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Correlating Wells to Mapped Aquifers, Township of Langley, British Columbia

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EXECUTIVE SUMMARY

Within the Township of Langley, B.C. (TOL), there are 7230 registered wells in the B.C. Groundwater Wells and Aquifers database (GWELLS) and of those approximately 1500 wells have not been correlated to mapped aquifers. Correlating wells to mapped aquifers in the TOL is crucial for groundwater licensing and allocation because it allows the point of well diversion (the well) to be identified with the source aquifer. This in turn supports use of other tools in the *Water Sustainability Act* (WSA), such as development of water sustainability plans or water objectives, and assessment of hydraulic connections between aquifers and streams to protect aquatic habitat and environmental flow needs during times of scarcity.

Four hundred and thirty-four (434) wells registered in GWELLS between 2018 and 2022 were targeted for correlation to the 31 mapped aquifers in the TOL. The main sources of information used to correlate wells to mapped aquifers were: 110 unpublished, draft cross-sections developed by Golder Associates Ltd. around 2003, mapped aquifer polygons in GWELLS, previously correlated wells in the TOL, and the general Quaternary stratigraphy mapped by Armstrong (1980). A significant part of the project involved verifying the geological units in the cross-sections to the mapped aquifers and digitizing the approximate cross-section locations to allow for a systematic correlation process. Results of verifying the geological units in the draft cross-sections to mapped aquifers are summarized in Appendices A and B.

The process of correlating wells to mapped aquifers was achieved by: 1) comparing the screened or open depth of the subject well to be correlated to the geological units in the nearest draft cross-section(s); 2) comparing the location of the subject well to the areal extent of the mapped aquifer; and, 3) cross-checking and comparing the correlations of up to three neighbouring wells. Where necessary the location of the well and lithologic description in the well record was also reviewed with respect to Armstrong's (1980) surficial geology mapping and to the aquifer reports for geological consistency.

In total, correlations to mapped aquifers were completed for 287 of the 434 registered wells (66%). Following the correlation of a well to a mapped aquifer, a consistency check was done in which up to three nearby wells previously correlated by others were reviewed (414 wells in total). Of that number, 41 wells (9.8%) were identified where the correlation to mapped aquifers should be revised in GWELLS. In verifying the geological units in the draft cross-sections to the mapped aquifers, the correlations for an additional 313 wells were also checked. Of these, the Aquifer ID number for 46 wells (15%) should be revised. Results of the well-to-aquifer correlations and consistency checking are documented in Excel worksheets in Appendix C.

Based on the project results, it is recommended:

- Results of the correlations and checking of wells from this project should be updated for the specific well records in GWELLS.
- Correlations of the remaining uncorrelated registered wells in the TOL should be completed. In the absence of a 3-D geological model, the correlation process developed in this project provides a systematic approach to follow. Once well correlation to mapped aquifers is updated, the province can assess whether further aquifer mapping efforts are required.
- Review the depth and stratigraphic relationship between Aquifers 33 and Aquifers 32, Aquifer 33 and Aquifer 50, Aquifer 58 and Aquifer 1194, and the correlation of Aquifer 52 to the Vashon Drift to clarify mapping and to assess if aquifers should be amalgamated.
- The draft cross-sections should be reconciled with the mapped aquifers, finalized and published as an authoritative reference for drillers and groundwater consultants in advising landowners about development of groundwater supplies and applying for licences for groundwater use.

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1. INTRODUCTION

British Columbia (B.C.) initiated licensing of nondomestic groundwater use in 2016 with passage of the *Water Sustainability Act* (WSA). There is an urgent need to provide improved access to information about aquifers. In the highly populated Township of Langley (TOL) there is a high demand on groundwater use, which prompted the Province of B.C. (Province) to update aquifer mapping in the TOL in 2017 to support groundwater licensing (Golder Associates, 2016). Aquifer mapping in the TOL had not been updated since they were initially mapped in the 1990's by Kreye and Wei (1994), whose work was influenced by the hydrostratigraphic units originally defined and mapped by Halstead (1986) for the Fraser Lowland.

A key element to the aquifer mapping work is to correlate the registered wells in the TOL to the remapped aquifers so that the source aquifer can be associated with the well diverting groundwater. Since the implementation of the WSA, the number of registered wells in the TOL has increased significantly. There are currently 7230 registered wells within the TOL, of which approximately 1500 have not been correlated with mapped aquifers. Between January 1, 2018 and December 12, 2022 alone, 434 wells within and adjacent to the TOL were registered in the B.C. Groundwater Wells and Aquifers database (GWELLS) for which the source aquifer hasn't been identified (Figure 1).

The 31 mapped aquifers within the TOL are comprised of unconsolidated sand and gravel deposits sediments that are geologically complex in their depositional history and distribution. The surficial sediment thickness is at least 369 m and many of the mapped aquifers are vertically stacked. Appendix A shows the stratigraphic relationship between the mapped aquifers based on the surficial geologic mapping by Armstrong (1980), presentation of the mapped aquifers by Golder Associates (2016), unpublished draft cross-sections by Golder Associates Ltd. (circa 2003) and Kreye and Wei (1994).

2. SCOPE OF WORK

The objectives of this project were:

- Correlate the recently (up to 434) registered wells in the TOL to the 31 mapped aquifers.
- Produce an Excel spreadsheet with registered wells in one column identified by well tag number (WTN), and the correlated mapped aquifer ID number in another column.
- Produce a report summarizing the procedure taken to correlate the wells to the mapped aquifers, the data used, assumptions, results (including identifying major issues along the way), and recommendations for future work.

3. DATA SOURCES

The data used in correlating registered wells to mapped aquifers include:

- Well records, digitized aquifer polygons and aquifer reports from the Province's GWELLS database,
- Unpublished draft Cross-sections from Golder Associates Ltd. (circa 2003), and
- Armstrong (1980)'s surficial geology map of the New Westminster mapsheet.

