PROJECT NUMBER S721101

EVALUATION OF THE SUITABILITY OF NEW DEROCHE SCHOOL WELL AS A SOURCE OF WATER FOR SCHOOL AND COMMUNITY USE

Prepared for

SCHOOL DISTRICT #75 (MISSION)
33919 Dewdney Trunk Road
MISSION, B.C. V2V 5X4

Prepared by

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SEPTEMBER 27, 1995

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Project No. S721101

September 27, 1995

School District #75 (Mission)
33919 Dewdney Trunk Road
MISSION, B.C. V2V 5X4

Attention: Mr. D. Milne
Director of Facilities

Subject: **Evaluation of the Suitability of New Deroche School Well as a Source of Water for School and Community Use**

Dear Sirs:

1.0 INTRODUCTION

This letter is further to recent telephone discussions between Mr. Dave Milne, Director of Facilities for School District #75 (Mission) (SD75), and Ann Badry, P. Geo., Hydrogeologist/Manager of Pacific Hydrology Consultants Ltd. (PHCL), and, in particular, to an onsite discussion of September 20, 1995 among Mr. Milne and Mr. Surinder Gahir, of SD75, and Ed Livingston, P. Eng., Associate Consultant of PHCL. The discussions concerned a new well which was recently constructed near the northwestern corner of the lot on which the Old Deroche School is located.

From the above-mentioned discussions, we understand that the situation concerning the new Deroche School, and development of a source of groundwater to supply the School, is as follows:

1. SD75 has built a new school in Deroche and work on the buildings is nearing completion.

2. In an effort to establish a water supply for the new school, two test wells were drilled at the new school site by A & H Construction Ltd. The first test well, which was drilled to 82.6 m (271 ft), was unsuccessful. A second test well, whose location was selected by a water dowser, was also unsuccessful at a depth of 24.4 m (80 ft).

3. A successful 200 mm (8") diameter well was then constructed by A & H near the northwestern corner of the lot on which the old School is located. The well is 23.2 m (76 ft) deep and is completed with 1.5 m (5 ft) of stainless steel well screen, set with the bottom at 23.2 m (76 ft). The driller estimates the capacity of the well to be about 15 l/sec (200 igpm) but a pumping test has not been carried out.

4. The Dewdney-Alouette Regional District is considering using the new well to supply Deroche Community as a replacement for the present Deroche Creek source.

5. After completion of the well, the Health Inspector for the area pointed out that the well is located less than 122 m (400 ft) from a graveyard located northwest of the well while the Health Act specifies that a community well must be at least 122 m from a graveyard. The distance has been measured at 97.6 m (320 ft). The graveyard is part of Indian Reserve No. 11 and is only used by the Lakahahmen Band.

At the request of School District #75, PHCL has examined the situation concerning the new Deroche School Well and this letter-report has been prepared to give an opinion as to the suitability of the new well for school and community supply and whether the graveyard poses any health risk.

The following documents are background information for preparation of this letter:

1. NTS Map 92 G/1, **Mission**, of scale 1:50,000 and with a contour interval of 20 metres.
2. A portion of a topographic map of the Deroche area of scale 1:5,000 with a contour interval of 2 metres.
3. Four oblique colour photos, recently taken for SD75, and which cover the Deroche area.
4. Vertical airphotos 172, 173 and 174 of Roll 30BCC823, of scale about 1:12,000.
5. Four water well records provided by A & H Construction Ltd., along with a location sketch and a note from Mr. Mike McDonald, Manager of A & H Construction Ltd.
6. Miscellaneous information from PHCL's files dealing with previous work in the Deroche area, particularly for the Lakahahmen Indian Band on Lakahahmen I.R. 11 south of the subject area.
7. Geological Survey of Canada Map 1485A, **Surficial Geology Mission British Columbia**, of scale 1:50,000.
8. **Cemeteries and Groundwater: An Examination of the Potential Contamination of Groundwater by Preservatives Containing Formaldehyde**; prepared by G. Soo Chan, M. Scafe, S. Emami, Water Resources Branch, Ontario Ministry of the Environment, February 1992, 11 pp.

