

ANVIL RANGE MINING CORPORATION
(Interim Receivership)

1999 VANGORDA PLATEAU ANNUAL ENVIRONMENTAL REPORT
WATER LICENCE IN89-002

MARCH 2000

SUMMARY

Water quality monitoring was performed during 1999 at the Vangorda Plateau minesite generally in accordance with the schedule for "temporary cessation of operations" per Water Licence IN89-002. This report is the annual report required under Part A.9 of the water licence. The biological and sediment monitoring program which is required every second year was performed in 1999 and the full consultant report is appended here. The required annual geotechnical inspection was performed in 1999 and the full consultant report is appended here. A performance review of the water treatment plant for 1999 is not necessary because the plant was not operated during 1999.

Mining activities in the Grum and Vangorda Open Pits were suspended in January 1998 and the shut down continued through 1999. Known economic ore reserves in the Vangorda open pit had been depleted at the time of the shut down. In April 1998, Anvil Range Mining Corporation entered into receivership and, since that time, the minesite has been under the management of Deloitte and Touche Inc. in their capacity as court appointed interim receiver.

The quantity of water entering Vangorda Creek from mine discharge locations was lower in 1998 and 1999 than in previous years because the open pits were not dewatered and the water treatment plant was not operated. Water chemistry entering Vangorda Creek was generally within maximum allowable discharge limits with the exception of several isolated events of short duration which are described herein. Seepage water from the Grum rock dump continued, in 1999, to show no positive indication of acid generation products exiting the rock dump. Non-Compliant run off water which accumulated in Little Creek Dam in 1999 was pumped into the mined out Vangorda open pit in order to maintain an acceptable water level in Little Creek Dam.

Several physical maintenance tasks were completed in 1999 according to consultant recommendations or best management planning. Emergency repairs were performed at the Vangorda Creek diversion flume in 1999 following a fall of rock from a sub vertical rock wall overlooking the flume which blocked water flow and damaged a portion of the flume.

One technical advisory committee meeting was held in 1999 at the minesite which included tours of the minesites. The primary topics discussed at the meeting included current environmental issues and on-going environmental management through the shut down period.

A permit amendment application was outstanding at year end. The application is primarily comprised of "housekeeping" issues.

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APPENDICES

1. 1999 Complete Water Quality Listing with Statistical Summaries
2. Biological Monitoring Program at Vangorda Creek, Faro, YT, 1999, B.E. Burns, Laberge Environmental Services, February 2000
3. 1999 Annual Inspection, Waste And Water Management Facilities, Vangorda Mine, Yukon Territory, Report No. 1CD003.02, Steffen Robertson and Kirsten (Canada) Inc., December 1999
4. 1999 Technical Advisory Committee Meeting
Agendas, Attendees, Minutes
5. Report on 1999 Maintenance Work at the Vangorda Creek Diversion Flume with Recommendations for Future Preventative Maintenance Work, Anvil Range Mining Corp. (Interim Receivership), October 1999



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March 1, 2000

Yukon Territory Water Board
Suite 106 - 419 Range Road
Whitehorse, Yukon
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Dear Sirs,

Enclosed are five bound copies and one unbound original of the report 1999 Vangorda Plateau Annual Environmental Report, Water Licence IN89-002. This submission represents the complete annual reporting requirements for 1999. Additionally, the body of the report and Appendix 1 are also enclosed in electronic format (WORDv.7.0 for Windows95 and EXCELv.7.0 for Windows 95). The computer files have been compressed using the Winzip program.

I trust that this information is self-explanatory. However, if you have any questions please do not hesitate to contact us.

Sincerely,

Anvil Range Mining Corporation (Interim Receivership)

Eric Denholm, Environmental Engineer

copies: Mr. Doug Sedgwick, Director Environmental Services, Deloitte & Touche Inc., Toronto
✓ Mr. Dana Haggart, Site Manager, Anvil Range Mining Corp. (Interim Receivership), Faro

1. INTRODUCTION

1.1 GENERAL INTRODUCTION

This annual environmental report has been prepared as required by Part A Section 9 of Water Licence IN89-002 for the Vangorda Plateau minesite. This report provides estimated water quantities used during 1999 and an interpretation of trends and variations in water chemistry. Anvil Range Mining Corporation entered into receivership in April 1998 and, since that time, management of the minesite has been performed by Deloitte and Touche Inc. in their capacity as court appointed interim receiver.

The biological monitoring and sediment sampling program is required to be performed every second year and was performed in 1999 by Laberge Environmental Services of Whitehorse who have performed all of these programs in the past and their full report is appended here. The required annual geotechnical inspection was performed in 1999 by Steffen Robertson and Kirsten Inc. and their full report is appended here.

Open pit mining activities were suspended in January 1998 and remained suspended through 1999. At the time when mining activities were suspended, the known economic ore reserves in the Vangorda open pit had been depleted. During previous mine operations, ore from the Vangorda and Grum open pits was trucked approximately 13 km to the Faro concentrator plant where tailings were deposited in the mined out Faro pit. There has been no tailings deposition at the Vangorda Plateau minesite. Activities at the Faro site are reported separately under Water Licence QZ95-003.

No water was pumped from either the Grum or Vangorda open pits during 1999. The water elevation in the Vangorda open pit was monitored and preliminary predictions regarding the rate of filling of the pit were made. There was no discharge of effluent from the water treatment plant during 1999. Some minesite surface run off water entered Vangorda Creek via the Grum interceptor ditch and Grum Creek.

Water quality monitoring locations are illustrated on Figures 1.1 and 1.2 and are listed on Table 1.1. Water chemistry analytical results for 1999 for all parameters analysed are listed in Appendix 1 with statistical summaries.

1.2 OVERVIEW OF MINE WATER MANAGEMENT SYSTEMS

The mine water management system is illustrated on Figure 1.2.

Water is diverted around the Grum pit via the Grum interceptor ditch. The interceptor ditch collects water from the slopes above the Grum Pit as well as water pumped from the deep wells along the eastern perimeter of the pit. In addition, water discharged from the water treatment plant clarification pond enters the interceptor ditch.

Water from the Grum interceptor ditch passes into two settlement ponds referred to as the Sheep Pad Ponds. A smaller pond allows for initial settlement of coarser heavier particles and for dissipation of flow energy. The main pond (Sheep Pond) provides retention time for settlement of finer particles. The Sheep Pond outflow passes into Vangorda Creek at the plunge pool above the haul road.

During previous mine operations, dewatering of the Grum pit was accomplished in several ways. Water was pumped from deep wells located around the eastern perimeter of the pit in an attempt to intercept groundwater prior to its entering the pit. Water pumped from these deep wells was directed into the Grum interceptor ditch. Dewatering of the underground exploration workings below the Grum pit was performed via wells into the workings drilled from within the pit. In 1997 and 1998, some of the underground workings were intercepted by pit development and it is uncertain whether future dewatering of the underground workings will be necessary or possible. Water pumped from the underground

exploration workings and any other water which accumulated in the pit was pumped to the water treatment plant holding pond prior to feeding into the plant for treatment.

Grum Creek contains water from only a portion of its' original watershed due to re-routing of surface water and interception of groundwater in the Grum open pit. A large portion of the remaining Grum Creek flow can be diverted, as necessary, towards a settlement pond referred to as the Moose Pond which is a natural swale in sandy gravelly soil bermed at the downstream end. Use of this diversion is intended to minimize suspended sediment loadings entering Vangorda Creek via Grum Creek. To date when the Moose Pond diversion has been in-place, the diverted Grum Creek water has seeped into the ground and there has been no significant accumulation of water in the Moose Pond.

