue.data.gov.bc.ca/dataset/ground-water-aquifers

- Canadian Climate Normals for Stave Falls climate station:
  https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=stave+falls&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=867&dispBack=1

- GWELLS Database:

  https://apps.nrs.gov.bc.ca/gwells/

- Vancouver Geomap:

  https://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=209909

- Government of Canada LiDAR:

  https://natural-resources.canada.ca/science-and-data/science-and-research/topographic-information/whats-new/new-lidar-derived-data-available-on-open-maps/24414

- City of Mission WebMap:

  https://map.mission.ca/Html5Viewer/?viewer=External#

Appendix B

2023 Zoning Codes

ID	Zone Class	DoM Zoning Description	AECOM Reclassification	Shape Area	Percent of Total Area
0	RU80	Rural 80 Zone	Rural	6868410	17.71
1	RU80	Rural 80 Zone	Rural	143707	0.37
2	RU80	Rural 80 Zone	Rural	2756202	7.11
3	RU80	Rural 80 Zone	Rural	5521	0.01
4	COR	Commercial Open Land Recreation Zone	Institutional or Commercial Park, Open Area, or Recreation Site	771	0.00
5	RU16	Rural 16 Zone	Rural	32427	0.08
6	CTR	Commercial Tourist Recreation Zone	Institutional or Commercial Park, Open Area, or Recreation Site	22524	0.06
7	IPRC	Institutional Parks, Recreation and Civic Zone	Institutional or Commercial Park, Open Area, or Recreation Site	3702	0.01
8	RU16	Rural 16 Zone	Rural	148459	0.38
9	COR	Commercial Open Land Recreation Zone	Institutional or Commercial Park, Open Area, or Recreation Site	608471	1.57
10	CTR	Commercial Tourist Recreation Zone	Institutional or Commercial Park, Open Area, or Recreation Site	127901	0.33
11	RU36	Rural 36 Zone	Rural	240056	0.62
12	RR7	Rural Residential 7 Zone	Rural Residential	41470	0.11
13	RR7	Rural Residential 7 Zone	Rural Residential	80483	0.21
14	RR7	Rural Residential 7 Zone	Rural Residential	21711	0.06
15	RR7	Rural Residential 7 Zone	Rural Residential	49331	0.13
16	RR7	Rural Residential 7 Zone	Rural Residential	107897	0.28
17	RR7	Rural Residential 7 Zone	Rural Residential	613019	1.58
18	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	4013	0.01
19	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	9479	0.02
20	RU16	Rural 16 Zone	Rural	20723	0.05
21	CR	Commercial Rural Zone	Rural	14762	0.04
22	RU36s	Rural 36 Secondary Dwelling Zone	Rural	37793	0.10
23	RR7	Rural Residential 7 Zone	Rural Residential	7908	0.02
24	RR7	Rural Residential 7 Zone	Rural Residential	61420	0.16
25	RU36	Rural 36 Zone	Rural	1586596	4.09
26	RU16	Rural 16 Zone	Rural	615161	1.59
27	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	79574	0.21
28	RR7	Rural Residential 7 Zone	Rural Residential	68193	0.18
29	IPRC	Institutional Parks, Recreation and Civic Zone	Institutional or Commercial Park, Open Area, or Recreation Site	1296926	3.34
30	RU36	Rural 36 Zone	Rural	575606	1.48
31	RU36	Rural 36 Zone	Rural	647326	1.67
32	A36	Agriculture 36 Zone	Agriculture	275240	0.71
33	CD7	Comprehensive Development 7 Zone	Commercial Development	160226	0.41
34	RU80	Rural 80 Zone	Rural	664274	1.71
35	RU16	Rural 16 Zone	Rural	225062	0.58
36	RU16	Rural 16 Zone	Rural	756987	1.95
37	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	20122	0.05
38	RR7	Rural Residential 7 Zone	Rural Residential	41721	0.11
39	RU16	Rural 16 Zone	Rural	1506663	3.88
40	RU16	Rural 16 Zone	Rural	41052	0.11
41	RU36	Rural 36 Zone	Rural	1567467	4.04
42	RR7	Rural Residential 7 Zone	Rural Residential	21010	0.05
43	RU16	Rural 16 Zone	Rural	21010	0.05
44	RR7	Rural Residential 7 Zone	Rural Residential	20270	0.05
45	RR7	Rural Residential 7 Zone	Rural Residential	20131	0.05
46	RR7	Rural Residential 7 Zone	Rural Residential	76612	0.20
47	RU16	Rural 16 Zone	Rural	76612	0.20
48	RR7	Rural Residential 7 Zone	Rural Residential	20421	0.05