Figure 1 in Appendix A is an area location map; Figure 2 is a site plan showing the approximate (unsurveyed) locations of water wells. The lithologs for the wells shown on Figure 1, along with details about well construction, are contained in Table 1 in Appendix B. Figure 3 (Appendix B) illustrates the construction details of the new Deroche School Well.

2.0 TOPOGRAPHY AND GEOLOGY

The new Deroche School, the Old School, and much of Deroche Community, are located on the modern fan of Deroche Creek. The fan starts where the Creek emerges from its steep canyon and extends southeastward to Nicomen Slough. A smaller unnamed creek from the northeast also flows out of its canyon onto the Deroche Creek fan; this is the small intermittent creek which flows on the west side and close to the New School.

The Deroche Creek fan, where it is exposed at surface, is composed of coarse bouldery gravel and sand. The lithologs of water wells/test holes show that there are also layers (probably lenses) of less permeable sediment described by the driller as "till" or "sand and gravel with binder". The unsuccessful test well drilled at the new School is the deepest well for which a litholog is available. As summarized in Table 1 (Appendix B), the deep unsuccessful test well at the new School shows that the gravelly sediments which make up the fan extend from surface to 18 m (59 ft). Below the modern fan, the sediments are mostly fine-grained, including till at 50.3 to 55.2 m (165 to 181 ft). The subject new Well at the Old School, which was still in coarse gravel at 23.2 m (76 ft) but had passed through "till and boulders" from 5.5 to 17.1 m (18 to 56 ft), encountered similar conditions as the Lakahahmen Band's well which is located a short distance south near the railway crossing (see Figure 2 in Appendix A and Table 1 in Appendix B). An exposure in a road cut near the upper end of the fan shows very coarse fan gravel resting on top of compact silt. It seems likely that the "till" reported in the new School Well is actually very silty compact fan gravel which may resemble till during drilling because of the poor sorting, the presence of boulders and low permeability which is apparently sufficient to create a confining situation in which the static water level in the Well rises above the top of the layer of low permeability.

In summary, lithologs of existing wells and the exposures indicate that:

- Deroche Creek fan is made up of coarse highly permeable gravel and sand with silty layers and lenses that have much lower permeability;
- the fan rests on finer grained sediments and becomes thicker toward the lower end.

The above summary shows that Deroche Creek fan is a fairly typical fan at the mouth of a steep mountain creek.

3.0 HYDROLOGY

There are two streams flowing down the fan of Deroche Creek to Nicomen Slough: Deroche Creek and a small unnamed creek. Both Deroche Creek and the unnamed Creek are intermittent, with the total flow going underground during periods of low flow. An examination of the stream bed indicates that the unnamed creek seldom flows over the fan. Any precipitation falling on the fan goes underground within a short distance due to the high permeability of the near-surface sediments. The water which goes underground later discharges from the lower edge of the fan into Nicomen Slough at the contact of the coarse permeable fan sediments and the underlying finer-grained valley fill sediments. This discharge, in the form of large springs, can be seen during times of low water at the edge of the Slough on Lakahahmen I.R. 11.

Water supply wells constructed in the sediments of Deroche Creek fan intercept part of the water flowing through the fan, much of which is infiltration from the two creeks; there is also water discharging into the upper part of the fan from large groundwater flow systems which are recharged on the mountains to the north and which involve flow through fractured bedrock. The amount of water flowing through the Deroche Creek fan is very large, even in times of drought.