Water is diverted around the Vangorda Pit via the Vangorda north east and north west interceptor ditches as well as through a diversion of Vangorda Creek. The Vangorda north east interceptor ditch passes water from the slopes to the north east of the pit into Shrimp Creek which, in turn, reports to the Main Fork of Vangorda Creek. The north west interceptor ditch diverts water from the north west slopes into a settlement/groundwater recharge basin with overflow from the basin entering the plunge pool above the haul road. Vangorda Creek is diverted around its' natural channel via a half culvert flume which discharges into the plunge pool above the haul road. Vangorda Creek is then returned into its' original channel below the haul road.

Prior to the depletion of economic ore reserves in the Vangorda open pit in 1998, the Vangorda open pit was dewatered into Little Creek Dam from which location water was subsequently pumped to the water treatment plant. Since the depletion of known economic ore reserves and during the current cessation of mining activities, the Vangorda open pit has not been dewatered and run off water which accumulates in Little Creek Dam has been pumped into the mined out Vangorda open pit in order to maintain an acceptable water level in Little Creek Dam. The run off water which accumulates in Little Creek Dam is typically non-compliant for zinc and other parameters due, in part, to the presence of surface run off and seepage from the Vangorda rock dump which enters Little Creek Dam via a dump seepage collector ditch.