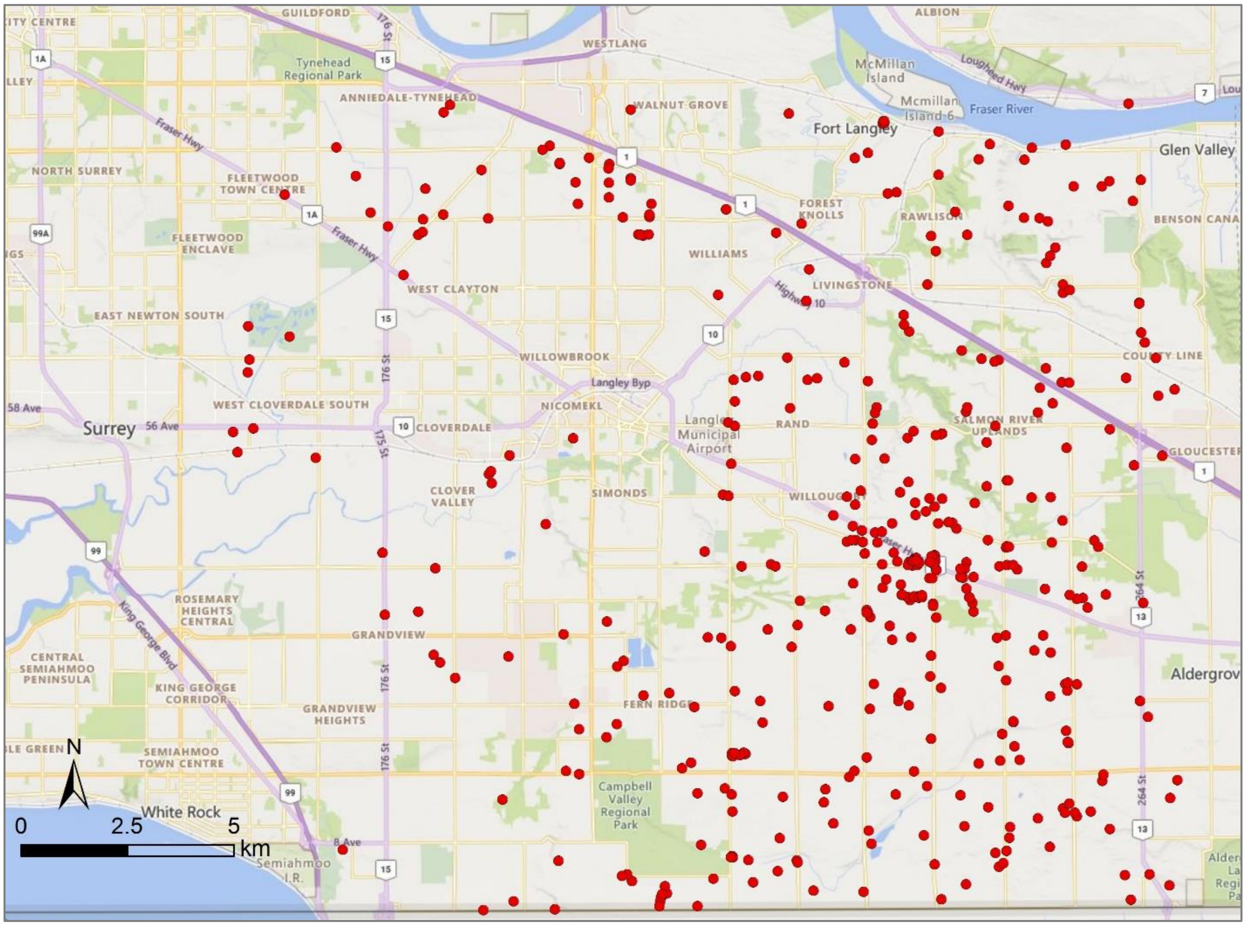

Figure 1: Location of the 434 *wells registered between 2018 and 2022 in and adjacent to the Township of Langley.*

4. <u>METHOD OF CORRELATING WELLS TO AQUIFERS</u>

4.1 Verifying Aquifers in the Draft Cross-Sections to Mapped Aquifers

Golder Associates Ltd. (circa 2003)'s draft cross-sections (110 cross-sections) and the mapped aquifer polygons in the provincial database provide the most crucial geologic controls for correlating wells to mapped aquifers in the TOL. The draft cross-sections were the basis for re-mapping the aquifers in 2017. However, the cross-sections were not reconciled with the mapped aquifers and finalized. In correlating wells to aquifers for this project we had to correlate the water-bearing units drawn in the draft cross-sections with the provincial mapped aquifer ID numbers as shown in Appendix B (an example cross-section is shown in Figure 2).

The table in Appendix B shows that some of the water-bearing units in the draft cross-sections were eventually amalgamated. For example, units Aldergrove C and Aldergrove D identified in Golder (2016) were recognized as a single mapped aquifer (Aldergrove CD – Aquifer 1192). In one instance (Campbell River), the water-bearing unit identified in Golder (2016) appeared to be split into two mapped aquifers - Campbell River A (Aquifer 1231) and Campbell River B (Aquifer 1232). This may be because the unit comprised two separate polygons. For other units in the draft cross-sections, there was insufficient documentation to determine whether the units have been amalgamated with any of the mapped aquifers (e.g., Brookswood C, Aldergrove E, West of Aldergrove B, D, and E, Clayton D and E, Beaver River B, Nicomekl-Serpentine C, D, E, and F). The water-bearing units that could not be positively correlated to mapped aquifers are identified in the table in Appendix B as rows shaded in yellow. Verifying how these units relate to the mapped aquifers would allow some of the uncorrelatable wells to be correlated. A more detailed spatial analysis of the mapped aquifers could help to reconcile these orphan units and enable the draft cross-sections to be finalized, but this was beyond the scope of the project.

