

Whiskey Creek

Groundwater Supply Assessment

August 2012

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Regional District of Nanaimo
6300 Hammond Bay Road
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(Via email)

Attention: Wayne Morman

Re: Whiskey Creek – Groundwater Supply Assessment

As requested by the Regional District of Nanaimo, GW Solutions Inc. (GW Solutions) has performed a groundwater supply assessment in the area of the Whiskey Creek water service area near Qualicum Beach, BC.

Introduction

GW Solutions understands that the Regional District of Nanaimo (RDN) wants to assess the viability of groundwater supply for the existing Whiskey Creek water service area. Water for the service area is currently taken from Crocker Creek under two water licences and delivered to approximately 120 residential lots. The highest monthly system water demand in 2011 was in July, with a total of 4867 cubic meters taken from Crocker Creek, or an average of approximately 30 USgpm.

Work Completed

GW Solutions has completed a review of information available on the aquifers in the vicinity of Whiskey Creek. This report presents the information collected during the study, an assessment of the data, and recommendations for next steps to take in assessing the viability of groundwater supply for Whiskey Creek.



Data Review and Assessment

GW Solutions reviewed the information available on aquifers and groundwater in the study area through geological maps and well logs within a radius of approximately 2 km of the water service area. Whiskey Creek is located southwest of the Town of Qualicum Beach on the south side of the Alberni Highway (Figure 1).

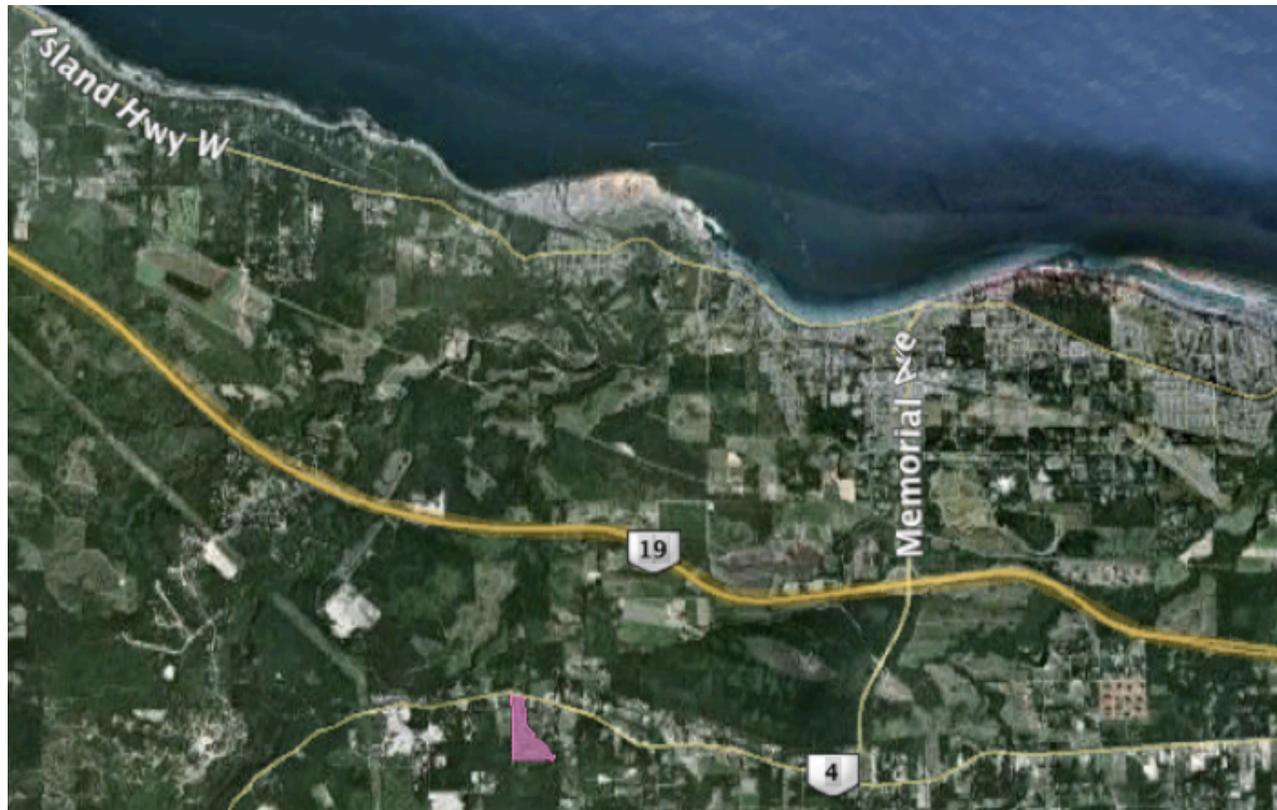


Figure 1: Location of Whiskey Creek (shown in pink)