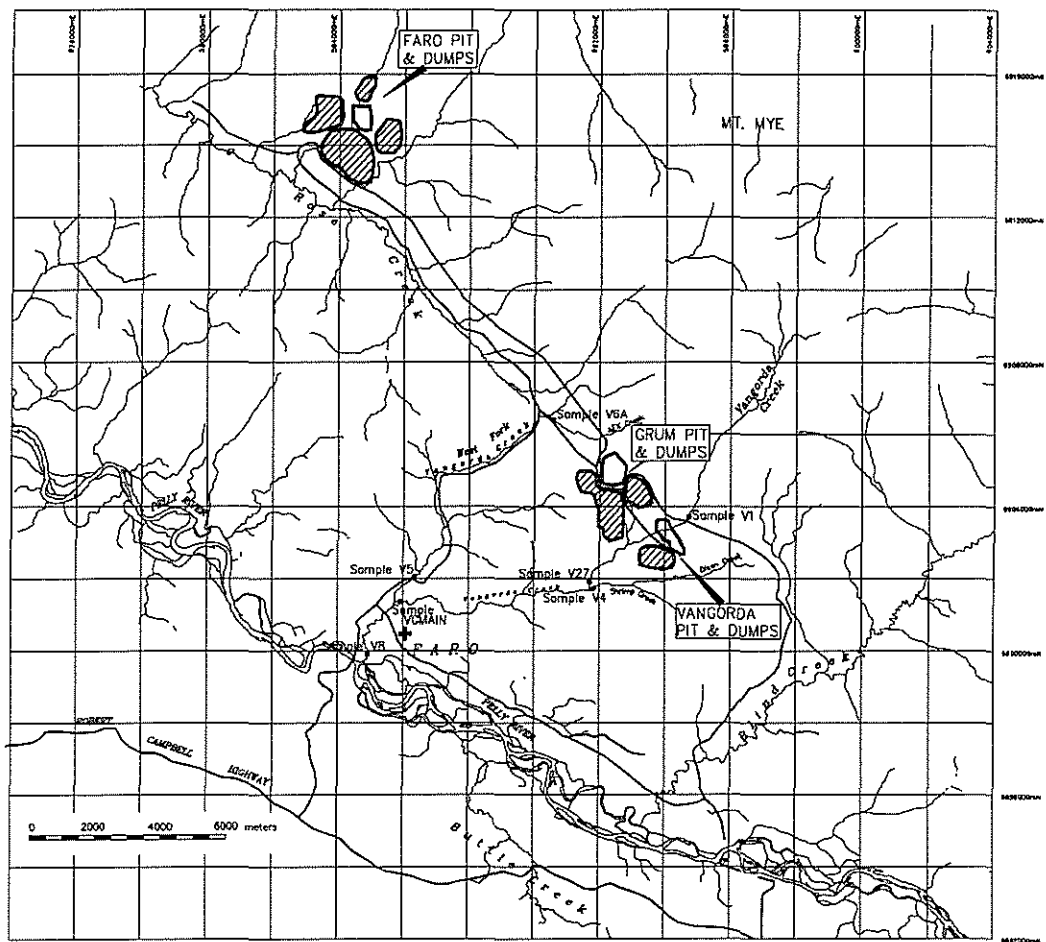


FIGURE 1.1 VANGORDA PLATEAU DRAINAGE AND MONITORING LOCATIONS

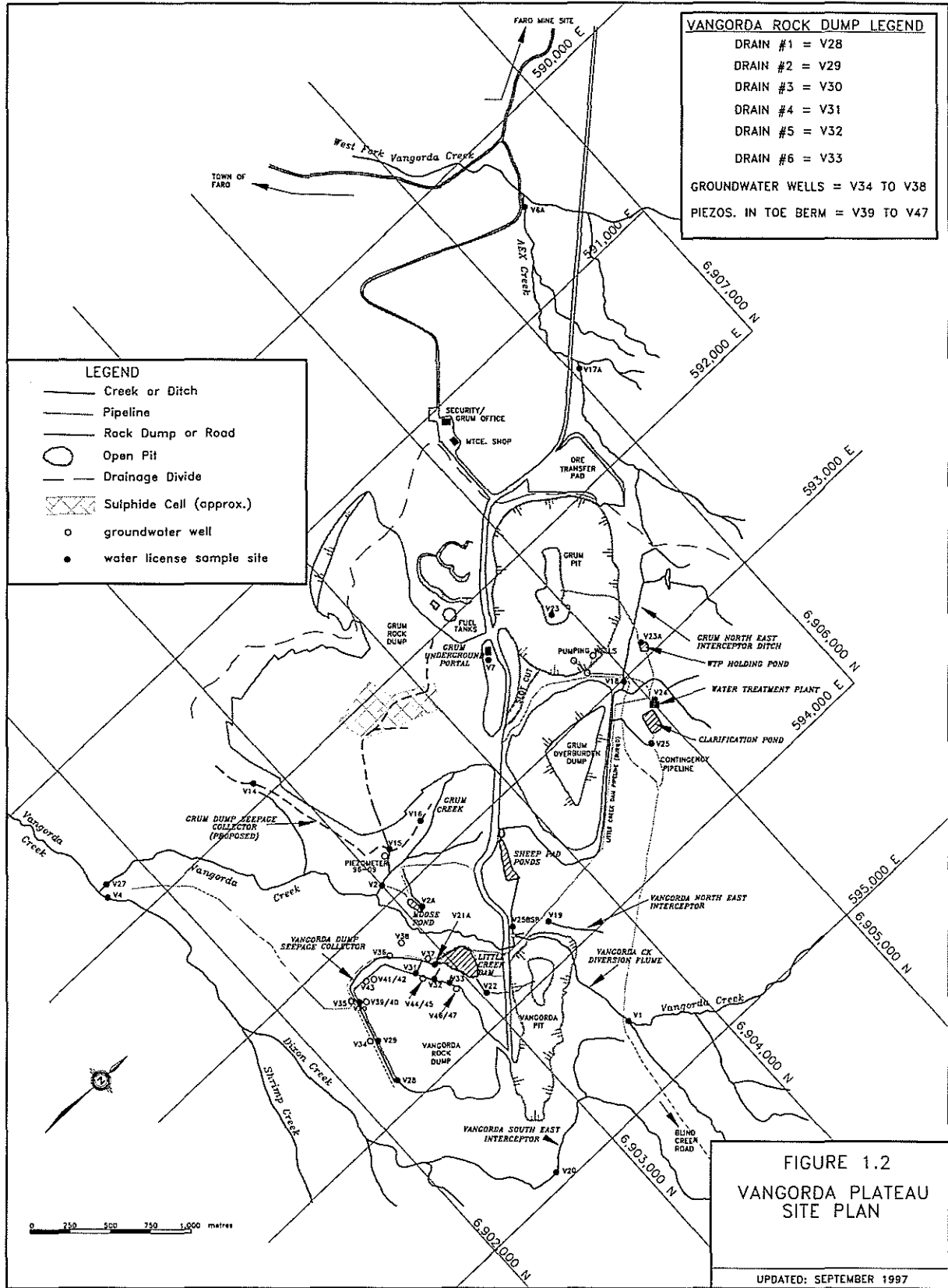


TABLE 1.1 WATER QUALITY MONITORING LOCATIONS

V1	Vangorda Creek, upstream from the mine and Blind Creek road.
V2	Grum Creek, upstream from its confluence with Vangorda Creek.
V2A	Grum Creek diversion to Moose Pond.
V4	Shrimp Creek, upstream from its confluence with Vangorda Creek.
V5	West Fork of Vangorda Creek upstream of mine access road.
V6A	A small tributary (AEX Creek) to the west fork of Vangorda Creek.
V7	Overflow from the Grum portal.
V8	Vangorda Creek near the bridge to Faro town water supply.
V14	Southwest sump Grum main waste dump.
V15	Sulphide cell sump Grum main waste dump.
V16	Southeast sump Grum main waste dump.
V17	Grum Interceptor Ditch when interceptor wells are pumping.
V17A	Surface drainage from the northern side of the Ore Transfer Pad (above the Vangorda haul road).
V18	Grum southeast interceptor ditch, when interceptor wells are pumping.
V19	Vangorda pit northwest interceptor ditch.
V20	Vangorda pit southeast interceptor ditch.
V21	Vangorda Waste Dump collector sump (middle).
V21A	Vangorda waste dump collector ditch at the discharge into Little Creek Dam.
V22	Vangorda pit water and Vangorda Lake at closure.
V23	Grum pit water and Grum Lake at closure.
V23A	Grum Pit water in the Grum external sump may be sampled in place of V23 during mine operations.
V24	Influent to treatment plant.
V25	Effluent from clarification pond outflow.
V25AF	Discharge from clarification pond discharge pipeline sampled when pipeline in use.
V25BSP	Outflow from the Sheep Pad Pond just above the Vangorda Creek plunge pool.
V26	"Little Creek" between Vangorda pit and waste dumps.
V27	Main stem of Vangorda Creek just upstream of the confluence with Shrimp Creek.
V28	Vangorda Drain #1.
V29	Vangorda Drain #2.
V30	Vangorda Drain #3.
V31	Vangorda Drain #4.
V32	Vangorda Drain #5.
V33	Vangorda Drain #6.
V34	Groundwater well 94GW-01 below Vangorda dump.
V35	Groundwater well 94GW-02 below Vangorda dump.
V36	Groundwater well 94GW-03 below Vangorda dump.
V37	Groundwater well 94GW-04 below Vangorda dump.
V38	Groundwater well 94GW-05 below Vangorda dump.
V39	Piezometer P-9401a on Vangorda dump berm.
V40	Piezometer P-9401b on Vangorda dump berm.
V41	Piezometer P-9402a on Vangorda dump berm.
V42	Piezometer P-9402b on Vangorda dump berm.
V43	Piezometer P-9402c on Vangorda dump berm.
V44	Piezometer P-9403a on Vangorda dump berm.
V45	Piezometer P-9403b on Vangorda dump berm.
V46	Piezometer P-9404a on Vangorda dump berm.
V47	Piezometer P-9404b on Vangorda dump berm.

2. WATER USE

Water Licence IN89-002 permits the use of up to 3.5 million Igpd (Imperial gallons per day) or 5.8 million m³ per year of water for storage, diversion and return. In total, the water estimated for these purposes during 1999 was greater than the allowable quantity as summarized on Table 2.1. This apparent over use of water was due to the volume of water flowing through Vangorda Creek which is out of the control of mine management. Since the flow through the Vangorda Creek diversion flume is not directly measured frequently enough to allow an accurate calculation of annual flow, the estimated "normal" flow calculated from hydrology data is used (the annual precipitation for 1999 was 108% of "normal").

The total water usage typically includes water passed through the water treatment plant (nil in 1999), water diverted in the Vangorda Creek diversion flume, water diverted in the Grum interceptor ditch and water pumped from the deep wells associated with the Grum open pit (nil in 1999). Water truck fill-ups from the Vangorda Creek plunge pool (nil in 1999) are not specifically included because this water will have been included in one of the other areas. Natural water flow collected in the Grum interceptor ditch is measured at location V25BSP below the Sheep Pad pond.

During 1999, run off water which accumulated in Little Creek Dam was pumped into the Vangorda pit. There was one period of pumping in 1999 during July when the water level was lowered from 1110.0 masl to 1104.6 masl. An estimated total of 44,000 m³ of water was pumped into the Vangorda pit at an estimated pumping rate of 34 litres per second (540 USgpm). A portable submersible pump was utilized operating from a portable diesel generator.

During 1999, water was syphoned from the Sheep Pad pond into the Vangorda open pit during May and June in order to prevent water which contained total suspended solids at a concentration greater than the maximum allowable discharge limit from entering Vangorda Creek. An estimated 20,000 m³ of water was syphoned.

TABLE 2.1 1999 WATER USE

Use for Storage, Diversion and Return in 1998	Estimated Quantity ('000 m³)
Vangorda Creek diversion	7,549
<u>Location V25BSP below Sheep Pad pond</u>	<u>32</u>
Total Water Use	7,581
Other Water Quantities in 1998	Estimated Quantity ('000 m³)
Pumped from Little Creek Dam into Vangorda Pit	44
Syphoned from Sheep Pad pond into Vangorda Pit	20
Pumped from Grum perimeter deep wells	0
WTP Feed from Grum Holding Pond	0
WTP Feed from Little Creek Dam	0

3. WATER QUALITY ENTERING VANGORDA CREEK

3.1 GRUM PIT DEWATERING (V7, V17, V18, V23, V23A)

Location V7 is outflow from the underground exploration workings. There was no flow at this location during 1999 and no samples were collected.

The deep dewatering wells reporting to location V17 were not installed and, therefore, no samples were collected at V17 during 1999.

Location V18 is in the Grum north east interceptor ditch immediately below the point of entry of water pumped from a series of deep dewatering wells around the eastern perimeter of the Grum pit. The dewatering wells were not pumped during 1999 and, therefore, no sampling was required at location V18.