49	RR7	Rural Residential 7 Zone	Rural Residential	58650	0.15
50	RU16	Rural 16 Zone	Rural	58650	0.15
51	RR7	Rural Residential 7 Zone	Rural Residential	53937	0.14
52	RU16	Rural 16 Zone	Rural	53937	0.14
53	RU16s	Rural 16 Secondary Dwelling Zone	Rural	1070	0.00
54	RU16	Rural 16 Zone	Rural	1070	0.00
55	IE	Institutional Educational Zone	Institutional or Commercial Park, Open Area, or Recreation Site	16049	0.04
56	RU16	Rural 16 Zone	Rural	16049	0.04
57	IPRC	Institutional Parks, Recreation and Civic Zone	Institutional or Commercial Park, Open Area, or Recreation Site	4115	0.01
58	RU16	Rural 16 Zone	Rural	4115	0.01
59	RU16	Rural 16 Zone	Rural	40573	0.10
60	RU36	Rural 36 Zone	Rural	40573	0.10
61	RU16	Rural 16 Zone	Rural	81637	0.21
62	RU36	Rural 36 Zone	Rural	81637	0.21
63	RU16	Rural 16 Zone	Rural	18729	0.05
64	RU16	Rural 16 Zone	Rural	55773	0.14
65	RU36	Rural 36 Zone	Rural	55773	0.14
66	RR7	Rural Residential 7 Zone	Rural Residential	12039	0.03
67	RR7	Rural Residential 7 Zone	Rural Residential	40278	0.10
68	RU16	Rural 16 Zone	Rural	40278	0.10
69	RR7	Rural Residential 7 Zone	Rural Residential	53733	0.14
70	RR7	Rural Residential 7 Zone	Rural Residential	19868	0.05
71	RU16	Rural 16 Zone	Rural	19868	0.05
72	RU16	Rural 16 Zone	Rural	28230	0.07
73	IE	Institutional Educational Zone	Institutional or Commercial Park, Open Area, or Recreation Site	28230	0.07
74	RU16	Rural 16 Zone	Rural	12218	0.03
75	IPRC	Institutional Parks, Recreation and Civic Zone	Institutional or Commercial Park, Open Area, or Recreation Site	12218	0.03
76	RU36	Rural 36 Zone	Rural	3909	0.01
77	RR7	Rural Residential 7 Zone	Rural Residential	15056	0.04
78	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	28309	0.07
79	RU16	Rural 16 Zone	Rural	686845	1.77
80	RR7	Rural Residential 7 Zone	Rural Residential	286321	0.74
81	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	20224	0.05
82	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	10846	0.03
83	IPRC	Institutional Parks, Recreation and Civic Zone	Institutional or Commercial Park, Open Area, or Recreation Site	2442262	6.30
84	RR7	Rural Residential 7 Zone	Rural Residential	20406	0.05
85	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	25695	0.07
86	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	7805	0.02
87	RR7	Rural Residential 7 Zone	Rural Residential	20163	0.05
88	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	20520	0.05
89	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	19560	0.05
90	CD38	Comprehensive Development 38 Zone	Commercial Development	16395	0.04
91	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	14533	0.04
92	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	10086	0.03
93	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	30337	0.08
94	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	20429	0.05
95	RU16s	Rural 16 Secondary Dwelling Zone	Rural	21496	0.06
96	RU16s	Rural 16 Secondary Dwelling Zone	Rural	4023	0.01
97	RU16s	Rural 16 Secondary Dwelling Zone	Rural	3771	0.01
98	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	20263	0.05
99	IU	Institutional Utility Zone	Commercial Development	441577	1.14
100	RU80	Rural 80 Zone	Rural	1063237	2.74
101	IPRC	Institutional Parks, Recreation and Civic Zone	Institutional or Commercial Park, Open Area, or Recreation Site	8637202	22.27
102	RU80	Rural 80 Zone	Rural	212363	0.55
103	A80	Agriculture 80 Zone	Agriculture	456727	1.18
104	A16	Agriculture 16 Zone	Agriculture	127300	0.33
105	RU36	Rural 36 Zone	Rural	223185	0.58
106	RU36	Rural 36 Zone	Rural	36257	0.09
107	RU16	Rural 16 Zone	Rural	22289	0.06
108	RU16	Rural 16 Zone	Rural	77728	0.20
109	A16	Agriculture 16 Zone	Agriculture	195120	0.50
110	RU80	Rural 80 Zone	Rural	27550	0.07

