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GROUNDWATER INPUT

to

FRASER-DELTA STRATEGIC PLAN

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FRASER-DELTA PLANNING UNIT

I. INTRODUCTION

The purpose of this report is to provide an assessment of the groundwater resources in the Fraser Delta Strategic Planning Unit, particularly in relation to the following terms of reference, as requested by the Planning and Assessment Branch, namely:

1. Coordinate groundwater data collation with Inland Waters Directorate studies.

2. Map groundwater resources and relative quantity/quality in important rural areas.

3. Identify sensitive recharge areas requiring protection.

4. Identify possible sources of groundwater contamination.

5. Specify areas where groundwater may provide additional water to meet projected water requirements and water shortages.

II. GROUNDWATER DATA

For the Fraser lowland area, there are in the Groundwater Section files about 10,000 water well records, as well as a number of reports and maps provided by various groundwater engineering consultants. Recently, Mr. E.C. Halstead of the Groundwater Division, Inland Waters Directorate, Environment Canada, has prepared a draft report on the hydrogeology of the Fraser Lowland. This draft report, presently being finalized for publication, constitutes a detailed hydrogeologic study of the Fraser Valley, based on 20 years of office and field investigation, and provides basic information on the occurrence, availability and quality of groundwater in the Fraser Valley area from White Rock to Chilliwack.

The following groundwater report is based upon a review and analysis of a number of selected water well records, reports, maps, and particularly the draft report by E.C. Halstead (1983). Extensive reference to Mr. Halstead's report has been used in preparing this groundwater report.

III. GROUNDWATER RESOURCES AND RELATIVE QUANTITY/QUALITY

GROUNDWATER RESOURCE - QUANTITY

Groundwater in the planning unit can be obtained from water-filled fractures within sandstone, siltstone or shale bedrock. However, available data indicates that the productive capacities of wells constructed in fractured bedrock is commonly less than 0.2 L/s, with some yields reported to be about 1 L/s. These low yields indicate that present development of groundwater from fractured bedrock in the planning unit is not very significant. Furthermore, the potential for further development is generally not good.

Of greater significance is the groundwater potential from aquifers within the unconsolidated deposits. The major unconfined aquifers in the planning unit are comprised of:

1. deltaic sand and gravel
2. floodplain sand and gravel deposited by the Fraser and Chilliwack rivers

3. lacustrine sands; as in the Sumas Prairie area.

Based on surficial geological mapping of the area (Armstrong, 1980), Figure A outlines the probable extent of the unconsolidated water-table aquifers throughout the planning unit. An analysis of this map indicates that these water-table aquifers are extensive.

The main confined aquifers in the Fraser-Delta unit are comprised of:

1. fluvial sand; confined between deposits of stony clay or clay.
2. sand and gravel lenses; interbedded within till deposits.

Mapping the locations and extent of the confined aquifers is complicated since it requires a detailed review and analysis of numerous well records in order to identify and correlate the locations of the aquifer materials at depth. To illustrate, Figures B and C have been drawn to show the regional variation of the unconsolidated deposits between Tsawwassen and Rosedale. This hydrogeologic cross-section also shows that the sand and/or gravel deposits which comprise the major confined aquifers are of limited extent and do not appear to be continuous throughout the planning unit.

Included in Halstead's report (1983), are a number of detailed hydrogeologic fence diagrams (see attached example, Figure D), which provide the basis for the identification and outlining of the location and extent of the confined aquifers in the Fraser lowland. These fence diagrams could also be used to further define the extent of the unconfined water-table aquifers.

Based on available data, there have been at least 10,000 water wells constructed within the Fraser-Delta Planning Unit. The majority of these wells have been constructed to supply groundwater for domestic and livestock requirements. There are also a number of large capacity wells constructed for irrigation, municipal, industrial and fish hatchery requirements (see Figure A and Table 1). Halstead (1983) estimates the groundwater consumption from these large capacity wells was about 21 x 10^9 liters (5.5 x 10^9 U.S. gallons) for the year 1981. Halstead further estimates the groundwater consumption for domestic use during the same year was about 8.5 x 10^9 liters (2.2 x 10^9 U.S. gallons). The total groundwater consumption (about 30 x 10^9 liters) represents about 44 percent of the total water consumption in the Fraser lowland for the year 1981. This figure indicates that groundwater use is significant,

The following summarizes the present development of the groundwater resource within the planning unit, in relation to four generalized geographic areas as outlined in Figure A.

(1) West Area (encompassing Serpentine and part of Nicomekl watershed)

The West Area, comprised of three small uplands, two river valleys and a flat deltaic area, is underlain by stoney clay, two fluvial sand aquifers below present day sea level and interbedded till/sand and gravel deposits above sea level. Within the Nickomekl watershed, production wells for the city of White Rock, Surrey Nursery, Brookswood Municipality and Langley, are reported by Halstead (1983) to be withdrawing groundwater in excess of 10^{12} liters per year. In the Newton Upland area, groundwater is generally developed from aquifers at depths of less than 30 meters. Well yields have been reported to be generally less than 0.5 L/s (7.8 U.S. gpm.). Elsewhere, groundwater development is from aquifers at depths between 30 to 120 metres, with yields reportedly up to 1.5 L/s (24 U.S. gpm.). Locally higher well yields in the range of 13 to 65 L/s have been reported in the White Rock, Langley and Tsawwasen areas. Similarly, well yields up to 13 L/s have been reported in the Hazelmere, Port Kells and Crescent Beach areas.

(2) Central Area, Langley Upland (encompassing Campbell River, Salmon River, Bertrand Creek, West Creek and Nathan Creek watersheds)

In this area, groundwater is generally developed from sand and gravel aquifers within the interbedded till/sand and gravel sequences, at depths of 30 to 60 metres below ground. Near the margins of the upland (near Brookswood) groundwater has been developed from shallow deltaic sand and gravel aquifers. Near Clearbrook, groundwater has been developed from ice-contact sand and gravel aquifers. Throughout these localities, well yields are considerably variable. Though most wells are reported capable of producing from 0.5 to 1.5 L/s, yields of up to 13 L/s are common from wells located in Sect. 14 and 15, TP.10; Sect. 14, 25 & 26, TP.11; Sect. 32, TP.13; Sect. 19 and 30, TP.14; and Sect. 18, TP.16. Some higher well yields ranging between 13 to 65 L/s occur in the southwest area of Clearbrook. Within the Salmon River watershed, the Town of Fort Langley utilizes production wells with capacities between 38 L/s and 151 L/s. Near Huntington, some very high yielding wells (130 to 160 L/s) have been developed from outwash sand and gravel deposits, for trout hatchery water supply requirements, and for the district of Abbotsford.

(3) Sumas and Matsqui Prairies (encompassing Fishtrap Creek, McLennan-Gifford Creek, Clayburn Creek and Sumas River watersheds)

Both of these localities are underlain by thick deposits of clay with some silt. Groundwater supplies, usually sufficient to meet domestic needs, are developed almost entirely by sandpoints, from shallow aquifers at depths less than 15 metres. In the Sumas Prairie area, the shallow aquifers originated from sand deposited in a lake which was drained in 1924. Near the southwest end of this area, well yields of up to 8 L/s have been reported. One well, located in Sect. 14, TP.19, was reported to yield about 7 L/s.

In the Matsqui Prairie area, groundwater supplies are developed from aquifers at depths of about 15 metres. Some wells, constructed in the sand

and gravel aquifers at depths of about 25 metres, have reported yields in the range of 5 to 15 L/s.

(4) <u>Greendale - Rosedale Area</u>

According to Halstead (1983), groundwater supplies in this area are developed from aquifers comprised of floodplain materials deposited by the Fraser River or by the Chilliwack River as it crossed the lowland region. Floodplain sands and gravels deposited by the Chilliwack River are up to 45 metres thick. An analysis of the eastern part of the cross-section, Figure C (from Greendale to Rosedale), indicates the possibility of a 10 metre thick sand and gravel aquifer overlain by 3 metres of clay. Yields for some wells in this aquifer are reported to be in the range of 1 to 10 L/s.

<u>Groundwater Resource - Quality</u>

Based on work done by Liebscher (1979), Figure E shows a generalized hydrochemical map of the groundwater quality across most of the planning unit. It appears that most groundwaters in the planning unit are of the calcium bicarbonate and sodium bicarbonate types.