4.0 POLLUTION AND CONTAMINATION HAZARDS

The main question which has been raised about contamination is whether the cemetery, which is located at a distance about 100 m, could contaminate groundwater at the new Deroche School Well. In our opinion, the cemetery does not and will not contaminate groundwater that will be withdrawn by the new Well. Evidence for this is the following:

1. The screen in the new Deroche School Well is installed opposite fan gravel, at a depth of 21.6 to 23.2 m (71 to 76 ft) in an aquifer zone that extends from 17.1 to 23.2 m (56 to 76 ft) and which is overlain by 11.6 m (38 ft) of sediments described as "till and boulders" from 5.5 to 17.1 m (18 to 56 ft) - sediment that is much less permeable than the gravel aquifer zone.
2. In the fan, through which groundwater is moving comparatively rapidly, any potential contaminants that would not be attenuated by the thick unsaturated zone after moving down to the water table would tend to remain near the water table, with gradual vertical and lateral dispersion and much dilution as the water flows away from any contaminant source. Layers and lenses of less permeable sediments within the fan sediments would tend to prevent, or at least slow, downward migration of contaminants.
3. The cemetery is relatively inactive, with the most recent grave dated 1989. Since the cemetery is only used by the Lakahahmen Band, it is not likely to be much more active in future.

In our opinion, properly constructed and maintained septic tank/disposal field systems are not sources of contamination on the Deroche Creek fan due to the following:

- there is a substantial thickness of unsaturated sediment for wastewater renovation;
- the potential contaminant in wastewater, nitrate, would be rapidly diluted by the large amount of groundwater moving through the fan gravel, such the concentration would be reduced within a short distance of the disposal field.

With respect to existing wastewater disposal field locations, there is no field directly upgradient of the Well and the existing field at the Old School Well is reported by SD75 to be located a distance about 46 m (150 ft) downslope of the School Building.

5.0 SUMMARY AND CONCLUSIONS

Based on field reconnaissance and examination of lithologs of water wells and test holes in the subject area, the hydrogeologic environment and groundwater flow regime relevant to the new Deroche School Well constructed at the site of the Old School may be summarized as follows:

1. The new and old Deroche Schools and Lakahahmen Band's Cemetery are all located on the modern post-glacial fan of Deroche Creek.

2. The modern fan of Deroche Creek is typical of a fan at the mouth of a steep mountain creek with the fan composed of alternating coarser more permeable layers and compact less permeable layers.

3. Groundwater flowing through the sediments of the Deroche Creek fan discharges into the thick fine-grained sediments filling the Fraser River Valley. Part of this discharge can be seen entering Nicomen Slough at the outer edge of the fan where it interfingers with valley fill sediments.

4. The Lakahahmen Cemetery, which is located on the upper part of the Deroche Creek fan, does not represent a source of contamination for the aquifer from which the new Deroche Creek School Well will withdraw water. Indications are that local topography may, in fact, direct groundwater flow past the new Deroche School Well. In any event, there is a thick unsaturated zone in which attenuation of contaminants can be expected.

5. If necessary, directions of groundwater flow in the vicinity of the cemetery can be confirmed. However, any potential contaminants which would enter the groundwater flow regime would be rapidly diluted so as to be undetected very far from the source of contamination. Evidence for rapid groundwater movement in the fan is the low mineralization of groundwater yielded by the Lakahahmen Well.

6.0 RECOMMENDATIONS

Despite the fact that the aquifer at the site of the new Deroche School Well on the Old School site is overlain by a substantial thickness of low permeability sediments, to ensure adequate protection of the groundwater resource represented by the Well, the following recommendations are made:

1. Provide for controlling and directing surface water flow in the vicinity of the well so as to prevent surface and shallow subsurface water from moving toward and down the outside of the well casing.

2. Design the trench for the water line connection from the Well to the distribution system such that the trench does not become a conduit for transport of surface water or shallow groundwater toward and down the outside of the well casing and into the aquifer zone; for example, provide for backfilling the trench for the water line connection for a few metres away from the Well with fine-grained sediments containing a bentonite sealant.