2023 Zoning Codes

ID	Zone Class	DoM Zoning Description	AECOM Reclassification	Shape Area	Percent of Total Area
111	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	10453	0.03
112	RR7	Rural Residential 7 Zone	Rural Residential	3962	0.01
113	RR7	Rural Residential 7 Zone	Rural Residential	8884	0.02
114	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	9575	0.02
115	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	9364	0.02
116	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	61091	0.16
117	RR7s	Rural Residential 7 Secondary Dwelling	Rural Residential	40150	0.10
118	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	20175	0.05
119	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	11268	0.03
120	RR7s	Rural Residential 7 Secondary Dwelling Zone	Rural Residential	20783	0.05
					100.00

Appendix C

2023 Borehole Data Simplified

2023 Borehole Data Simplified

ID	Well Tag	Top Elevation (m)	Bottom Elevation (m)	GWELLS Lithology Description	AECOM Simplified Lithology	AECOM Hydrostratigraphy
0	1233	1.8288	18.288	hrd pan and boulders	boulders	coarse
1	1233	19.2024	26.8224	clay	clay	fine
2	1233	28.3464	38.1	hard packed sand and gravel	sand	coarse
3	1233	38.1	56.6928	hard packed sand	sand	coarse
4	1913	0.6096	10.668	blue hardpan clay with boulders	hardpan	fine
5	3118	0	6.096	quicksand	quicksand	coarse
6	5560	0	6.096	glacial hardpan	hardpan	fine
7	5564	0	10.668	glacial hardpan to sand	hardpan	fine
8	5587	0	10.0584	glacial hardpan with 7' of sand at the bottom	hardpan	fine
9	5592	0	11.8872	glacial hardpan	hardpan	fine
10	5594	0	9.144	glacial hardpan with quicksand at the bottom	hardpan	fine
11	5597	0	6.4008	glacial hard clay and gravel with sand at the bottom	clay	fine
12	11376	0	10.668	glacial clay hardpan gravel and rocks	clay	fine
13	11410	0	8.2296	blue hardpan with layers of gravel	hardpan	fine
14	11419	0	8.9916	glacial hardpan and clay	hardpan	fine
15	11423	0	7.62	glacial clay and hardpan	clay	fine
16	11447	0	7.9248	glacial gravel and hardpan	gravel	coarse
17	11452	0	5.1816	glacial hardpan	hardpan	fine
18	11474	0	7.62	glacial hardpan	hardpan	fine
19	11489	0.6096	6.4008	clay with big boulders	clay	fine
20	11579	0	6.096	glacial hardpan	hardpan	fine
21	11599	0	6.096	glacial clay and hardpan	clay	fine
22	11637	0	6.7056	glacial hardpan	hardpan	fine
23	11642	0	9.144	glacial hardpan	hardpan	fine
24	11661	0	6.7056	hardpan and boulders	hardpan	fine
25	11672	0	6.096	glacial clay and sand	clay	fine
26	11679	0	8.5344	glacial hardpan	hardpan	fine
27	11695	0	10.9728	glacial clay hardpan and gravel	clay	fine
28	11696	0	7.0104	clay at top gravel at hardpan	clay	fine
29	11697	0	5.4864	hardpan with boulders	hardpan	fine
30	15377	0.9144	8.2296	3-? brown clay	clay	fine

