Deloitte & Touche

1999 Annual Inspection Waste and Water Management Facilities Vangorda Mine Yukon Territory

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Consulting Engineers

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1999 ANNUAL INSPECTION
WASTE AND WATER MANAGEMENT FACILITIES
VANGORDA MINE
YUKON TERRITORIES

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1. Introduction

At the request of Deloitte and Touche Inc. (DTI) Mr. Peter Healey of Steffen Robertson and Kirsten (Canada) Inc. (SRK) completed an inspection of the waste and water management facilities at Vangorda Plateau Mine on June 14 and 15, 1999. The Vangorda mine is located 16 km south of the Faro Mine, Yukon Territory as shown on Figure 1. The purpose of this inspection was to evaluate the geotechnical performance and stability of the following structures:

- Vangorda Waste Rock Containment Facility (Photos 1 and 2) including the seepage collection system ;
- Little Creek Dam;
- Vangorda Creek Diversion;
- Sludge Pond Embankments at the Water Treatment Plant,
- Grum Waste Rock Piles;
- The Grum Interceptor Ditch; and
- The Sheep Pad Sediment Ponds below the Overburden Stockpile.

A plan of the Vangorda Plateau area and the above components are shown in Figure 2.

This report presents our observations and comments on the performance and stability of the structures and provides recommendations, where appropriate.

2. Vangorda Waste Rock Pile

2.1 Observations

2.1.1 Seepage Collection System

2.2.1.1 Channel Berm

At the outlet of the seepage channel and at the south abutment of the Little Creek Dam, a small depression still exists which provides the opportunity for ponding of water. The remaining sections of the dyke show no signs of settlement, cracking or sloughing.

2.2.1.2 Transverse Drains and Weirs

During construction of the original till berm, six transverse drains were installed beneath the berm to allow seepage to drain from the waste dump. These drains were connected to the seepage collection channel during the 1994 upgrading.

During the inspection, small amounts of seepage were observed in Drains 3 (Photo 6), 5 (Photo 3) and 6 (Photo 5) only. Weir 6 remains silted up and the erosion gully in the till starter dyke behind the drain continues to provide further opportunity for silt build up behind the weir and instability of the dyke. Ice was observed in behind the drain at the toe of the dyke (Photo 4).

2.2.1.3 Seepage Channel

No instability of the sideslopes of the seepage channel was observed. Seepage from the transverse drains at Weir 3 is entering the channel and a measurable amount of flow was observed in the lower reaches of the channel as shown on Photo 7.

2.2.2 Starter Dyke and Till Cover

The sideslopes of the till starter dyke remain susceptible to erosion. There is one area that is particularly eroded (Photo 21). This area lies just below the 1994 resloping and till cover placement. Runoff concentrates in-between the till cover and the resloped rock causing erosion gullies and silt spill into the seepage channel at the toe of the dyke.

Adjacent to Weir 3, till was removed from the toe of the starter dyke in 1992 by the mine to construct an adjacent sump. This remains a potential risk to the stability of the dyke with the possible loss of the piezometers above (P94-01A and 01B). Erosion gullies that have formed below P94-3A and 3B pose a threat to these piezometers also.

2.2.4 Instrumentation

DTI has been taking water level readings from the nine piezometers and four of the five groundwater wells around and within the facility. A summary of the water level readings taken to date in both the piezometers and the groundwater wells is presented in Table 1. Water levels, as recorded on October 12, 1999 in Piezometers P94-01A, 01B, 02A and 02B, are shown in Figures 3 and 4. A plot of the historical readings for these piezometers is shown on Figure 5. The water levels in the piezometers continue to remain generally static with minor fluctuations. Figure 6 presents a plot of the levels in the groundwater wells around the dump.

2.2.5 Rock Pile

Tension cracks are still evident in places along the crest at the northeast end of the dump. The cracks have not widened since SRK last inspected the rock pile in 1998.

TABLE 1: VANGORDA ROCK DUMP PIEZOMETERS - STATIC WATER LEVELS AND PIEZOMETRIC ELEVATIONS

Measured Static Water Level (meters)

readings in red underlined or in *italics* (begin in 1998) indicate that no water was identified (hole was dry or frozen).
readings post Sep/98 given as metres below top of plastic piezometer pipe.
readings prior to Nov/98 could be metres below to top of piezo. pipe or steel casing.

Date	V34 GW-94-01	V35 GW-94-02	V36 GW-94-03	V37 GW-94-04	V38 GW-94-05*	V39 P-94-01A	V40 P-94-01B	V41 P-94-02A	V42 P-94-02B	V43 P-94-02C	V44 P-94-03A	V45 P-94-03B	V46 P-94-04A	V47 P-94-04B
3-May-94	8.28	14.33	11.28	14.33	11.56	12.37	6.05	10.57	6.12	13.08	14.10	9.80	12.17	8.99
21-Jun-94	7.45	8.65	9.15	9.65										
30-Jun-95						7.79	5.62	8.02	6.11	9.02	13.91	9.80	11.35	8.99
13-Jul-95						7.80	5.59							
30-Jul-95						7.86	5.48	7.99	6.12	8.81	13.68	9.80	11.83	8.99
26-Aug-95	6.89	8.47		9.05										
31-Aug-95	7.36					7.93	4.85	7.97	6.06	8.66	13.62		12.60	
17-Oct-95	7.14	8.26		9.37		7.90	4.23	8.70	5.76	8.54	13.41		11.88	
20-Nov-95	7.10	8.18		9.19										
13-Mar-96	7.44	9.23		9.39										
28-May-96	7.50	9.34	10.00	10.25		8.34	5.38	9.94	6.12	9.37	14.12		12.77	
24-Sep-96	7.50	7.43	7.95	9.17		10.40	5.30	8.30	6.12	8.66	13.68	9.88	12.80	8.99
13-May-97	6.84	9.42	9.96	9.53		9.17	5.67	7.74	6.40	9.51	12.78	9.96	12.78	9.62
11-Jul-97						9.80	5.90	7.92	6.12	8.97	14.10	9.80	9.97	9.00
11-Aug-97	6.75	8.38	8.41	8.81	1.99	9.59	5.25	8.10	6.25	8.77	12.84	9.96	12.62	9.21
14-Oct-97	6.76	8.58	9.15	8.99		9.51	4.96	7.99	6.23	8.94	12.96	9.96	12.73	9.21
23-Dec-97	6.70	9.05	9.53	9.13		9.25	4.76	7.68	6.07	8.95	12.70	9.81	12.66	9.02
31-May-98	6.72	8.60	9.73	9.59	1.86	9.52	*5.25*	8.05	*6.24*	9.20	*12.87*	9.95	12.77	9.20
25-Jul-98						10.20	*5.22*	8.04	*6.20*	9.11	*12.58*	*9.92*	12.79	*9.18*
15-Sep-98	6.67	8.85	9.52	9.10	2.40	10.02	*5.22*	7.98	*6.20*	9.22	*12.54*	*9.92*	12.83	*9.19*
16-Nov-98						10.32	*5.11*	7.93	*6.11*	9.06	*12.45*	*9.78*	*12.70*	*8.99*
31-Dec-98	6.70	9.06	9.91	9.23										
18-Jun-99	6.88	9.24	10.24	10.18		9.96	*5.09*	8.35	*6.11*	9.48	*12.48*	*9.77*	*12.70*	*8.99*
12-Oct-99	6.61	7.58	8.81	8.79		10.01	*5.10*	8.16	5.73	8.82	*12.49*	*9.78*	*12.71*	8.97

*: depth to bottom of hole GW-94-05 (V38) checked as 14.7m on Sep 15/98.

Top of Pipe Elevations (masl)

V34 GW-94-01	V35 GW-94-02	V36 GW-94-03	V37 GW-94-04	V38 GW-94-05	V39 P-94-01A	V40 P-94-01B	V41 P-94-02A	V42 P-94-02B	V43 P-94-02C	V44 P-94-03A	V45 P-94-03B	V46 P-94-04A	V47 P-94-04B
1117.445	1117.405	1118.431	1116.165	1101.673	1136.555	1136.493	1138.41	1138.332	1129.84	1134.373	1134.459	1134.609	1134.327

Piezometric Elevation (masl)

Date	V34 GW-94-01	V35 GW-94-02	V36 GW-94-03	V37 GW-94-04	V38 GW-94-05	V39 P-94-01A	V40 P-94-01B	V41 P-94-02A	V42 P-94-02B	V43 P-94-02C	V44 P-94-03A	V45 P-94-03B	V46 P-94-04A	V47 P-94-04B
3-May-94	1109.165	1103.075	1107.151	1101.835	1090.113	1124.185	1130.443	1127.84	1132.212	1116.76	1120.273	1124.659	1122.439	1125.337
21-Jun-94	1109.995	1108.755	1109.281	1106.515										
30-Jun-95						1128.765	1130.873	1130.39	1132.222	1120.82	1120.463	1124.659	1123.259	1125.337
13-Jul-95						1128.755	1130.903							
30-Jul-95						1128.695	1131.013	1130.42	1132.212	1121.03	1120.693	1124.659	1122.779	1125.337
26-Aug-95	1110.555	1108.935		1107.115										
31-Aug-95	1110.085					1128.625	1131.643	1130.44	1132.272	1121.18	1120.753		1122.009	
17-Oct-95	1110.305	1109.145		1106.795		1128.655	1132.263	1129.71	1132.572	1121.3	1120.963		1122.729	
20-Nov-95	1110.345	1109.225		1106.975										
13-Mar-96	1110.005	1108.175		1106.775										
28-May-96	1109.945	1108.065	1108.431	1105.915		1128.215	1131.113	1128.47	1132.212	1120.47	1120.253		1121.839	
24-Sep-96	1109.945	1109.975	1110.481	1106.995		1126.155	1131.193	1130.11	1132.212	1121.18	1120.693	1124.579	1121.809	1125.337
13-May-97	1110.605	1107.99	1108.476	1106.635		1127.385	1130.823	1130.67	1131.932	1120.33	1121.593	1124.499	1121.829	1124.707
11-Jul-97						1126.755	1130.593	1130.49	1132.212	1120.87	1120.273	1124.659	1124.639	1125.327
11-Aug-97	1110.695	1109.025	1110.021	1107.355	1099.683	1126.965	1131.243	1130.31	1132.082	1121.07	1121.533	1124.499	1121.989	1125.117
14-Oct-97	1110.685	1108.825	1109.281	1107.175		1127.045	1131.533	1130.42	1132.102	1120.9	1121.413	1124.499	1121.879	1125.117
23-Dec-97	1110.745	1108.355	1108.901	1107.035		1127.305	1131.733	1130.73	1132.262	1120.89	1121.673	1124.649	1121.949	1125.307
31-May-98	1110.725	1108.805	1108.701	1106.575	1099.813	1127.035	*1131.243*	1130.36	*1132.092*	1120.64	*1121.503*	1124.509	1121.839	1125.127
25-Jul-98						1126.355	*1131.273*	1130.37	*1132.132*	1120.73	*1121.793*	1124.539	1121.819	*1125.147*
15-Sep-98	1110.775	1108.555	1108.911	1107.065	1099.273	1126.535	*1131.273*	1130.43	*1132.132*	1120.62	*1121.833*	1124.539	1121.779	*1125.137*
16-Nov-98						1126.235	*1131.383*	1130.48	*1132.222*	1120.78	*1121.923*	1124.679	*1121.909*	*1125.337*
31-Dec-98	1110.745	1108.345	1108.521	1106.935										
18-Jun-99	1110.565	1108.165	1108.191	1105.985		1126.595	*1131.403*	1130.06	*1132.222*	1120.36	*1121.893*	*1124.689*	*1121.909*	*1125.337*
12-Oct-99	1110.835	1109.825	1109.621	1107.375		1126.545	*1131.393*	1130.25	1132.602	1121.02	*1121.883*	*1124.679*	*1121.899*	1125.357

2.3 Recommendations

2.3.1 Seepage Collection Channel

2.3.1.1 Channel Berm

SRK recommends that DTI backfill the depression at the south abutment of Little Creek Dam with locally available till and compact with several passes of a dozer. Monthly monitoring of the area should be conducted for any signs of further settlement.

2.3.1.2 Transverse Drain and Weirs

To minimise the erosion and silt build-up in Weir 6, DTI should divert the runoff from the road above, away from the weir. DTI should also remove the silt in the area behind the weir and remove the loose material from the face of the drain to expose the granular filter material in the underdrain. SRK understands that some of this work was carried out in the fall of 1999.