The quality of groundwater in some areas of the planning unit, particularly in the Nicomekl-Serpentine River valleys, falls within the sodium-chloride type. Figure E shows the areas where high sodium-chloride type groundwaters occur. An analysis of three selected water well records (Appendix A), indicates that the chloride content varies with depth. In fact, the record for the well on Lot 2, Sect. 18, TP.11 shows that fresh water was encountered below the saline zones, at a depth of 275 metres (900 feet). The reduced chloride concentration at depth may be due to deep groundwater flow systems. The source of the chloride type groundwaters is not clearly known, however, its presence may be due to the depositional environment. Sea water or brackish water may have been trapped in aquifers underlain and overlain by thick deposits of low permeable materials, eg. stony clay. Another reason may be due to the solution of chlorides from materials deposited in a marine environment and their movement into an adjacent aquifer, or to the occurrence of extremely sluggish moving groundwaters. However, an important factor associated with the occurrence of areas of chloride groundwater may be the influence of topography. Convergence of groundwater flow from the several uplands, some narrowing of valleys (as occurs southeast of Langley), and local gradients contrary to the regional gradient, could contribute to a concentration of salts in groundwaters in some localities.

Based on work done by Halstead (1983), Figure F has been drawn to show the vertical variation in groundwater quality. This figure illustrates that across much of the study area, groundwaters from shallow and deep aquifers (to depths of 100 metres), are low in total dissolved solids (generally below 500 mg/L). Based on available data high values of total dissolved solids, ranging between 2000 and 6000 mg/L are locally confined to parts of the Nicomekl-Serpentine valleys in the vicinities of Cloverdale, Port Kells, Milner and immediately southeast of Fern Ridge. Most of the groundwaters are basic, with pH values generally reported greater than 7.0. However, some ground-waters, especially in the ice-contact sand and gravel aquifers in the Clearbrook-Abbotsford area, are reported to be slightly acidic.

In terms of the main anions, cations and total dissolved solids, most of the groundwaters in the study area are suitable for human consumption; with the exceptions of areas where groundwaters may be phosphate rich or contain high levels of sodium chloride. According to Halstead (1983), phosphate rich groundwaters have been encountered beneath Vashon till and in localized areas of Aldergrove (Sec. 30, Tp.13, NE 1/4), where groundwater at a depth of about 110 metres (just below sea level) had a phosphate content of 2.5 mg/L thus rendering the water unsuitable for municipal supplies.

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Nitrate concentrations in groundwaters throughout the Fraser Lowland are generally low. However, according to Halstead (1983), there are a number of isolated areas where nitrogen concentrations of groundwater from wells exceed the acceptable limit of 10 mg/L Nitrate. Halstead (1983) indicates that the source of nitrogen contamination is commonly a point source, such as stockpiled animal wastes (notably from poultry, cattle and mink), or agricultural activities (such as improper application of fertilizers or pesticides). While contamination from a point source does not appear to extend more than a few thousand metres contamination from several point sources, as in the Brookswood area (Tp. 7, Sec. 21), can develop into a regional problem. Further field investigations are required to determine the extent and degree of nitrate contamination throughout the Fraser Valley.

IV. SENSITIVE RECHARGE AREAS REQUIRING PROTECTION

The main areas within the Fraser-Delta planning unit that are most vulnerable (ie. most sensitive) to potential contamination of the groundwater resource are those areas principally underlain by permeable sand and/or gravel deposits. Figure A shows the locations and extent of the unconsolidated water-table aquifers, based on the presence of permeable sand and gravel deposits as determined from surficial geologic mapping for the area. These areas (aquifers) constitute sensitive recharge areas which warrant protection from various potential sources of groundwater contamination. As an example, the Abbotsford Upland aquifer (see Figure C) is underlain by very permeable water-bearing sand and gravel deposits. This aquifer supplies large quantities (ie. in the order of 300 L/s) of groundwater for the Municipality of Abbotsford and the Fraser Valley Trout Hatchery. Any major amounts of contaminants entering the ground south of the Trans-Canada Highway between the Abbotsford airport and Huntington (ie. the general areal extent of the Abbotsford Upland aquifer), may have serious effects upon the quality of the water supplies for the above mentioned users.

Further analysis of numerous water well record data and surficial geology mapping is required to identify other such areas throughout the entire Fraser-Delta planning unit.

V. POSSIBLE SOURCES OF GROUNDWATER CONTAMINATION

The locations of known sources of potential groundwater contaminants within the Fraser-Delta plan area, are outlined in Figure G. The locations of these landfills and special waste disposal sites were obtained from Lower Mainland Waste Management staff. Further research is required to identify the locations of other possible sites.

Besides the above-mentioned sources, there are other sources that may contribute contaminants to the groundwater regime within the Fraser-Delta plan, including: sewage disposal (ie. septic tank effluent or lagoons), agricultural activities (such as improper application of fertilizers thus, possibly introducing nitrate into the groundwater system as may be the case in the Brookswood area south of Langley and the Abbotsford airport area), and outside storage of chemicals (ie. salts, sulphur, etc.). The extent of these sources and degree of potential contamination, however, are not known due to a lack of data. Further research and investigation of site-specific areas would be required to obtain this data.

VI. POTENTIAL AREAS FOR FURTHER GROUNDWATER DEVELOPMENT

Figure H shows two areas, one southeast of Langley and another southwest of Abbotsford, which staff of the Lower Mainland Regional Water Management office have identified as areas where additional groundwater is required for "water intensive agriculture".

The area to the southeast of Langley covers most of TP.10, most of the southeast part of TP.13, near Abbotsford, and a small part of the southwest corner of TP.36. The potential for increased groundwater development for agricultural supplies is considered to be good. Though the majority of well records report yields of about 0.5 to 1.5 L/s, some wells have reported yields up to 65 L/s. According to mapping by Halstead (1983), there are three aquifers within the interbedded till/sand and gravel sequence underlying the Langley Upland area. These aquifers occur at depths of about 30, 60 and 80 metres and are about 20, 10 and 10 metres thick respectively.

A review of the more than 600 wells constructed within TP.10 alone indicates that the greatest amount of groundwater withdrawal comes from the shallowest aquifer. Further analysis of basic well record data and field inventory is required in order to determine the extent to which these aquifers are being utilized and how much potential exists for further development. Generally, the groundwaters are low in total dissolved solids, commonly less than 500 mg/L, and should be quite suitable for agricultural requirements.

Figure H also shows 11 other areas outlined by Lower Mainland Regional Water Management staff, where groundwater supplies may be required for projected developments. Six of these areas occur within or adjacent to the Langley Upland. In terms of the immediate foregoing comments, five of these six areas, i.e., area 1: the area approximately 5 km east of Douglas; area 2: Brookswood; area 3: Murrayville/Hopington; area 4: Aldergrove and area 5: Abbotsford, have favourable prospects for further groundwater development. In the Abbotsford locality, groundwater may be obtained from shallow aquifers (up to 30 metres deep) comprised of ice-contact sand and gravel deposits and from deeper aquifers (45 to more than 55 metres deep) comprised of outwash sand and gravel deposits. However, according to Halstead (pers. comm.), groundwater development in area 6, the Clearbrook locality (TP.16), may have reached its limit and therefore there may not be any potential for further groundwater development.

In area 7, the Sardis and Vedder Crossing areas (south of Chilliwack), there is evidence of the presence of a 10 metre thick aquifer (see Figure C) in which wells capable of yielding 10 L/s can be constructed. The potential for further groundwater development in this area is good. Yields of up

to 126 L/s have been reported for wells constructed in shallow (30 metres) floodplain sands and gravels near the Vedder Crossing area. Prospects for increased groundwater supply are also favourable in area 8, Lindell Beach (S. end of Cultus Lake).

According to Halstead (1983), floodplain gravel and sand up to 45 m thick, make up a watertable aquifer from which groundwater has been developed for production wells supplying the Canadian Forces Base at Sardis and also the Elk Creek Water Works serving Chilliwack municipality. One production well 30 m in depth was developed and pump tested at rates up to 126 L/s. The extent of the aquifer has not been analyzed. However, it appears that there is further potential for groundwater development in area 9, the Chilliwack area. Further east, in area 10, Rosedale, the groundwater potential is not fully known. Test drilling, especially in the shallow, 15 metre thick sand and gravel aquifer in the area would be needed in order to assess the groundwater potential. In area 11, Hope, available well log data indicates well yields of up to 25 L/s. It appears that there is further potential for groundwater development in this area.

VII. CONCLUSIONS AND RECOMMENDATIONS

There is a considerable amount of basic groundwater data available for the Fraser-Delta planning unit, including well records, pump test data, water quality analysis reports, mapping, groundwater consultant reports and a major hydrogeologic study of the Fraser lowland area. An assessment of available data indicates that the groundwater resources within this planning unit constitute a very significant part of the total amount of water that is required and utilized throughout the unit. The planning unit is underlain by extensive, generally good quality groundwater reserves (aquifers); and indications are that most of these aquifers can provide additional groundwater for further development. Sensitive areas that require protection against indiscriminate waste disposal practices and other major potential contaminants have been identified.