Appendix D

2023 Digitized Groundwater Chemistry

2023 Digitized Groundwater Chemistry

Well ID	Well Tag No	Date	pH	Turbidity	Total Coliforms	Escherichia coli	Aluminium	Arsenic	Iron	Lead	Manganese
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
54752		2020-04-17			1				4.2		0.31
54752		2020-04-28			6.3				12		0.46
54753		2020-02-27									0.15
67421		2023-03-02									0.02
54720		2020-12-03		2.95					0.42		0.088
54721		2020-12-09		1.04							0.263
	78326				1						0.062
	78326	2022-04-06			<1						-
	124594	2021-12-09			6.3						
	124594	2022-04-06			<1						
	124593	2021-12-09			12.1						
	124593	2022-04-06			<1						
	93361	2021-03-24									0.1
	122289	2021-04-08							0.32		0.046
	122287	2021-03-03									0.035
	122288	2021-02-03			69.7						0.06
	122288	2021-02-19			<1						0.11
64074		2019-11-05			4.2						
64074		2020-12-09			<1						
67589		2022-02-25		0.8							0.065
61552		2020-11-04			7.5						0.032
67588		2022-02-25		0.57							0.044
40652		2020-11-02			>200.5	3.1					
40652		2020-12-08			<1	<1					
64092		2022-03-03		2.25	11.1					0.015	0.033
51761		2020-10-28		5.44	3.1				0.73		0.071
67407		2022-05-19		0.6	1						
63652		2020-10-27		2.86	144.5				0.81		0.093
63652		2020-12-09			17.8						
67406		2022-05-13		0.34							0.092
63687		2020-10-29									0.022
40691		2022-05-05		0.63	2				0.94		0.2
63686		2020-10-30			32.4						
40689				1.48							0.27
61568		2020-12-08		36.4	64.4		1.4		1.4		0.14
40690		2022-04-26		0.8							0.064
63699		2022-05-30		0.66					1.4		0.21
40632		2021-12-08		0.47							0.069
40634		2021-12-01		0.36							0.046
40633		2021-12-02						0.036			0.14
63725		2021-11-30		0.37				0.01			0.11
63677		2021-07-12		0.67	1			0.012			0.057
61540		2021-07-13		1.35							0.065
41582		2021-06-24		1.35							0.064
61595		2021-07-14		4.68					0.84		0.064
65722		2021-06-25		1.55	547.5						0.063
63677		2021-06-23		4.68	62.4						0.064
63721		2021-08-11		0.22	3.1			0.012			0.025
61596		2021-08-13		0.39				0.011			0.035
63706		2021-08-10		0.48	1						0.063
63705		2021-06-23		0.28							0.063
64224		2022-03-01		1.05							0.063
64243		2022-03-01		0.79							0.057
41556		2015-12-15	5.98		1				3.29		

Notes:

Guidelines for Canadian Drinking Water Quality - Maximum Allowable Concentration (MAC) Exceeded

Guidelines for Canadian Drinking Water Quality - Aesthetic Objective (AO) Exceeded

Guidelines for Canadian Drinking Water Quality - Operation Guidelines (OG)