Whiskey Creek is situated in an area of marine and glaciomarine sediments, featuring layers of fine and coarse deposits, and bordered on the south and west by glaciofluvial sediments which feature coarser aquifer material (Figure 2). The deposits in this area overlay sedimentary bedrock, featuring alternating layers of conglomerate, sandstone and shale (Figure 3).

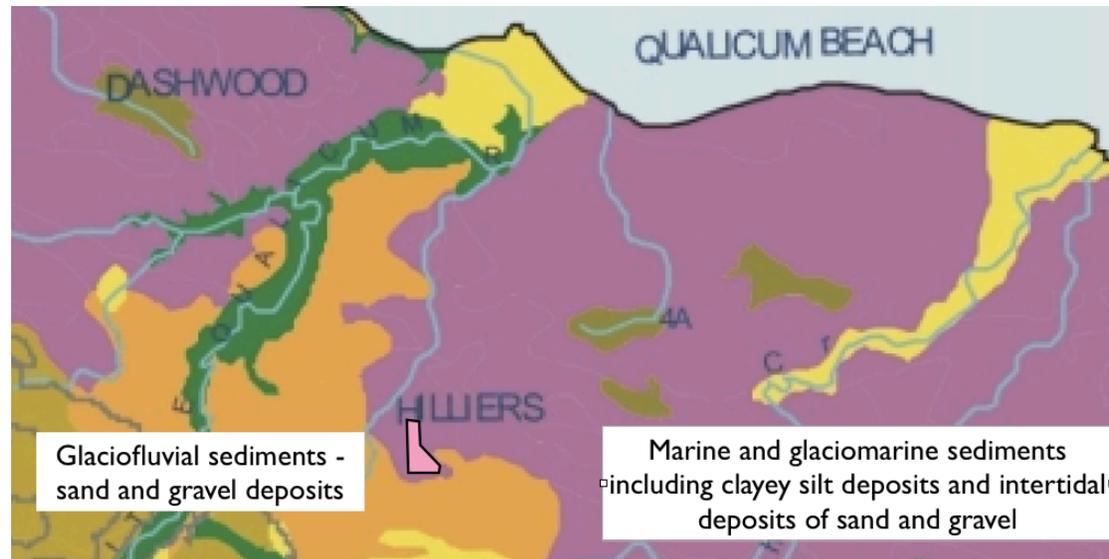


Figure 2: Surficial geology (location of Whiskey Creek shown in pink)