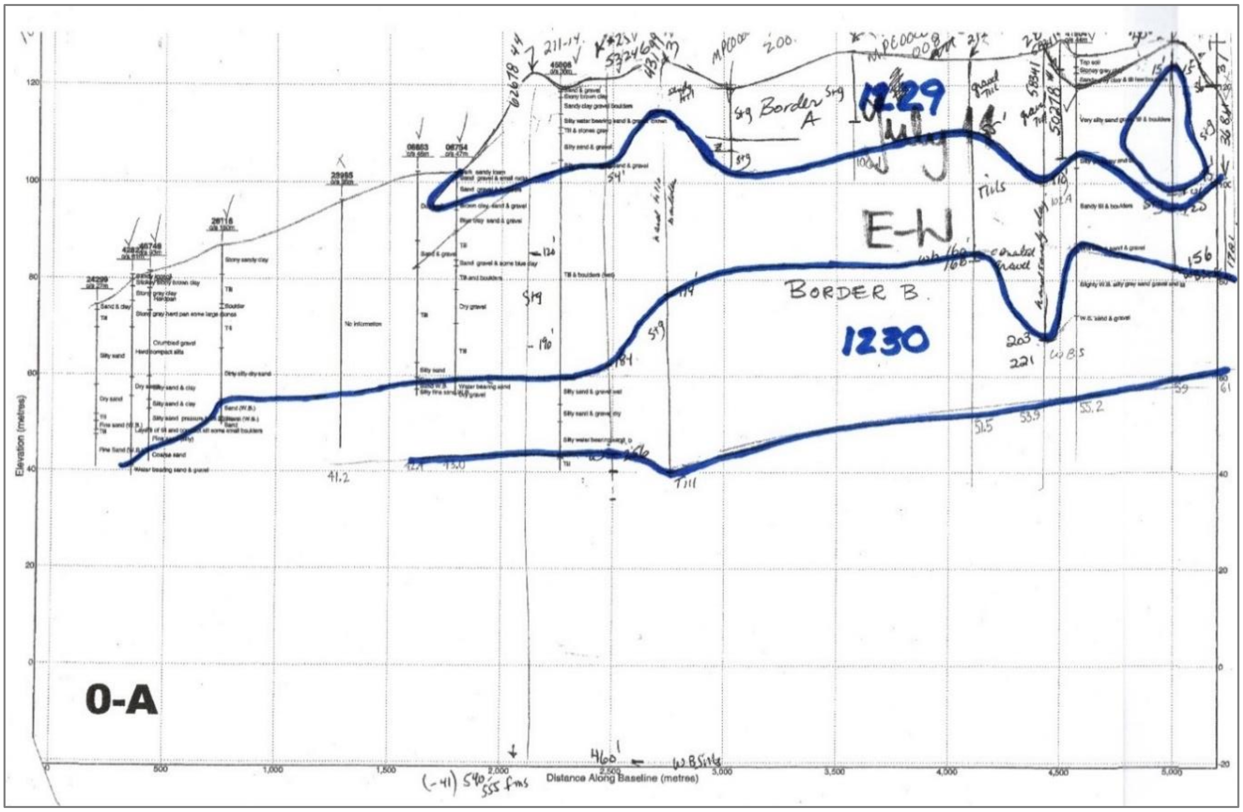

Figure 2: Example draft cross-section 0-A, a West-to-East cross-section, with Aquifer 1229 and 1230 identified in the cross-section.

4.2 Inconsistencies in the Draft Cross-Sections

The draft cross-sections reveal several inconsistencies between Aquifers 32 (Beaver River) and Aquifer 33 (West of Aldergrove), Aquifer 33 and Aquifer 50 (South of Hopington), and Aquifers 52 (Langley Upland Intertill). Cross-section 6-D shows Aquifer 32 to occur slightly above Aquifer 33, however cross-sections G-3, H-3 show the reverse. Additionally, the mapping report for Aquifer 52 indicates the aquifer comprises the Fort Langley Formation (or potentially Vashon Drift), whereas the stratigraphic location of Aquifer 52 in relation to Aquifers 50, 33, 1233 and 1193 in the draft cross-sections suggests Aquifer 52 more likely comprises Vashon Drift. The implications from these inconsistences are that it makes the process of correlating wells to mapped aquifers more uncertain and time-consuming.

4.3 Correlating Wells to Mapped Aquifers

To use the draft cross-sections, their approximate locations had to be spatially digitized so they could be brought into Google Earth along with the registered wells (Figure 3). The approximate location of the draft cross-sections was determined by the coordinates of the wells at either ends of each cross-section. Each draft cross-section was scanned and linked to the cross-section location on Google Earth.

In correlating wells to mapped aquifers, we relied primarily on the mapped aquifer polygons from the provincial GWELLS database, the draft cross-sections, and nearby registered wells that have been previously correlated to mapped aquifers. Given the reported location of a subject well to be correlated, the following steps were followed:

- Identify the draft cross-section(s) closest to the subject well and record the cross-section name(s) in the Excel worksheet entitled “434 wells” (Appendix C) in the row corresponding to the subject well’s WTN (Column C: “X-Section Name”).
- From the cross-section and from Google Earth, identify the mapped aquifer(s) underlying the vicinity of the well location.
- It may be necessary to examine the well in relation to the other three adjacent cross-sections, especially if the subject well is located at some distance away from any one cross-section.
- Compare the screened or open depth of the subject well to the depth range of the mapped aquifer(s) in the vicinity of the well location in the cross-section(s). If the well depth and aquifer depth range match, and the well lies within the aquifer polygon, the subject well is correlated to that mapped aquifer, which is recorded in column D: “Aquifer ID Number”.
- Compare the well/aquifer correlation with up to three neighbouring and previously correlated wells to check and corroborate the correlation of the subject well. The results of these comparisons are recorded in columns J to O in the Excel worksheet entitled “434 wells”.
- Where necessary, review the location and lithologic description in the record of the subject well with respect to Armstrong (1980)’s surficial geology mapping and to the aquifer mapping reports for geological consistency.
- A well may not correlate to an aquifer if the subject well is completed into a water-bearing unit that has not been associated with a mapped aquifer. In these cases, we have attempted to identify the probable Quaternary unit that the well is completed into (column F – “Probable Quaternary Unit”). The reason for non-correlation is entered in Column E – “Reason for Non-Correlation”.

In many instances, the draft cross-sections may not show a deeper mapped aquifer that underlies the area. This is probably because there are insufficient wells in the cross-section to show the deeper aquifer in the cross-section. In these instances, we relied on the nearby correlated wells and on the areal extent of the mapped aquifer. For example, WTN 123481 was correlated to Aquifer 52 because the finished well depth (89 m) matches the depth of Aquifer 52 and Aquifer 52 is mapped in the area, even though Aquifer 52 is not shown in draft cross-sections C-1 and 1-B.