In order to clarify and provide greater details of various aspects of this report, the following recommendations are proposed:

1. more detailed review of surficial geology, well records and Mr. Halstead's fence diagrams, to more accurately outline the extent of all the water-table and confined aquifers.
2. further detailed analyses of topographic mapping, chemistry data and groundwater level data, to more accurately identify and outline the local recharge areas and sensitive areas that may require protection against potential contaminants.
3. more detailed review of water well records, to identify and outline areas of high, moderate, and low groundwater use and further potential.
4. additional research to identify locations of potential groundwater contaminants.
5. further groundwater quality sampling in order to identify and monitor areas of groundwater anomalies, such as high nitrates or high chlorides, etc...

REFERENCES

Armstrong, J.E. (1980) Surficial Geology; New Westminster, Mission, Vancouver and Chilliwack (W/2); Geological Survey of Canada, Maps 1484A, 1485A, 1486A, and 1487A.

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Halstead, C. (1983) The Hydrogeology of the Fraser Lowland, Inland Waters Directorate, Environment Canada, Unpublished draft report.

Liebscher, H. (1979) Unpublished hydrochemical map of the Fraser Lowland. Inland Waters Directorate, Environment Canada.

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TABLE ___
MAJOR PRODUCTION WELLS - DATA SUMMARY
(After Halstead, 1983)

Municipality or District	Location Number (See Map)	Depth of Well in Metres	Static Water Level in Metres	Avg. Pumping Test Rate in Litres/ Sec.	Estimated Potential Yield in Litres/Sec.	Present Status *	Source of Data and Remarks	Year Well Drilled
Delta	1	75	53.3	12.5		N	Pacific Water Wells Ltd. (1969) Ltd.	1955
Delta	1	64.6	44	11.3		N	3 wells delivered 47.3 L/s.	1955
Delta	1	73.4	55.4	26.5		N	Discharge to 3785 m^3 reservoir.	1955
Surrey	2	32.3	22.2	15	15	I	Pacific Hydrology Consultants.	1962
Surrey	2	48	27.6	9.4	9.5	I	Green Timbers Forest Nursery.	1972
Surrey	2	35	21.6	15.7	15	I	Annual requirement 10,000 m^3.	1980
Surrey	3	149	102	25	25	ST	Ker, Priestman & Assoc. Ltd.	1976
Surrey	3	151	105	50	250	ST		
Surrey	4	123.4	97.8		38	N	Brown, Erdman & Assoc. Ltd.	1959
Surrey	4	117.3	97.8	27.5	26.2	N	Surrey Municipal Wells.	1963
Surrey	4	124	99.7	69	75.6	ST	McBeth Rd.	1966
Surrey	5	104.7	80.7	26.8	28	M	Robinson & Roberts Ground Water Consultants	1959
Surrey	5	97.5	74.9	26.5	30	M	Dayton & Knight Ltd.	1972
Surrey	5	103.3	81.6	37.8	28	M	White Rock Utilities Pacific Water Wells (1969) Ltd.	1974
Surrey	5	101.8	82.3	60.7	63	M	Aqua-flo Testing & Equipment Ltd.	1981
Surrey	6	22	2.4	17.6	5	N	Crescent Beach Water Works, Engineering Dept., Surrey Dist. Munic.	1956
Surrey	7	136	0		6.5	N	Also a well 87 m. Engineering Dept., Surrey Dist. Munic.	1964
Surrey	8	58.3	48.4		3.8	N	Surrey Municipal Well Dayton & Knight Ltd.	1962
Surrey	9	90	43		3.8	N	Cloverdale #I Well Brown, Erdman & Assoc. Ltd.	1958

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Municipality or District	Location Number (See Map)	Depth of Well in Metres	Static Water Level in Metres	Avg. Pumping Test Rate in Litres/ Sec.	Estimated Potential Yield in Litres/Sec.	Present Status *	Source of Data and Remarks	Year Well Drilled
Langley	10	133	f.a. +	38	38	M	Fort Langley Well Field	1976
Langley	10	20.3	1.5	151	150	M	Brown, Erdman & Assoc. Ltd.	1976
Langley	11	18.2	11.7		14	N	Copper Beach Water System Brown, Erdman & Assoc. Ltd.	1975
Langley	12	137	24.5	25	25	M	Willoughby Production Well #1 Brown, Erdman & Assoc. Ltd.	1978
Surrey	13	28	5.4		20	I		
Surrey	13	28.4	5.5	14.3	38	I	B.C. Forestry Nursery.	1980
Surrey	13	43.9	4.3	46.2	38	I	Pacific Hydrology Consultants.	1980
Langley	14	20	2		38	M	Sully #2 Well, Robertson & Roberts.	1960
Langley	15	23.7	2		10	M	Langley Mun. Production Well #5.	1971
Langley	16	23.3			17	M	Langley Mun. Production Well #1 Brown, Erdman & Assoc. Ltd.	1960
Langley	16	22			15	M	Langley Mun. Production Well #2.	1960
Langley	16	29	6			M	Langley Mun. Production Well #6.	1971
Langley	16	27			16	M	Langley Mun. Production Well #4.	1973
Langley	17	35.4	4.5	35.7	30	M	Langley Mun. Production Well #8 Brown, Erdman & Assoc. Ltd.	1979
Langley	18	57.9	5.3	38.8	30	M	Langley Mun. Production Well #7 Pacific Hydrology Consultants.	1974
Langley	19	115.5	26.6	29.8	15	M	Murrayville Test Well #1 Brown, Erdman & Assoc. Ltd.	1978
Langley	19	63	f.a. +	105	75	M	Murrayville Well, Old Yale Rd. Brown, Erdman & Assoc. Ltd.	1979
Langley	20	66.7	f.a. +	12.6	9	I	Murray's Nursery Pacific Hydrology Consultants	1975
Langley	21	37.3	2.7	3.8	8.5	S	Forest Knotts Subdivision Brown, Erdman & Assoc. Ltd.	1973

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Municipality or District	Location Number (See Map)	Depth of Well in Metres	Static Water Level in Metres	Avg. Pumping Test Rate in Litres/ Sec.	Estimated Potential Yield in Litres/Sec.	Present Status *	Source of Data and Remarks	Year Well Drilled
Langley	22	68.2	22		125	I	Pacific Hydrology Consultants	1978
Langley	23	48	23.4	3.8	3.8	S	Larco Subdivision Pacific Water Wells (1969) Ltd.	1973
Langley	24	71.3				S	Tall Timbers Subdivision.	1979
Langley	25	168	46	10	10	S	Ben Pel Subdivision Brown, Erdman & Assoc. Ltd.	1979
Langley	26	51	29.7	6.5	19	D	Otter Shopping Mall Brown, Erdman & Assoc. Ltd.	1979
Maple Ridge	27	36.5	1.2	7	12.6	O	B.C. Ministry of Environment.	1981
Langley	28	109	56.3	6.3	7.5	I	Geol. Survey of Canada, Bull. 64-51.	1963
Langley	28	27	8.3	2.3	2.3	D	C.F.B. Aldergrove.	1974
Langley	28	38	10.8	1.9	1.9	D	Brown, Erdman & Assoc. Ltd.	1975
Langley	29	35	12	4.4		M	Aldergrove Production Well #1, Boundary Ave.	1962
Langley	29	38	10.9	18.9		M	Aldergrove Production Well #2, Boundary Ave. Brown, Erdman & Assoc. Ltd.	1972
Langley	30	33.2	6	48.5	44	M	Aldergrove Production Well, 272 St. and 25 Ave.	1977
Matsqui	31	28.2	15	11.3	8	M	Dayton & Knight Ltd.	1961
Matsqui	32	32	24	5.6	9	M	Bradner Well, Dayton & Knight Ltd.	1970
Matsqui	33	9	1.8	4.4	10	M	Mt. Lehman Rd. Well.	1962
Matsqui	34	44.5	24	53	50	I	Valley Gravel Sales Pacific Hydrology Consultants.	1977
Matsqui	35	12	3	12.6	12	I	Clearbrook Food Processing Plant.	1959
Matsqui	35	18	2	41		I	Clearbrook Food Processing Plant.	1967
Matsqui	36	26.7	5.6	82		M	Matsqui Mun. Townline Rd. Wells.	1975