3. Carry out a pumping test on the new Deroche School Well to determine its capacity, and more importantly to obtain more information on the aquifer which yields water to the Well. Such a test should be carried out by pumping at a rate close to the estimated well capacity, by a properly-equipped testing contractor using standard testing procedures. When the permanent pump is installed, a 18 mm (¾") diameter PVC tube should be included to facilitate water level measurements with an electric water level indicator; a totalizing water meter and hour meter should also be included in the wellhead installation to record total water consumption from the Well. The usual procedure is to tape the PVC water level measuring tube to the drop pipe of the pump, with the top of the tube in the pitless adaptor.

This report and attachments have been researched in order to provide a basis for evaluating the suitability of New Deroche School Well as a source of water for both School and Community Use. In the event that is is necessary for the writer to be of further assistance with the subject of this report, please do not hesitate to contact us at the address on the letterhead.

Yours truly,
PACIFIC HYDROLOGY CONSULTANTS LTD.

Ed Livingston

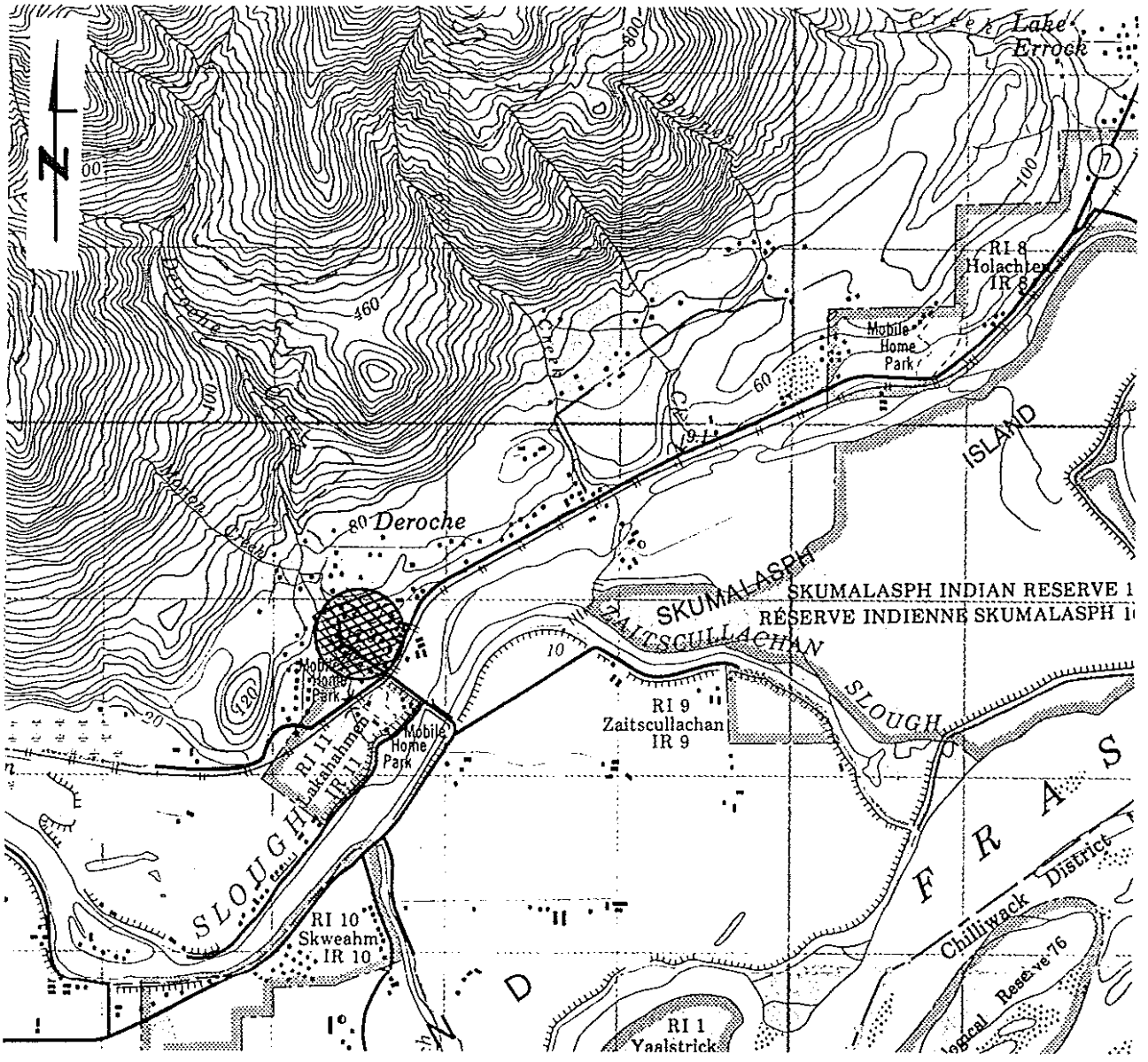
Ed Livingston, P. Eng.
Associate Consultant