2.3.2 Till Covers and Berms

In the upper reaches of the seepage collection channel below the till cover, DTI should remove any silt that has accumulated in the channel. When the next phase of till cover is placed, this area would be recontoured and the sediment problem would be reduced. In the meantime, DTI should continue to monitor the silt build-up and periodically remove the material.

DTI should also place backfill up against the toe of the starter dyke adjacent to Weir 3, where material has been removed.

2.3.3 Instrumentation

Water level readings should continue to be taken from both the groundwater wells and the standpipe piezometers in the till berm around the rock pile. These readings should be taken at least semi-annually with close attention given to the water levels in P94-01A and B, and P94-02A, 02B and 02C.

Water quality samples should continue to be taken from the groundwater wells around the Vangorda Waste dump.

2.3.4 Rock pile

DTI should continue to regularly monitor the cracks observed on the surface of the rock fill. Any widening of these cracks should be reported.

3. Little Creek Dam

3.1 Observations

A view of the dam and the new emergency spillway are shown on Photos (8 and 9). Runoff from the eastern approach road (Photo 11) continues to cause erosion of the road embankment sideslopes. Two erosion gullies (photo 13), which are in places 1m deep, are located on the upstream face of the approach road. Runoff from the road flows through the two gullies and over the sideslopes. These gullies pose no immediate threat to the stability of the dam itself but if allowed to go unchecked could result in loss of a section of the road.

Water level in the pond during our inspection was recorded at about 1110.5m (Photo 10). The mine periodically pumps water from the pond to Vangorda Pit. However, at the time of our inspection no water was being pumped from the pond. Small erosion gullies were observed along the upstream face (Photo 12) of the dam resulting from runoff from the crest. No cracks or major settlement of the dam were observed and there was no noticeable seepage along the toe.

The downstream face of the dam (Photo 14) shows little evidence of surficial movement, bulging or instability. The loose, uncompacted material at the toe of the dam, which was deposited during it's construction in 1991, has not moved but does shows signs of erosion.

The new spillway culvert in Little Creek dam (photos 15 and 16) was also inspected during the site visit. It was noted that the upstream entrance to the culvert (photo 15) required more riprap around the pipe. Following the site visit, DTI added more riprap around the inlet of the pipe as shown in photo 16.

The outlet end of the culvert (Photo 17 and 18) was constructed in such a way that in the event of a discharge, the projected path of the flow would impact the riprapped side of the plunge pool rather than the pool itself. Although the riprap is considerably larger where the discharge would impact than the riprap on the remaining sides of the pool, SRK has recommended that a flume be added to the end of the pipe to convey any flow directly to the pool area. This work was carried out in September 1999 as shown on Photos 19 and 20.

The riprap in the plunge pool and the upper reaches of the exit chute meets design criteria. However, more work is required in the lower reaches of the exit chute to provide adequate channel depth, freeboard and erosion protection for the 200-year flood event. SRK understand that this work was also carried out in September ,1999.

In 1994, six pneumatic piezometers and three thermistors were installed along the crest of the Little Creek dam. The six piezometers are located at three separate locations; two piezometers, one deep and one shallow, at each location. The location of the piezometers and thermistors are shown on Figure 7 and the most recent 1999 piezometric levels are shown in section on Figures 8 and 9. Actual readings are presented in Appendix B.

During the inspection, no seepage was observed at along the toe of the downstream dam.

3.2 Recommendations

The mine should continue to regularly monitor the crest of the dam for any cracks, settlement or surficial movement of the slope.

The piezometric levels are consistent with the water levels recorded in the impoundment and are in accordance with the design safety factors associated with the stability of the dam. The thermistor readings are also consistent.

SRK recommends that the pneumatic piezometers and thermistors are monitored on a semi-annual basis and the results compiled and forwarded to SRK.

It is recommended that the runoff from the approach road be directed into a CMP culvert constructed in the road, which would feed into a half-round culvert section installed down the upstream fare of the approach road. Furthermore, the road surface should be regraded to encourage drainage off the crest and a 150mm layer of 20mm minus sand and gravel should be placed and compacted on the crest.

4. Vangorda Creek Diversion

4.1 Observations

The potential still remains for slide debris to enter the flume at certain locations along the channel. SRK understands that a slide occurred in June, 1999, which damaged several sections of the flume, forcing flow to discharge into the overflow section of the channel. DTI removed the slide debris and damaged sections and reconstructed the flume section.

The half-round culvert in the upper reaches has performed well but the flume does not weather well along the lower reaches. The crossbars are badly bent and the flume is buckled in places. In several areas along the flume, riprap has settled to below the lip of the culvert (Photo 23).

Riprap around the entrance to the culvert at the headwork's of the Vangorda diversion has dropped away exposing the underlying geotextile (Photo 22). This situation is not new and has been noted on previous inspections. Furthermore, riprap has begun to collect in the channel and around the trash rack at the inlet to the CMP narrowing the entrance. The pipe itself appears to be sound.

There are no signs of instability or settlement of the headwork's dam.

The plunge pool (photo 24 and 25) at the outlet of the flume has lost some of the original riprap that had been placed on the sideslopes of the basin. Furthermore, where an area of the pool was excavated to allow water trucks to be filled, the water is slowly undermining the bank. The issue of the capacity of the system to accommodate peak flows with the addition of flow from Sheep Pad Settling pond, remains a concern.

4.2 Recommendations

DTI should place additional riprap over exposed geotextile at the headworks and continue to monitor the sideslopes above the flume for sloughing. SRK also recommends that a more complete evaluation of the stability of the rock face above the flume be carried out.

We also recommend that a hydrological evaluation be carried out of the Plunge pool.

The riprap along flume where the material has settled below the rim of the culvert sections should be topped up and additional riprap should be placed in the excavated pool at the southeast corner of the plunge pool. Additional riprap should also be placed on the sideslopes around the perimeter of the pool. Where fresh soil is exposed non-woven geotextile filter fabric should be placed prior to laying down the rock.

5. Sludge Pond Embankment-Vangorda Water Treatment Plant

5.1 Observations

At the time of our inspection, the water level in the sludge pond was about 6 m below the crest of the dyke and the outlet pipe at the south end of the pond was exposed (Photo 26). At the north end of the pond, dry sludge has covered over the inlet pipe to the pond. The tension cracks along the inside face of the pond and along the crest of the dyke have narrowed since the last inspection. Although there is still evidence of previous settlement and minor sloughing of the downstream slope in the southwest corner of the pond, there are no signs of recent movement. Vegetation on the downstream slope is providing some stability to the face.

During the inspection no water treatment was in progress.

5.2 Recommendations

The following actions should be taken at the Water Treatment Plant:

- Ensure that the pond level does not exceed 2m. below crest;
- Continue to monitor on a monthly basis, the crest and sideslopes for cracking or any signs of sloughing. With the pond level at an all time low, the risk of any instability is quite small.
- Fill in or blade over tension cracks both in the crest and along the upstream face to prevent entry from runoff and precipitation.
- Weekly inspection of the upstream face and the crest for further development of the cracks is recommended.

6. Grum Settling Pond

6.1 Observations

At the time of our inspection the water level in the pond was about 3m below the crest of the dyke (Photo 27) and the downstream sideslopes showed no signs of any recent movement. No significant cracks were observed in the crest.

There was no seepage noted along the toe of the dyke.

The pipe arrangement in the northwest corner of the pond is disorganised.

6.2 Recommendations

The crest of the embankment should be monitored monthly for cracks and the pond level should not exceed 1.0 m below crest. Seepage into and out of the pond should also be monitored.

Runoff control using berms or diversion ditches should also be adopted to reduce erosion of the slopes.

Regular monitoring along the toe of the embankment for seepage is recommended.

The need for the pond should be reviewed and the piping arrangement in the northwest corner should be evaluated.

7. Grum Interceptor Ditch and Sheep Pad Settling Pond

7.1 Observations

In the upper reaches of the GID, the slopes have performed well and the vegetation is providing effective erosion control of the sideslopes (Photo 28). Inlets and outlets of some of the culverts are silted up and require cleaning. Below the treatment plant, however, there are sections of the ditch where the grade steepens and the sideslopes have subsided narrowing the channel (photo 29 and 30). This subsidence results in an increase in the sediment load reporting to the Sheep Pad ponds. No riprap has been placed on the sideslopes in this area. During the inspection it was noted that the culvert that conveys flow from the GID into the sediment ponds has been damaged and the road fill above the culvert is badly eroded. However, in September 1999 DTI removed the road and the culvert (Photo 30).

The channel below the sediment pond and the energy dissipators along the channel are functioning satisfactorily.

At the bottom of the outlet channel from the ponds there are two sediment collection ponds, which intercept suspended matter prior to discharge into the Vangorda plunge pool. The upper pond is full of sediment and the lower pond is about half full.

7.2 Recommendations

The following actions are recommended:

- Place riprap (shotrock) around inlets and outlets of all culverts where applicable to prevent erosion and sediment build-up. Geotextile should be placed against the exposed soil prior to placing the riprap;
- Monitor for tension cracks in the settling pond dykes, on the crest and on the upstream and downstream slopes;
- Monitor for seeps that develop along the toe of the dykes;
- Clean out the fine material in the two small sediment ponds at the base of the channel.

This Report, **1CD003.02 - 1999 Annual Inspection Waste and Water Management Facilities Vangorda Mine, Yukon Territories** has been prepared by:

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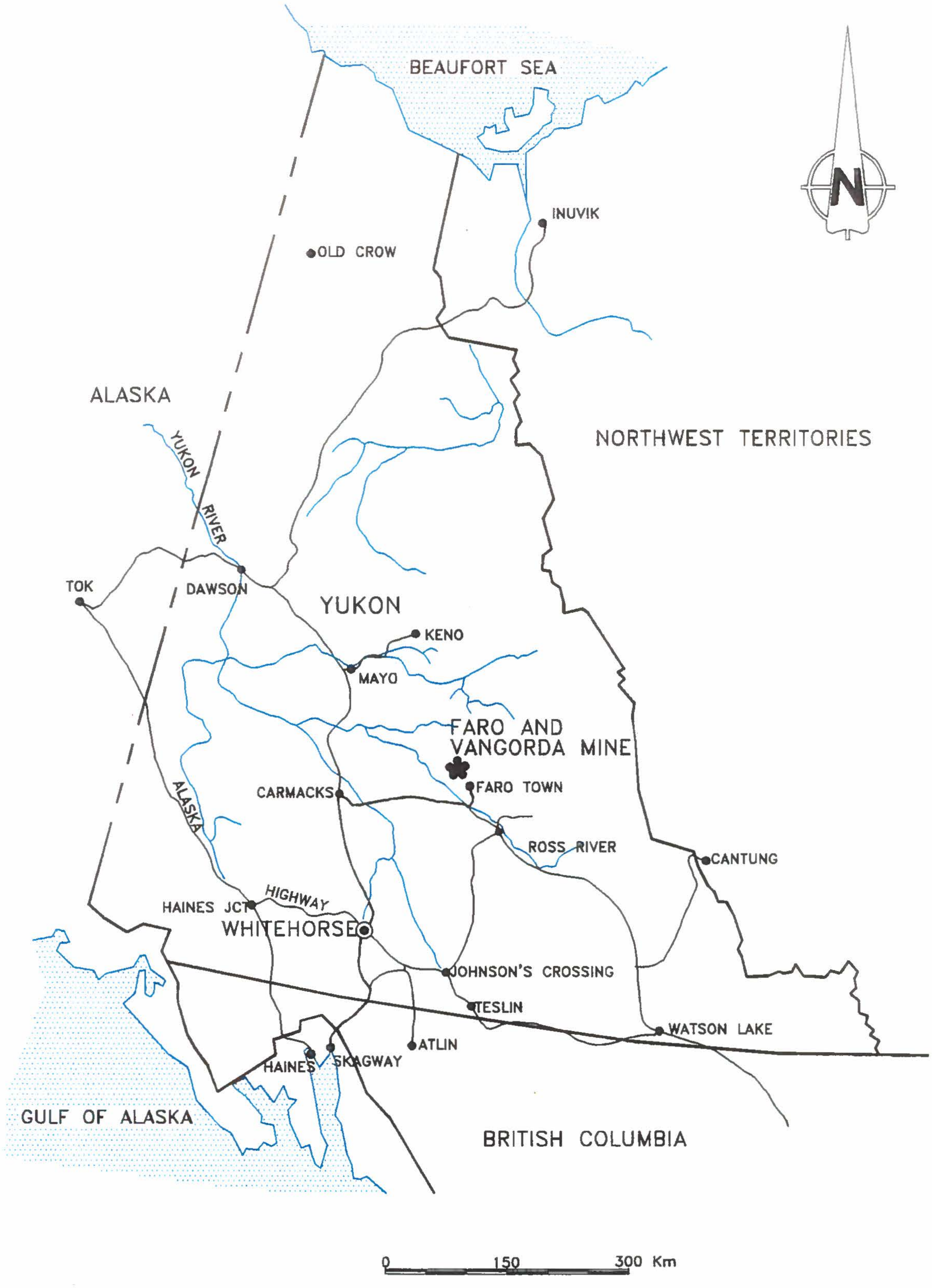
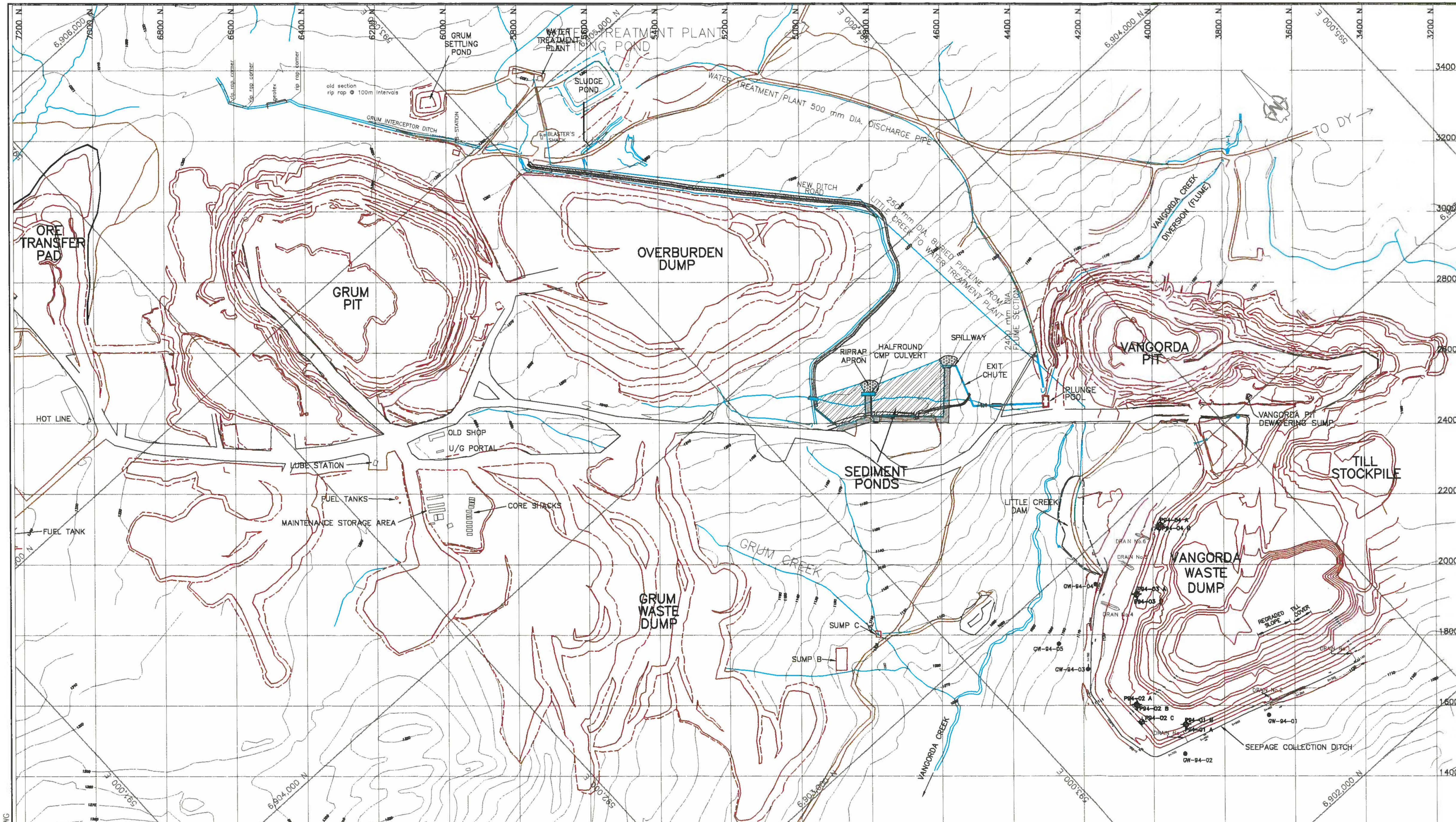
Figures



SRK CONSULTING Consulting Engineers	VANGORDA PLATEAU MINE		
	LOCATION MAP		
DELOITTE & TOUCHE LTD.	PROJECT NO. 1CA003.02	DATE DEC. 1999	APPROVED	FIGURE 1

FILE REF: YUKON



NOTES:
1. TOPOGRAPHIC MAP PROVIDED BY ANVIL RANGE MINING CORPORATION

0 50 100 150 200 250 Metres
1:10000

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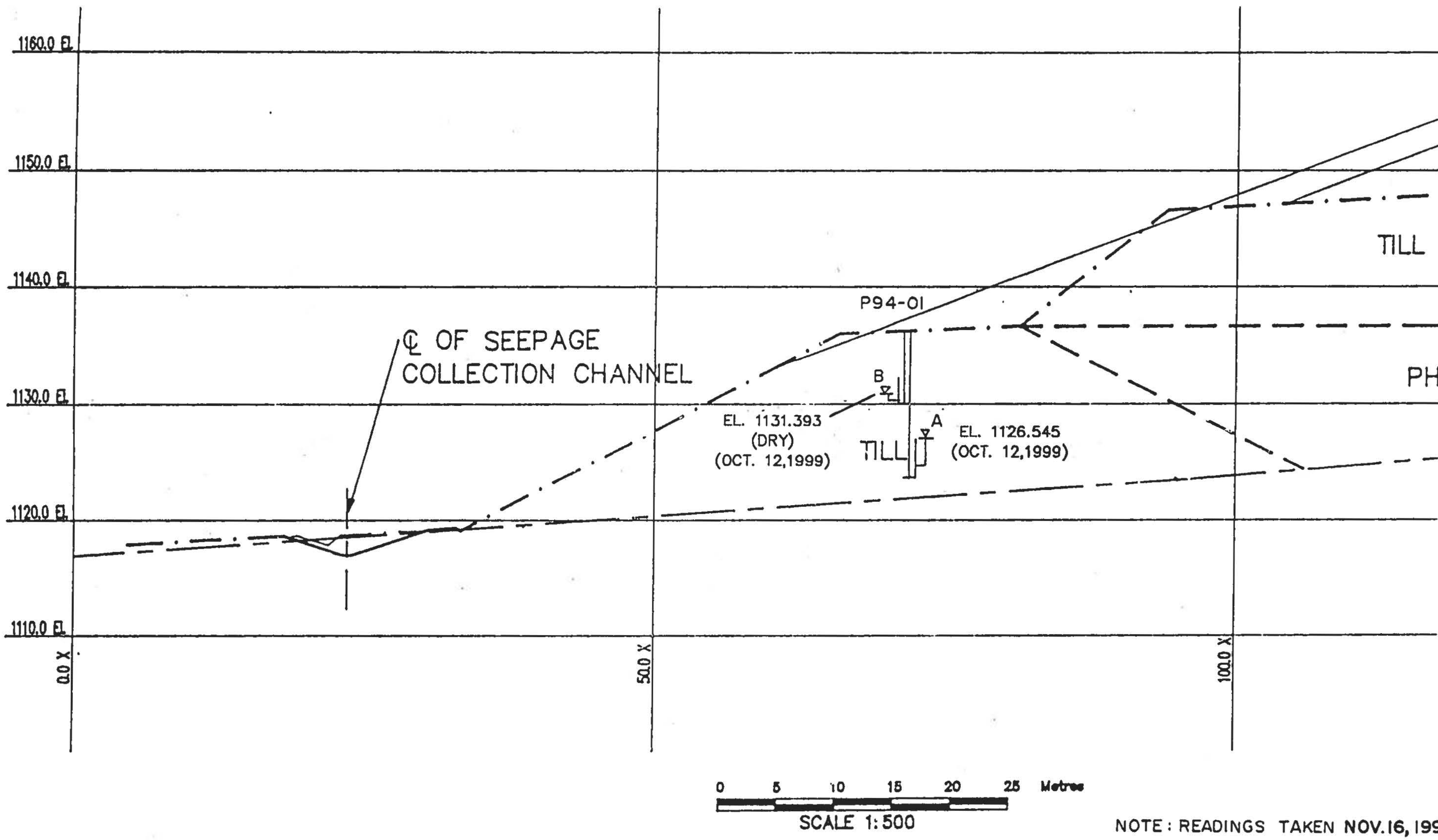
DELOITTE & TOUCHE LTD.

VANGORDA PLATEAU MINE

SITE PLAN

PROJECT NO.	DATE	DRAWING NO.
1CA003.02	DEC. 1999	2

FILE REF. VAN-96-b.DWG



NOTE: READINGS TAKEN NOV.16, 1998

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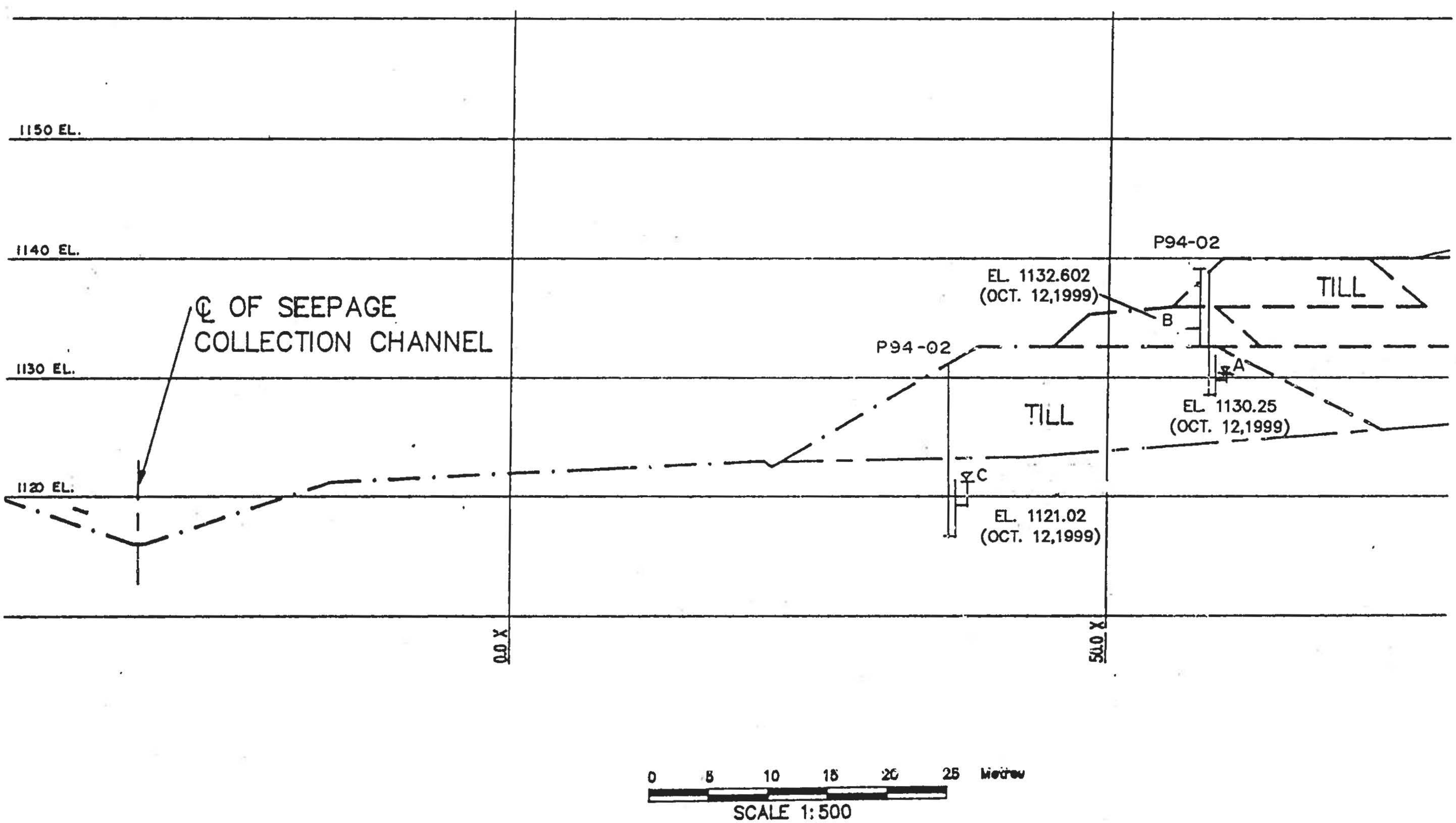
VANGORDA PLATEAU