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Municipality or District	Location Number (See Map)	Depth of Well in Metres	Static Water Level in Metres	Avg. Pumping Test Rate in Litres/Sec.	Estimated Potential Yield in Litres/Sec.	Present Status *	Source of Data and Remarks	Year Well Drilled
Matsqui	36	18.6	3.4	62	25	M	Dayton & Knight Ltd.	1978
Matsqui	37	35.8	18	19		M	Marshall Rd. Well #2.	1958
Matsqui	37	37.6	19	63		M	Marshall Rd. Well #1 Dayton & Knight Ltd.	1967
Matsqui	37	42.5	18		125	M	Marshall Rd. Well #3.	1971
Matsqui	38	31.4	13	22	3.8	M	Clearbrook Water Works Well #1.	1954
Matsqui	38	37	14.5	25	29.5	M	Clearbrook W.W. Autumn Rd. Well.	1963
Matsqui	38	83.7	42	3.8	3.8	M	Clearbrook W.W. at Tower.	1980
Matsqui	39	35	8.2	30	40	I	Valley Rite Mix Pacific Water Wells (1969) Ltd.	1982
Matsqui	40	8.5	1.3	19	18	M	Hazelwood Well Dayton & Knight Ltd.	1958
Abbotsford	41	18.5	1.5	14.5	13.5	M	Well #1, Essendene Street.	1954
Abbotsford	41	22.2		33	20	M	Well #2, Pine Street Dayton & Knight Ltd.	1960
Abbotsford	42	32	16	25	22	M	Well #3, McCallum Rd. & Freeway.	1966
Abbotsford	43	2~~3~~4.3	14.5	9	6	M	Brown, Erdman & Assoc. Ltd.	1963
Abbotsford	44	16	3.8	27	14	M	Ker, Priestman & Assoc. Ltd., Riverside #2.	1972
Abbotsford	45	44	4	114	90	M	Farmer Rd. Well #1 Ker, Priestman & Assoc. Ltd.	1973
Abbotsford	45	47	6.2	124	114	M	Farmer Rd. Well #2 Ker, Priestman & Assoc. Ltd.	1977
Abbotsford	46	80.7	11	153		I	Abbotsford Trout Hatchery B.C. Ministry of Environment	1980
Mission	47	48.7	1.5	30		N	A&H Construction Co. Ltd.	1976
Nicomen	48	21	3	96	95	I	Inches Creek Production Well #1 Fisheries & Oceans Canada.	1977

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Municipality or District	Location Number (See Map)	Depth of Well in Metres	Static Water Level in Metres	Avg. Pumping Test Rate in Litres/Sec.	Estimated Potential Yield in Litres/Sec.	Present Status *	Source of Data and Remarks	Year Well Drilled
Nicomen	48	21.5	3.9	140	95	I	Inches Creek Production Well #2 Fisheries & Oceans Canada.	1978
Nicomen	49	48	f.a. +	12.5	15	D	Trailer Park Brown, Erdman & Assoc. Ltd.	1981
Chilliwack	50	24.6	7.8	50	13	M	Elk Creek Water Works.	1973
Chilliwack	50	30	8.3	126	20	M	Pacific Hydrology Consultants.	1977
Chilliwack	51	34	18	75	68	D	Canadian Forces Base, Chilliwack.	1964
Chilliwack	51	45	16	75	68	D	Brown, Erdman & Assoc. Ltd.	1975
Chilliwack	52	70	f.a. +		20	I	Slesse Creek Production Wells.	1970
Chilliwack	52	118	f.a. +	107	300	I	Fisheries & Oceans Canada Pacific Hydrology Consultants.	1978
Kent	53	29	1.12	138	183	I	Chehalis Fish Hatchery.	1980
Kent	53	27.2	2.13	75	98	I	Fisheries & Oceans Canada Piteau & Assoc. Ltd.	1980
Kent	53	23.4	1.27	40	65	I	See Figure __ for Well Locations.	1980

* D - Domestic; I - Irrigation; Id - Industrial; M - Municipal; N - Not Used; O - Observation; S - Subdivision; ST - Standby.

+ f.a. - Flowing Artesian.

WORKSPACE: PLN/STRATEG6
JOB NUMBER: PA297~~.#~~19

APPENDIX A

1) SOUTH DELTA TEST WELL NO. 1

LOCATION

Block C, Plan 17012, SW 1/4, Section 14, Township 5, New Westminster District or commonly as approximately 1000 feet north of 16th Ave., immediately east of 56th Street in Delta Municipality.

LITHOLOGY

DEPTH IN FEET	DESCRIPTION
0 - 5 feet	top soil and brown clay.
5 - 14 feet	pebbly, silty clay (lower 7 feet till-like).
14 - 26 feet	sand and gravel, fine- to coarse-grained, seashells, salt water.
26 - 55 feet	silty sand, medium- to fine-grained, seashells.
55 - 90 feet	interbedded silt, sand, gravel, containing seashells; well flowing salt water at 79 and 90 feet.
90 - 140 feet	sand, compact, silty, containing seashells.
140 - 169 feet	sand and silty gravel, water-bearing.
169 - 177 feet	sand and gravel, clean, water-bearing, containing water well 200 ppm of chloride. Static water level, one foot above ground.
177 - 236 feet	clay, gray, gritty and pebbly.
236 - 330 feet	clay interbedded with sand. The clay is silty and gray in colour. The sand is fine-grained, silty and compact, and contains small pebbles. This is probably sub-stratified drift.
330 - 364 feet	sand, medium- to fine-grained, silty, with minor clay interbeds, water-bearing, chloride content, 1350 ppm.

WORKSPACE: PLN/STRATEG6
JOB NUMBER: PA297.~~18~~20

DEPTH IN FEET	DESCRIPTION
378 - 388 feet	hard, silty sand and gravel, typical marine drift, containing organic stringers and seashells.
388 - 420 feet	clay, gritty, blue-gray.
420 - 432 feet	sand, fine- to coarse-grained and compact, well flows at approximately one gpm, chloride content 1500 ppm. Static water level approx. three feet above ground surface. Between 427 and 429 feet the sand contained pieces of wood, sticks and minor seashells.
432 - 436 feet	sand, fine-grained, wilty, with black clay interbeds and organic material.
436 - 450 feet	clay, gray.
450 - 460 feet	silt with minor fine- to medium-grained sand stringers, well stratified and varvelike. Flakes of mica and soe organic material and pebbles.
460 - 554 feet	clay, silty, gray.
554 - 559 feet	clay, containing some sand and pieces of wood.
559 - 600 feet	clay, gray and silty.
600 - 640 feet	clay with fine-grained sand interbeds and a considerable amount of wood and peat.
640 - 645 feet	sand, fine-grained, silty.
645 - 779 feet	clay, silty, gray.
779 - 792 feet	sand, fine- to medium-grained, silty water-bearing. Screen set and tested.
792 - 869 feet	clay, gritty.
869 - 901 feet	stoney, pebbly clay.
901 - 915 feet	very hard, pebbly clay, till-like, with stringers of water-bearing sand. Well flowing one gpm. Static water level approx. 5 feet above ground. Chloride content 750 ppm.
915 - total depth of 1000 feet	clay, silty, with minor beds of pebbly clay.

WORKSPACE: PLN/STRATEG6
JOB NUMBER: PA297~~19~~21

2) [illegible]MESTIC WELL

LOCATION

Tp. 10, Sec. 13, SW 1/4;; 25837 - 16th Avenue, Aldergrove

LITHOLOGY

DEPTH IN FEET	DESCRIPTION
1 - 26 feet	brown, sandy clay.
26 - 42 feet	blue clay and sand.
42 - 175 feet	blue clay, sand, gravel and silt.
175 - 290 feet	flue clay, sand and gravel.
290 - 308 feet	hardpan.
308 - 310 feet	W.B. gravel (salty). This was salt water. Gravel would blow up casing.
310 - 338 feet	blue clay, sand and gravel.
338 - 342 feet	gravel (fresh water). Gravel would blow up casing 20' to 30'. Not as salty as upper zone. Na 470 mg/ℓ. Cl 700 mg/ℓ. = NaCl type water (well yield = 20 gpm.).

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3) DOMESTIC WELL

LOCATION

Lot 2, Sec. 18, Tp 11, D.L. 3162, Land District New West, Plan 7517, 22264 Springbrook Road, Langley.

WORKSPACE: PLN/STRATEG6
JOB NUMBER: PA297.~~20~~22

LITHOLOGY

DEPTH IN FEET	DESCRIPTION
0 - 2 feet	top soil.
2 - 10 feet	hard, gray clay.
10 - 143 feet	soft, gray clay.
143 - 190 feet	gray, clay seams, water-bearing sand.
190 - 215 feet	silty, water-bearing sand.
215 - 296 feet	gray, clay seams, water-bearing sand.
296 - 435 feet	sandy, gray clay.
435 - 455 feet	gray, clay stones.
455 - 463 feet	loose, sandy till.
463 - 536 feet	hard, sandy, gray clay.
536 - 549 feet	hard till and stones.
549 - 553 feet	soft, stoney, gray clay.
553 - 556 feet	hard, stoney, gray clay.
556 - 710 feet	sand and gravel (salt water).
710 - 724 feet	sandy clay.
724 - 735 feet	clay.
735 - 755 feet	silty sand and clay.
755 - 765 feet	silty sand.
765 - 795 feet	sand.
795 - 800 feet	water-bearing sand (coarser).
800 - 809 feet	fine sand.
809 - 815 feet	fine sand (some wood and charcoal).
815 - 850 feet	fine sand, some clay.
850 - 870 feet	fine sand, water-bearing.
870 - 895 feet	fine, silty sand.
895 - 900 feet	stoney clay.
900 - 903 feet	coarse, water-bearing sand (flowing).

