MEMO

ASSOCIATED ENGINEERING

DATE: October 10, 1997 FILE 972684

TO: Brian McEwan, District of Lake Country

FROM: Andrew Ambrozy, AEL - Kelowna

PROJECT/No Knopf Brook Drainage Study

SUBJECT Summary of Preliminary Findings

1 INTRODUCTION

We have completed our initial assessment of the above drainage basin and herein a summary of our preliminary findings. Also, there are a number of issues that need to be resolved by the District to ensure satisfactory completion of the report and successful implementation of the report contents.

To date, we have compiled a comprehensive base plan of the entire study area, conducted field surveys and reconnaissance, arranged for the preparation of a geotechnical investigation and report, and computer modelled the drainage basin using nine time-varying storm events, under existing and future conditions.

Our initial work involved determination of the drainage basin area from available topographic mapping. Once the entire basin area was determined, it was divided into subbasins all of which are interconnected and ultimately produce runoff that flows into Vernon Creek. Electronic digitizing transferred the basin and subbasin boundary data into our AutoCad system to ease in further analysis and drawing preparation. The Regional District of Central Okanagan provided us with electronic legal base mapping which the basin information was digitized into. Through a detailed site reconnaissance and electronic survey, we superimposed our survey information into the base plan. The survey information includes flow route, pipe sizes and elevations, ditches, cross sections and any known significant features impacting on drainage within the area. The base plan is included with this memo and is titled *Existing Conditions No. 2684-0-103*.

2 EXISTING DRAINAGE SYSTEM

The existing drainage system is extremely fragmented, consisting of undersized pipes, non-standard manholes and overland flow routes that are not confined to definite channels. The upper zone (headwaters) of the basin around Cemetery Road and Nygren Road is currently the area that experiences flooding. This area is relatively flat and contains a depression that accumulates water, as there is no outlet until the ponding water reaches a certain level. This area once contained an active orchard, which has been removed. Reportedly, the flooding was not as evident when the orchard was in operation. Immediately south of the problematic area is a large track of orchards down to Camp Road. These orchards contain a drainage system consisting of a series of manholes made of oil drums and/or tanks interconnected with small diameter perforated plastic piping.

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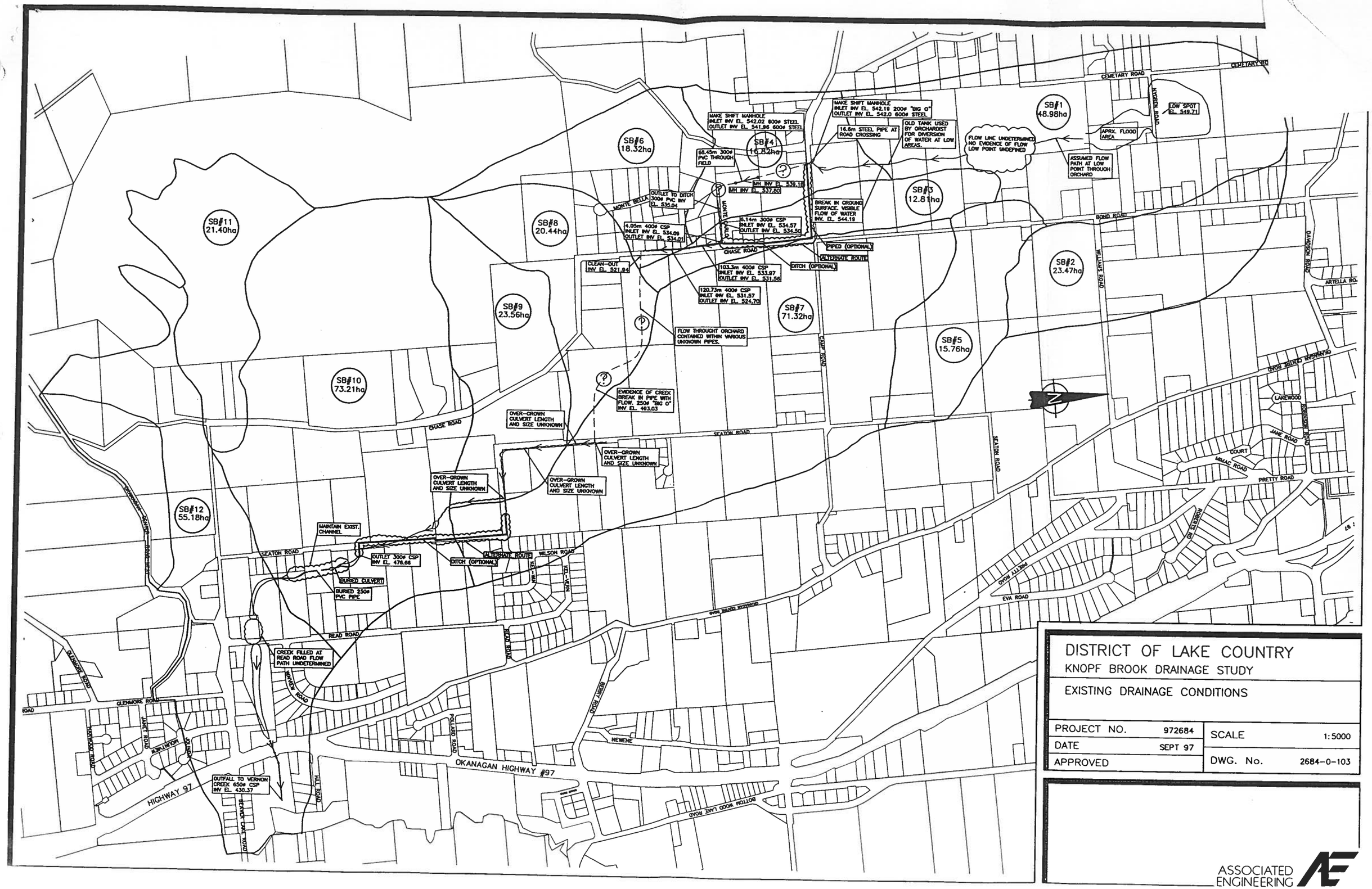

DISTRICT OF LAKE COUNTRY

KNOPF BROOK DRAINAGE STUDY

EXISTING DRAINAGE CONDITIONS

PROJECT NO.	972684	SCALE	1:5000
DATE	SEPT 97		
APPROVED		DWG. No.	2684-0-103

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The manholes are all located in localized depressions in the orchard and our field reconnaissance revealed a steady water flow through each of the manholes. This drainage system then converges into a manhole on the north side of Camp Road, where it flows through a 600 mm diameter steel pipe under Camp Road. Between Camp Road and Monte Carlo Road, two manholes containing 300 mm plastic pipe were located in an alignment that appears to line up with the channel that contained Knopf Brook. The drainage path then appears to have been routed into a 300 mm PVC pipe and open ditch on Monte Carlo Road. The intersection of this assumed interception point was not locatable in the field, and therefore the type of connection is unknown. The channel of Knopf Brook continues southward beyond this point and reportedly there are several homes in the Monte Bella Road area that experience basement water problems. Therefore, we believe that the entire flow has not been intercepted at Monte Carlo Road and that some flow is percolating through the ground or an old pipe creating the problems in the Monte Bella area as the alignment of the old creek bed traverses this area. From Monte Carlo Road, the flow is contained in a 400 mm diameter corrugated metal pipe routed southward along Chase Road. Between Chase Road and Seaton Road the flow is contained in assumed varying sized pipes and generally follows the path of the Knopf Brook Channel. An open ditch then collects the flow on Seaton Road where it once again traverses an orchard and connects to a well defined channel paralleling Seaton Road. Some homeowners along Seaton Road have enclosed the creek channel in severely undersized pipes. At Reid Road the creek channel has been filled in with granular fill and runoff waters currently percolate through the fill. Between Reid Road and Hwy 97 there is a very well defined creek channel and between Hwy 97 and Vernon Creek there is a 450 mm diameter corrugated metal pipe.

3 COMPUTER MODELLING

Our conclusion up to this point of the study indicated that a simple ditching program would solve the flooding in the upstream reaches of the basin. However, to ensure that the flooding is not transferred to another location within the basin, an adequately sized continuous stormwater conveyance system must be established out to Vernon Creek. We then proceeded to computer model the basin to determine the size and shape of the conveyance system.

We selected the use of stormwater computer modelling software entitled MIDUSS which is an acronym for Microcomputer Interactive Design of Urban Stormwater Systems. MIDUSS software was chosen because of its versatility, ease of use and limited data input requirements.

The geotechnical investigation and report provided us with the necessary soil infiltration parameters required for the computer model. The report classified the existing soils into four distinct categories in terms of their percolation ability. In several instances, the soils crossed the boundaries of the four categories and for modelling purposes, a straight line interpretation was used.

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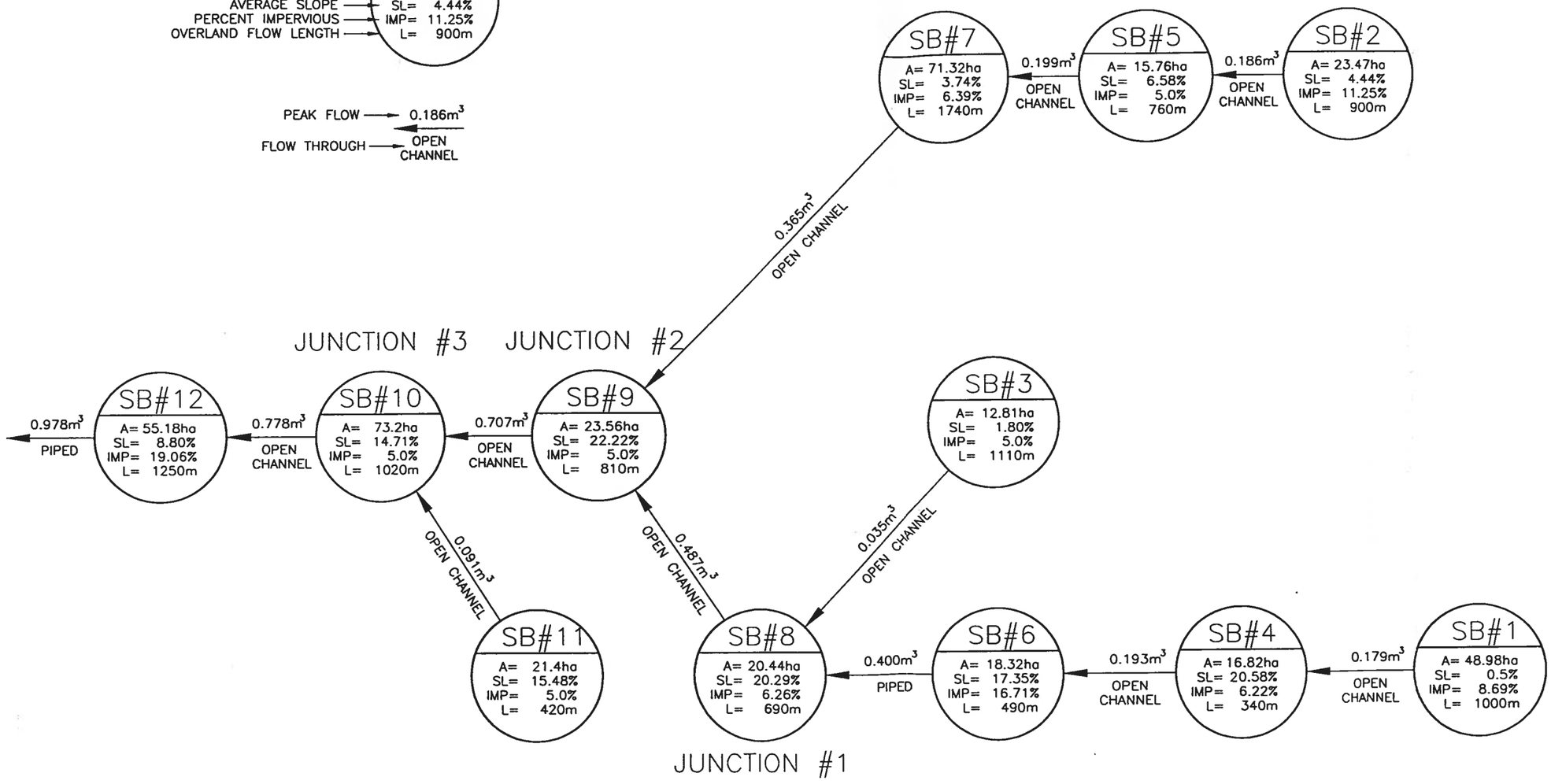
LEGEND

SUBBASIN NUMBER → SB#2
AREA IN HECTARES → A= 23.47ha
AVERAGE SLOPE → SL= 4.44%
PERCENT IMPERVIOUS → IMP= 11.25%
OVERLAND FLOW LENGTH → L= 900m

PEAK FLOW → 0.186m³
FLOW THROUGH → OPEN CHANNEL



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DATE	SEPT/97

ASSOCIATED ENGINEERING

DISTRICT OF LAKE COUNTRY

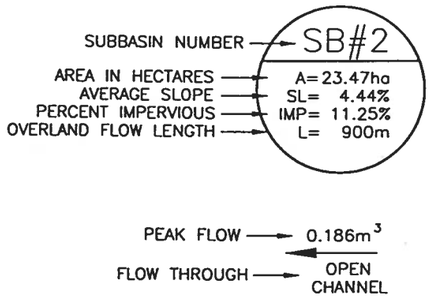
LAKE COUNTRY, B.C.