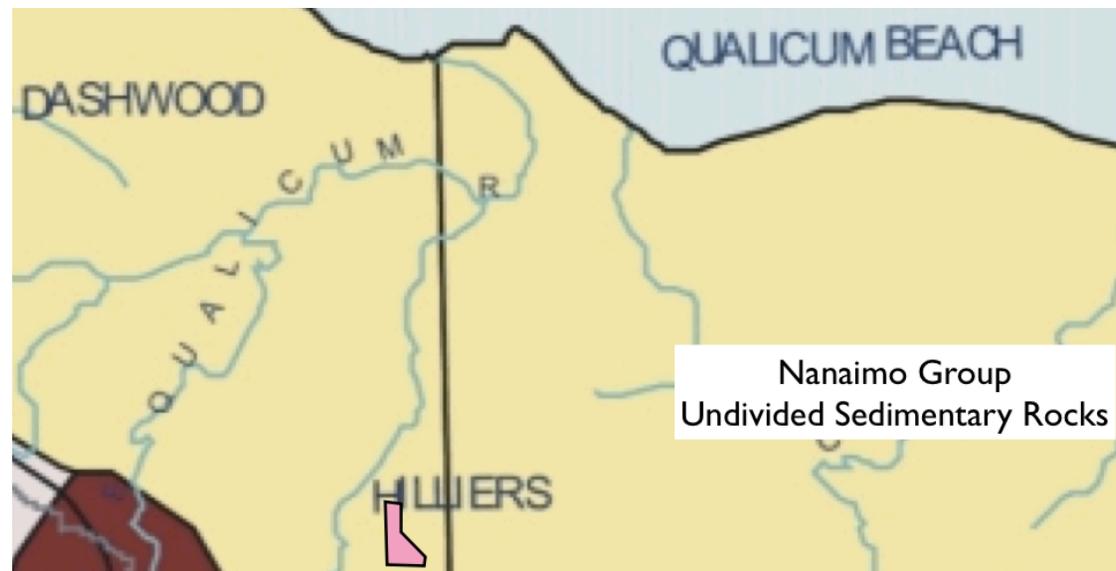


Figure 3: Bedrock geology (location of Whiskey Creek shown in pink)

Information from the well logs was used to draw three cross-sections describing the soil horizons, the bedrock, and identifying the locations of high yielding wells in the area (Figures 4 – 7). The information available from previously completed wells suggested the following:

- Bedrock is encountered at depths between 6 m and 23 m across the study area, and is predominantly a crumbly shale, with a deeper sandstone identified in some locations.
- The overburden consists of layers of low permeability material (clays), layers of medium permeability material (silts and till), and layers of permeable material (sand and gravel).
- The overburden is highly variable within the study area, with the thickness and composition of layers changing significantly over relatively short distances.
- The most productive wells in the area are completed in overburden and located 1.5 to 2 km away from the Whiskey Creek water service area in 3 locations (Figure 4):
 - 1. To the northeast of Whiskey Creek, one well with an estimated yield of 100 USgpm (WTN 86906);
 - 2. To the west of Whiskey Creek, two wells with estimated yields of 60 (WTN 60285) and 30 USgpm (WTN 100291);
 - 3. To the southwest of Whiskey Creek, one well with an estimated yield of 30 USgpm (WTN 50610).
- Wells completed in bedrock have reported relatively low estimated yields, with the exception of one well reporting an estimated yield of 15 USgpm (WTN 27360), located to the west of Whiskey Creek and shown in cross-section B-B' (Figure 6).