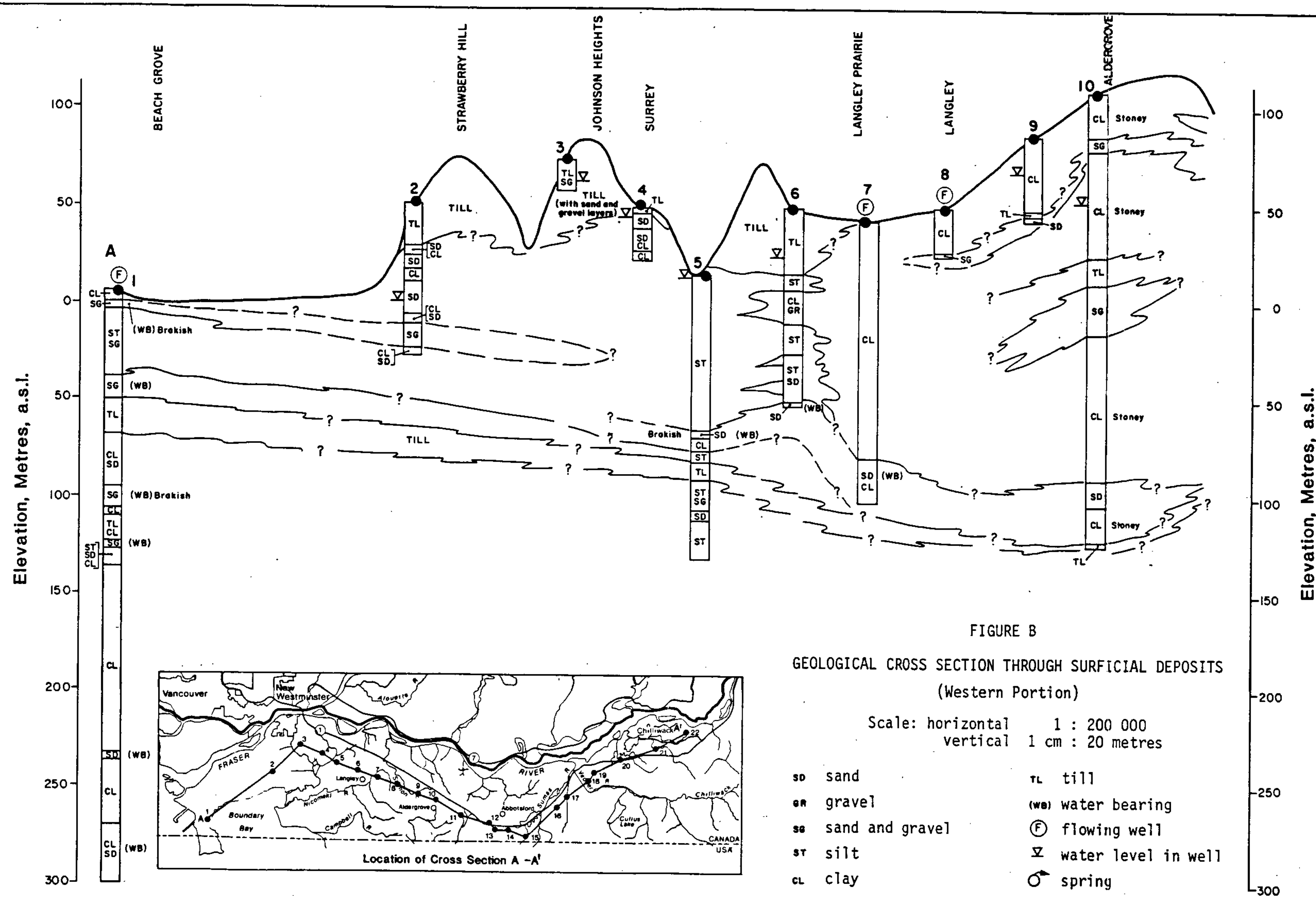
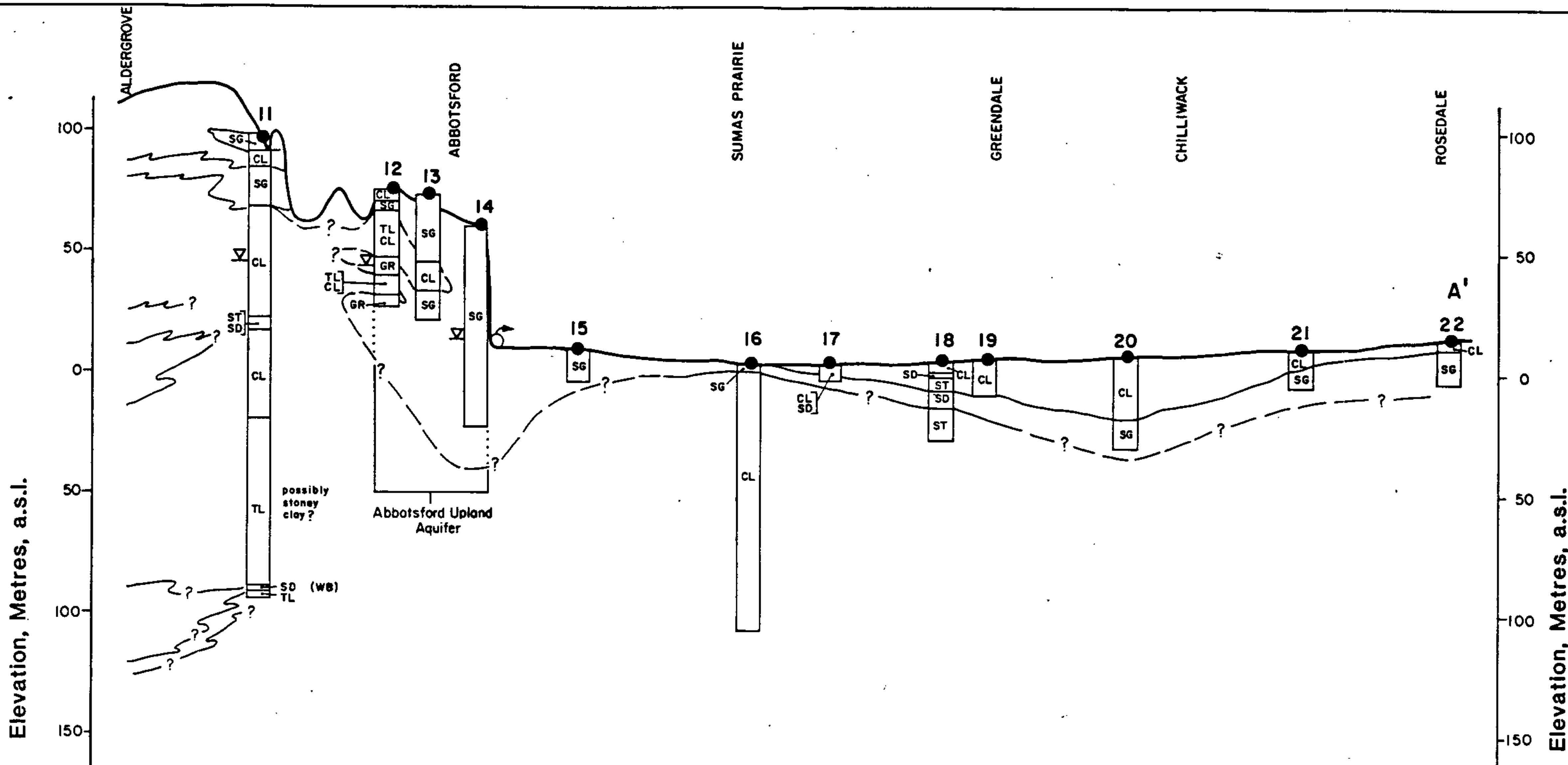


FIGURE B

GEOLOGICAL CROSS SECTION THROUGH SURFICIAL DEPOSITS
(Western Portion)

Scale: horizontal 1 : 200 000
vertical 1 cm : 20 metres

SD	sand	TL	till
GR	gravel	(WB)	water bearing
SG	sand and gravel	Ⓕ	flowing well
ST	silt	▽	water level in well
CL	clay	♂	spring



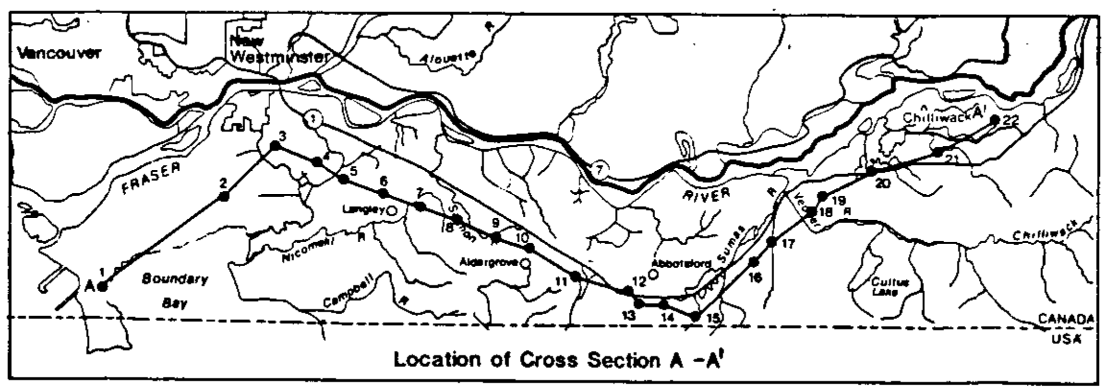


FIGURE C.