Appendix E

2023 Digitized Septic Locations

2023 Digitized Septic Locations

Project Number	TM Eastin	TM Northin	Year	Applicant	Address 1	Address 2	Comments	Subdivison Number	Rezoning Number	OCP Amend Number	DP Number	DV Permit	Other
P2019-030	544912	5451019	2019	Thor Shay	#13 - 11540 Glacier Dr		Variance for Retaining Wall				DP19-051	DV19-006	
P2021-069	544912	5451019	2021	Eleven Eleven Homes Ltd	#14-11540 Glacier Dr		Fire Interface DP - Duplex				DP21-103		
P2018-057	542647	5449129	2018	Annika & Stewart Swingle	10531 Ruskin Cres		Environmental DP				DP18-058		
P2015-033	542702	5449170	2015	Flowerdew	10549 Reedal St		Garden Cottage		R15-015			DV15-011	
P2020-065	543394	5449844	2020	OTG Developments	10911 Wilson St		5 lot subdivision	S20-010	R20-020		DP20-071/DP20-072/DP20-073		
P2018-022	542047	5450059	2018	Kelly Brack	11020 288th St		Coach House		R18-016				
P2013-050	543294	5450226	2013	Wurster	11061 Wilson St		2 Lot Subdivision	S13-016	R13-024				
P2018-077	543276	5450283	2018	Jeff Tupper	11067 Wilson St		Geo-line Adjustment				DP18-081		
P2023-026	542059	5450266	2023	Wayne Lindberg	11150 288th St		Fire Interface DP				DP23-022		
P2015-061	543384	5450975	2015	Orca Pacific Developments	11445 Wilson St		3 Lot Subdivision	S15-018	R15-028		DP16-010		
P2018-039	543415	5451302	2018	OTG Developments	11533 Wilson St	11511 Wilson St	4 Lot Subdivision	S18-015	R18-027		DP18-033		
P2023-060	545157	5451639	2023	Daniel Ewart	11666 Allan St		Fire Interface DP				DP23-061		
P2021-128	543336	5451483	2021	Marty Nault	11707 Wilson St		2 lot subdivision	S21-028	R21-048		DP21-155/DP21-156/DP21-157		
P2019-083	543341	5451564	2019	Lacey Developments	11764 Wilson St		Fire Interface DP				DP19-099		
P2018-027	544290	5451685	2018	Hilda Goddard	11809 Statim St		Garden Cottage		R18-019				
P2019-023	544290	5451685	2019	Kriemhild Goddard	11809 Statim St		Fire Interface DP				DP19-032		
P2018-024	544387	5451762	2018	Janet Cox	11826 Statim St		Coach House		R18-015			DV18-011	
P2021-109	543149	5451926	2021	Ivon Gill	11919 Wilson St		Variances - SFD				DP21-127/DP21-128/DP21-129		
P2020-013	545153	5451949	2020	Scott Wideen	11930 Yeo St		Fire Interface DP - Accessory Building				DP20-011		
P2023-064	545729	5452388	2023	William Coughlin	12060 Coughlion Crt		Discharge of Covenant - Register New						
P2022-027	544341	5452089	2022	Wei Zhang	12071 Rolley Lake St		Fire Interface DP				DP22-023		
P2023-007	544341	5452089	2023	Wei Zhang	12071 Rolley Lake St		Natural Environmental DP				DP23-005		
P2023-068	545729	5452388	2023	Formosa Homes Joint Venture	12100 Coughlin Ct		Fire Interface DP				DP23-068		
P2023-074	545729	5452388	2023	Ben Sidhu	12140 Coughlin Ct		Release of Septic Cov. and provide new						
P2017-052	544344	5452460	2017	Len Murdoch	12162 Rolley Lake St		3 Lot Subdivision	S17-019	R17-035		DP17-034		
P2022-029	544336	5452512	2022	Lafleur Developments	12187 Rolley Lake St		4 lot subdivision	S22-012	R22-012		DP22-024/DP22-025/DP22-026		
P2019-043	544245	5452592	2019	Kelly Molloy	12243 Rolley Lake St		Fire Interface DP				DP19-059		
P2022-124	545082	5452646	2022	BC Quality Surveyors	12281 Bell St		Discharge of Covenant						
P2018-074	545174	5452785	2018	Lacey Developments Ltd	12334 Bell St		3 Lot Subdivision	S18-022	R18-047		DP18-076/DP18-077		
P2019-136	543538	5452828	2019	Mitchel Loor	12358 Carr St		Secondary Suite		R19-045		DP19-171/DP19-172		
P2022-065	543538	5452828	2022	Mitchel Loor	12358 Carr St		2 lot subdivision	S22-025	R22-028		DP22-074/DP22-075		
P2019-010	543118	5452872	2019	Chad & Amy Hensbee	12370 Powell St		Variance for Setbacks - accessory building					DV19-001	