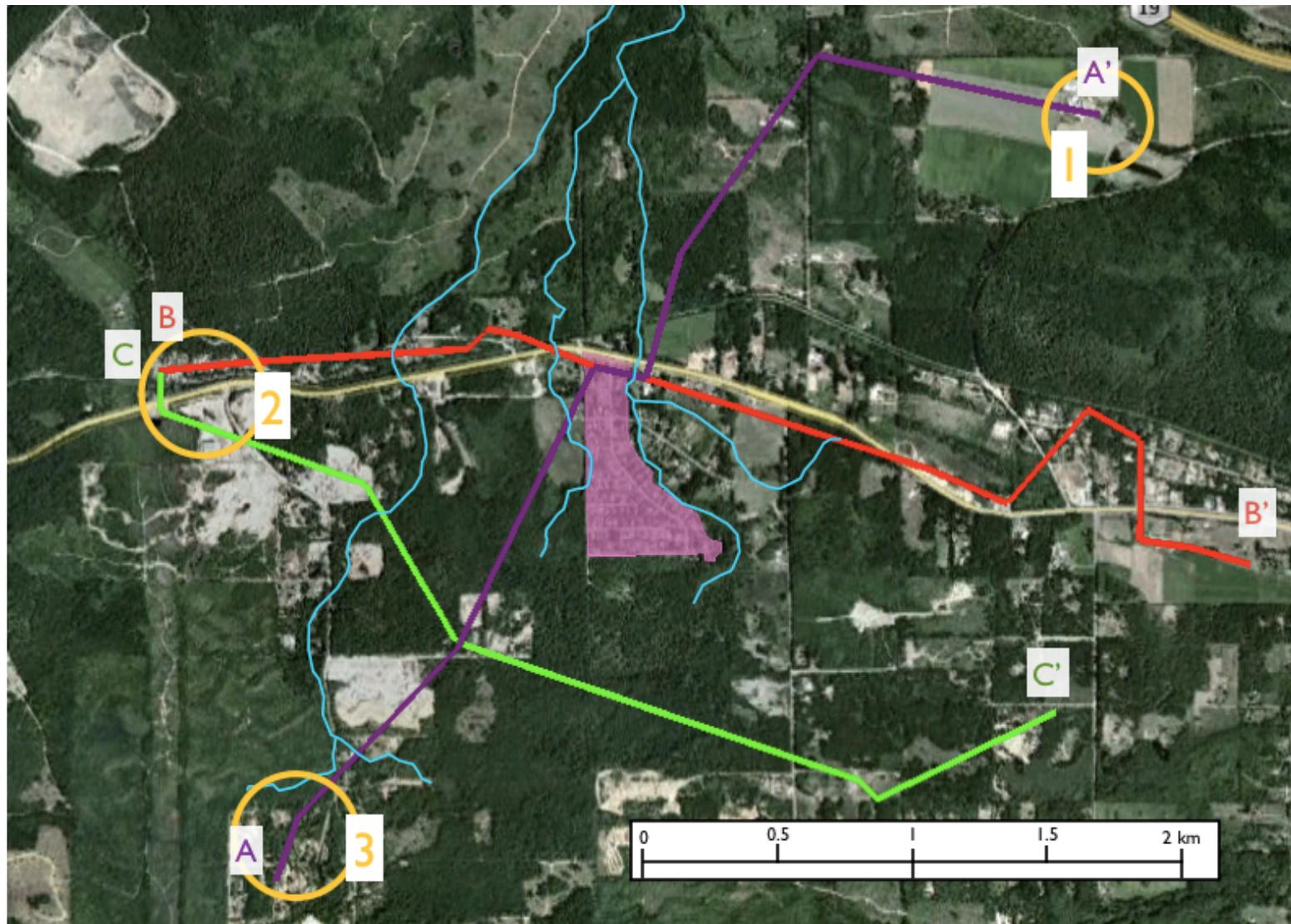


Figure 4: Cross-section locations (purple, red, and green lines) and locations of high yielding wells (yellow circles) (location of Whiskey Creek shown in pink)