SECTION D-3
CHANNEL STA. 4+80

PROJECT NO.	DATE	APPROVED	FIGURE
1CA003.02	DEC. 1999		3

FILE REF:SECT-03



NOTE: READINGS TAKEN NOV. 16, 1998

SRK CONSULTING Consulting Engineers	VANGORDA PLATEAU
DELOITTE & TOUCHE LTD.	SECTION D-4 CHANNEL STA. 9+00

PROJECT NO.	DATE	APPROVED	FIGURE
1CA003.02	DEC. 1999		4

FILE REF: SECT-D4

FIGURE 5: PIEZOMETER LEVELS - VANGORDA WASTE DUMP

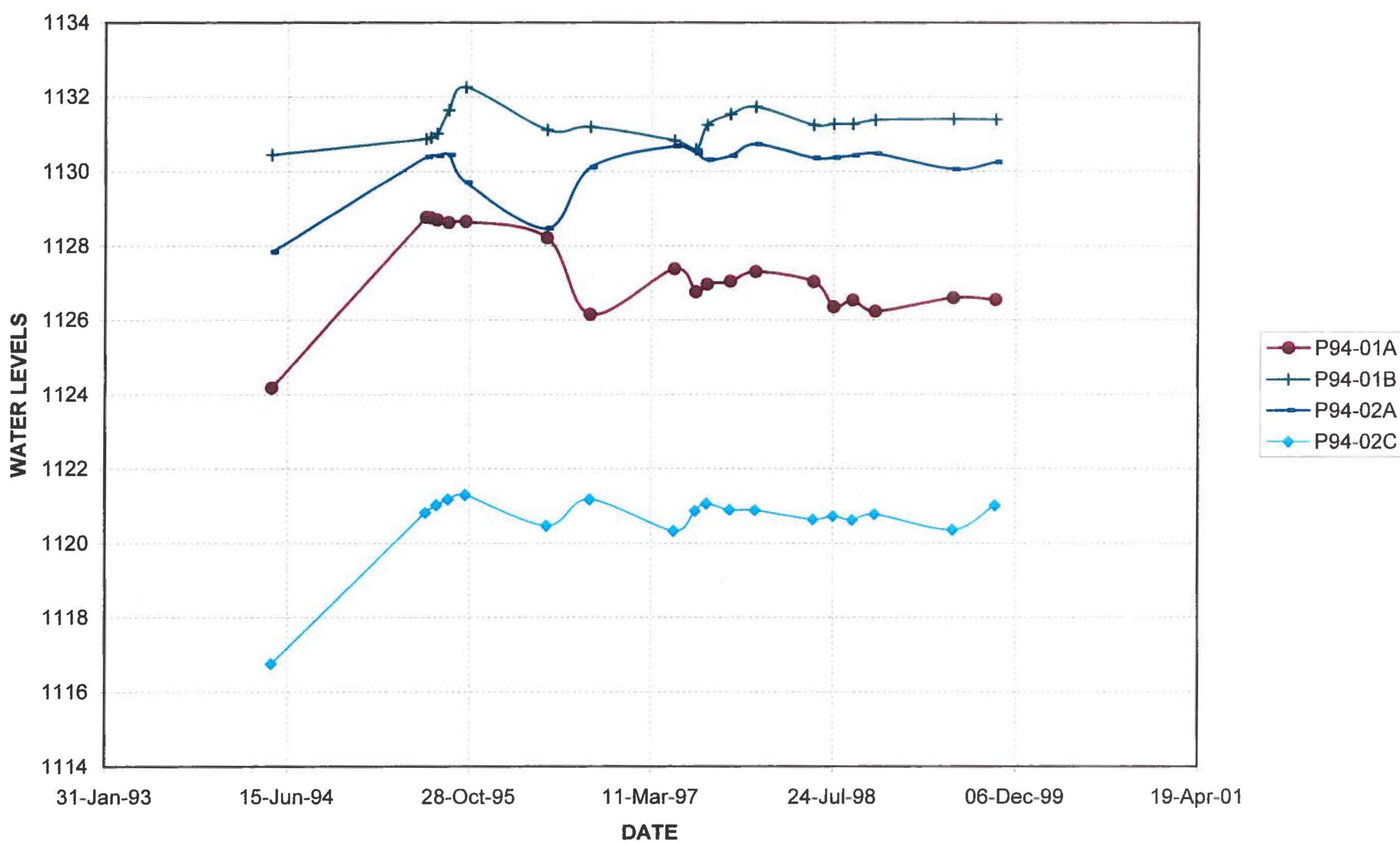
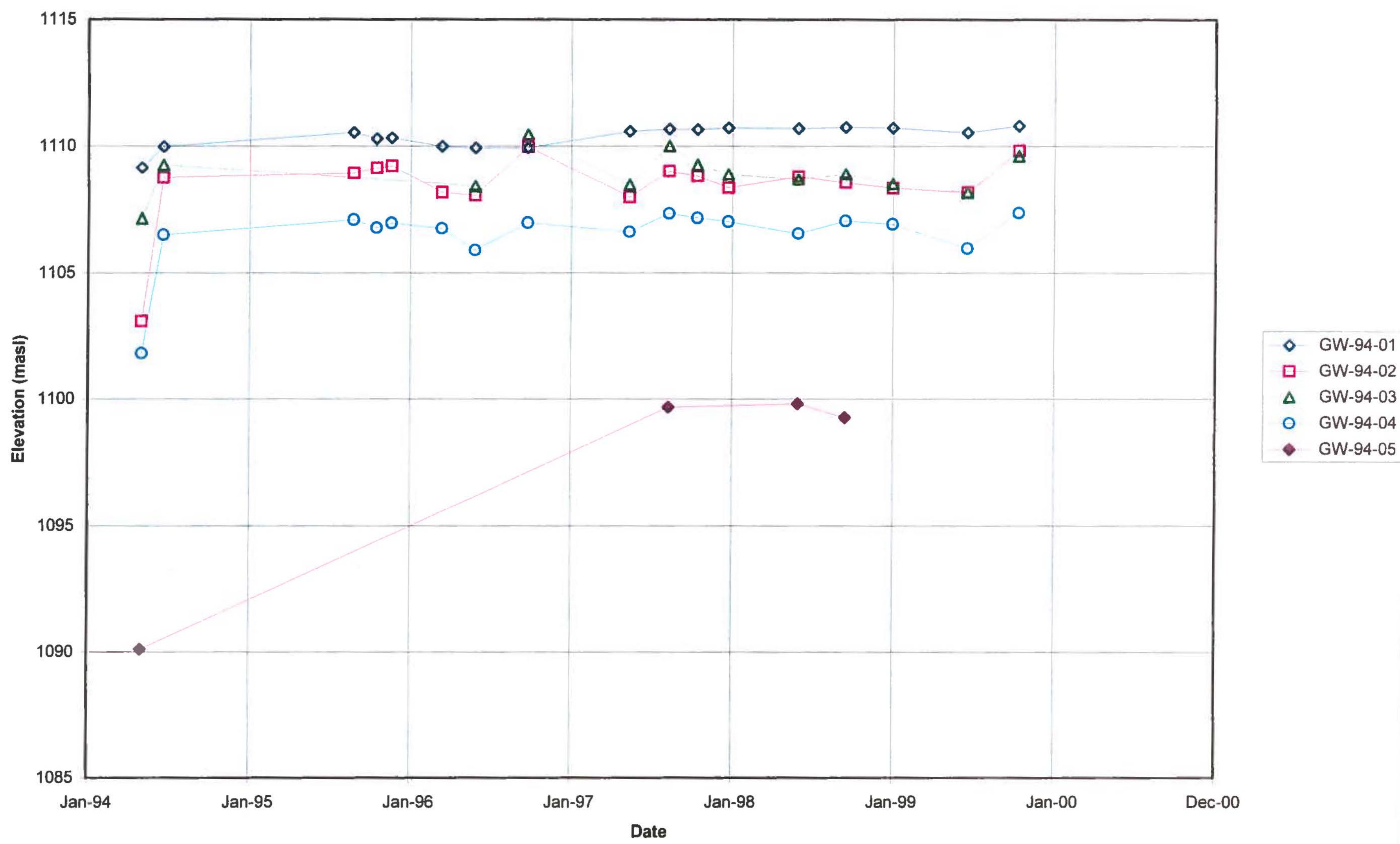
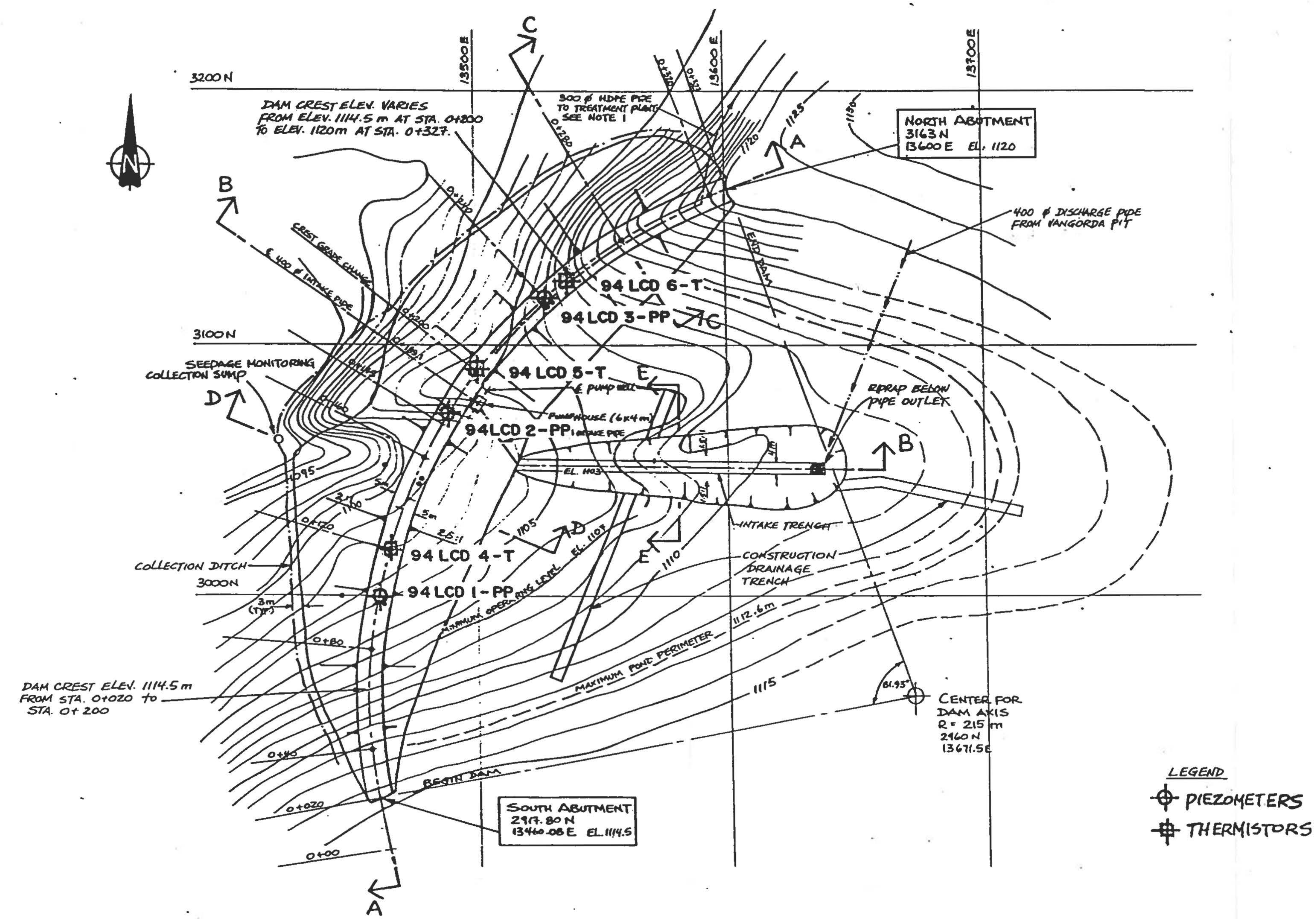