P2021-069	543118	5452872	2021	Chad Hensbee	12370 Powell St		Enviromental & Fire Interface DP's				DP21-078/DP21-079	<Null>	
P2016-061	543517	5452899	2016	Nolan Woods	12411 Carr St		Garden Cottage		R16-035				
P2020-045	544366	5453026	2020	Sander Hunfeld	12454 Rolley Lake St		Garden Cottage - RAR DP - Fire Interface DP		R20-012		DP20-053/DP20-054		
P2015-006	543119	5453181	2015	Holzapfel	12550 Powell St		2 Lot Subdivision	S15-003	R15-003				
P2013-011	545034	5452916	2013	Pacific Peak Homes Inc	12587 Russell Terr		Rezone to allow for Duplex		R13-006				
P2023-030	544072	5453269	2023	Don Bowins	12620 Cathy Cres		4 lot subdivision	S23-006	R23-008		DP23-027/DP23-028/DP23-029		
P2018-114	545082	5453356	2018	FlorWest Construction	12631 Bell St		26 lot Subdivision	S18-031	R18-062		DP18-128/DP18-129/DP18-130		
P2021-097	543519	5453341	2021	Gary Lowther	12631 Carr St		2 lot subdivision - RR7s	S21-020	R21-036		DP21-111/DP21-112/DP21-113		
P2018-075	543068	5453355	2018	Bodana Ollen	12631 Powell St		2 Lot Subdivision	S18-024	R18-048		DP18-078/DP18-079		
P2015-019	544109	5453364	2015	Chad Swash	12638 Cathy Cres		Secondary Suite		R15-008				
P2015-003	543115	5453448	2015	Bondana Oilen	12654 Powell St		2 Lot Subdivision	S15-002	R15-002				
P2019-061	543115	5453448	2019	Bodana Oilen	12654 Powell St		Fire Interface DP for Coach House				DP19-071		
P2018-076	543080	5453527	2018	James Ollen	12656 Powell St		Fire Interface DP				DP18-080		
P2021-063	542975	5453631	2021	Marie Krzus	12658 Powell St		Fire Interface DP				DP21-069		
P2022-011	542975	5453631	2022	Marie Krzus	12658 Powell St		Environmental DP				DP22-012		
P2022-116	542975	5453631	2022	Marie Krzus	12658 Powell St		Rezone for Secondary Dwelling		R22-051				
P2020-082	544180	5453570	2020	Michael Widdows	12712 Cathy Cres		Coach House		R20-025		DP20-086/DP20-087		
P2017-061	545916	5453968	2017	Gamache	12913 Pilgrim St		Accessory Building					V17-031/DV17-0	
P2022-008	545117	5453855	2022	RayRidge Developments	12933 Bell St		Fire Interface DP				DP22-011		
P2016-012	545869	5454210	2016	Tom Potucek	13033 Pilgrim St	13085 Pilgrim St	10 Lot Subdivision	S16-007	R16-008		DP16-008		
P2022-031	545869	5454210	2022	OTG Developments Ltd	13033 Pilgrim St	13085 Pilgrim St	10 lot subdivision	S22-013	R22-014		DP22-030/DP22-031/DP22-032		
P2023-047	545834	5454393	2023	Harjot Singh Toor	13157 Pilgrim St		4 lot subdivision	S23-008	R23-012		DP23-045/DP23-046/DP23-047		
P2020-096	542406	5449848	2020	Brent Lindberg	29110 Matheson Ave		Variance to build SFD				DP20-100	DV20-019	
P2020-058	542365	5452187	2020	1209381 BC Ltd	29317 Dewdney Trunk Rd		11 lot subdivision & rezoning to RR7s	S20-009	R20-017		DP20-063/DP20-064/DP20-065		
P2021-007	543252	5452213	2021	Cavalier Homes Ltd	29546 Taise Pl		Fire Interface DP - Accessory Building				DP21-009		
P2017-020	543292	5453450	2017	Deanna Garcia	29573 Hudson Ave	29585 Hudson Ave	Lot Line Adjustment	S17-005					
P2018-019	543315	5450914	2018	Olaf Haeussler	29583 Kennedy Terr		Geotechnical DP				DP18-018		
P2022-012	543315	5450914	2022	Edward Grice	29599 Kennedy Terr		2 lot subdivision	S22-004			DP22-010		
P2017-066	543351	5453451	2017	Hellofs & Gillespie	29609 Hudson Ave		5 Lot Subdivision	S17-021	R17-042		DP17-040		
P2018-007	543373	5451980	2018	Eros Homes Ltd	29622 Dewdney Trunk Rd		Gas Station/Convenience Store		R18-006	OCP18-001	DP18-005/DP18-006		
P2019-042	543373	5451980	2019	Veer Sidhu	29622 Dewdney Trunk Rd		Fire Interface DP				DP19-058		
P2020-101	543373	5451980	2020	Eros Homes Ltd	29622 Dewdney Trunk Rd		Variance - Accessory Building Height				DP20-107	DV20-020	