Location V23 represents Grum pit water sampled in the pit bottom. Location V23 was sampled twice during 1999 in September and October. The samples indicate that water quality during 1999 was similar to that observed during mine operations. The 1999 samples showed concentrations of ammonia, total zinc and sulphate which were generally within the ranges observed in recent years for Grum pit water. The concentrations of ammonia and sulphate in September and October 1999 were ~ 0.5 mg/L and 266/234 mg/L, respectively. The concentrations of total and dissolved zinc in September and October 1999 were 3.42/5.91 mg/L and 0.20/1.30 mg/L, respectively.

Location V23A also represents Grum pit water but is sampled at the inflow to the water treatment plant holding pond. This sampling location is useful during mine operations because it captures the combined water from various pit sumps and, prior to 1998, underground workings dewatering holes. No samples were collected at location V23A in 1999 because no water was pumped to the water treatment plant holding pond.

3.2 VANGORDA PIT DEWATERING AND ROCK DUMP SEEPAGE (V21A, V22, V26, LCD, V28-V47)

Location V21A is the discharge end of the Vangorda Dump seepage collector ditch where the ditch empties into Little Creek Dam. Flow at this location is intermittent and is usually present only during freshet. Sampling location V21A is used as a substitute for location V21 which is located near the middle of the seepage collector ditch because the likelihood of locating water to sample is greater at the discharge end of the ditch. One sample was collected at location V21A during 1999 on May 18. This sample likely includes a large portion of snow melt and is not considered representative of this location. This is based on the relatively low concentrations of total and dissolved zinc which were 0.14 and 0.10 mg/L, respectively. The concentration of sulphate was also relatively low for this location at 292 mg/L and the concentration of total suspended solids was low at only 9 mg/L.

Location V22 is Vangorda Pit water. Following the suspension of mining activities (and dewatering) in January 1998, water which has accumulated in the Vangorda open pit has included natural inflows, water pumped from Little Creek Dam, and, in 1999, water syphoned from the Sheep Pad pond. During 1999, three samples of Vangorda pit water were collected. The water chemistry data showed an increase in the concentrations of zinc and sulphate through 1999 although not to the relatively high concentrations reported for September 1998. The concentrations of total and dissolved zinc in 1999 ranged from 11.2 mg/L to 37.4 mg/L and from 3.5 mg/L to 8.7 mg/L, respectively, and the concentration of sulphate in 1999 ranged from 247 mg/L to 635 mg/L. The concentration of ammonia in 1999 was much lower than that observed in 1998 at only 0.1 to 0.6 mg/L.

The water level in the Vangorda open pit was monitored in 1999 and a series of stakes were installed along the pit ramp at one metre vertical intervals which will allow on-going monitoring to be continued.

The in-pit water elevation was estimated to have risen approximately 9 metres from April 1999 to February 2000 and was estimated to be approximately 1171.0 masl in February 2000. Planning regarding future management of the pit once the period of filling is complete was initiated in 1999.

Location V26 is a "Little Creek" between the Vangorda pit and rock dump. This location does not exist and the application for licence amendment currently under review includes the deletion of this location. No samples were collected at V26 during 1999.

Little Creek Dam is the collection point for local area run off and precipitation, surface run off from the Vangorda rock dump and toe seepage from the Vangorda rock dump. Prior to the shut down of mining activities in January 1998, the Vangorda pit was dewatered directly into Little Creek Dam and all water was pumped from Little Creek Dam to the water treatment plant for treatment and discharge. During 1999, water was pumped from Little Creek Dam into the Vangorda pit in order to maintain an acceptable water level in Little Creek Dam. One water sample was collected from Little Creek Dam in 1999 on June 18 which confirmed that the water was non-compliant as expected. The sample pH was 7.5 with concentrations of sulphate, ammonia, total zinc and dissolved zinc of 299 mg/L, 0.5 mg/L, 7.2 mg/L and 4.8 mg/L, respectively.

The six transverse drains which pass toe seepage from the Vangorda rock dump (licence monitoring locations V28 through V33) were sampled as flow allowed during 1999. As usual, no flow was observed at drain #1. No flow was present in drains #2 and #4 even during freshet. Flow was present at drain #6 only during freshet which is unusual for this location where flow has previously been present during most of the year. Physical maintenance work which was performed during summer 1999 including cleaning out of the weir approach channel and installation of a surface water control ditch above drain #6 apparently resulted in the cessation of flow at the weir for unknown reasons. Flow was present at drains #3 and #5 until November or December. In general, water quality in the drains which were sampled continued to show high metal concentrations and sulphate at continued neutral pH with the exception of drain #5 where pH was in the acidic range. Flows at the drains continued to be extremely low in 1999 with a maximum observed flow rate of only 0.14 litres per second at drain #3 in May.

As usual, the poorest water quality in 1999 was observed in drain #5 with peak concentrations of dissolved zinc and sulphate of 4,004 mg/L and 17,010 mg/L, respectively, with a range in pH from 3.0 to 5.8. Flows from drain #5 were extremely low and ranged from only 0.01 Lps to only 0.03 Lps. Water quality for drain #3 may be more representative of general conditions within the dump because drain #3 most consistently has flow and because the collection area is thought to be the greatest. The peak and annual average concentrations of dissolved zinc in drain #3 during 1999 were 565 mg/L and 324 mg/L, respectively. The peak and annual average concentrations of sulphate in drain #3 in 1999 were 4,281 mg/L and 3,266 mg/L, respectively, and pH ranged from 5.1 to 6.5 in 1999. The concentrations of dissolved zinc and sulphate for drains #3 and #5 are illustrated on Figures 3.1 and 3.2, respectively. There may be an increasing trend in the concentrations of dissolved zinc and sulphate emerging at drain #5 which on-going monitoring may identify.

Standpipe piezometers labeled GW94-01 through GW94-04 (licence monitoring locations V34 through V37) are located below the Vangorda rock dump seepage collector ditch and allow monitoring of groundwater seeping below the collector ditch. Each of these piezometers was sampled twice during 1999 in June and October. Piezometer GW94-05 (licence monitoring location V38) was not monitored.

The water chemistry data for piezometers GW94-01 through GW94-04 showed no positive indications of the presence of acid generation products exiting the rock dump in 1999. The irregular and aseasonal spikes in the concentration of dissolved zinc which occurred in 1997 and 1998 were not repeated in 1999. However, the concentration of sulphate in piezometer GW94-02 was unusually elevated during winter 1998/99. The other concentrations of sulphate were generally within the ranges observed in previous years. The static water levels and pH for all four piezometers were generally stable. The concentrations

of dissolved zinc and sulphate for piezometers GW94-01 through GW94-04 are illustrated on Figures 3.3 and 3.4, respectively.