Figure 6: Vangorda Dump Toe Groundwater Elevations



graph Chart 2



GENERAL ARRANGEMENT PLAN

SCALE - 1:2000

CONTOUR INTERVAL = 1 metre
GRID SHOWN IS MINE GRID

0 10 20 30 40 50 metres

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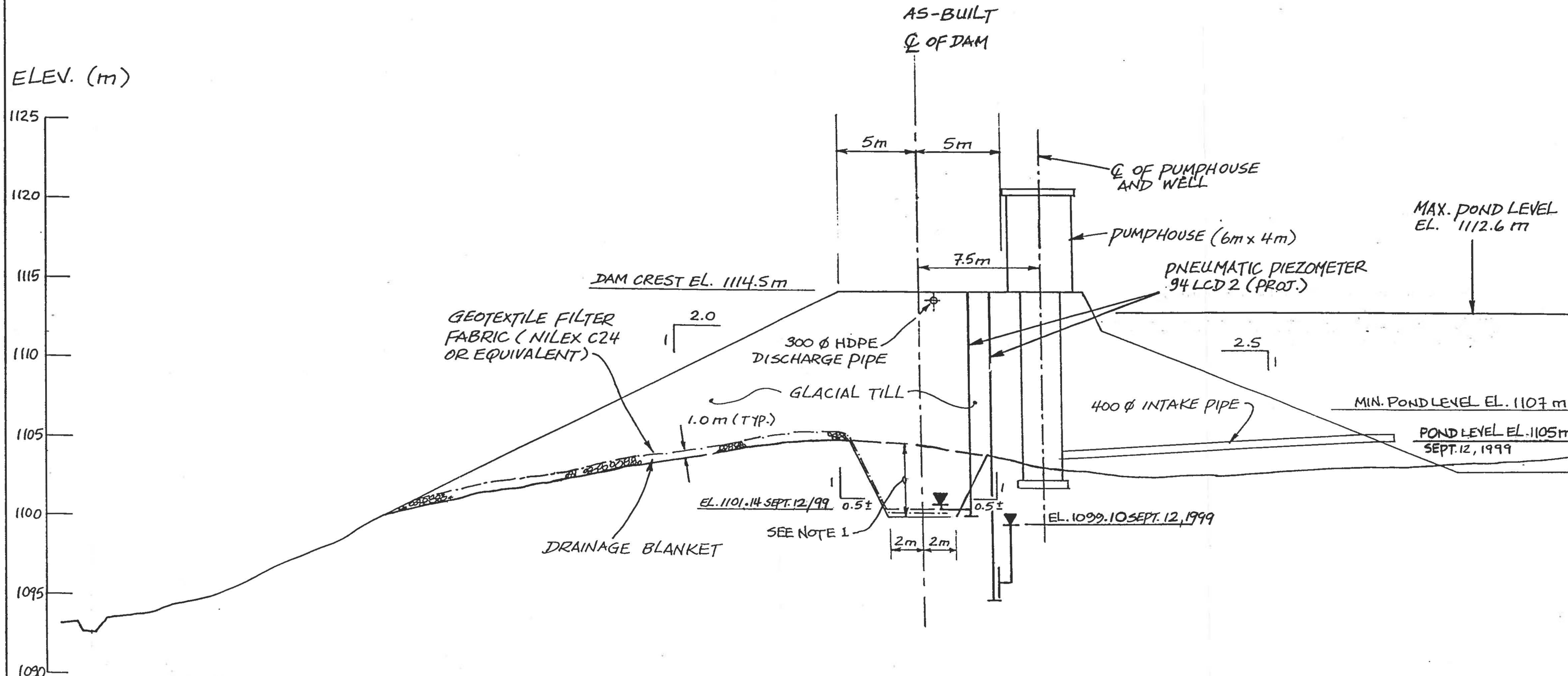
VANGORDA PLATEAU MINE

LITTLE CREEK DAM
GENERAL ARRANGEMENT PLAN

PROJECT NO.	DATE	APPROVED	FIGURE
1CA003.02	DEC. 1999		7

FILE REF: FIG-4



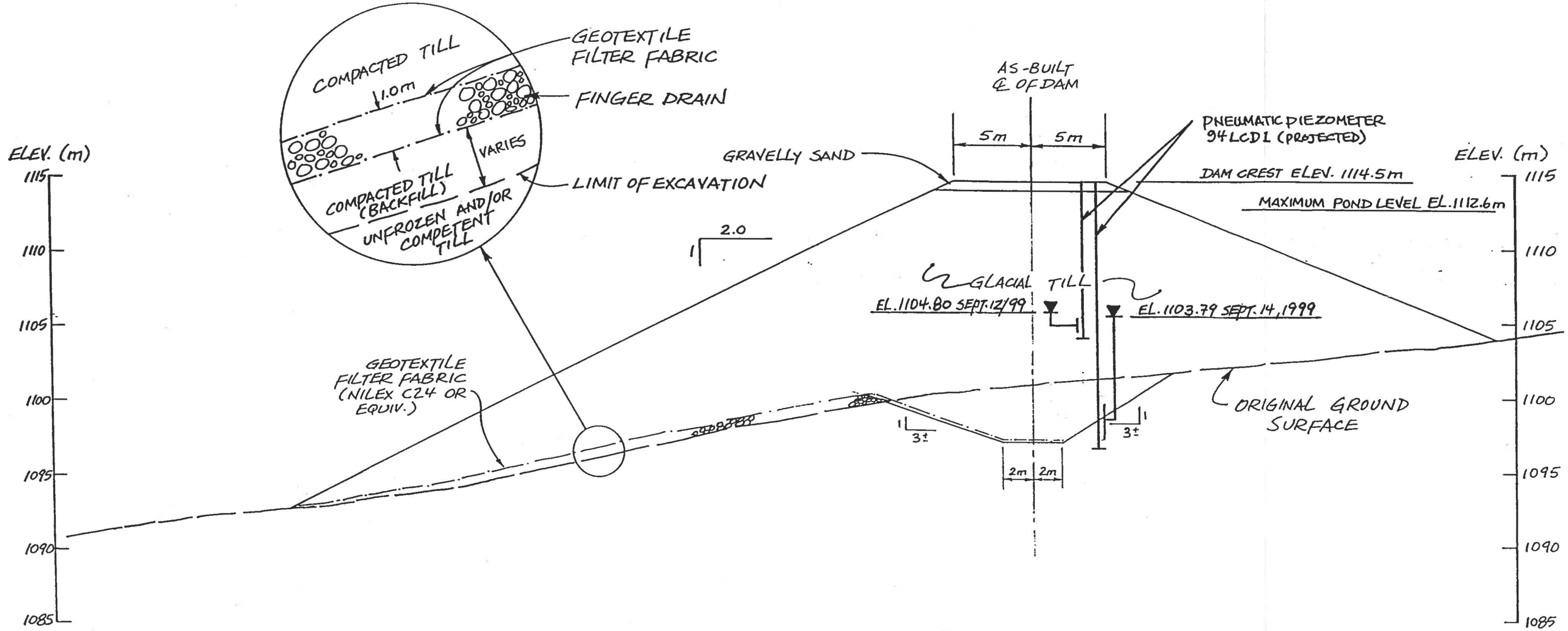
SECTION B-B (STA. 0+190)

SCALE – 1:250

FILE REF: FIG-5

SRK CONSULTING Consulting Engineers	VANGORDA PLATEAU MINE
DELOITTE & TOUCHE LTD.	LITTLE CREEK DAM SECTION B-B

PROJECT NO.	DATE	APPROVED	FIGURE
1CA003.02	DEC. 1999		8



SECTION D-D (STA. 0+144)

SCALE - 1:300

SRK CONSULTING Consulting Engineers	VANGORDA PLATEAU MINE
DELOITTE & TOUCHE LTD.	LITTLE CREEK DAM SECTION D-D

PROJECT NO.	DATE	APPROVED	FIGURE
1CA003.02	DEC. 1999		9

FILE REF: FIG-6

APPENDIX A

Photos

Photo 1: A view overlooking the Vangorda Waste Dump and the Seepage Collection Ditch

Photo 2: View of the Till Stockpile and Pelley Pond.