2023 Digitized Septic Locations

Project Number	TM Eastin	TM Northin	Year	Applicant	Address 1	Address 2	Comments	Subdivison Number	Rezoning Number	OCP Amend Number	DP Number	DV Permit	Other
P2017-022	543537	5452073	2017	CHP Architects	29684 Dewdney Trunk Rd		Gas Station/Convenience Store		R17-017	OCP17-003	DP17-028		
P2013-029	543706	5452130	2013	Patricia Schill	29809 Dewdney Trunk Rd		2 Lot Subdivision	S13-012	R13-017				
P2018-064	543879	5452096	2018	Leslie & Lucy Poirier	29873 Dewdney Trunk Rd				R18-041		DP18-064		
P2020-057	543937	5452083	2020	Tonya Bieman	29907 Dewdney Trunk Rd		Rezoning for Garden Cottage & Fire Interface DP		R20-016		DP20-062		
P2023-072	544408	5452101	2023	Mary Griffiths	30131 Dewdney Trunk Rd		Rezone for Secondary Suite		R23-025				
P2019-031	544463	5452075	2019	Jamie Redekop	30160 Dewdeny Trunk Rd		Fire Interface DP				DP19-041		
P2022-058	544463	5452075	2022	Scott Roberge	30160 Dewdney Trunk Rd		Garden Cottage		R22-023		DP22-057		
P2013-067	544470	5452886	2013	Russell Lyons	30180 Berg Ave		Secondary Dwelling		R13-034				
P2022-094	544630	5452576	2022	Glenn & April Birkedal	30255 Barcley Ave		Single family home and coach house				DP22-111		
P2023-033	544630	5452576	2023	Glenn & April Birkedal	30255 Barcley Ave		Natural Environmental DP				DP23-031		
P2021-140	544403	5453644	2021	Gene Nikula	30256 Nikula Ave		2 lot subdivision	S21-032	R21-052		DP21-163		
P2016-067	544653	5452836	2016	Bikoulov	30260 Berg Ave		2 Lot Subdivision	S16-033	R16-041		DP16-028	DV16-015	
P2018-087	544661	5452076	2018	Ler Her	30270 Dewdney Trunk Rd		Fire Interface DP				DP18-093		
P2021-052	544508	5453692	2021	Nigel Jensen	30272 Nikula Ave		2 lot subdivision & rezoning to RR7	S21-007	R21-017				
P2018-092	544758	5452502	2018	Darren Rutledge	30310 Brackley Ave		Fire Interface DP				DP18-101		
P2015-027	544792	5453691	2015	Klimaschek	30320 Nikula Ave		2 Lot Subdivision	S15-010	R15-013				
P2017-026	544754	5452946	2017	Stewart & Son Development Group	30323 Berg Ave		2 Lot Subdivision	S17-007	R17-019				
P2020-061	544754	5452946	2020	Brandie McCoach	30323 Berg Ave		Fire Interface DP - SFD & Detached Garage				DP20-067		
P2022-056	544806	5452892	2022	Shushack	30328 Berg Ave		2 lot subdivision	S22-021/S22-025	R22-025		DP22-060/DP22-061/DP22-062		