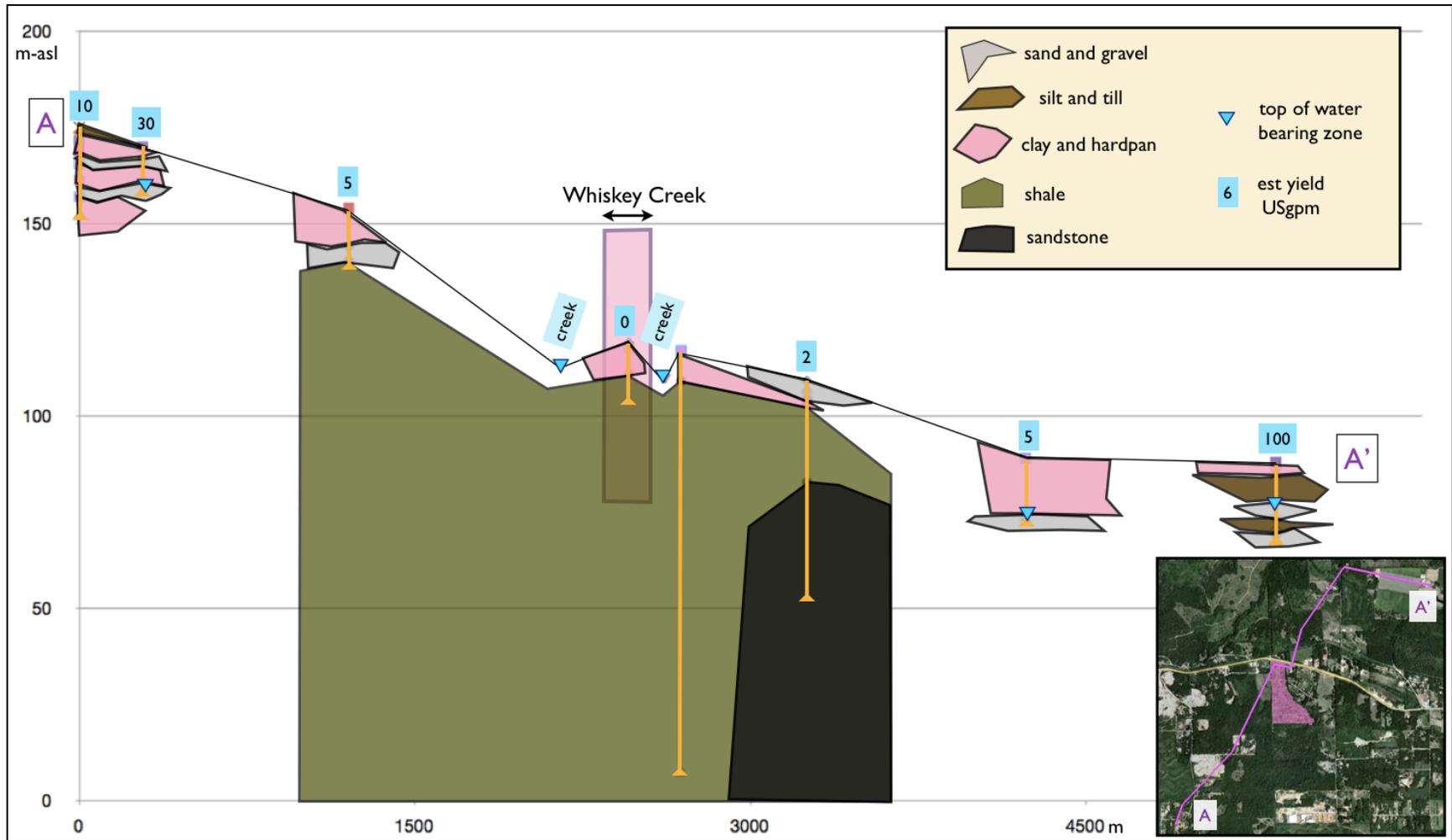


Figure 5: Cross-section A-A'