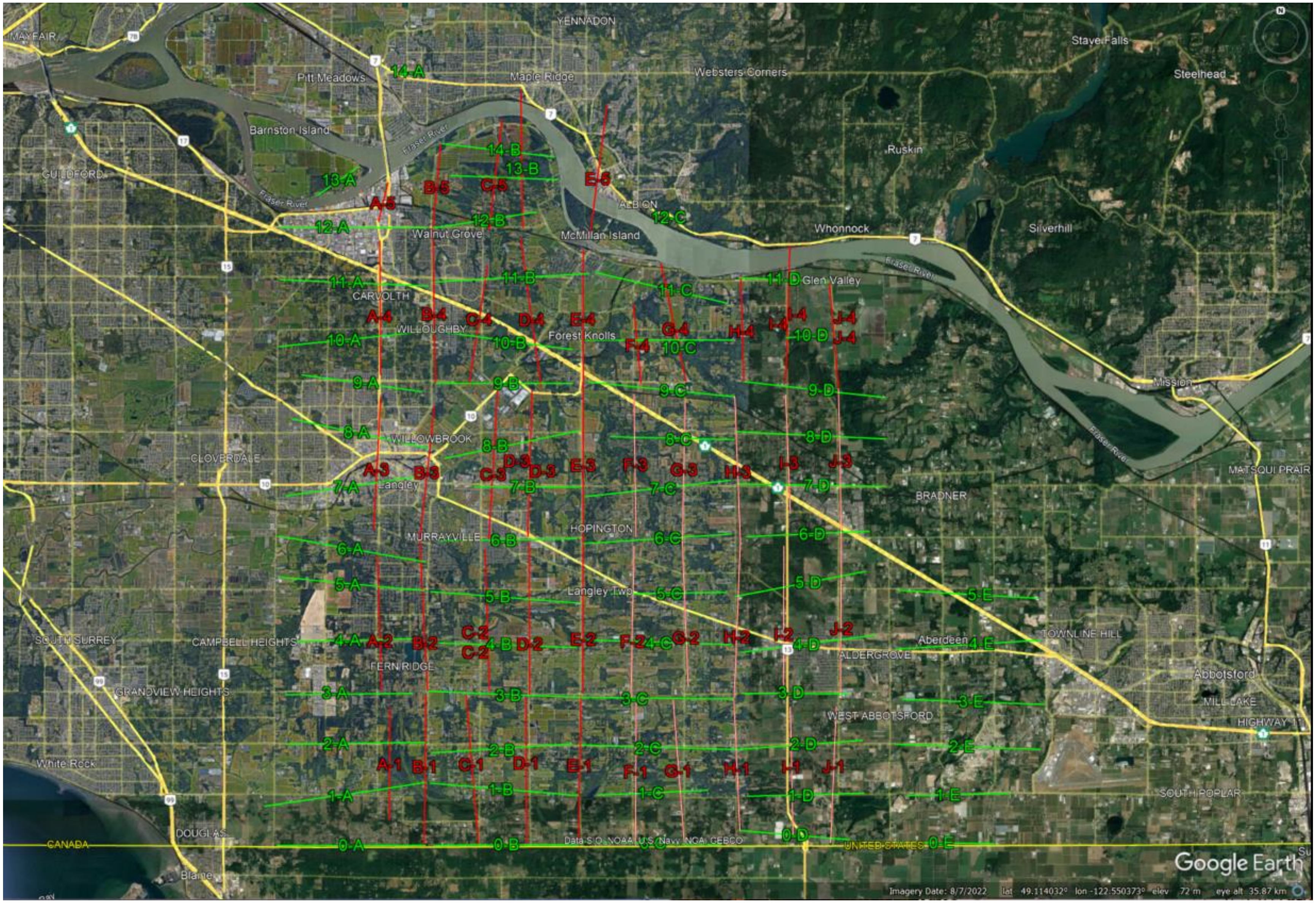

Figure 3: Approximate location of the draft cross-sections.

There were also cases when the subject well's depth and location were beyond the depth range and lateral extent of an aquifer. In these cases, we assessed the borehole control informing the drawing of the aquifer boundary and whether a match could be reasonably inferred, given how the aquifer boundary is drawn. Aquifer boundaries are more subjective where distances between wells are greater. Boundaries drawn for the base of the deepest aquifer within a draft cross-section are also often more subjective because wells are not often drilled through the entire aquifer thickness, but rather drilling is terminated when sufficient water supply is found. Correlation of WTN 115778 offers an illustrative example. Draft cross-sections 2-B and C-1 show WTN 115778 is too deep to be correlated to Aquifer 50. Aquifer 33 which underlies Aquifer 50 is not shown in draft cross-section C-1 but is shown in 2-B and C-2. Additionally, WTN 115778 lies just beyond the western mapped boundary for Aquifer 33. Despite the above apparent inconsistencies, we interpreted WTN 115778 to be most likely completed into Aquifer 33 because that is the main aquifer corresponding to that depth horizon in the local area; Aquifer 33 may not be shown in draft cross-section C-1 because of insufficient well coverage along that section at the time of preparation (circa 2003).

The correlation process included a consistency check that involved comparison of the correlation results with previously correlated wells nearby. The results of this evaluation are entered into the Excel worksheet "434 wells" in the row corresponding to the subject well's WTN and documented in columns J to O (check up to 3 nearby previously correlated wells). If we agreed with the aquifer ID number from the previous correlation, the cell containing the (previously correlated) aquifer ID number is unshaded. However, if we disagreed with the correlation, we would shade what we believe to be the correct aquifer ID number in red. If we are unsure of the correlation but did not have enough evidence to recommend an aquifer ID number, the cell is shaded in yellow.