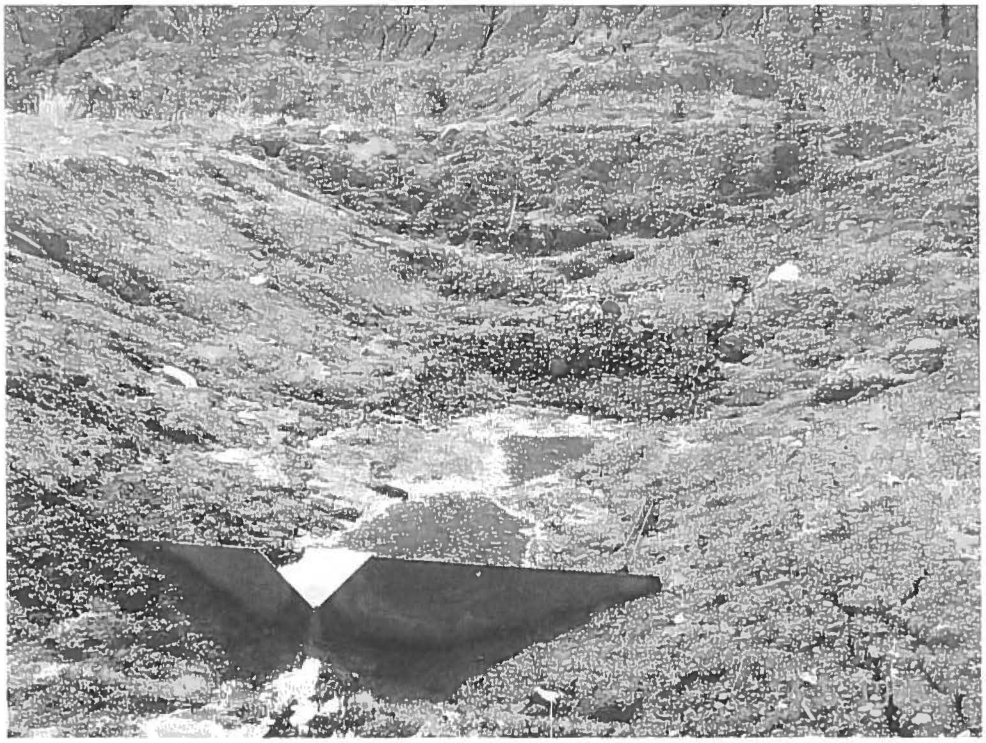


Photo 3: Weir at Drain 5

Photo 4: Erosion above Weir 6

Photo 5: Weir 6

Photo 6: Weir 3

Photo 7: Seepage Collection Ditch on Northside of Waste Dump

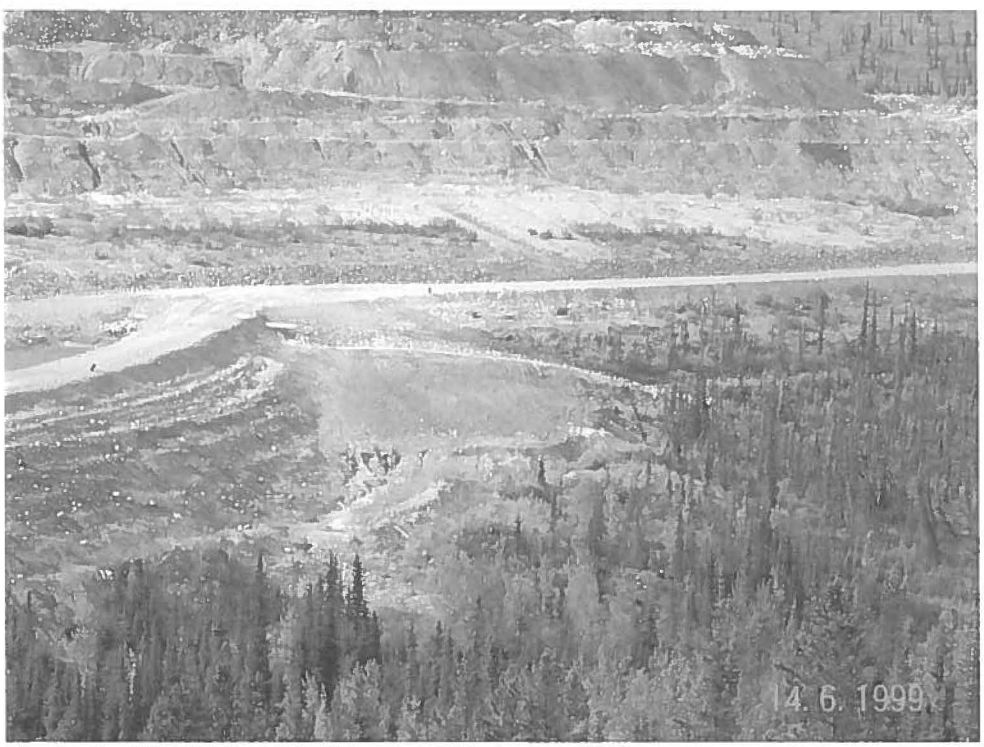


Photo 8: CSP Culvert Spillway in Little Creek Dam

Photo 9: Little Creek Dam

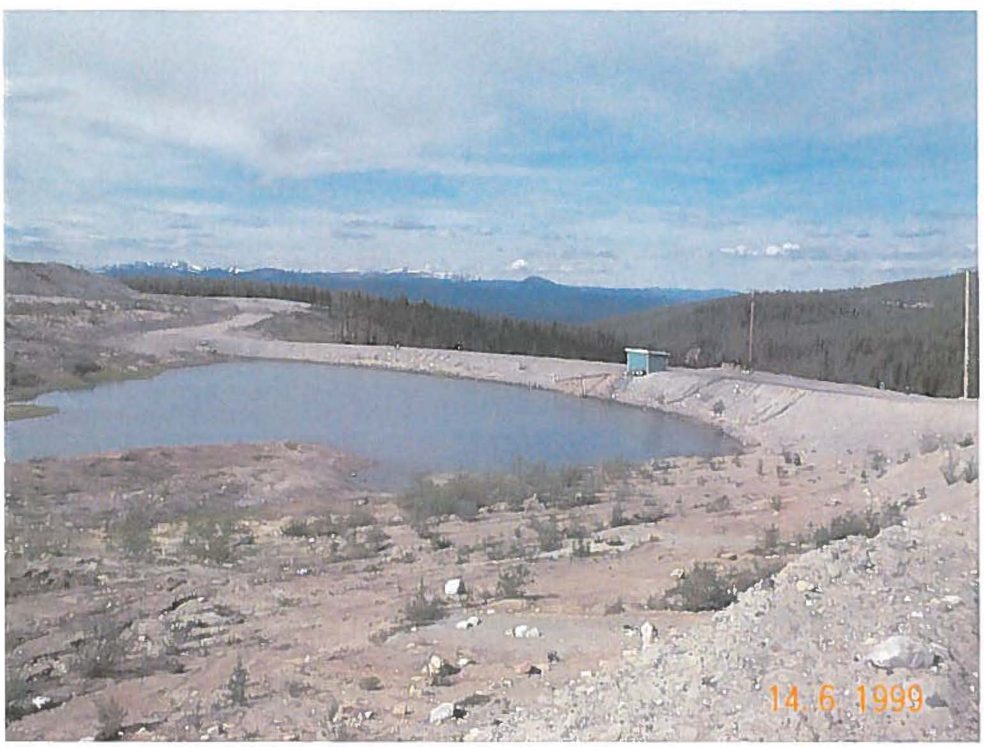


Photo 10: Ponded Water Behind Little Creek Dam

Photo 11: Approach Road to Little Creek Dam after Pipeline Return to Treatment Plant on side of Road

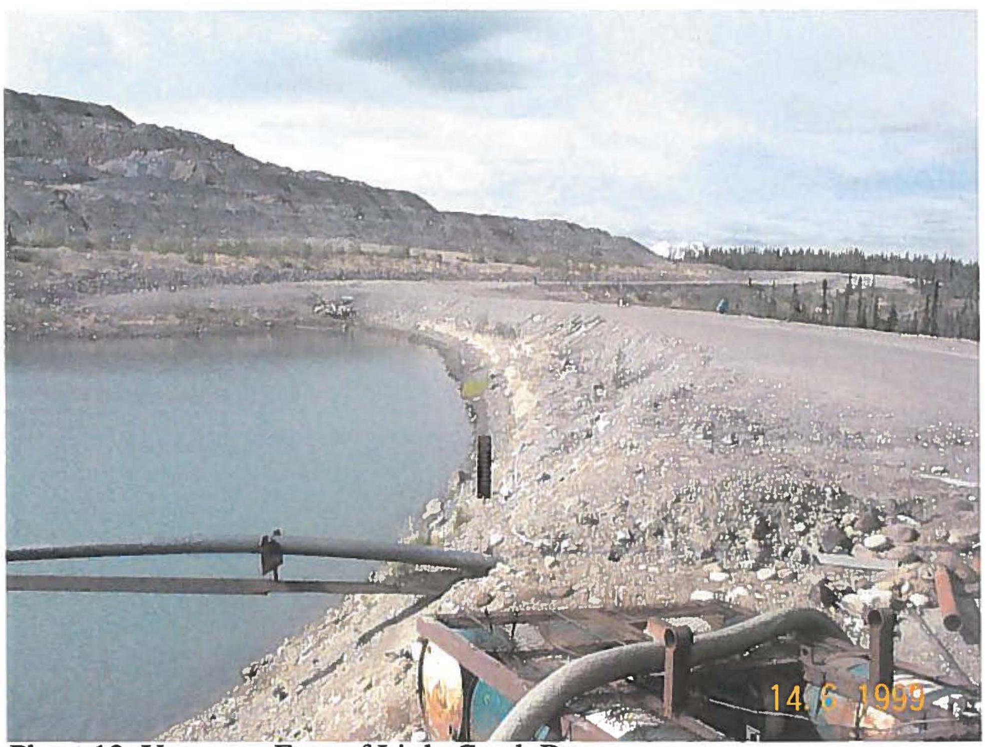


Photo 12: Upstream Face of Little Creek Dam

Photo 13: Erosion Gullies in Approach Road to Little Creek Dam

Photo 14: Downstream Face of Little Creek Dam

Photo 15: Inlet of Culvert Spillway at South end of Little Creek Dam

Photo 16: View of the inlet to the culvert after more rip rap was placed

Photo 17: View South of Outlet end of Spillway in June 1999

Photo 18: View North of Outlet end of Culvert Spillway at Little Creek Dam

Photo 19: View of the Culvert outlet with additional riprap and the attached half-round flume, September 1999

Photo 20: outlet of LCD culvert with Flume attached, September 1999

Photo 21: Erosion Gullies in till Berm below resloped areas of Vangorda Waste Dump

Photo 22: Headworks of the Vangorda Creek Diversion

Photo 23: Vangorda Creek Diversion

Photo 24: Outlet of the Vangvorda Creek Diversion

Photo 25: Erosion of the Sideslopes at the Stilling Basin below the Vangorda Creek Diversion

Photo 26: Sludge Pond at the Treatment Plant

Photo 27: Croucho Pond (Grum Settling Pond)

Photo 28: Grum Interceptor Ditch above Treatment Plant

Photo 29: Erosion in GID Sideslopes below Treatment Plant

Photo 30: Grum Interceptor Ditch

Photo 30: View of removed culvert at the end of the GID

APPENDIX B

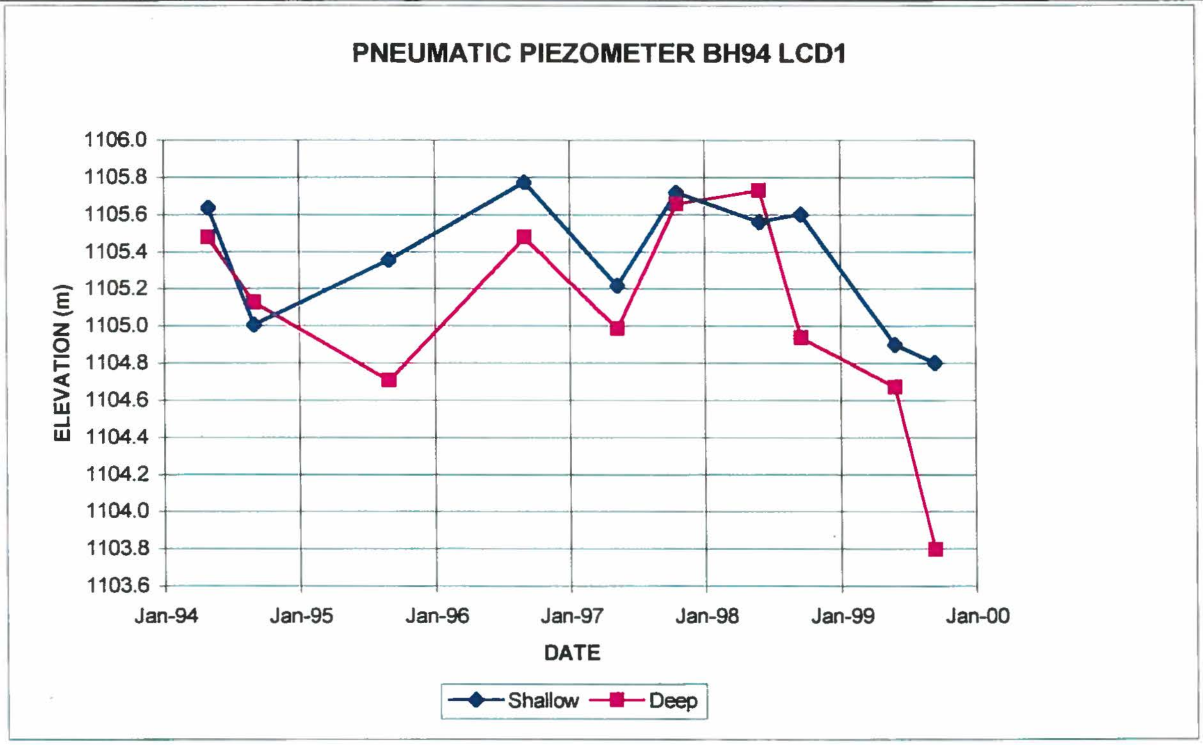
Pneumatic Piezometer and Thermistor Readings - Little Creek Dam

Little Creek Dam Pneumatic Piezometers

BH94 LCD1 **Location:** Little Creek Dam Crest **Ground Elevation:** 1114.5m **Coordinates:** 3000N, 13460E

Date Installed: June '94 **Shallow Tip Elevation:** 1103.6 **Deep Tip Elevation :** 1097.0 **Surface Protector:** yes