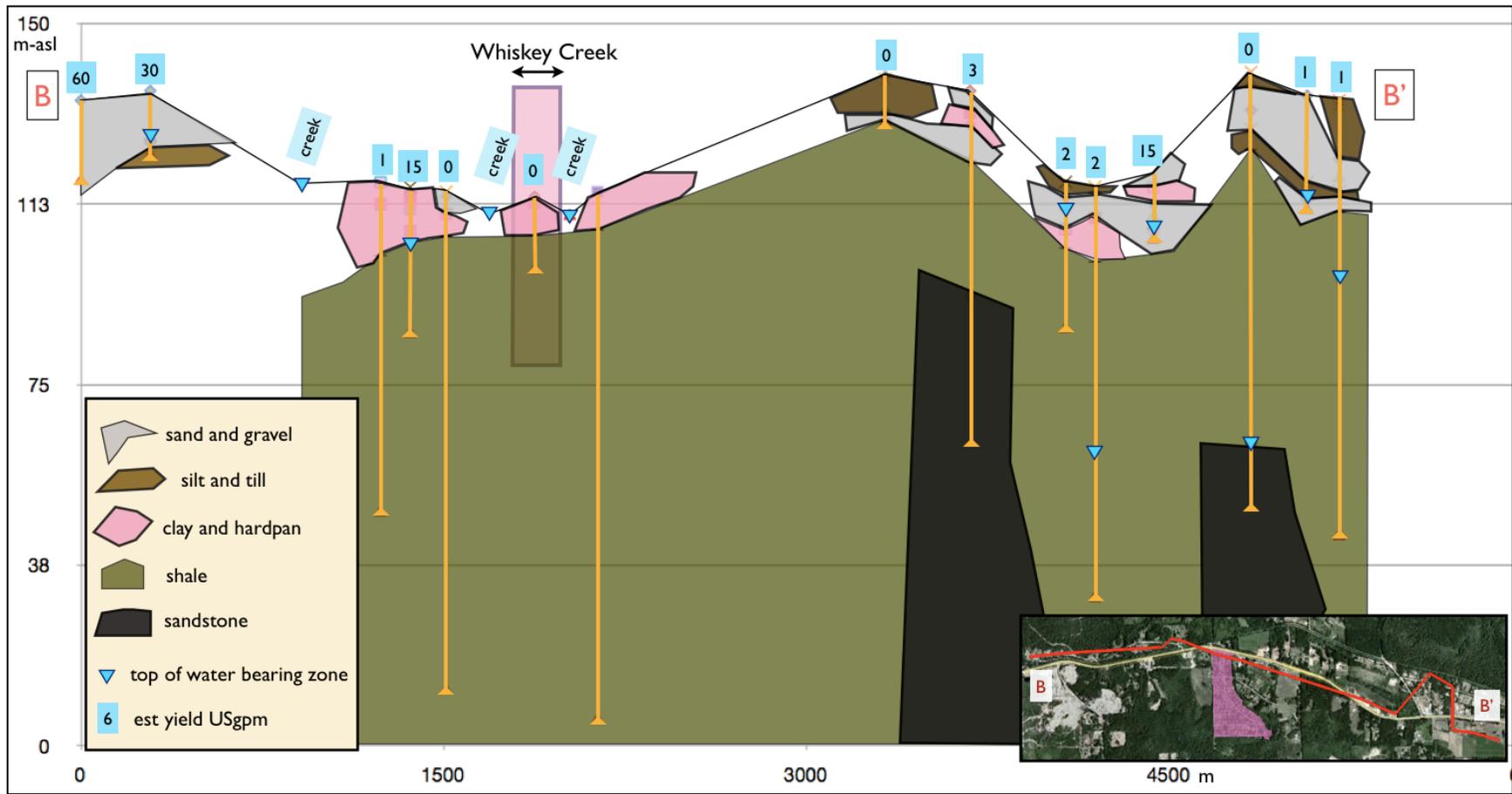


Figure 6: Cross-section B-B'