KNOPF BROOK
DRAINAGE STUDY

MIDUSS MODEL
EXISTING DRAINAGE CONDITIONS

DRAWING NUMBER	REV. NO.	SHEET
2684-0-104		4

LEGEND



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ASSOCIATED ENGINEERING

DISTRICT OF LAKE COUNTRY

LAKE COUNTRY, B.C.

KNOPF BROOK
DRAINAGE STUDY

MIDUSS MODEL
FUTURE DRAINAGE CONDITIONS

DRAWING NUMBER	REV. NO.	SHEET
2684-0-105		5

The closest meteorological station to the study area is the Kelowna Airport. Atmospheric Environment Services of Canada compiled the available rainfall data into a series of intensity/duration/frequency (IDF) curves. These curves relate rainfall intensity to time for varying storm return periods. The return period used in our preliminary model runs was the 1:10 year return period, which is typical for this type of study. For modelling purposes, the IDF curve information was transformed using the typical British Columbia rainfall distribution pattern, into storm hyetographs. Hyetographs are simply the depth of rain that falls in a given time period for a fixed length storm. Table 1 summarizes the storm hyetographs used in our modelling. We used nine different storm events ranging from 15 minutes to 12 hour duration.

The next key component that is required for the computer model is the percentage of land that is impervious. To accomplish this, we obtained the District's Official Community Plan in electronic format and overlaid it onto our base plan. We then determined the area of each land use type and assigned a percentage impervious to each land use. In most cases, each subbasin contained more than one land use and we calculated a weighted percentage impervious for each subbasin which was input into the computer model. Table 2 summarizes the land use areas and percentage impervious used in the model for both the existing and future land use conditions.

Other parameters used in the computer model include subbasin area, average overland slope, overland flow length and soil infiltration parameters. Table 3 summarizes the model parameters used for both the existing and future land use conditions.

The overall model schematic is depicted on drawings 2684-0-104 and 2684-0-105 for the existing and future conditions respectively.

The results of the computer model runs produced a flow rate and size/shape of conduit system required to adequately convey runoff through the basin. Table 4 summarizes the subbasin flow rates with the varying storm durations and peak flows highlighted. Table 5 assigns a conveyance (open channel vs pipe) to the peak flow for each subbasin.

4 DISTRICT'S INPUT

At this point in our analysis, we feel that there is a strong need to have the District's input prior to proceeding to the next phase of modelling and final report preparation. As previously indicated, the key to successful implementation of the final report is to establish an adequately sized continuous flow path through the basin out to Vernon Creek. Most of the existing flow route lies within privately owned land. To further complicate matters, many of the landowners have altered the drainage system to satisfy their own needs, creating an extremely fragmented non-standard drainage system.

In order to obtain a continuous flow route through the basin, discussions with individual landowners must commence as early as possible. As much of the land in question is within the Agricultural Land Reserve and is currently within active orchard operations, land negotiations could be of extended duration. The objective of the landowner discussions is to secure legal rights of way in favor of the District to ensure access for regular maintenance, and provide the District with the ability to prevent future alteration of the drainage system.

Another avenue that should be explored is to obtain a legal opinion of the status of Knopf Brook. In the event that it is deemed as a known creek, this will have an impact on the District's legal position during land negotiations.

In selecting a route, the conduit system should be confined to the municipal road system as much as possible. In some areas this will not be possible and a route will have to be secured on privately owned land and conveyance system designed to fit in with land uses. This is the case in subbasin No. 1 between Nygren Road and Camp Road where the entire route traverses several operating orchards. In this area we would suggest that the conduit system consist of shallow open ditches with adequately sized culverts at regular intervals, to provide the required flow path and limit disruption to the orchard operation, depending on orientation of the tree rows. This suggestion should be reviewed with the orchardists themselves, who could offer advice in this regard. There are two other areas where the existing flow path traverses privately held lands that are problematic. The first is immediately south of Camp Road and the other is on Seaton Road. In both these areas an opportunity exists to transfer the flow route onto the municipal road system in either buried pipes or open ditches.

In selecting a flow route the capital cost of selected conveyance method must be factored in to ensure successful implementation of the project. Buried storm sewers must be adequately designed, including pipe size and material, must have adequate depth of cover to prevent freezing and contain manholes at regular intervals. Open channels are relatively inexpensive from a capital cost standpoint, but do require an annual maintenance program to remove vegetation which inhibits flow. A capital cost comparison between storm sewers and open channels would be as follows:

Storm Sewer of Minimal Depth	$125.00 to $150.00 per metre
Open Channel	$25.00 to $50.00 per metre

Another area where the District's input is required is establishing a stormwater policy for future development. From the computer model the impact of the future land uses greatly increase flows and requires significantly larger pipes and channels. The greatest single impact results from the future Comprehensive Mixed Density land use proposed in the southwest portion of the basin. The District should impose a condition on the development such that stormwater flows are restricted by the developer, to pre-development flow rates

through the use of stormwater detention ponds. Other policy statements that the District should consider are to impose some stormwater quality controls on development, and prepare a sediment and erosion control bylaw.

5 CONCLUSION

In conclusion, the following items require the District's attention prior to proceeding with the next phase of the study.

- ✓ Obtain legal opinion on status of Knopf Brook.
- ✓ Meet with affected landowners on an individual basis to obtain concurrence with project requirements.
- ✓ Hold a public meeting to ensure that all affected landowners are aware of project issues and constraints.
- ✓ Finalize report.
- Negotiate with individual landowners for rights of ways (a professional land negotiator will provide valuable assistance in this task).
- Create a capital fund for land acquisition.
- Establish a stormwater policy and/or bylaw for entire District.
- Create a capital fund for the physical construction requirements.

Prepared by,

A. Ambrozy, P.Eng.

AA/cb

Enclosures

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TABLE 1
CITY OF KELOWNA
AIRPORT IDF CURVE
HYETOGRAPHS

15 MIN 10 YEAR			DEPTH =	8 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
1.25	0.083	7.50	7.50	0.60	28.80
2.50	0.167	17.50	10.00	0.80	38.40
3.75	0.250	37.50	20.00	1.60	76.80
5.00	0.333	56.00	18.50	1.48	71.04
6.25	0.417	67.00	11.00	0.88	42.24
7.50	0.500	74.00	7.00	0.56	26.88
8.75	0.583	81.00	7.00	0.56	26.88
10.00	0.667	87.00	6.00	0.48	23.04
11.25	0.750	92.50	5.50	0.44	21.12
12.50	0.833	96.00	3.50	0.28	13.44
13.75	0.917	98.00	2.00	0.16	7.68
15.00	1.000	100.00	2.00	0.16	7.68
				8.00	

0.5 HOUR 10 YEAR			DEPTH =	10 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
2.50	0.083	7.50	7.50	0.75	18.00
5.00	0.167	17.50	10.00	1.00	24.00
7.50	0.250	37.50	20.00	2.00	48.00
10.00	0.333	56.00	18.50	1.85	44.40
12.50	0.417	67.00	11.00	1.10	26.40
15.00	0.500	74.00	7.00	0.70	16.80
17.50	0.583	81.00	7.00	0.70	16.80
20.00	0.667	87.00	6.00	0.60	14.40
22.50	0.750	92.50	5.50	0.55	13.20
25.00	0.833	96.00	3.50	0.35	8.40
27.50	0.917	98.00	2.00	0.20	4.80
30.00	1.000	100.00	2.00	0.20	4.80
				10.00	

0.75 HOUR 10 YEAR			DEPTH =	12 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
3.75	0.08	7.50	7.50	0.90	14.40
7.50	0.17	17.50	10.00	1.20	19.20
11.25	0.25	37.50	20.00	2.40	38.40
15.00	0.33	56.00	18.50	2.22	35.52
18.75	0.42	67.00	11.00	1.32	21.12
22.50	0.50	74.00	7.00	0.84	13.44
26.25	0.58	81.00	7.00	0.84	13.44
30.00	0.67	87.00	6.00	0.72	11.52
33.75	0.75	92.50	5.50	0.66	10.56
37.50	0.83	96.00	3.50	0.42	6.72
41.25	0.92	98.00	2.00	0.24	3.84
45.00	1.00	100.00	2.00	0.24	3.84
				12.00	

15 MIN 100YEAR			DEPTH =	12 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
1.25	0.083	7.50	7.50	0.90	43.20
2.50	0.167	17.50	10.00	1.20	57.60
3.75	0.250	37.50	20.00	2.40	115.20
5.00	0.333	56.00	18.50	2.22	106.56
6.25	0.417	67.00	11.00	1.32	63.36
7.50	0.500	74.00	7.00	0.84	40.32
8.75	0.583	81.00	7.00	0.84	40.32
10.00	0.667	87.00	6.00	0.72	34.56
11.25	0.750	92.50	5.50	0.66	31.68
12.50	0.833	96.00	3.50	0.42	20.16
13.75	0.917	98.00	2.00	0.24	11.52
15.00	1.000	100.00	2.00	0.24	11.52
				12.00	

0.5 HOUR 100 YEAR			DEPTH =	14.5 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
2.50	0.08	7.50	7.50	1.09	26.10
5.00	0.17	17.50	10.00	1.45	34.80
7.50	0.25	37.50	20.00	2.90	69.60
10.00	0.33	56.00	18.50	2.68	64.38
12.50	0.42	67.00	11.00	1.60	38.28
15.00	0.50	74.00	7.00	1.02	24.36
17.50	0.58	81.00	7.00	1.02	24.36
20.00	0.67	87.00	6.00	0.87	20.88
22.50	0.75	92.50	5.50	0.80	19.14
25.00	0.83	96.00	3.50	0.51	12.18
27.50	0.92	98.00	2.00	0.29	6.96
30.00	1.00	100.00	2.00	0.29	6.96
				14.50	

.75 HOUR 100 YEAR			DEPTH =	17.25 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
3.75	0.08	7.50	7.50	1.29	20.70
7.50	0.17	17.50	10.00	1.73	27.60
11.25	0.25	37.50	20.00	3.45	55.20
15.00	0.33	56.00	18.50	3.19	51.06
18.75	0.42	67.00	11.00	1.90	30.36
22.50	0.50	74.00	7.00	1.21	19.32
26.25	0.58	81.00	7.00	1.21	19.32
30.00	0.67	87.00	6.00	1.04	16.56
33.75	0.75	92.50	5.50	0.95	15.18
37.50	0.83	96.00	3.50	0.60	9.66
41.25	0.92	98.00	2.00	0.35	5.52
45.00	1.00	100.00	2.00	0.35	5.52
				17.25	