4.4 Checking Correlations of Selected Wells along the Draft Cross-Sections

In relating the water-bearing units in the draft cross-sections to mapped aquifers in GWELLS, it was necessary to verify a number of previously correlated and uncorrelated wells for consistency with the water bearing units in the draft cross-section. The results of these comparisons are recorded in a separate Excel worksheet entitled: "TOL wells (QAQC)". If we disagreed with the previous well/aquifer correlation, we indicate that in Column C and shade the cell red. What we interpret as the correct aquifer ID number for that well is entered in Column E, with rationale given in Column D. If we are unsure of the previous well/aquifer correlation, we would also indicate that in Column C, shade the cell yellow and provide rationale in Column D; however, we did not have enough information to suggest a correct aquifer ID number in Column E.

5. RESULTS AND DISCUSSIONS

Results of the correlations are summarized in Table 1 below and in the Excel file in Appendix C. In total, 287 of the 434 wells were correlated (66%), leaving 147 wells to be correlated (rows shaded yellow in the Excel worksheet: "434 wells"). Locations of the 434 wells that were correlated and remain to be correlated are shown in Figure 4.

In correlating the wells, a total of 414 nearby wells were checked. Of the 414 nearby wells checked, we identified 41 wells (9.8%) where the correlation to mapped aquifers should be changed. These changes are shaded in red cells in Columns J, M, O, and R in the worksheet entitled "434 wells". There were an additional 11 wells where we did not feel confident enough to recommend changing the previous correlation; cells for these 11 correlations are shaded in yellow in Columns J, M, O and R.

Table 1: Summary of well/aquifer correlation results.

Correlated by	Wells correlated to aquifers	Nearby wells checked for consistency during well/aquifer correlations	Check of well/aquifer correlation results
M. Jackson	264	387	
M. Wei	23	27	40
Total	287	414	

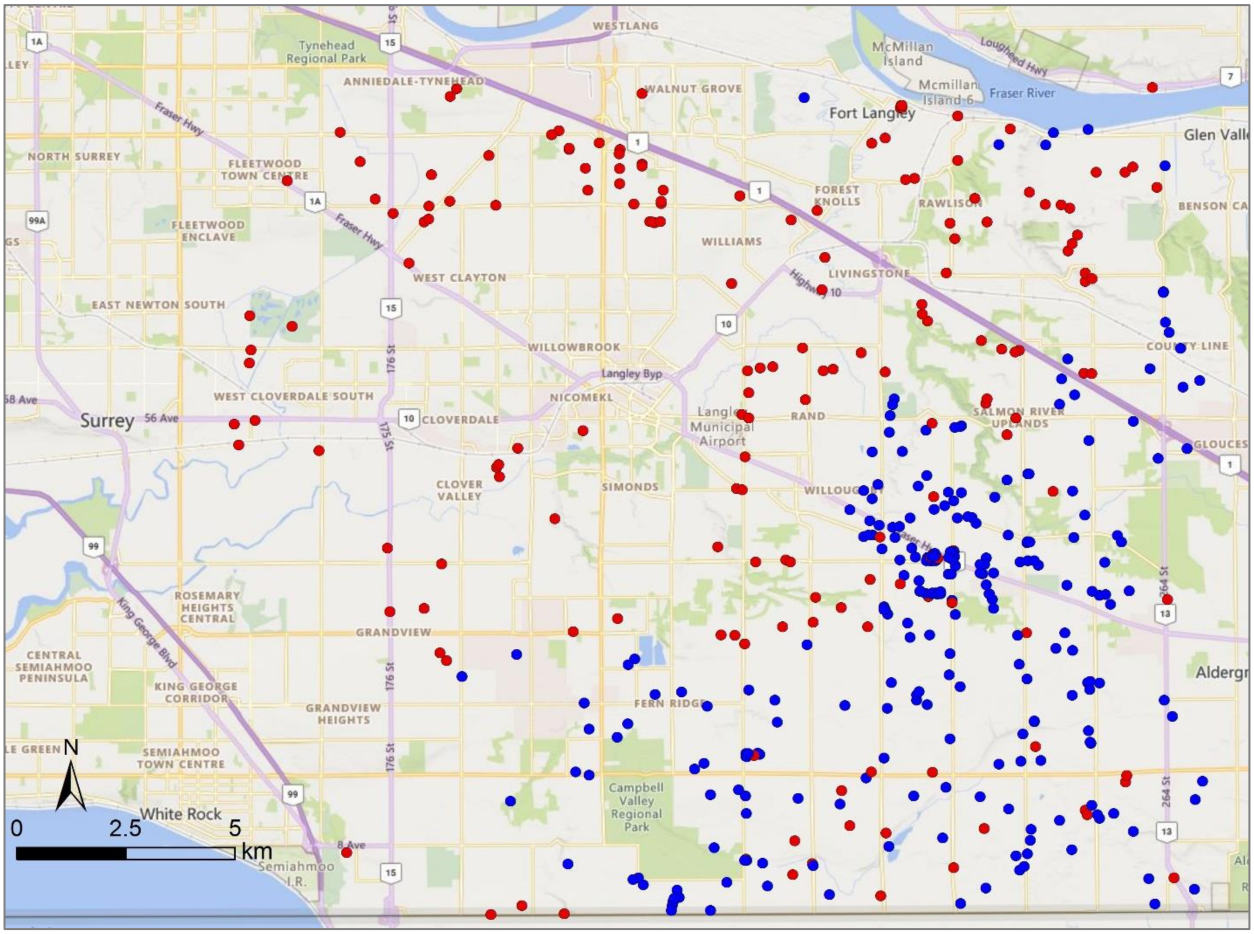

Figure 4: Locations of the 434 wells, and those that have been correlated (blue dots) and those wells that need to be correlated (red dots).

5.1 Results of Checking Selected Wells along the Cross-Sections

In verifying the units to the mapped aquifers in the draft cross-sections, 313 wells along the cross-sections were also checked for their correlations to mapped aquifers. Results of this checking are shown in the Excel worksheet entitled “TOL wells (QAQC)”. Correlations to mapped aquifers are recommended to be changed for 46 wells (cells shaded red - 15%) of the 313 wells checked. We were unsure of the correlations for 36 other wells but did not have enough evidence to recommend changes to the correlations to mapped aquifers (cells shaded yellow in the worksheet).

5.2 Questions Related to the Mapped and Unmapped Aquifers

Several questions and issues related to the mapped and unmapped aquifers arose from this project and are presented below. Addressing these issues was beyond the scope of this project.