09/29/95

Attachments

APPENDIX A

NEW DEROCHE SCHOOL WELL AREA
AND
WATER WELL LOCATION MAPS



Notes:

1. The base map is 1:50,000 scale topographic map N.T.S. 92G/1, **Mission**, enlarged to an approximate scale of 1:38,600; contour interval is 20 metres.
2. ▨ outlines subject area of new Deroche School Well; for detail, see Figure 2.

PROJECT NO.: S721101

PROJECT:

SCHOOL DISTRICT #75 (MISSION)

NEW DEROCHE SCHOOL WELL

LOCATION: DEROCHE, B.C.

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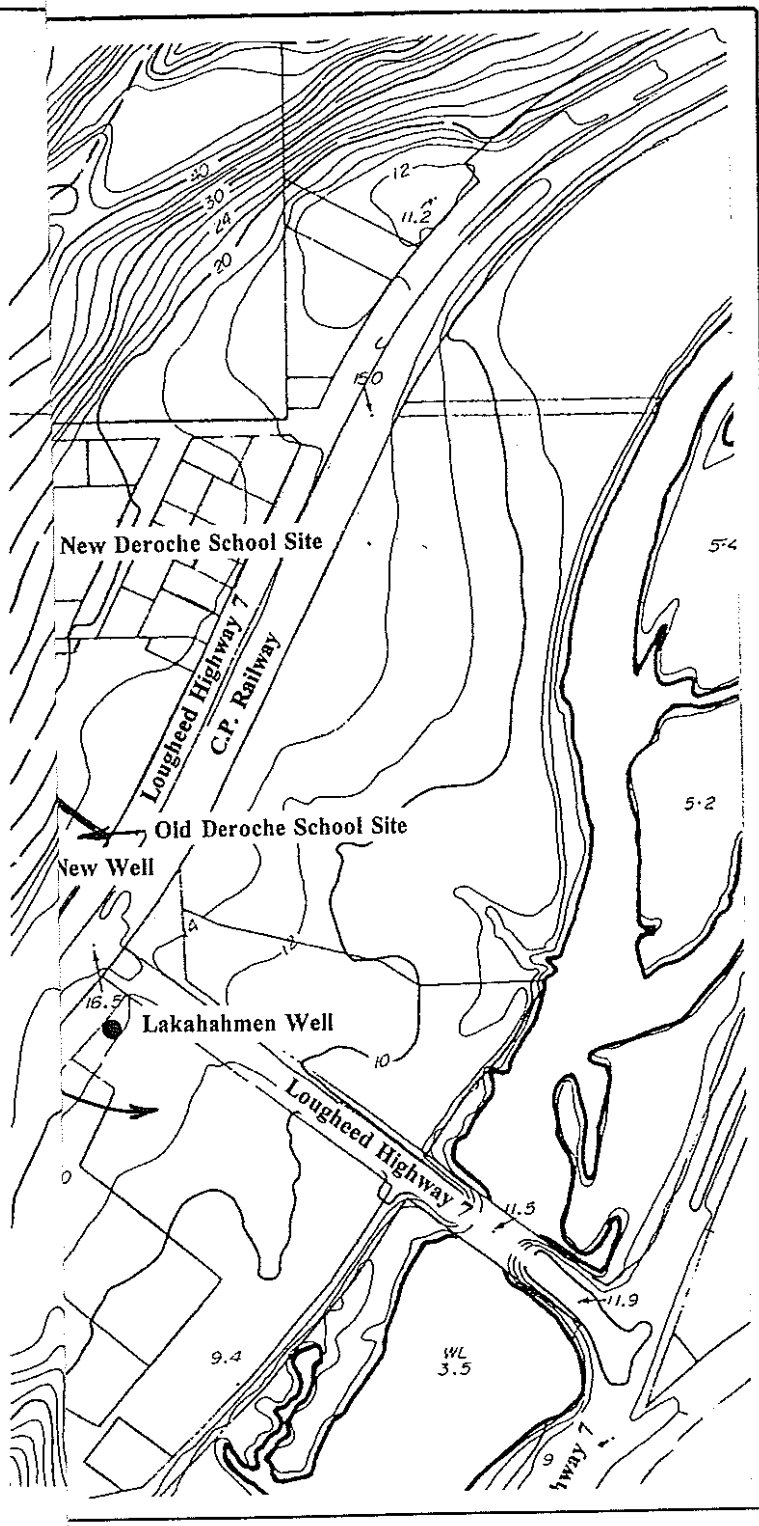
AREA LOCATION MAP