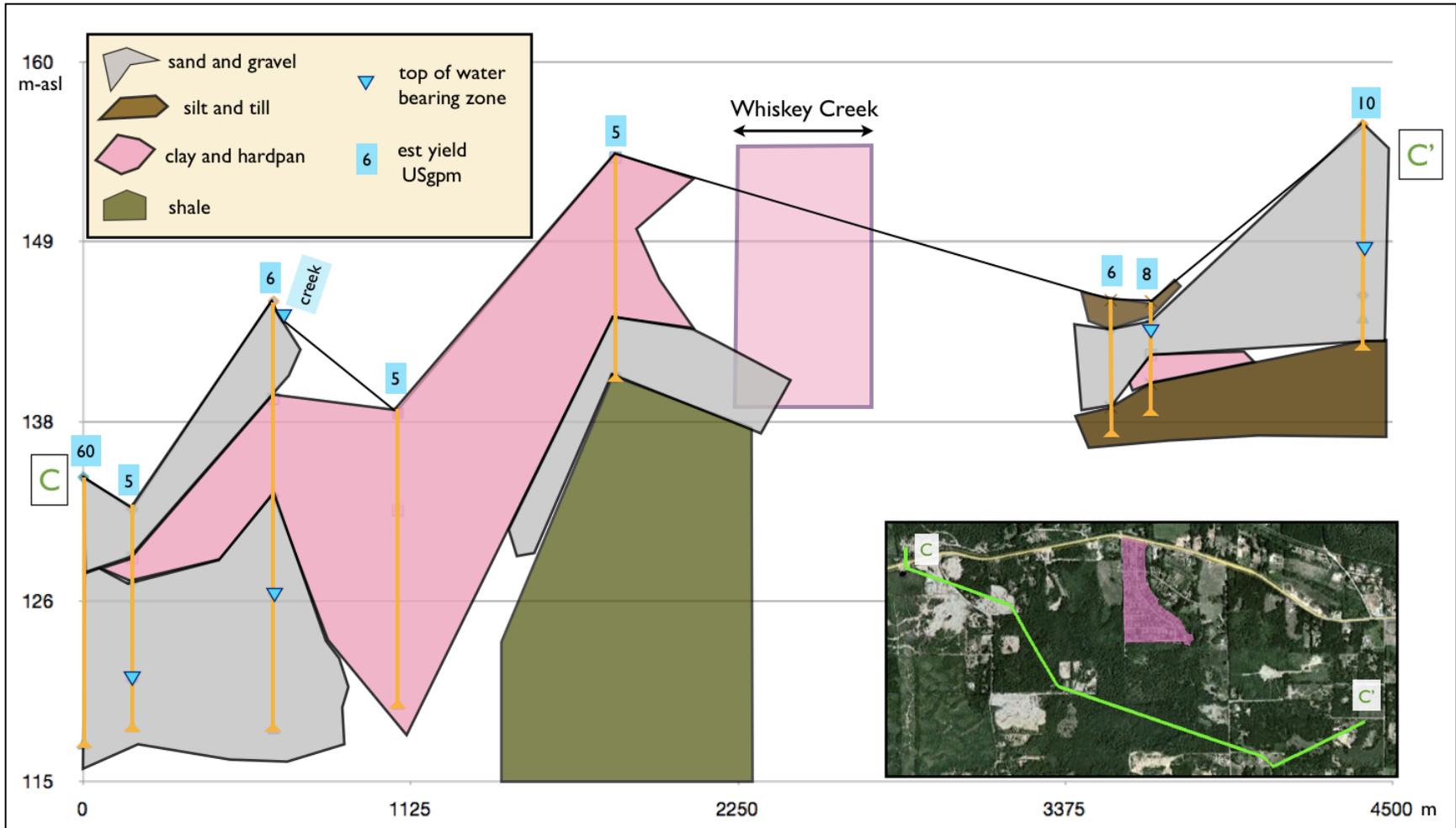


Figure 7: Cross-section C-C'

Conclusions

The investigation completed to date has provided the following information:

- ✓ The highest yielding wells in the area are completed in overburden aquifers at distances of approximately 1.5 to 2 km from the Whiskey Creek water service area.
- ✓ The thickest aquifer identified in the area is to the west of Whiskey Creek along the Alberni Highway (area 2 in Figure 4), where a number of wells have encountered a productive brown sand and gravel aquifer that is at least 6 – 20 m thick where wells have been completed. This area is also identified as having glaciofluvial deposits, where coarser aquifer material is expected. The productivity of the aquifer will be a function of its size (areal extent) and of its recharge.
- ✓ Wells in the immediate vicinity of Whiskey Creek (within 1 km) have not reported estimated yields above 5 USgpm, whether completed in overburden or bedrock, with the exception of one bedrock well reporting an estimated yield of 15 USgpm.

Recommendations

GW Solutions makes the following recommendations, based on the information available to date, and with the objective to plan the next phase of the water supply study in a cost effective way:

- ✓ Overburden aquifers should be targeted.
- ✓ A well completed in the identified sand and gravel aquifers could potentially yield in the order of 50 l/gpm.
- ✓ The likelihood of reaching such a yield will increase if the development of the well is optimized, combining several methods of development.

Closure

Conclusions and recommendations presented herein are based on available information at the time of the study. The work has been carried out in accordance with generally accepted engineering practice. No other warranty is made, either expressed or implied. Engineering judgment has been applied in producing this letter-report.

This report was prepared by personnel with professional experience in hydrogeology. Reference should be made to the 'GW Solutions Inc. General Conditions and Limitations', attached in Appendix 1 which forms a part of this report.

GW Solutions was pleased to produce this document. If you have any questions, please do not hesitate to contact me.

Yours truly,

GW Solutions Inc.



Gilles Wendling, Ph.D., P.Eng.
President

Appendices

Appendix 1 – GW Solutions General Conditions and Limitations



Appendix 1: GW Solutions General Conditions and Limitations

1.0 USE OF REPORT

This report pertains to a specific area, a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment. This report and the assessments and recommendations contained in it are intended for the sole use of GW SOLUTIONS's client. GW SOLUTIONS does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than GW SOLUTIONS's client unless otherwise authorized in writing by GW SOLUTIONS. Any unauthorized use of the report is at the sole risk of the user. This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of GW SOLUTIONS. Additional copies of the report, if required, may be obtained upon request.

2.0 LIMITATIONS OF REPORT

This report is based solely on the conditions that existed within the study area or on site at the time of GW SOLUTIONS's investigation. The client, and any other parties using this report with the express written consent of the client and GW SOLUTIONS, acknowledge that conditions affecting the environmental assessment of the site can vary with time and that the conclusions and recommendations set out in this report are time sensitive. The client, and any other party using this report with the express written consent of the client and GW SOLUTIONS, also acknowledge that the conclusions and recommendations set out in this report are based on limited observations and testing on the area or subject site and that conditions may vary across the site which, in turn, could affect the conclusions and recommendations made. The client acknowledges that GW SOLUTIONS is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the client.