Figure 3.1 Vangorda Dump Drains Diss. Zinc

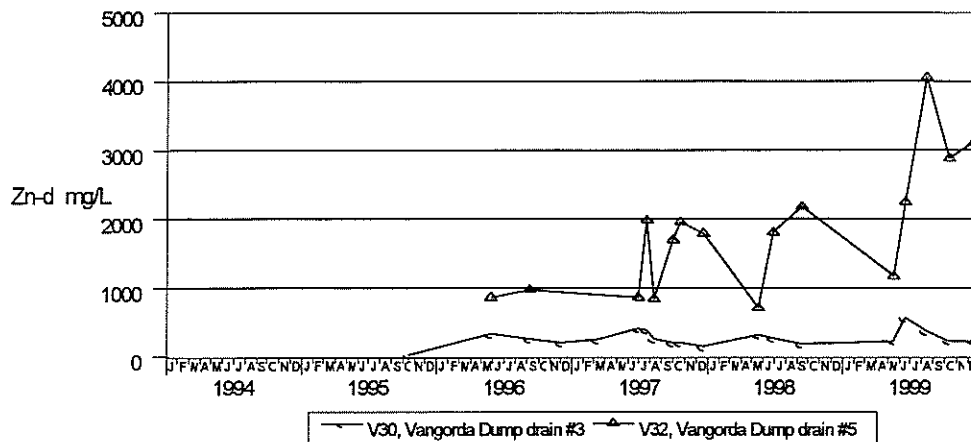
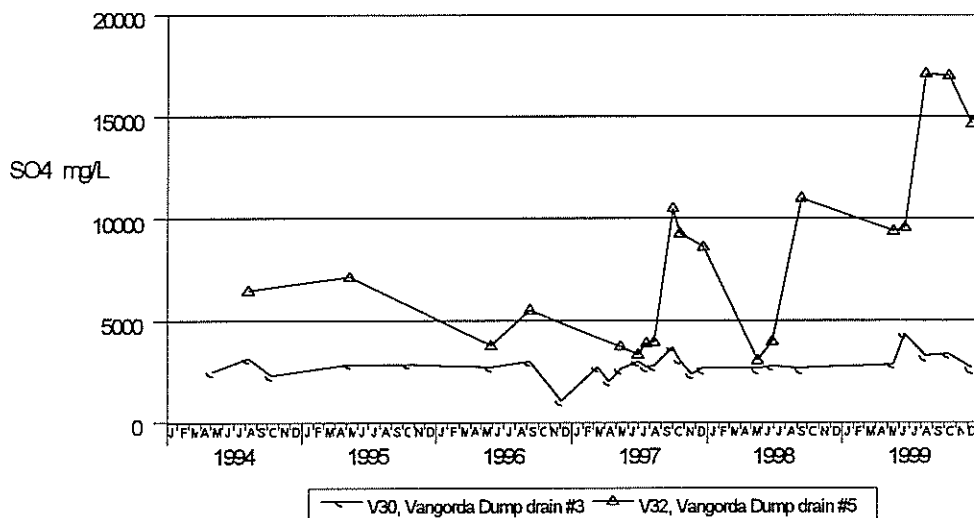


Figure 3.2 Vangorda Dump Drains Sulphate



A series of piezometers (P94-01 through P94-04, monitoring locations V39 to V47) are installed in the till berm which surrounds the base of the rock dump and through which the transverse drains are intended to pass seepage water. Static water levels in these piezometers were monitored for physical stability assessments as described in Section 6 of this report. No water chemistry monitoring in these piezometers was required in 1999 and none was performed.

Figure 3.3 Vangorda Dump Piezos. Diss. Zinc

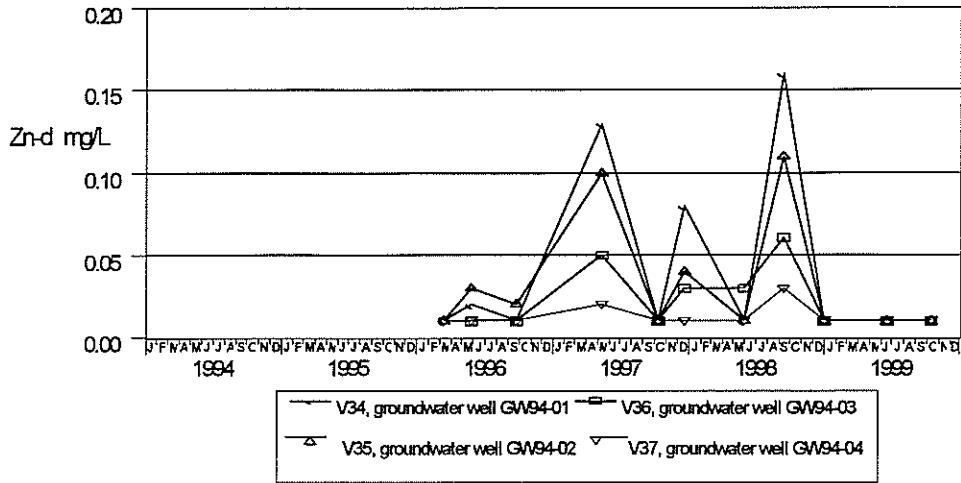
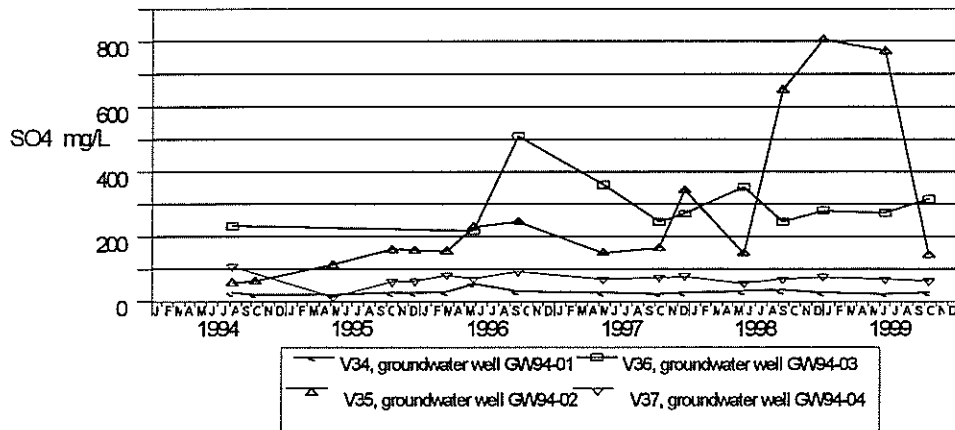


Figure 3.4 Vangorda Dump Piezos. Sulphate



3.3 WATER TREATMENT PLANT (V24, V25)

The water treatment plant located near the Grum pit is a conventional lime plant and the treatment process consists of pH modification using lime followed by enhanced settlement of metal hydroxides with the aid of flocculant. This process does not reduce ammonia concentrations except, possibly, via retention time in the clarification pond. During periods of past mining operations, the plant has been operated on an as-required basis to maintain acceptable water levels in in-pit sumps, Little Creek Dam and the Grum holding pond and the plant performed acceptable well.

The water treatment system was not operated during 1999. During 1999, run off water which accumulated in Little Creek Dam was pumped into the mined out Vangorda open pit as required to maintain an acceptable water level in Little Creek Dam.

Location V24 is the inflow to the treatment plant which includes water from the Grum pit via the holding pond and water pumped directly from Little Creek Dam. Location V25 is the outlet of the Clarification

Pond and is sampled weekly when there is outflow. No samples were collected at either of these locations in 1999.

3.4 GRUM DUMP TOE SEEPAGE (V14, V15, V16, P96-9A/B)

Locations V14, V15 and V16 are surface seepages at the toe of the ultimate (per design) Grum rock dump area. Locations V14 and V16 are not currently specifically located in the field but would become defined as part of possible future construction of a toe seepage collector ditch. No flow was observed in the areas intended for locations V14 or V16 during 1999 and no samples were collected.