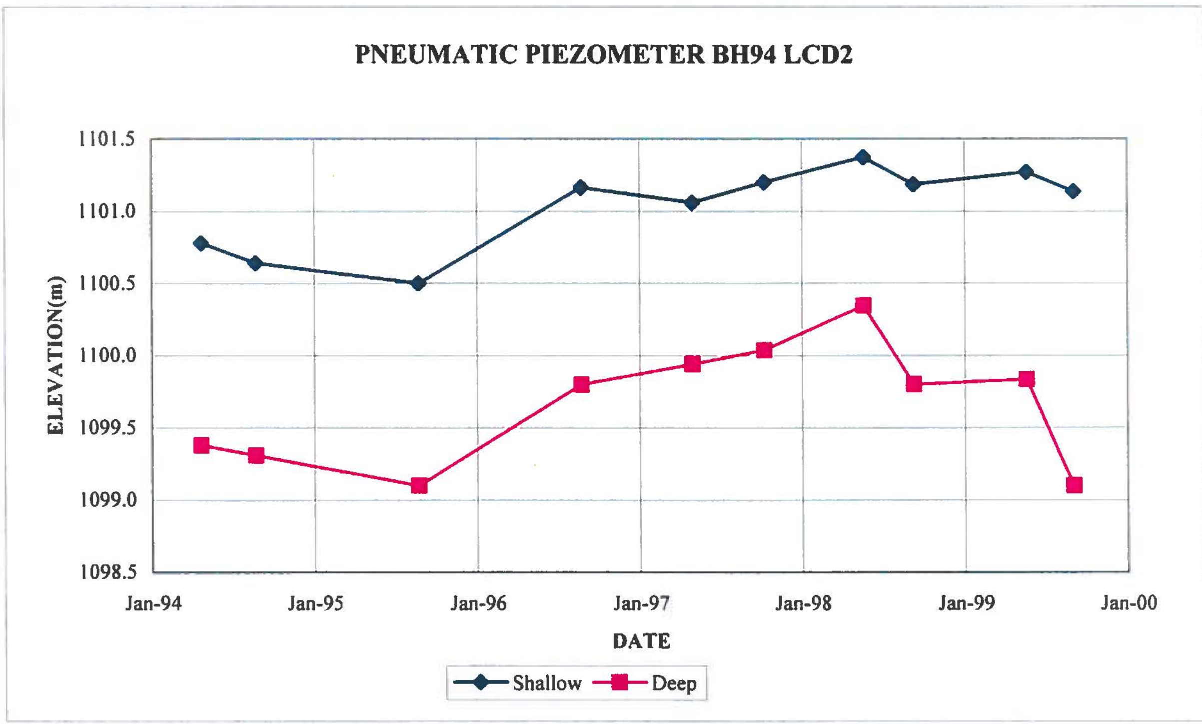
Date	Reading (psi)		Piezometric Elevation (m)		Pond
	Shallow	Deep	Shallow	Deep	Level
May-94	2.9	12.1	1105.63	1105.47	
Sep-94	2.0	11.6	1105.00	1105.12	
Sep-95	2.5	11.0	1105.35	1104.70	
Sep-96	3.1	12.1	1105.77	1105.47	
May-97	2.3	11.4	1105.21	1104.98	
Oct-97	3.02	12.36	1105.71	1105.65	
May-98	2.79	12.46	1105.55	1105.72	
Sep-98	2.85	11.33	1105.60	1104.93	~1109.5
May-99	1.85	10.95	1104.90	1104.67	
Sep-99	1.71	9.70	1104.80	1103.79	~1105



Little Creek Dam Pneumatic Piezometers

BH94 LCD2	**Location:** Little Creek Dam Crest	**Ground Elevation:** 1114.5m		**Coordinates:** 3065N,13485E
	Date Installed: June '94	**Shallow Tip Elevation:** 1100.5		**Surface Protector:** yes
		Deep Tip Elevation : 1094.9		

Date	Reading (psi)		Piezometric Elevation (m)		Pond
	Shallow	Deep	Shallow	Deep	Level
May-94	0.4	6.4	1100.78	1099.38	
Sep-94	0.2	6.3	1100.64	1099.31	
Sep-95	0.0	6.0	1100.50	1099.10	
Sep-96	0.95	7.0	1101.17	1099.80	
May-97	0.8	7.2	1101.06	1099.94	
Oct-97	1.00	7.34	1101.20	1100.04	
May-98	1.25	7.78	1101.38	1100.35	
Sep-98	0.98	7.00	1101.19	1099.80	~1109.5
May-99	1.10	7.05	1101.27	1099.84	
Sep-99	0.91	6.00	1101.14	1099.10	~1105

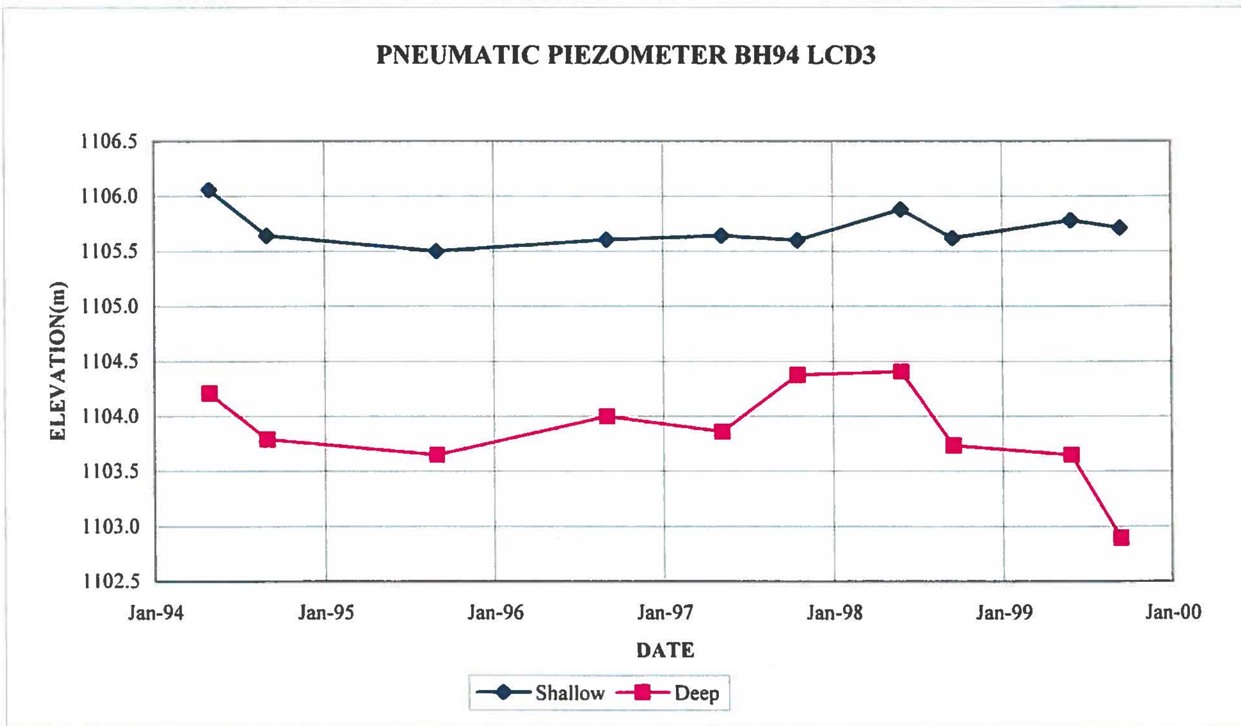


Little Creek Dam Pneumatic Piezometers

BH94 LCD3 **Location:** Little Creek Dam Crest **Ground Elevation:** 1114.5m **Coordinates:** 3115N, 13525E

Date Installed: June '94 **Shallow Tip Elevation:** 1105.5 **Deep Tip Elevation :** 1101.2 **Surface Protector:** yes

Date	Reading (psi)		Piezometric Elevation (m)	
	Shallow	Deep	Shallow	Deep
May-94	0.8	4.3	1106.06	1104.21
Sep-94	0.2	3.7	1105.64	1103.79
Sep-95	0.0	3.5	1105.50	1103.65
Sep-96	0.15	4.0	1105.61	1104.00
May-97	0.2	3.8	1105.64	1103.86
Oct-97	0.14	4.54	1105.60	1104.38
May-98	0.54	4.58	1105.88	1104.41
Sep-98	0.17	3.62	1105.62	1103.73
May-99	0.40	3.50	1105.78	1103.65
Sep-99	0.30	2.42	1105.71	1102.89



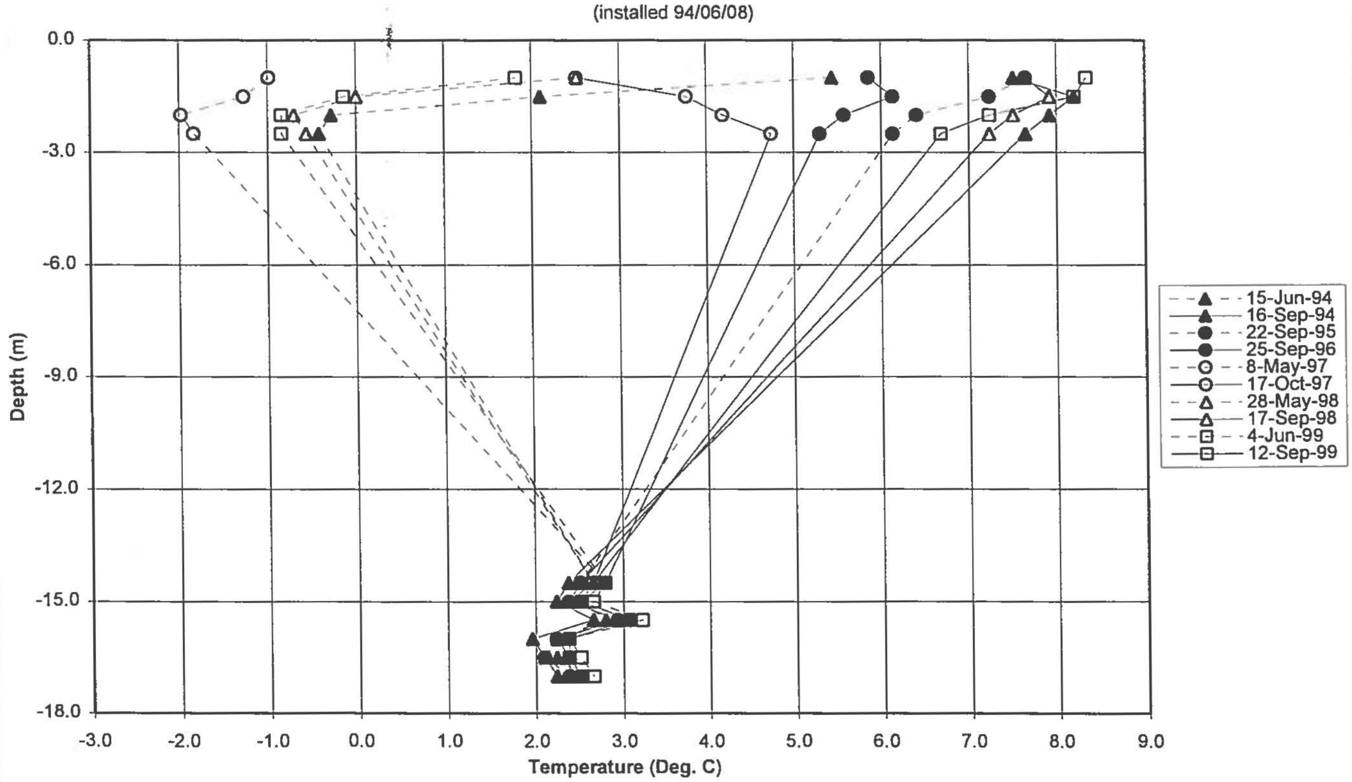
Little Creek Dam Thermistors

BH94 LCD-4	**Location:**	Little Creek Dam Crest	**Elevation:**	1114.5m	**Coordinates** 3015N, 13465E		
	Date Installed:	8-Jun-94	**Thermistor Type:**	SINCA RTD's	**Ice-Bath Calibration:** not applied	**Surface Protector:**	yes
Depth Correction	0		Ro (Ohms)=	1854			

Depth on String (m)	Actual Depth (m)	Resistivity (Ohms) 15-Jun-94	Resistivity (Ohms) 16-Sep-94	Resistivity (Ohms) 22-Sep-95	Resistivity (Ohms) 25-Sep-96	Resistivity (Ohms) 8-May-97	Resistivity (Ohms) 17-Oct-97	Resistivity (Ohms) 28-May-98	Resistivity (Ohms) 17-Sep-98	Resistivity (Ohms) 4-Jun-99	Resistivity (Ohms) 12-Sep-99
1.0	-1.0	1893	1908	1909	1896	1847	1872	1872	1909	1867	1914
1.5	-1.5	1869	1913	1906	1898	1845	1881	1854	1911	1853	1913
2.0	-2.0	1852	1911	1900	1894	1840	1884	1849	1908	1848	1906
2.5	-2.5	1851	1909	1898	1892	1841	1888	1850	1906	1848	1902
14.5	-14.5	1873	1871	1872	1874	1874	1873	1873	1872	1874	1873
15.0	-15.0	1872	1870	1871	1872	1872	1871	1871	1871	1873	1872
15.5	-15.5	1874	1873	1875	1876	1876	1875	1875	1875	1877	1876
16.0	-16.0	1870	1868	1870	1871	1871	1870	1870	1870	1871	1871
16.5	-16.5	1870	1869	1869	1871	1871	1871	1870	1871	1872	1871
17.0	-17.0	1870	1870	1871	1872	1872	1872	1872	1871	1873	1872