DATE:	DRAWN BY:	FIGURE:
09/27/95	ab	1



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PROPERTY AND WELL/TEST WELL LOCATIONS

	DRAWN BY:	FIGURE:
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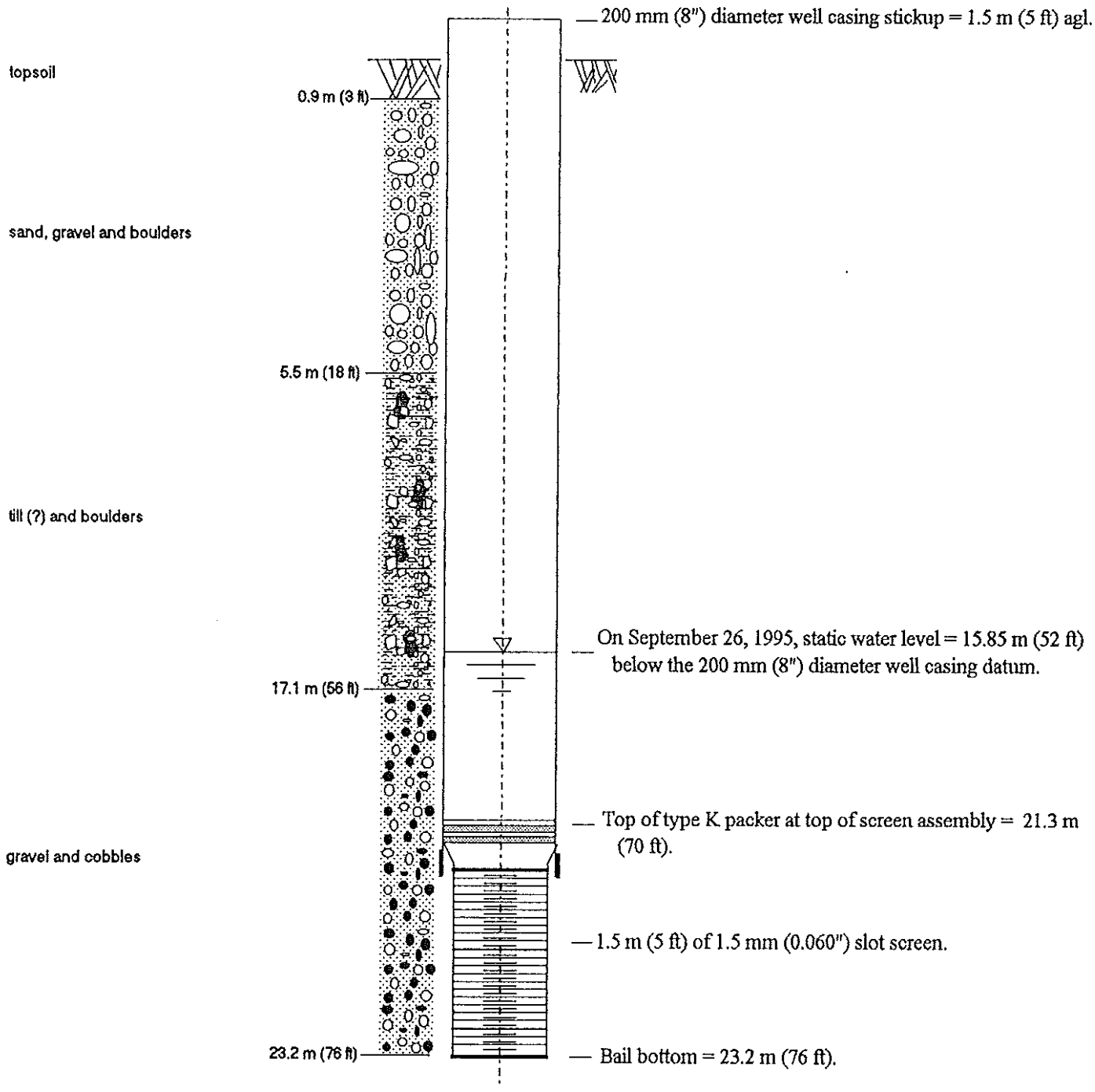
APPENDIX B