TABLE 1
CITY OF KELOWNA
AIRPORT IDF CURVE
HYETOGRAPHS

1.0 HOUR 10 YEAR			DEPTH =	12.5 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
5.00	0.08	7.50	7.50	0.94	11.25
10.00	0.17	17.50	10.00	1.25	15.00
15.00	0.25	37.50	20.00	2.50	30.00
20.00	0.33	56.00	18.50	2.31	27.75
25.00	0.42	67.00	11.00	1.38	16.50
30.00	0.50	74.00	7.00	0.88	10.50
35.00	0.58	81.00	7.00	0.88	10.50
40.00	0.67	87.00	6.00	0.75	9.00
45.00	0.75	92.50	5.50	0.69	8.25
50.00	0.83	96.00	3.50	0.44	5.25
55.00	0.92	98.00	2.00	0.25	3.00
60.00	1.00	100.00	2.00	0.25	3.00
				12.50	

1.5 HOUR 10 YEAR			DEPTH =	13.5 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
7.50	0.08	7.50	7.50	1.01	8.10
15.00	0.17	17.50	10.00	1.35	10.80
22.50	0.25	37.50	20.00	2.70	21.60
30.00	0.33	56.00	18.50	2.50	19.98
37.50	0.42	67.00	11.00	1.49	11.88
45.00	0.50	74.00	7.00	0.95	7.56
52.50	0.58	81.00	7.00	0.95	7.56
60.00	0.67	87.00	6.00	0.81	6.48
67.50	0.75	92.50	5.50	0.74	5.94
75.00	0.83	96.00	3.50	0.47	3.78
82.50	0.92	98.00	2.00	0.27	2.16
90.00	1.00	100.00	2.00	0.27	2.16
				13.50	

2.0 HOUR 10 YEAR			DEPTH =	15.6 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
10	0.08	7.50	7.50	1.17	7.02
20	0.17	17.50	10.00	1.56	9.36
30	0.25	37.50	20.00	3.12	18.72
40	0.33	56.00	18.50	2.89	17.32
50	0.42	67.00	11.00	1.72	10.30
60	0.50	74.00	7.00	1.09	6.55
70	0.58	81.00	7.00	1.09	6.55
80	0.67	87.00	6.00	0.94	5.62
90	0.75	92.50	5.50	0.86	5.15
100	0.83	96.00	3.50	0.55	3.28
110	0.92	98.00	2.00	0.31	1.87
120	1.00	100.00	2.00	0.31	1.87
				15.60	

1.0 HOUR 100 YEAR			DEPTH =	18 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
5.00	0.08	7.50	7.50	1.35	16.20
10.00	0.17	17.50	10.00	1.80	21.60
15.00	0.25	37.50	20.00	3.60	43.20
20.00	0.33	56.00	18.50	3.33	39.96
25.00	0.42	67.00	11.00	1.98	23.76
30.00	0.50	74.00	7.00	1.26	15.12
35.00	0.58	81.00	7.00	1.26	15.12
40.00	0.67	87.00	6.00	1.08	12.96
45.00	0.75	92.50	5.50	0.99	11.88
50.00	0.83	96.00	3.50	0.63	7.56
55.00	0.92	98.00	2.00	0.36	4.32
60.00	1.00	100.00	2.00	0.36	4.32
				18.00	

1.5 HOUR 100 YEAR			DEPTH =	22.5 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
7.50	0.08	7.50	7.50	1.69	13.50
15.00	0.17	17.50	10.00	2.25	18.00
22.50	0.25	37.50	20.00	4.50	36.00
30.00	0.33	56.00	18.50	4.16	33.30
37.50	0.42	67.00	11.00	2.48	19.80
45.00	0.50	74.00	7.00	1.58	12.60
52.50	0.58	81.00	7.00	1.58	12.60
60.00	0.87	87.00	6.00	1.35	10.80
67.50	0.75	92.50	5.50	1.24	9.90
75.00	0.83	96.00	3.50	0.79	6.30
82.50	0.92	98.00	2.00	0.45	3.60
90.00	1.00	100.00	2.00	0.45	3.60
				22.50	

2.0 HOUR 100 YEAR			DEPTH =	23 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
10	0.08	7.50	7.50	1.73	10.35
20	0.17	17.50	10.00	2.30	13.80
30	0.25	37.50	20.00	4.60	27.60
40	0.33	56.00	18.50	4.26	25.53
50	0.42	67.00	11.00	2.53	15.18
60	0.50	74.00	7.00	1.61	9.66
70	0.58	81.00	7.00	1.61	9.66
80	0.67	87.00	6.00	1.38	8.28
90	0.75	92.50	5.50	1.27	7.59
100	0.83	96.00	3.50	0.81	4.83
110	0.92	98.00	2.00	0.46	2.76
120	1.00	100.00	2.00	0.46	2.76
				23.00	

TABLE 1
CITY OF KELOWNA
AIRPORT IDF CURVE
HYETOGRAPHS

3.0 HOUR 10 YEAR			DEPTH =	17.7 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
15	0.08	7.50	7.50	1.33	5.31
30	0.17	17.50	10.00	1.77	7.08
45	0.25	37.50	20.00	3.54	14.16
60	0.33	56.00	18.50	3.27	13.10
75	0.42	67.00	11.00	1.95	7.79
90	0.50	74.00	7.00	1.24	4.96
105	0.58	81.00	7.00	1.24	4.96
120	0.67	87.00	6.00	1.06	4.25
135	0.75	92.50	5.50	0.97	3.89
150	0.83	96.00	3.50	0.62	2.48
165	0.92	98.00	2.00	0.35	1.42
180	1.00	100.00	2.00	0.35	1.42
				17.70	

4.0 HOUR 10 YEAR			DEPTH =	20.4 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
20	0.08	7.50	7.50	1.53	4.59
40	0.17	17.50	10.00	2.04	6.12
60	0.25	37.50	20.00	4.08	12.24
80	0.33	56.00	18.50	3.77	11.32
100	0.42	67.00	11.00	2.24	6.73
120	0.50	74.00	7.00	1.43	4.28
140	0.58	81.00	7.00	1.43	4.28
160	0.67	87.00	6.00	1.22	3.67
180	0.75	92.50	5.50	1.12	3.37
200	0.83	96.00	3.50	0.71	2.14
220	0.92	98.00	2.00	0.41	1.22
240	1.00	100.00	2.00	0.41	1.22
				20.40	

6.0 HOUR 10 YEAR			DEPTH =	21.6 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
30	0.08	7.50	7.50	1.62	3.24
60	0.17	17.50	10.00	2.16	4.32
90	0.25	37.50	20.00	4.32	8.64
120	0.33	56.00	18.50	4.00	7.99
150	0.42	67.00	11.00	2.38	4.75
180	0.50	74.00	7.00	1.51	3.02
210	0.58	81.00	7.00	1.51	3.02
240	0.67	87.00	6.00	1.30	2.59
270	0.75	92.50	5.50	1.19	2.38
300	0.83	96.00	3.50	0.76	1.51
330	0.92	98.00	2.00	0.43	0.86
360	1.00	100.00	2.00	0.43	0.86
				21.60	

3.0 HOUR 100 YEAR			DEPTH =	24 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
15	0.08	7.50	7.50	1.80	7.20
30	0.17	17.50	10.00	2.40	9.60
45	0.25	37.50	20.00	4.80	19.20
60	0.33	56.00	18.50	4.44	17.76
75	0.42	67.00	11.00	2.64	10.56
90	0.50	74.00	7.00	1.68	6.72
105	0.58	81.00	7.00	1.68	6.72
120	0.67	87.00	6.00	1.44	5.76
135	0.75	92.50	5.50	1.32	5.28
150	0.83	96.00	3.50	0.84	3.36
165	0.92	98.00	2.00	0.48	1.92
180	1.00	100.00	2.00	0.48	1.92
				24.00	

4.0 HOUR 100 YEAR			DEPTH =	26 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
20	0.08	7.50	7.50	1.95	5.85
40	0.17	17.50	10.00	2.60	7.80
60	0.25	37.50	20.00	5.20	15.60
80	0.33	56.00	18.50	4.81	14.43
100	0.42	67.00	11.00	2.86	8.58
120	0.50	74.00	7.00	1.82	5.46
140	0.58	81.00	7.00	1.82	5.46
160	0.67	87.00	6.00	1.56	4.68
180	0.75	92.50	5.50	1.43	4.29
200	0.83	96.00	3.50	0.91	2.73
220	0.92	98.00	2.00	0.52	1.56
240	1.00	100.00	2.00	0.52	1.56
				26.00	

6.0 HOUR 100 YEAR			DEPTH =	30 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
30	0.08	7.50	7.50	2.25	4.50
60	0.17	17.50	10.00	3.00	6.00
90	0.25	37.50	20.00	6.00	12.00
120	0.33	56.00	18.50	5.55	11.10
150	0.42	67.00	11.00	3.30	6.60
180	0.50	74.00	7.00	2.10	4.20
210	0.58	81.00	7.00	2.10	4.20
240	0.67	87.00	6.00	1.80	3.60
270	0.75	92.50	5.50	1.65	3.30
300	0.83	96.00	3.50	1.05	2.10
330	0.92	98.00	2.00	0.60	1.20
360	1.00	100.00	2.00	0.60	1.20
				30.00	

TABLE 1
CITY OF KELOWNA
AIRPORT IDF CURVE
HYETOGRAPHS

12HOUR 10 YEAR			DEPTH =	26.4 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
60.00	0.083	7.50	7.50	1.98	1.98
120.00	0.167	17.50	10.00	2.64	2.64
180.00	0.250	37.50	20.00	5.28	5.28
240.00	0.333	56.00	18.50	4.88	4.88
300.00	0.417	67.00	11.00	2.90	2.90
360.00	0.500	74.00	7.00	1.85	1.85
420.00	0.583	81.00	7.00	1.85	1.85
480.00	0.667	87.00	6.00	1.58	1.58
540.00	0.750	92.50	5.50	1.45	1.45
600.00	0.833	96.00	3.50	0.92	0.92
660.00	0.917	98.00	2.00	0.53	0.53
720.00	1.000	100.00	2.00	0.53	0.53
				26.40	

12HOUR 100YEAR			DEPTH =	34.8 mm	
TIME (min)	RATIO (min/min)	CUMUL % 0	INCRE%	DEPTH (mm)	INTENSITY (mm/hr)
60.00	0.083	7.50	7.50	2.61	2.61
120.00	0.167	17.50	10.00	3.48	3.48
180.00	0.250	37.50	20.00	6.96	6.98
240.00	0.333	56.00	18.50	6.44	6.44
300.00	0.417	67.00	11.00	3.83	3.83
360.00	0.500	74.00	7.00	2.44	2.44
420.00	0.583	81.00	7.00	2.44	2.44
480.00	0.667	87.00	6.00	2.09	2.09
540.00	0.750	92.50	5.50	1.91	1.91
600.00	0.833	96.00	3.50	1.22	1.22
660.00	0.917	98.00	2.00	0.70	0.70
720.00	1.000	100.00	2.00	0.70	0.70
				34.80	

TABLE 2
LAND USE AND
PERCENT IMPERVIOUS
SUMMARY

KNOPF BROOK DRAINAGE STUDY

EXISTING LAND USE AREA (ha) SUMMARY

	LAND USES								
SUB-BASIN	LDR-U 25%	LDR-R 10%	CMDR 25%	A/R 5%	WTC 60%	E/I 40%	PC 5%	TOTAL	PERCENT IMP
SB1	6.09	0.00	0.00	39.66	0.00	1.69	1.54	48.98	8.69%
SB2	7.33	0.00	0.00	16.14	0.00	0.00	0.00	23.47	11.25%
SB3	0.00	0.00	0.00	12.81	0.00	0.00	0.00	12.81	5.00%
SB4	1.03	0.00	0.00	15.21	0.00	0.00	0.58	16.82	6.22%
SB5	0.00	0.00	0.00	15.76	0.00	0.00	0.00	15.76	5.00%
SB6	10.73	0.00	0.00	7.59	0.00	0.00	0.00	18.32	16.71%
SB7	4.95	0.00	0.00	66.37	0.00	0.00	0.00	71.32	6.39%
SB8	1.29	0.00	0.00	19.15	0.00	0.00	0.00	20.44	6.26%
SB9	0.00	0.00	0.00	23.56	0.00	0.00	0.00	23.56	5.00%
SB10	0.00	0.00	0.00	73.20	0.00	0.00	0.00	73.20	5.00%
SB11	0.00	0.00	0.00	21.40	0.00	0.00	0.00	21.4	5.00%
SB12	18.50	0.63	0.00	28.73	7.32	0.00	0.00	55.18	19.06%
							TOTAL	401.26	8.65%