Location V15 is located in a small draw which naturally collects some surface flow below the rock dump including the area occupied by the sulphide cell. A small sump was constructed at this location in the past and five samples were collected at location V15 in 1999. Water chemistry did not show a positive indication of the presence of acid generation products exiting the rock dump. Water chemistry at location V15 in 1999 showed neutral to slightly alkaline pH ranging from 7.6 to 8.5. The concentrations of total and dissolved zinc were relatively low through 1999 with peaks of only 0.04 mg/L and <0.01 mg/L, respectively. The peak concentration of total suspended solids in 1999 was only 8 mg/L in July. The concentration of sulphate during 1999 ranged from 200 to 330 mg/L with the peak concentration occurring in December. The flow at location V15 was generally consistent in a range from 0.5 to 1.0 Lps. The water present at location V15 enters Grum Creek upstream of sampling location V2.

Groundwater wells P96-9A and P96-9B are nested in one drill hole in a bedrock valley at least 20 metres deep near surface monitoring location V15. The groundwater wells allow monitoring of groundwater seepage passing through the Grum Creek channel area which drains a portion of the Grum rock dump including the sulphide cell. Each piezometer was sampled twice during 1999 and water chemistry did not show a positive indication of the presence of acid generation products exiting the dump. The deeper well (P96-9B) which is screened over the interval from 16.5 to 18.0 metres below surface flows during summer and fall (i.e. piezometric head higher than the ground elevation). The concentrations of dissolved zinc in the two piezometers during 1999 were all <0.01 mg/L and the concentrations of sulphate ranged from 167 mg/L to 190 mg/L with pH in a range from 7.0 to 7.7.

3.5 GRUM CREEK (V2, V2A)

Location V2 is in Grum Creek upstream of entry into Vangorda Creek. The changes to the water management system implemented during 1995 and 1996 allow for the diversion of a substantial portion of Grum Creek water towards the Moose pond where the water is observed to seep into the ground and enter the groundwater regime. This diversion was put into place as part of the mitigation plan for reducing suspended sediment loadings entering Vangorda Creek via Grum Creek. Diverted Grum Creek water is sampled at location V2A prior to entry into the Moose pond at times when the diversion is in place. Location V2 is sampled in addition to sampling at location V2A even during times when the Moose pond diversion is in place. The diversion of part of Grum Creek into the Moose Pond was implemented in June 1996 and remained in place through 1999.

Location V2 was sampled on five occasions in 1999. The concentrations of total suspended solids and total zinc at location V2 in 1999 were improved over previous years as illustrated on Figures 3.5 and 3.6. No freshet spike in the concentration of total suspended solids was observed in 1999 and the peak concentration was within the discharge limit at only 11 mg/L. The flow at location V2 during 1999 ranged from 0.5 to 1.5 Lps. The concentration of total zinc during 1999 ranged from 0.01 to 0.24 mg/L with the peak concentration occurring in September. The concentrations of dissolved zinc during 1999, however, were all <0.01 mg/L with the exception of one sample at 0.07 mg/L which corresponded to the peak concentration of total zinc in September.

Figure 3.5 Grum Creek (V2) Total Sus. Solids

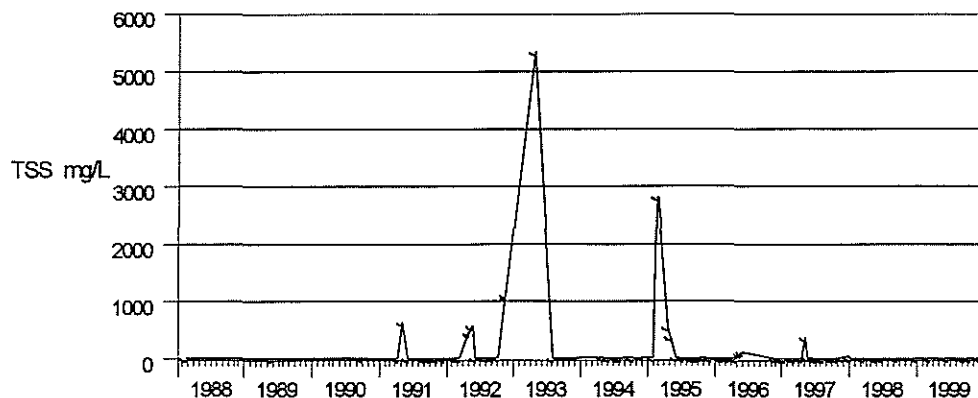
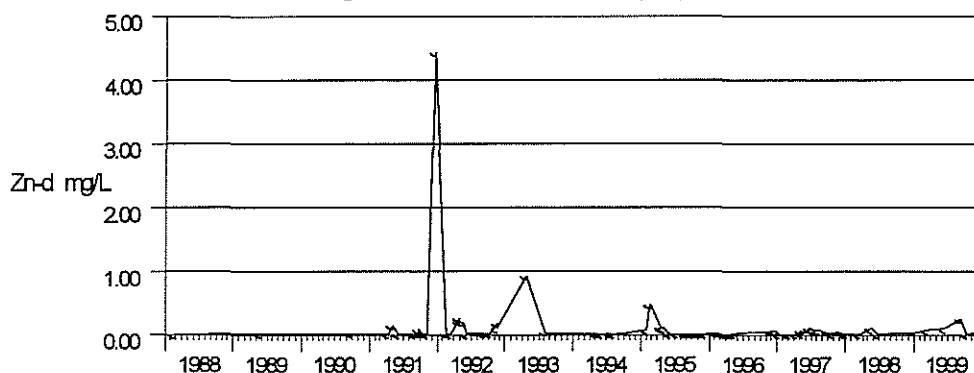


Figure 3.6 Grum Creek (V2) Total Zinc



Location V2A was sampled on three occasions in 1999. There was no flow present on other sampling occasions. Flow at location V2A ranged from 0 to 2 Lps. Water chemistry was generally good with metals at or near detection limits. The peak concentrations of total and dissolved zinc in 1999 were 0.08 mg/L and 0.05 mg/L, respectively, in September which correspond to the peak concentrations recorded for location V2.

3.6 VANGORDA CREEK PLUNGE POOL (V19, V25BSP)

Location V19 is the Vangorda north west interceptor ditch which drains into Vangorda Creek at the plunge pool. A sump was built during April 1996 near the discharge end of the V19 ditch which allows the low flows of ditch water to seep into the ground, thereby eliminating a flow of potentially high suspended sediment into Vangorda Creek.

One sample was collected at location V19 in 1999 in May. No flow was observed exiting the V19 ditch at other times during 1999. The concentration of total suspended solids in May 1999 was slightly greater than the maximum allowable discharge limit of 15 mg/L at 25 mg/L. The flow of water was for a brief period only while the ground in the bottom of the sump remained frozen. The concentrations of total and dissolved zinc in May 1999 were 0.19 mg/L and 0.09 mg/L, respectively.

Location V25BSP is not currently included in the licence but is necessary to monitor flow into Vangorda Creek from the Sheep Pad pond which was constructed during 1995 as part of the mitigative actions intended to minimize sediment loading into Vangorda Creek. The application for licence amendment currently under review includes the addition of location V25BSP to Schedule A of the licence.

