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May 9, 1980

British Columbia Development Corporation
272 Granville Square
Vancouver, British Columbia
V6C 1S4

ATTENTION: Mr. Stan Jobb, Project Director

SUBJECT: CAMPBELL HEIGHTS
HYDROGEOLOGICAL IMPACT

Dear Sirs:

During May 4 to 7, 1980 a field traverse, water well inventory and numerous calculations, concerning the hydrogeology of the subject area, were completed. In connection with this work, three maps (Drawing Nos. 1, 2 & 3) and three tables (Tables 1, 2 & 3) have been prepared as a supplement to our April 1980 report and three copies of each are attached to this letter.

In order to describe the baseline groundwater conditions around the proposed Campbell Heights development, field mapping of groundwater discharge features and a well inventory of existing domestic water wells were completed. The field mapping was conducted along the western perimeter of the terrace (Campbell Upland) area on which the subject site occurs. The Campbell Upland is composed of deltaic outwash sand and gravel deposits referred to as Abbotsford Outwash (Drawing No. 1) which form the significant aquifer under the proposed

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development. Under present conditions groundwater moves in a westerly direction under the Campbell Upland and is discharged as a series of springs and seeps along (1) the edge of the terrace and (2) in areas where drainages have deeply incised the Upland. Field mapping (Drawing No. 2, Table 3) indicated that groundwater discharge from the Abbotsford Outwash Aquifer occurs not only as distinctive springs and seeps but also as narrow belts of permanently wet, boggy ground near the base of the terrace edge (Groundwater Observation Points 1 to 13). Seeps generally form near the base of the terrace edge while larger springs generally form in incised channels beginning about 10 to 15 feet below the Upland. At some locations (Groundwater Observation Points 8 and 16) groundwater discharge has been utilized for landscaping and business purposes. Along the deeply incised Campbell River channel (Groundwater Observation Points 17 to 22) groundwater discharges in seeps, small springs, and permanently boggy ground. Ditching to maintain dry working conditions in a gravel pit, near the southeast corner of the proposed development, indicates a water table 5 feet below surface and a very permeable sequence of sand and gravel forming the upper portion of the Abbotsford Outwash Aquifer.

Drawing No. 2 also indicates the distribution of existing domestic water wells in the vicinity of the proposed development area. The logs of these wells were obtained from E. C. Halstead, Inland Waters Directorate and the pertinent details of wells completed in the Abbotsford Outwash Aquifer are shown in Table 1 with well numbers cross referenced to Drawing No. 2. Table 2 summarizes wells in the vicinity of the proposed development which are not obtaining groundwater from the Abbotsford Outwash Aquifer (Drawing No. 1). All domestic wells on the Campbell Upland obtain groundwater from sand or sand and gravel and are generally 40 to 60 feet deep. Static water levels are 10 to 15 feet below ground surface and average well yields are 5 to 15 gallons per minute (GPM). Available drawdowns (the height of water above the well intake screen) generally range from 20 to 50 feet. Four, one inch, Government of British Columbia observation wells are located in or near the proposed development (Table 1, Drawing No. 2) and long term water level records are available for these wells. These records indicate that the unconfined Abbotsford Outwash Aquifer responds quickly to precipitation recharge and that annual water level fluctuations are in the order of 5 to 10 feet.

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It is understood that Phases I and II of the proposed Campbell Heights development will require a total of 700 USGPM (600 USGPM process water and 100 USGPM domestic water). After use, this water will be treated and approximately 80 to 90% will be returned to the ground via effluent-disposal drain fields, injection wells, or sprinkler systems.

This water supply will be obtained using seven properly constructed water wells, located along the eastern border of the area (Drawing No. 3), each rated at 100 USGPM. These wells will utilize the Abbotsford Outwash Aquifer as the groundwater source.

In order to study the effects of the production well - drain field configuration on the groundwater resources of the Campbell Upland, a mathematical simulation, using the aquifer transmissivity obtained from the pump testing of Groundwater Test Hole No. 2 and an assumed storativity of 0.2, was completed. It was assumed that seven production wells at 100 USGPM each, were pumped continuously for one hundred days with no recharge to the aquifer and that treated process water and effluent was returned to the ground via a drain field located in the northwest corner of the subject area. The exact location of drain fields will depend on the final engineering design of the proposed development. Drawing No. 3 shows the location of the hypothetical production wells and drain field, the limits of the cones of depression and impression, and the approximate one foot drawdown contour line. It can be seen that the production well - drain field configuration has a negligible effect on:

1. The total groundwater resources of the Campbell Upland.

2. Existing water wells in the area, and

3. Groundwater discharge features associated with the edge of the upland terrace.

Two Government of British Columbia observation wells (Well Nos. 12 and 46, Table 1) are located within the cone of depression of the proposed production well field. It is suggested that monitoring of these wells during pumping will accurately establish the drawdown pattern and will therefore allow a continuing assessment of any impact of the proposed development on the surrounding area.