GEOLOGICAL CROSS SECTION THROUGH SURFICIAL DEPOSITS
(Eastern Portion)

Scale: horizontal 1 : 200 000
vertical 1 cm : 20 metres

SD sand
GR gravel
SG sand and gravel
ST silt
CL clay
TL till
(WB) water bearing
Ⓕ flowing well
water level in well
spring

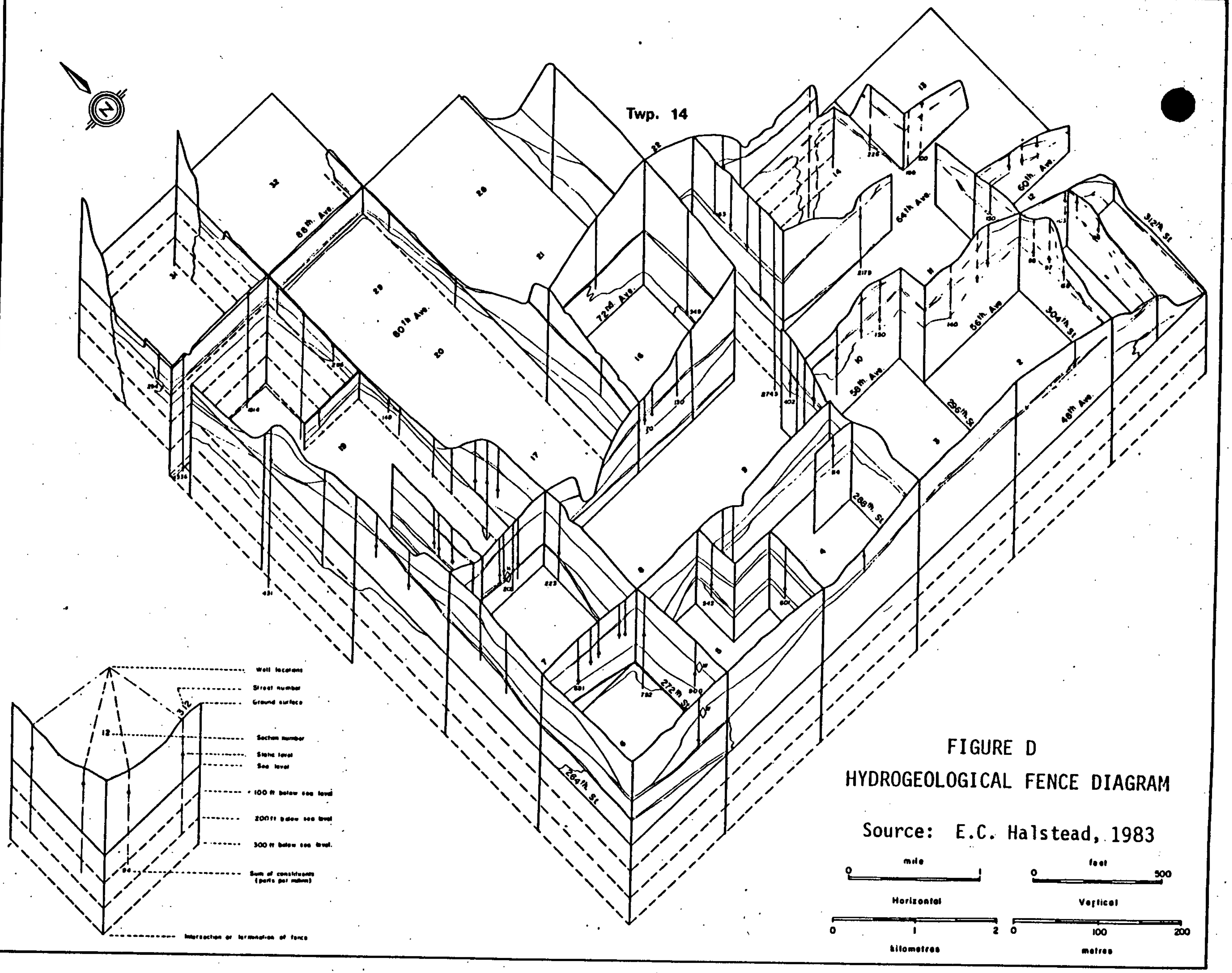


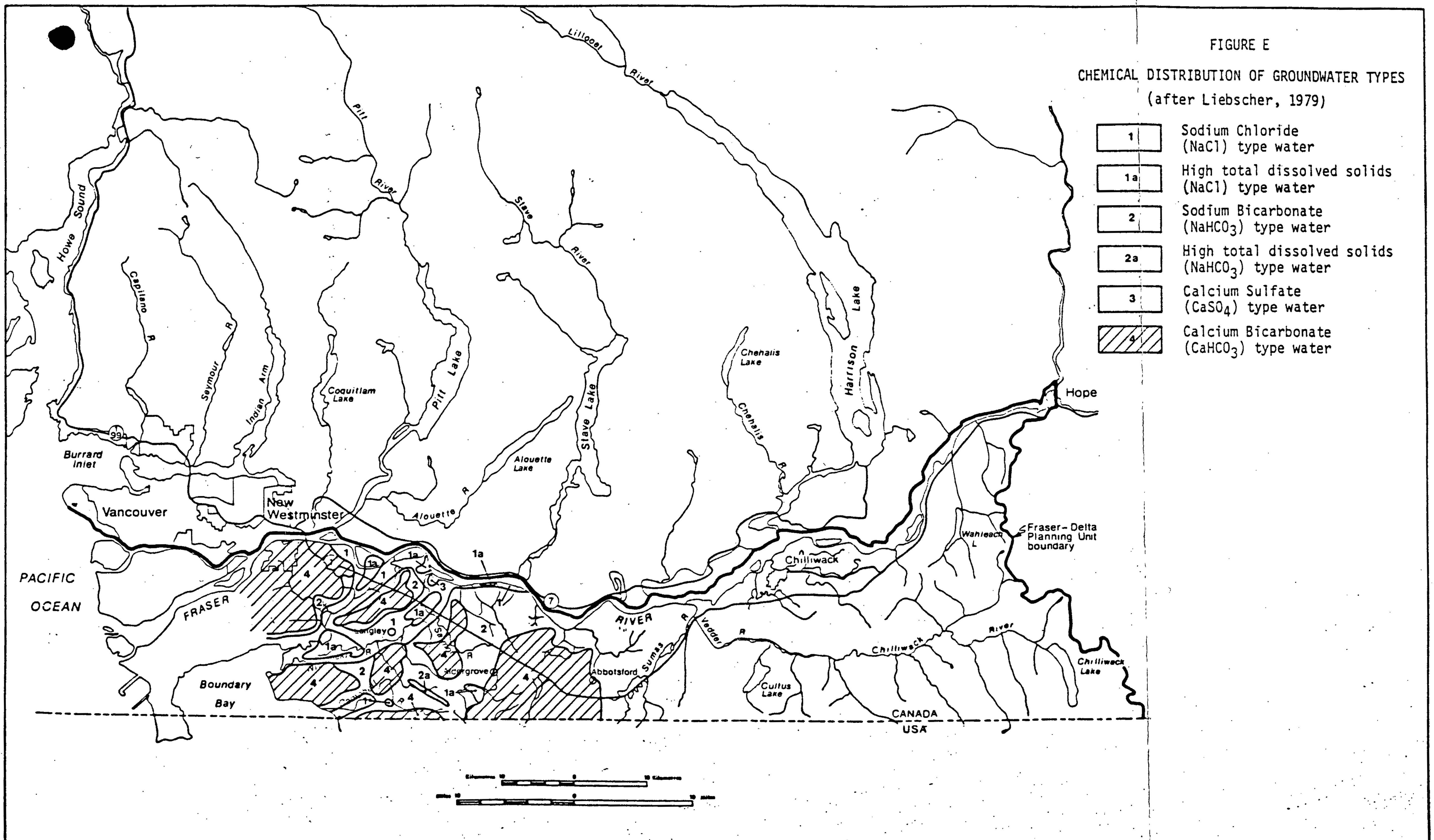
FIGURE D
HYDROGEOLOGICAL FENCE DIAGRAM

Source: E.C. Halstead, 1983

FIGURE E

CHEMICAL DISTRIBUTION OF GROUNDWATER TYPES

(after Liebscher, 1979)