DETAILS ABOUT AREA DRILLED WELLS/TEST HOLES

Table 1. Selected Details About New Deroche School Well at Old School Site and About Area Wells

Well (Completion Date)	Completed Depth		Static Water Level		Aquifer Lithology and Well Completion	Driller's Litholog			Remarks
						Interval		Description	
	m	ft	m	ft		m	ft		
1 (08/95)	23.2	76	15.85	52	Completed with 1.5 m (5 ft) of 200 mm (8") nominal diameter stainless steel screen with 1.524 mm (0.060") slots set with the bottom at 23.2 m (76 ft).	0.0 - 0.9 0.9 - 2.4 2.4 -17.1 17.1 -23.2	0 - 3 3 - 8 8 - 56 56 - 76	topsoil sand and gravel and boulders till and boulders gravel and cobbles	New Deroche School Well at old school site; 200 mm (8") diameter well; capacity estimated at 15.1 *l*/sec (200 i(?) gpm).
2 (03/83)	24.4	80	8.2	27	Completed with 1.5 m (5 ft) of 200 mm (8") nominal diameter stainless steel well screen with 1.524 mm (0.060") slots set with the bottom at 24.4 m (80 ft).	0.0 - 6.4 6.4 - 15.9 15.9 - 24.4	0 - 21 21 - 52 52 - 80	sand and gravel, some clay gravel and till sand and gravel.	Lakahahmen Well supplying Kelly Estates Mobile Home Park; 200 mm (8") diameter with rated capacity of 7.6 *l*/sec (100 igpm).
3 (07/95)	82.6	271	-	-	-	0.0 - 13.1 13.1 - 14.9 14.9 - 16.5 16.5 - 18.0 18.0 - 31.7 31.7 - 46.6 46.6 - 50.3 50.3 - 55.2 55.2 - 61.3 61.3 - 65.5 65.5 - 82.6	0 - 43 43 - 49 49 - 54 54 - 59 59 - 104 104 - 153 153 - 165 165 - 181 181 - 201 201 - 215 215 - 271	gravel and boulders sand and gravel with binder sand and gravel clay fine silty sand clay fine silty sand clay till clay fine silty sand fine sand.	Test Well at site of new Deroche School; casing broken during pulling; well abandoned.
4 (07/95)	24.4	80	-	-	-	0.0 - 13.1 13.1 - 18.6 18.6 - 24.4	0 - 43 43 - 61 61 - 80	gravel and boulders sand and gravel with binder fine silty sand.	Test Well, selected by water dowser at site of new Deroche School; pulled casing and abandoned site.