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Also shown on Drawing No. 3 is the limit of the drawdown effect caused by the ultimate pumping rate (4150 USGPM) of the Brookswood wells owned by the Municipality of Langley. It can be seen that there is no interference effects between the proposed production wells and the Brookswood wells during the 100 day - no recharge pumping period.

We feel that the above analysis indicates that the proposed Campbell Heights development will have no detrimental effect on the existing groundwater regime of the Campbell Upland. Proper monitoring of nearby observation wells and groundwater discharge features will ensure a thorough, continuing environmental impact assessment.

If any of the above needs clarification or amplification please do not hesitate to contact us.

Yours truly,

BROWN, ERDMAN & ASSOCIATES LTD.

W. L. BROWN, P. ENG.

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Encl.

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CAMPBELL HEIGHTS DEVELOPMENT

TABLE 1

DOMESTIC WATER WELLS
COMPLETED IN THE
ABBOTSFORD OUTWASH AQUIFER

WELL No.	ELEV.	DEPTH (ft.)	S.W.L. (ft.)	TOP OF AQUIFER (ft.)	AQUIFER LITHOLOGY	AVAILABLE DRAWDOWN TO SCREEN (ft.)	REMARKS
4	161	43	16	18	Sand	22	15 GPM
5	165	43	20	20	S&G	18	8 GPM
6	164	46	12	25	Sand	29	10 GPM
7	167	39	19	33	S&G	14	15 GPM
8	170	46	23	23	S&G	18	10 GPM
9	165	46	4	31	Sand	33	50 GPM
10	156	41	18	20	S&G	18	15 GPM
11	155	32	2	16	Sand	23	--
12	152	18	1-10	--	S&G	--	Government observation well
13	165	46	19	23	Sand	22	7 GPM
14	160	40	15	15	S&G	20	15 GPM
15	165	55	20	49	Sand	31	50 GPM
16	169	45	20	26	S&G	21	6 GPM
17	160	47	20	30	S&G	20	20 GPM
18	169	56	18	30	S&G	--	40 GPM
19	160	60	20	20	Gravel	--	--
20	167	80	19	51	S&G	51	40 GPM

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CAMPBELL HEIGHTS DEVELOPMENT

TABLE 1 continued ...

DOMESTIC WATER WELLS
COMPLETED IN THE
ABBOTSFORD OUTWASH AQUIFER

WELL No.	ELEV.	DEPTH (ft.)	S.W.L. (ft.)	TOP OF AQUIFER (ft.)	AQUIFER LITHOLOGY	AVAILABLE DRAWDOWN TO SCREEN (ft.)	REMARKS
21	167	75	34	62	S&G	36	2 GPM
22	157	50	13	36	S&G	26	20 GPM
23	160	47	15	42	Sand	28	18 GPM
24	164	47	--	41	Sand	--	--
25	165	58	21	34	S&G	30	20 GPM
26	160	36	16	30	Sand	15	5 GPM
27	152	93	14	56	Sand	50	25 GPM
28	162	44	14	41	S&G	27	5 GPM
29	151	68	31	60	Sand	29	9 GPM
30	153	50	20	45	Sand	26	4 GPM
31	152	40	10	12	S&G	25	15 GPM
32	153	37	10	19	Sand	22	10 GPM
33	150	40	15	16	S&G	20	17 GPM
34	152	70	14	60	S&G	51	30 GPM
35	55	240	--	--	--	--	DRY

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CAMPBELL HEIGHTS DEVELOPMENT

TABLE 1 continued ...