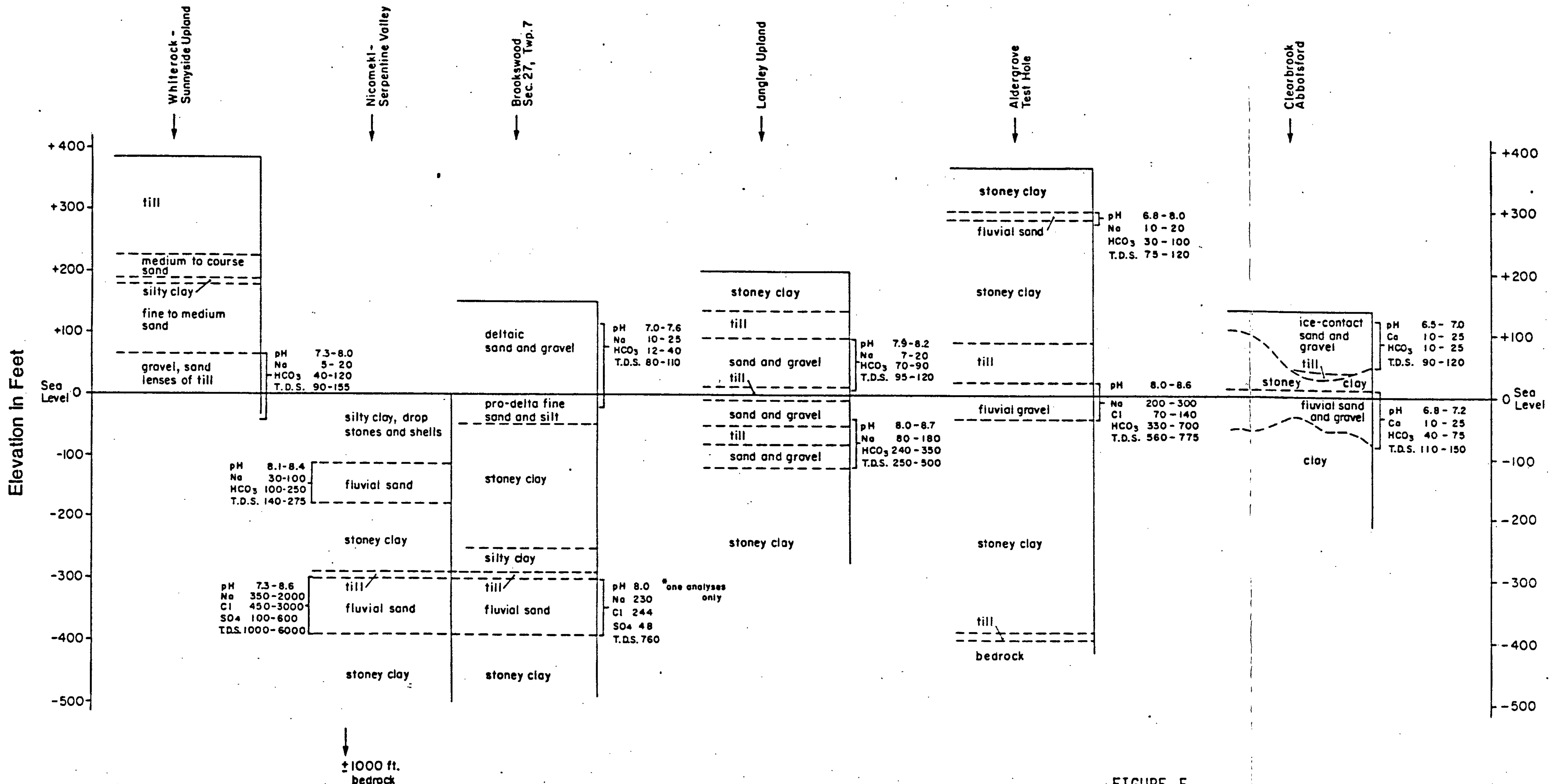


FIGURE F

CROSS SECTION RELATING GEOLOGY AND GROUNDWATER QUALITY
(after Halstead, 1983)
chemical units in mg/L except for pH