Location V25BSP was sampled on five occasions in 1999 as flow allowed. There was no flow January through mid-May and no flow again from mid-September through to year end due to the absence of sufficient run off. Additionally, there was no flow for parts of May and June due to syphoning water from the Sheep Pad pond into the Vangorda pit. The syphoning was done to avoid the discharge of non-compliant concentrations of total suspended solids from the Sheep Pad pond during freshet as described below. In previous years, ferric sulphate and percol E10 flocculants were added into the inflow into the Sheep Pad pond to ensure settlement of fine clayey suspended particles which would not settle naturally. However, the lower flows passing through the Sheep Pad ponds following the cessation of mining operations and the absence of manpower and physical resources at the Vangorda Plateau site indicated that syphoning water into the Vangorda open pit was a more efficient means of maintaining compliance in 1999. An estimated 20,000 m³ of water was syphoned from the Sheep Pad pond into the Vangorda open pit in May and June 1999. Flows at location V25BSP in 1999 ranged from 0 to 5 Lps.

The concentration of total suspended solids at location V25BSP was greater than the maximum allowable discharge limit of 15 mg/L on two occasions in 1999. The concentrations of total suspended solids were 129 mg/L and 148 mg/L on May 18 and May 27, respectively. The corresponding concentration of total suspended solids at the inflow to the Sheep Pad pond (location INSPOND) on May 18 was 299 mg/L which indicated that partial settlement was occurring in the Sheep Pad pond. The corresponding concentration of total suspended solids in Vangorda Creek immediately downstream of the plunge pool mixing zone (location V19CULVERT) was 38 mg/L on May 18 which indicated that the inflow of water from location V25BSP was diluted in Vangorda Creek by a factor of approximately 3.5 times. The syphoning of water from the Sheep Pad pond into the Vangorda open pit as described above was implemented in May as a means of preventing the continued discharge of non-compliant concentrations of total suspended solids into Vangorda Creek.

The concentrations of total and dissolved zinc at location V25BSP which correspond to the elevated concentrations of total suspended solids on May 18 were compliant at 0.19 mg/L and 0.05 mg/L, respectively. The peak concentrations of total and dissolved zinc at location V25BSP in 1999 were 0.38 mg/L and 0.72 mg/L, respectively, in August although the concentration of dissolved zinc of 0.72 mg/L is considered unreliable given that it is nearly twice the corresponding concentration of total zinc.

3.7 AEX CREEK (V17A, V6A)

Location V17A is not currently included in the water licence but is proposed as a replacement for location V17 in the licence amendment application currently under review. Location V17A is a small stream which contains natural run off from the slopes north of the Grum pit as well as surface run off from the north side of the Ore Transfer Pad. This stream then passes into AEX Creek which is sampled further downstream at location V6A.

Location V17A was sampled on two occasions in 1999 in July and September. There was no flow during the winter season. In 1999, the concentrations of total and dissolved zinc ranged from 0.03 mg/L to 0.06 mg/L and from <0.01 mg/L to 0.02 mg/L and the concentration of sulphate ranged from 6 mg/L to 7 mg/L.

Location V6A is AEX Creek immediately prior to entry into the west fork of Vangorda Creek and was sampled on five occasions in 1999. The concentrations of total zinc in 1999 ranged from 0.01 mg/L to 0.08 mg/L and the concentrations of dissolved zinc in 1999 were all <0.01 mg/L. The concentrations of sulphate in 1999 ranged from 10 mg/L to 46 mg/L.

4. RECEIVING AND BACKGROUND WATER QUALITY

4.1 SHRIMP CREEK (V4)

Location V4 is Shrimp Creek upstream of the confluence with the main fork of Vangorda Creek. This location provides reference information regarding background water quality.

There were four samples collected at location V4 during 1999. The water at location V4 continued to be harder than the other background water quality reference location in Vangorda Creek (V1) as has been observed in previous years. The increased hardness may be due to the presence of calcareous phyllites in the drainage area of Shrimp Creek which are not present in the drainage area of Vangorda Creek above location V1. Metal concentrations in Shrimp Creek were generally at or near detection limits in 1999 with the exception of total zinc which was measured as high as 0.07 mg/L in June. The concentrations of dissolved zinc in 1999 were all <0.01 mg/L.

4.2 UPPER VANGORDA CREEK (V1, V27)

"Upper" Vangorda Creek is the primary receiving water for mine site discharges and is sampled upstream of mine activities at V1, and locally downstream of mine activities at V27 above the confluence with Shrimp Creek. There is no known fish habitat in "upper" Vangorda Creek due to natural impasses near the town of Faro.

Location V1 is the main fork of Vangorda Creek immediately upstream of mine activities. This location provides information regarding background water quality upstream of the mine site.

There were five samples collected at location V1 during 1999. During 1999, pH ranged from 6.8 to 8.1, sulphate concentrations ranged from 3 to 13 mg/L, and hardness ranged from 9 to 56 mg/L. The concentrations of most total metals were at or near detection limits with the exceptions of total zinc which was unusually elevated at 0.24 mg/L in June and total iron which ranged from 0.07 to 4.2 mg/L. The concentration of total suspended solids was low throughout the year at less than 3 mg/L.

Location V27 is the main fork of Vangorda Creek upstream of the confluence with Shrimp Creek and provides information regarding the impact on Vangorda Creek from mining activities on the Vangorda Plateau. All surface water from the Grum rock dump, the Grum interceptor ditch/Sheep Pad Pond, and the Vangorda north east interceptor ditch reports to location V27 via Grum Creek or the Vangorda Creek plunge pool.

There were five samples collected at location V27 during 1999. The peak concentration of total zinc was 0.07 mg/L in March. The peak concentration of dissolved zinc was 0.02 mg/L in July and October. The highest concentration of sulphate in 1999 was 46 mg/L in March and ammonia was measured at <0.05 mg/L for all samples.

4.3 LOWER VANGORDA CREEK (V5, VGMAIN, V8)

"Lower" Vangorda Creek is near the town of Faro in the juvenile fish rearing habitat in the first 1 to 2 km above the mouth of the creek. The west fork of Vangorda Creek represents natural run off and some minesite drainage originating from location V6A in AEX Creek, the Vangorda ore haul road and a calcareous phyllite portion of the Grum rock dump. The main fork of Vangorda Creek represents natural run off plus drainage from the minesite via location V27 and also includes flow from Shrimp Creek via location V4.

Location V5 is the west fork of Vangorda Creek upstream of the confluence with the main fork. Location V5 receives drainage from AEX Creek and, thereby, potential influences from surface drainage from the

north portion of the Ore Transfer Pad. Both AEX and West Fork Vangorda Creeks receive drainage from the Vangorda ore haul road and the mine access road. Road maintenance activities such as re-surfacing or application of dust suppression products or spills could potentially affect water quality at V5. There is a small portion of the Grum calcareous phyllite rock dump which drains into the west fork of Vangorda Creek between AEX Creek and location V5. This portion of the Grum rock dump does not include any part of the sulphide cell.

There were ten samples collected at location V5 during 1999. The concentration of total suspended solids was elevated from May through July 1999 at 100 mg/L to 731 mg/L. The source of the suspended solids was not clearly identified except as being downstream of the mine developments and between the mine access road at the Grum turn off and the ski hill road. The concentration of total suspended solids at the mine access road crossing at the Grum turn off (and downstream of the mine developments) was 33 mg/L on June 20, 1999 when the concentration at downstream location V5 was 731 mg/L. The concentration of total suspended solids at location V5 during the remainder of 1999 was less than 29 mg/L. The concentrations of total iron and total aluminum at location V5 were also elevated from May through July 1999 in concert with the elevated concentrations of total suspended solids indicating that the source of these metals may have been clayey sediment in suspension. There were no corresponding elevated concentrations of total zinc from May to July 1999.