- It was unclear what became of some of the geological units drawn in the draft cross-sections. These units are identified in the table in Appendix B in the rows shaded yellow. How these units relate to the mapped aquifers would bring greater clarity to the well-to-mapped aquifer correlation process.
- The relative depth and stratigraphic position between Aquifer 33 and Aquifer 32 is uncertain and should be checked.
- The depth of Aquifer 52 in the cross-sections relative to Aquifers 50, 33, 1233 and 51 suggests Aquifer 52 may be more likely of Vashon Drift age.
- The similar depth positions and different mapped extent of some of the aquifers (i.e., Aquifer 33 and Aquifer 50; Aquifer 58 and Aquifer 1194) raises the question of whether some of the aquifers should be amalgamated, reducing uncertainty in well-to-mapped aquifer correlation.
- Mapped aquifers, especially the deeper aquifers do not always show up in the cross-sections where they are expected to occur. One example occurs in cross-sections 7-C and E-3. Aquifer 1195 appears in 7-C but not in E-3 (Aquifer 1195 should be in the depth range of the E-3 cross-section). This may be because the draft cross-sections were never reconciled with the mapped aquifers. In finalizing the cross-sections, reconciling the mapped aquifers within each cross-section would clarify the positions of the mapped aquifers at depth.
- Finally, how can a groundwater source be specified in the water licence for wells that are not correlated to a mapped aquifer? Fortunately, the policy on *Describing the Aquifer, Point of Groundwater Diversion and Point of Well Diversion in Authorizations for Diversion and Use of Groundwater* (Province of B.C., 2021) does not require the aquifer ID number to be stated in the licence itself. Operationally however, demand for groundwater use would likely be categorized by mapped aquifers (see Aquifer Summary pages on-line). Groundwater demand from uncorrelatable wells may need to be considered as individual wells (along with other correlated wells) in the context of potential impacts to streams and mapped aquifers via an assessment of likelihood of hydraulic connection to those sources.

6. RECOMMENDATIONS

6.1 Enter Correlation Results into GWELLS

Enter the aquifer ID numbers from well/aquifer correlations into GWELLS (Column D in worksheet: “434 wells”), including “not correlatable” so others will know that correlation to mapped aquifers for a particular well has been attempted. Recommendations for correct aquifer ID numbers for the wells checked should also be entered into GWELLS. These are the cells shaded red in Columns J, M, and O, in worksheet “434 wells” and cells shaded red in Column E in worksheet “TOL wells (QAQC)”.

6.2 Complete Correlation of Wells in the TOL

There are registered wells in the TOL that either can not be correlated or have not yet been correlated to mapped aquifers. Some of the wells in the former category were identified via this project and noted as a comment in the corresponding well record in GWELLS. For the wells in the latter category, work to correlate those wells should continue.

Results from this project indicate that correlating wells in the TOL can be realistically done at a rate of about 3-4 wells/hour. This rate of correlation should be considered in budgeting for correlation work. A contingency of 10-20% would also be prudent as poor quality well records or uncertainty in a particular draft cross-section can severely affect the correlation rate.

6.3 Review of the Mapped Aquifers

As more and more wells are correlated to mapped aquifers, the originally mapped aquifer boundaries should be reviewed to assess whether they need to be updated. This applies to the boundary defining the areal extent of an aquifer but also its depth. Where there is a cluster of wells that can not be correlated to mapped aquifers, the local stratigraphy should be reviewed to see if new aquifers need to be identified and mapped.

Specifically, we recommend reviewing the depth and stratigraphic relationship between Aquifer 33 and Aquifer 32, Aquifer 33 and Aquifer 50, Aquifer 58 and Aquifer 1194, and the correlation of Aquifer 52 to the Vashon Drift to clarify the mapping and to assess if some of the aquifers should be amalgamated. Amalgamating some of the aquifers may allow some of the uncorrelatable wells to be correlated because lumping increases the areal extent and depth range of the amalgamated aquifer.

6.4 Finalize the Draft Cross-Sections

The draft cross-sections should be reconciled with the mapped aquifers, finalized, and published to reduce barriers for groundwater users to comply with the licensing requirements of the WSA and to support a Water Sustainability Plan in the TOL. For example, a landowner (e.g., a farmer) may drill a well on the property to replace an existing well. The cross-sections would allow the driller or groundwater consultant and landowner to know whether the new well is drilled into the same aquifer or into a different aquifer, thereby triggering licensing of a new source.

Finalizing the draft cross-sections would also provide the opportunity to complete the correlation for some of the units (shaded in yellow) in Appendix B with mapped aquifers, allowing more wells to be correlated and correlations to be done with greater certainty. Finalized cross-sections would also allow identification of areas where hydraulic connection between aquifers is most likely to exist (e.g., areas where the confining layers and aquitard units are thin or absent).

Other well records in the TOL that are not currently registered in the GWELLS database likely exist. Such records may reside with environmental and geotechnical companies, as well as with water well drillers who did not voluntarily submit records prior to the WSA. These records could potentially help to refine the 3-D delineation of aquifers in the TOL, however, the cost and effort to locate, collect, and enter historic well records into GWELLS may not be practical or may need to be prioritized to areas where information is lacking.

In finalizing the draft cross-sections, it may be beneficial to identify key reference wells within the TOL to help correlate lithology to the Quaternary units mapped by Armstrong (1980) and to the mapped aquifers. Some criteria for identifying reference wells could include:

- Lithology and locations that allow correlation to Quaternary units and mapped aquifers with a greater degree of certainty, and
- Locations that cover the range of different hydrogeologic settings within the TOL.