FUTURE LAND USE AREA (ha) SUMMARY

	LAND USES								
SUB-BASIN	LDR-U 25%	LDR-R 10%	CMDR 25%	A/R 5%	WTC 60%	E/I 40%	PC 5%	TOTAL	PERCENT IMP
SB1	6.09	0.00	4.75	34.91	0.00	1.69	1.54	48.98	10.63%
SB2	7.33	0.00	0.00	16.14	0.00	0.00	0.00	23.47	11.25%
SB3	0.00	0.00	0.36	12.45	0.00	0.00	0.00	12.81	5.56%
SB4	1.03	0.00	6.63	8.58	0.00	0.00	0.58	16.82	14.11%
SB5	0.00	0.00	0.00	15.76	0.00	0.00	0.00	15.76	5.00%
SB6	10.73	0.00	7.15	0.44	0.00	0.00	0.00	18.32	24.52%
SB7	4.95	0.00	0.00	66.37	0.00	0.00	0.00	71.32	6.39%
SB8	1.29	0.00	11.53	7.62	0.00	0.00	0.00	20.44	17.54%
SB9	0.00	0.00	13.93	9.63	0.00	0.00	0.00	23.56	16.83%
SB10	0.00	0.00	38.02	35.18	0.00	0.00	0.00	73.20	15.39%
SB11	0.00	0.00	20.61	0.79	0.00	0.00	0.00	21.4	24.26%
SB12	12.43	0.63	12.13	22.67	7.32	0.00	0.00	55.18	21.25%
							TOTAL	401.26	14.08%

TABLE 3
MIDUSS MODEL
SUB-BASIN PARAMETER
SUMMARY

KNOPF BROOK DRAINAGE STUDY
BASIN MODELLING PARAMETERS - EXISTING CONDITIONS

	IMPERVIOUS DATA						
SUB-BASIN	LENGTH (m)	AVR SLOPE	MANNING "n"	Fo (mm/hr)	Fc (mm/hr)	DECAY (hrs)	DEP STOR (mm)
SB1	1000	0.50%	0.35	177	10	0.37	4.55
SB2	900	4.44%	0.35	200	13	0.40	5.50
SB3	1110	1.80%	0.25	208	15	0.41	6.13
SB4	340	20.58%	0.25	146	8	0.31	3.38
SB5	760	6.58%	0.35	187	11	0.38	4.96
SB6	490	17.35%	0.25	168	10	0.36	4.39
SB7	1740	3.74%	0.35	202	10	0.35	4.22
SB8	690	20.29%	0.40	233	21	0.46	4.46
SB9	810	22.22%	0.40	225	19	0.45	3.93
SB10	1020	14.71%	0.40	150	11	0.32	4.03
SB11	420	15.48%	0.40	200	25	0.50	5.50
SB12	1250	8.80%	0.40	162	9	0.35	3.92

BASIN MODELLING PARAMETERS - FUTURE CONDITIONS

	IMPERVIOUS DATA						
SUB-BASIN	LENGTH (m)	AVR SLOPE	MANNING "n"	Fo (mm/hr)	Fc (mm/hr)	DECAY (hrs)	DEP STOR (mm)
SB1	1000	0.50%	0.30	177	10	0.37	4.55
SB2	900	4.44%	0.35	200	13	0.40	5.50
SB3	1110	1.80%	0.25	208	15	0.41	6.13
SB4	340	20.58%	0.25	146	8	0.31	3.38
SB5	760	6.58%	0.35	187	11	0.38	4.96
SB6	490	17.35%	0.25	168	10	0.36	4.39
SB7	1740	3.74%	0.35	202	10	0.35	4.22
SB8	690	20.00%	0.25	233	21	0.46	4.46
SB9	810	20.00%	0.25	225	19	0.45	3.93
SB10	1020	15.00%	0.25	150	11	0.32	4.03
SB11	420	15.00%	0.25	200	25	0.50	5.50
SB12	1250	8.80%	0.25	162	9	0.35	3.92

TABLE 4
MIDUSS MODEL
FLOW
SUMMARY

KNOPF BROOK DRAINAGE STUDY

STORMWATER RUNOFF SUMMARY - EXISTING CONDITIONS

SUB-BASIN	FLOW RATES m^3/sec WITH VARYING STORM DURATIONS								
	15 min	30 min	45 min	60 min	90 min	120 min	180 min	360 min	720 min
SB1	0.148	0.163	0.179	0.166	0.142	0.147	0.140	0.107	0.066
SB2	0.186	0.175	0.182	0.159	0.128	0.143	0.100	0.069	0.039
SB3	0.031	0.033	0.035	0.031	0.026	0.028	0.024	0.015	0.010
SB4	0.157	0.175	0.193	0.180	0.157	0.158	0.149	0.121	0.074
SB5	0.194	0.191	0.199	0.175	0.150	0.156	0.115	0.081	0.047
SB6	0.400	0.377	0.389	0.325	0.285	0.267	0.232	0.186	0.117
SB7	0.329	0.341	0.365	0.317	0.275	0.283	0.240	0.189	0.110
SB8	0.487	0.453	0.463	0.399	0.334	0.317	0.291	0.223	0.141
SB9	0.667	0.640	0.707	0.643	0.553	0.569	0.514	0.407	0.266
SB10	0.688	0.738	0.778	0.691	0.617	0.625	0.555	0.454	0.311
SB11	0.038	0.090	0.091	0.080	0.066	0.052	0.047	0.026	0.016
SB12	0.746	0.810	0.978	0.912	0.818	0.815	0.729	0.636	0.455

Down by Hwy.

STORMWATER RUNOFF SUMMARY - FUTURE CONDITIONS

SUB-BASIN	FLOW RATES m^3/sec WITH VARYING STORM DURATIONS								
	15 min	30 min	45 min	60 min	90 min	120 min	180 min	360 min	720 min
SB1	0.182	0.199	0.219	0.203	0.174	0.180	0.171	0.131	0.080
SB2	0.186	0.175	0.182	0.159	0.128	0.143	0.100	0.069	0.036
SB3	0.023	0.025	0.028	0.025	0.022	0.022	0.021	0.018	0.010
SB4	0.269	0.258	0.266	0.244	0.213	0.213	0.205	0.172	0.107
SB5	0.192	0.193	0.201	0.177	0.151	0.155	0.115	0.081	0.047
SB6	0.671	0.629	0.642	0.523	0.463	0.421	0.353	0.270	0.171
SB7	0.328	0.343	0.366	0.318	0.275	0.282	0.239	0.189	0.110
SB8	0.972	0.872	0.851	0.750	0.597	0.583	0.491	0.347	0.225
SB9	1.357	1.234	1.254	1.087	0.899	0.885	0.751	0.450	0.388
SB10	1.607	1.607	1.738	1.524	1.262	1.252	1.082	0.817	0.537
SB11	0.504	0.436	0.440	0.390	0.319	0.251	0.228	0.125	0.076
SB12	1.628	1.927	2.177	1.903	1.637	1.540	1.412	1.121	0.754

NOTE: PEAK FLOWS ARE HIGHLIGHTED

6% rise in impervious area.

TABLE 5
PEAK FLOW AND
CONVEYANCE SYSTEM
SUMMARY

KNOPF BROOK DRAINAGE STUDY

MODEL CONVEYANCE SYSTEM SUMMARY - EXISTING CONDITIONS

SUB-BASIN	PEAK FLOW m^3	CONVEY SYSTEM	DESCRIPTION	SLOPE	MANNING "n"	CAPACITY m^3
SB1	0.179	CHANNEL	B=0.0m, S=2:1, D=0.375m	0.50%	0.025	0.242
SB2	0.186	CHANNEL	B=0.0m, S=2:1, D=0.300m	1.00%	0.025	0.189
SB3	0.035	PIPE	D=0.250m, PVC	1.00%	0.009	0.086
SB4	0.193	PIPE	D=0.375m, PVC	1.00%	0.009	0.253
SB5	0.199	CHANNEL	B=0.0m, S=2:1, D=0.350m	1.00%	0.025	0.285
SB6	0.4	PIPE	D=0.450m, PVC	1.00%	0.009	0.412
SB7	0.365	CHANNEL	B=0.0m, S=2:1, D=0.400m	1.00%	0.025	0.406
SB8	0.487	CHANNEL	B=0.6m, S=2:1, D=0.400m	1.00%	0.025	0.852
SB9	0.707	CHANNEL	B=0.6m, S=2:1, D=0.400m	1.00%	0.025	0.852
SB10	0.778	CHANNEL	B=0.6m, S=2:1, D=0.400m	1.00%	0.025	0.852
SB11	0.091	CHANNEL	B=0.0m, S=2:1, D=0.300m	1.00%	0.025	0.189
SB12	0.978	PIPE	D=0.600m, PVC	1.00%	0.009	1.086

MODEL CONVEYANCE SYSTEM SUMMARY - FUTURE CONDITIONS

SUB-BASIN	PEAK FLOW m^3	CONVEY SYSTEM	DESCRIPTION	SLOPE	MANNING "n"	CAPACITY m^3
SB1	0.219	CHANNEL	B=0.3m, S=2:1, D=0.300m	0.50%	0.025	0.229
SB2	0.186	CHANNEL	B=0.0m, S=2:1, D=0.300m	1.00%	0.025	0.189
SB3	0.28	PIPE	D=0.250m, PVC	1.00%	0.009	0.086
SB4	0.269	PIPE	D=0.375m, PVC	1.50%	0.009	0.31
SB5	0.201	CHANNEL	B=0.0m, S=2:1, D=0.350m	1.00%	0.025	0.285
SB6	0.671	PIPE	D=0.525m, PVC	1.50%	0.009	0.761
SB7	0.366	CHANNEL	B=0.0m, S=2:1, D=0.400m	1.00%	0.025	0.406
SB8	0.972	CHANNEL	B=0.6m, S=2:1, D=0.500m	1.00%	0.025	1.376
SB9	1.357	CHANNEL	B=0.6m, S=2:1, D=0.500m	1.00%	0.025	1.376
SB10	1.738	CHANNEL	B=0.6m, S=2:1, D=0.600m	1.00%	0.025	2.059
SB11	0.504	CHANNEL	B=0.3m, S=2:1, D=0.400m	1.00%	0.025	0.623
SB12	2.177	PIPE	D=0.900m, PVC	1.00%	0.009	2.615

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1 - 1925 KIRSCHNER ROAD
KELOWNA, B.C. V1Y 4N7
PHONE: 860-6540
FAX: 860-5027

Associated Engineering (B.C.) Ltd.
Suite 222 - 1634 Harvey Avenue
Kelowna, B.C. V1Y 6G2

August 26, 1997
Job 9768

ATTENTION: Mr. Andrew Ambrozy, P.Eng.

Dear Sir:

RE: Geotechnical Investigation
Knopf Brook Basin Drainage Study
Lake Country, B.C.

As requested, Interior Testing Services Ltd. has completed a geotechnical investigation for the above noted project. A location plan, one page of schematic logs, 33 auger hole logs and one soil group table are attached to this letter report.

INTRODUCTION

It is understood that the District of Lake Country wishes to develop a suitable drainage plan for the Knopf Brook basin that will address future development as well as preserve existing drainage corridors. In addition, current groundwater and overland flow in specific regions of the study zone require remedial work.