Depth on String (m)	Actual Depth (m)	Temperature (C) 15-Jun-94	Temperature (C) 16-Sep-94	Temperature (C) 22-Sep-95	Temperature (C) 25-Sep-96	Temperature (C) 8-May-97	Temperature (C) 17-Oct-97	Temperature (C) 28-May-98	Temperature (C) 17-Sep-98	Temperature (C) 4-Jun-99	Temperature (C) 12-Sep-99
1.0	-1.0	5.4	7.5	7.7	5.9	-1.0	2.5	2.5	7.7	1.8	8.3
1.5	-1.5	2.1	8.2	7.2	6.1	-1.3	3.8	0.0	7.9	-0.1	8.2
2.0	-2.0	-0.3	7.9	6.4	5.6	-2.0	4.2	-0.7	7.5	-0.8	7.2
2.5	-2.5	-0.4	7.7	6.1	5.3	-1.8	4.7	-0.6	7.2	-0.8	6.7
14.5	-14.5	2.7	2.4	2.5	2.8	2.8	2.7	2.7	2.5	2.8	2.7
15.0	-15.0	2.5	2.2	2.4	2.5	2.5	2.4	2.4	2.4	2.7	2.5
15.5	-15.5	2.8	2.7	2.9	3.1	3.1	2.9	2.9	2.9	3.2	3.1
16.0	-16.0	2.2	2.0	2.2	2.4	2.4	2.2	2.2	2.2	2.4	2.4
16.5	-16.5	2.2	2.1	2.1	2.4	2.4	2.4	2.2	2.4	2.5	2.4
17.0	-17.0	2.2	2.2	2.4	2.5	2.5	2.5	2.5	2.4	2.7	2.5

THERMISTOR BH94 LCD-4
(installed 94/06/08)



Little Creek Dam Thermistors

BH94 LCD-5 **Location:** Little Creek Dam Crest **Elevation:** 1114.5m **Coordinate** 3090N, 13500E

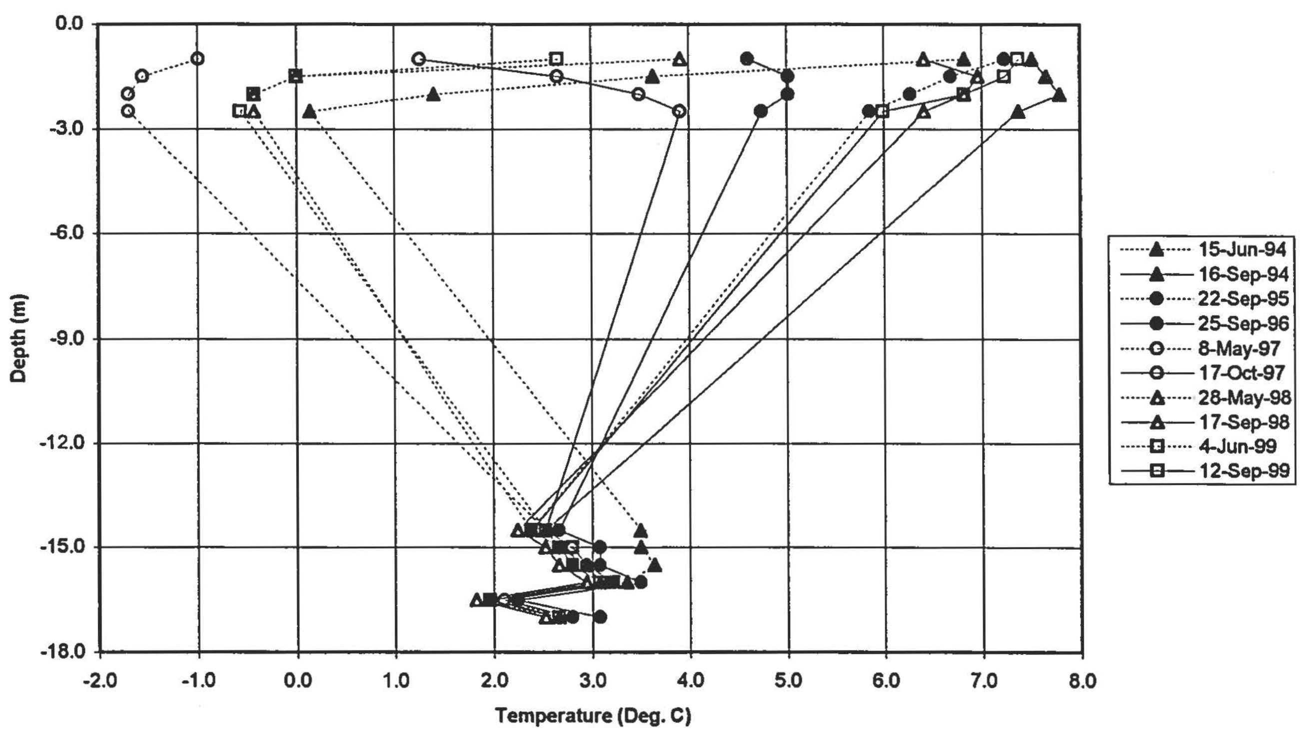
Date Installed: 8-Jun-94 **Thermistor Type:** SINCA RTD's **Ice-Bath Calibration:** not applied **Surface Protector:** yes

Depth Correction 0 Ro (Ohms)= 1854

Depth on String (m)	Actual Depth (m)	Resistivity (Ohms) 15-Jun-94	Resistivity (Ohms) 16-Sep-94	Resistivity (Ohms) 22-Sep-95	Resistivity (Ohms) 25-Sep-96	Resistivity (Ohms) 8-May-97	Resistivity (Ohms) 17-Oct-97	Resistivity (Ohms) 28-May-98	Resistivity (Ohms) 17-Sep-98	Resistivity (Ohms) 4-Jun-99	Resistivity (Ohms) 12-Sep-99
1.0	-1.0	1903	1908	1906	1887	1847	1863	1882	1900	1873	1907
1.5	-1.5	1880	1909	1902	1890	1843	1873	1854	1904	1854	1906
2.0	-2.0	1864	1910	1899	1890	1842	1879	1851	1903	1851	1903
2.5	-2.5	1855	1907	1896	1888	1842	1882	1851	1900	1850	1897
14.5	-14.5	1879	1872	1871	1873	1872	1872	1871	1870	1872	1871
15.0	-15.0	1879	1873	1873	1876	1874	1874	1873	1872	1874	1873
15.5	-15.5	1880	1875	1874	1876	1875	1875	1874	1873	1874	1874
16.0	-16.0	1878	1876	1877	1879	1877	1877	1876	1875	1877	1876
16.5	-16.5	1868	1868	1868	1870	1869	1869	1867	1867	1868	1868
17.0	-17.0	1873	1873	1874	1876	1874	1874	1873	1872	1873	1873

Depth on String (m)	Actual Depth (m)	Temperature (C) 15-Jun-94	Temperature (C) 16-Sep-94	Temperature (C) 22-Sep-95	Temperature (C) 25-Sep-96	Temperature (C) 8-May-97	Temperature (C) 17-Oct-97	Temperature (C) 28-May-98	Temperature (C) 17-Sep-98	Temperature (C) 4-Jun-99	Temperature (C) 12-Sep-99
1.0	-1.0	6.8	7.5	7.2	4.6	-1.0	1.3	3.9	6.4	2.7	7.4
1.5	-1.5	3.6	7.7	6.7	5.0	-1.5	2.7	0.0	7.0	0.0	7.2
2.0	-2.0	1.4	7.8	6.3	5.0	-1.7	3.5	-0.4	6.8	-0.4	6.8
2.5	-2.5	0.1	7.4	5.9	4.7	-1.7	3.9	-0.4	6.4	-0.6	6.0
14.5	-14.5	3.5	2.5	2.4	2.7	2.5	2.5	2.4	2.2	2.5	2.4
15.0	-15.0	3.5	2.7	2.7	3.1	2.8	2.8	2.7	2.5	2.8	2.7
15.5	-15.5	3.6	2.9	2.8	3.1	2.9	2.9	2.8	2.7	2.8	2.8
16.0	-16.0	3.4	3.1	3.2	3.5	3.2	3.2	3.1	2.9	3.2	3.1
16.5	-16.5	2.0	2.0	2.0	2.2	2.1	2.1	1.8	1.8	2.0	2.0
17.0	-17.0	2.7	2.7	2.8	3.1	2.8	2.8	2.7	2.5	2.7	2.7

THERMISTOR BH94 LCD-5
(installed 94/06/08)



Little Creek Dam Thermistors

BH94 LCD-6 Location: Little Creek Dam Crest | Elevation: 1114.5m | Coordinates 3125N, 13535E

Date Installed: 10-Jun-94 | Thermistor Type: SINCA RTD's | Ice-Bath Calibration: not applied | Surface Protector: yes

Depth Correction 0.4 | Ro (Ohms)= 1854

Depth on String (m)	Actual Depth (m)	Resistivity (Ohms) 15-Jun-94	Resistivity (Ohms) 16-Sep-94	Resistivity (Ohms) 22-Sep-95	Resistivity (Ohms) 25-Sep-96	Resistivity (Ohms) 8-May-97	Resistivity (Ohms) 17-Oct-97	Resistivity (Ohms) 28-May-98	Resistivity (Ohms) 17-Sep-98	Resistivity (Ohms) 4-Jun-99	Resistivity (Ohms) 12-Sep-99
1.0	-1.4	1881	1915	1913	1909	1853	1875	1866	1909	1864	1912
1.5	-1.9	1858	1909	1902	1903	1841	1877	1849	1901	1849	1899
2.0	-2.4	1857	1910	1901	1903	1843	1882	1850	1901	1850	1896
2.5	-2.9	1858	1907	1899	1901	1843	1883	1850	1897	1849	1891
10.0	-10.4	1896	1884	1884	1894	1883	1881	1882	1881	1883	1880
10.5	-10.9	1877	1875	1875	1887	1875	1873	1875	1873	1876	1873
11.0	-11.4	1880	1877	1877	1889	1878	1874	1876	1875	1878	1875
11.5	-11.9	1877	1875	1875	1886	1875	1872	1874	1872	1875	1872
12.0	-12.4	1880	1875	1875	1885	1874	1871	1873	1872	1874	1871
12.5	-12.9	1876	1875	1875	1886	1875	1872	1873	1872	1875	1872

Depth on String (m)	Actual Depth (m)	Temperature (C) 15-Jun-94	Temperature (C) 16-Sep-94	Temperature (C) 22-Sep-95	Temperature (C) 25-Sep-96	Temperature (C) 8-May-97	Temperature (C) 17-Oct-97	Temperature (C) 28-May-98	Temperature (C) 17-Sep-98	Temperature (C) 4-Jun-99	Temperature (C) 12-Sep-99
1.0	-1.4	3.8	8.5	8.2	7.7	-0.1	2.9	1.7	7.7	1.4	8.1
1.5	-1.9	0.6	7.7	6.7	6.8	-1.8	3.2	-0.7	6.5	-0.7	6.3
2.0	-2.4	0.4	7.8	6.5	6.8	-1.5	3.9	-0.6	6.5	-0.6	5.9
2.5	-2.9	0.6	7.4	6.3	6.5	-1.5	4.1	-0.6	6.0	-0.7	5.2
10.0	-10.4	5.9	4.2	4.2	5.6	4.1	3.8	3.9	3.8	4.1	3.6
10.5	-10.9	3.2	2.9	2.9	4.6	2.9	2.7	2.9	2.7	3.1	2.7
11.0	-11.4	3.6	3.2	3.2	4.9	3.4	2.8	3.1	2.9	3.4	2.9
11.5	-11.9	3.2	2.9	2.9	4.5	2.9	2.5	2.8	2.5	2.9	2.5
12.0	-12.4	3.6	2.9	2.9	4.3	2.8	2.4	2.7	2.5	2.8	2.4
12.5	-12.9	3.1	2.9	2.9	4.5	2.9	2.5	2.7	2.5	2.9	2.5