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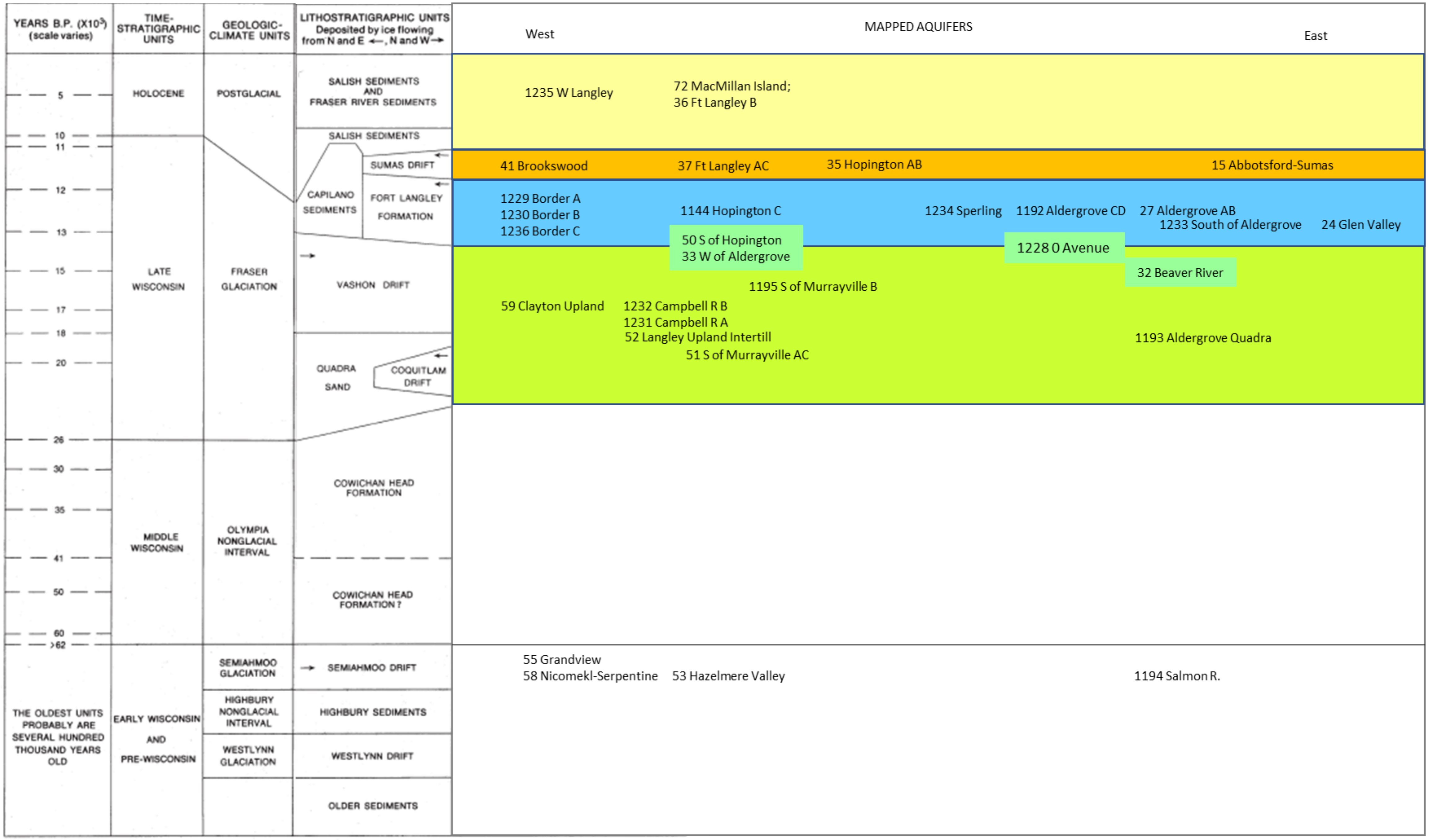
GLOSSARY

Mapped aquifer: Aquifer that has been mapped, digitized and entered into the Province's GWELLS database and assigned an aquifer identification number.

Registered well: A well whose record is entered into the Province's GWELLS database.

Well Tag Number: A unique file number assigned to the well record in the Province's GWELLS database.

APPENDIX A. CORRELATION OF MAPPED AQUIFERS TO LITHOSTRATIGRAPHIC UNITS OF ARMSTRONG (1980)



APPENDIX B. CORRELATION OF MAPPED AQUIFERS TO ORIGINAL WATER-BEARING UNITS IN GOLDER (2016) AND IN THE GOLDER DRAFT CROSS-SECTIONS

Provincial Aquifer No.	Provincial Aquifer Name	Aquifer Names in Golder Draft Cross-Sections and 2016 Report	Inferred Quaternary unit	Notes
1235	West Langley	West Langley A West Langley B West Langley C West Langley D	Fraser River Sediments	Mapped polygon for Aquifer 1235 & Table 1 of Golder (2016) suggest West Langley A, B, C, and D have been grouped together as one single aquifer (West Langley).
72	MacMillan Island	MacMillan Island	Fraser River Sediments	
36	Fort Langley B	Fort Langley B	Fraser River Sediments	
41	Brookswood	Brookswood A Brookswood B	Sumas Drift	Mapped polygon for Aquifer 41 suggests Brookswood A and Brookswood B have been grouped together as one single aquifer (Brookswood).
		Brookswood C		This unit is shown in cross-section A-1.
37	Fort Langley AC	Fort Langley A Fort Langley C	Sumas Drift	Aquifer report indicates Fort Langley A and C have been grouped into one single aquifer (Fort Langley AC)
35	Hopington AB	Hopington A Hopington B	Sumas Drift	Aquifer report indicates Hopington A and B have been grouped into one single aquifer (Hopington AB).
15	Abbotsford	Abbotsford A	Sumas Drift	
1229	Border A	Border A	Fort Langley Formation	
1230	Border B	Border B	Fort Langley Formation	
1236	Border C	-	Fort Langley Formation	
1144	Hopington C	Hopington C	Fort Langley Formation	
1234	Sperling	Sperling	Fort Langley Formation	
27	Aldergrove AB	Aldergrove AB	Fort Langley Formation	
1192	Aldergrove CD	Aldergrove C Aldergrove D	Fort Langley Formation	Aquifer report and Table 1 of Golders (2016) report indicate Aldergrove C and D have been grouped into one single aquifer (Aldergrove CD)
		Aldergrove E		This unit is shown in cross-sections J-4, 9-E. Unclear whether this unit has been incorporated into Aquifer 1192 or 27 or not.
1233	South of Aldergrove	South of Aldergrove	Fort Langley Formation	
24	Glen Valley	Glen Valley A Glen Valley B Glen Valley C	Not reported (Fort Langley Formation?)	Mapped polygon for Aquifer 24 suggests Glen Valley A, B and C have been grouped together as one single aquifer (Glen Valley). Aquifer report indicates aquifer underlies Fraser Sediments and Sumas Drift.
50	South of Hopington	South of Hopington B South of Hopington C	Fort Langley Formation or possibly Vashon Drift	Mapped polygon for Aquifer 50 indicates South of Hopington B and South of Hopington C have been grouped into a single aquifer (South of Hopington).
1228	0 Avenue	0 Avenue	Early Fort Langley Formation or Vashon Drift	
32	Beaver River	Beaver River Beaver River A	Early Fort Langley Formation or Vashon Drift	We have interpreted Beaver River A is the same as Aquifer 32. Cross-section 6-D shows this aquifer to occur slightly higher in elevation than Aquifer 33 but cross-sections G-3, H-3 shows it slightly lower than Aquifer 33.