The purpose of the geotechnical investigation was to identify soil types as well as current groundwater conditions.

The study area has been divided into 12 zones by others. This report discusses each zone with the exception of Study Basin 3. Some modifications to the Study Basin areas occurred after drilling was completed.

DESCRIPTION

The drainage study encompasses an area of roughly 400 hectares. It is bordered by Beaver Lake Road/Dick Road to the south, Cemetary Road to the west, Davidson Road to the north, and Seaton/Read Road to the east.

The properties within the study zone consist of residential and agricultural development. The terrain is a mixture of hills and fields, occasional bedrock outcrops, wooded areas, and orchards. The roadways have been paved or level coursed and their quality ranges from relatively good with few lateral cracks (Beaver Lake Road), to very poor with many potholes (Cemetary/Nygren Road).

FIELD WORK

On three separate occasions (June 25, 26 and July 9, 1997), a truck mounted drill rig was used to drill 32 holes to a maximum depth of 2.4 metres, and 1 hole to 5.5 metres below existing grade. Furthermore, one additional auger hole was terminated immediately on commencement of drilling, after hitting a natural gas line on Chase Road (AH25 - SB3), near Monte Bella Road.

Underlying soils were identified and logged in the field with samples taken at various depths for further laboratory analysis. In addition, the soils were categorized after the United States Soil Conservation Services Hydrological Soil Group as follows.

Group A: soils having high infiltration rates
Group B: soils having moderate infiltration rates
Group C: soils having slow infiltration rates
Group D: soils having a very slow infiltration rate.

Soils were given a split lettering (i.e. Group B/C), where they could not be classified specifically to one group.

With the exception of AH23 and AH32, each test hole had a 19 mm diameter pvc standpipe installed to monitor the groundwater elevation. Twenty two of the standpipes were recorded on July 28, 1997 with the remaining 9 recorded on August 1, 1997.

Geodetic elevations of the test holes were not obtained.

FIELD AND LABORATORY RESULTS

Location of the 12 study basins and 34 auger holes are showing on drawing 9788-1. Schematic logs are presented on drawing 9788-2, followed by the Hydrological Soil Groups on drawing 9788-3. Detailed soil descriptions and individual hydrological soil categories are shown on auger hole logs numbered 9788-4 to 9788-36.

It should be noted that where FILLS were encountered, these soils were not given a "Group" identification. However, in our opinion, these soils would generally fall in the categories of Group A and/or Group B.

Laboratory work consisted of moisture contents.

Study Basin 1 (SB1) - Auger Holes 12, 16, 17, 18, 19, 20 and 21

Study Basin 1 is located at the northwest end of the study area. It is roughly 49 hectares in size and includes Cemetary Road and Nygren Road.

Seven auger holes were drilled in this area, four on Cemetary Road (one of them outside of the zone - AH21), 2 on Nygren Road and 1 on Bond Road.

Generally, the soil profile along Cemetary Road consisted of SANDS to till-like SILT, SAND and GRAVEL. Nygren Road was logged as a silty

SAND/sandy SILT overlying silty SANDS and GRAVELS. Based on the United States Soil Conservation Services Hydrological Soil Groups, it is our opinion these soils would be classified as a Group B/C. Auger hole 18 did encounter a fairly clean SAND at 2.1 metres below grade. It would be best described as belonging to Group A, except for the high water level.

Auger hole 12 (Bond Road), indicated over 5 metres of silty SAND & GRAVEL FILL had been used to raise the grade through the existing gully. Natural soils encountered at 5.2 metres were noted as a brown fine SAND with some silt (Group A/B).

Water levels ranged from 0.4 metres (AH19) to 1.8 metres (AH16) below existing grade. Auger hole 12 was dry.

Moisture contents ranged from 7.4 % in the till-like soil (AH17), to 23.1 % in the silty SAND/sandy SILT material (AH18).

Study Basin 2 (SB2) - Auger Holes 13, 14 and 15

Study Basin 2 is located east of SB1. It is roughly 23 ha in size and includes part of Bond Road and Williams Road.

Two holes were drilled within this area plus one (AH14) just east of SB2. Auger hole 13 and 14, located on Williams Road, show brown silty SANDS/sandy SILTS (Group B and Group C) overlying SANDS (Group A and Group A/B). Auger hole 15, located on the northern section of Bond Road, consists of silty SANDS (Group B to Group C at depth).

Auger hole 14 had a recorded water level of 2.3 metres below grade. Auger hole 13 and 15 were noted as dry.

Moistures in the silty SAND/sandy SILT zone ranged from 14.6 % to 20.9 %.

Study Basin 3 (SB3) - Auger Hole 25 (deleted)

Study Basin 4 (SB4) - Auger Holes 22, 23, and 24

Study Basin 4 is located south of SB1. It is roughly 17 ha and includes Long Road, the west end of Camp Road, and Monte Carlo Road.

A total of three holes were drilled in this area. Auger hole 23, located on Long Road, was logged as weathered BEDROCK (Group D) with refusal at 1.2 metres below grade. Auger hole 22, on Camp Road, was logged as interlayered silty SANDS and sandy SILTS (Group B and Group C) with a water level recorded at 1.1 metres below grade. Auger hole 24 was drilled on Monte Carlo Road. It was recorded as interlayered sandy SILT and silty SAND (Group B) overlying medium to fine SAND at depth (Group A/B).

Groundwater was not present in AH23 and AH24.

Moisture contents in AH22 ranged from 22.2 % to 39.8 %.

Study Basin (SB5) - Auger Hole 9

Study Basin 5 is located south of SB2. It is roughly 16 ha in size and covers an area between Chase Road and Seaton Road.

Auger hole 9 was drilled at the northern end of Seaton Road, just outside of the study area. The soils change from silty SAND and sandy SILT (Group B), to SILT (Group C), to SAND (Group A) at depth.

The recorded water level on July 28, 1997 was 1.8 metres below grade.

The moisture content varied from 13.4 % to 21.7 %.

Study Basin 6 (SB6) - Auger Holes 26, 27, and 29

Study Basin 6 is located south of SB4. It is approximately 18 ha and includes Monte Bella Road and a small portion of Chase Road.

Three holes were drilled in this area, with one of them (AH29) located on Chase Road. Monte Bella Road varies from a brown silty SAND/sandy SILT (Group A and Group B) material at AH26, to a till-like silty SAND and GRAVEL (Group C) at AH27. Auger hole 29, located on Chase Road, ranges from SAND (Group A/B) to silty SAND (Group B), to coarse SAND and fine GRAVEL at depth (Group A).

Water levels were noted as 0.6 metres (AH27), dry (AH26), and 1.1 metres (AH29) below grade.

Moisture levels ranged from 7.4 % (AH26) to 17.3 % (AH29).

Study Basin 7 (SB7) - Auger Holes 6, 7, 8, 10, and 11

Study Basin 7 is located south of SB5 and east of SB3. It is approximately 71 ha and includes Seaton Road and Camp Road.

Five holes were drilled within this zone with three of them located on Seaton Road (AH6, AH7, AH8). Auger hole 6 encountered brown silty CLAY/clayey SILT (Group D) overlying fine to medium SAND (Group B) at depth. Auger hole 7 and 8 were logged as silty SAND (Group B) and SAND (Group A/B).

Auger hole 10 consisted of silty SANDS/sandy SILTS (Group B/C) at the surface, to medium fine SAND (Group A/B) at depth. In addition, a 200 mm silty CLAY/clayey SILT layer (Group D) was encountered at 1.7 metres below grade. Auger hole 11 varied from silty SANDS/sandy SILTS (Group B) to silty SAND and GRAVEL (Group B/C) at depth.

Water levels were noted as 2.2 metres and 2.4 metres in AH6 and AH7 with the remaining 3 holes recorded as dry.

Moistures ranged from 5.1 % in the silty SANDS (AH8), to 30.0 % in the silty CLAYS/clayey SILTS (AH6).

Study Basin 8 (SB8) - Auger Holes 28, 30, and 34

Study Basin 8 is located south of SB7, SB3, and SB6 and is roughly 20 hectares. It includes the cul-de-sac at the terminus of Monte Bella Road as well as part of Chase Road.

Three holes were drilled in this zone with one at the southernmost end of Monte Bella Road. Auger hole 28 (Monte Bella Road) was identified as a till-like SILT, SAND and GRAVEL (Group C). Auger hole 30 and 34 were noted as silty SAND (Group B) to SAND (Group A) at depth.

Auger hole 30 had a water level at 0.7 metres below grade, AH34 was noted as wet at the base of the piezometer, and AH28 was dry.

Moistures in AH28 and AH34 were roughly 8 %.

Study Basin 9 (SB9) - Auger Hole 31

Study Basin 9 is located south of SB8 and is roughly 24 hectares.

One auger hole was drilled along the east side of Chase Road and soils were logged as silty SAND and GRAVEL (Group A/B) to till-like SILT, SAND, and GRAVEL (Group C) at depth.

The auger hole was dry.

Moisture content of the underlying soil was 8.7 %.

Study Basin 10 (SB10) - Auger Holes 3, 5, and 32

Study Basin 10 is located south of SB9 and SB7. It is roughly 73 hectares and includes part of Chase Road, Seaton Road, and Read Road.

Auger hole 32 (Chase Road) was terminated at a depth of 1.2 metres below existing grade as a result of possible BEDROCK (Group D). The overlying soil consisted of a brown silty SAND and GRAVEL with some cobble (Group B).

Auger hole 5 (Seaton Road) encountered silty CLAY/clayey SILT (Group D) with a sandy SILT (Group C/D) seam at 0.9 metres.

Auger hole 3 (Read Road) consisted of sandy SILT/silty SAND (Group C) followed by medium fine SAND (Group A/B to A at depth).

Auger hole 5 showed a water level of 0.5 metres below existing grade and AH3 was recorded as dry. Auger hole 32 did not have a standpipe installed.

Moistures ranged from 6.9 % (AH3) to 32.6 % (AH5).

Study Basin 11 (SB11) - Auger Hole 33

Study Basin 11 is located south of SB10 and is roughly 21 hectares in size.

Auger hole 33, located near the south end of Chase Road, showed brown silty SAND (Group B) followed by SAND (Group A) at depth.

The water level was noted at 2.4 metres below grade.

A moisture content of 15.3 % was recorded in the silty SAND zone.

Study Basin 12 (SB12) - Auger Holes 1, 2, and 4

Study Basin 12 is located south of SB10. It is approximately 55 hectares and stretches along the southern section of the study area.

Three holes were drilled in this zone. Auger hole 1, located near the northwest corner of Highway 97 and Beaver Lake Road, showed brown SILT and SAND (Group B/C) overlying SAND (Group A). Auger hole 2, located on the southern end of Read Road, was logged as a brown silty SAND, GRAVEL and COBBLE (Group B). Auger hole 4 located near the south end of Seaton Road consisted of brown SILT (Group C), followed by silty SAND (Group B) with the underlying soil identified as SAND (Group A).

AH1, AH2, and AH4 showed water levels respectively at 2.3 metres, 1.3 metres, and 2.1 metres below grade.

Moisture contents ranged from 14.7 % to 16.5 % in AH4.

CONCLUSIONS

1. The District of Lake Country is proposing to develop a drainage plan for the Knopf Brook basin that will include existing drainage corridors as well as address future developments. In order to evaluate the present conditions, a geotechnical investigation was carried out to identify the soil and groundwater conditions within the study area.

2. Our estimation of the soil classification according to the broad Hydrological Soil Groups have been shown on the individual test hole logs and on the schematic logs. These are primarily based on the indicated soil type, and in some instances (as for till-like soil) on the soil density. The existing water level is indicated, but has not typically been used in the classification proposed.