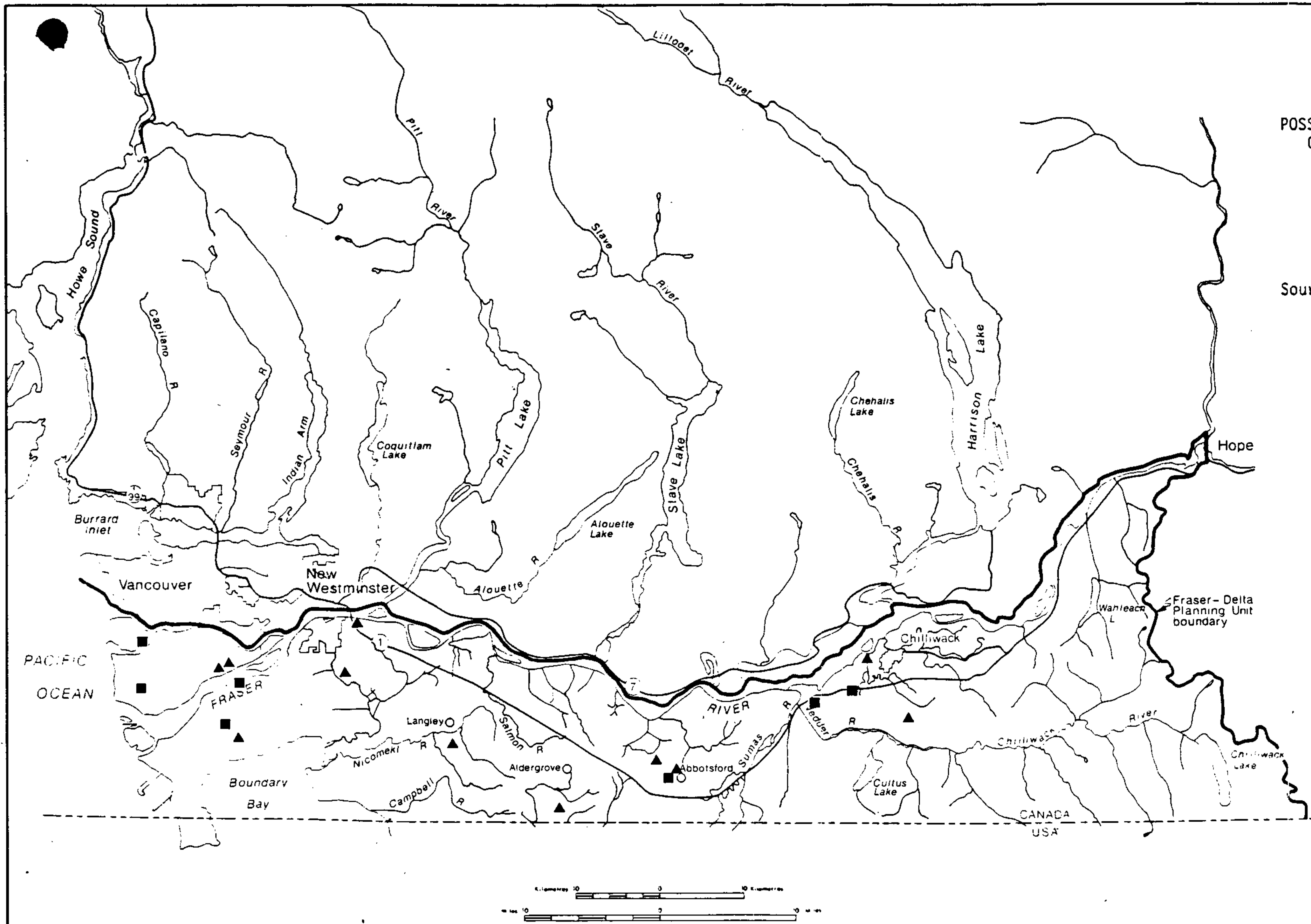


FIGURE G

POSSIBLE SOURCES OF GROUNDWATER CONTAMINATION WITHIN THE PLANNING AREA

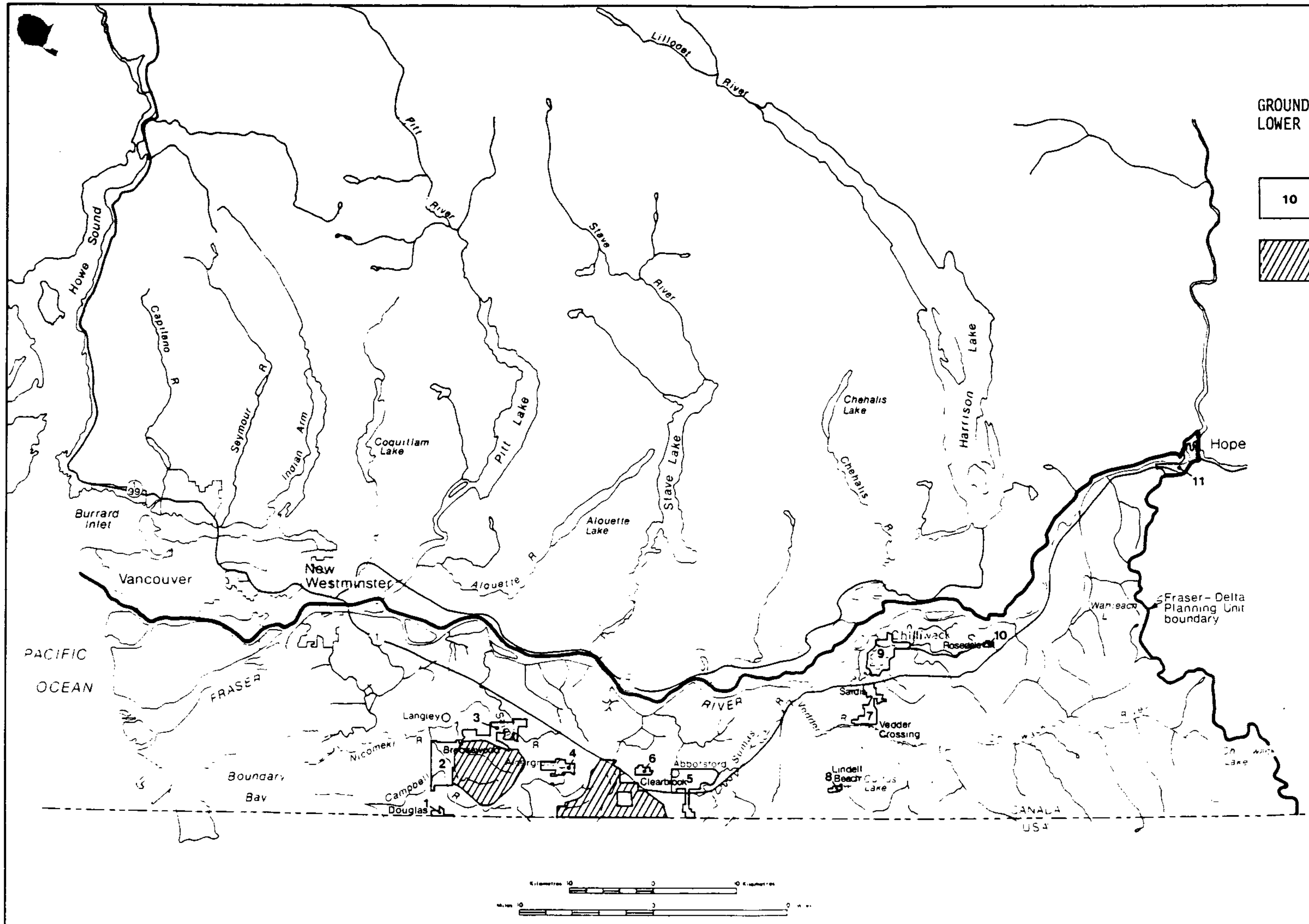
■ special waste sites

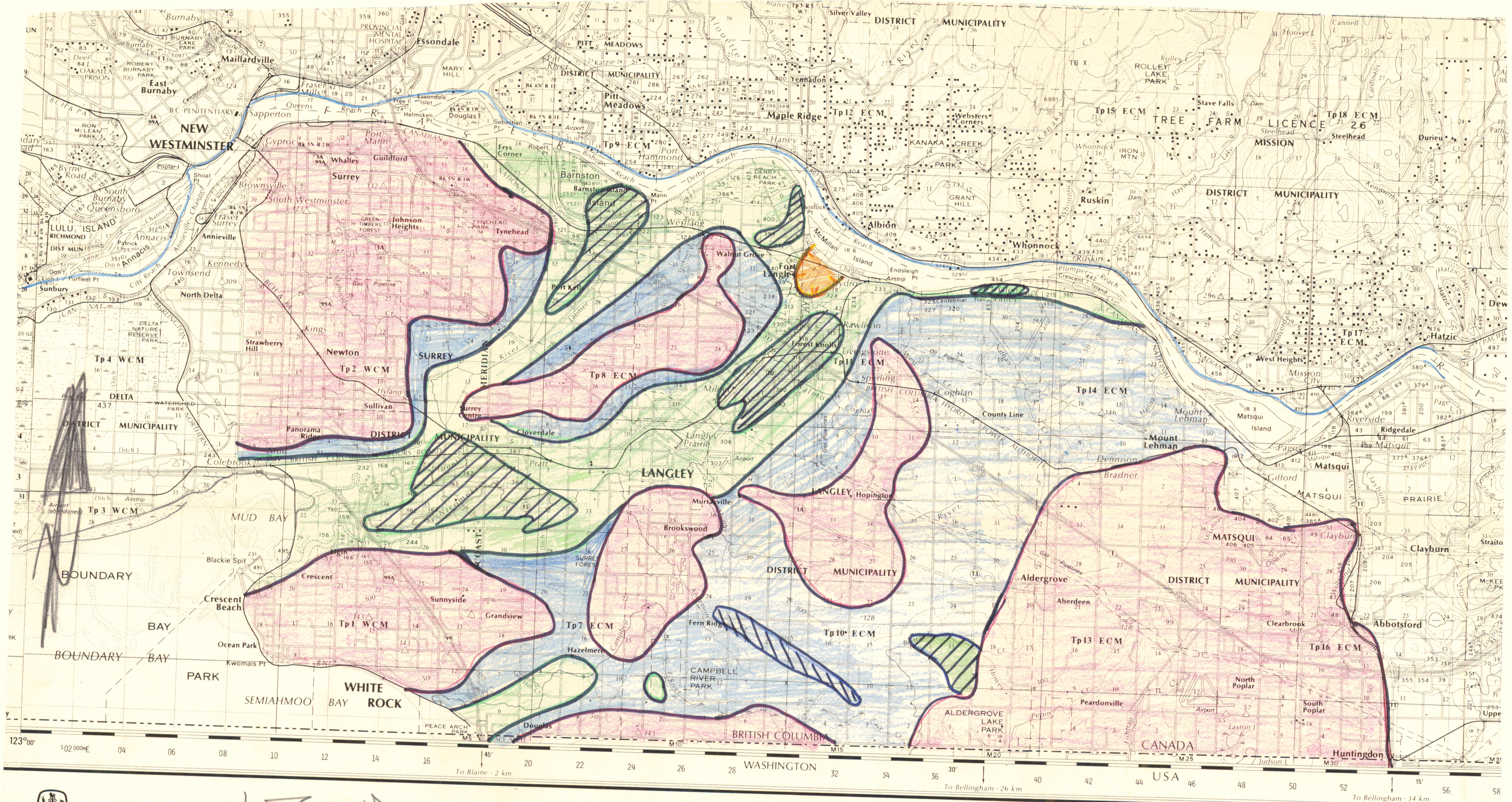
▲ municipal landfills

Source: Lower Mainland Region Waste Management

FIGURE H

GROUNDWATER DEMAND AREAS PROJECTED BY LOWER MAINLAND REGION WATER MANAGEMENT





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LEGEND

1 SODIUM CHLORIDE (NaCl) Type Water

1a HIGH Total Dissolved Solids (NaCl) Type Water

3 CALCIUM SULFATE ($CaSO_4$) Type Water

2 SODIUM BICARBONATE ($NaHCO_3$) Type Water

2a HIGH Total Dissolved Solids ($NaHCO_3$) Type Water

4 CALCIUM BICARBONATE ($CaHCO_3$) type Water

FRASER-DELTA STRATEGIC PLANNING UNIT

FIGURE 3: CHEMICAL CLASSIFICATION OF GROUNDWATERS

(after Liebscher, 1979)

SCALE 1:100,000

FIG 3

Compiled by Map Production, Surveys and Mapping Branch,
Ministry of Environment, Parliament Buildings, Victoria, B.C. 1979.

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Ministry of Environment

FRASER-DELTA STRATEGIC PLANNING UNIT

Scale 1:100 000
(1 cm = 1 km)

km 2 0 2 4 6 8 10 12 14 km

Compiled by Map Production, Surveys and Mapping Branch, Ministry of Environment, Parliament Buildings, Victoria, B.C. 1979.

Province of British Columbia
Ministry of Environment

FRASER-DELTA STRATEGIC PLANNING UNIT

Scale 1:100 000
(1 cm = 1 km)