Provincial Aquifer No.	Provincial Aquifer Name	Aquifer Names in Golder Draft Cross-Sections and 2016 Report	Inferred Quaternary unit	Notes
		West of Aldergrove E		Cross-section 4-D shows this unit overlying West of Aldergrove B. Unclear whether this unit has been incorporated into Aquifer 33 or not. In cross-section 5-C, this unit joins up with Aquifer 33.
33	West of Aldergrove	South of Hopington A West of Aldergrove A West of Aldergrove B West of Aldergrove C	Early Fort Langley Formation or Vashon Drift	Mapped polygon for Aquifer 33, Table 1 of Golder (2016), and aquifer report indicate South of Hopington A, West of Aldergrove A, B and C have been grouped into one single aquifer (West of Aldergrove). Cross-sections 3-B, 3-C, 3-D, F-3, H-3, 4-C, 5-D, 6-D, G-2 show Aquifer 33 comprise up to 2 layers. Cross-sections 6-B and 6-D show Aquifer 33 splitting up into an upper and lower layer.
		West of Aldergrove D		This unit is shown in cross-sections 5-B, C-2, D-2. Unclear whether this unit has been incorporated into Aquifer 33 or not.
		South of Aldergrove B		This unit is shown in cross-section F-1. Unclear whether this unit has been incorporated into Aquifer 33 or not.
59	Clayton Upland	Clayton; Clayton A Clayton B	Vashon Drift	Clayton B is shown in cross-section 11-B. It appears to be an extension of Aquifer 59 from cross-section 11-A. Three wells drilled into this unit have been correlated with Aquifer 59. We interpret this unit to be part of Aquifer 59.
		Clayton D		This unit is shown in cross-sections A-4, D-4, 8-A, 10-A, 11-A, 11-B. This unit underlies Aquifer 59.
		Clayton E		This unit is shown in cross-sections 8-A, 11-A. Unclear whether this unit has been incorporated into Aquifer 59 or not.
1231	Campbell River A	Campbell River	Vashon Drift	Golder (2016) Table 1 notes that two permeable units were grouped into one. Province may have recognized two separate aquifers because the aquifer polygons were not continuous?
1232	Campbell River B		Vashon Drift	See note immediately above.
1195	South of Murrayville B	South of Murrayville B	Vashon Drift	Cross-sections C-2, D-2, 6-B show this aquifer overlies Aquifer 51.
52	Langley Upland Intertill	Langley Upland Intertill	Fort Langley Formation (potentially Vashon Drift)	Cross-section 1-C clearly shows this aquifer to occur below Aquifer 50, even though Aquifer 50 may be interpreted to be possibly Vashon Drift. Cross-section 2-A shows this aquifer to occur below Aquifer 1231 but Cross-section 1-A shows this aquifer to overlie Aquifer 1231 (?). Cross-section 2-B shows this aquifer to occur below Aquifers 33 and 1233. Cross-sections C-2 and 3-B show this aquifer to occur above Aquifer 51.
1193	Aldergrove Quadra	Aldergrove Quadra	Quadra Sand	
		Beaver River B		This unit is shown in Cross-sections G-3, H-4, I-4, 7-C, 7-D. We don't think this unit has been incorporated into Aquifer 32. Cross-sections 7-C, 7-D show this unit to occur below Aquifers 1195 and 1193.
51	South of Murrayville AC	South of Murrayville A South of Murrayville C	Vashon Drift	Mapped polygon for Aquifer 1235 & Table 1 of Golders (2016) suggest South of Murrayville A and C been grouped into one single aquifer (Murrayville AC).

Provincial Aquifer No.	Provincial Aquifer Name	Aquifer Names in Golder Draft Cross-Sections and 2016 Report	Inferred Quaternary unit	Notes
55	Grandview	Not shown in Figure B6 nor Table 1 of Golder (2016) report	Not reported	
53	Hazelmere Valley	Not shown in Figure B6 nor Table 1 of Golder (2016) report	Simiamhoo Drift	
58	Nicomekl-Serpentine	Nicomekl-Serpentine A	Simiamhoo Drift	Aquifer report indicates Nicomekl-Serpentine A and B have been grouped into one single aquifer (Nicomekl-Serpentine).
		Nicomekl-Serpentine B	Simiamhoo Drift and possibly pre-Simiamhoo Drift	
		Nicomekl-Serpentine C		This unit is shown in cross-sections F-3, 9-C, 11-C but is not mentioned in Table 1 nor Figure B6 in Golder (2016).
		Nicomekl-Serpentine D		This unit is shown in cross-sections D-4, 9-B and occurs above Aquifer 58.
		Nicomekl-Serpentine E		This unit is shown in cross-section E-4.
		Nicomekl-Serpentine F		This is shown in Figure B6 of Golder (2016) and cross-section D-4.
1194	Salmon River	Salmon River	Simiamhoo Drift and possibly pre-Simiamhoo Drift	Can’t find this aquifer in the cross-sections? Is it Nicomekl-Serpentine C, D, E, or F?

APPENDIX C. EXCEL WORKBOOK CONTAINING WELL CORRELATION AND QA/QC RESULTS

Available as a separate data attachment.