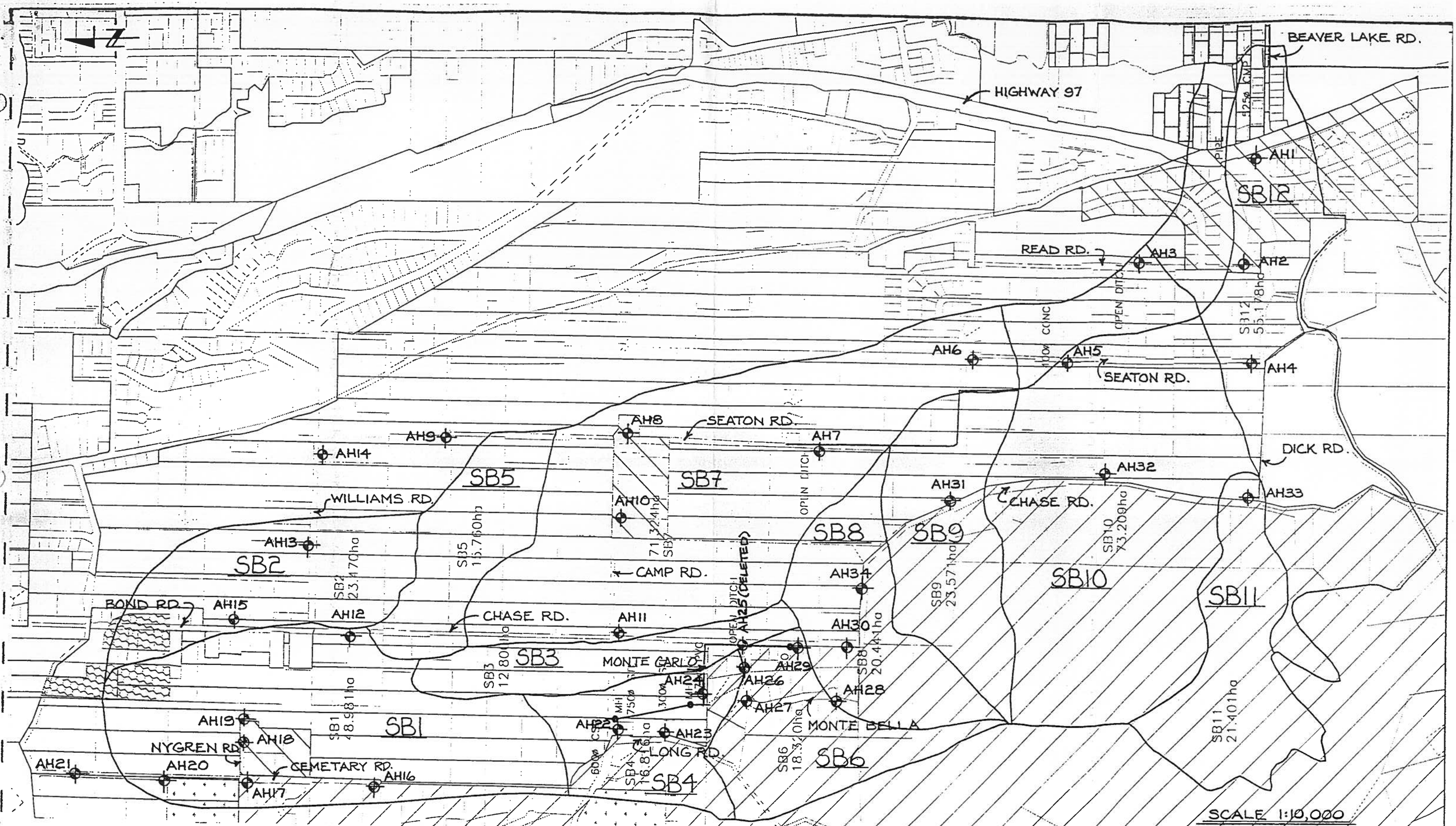
We trust this will assist you. If you have any further questions, please call.

Yours truly,

INTERIOR TESTING SERVICES LTD.

Fiona Sharman, A.Sc.T.

Norman K. Williams, P.Eng.

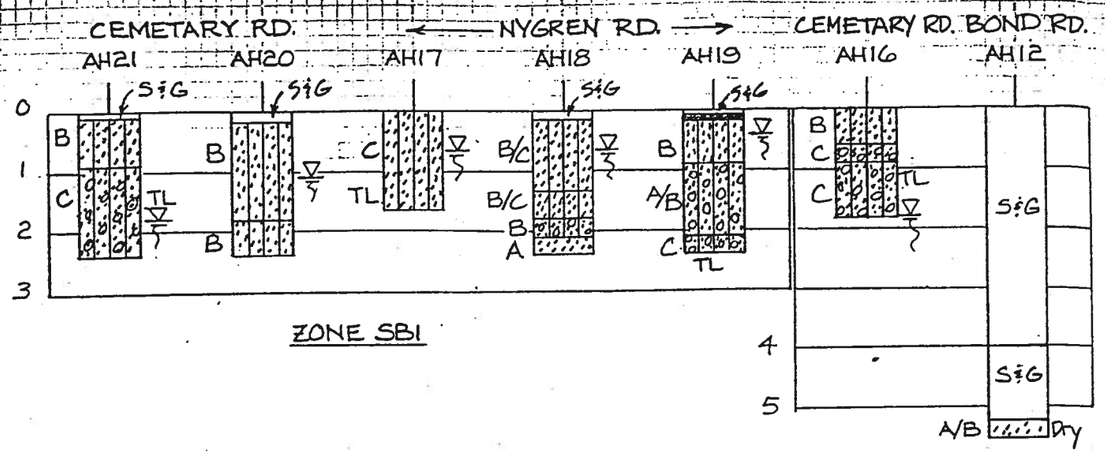


NOTES

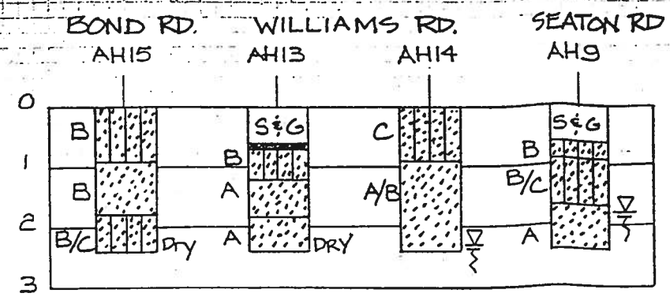
1. FOR SCHEMATIC LOGS REFER TO DWG. NO. 9788-2.
2. REFERENCE PLAN BY ASSOCIATED ENGINEERING, KELOWNA, B.C.

ASSOCIATED ENGINEERING	LOCATION PLAN & SCHEMATIC LOGS	INTERIOR TESTING SERVICES LTD. SOILS – CONCRETE – ASPHALT – FIELD SUPERVISION
KNOPF BROOK BASIN DRAINAGE STUDY LAKE COUNTRY, B.C.		DATE DRILLING: JUN 25,26 JUL 9, 1997 | JOB NO.: 9788
		DATE REPORT: AUGUST 1997 | DWG. NO.: 9788-1

DEPTH BELOW GRADE (m)



ZONE SB1



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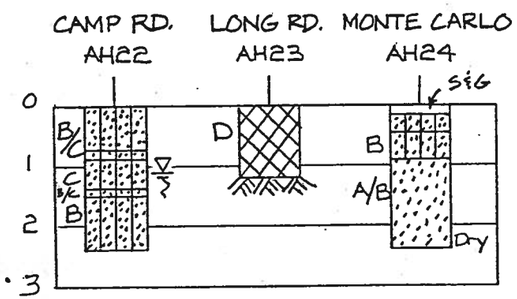

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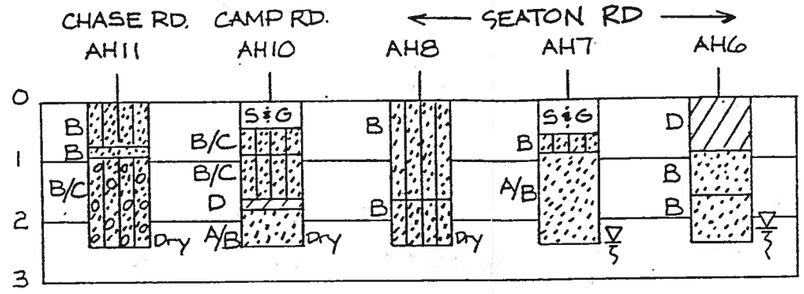

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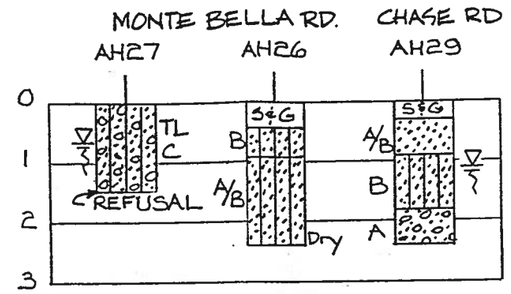

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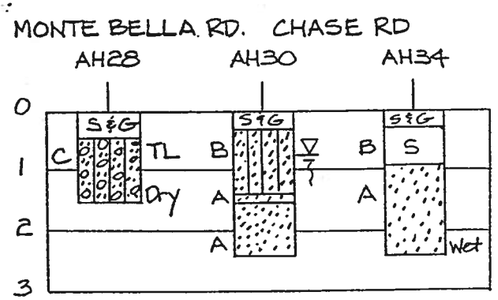

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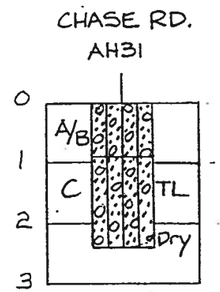

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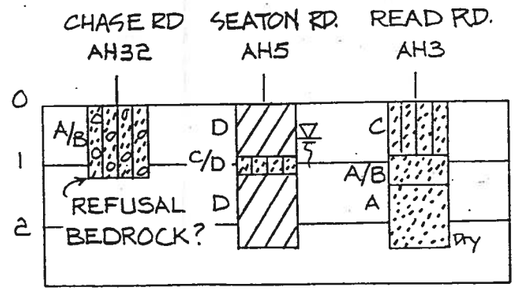

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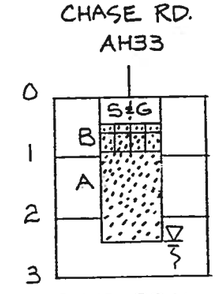

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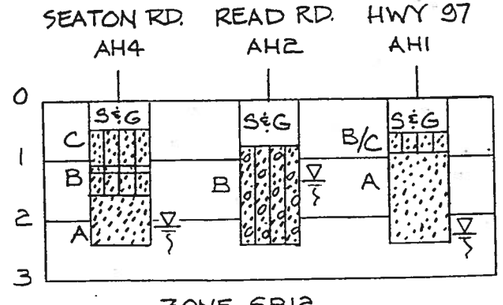

ZONE SB12

VERTICAL SCALE 1:100

LEGEND

- S&G — SAND & GRAVEL FILL (MAY CONTAIN SILT)
- TOPSOIL
- SILT
- SAND
- GRAVEL
- SILT/CLAY
- WEATHERED BEDROCK
- BEDROCK
- TL — TILL-LIKE
- S — SAND FILL

▽ PIEZOMETER READING (JULY 28/97)

A,B,C,D DENOTES HYDROLOGICAL SOIL GROUPS

NOTES

1. FOR AUGER HOLE LOCATIONS REFER TO DWG. NO. 9788-1
2. FOR DETAILED SOIL DESCRIPTIONS REFER TO AUGER HOLE LOGS.
3. FOR HYDROLOGICAL SOIL DESCRIPTIONS REFER TO DWG. NO. 9788-3

ASSOCIATED ENGINEERING	SCHEMATIC LOGS	INTERIOR TESTING SERVICES LTD. SOILS – CONCRETE – ASPHALT – FIELD SUPERVISION
KNOPF BROOK BASIN DRAINAGE STUDY LAKE COUNTRY, B.C.		DATE DRILLING: JUN 25/26 JUL 9, 1997 | JOB NO.: 9788
		DATE REPORT: AUGUST 1997 | DWG. NO.: 9788-2

United States Soil Conservation Services
Hydrological Soil Groups

Group A Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of sands or gravel that are deep and well to excessively drained. These soils have a high rate of water transmission. The soils normally consist of deep fluvial and glacio-fluvial deposits of sands and gravels. These deposits are often interbedded and range from moderately coarse gravels to fine sands, but contain little silt.