DOMESTIC WATER WELLS
COMPLETED IN THE
ABBOTSFORD OUTWASH AQUIFER

WELL NO.	ELEV.	DEPTH (ft.)	S.W.L. (ft.)	TOP OF AQUIFER (ft.)	AQUIFER LITHOLOGY	AVAILABLE DRAWDOWN TO SCREEN (ft.)	REMARKS
76	155	41	18	22	Sand	19	20 GPM
78	158	50	--	--	--	--	--
80	150	57	18	36	Sand	34	4 GPM
81	161	41	19	20	S&G	18	20 GPM
82	158	35	13	26	Sand	13	8 GPM
83	165	109	16	90	Sand	81	108 GPM
84	155	56	15	52	Sand	34	4 GPM
85	160	36	5-24	34	S&G	--	Government observation well
86	144	47	14	42	S&G	28	20 GPM
87	150	20	1-16	15	S&G	--	Government observation well

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CAMPBELL HEIGHTS DEVELOPMENT

TABLE 2

DOMESTIC WATER WELLS
NOT COMPLETED IN THE
ABBOTSFORD OUTWASH AQUIFER

WELL NO.	ELEV.	DEPTH (ft.)	S.W.L. (ft.)	TOP OF AQUIFER (ft.)	AQUIFER LITHOLOGY	AVAILABLE DRAWDOWN TO SCREEN (ft.)	REMARKS
1	160	88	30	40	S&G	--	--
2	50	139	--	--	--	--	4 GPM
3	40	88	Flowing	60	Sand	76	--
39	130	89	69	69	Sand	16	10 GPM
40	60	88	Flowing	80	S&G	83	7 GPM, FLOW
41	100	63	25	54	Gravel	23	30 GPM
42	180	78	30	40	S&G	--	8 GPM
43	140	62	19	50	S&G	--	15 GPM
44	120	72	37	70	Gravel	33	2 GPM
45	150	155	55	--	--	--	--
47	71	154	Flowing	130	Sand	--	5 GPM, FLOW
48	110	135	2	118	Sand	110	40 GPM
49	165	185	85	176	S&G	91	30 GPM
50	92	31	Flowing	--	--	--	2 GPM, FLOW
51	60	256	Flowing	--	--	--	--
77	190	117	40	110	S&G	--	8 GPM
79	231	102	56	89	S&G	33	10 GPM

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CAMPBELL HEIGHTS DEVELOPMENT

TABLE 3 continued ...

SUMMARY OF GROUNDWATER DISCHARGE FEATURES

No.	Feature Description	Estimated Flowrate
17	One spring and two seeps. Channel bottoms are sandy.	Combined 5 GPM
18	Seep. 100 feet from base of slope.	1-2 GPM
19,20, 21	Numerous small seeps. Boggy	Combined 10 GPM
22	No discharge along slope.	--
23	Gravel pit. Two drainage ditches keep gravel pit dry. Water 5 feet below ground surface.	25-30 GPM

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CAMPBELL HEIGHTS DEVELOPMENT

TABLE 3 continued ...

SUMMARY OF GROUNDWATER DISCHARGE FEATURES

No.	Feature Description	Estimated Flowrate
9	Large creek, develops from seep which has cut into plateau 15 feet from top.	20 GPM
10	Large creek in pasture. Sandy bottom. Sand outcropping on sides of channel. Starts as groundwater discharge.	15-20 GPM
11	Small seep.	5 GPM
12	Large wet bog from here to 32nd Avenue.	--
13	Flow under road is a result of groundwater discharge	25-30 GPM
14	Small creek rises west of abandoned railway grade as spring.	10-15 GPM
15	Seeps forming relatively large creek. Headwaters high on plateau.	15-20 GPM
16	Man made lake formed partially by groundwater discharge. Slopes here are permanently moist.	--

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CAMPBELL HEIGHTS DEVELOPMENT

TABLE 3

SUMMARY OF GROUNDWATER DISCHARGE FEATURES

No.	Feature Description	Estimated Flowrate
1	Seepage area, starts 15 feet below top of plateau. Headwaters of small creek. Sandy.	10 GPM
2	Two small seepages. Very boggy.	15 GPM
3	Small seep. Very boggy. Occurs 100 feet from base of slope	10 GPM
4	Seep. Boggy	10 GPM
5	Headwaters of creek comprised of 5 springs. Very boggy. Sandy drainages. Start 15 feet below plateau.	Combined 25 GPM
6	Five springs. Sandy channels.	Combined 40-50 GPM
7	Three springs. One very large channel with firm sandy bottom.	Combined 15-30 GPM
8	Houses at 32nd Avenue utilize groundwater discharge to develop small pools and waterfalls by using horizontal drains.	10-15 GPM each

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