FIGURE 3	SCHOOL DISTRICT #75 (MISSION) NEW DEROCHE SCHOOL WELL CONSTRUCTION DETAILS



Notes:

1. The sketch is not to scale.
2. The well screen is 200 mm (8") nominal diameter Johnson stainless steel, of 168 mm (6.6") i.d.
3. All measurements are below ground unless otherwise indicated.

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Project No. S721101

October 10, 1995

School District #75 (Mission)
33919 Dewdney Trunk Road
MISSION, B.C. V2V 5X4

Attention: Mr. D. Milne
Director of Facilities

Subject: **Effluent Disposal Field for the New School at Deroche**

Dear Sirs:

This letter is further to a telephone discussion on October 6, 1995 between you Dave Milne, Director of Facilities for School District #75 (Mission), and Ed Livingston, P. Eng., Associate Consultant of Pacific Hydrology Consultants Ltd. (PHCL), about concerns expressed by Ms. Jane Guo, P. Eng., B.C. Environment, in regard to possible migration of effluent from the disposal field at the new Deroche School into Deroche Creek, and also the unnamed creek, both of which flow over the Deroche Creek Fan.

In preparation of this letter, we have considered a letter-report dated October 3, 1995 prepared by Kerr Wood Leidal Associates Ltd. for School District No. 75 (Mission) "Re: Deroche Elementary School Flood Risk for the Tile Field", which was signed by Mike V. Currie, M. Eng., P. Eng., Project Engineer, and to which was attached streamflow data for Deroche Creek.

Background information concerning the above subject is also contained in the following correspondence:

- A letter dated November 4, 1994 from PHCL to SRK-Robinson Inc. on the subject "Groundwater Hydrology at the Site of a Septic Tank Effluent Disposal Field for a new School at Deroche".
- A letter dated August 28, 1995 from PHCL to B.C. Environment on the subject "Results of Groundwater Monitoring of a Wastewater Disposal Field at a new School at Deroche".

In assessing the possible migration of water from the field to the two creeks, there are two conditions to consider:

1. When one or both creeks are flowing over the entire fan.
2. When one or both creeks are losing enough water from their beds such that their beds are dry over part of their course over the fan.

When either creek is flowing over the fan, it is losing water from its bed; flow is from the creek into the ground. Under these conditions, effluent cannot flow from the field into either creek.

When both creeks are losing their entire flow to the fan, as is the case in late summer and early autumn, effluent from the disposal field cannot flow against the groundwater gradient into the creek bed. This might not be the case if the creeks re-appeared in their beds on the lower parts of their courses; however, this concern can be ruled out in the Deroche Creek situation, as the lower reaches of the creeks were checked during late summer and early autumn and the beds were observed to be dry for their entire course, with groundwater discharge from the fan taking place below water level into Nicomen Slough. Such discharge includes the effluent from the field which has been treated during its migration, first downward as unsaturated flow below the field to the water table and then during transport in a relatively long path of flow to the lower edge of the fan within the natural groundwater flow regime in which the effluent has become highly diluted so as to be unlikely to even be detected.

We trust that this letter adequately addresses concerns of B.C. Environment with respect to potential impacts to Deroche Creek and the unnamed creek due to effluent disposal at the new Deroche Elementary School. However, please do not hesitate to call if further clarification of the contents of this letter is required.

Yours truly,
PACIFIC HYDROLOGY CONSULTANTS LTD.

Ed Livingston

Ed Livingston, P. Eng.
Associate Consultant