Group B Soils having moderate infiltration rates when thoroughly wetted, chiefly moderately deep to deep, moderately well to well drained, with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission. The soils consist of fine sands containing a moderate amount of silt or deposits of Group A materials capped with a relatively shallow layer of silt or silty sand.

Group C Soils having slow infiltration rates when thoroughly wetted, chiefly with a layer that impedes the downward movement of water, or of moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission. The soils usually consist of silt and sandy silt deposits.

Group D Soils having very slow infiltration rates when thoroughly wetted, chiefly clay soils with high swelling potential; soils with a high permanent water table; soils with a clay pan or clay layer at or near the surface; and shallow soils over nearly impervious materials such as bedrock. These soils have a very slow rate of water transmission.

ASSOCIATED ENGINEERING KNOPF BROOK BASIN DRAINAGE STUDY LAKE COUNTRY, B.C.	HYDROLOGICAL SOIL GROUPS	INTERIOR TESTING SERVICES LTD. SOILS - CONCRETE - ASPHALT - FIELD SUPERVISION DATE DRILLING: JOB NO.: 9788 DATE REPORT: AUG. 1997 DWG. NO.: 9788-3

(2612)

TEST HOLE NO. AH-1

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1 NORTHWEST of BEAVER LAKE RD./ HWY 97 INTERSECTION, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.

DATE JUN. 25, 26 & JUL 9, 1997

METHOD MACHINE AUGER

DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			Brown SAND & GRAVEL FILL	
			FILL			
			O	S1	Brown SILT & SAND (Group B/C)	
		19mm Ø Piezometer			Grey & Brown Interlayered C-M-F SAND, some silt (Group A)	1
		▽ July 28/97	O	S2		2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- ☐ DISTURBED SAMPLE
- ▪ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. NO. 9788-4

500-9-65 FORM 3

SCALE:

FILE NO

(SB12)

TEST HOLE NO. AH-2

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1 EAST PAVEMENT EDGE, OPPOSITE DRIVEWAY 9514 READ RD., LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.

DATE JUN. 25, 26 & JUL. 9, 1997

METHOD MACHINE AUGER

DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.				
		19 mm ø Piezo ▽ July 28/97	O	FILL S1	Brown Silty SAND & GRAVEL FILL	
					Brown Silty SAND & GRAVEL & COBBLES, hard drilling (Group B)	1
						2
					Bottom of Hole	
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-5

500-9-65 FORM 2

(SB10)

TEST HOLE NO. AH-3

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
EAST PAVEMENT EDGE, OPPOSITE
9686 READ RD,
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26; JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
6.9 x		Top of Hole Elev.			Brown Sandy SILT to Silty SAND (Group C)	
		19mm ø Piezometer	O	S1		
					Brown Med-Fine SAND, some silt, (Group A/B)	1
			O	S2		
					Brown Med-Fine SAND, fairly clean (Group A)	
		Dry July 28/97	O	S3		2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- ☐ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-6

500-9-65 FORM 7

(SD12)

TEST HOLE No. AH-4

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
WEST SHOULDER of SEATON RD.
3.5 m EAST & 25 m NORTH OF SE
CORNER of PROPERTY LINE of 2728
DICK ROAD, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26; JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			Brown Silty SAND & GRAVEL FILL	
16.5 x				S1	Brown SILT, hard (Group C)	1
14.7 x		(Group B) →		S2	Brown Silty Fine SAND	
				S3	Brown Silty SAND (Group B)	
		19mm Ø Piezometer ▽ July 28/97		S4	Brown to Grey C-M-F SAND, fairly clean (Group A)	2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

FILL

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788 - 7

500-9-65 FORM 3

SCALE:

FILE No

(SB10)

TEST HOLE NO. AH-5

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
4.5m WEST of PAVEMENT EDGE,
SOUTH of 9790 SEATON RD.
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26; JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS (Top of Hole Elev.)	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
26.2 x		19mm Ø Piezometer ▽ July 28/97	○	S1	Brown Silty CLAY/Clayey SILT, hard, occasional very fine sand seams (Group D)	
31.8 x			○	S2	Grey Sandy SILT, trace clay, (Group C/D)	
32.6 x			○	S3	Brown Clayey SILT to Silty CLAY @ depth, firm to hard, (Group D)	2
29.6 x			○	S4		
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
□ DISTURBED SAMPLE
■ UNDISTURBED SAMPLE
L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
○ GRAB SAMPLE

DWG. No. 9788-8

(5D1)

TEST HOLE NO. AH-6

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9783-1 FRONT of 9990 SEATON ROAD, at CORNER LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.

DATE JUN. 25, 26; JUL 9, 1997

METHOD MACHINE AUGER

DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
30.0 ×	19mm ø Piezometer ▽ July 28/97	Top of Hole Elev.	○	51	Brown Silty CLAY / Clayey SILT, hard, some light brown mottling, (Group D)	
			○	52	Brown Fine SAND, some silt, (Group B)	1
			○	53	Brown Medium SAND, some silt (Group B)	2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-9

500-9-65 FORM 3

SCALE:

FILE NO.

(5D1)

TEST HOLE NO. AH-7

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
19 m SOUTH of DRIVEWAY 10275 SEATON RD. & 1m WEST of EDGE of PAVEMENT, LAKE COUNTRY B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 2 - JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

Moisture Content (%) 10 20 30 40 50	Elevation (m)	Remarks	Sample Type	Sample Number	Drilling Log	Depth (m)
		Top of Hole Elev.			Brown SILT, SAND & GRAVEL FILL	
22.0 x	19mm Ø Piezometer		O	S1	Brown Silty SAND to Sandy SILT, (Group B)	1
			O	S2	Brown SAND, some to little silt (Group A/B)	
	▽ July 28/97		O	S3		2
					Bottom of Hole	3
						4
						5
						6
						7

FILL

Unified Soil Classification System

LEGEND:
- □ Disturbed Sample
- ■ Undisturbed Sample
- L.L. Liquid Limit
- P.L. Plastic Limit
- ○ Grab Sample

DWG. No. 9788-10

TEST HOLE NO. AH-8

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1 ROUGHLY 46m SOUTH of ℄ of CAMP ROAD, 7m EAST of PAVEMENT EDGE (SEATON RD) LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.

DATE JUN. 2, ... : JUL 9, 1997

METHOD MACHINE AUGER

DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	SAMPLE TYPE	SAMPLE NUMBER	DRILLING LOG	DEPTH (m)
5.1 X	19mm ø Piezometer	Top of Hole Elev. Dry July 28/97	○	S1	Brown Silty SAND, cleaner past 1500 mm (Group B)	1
			○	S2		
			○	S3	Brown Silty Fine SAND with occasional clean grey sand seams (Group B)	2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. NO. 9788 - 11

500-9-65 FORM 3

SCALE

FILE NO

(DD5)

TEST HOLE NO. AH-9

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
NORTH SIDE of DRIVEWAY 10910
SEATON ROAD
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

Moisture Content (%) 10 20 30 40 50	Elevation (m)	Remarks	Sample Type	Sample Number	Drilling Log	Depth (m)
		Top of Hole Elev.			Brown Silty SAND & GRAVEL FILL	
13.4 x			FILL			
			O	S1	Brown Silty SAND/Sandy SILT, (Group B)	
21.7 x			O	S2	Brown Sandy SILT to SILT past 1500 mm (Group B/C)	1
	19mm Ø Piezometer	▽ July 28/97				
			O	S3	Brown SAND, fairly clean to little silt (Group A)	2
					Bottom of Hole	3
						4
						5
						6
						7

Unified Soil Classification System

LEGEND:
- □ Disturbed Sample
- ■ Undisturbed Sample
- L.L. Liquid Limit
- P.L. Plastic Limit
- ○ Grab Sample

DWG. No. 9788-12

500-9-65 FORM 3

SCALE:

FILE No.

(SB7)

TEST HOLE NO. AH-10

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
SOUTH SIDE of ROAD
NEAR 2525 CAMP ROAD
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26; JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			SAND FILL	
				FILL	SILT, SAND & GRAVEL FILL	
16.2 x			O	S1	Brown Silty SAND/Sandy SILT, (Group B/C)	1
14.6 x			O	S2	Brown Silty Fine SAND/ Sandy SILT, (Group B/C)	
25.9 x		(Group D) →	O	S3	Brown Silty CLAY/Clayey SILT, hard	2
			O	S4	Brown Med-Fine SAND some silt, (Group A/B)	
		19 mm Ø Piezometer Dry July 28/97			Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-13

500-9-65 FORM 3

SCALE

FILE No.

(TD.1)

TEST HOLE NO. AH-11

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
SOUTHEAST CORNER of CHASE & CAMP ROAD
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (M)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (M)
9.2 X		Top of Hole Elev.			Brown Silty SAND/Sandy SILT (Group B)	
		(Group B) →	O	S1	Brown Fine SAND, some silt	
						1
			O	S2	Pinkish Brown Silty SAND & GRAVEL (Group B/C)	
		19mm Ø Piezometer Dry July 28/97	O	S3		2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- ☐ DISTURBED SAMPLE
- ▩ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. NO. 9788-14

500-9-65 FORM 3

SCALE

FILE NO

(501)

TEST HOLE No. AH-12

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
9m WEST of PAVEMENT EDGE,
NORTH of 10910 BOND RD.
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		TOP OF HOLE ELEV.			Brown Silty SAND & GRAVEL, pc's of old tree 900 to 2400 mm	
				S1		1
						2
						3
						4
					Brown Silty SAND & GRAVEL	
				S1A		5
				S2	Brown Fine SAND, some silt. (Group A/B)	
					Bottom of Hole	6
						7

FILL

Possible FILL?

UNIFIED SOIL CLASSIFICATION SYSTEM

19mm Ø Piezometer

Dry July 28/97

LEGEND:
- □ DISTURBED SAMPLE
- ▣ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788 - 15

500-9-65 FORM 3

SCALE

FILE NO

TEST HOLE No. AH-13

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1 WESTERN PORTION of WILLIAMS RD., 0.5 m NORTH of PAVEMENT EDGE, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.

DATE JUN. 25, 26 & JUL. 9, 1997

METHOD MACHINE AUGER

DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			Silty SAND & GRAVEL FILL 100 mm TOPSOIL seam @ 600 mm	
20.9 x		19mm Ø Piezometer Dry (Aug 1/97)	○	S1	Brown Silty Fine SAND/ Sandy SILT (Group B)	1
			○	S2	Brown Fine to Med-Fine SAND (@ depth), some to little silt, (Group A)	
			○	S3	Brown SAND, trace silt, (Group A)	2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

FILL

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-16

TEST HOLE NO. AH-14

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1 EASTERN PORTION of WILLIAMS RD., 2m SOUTH of PAVEMENT EDGE, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.

DATE JUN. _, _ ; JUL 9, 1997

METHOD MACHINE AUGER

DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.				
14.6 X			O	S1	Brown Silty SAND/Sandy SILT (Group C)	
			O	S2	Brown SAND, some silt, some fine gravel @ depth (Group A/B)	1
		19mm Ø Piezometer ▽ Aug 1/97	O	S3		2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-17

500-9-65 FORM 3

SCALE

FILE NO

(J.C.)