P2020-015	544798	5452906	2020	Stewart & Son Development	30331 Berg Ave		Fire Interface DP				DP20-013		
P2019-089	544811	5452524	2019	Peter Koeder	30340 Brackley Ave		Fire Interface DP				DP19-107		
P2017-032	544837	5452110	2017	Redekop Investments Group	30343 Dewdney Trunk Rd		3 Lot Subdivision	S17-012				DV17-033	
P2013-001	544844	5452048	2013	Grootendorst	30352 Dewdney Trunk Rd		Variance for Height on Accessory Building					DV13-001	
P2019-070	544742	5452579	2019	Eric Stewart	30353 Brackley Ave		Geotechnical & Fire Interface DP's				DP19-076/DP19-091		
P2020-056	544877	5452102	2020	Steve Lafleur	303737 Dewdney Trunk Rd		lot subdivision & rezoning for north 2 lots to RR	S20-008	R20-015		DP20-060/DP20-061		
P2016-013	544837	5452891	2016	Steven Lafleur	30374 Berg Ave		4 Lot Subdivision	S16-008	R16-009				
P2018-065	544742	5452579	2018	Steven Lafleur	30379 Brackley Ave		Geotechnical DP				DP18-065		
P2018-068	544871	5452797	2018	Jim Roberds	30388 Berg Ave						DP18-068		
P2020-067	544935	5452081	2020	Modern Demensions Desing Inc	30420 Dewdney Trunk Rd		Fire Interface DP - Agricultural Storage Buildings				DP20-077		
P2022-086	544982	5454038	2022	Phil Cooper	30424 Keeves Pl		Fire Interface DP				DP22-098		
P2016-072	545006	5452044	2016	JKO Foundations	30440 Dewdney Trunk Rd		2 Lot Subdivision	S16-035			DP17-019	DV17-022	
P2020-073	545006	5452044	2020	JKO Construction - Bodana Oilen	30440 Dewdney Trunk Rd	11677 Yeo St	Subdivision - ALC ID 61273						ALR20-001
P2022-112	545006	5452044	2022	Bodana Oilen	30440 Dewdney Trunk Rd	11677 Yeo St	2 lot subdivision	S22-040	R22-047		DP22-135/DP22-136/DP22-137		
P2019-003	545419	5452248	2019	Jigsaw Constructive Solutions Ltd	30624 Dewdney Trunk Rd		Rezone for new SFD and keep exisitng SFD		R19-001		DP19-003/DP19-004/DP19-005		
P2021-119	545556	5452269	2021	Hunfeld Industries Ltd	30684 Dewdney Trunk Road		6 lot subdivision	S21-025	R21-044		DP21-144/DP21-145/DP21-146		
P2019-029	545742	5452399	2019	Slade Dyer	30782 Dewdney Trunk Rd		8 Lot Subdivision	S19-007	R19-013		DP19-039/DP19-040		
P2013-060	546480	5452847	2013	David Beland	31173 Dewdney Trunk Rd		Coach House		R13-028				
P2019-117	546480	5452847	2019	David Beland	31173 Dewdney Trunk Rd		3 lot subdivision	S19-022	R19-038		DP19-146/DP19-147/DP19-148		

aecom.com

aecom.com