2.1 Information Provided to GW SOLUTIONS by Others

During the performance of the work and the preparation of this report, GW SOLUTIONS may have relied on information provided by persons other than the client. While GW SOLUTIONS endeavours to verify the accuracy of such information when instructed to do so by the client, GW SOLUTIONS accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

3.0 LIMITATION OF LIABILITY

The client recognizes that property containing contaminants and hazardous wastes creates a high risk of claims brought by third parties arising out of the presence of those materials. In consideration of these risks, and in consideration of GW SOLUTIONS providing the services requested, the client agrees that GW SOLUTIONS's liability to the client, with respect to any issues relating to contaminants or other hazardous wastes located on the subject site shall be limited as follows:

(1) With respect to any claims brought against GW SOLUTIONS by the client arising out of the provision or failure to provide services hereunder shall be limited to the amount of fees paid by the client to GW SOLUTIONS under this Agreement, whether the action is based on breach of contract or tort;



(2) With respect to claims brought by third parties arising out of the presence of contaminants or hazardous wastes on the subject site, the client agrees to indemnify, defend and hold harmless GW SOLUTIONS from and against any and all claim or claims, action or actions, demands, damages, penalties, fines, losses, costs and expenses of every nature and kind whatsoever, including solicitor-client costs, arising or alleged to arise either in whole or part out of services provided by GW SOLUTIONS, whether the claim be brought against GW SOLUTIONS for breach of contract or tort.

4.0 JOB SITE SAFETY

GW SOLUTIONS is only responsible for the activities of its employees on the job site and is not responsible for the supervision of any other persons whatsoever. The presence of GW SOLUTIONS personnel on site shall not be construed in any way to relieve the client or any other persons on site from their responsibility for job site safety.

5.0 DISCLOSURE OF INFORMATION BY CLIENT

The client agrees to fully cooperate with GW SOLUTIONS with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The client acknowledges that in order for GW SOLUTIONS to properly provide the service, GW SOLUTIONS is relying upon the full disclosure and accuracy of any such information.

6.0 STANDARD OF CARE

Services performed by GW SOLUTIONS for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

7.0 EMERGENCY PROCEDURES

The client undertakes to inform GW SOLUTIONS of all hazardous conditions, or possible hazardous conditions which are known to it. The client recognizes that the activities of GW SOLUTIONS may uncover previously unknown hazardous materials or conditions and that such discovery may result in the necessity to undertake emergency procedures to protect GW SOLUTIONS employees, other persons and the environment. These procedures may involve additional costs outside of any budgets previously agreed upon. The client agrees to pay GW SOLUTIONS for any expenses incurred as a result of such discoveries and to compensate GW SOLUTIONS through payment of additional fees and expenses for time spent by GW SOLUTIONS to deal with the consequences of such discoveries.



8.0 NOTIFICATION OF AUTHORITIES

The client acknowledges that in certain instances the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by GW SOLUTIONS in its reasonably exercised discretion.

9.0 OWNERSHIP OF INSTRUMENTS OF SERVICE

The client acknowledges that all reports, plans, and data generated by GW SOLUTIONS during the performance of the work and other documents prepared by GW SOLUTIONS are considered its professional work product and shall remain the copyright property of GW SOLUTIONS.

10.0 ALTERNATE REPORT FORMAT

Where GW SOLUTIONS submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed GW SOLUTIONS's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by GW SOLUTIONS shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by GW SOLUTIONS shall be deemed to be the overall original for the Project. The Client agrees that both electronic file and hard copy versions of GW SOLUTIONS's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except GW SOLUTIONS. The Client warrants that GW SOLUTIONS's instruments of professional service will be used only and exactly as submitted by GW SOLUTIONS. The Client recognizes and agrees that electronic files submitted by GW SOLUTIONS have been prepared and submitted using specific software and hardware systems. GW SOLUTIONS makes no representation about the compatibility of these files with the Client's current or future software and hardware system

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