TEST HOLE NO. AH-15

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
WEST SIDE of BOND RD.,
OPPOSITE ℄ of 11231 & 11183
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS (Top of Hole Elev.)	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		19 mm Ø Piezometer			Brown Silty Fine SAND some gravel	
			O	S1	(Group B)	
					Brown SAND, some silt, trace gravel	1
			O	S2	(Group B)	
					Pinkish Silty SAND, some gravel	2
			O	S3	(Group B/C)	
		Dry July 28/97			Bottom of Hole	
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788 - 18

500-9-65 FORM 3

SCALE

FILE NO

(SB1)

TEST HOLE NO. AH-16

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
3m WEST of PAVEMENT EDGE
JUST NORTH of DRIVEWAY 11190
CEMETARY RD., LAKE COUNTRY B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.				
11.9 X		19mm Ø Piezometer ▽ Aug 1/97		S1	Brown Silty Fine SAND (Group B)	
		(Group C) →		S2	Brown SILT, SAND, GRAVEL, tillish-like, reddish br. & pink ash seams	
				S3	Brown SILT, SAND, GRAVEL till-like, hard drilling past 1200mm, (Group C)	
					Bottom of Hole	2
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788 - 19

(SB1)

TEST HOLE NO. AH-17

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
28 m SOUTH of ℄ of NYGREN ROAD,
WEST SHOULDER of CEMETARY RD.
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26; JUL. 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.				
7.9 x		▽ AUG. 1/97			Pinkish Grey SILT & SAND, some gravel, till-like, hard drilling past 1200 mm (Group C)	
		19 mm ø Piezometer	O	S1		1
7.4 x			O	S2		
					Bottom of Hole.	2
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
□ DISTURBED SAMPLE
■ UNDISTURBED SAMPLE
L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
○ GRAB SAMPLE

DWG. NO. 9788 - 20

(SB1)

TEST HOLE NO. AH-18

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
28m WEST of E. R of 2061
NYGREN RD & 1m SOUTH of
℄ of ROAD, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS (Top of Hole Elev.)	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
15.6 x	19mm Ø Piezometer	▽ AUG. 1/97			FILL GRAVEL Base	
			O	S1	Brown Silty SAND/ Sandy SILT (Group B/C)	1
23.1 x			O	S2	Brown Silty Fine SAND/ Sandy SILT, (Group B/C)	
		Harder Drilling Past 1800mm →	O	S3	Brown Silty SAND & GRAVEL occ. small cobble (Group B)	2
					Brown Med-Coarse SAND fairly clean (Group A)	
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- O GRAB SAMPLE

DWG. NO. 9788-21

(SB1)

TEST HOLE NO. AH-19

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
33m WEST of ENTRANCE to
2111 NYGREN RD. & 1.5m SOUTH
of ℄ of ROAD, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 2, -- & JUL. 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

Moisture Content (%) 10 20 30 40 50	Elevation (m)	Remarks (Top of Hole Elev.)	Sample Type	Sample Number	Drilling Log (GRAVEL Base ▽)	Depth (m)
		Blk. Org. SILT →			FILL	
		▽ AUG. 1/97			Brown Silty SAND, some grey, wet @ 760 mm (Group B)	
16.8 x			○	S1		
					Grey Silty Coarse SAND & Fine GRAVEL, harder drilling past 1900 mm (Group A/B)	1
13.7 x			○	S2		
						2
14.6 x		(Group C) →	○	S3	Grey SILT, SAND, GRAVEL, till-like, Black patches, Gold specs	
						3
						4
						5
						6
						7

19mm ø Piezometer

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
□ DISTURBED SAMPLE
■ UNDISTURBED SAMPLE
L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
○ GRAB SAMPLE

DWG. No. 9788 - 22

(SB1)

TEST HOLE NO. AH-20

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
28m SOUTH of ENTRANCE to
1374 CEMETARY RD., 3m WEST
of ℄ of ROAD, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			FILL	
		19mm ø Piezometer			GRAVEL BASE	
		▽ Aug 1/97	O	S1	Brown Silty Medium SAND, (Group B)	1
			O	S2		
						2
			O	S3	Brown & Grey Silty Med-Fine to Fine SAND (Group B)	
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- ☐ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. NO. 9788-23

(SB1)

TEST HOLE NO. AH-21

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1 FRONT of ENTRANCE to 11524 CEMETARY RD., 2.5 m EAST of ℄ of ROAD, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.

DATE JUN. 25, 26 & JUL. 9, 1997

METHOD MACHINE AUGER

DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	SAMPLE TYPE	SAMPLE NUMBER	DRILLING LOG	DEPTH (m)
		TOP OF HOLE ELEV.			Road Base GRAVEL	
		19mm ø Piezometer ▽ July 28/97	○	S1	Brown Silty SAND (Group B)	
						1
			○	S2	Brownish Grey SILT, SAND & GRAVEL, till-like, hard drilling past 1200 mm (Group C)	
						2
			○	S3		
					Bottom of Hole	
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-24

(SB4)

TEST HOLE NO. AH-22

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
68m EAST of LONG RD. & 7m
SOUTH of ℄ of CAMP RD.
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	SAMPLE TYPE	SAMPLE NUMBER	DRILLING LOG	DEPTH (m)
22.2 x	19mm ø Piezometer	Top of Hole Elev.			TOPSOIL	
			O	S1	Brown Interlayered Silty SAND & Sandy SILT, (Group B/C)	
x 39.8		(Group B/C) →	O	S2	Lt Grey Silty SAND/Sandy SILT	1
x 38.0		▽ JULY 28/97	O	S3	Lt. Grey Sandy SILT & Volcanic ASH, (Group C)	
x 28.6		(Group B/C) →	O	S4	Gr. Silty Fine SAND/Sandy SILT	
25.6 x			O	S5	Rusty Brown Silty Medium SAND (to med-fine) (Group B)	2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
□ DISTURBED SAMPLE
■ UNDISTURBED SAMPLE
L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
○ GRAB SAMPLE

DWG. NO. 9788-25

500-9-65 FORM 2

(SB4)

TEST HOLE NO. AH-23

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
34m SOUTH of ENTRANCE to
10558 LONG RD. & 6m EAST of
℄ of RD. LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			Weathered BEDROCK (Group D)	1
		Refusal → BEDROCK			Bottom of Hole	2
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- ☐ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-26

(SB4)

TEST HOLE NO. AH-24

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
1m WEST of EAST ℄ of 2163
MONTE CARLO ROAD & 1m NORTH
of ℄ of ROAD, LAKE COUNTRY
B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 2 - JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			FILL	
					ROAD BASE GRAVEL	
					Dark Brown Sandy SILT/ Silty SAND (Old Topsoil?)	
			O	S1	Brown Silty SAND (Group B)	
						1
			O	S2	Brown Medium to Fine SAND, some silt, trace coarse sand (Group A/B)	
						2
			O	S3		
		19mm Ø Piezometer Dry July 28/97			Bottom of Hole	
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ▣ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788 - 27

(SB6)

TEST HOLE NO. AH-26

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1 NORTH SHOULDER of ROAD FRONT of 10470 MONTEBELLA ROAD, LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.

DATE JUN. 25, 26; JUL 9, 1997

METHOD MACHINE AUGER

DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS (Top of Hole Elev.)	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
					SAND & GRAVEL Road Base	
7.4 X		19mm Ø Piezometer Dry July 28/97	O	S1	Brown Silty SAND/Sandy SILT (Group B)	1
			O	S2	Brown Silty SAND (Group A/B)	2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- ☐ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. NO. 9788-28

(SB6)

TEST HOLE NO. AH-27

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
22 m SOUTH of 10410 MONTE BELLA ROAD, WEST SHOULDER
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL. 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
	19mm Piezometer	▽ July 28/97	O	S1	Brown Silty SAND & GRAVEL, till-like, hard drilling (Group C)	1
		Refusal →	O	S2	Bottom of Hole	2
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
□ DISTURBED SAMPLE
■ UNDISTURBED SAMPLE
L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
○ GRAB SAMPLE

DWG. NO. 9788-29

(SB8)

TEST HOLE NO. AH-28

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
SW SIDE of CUL-DE-SAC,
3m WEST of PAVEMENT, NEAR
10250 MONTEBELLA ROAD
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (M)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (M)
8.8 x	19mm Ø Piezo	Top of Hole Elev.			Brown Silty SAND & GRAVEL FILL	
			FILL			
7.9 x		Dry July 28/97	O	S1	Light Grey SILT, SAND & GRAVEL, till-like (Group C)	1
		Refusal →	O	S2		
					Bottom of Hole	2
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ▩ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-30

(SB6)

TEST HOLE NO. AH-29

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
WEST SIDE of ROAD, BETWEEN
10282 & 10330 CHASE RD.
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL. 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			Brown SAND & GRAVEL	
16.9 X					Brown Medium SAND, some silt, trace gravel @ 700m. (Group A/B)	
17.3 X		▽ Aug. 1/97		S1		1
		19mm Ø Piezometer		S2	Brown Silty SAND (Group B)	
				S3	Brown Coarse SAND & Fine GRAVEL, some silt (Group A)	2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
□ DISTURBED SAMPLE
■ UNDISTURBED SAMPLE
L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
○ GRAB SAMPLE

DWG. No. 9788-31

(SB8)

TEST HOLE NO. AH-30

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
WEST SHOULDER, FRONT OF
DRIVEWAY 10250 CHASE ROAD
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 2 - JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			FILL	SAND & GRAVEL FILL
	19mm ø Piezometer	▽ AUG. 1/97	O	S1	Brown Silty SAND, trace gravel (Group B)	1
		(Group A) →			Brown C-M-F SAND, fairly clean	
					Brown Med-Fine SAND, some silt (Group A)	2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
□ DISTURBED SAMPLE
■ UNDISTURBED SAMPLE
L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
○ GRAB SAMPLE

DWG. NO. 9788 - 32

(SB9)

TEST HOLE NO. AH-31

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
EAST SHOULDER of CHASE ROAD
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			Brown Silty SAND & GRAVEL (Boulder near surface) (Group A/B)	
					Grey SILT, SAND & GRAVEL, till-like, hard drilling past 1500 mm (Group C)	1
8.7 X		19mm Ø Piezometer Dry July 28/97	O	S1		2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. NO. 9788-33

(SB10)

TEST HOLE NO. AH-32

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
EAST SHOULDER, 68 m SOUTH
of 9751 CHASE ROAD
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 2; ; JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			Brown Silty SAND & GRAVEL, some cobble, hard drilling @ 900 mm (Group A/B)	1
		Refusal → BEDROCK?			Bottom of Hole	2
						3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- ☐ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. NO. 9788-34

(SB11)

TEST HOLE NO. AH-33

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
60m SOUTH of 9614 CHASE ROAD, EAST SHOULDER
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26 & JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
15.3 ×	19 mm ø Piezometer	(Group B) →	O	S1	FILL: Brown Silty SAND & GRAVEL	
					Brown Silty SAND, (Group B)	
					Brown Silty Med-Fine SAND	
					Brown SAND, trace sand, trace gravel (Group A)	2
		▽ July 28/97			Bottom of Hole	3 4 5 6 7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- □ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-35

500-9-65 FORM

(SB8)

TEST HOLE NO. AH-34

INTERIOR TESTING SERVICES LTD.

LOG OF TEST BORING

LOCATION SEE DWG. NO. 9788-1
NORTH SIDE of ROAD, EAST of
10151 CHASE ROAD,
LAKE COUNTRY, B.C.

PROJECT KNOPF BROOK BASIN
DRAINAGE STUDY, WINFIELD, B.C.
DATE JUN. 25, 26; JUL 9, 1997
METHOD MACHINE AUGER
DRILLER SANDWELL GEOLOGICAL

MOISTURE CONTENT (%) 10 20 30 40 50	ELEVATION (m)	REMARKS	Sample Type	Sample Number	DRILLING LOG	DEPTH (m)
		Top of Hole Elev.			SAND & GRAVEL FILL	
8.4 x			FILL?	S1	Brown Silty SAND, charcoal bits @ 700mm, Old FILL? (Group B)	
8.1 x		19mm Ø Piezometer Wet. July 28/97		S2	Brown Medium to Fine (@ depth) SAND, some silt (Group A)	1
						2
					Bottom of Hole	3
						4
						5
						6
						7

UNIFIED SOIL CLASSIFICATION SYSTEM

LEGEND:
- ☐ DISTURBED SAMPLE
- ■ UNDISTURBED SAMPLE
- L.L. LIQUID LIMIT
- P.L. PLASTIC LIMIT
- ○ GRAB SAMPLE

DWG. No. 9788-36