The concentrations of sulphate and hardness at location V5 continued to exhibit a general seasonal trend during 1999 in which these concentrations were greater during the winter season when surface run off was at a minimum. These observations are in agreement with previous hypotheses that groundwater seepage from the Red River and Earn Group rocks is responsible for the observed trends in sulphate in the West Fork and lower section of Vangorda Creek and that seepage from Vangorda Formation rocks is similarly responsible for observed seasonal trends in hardness in the West Fork and lower Vangorda Creek. The ranges in concentrations of sulphate and hardness at location V5 in 1999 were from 34 to 532 mg/L and from 126 to 1161 mg/L, respectively.

Location VGMAIN is an informal (non licence) sampling location located in the main fork of Vangorda Creek immediately upstream of the confluence with the west fork. Water chemistry at this location provides important information regarding the relative impacts of the main and west forks on the fish rearing habitat in lower Vangorda Creek. Although licence location V27 is also in the main fork, location V27 is several kilometers upstream of the confluence with the west fork and it is difficult to apply water chemistry data from location V27 in an analysis of lower Vangorda Creek because of the potential for numerous and unquantified impacts on the main fork between location V27 and the confluence with the west fork.

A total of five samples were collected at location VGMAIN in 1999. The concentration of total suspended solids at location VGMAIN followed the established trend for this location with generally low concentrations and a brief spring spike (125 mg/L on June 20). The concentration of ammonia was low with a peak concentration of only 0.07 mg/L. The peak and average concentrations of total zinc in 1999 were 0.12 mg/L and 0.06 mg/L, respectively. The peak concentration of total zinc occurred in June and corresponded to the peak concentration of total suspended solids. The peak concentration of dissolved zinc in 1999 also occurred on June 20 at 0.03 mg/L.

The concentrations of sulphate and hardness at location VGMAIN followed a seasonal trend in 1999 as observed for location V5 with higher concentrations observed in the winter season. The ranges in concentrations of sulphate and hardness in 1999 at location VGMAIN were from 7 to 126 mg/L and from 34 to 298 mg/L, respectively.

Location V8 is in the Vangorda Creek fish rearing area near the confluence with the Pelly River. There were ten samples collected at location V8 during 1999.

The concentration of total suspended solids at location V8 was elevated from May through July 1999 in concert with elevated concentrations at upstream location V5 as described above. The peak concentration of total suspended solids at location V8 in 1999 was 184 mg/L on June 20. The concentrations of total suspended solids during the remainder of 1999 (excluding May through July) were less than 12 mg/L.

The highest concentration of total zinc observed at location V8 during 1999 was 0.09 mg/L on June 20. This peak concentration corresponds to the peak concentration of total suspended solids as described above and also corresponds to the peak concentration of total zinc at upstream location VGMAIN. The peak concentration of dissolved zinc in 1999 also occurred on June 20 at 0.03 mg/L.

The peak concentration of total lead at location V8 in 1999 was 0.04 mg/L in December. Concentrations of ammonia were all less than the method detection limit of 0.05 mg/L in 1999. The concentrations of total aluminum and total iron were as high as 2.6 mg/L and 4.6 mg/L, respectively, in June which corresponded to the peak concentration of total suspended solids.

The trend in the concentration of sulphate at location V8 closely followed that at location V5 during 1999 in a range from 12 mg/L to 238 mg/L. The hardness observed at location V8 in 1999 ranged from 37 mg/L to 462 mg/L and closely followed the trend described for locations V5 and VGMAIN with greater hardness recorded in the winter season when surface flows were at a minimum.

The concentrations of total suspended solids, total zinc, total sulphate and hardness for locations V5, VGMAIN and V8 during 1998 and 1999 are illustrated on Figures 4.1 through 4.4, respectively.

Figure 4.1 Lower Vangorda Creek T.S.S.

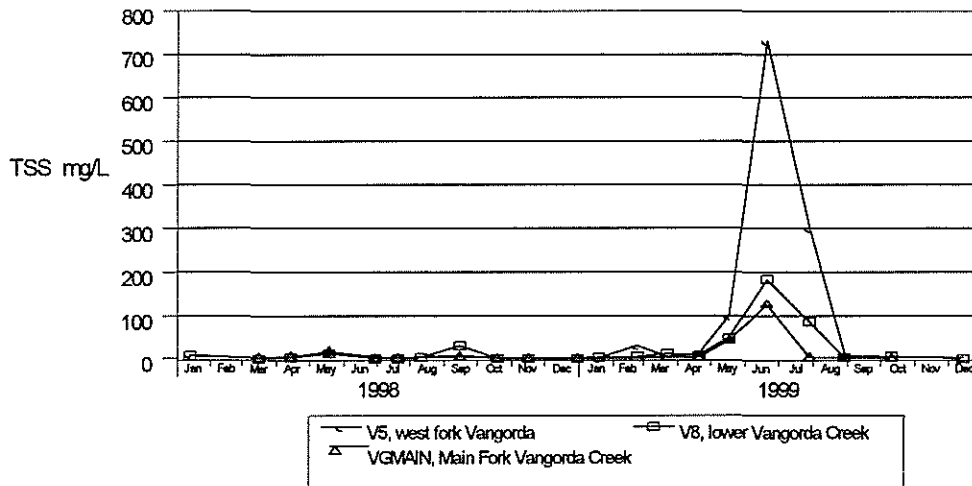


Figure 4.2 Lower Vangorda Creek Total Zinc

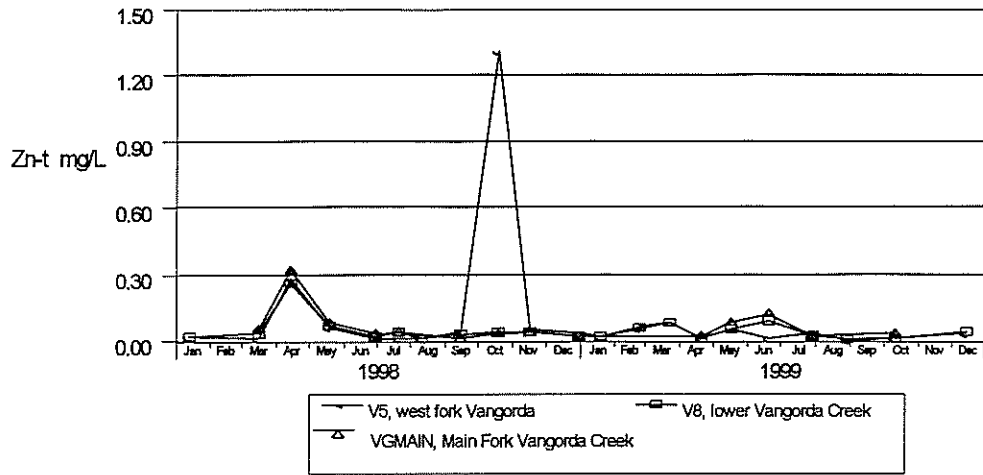


Figure 4.3 Lower Vangorda Creek Sulphate

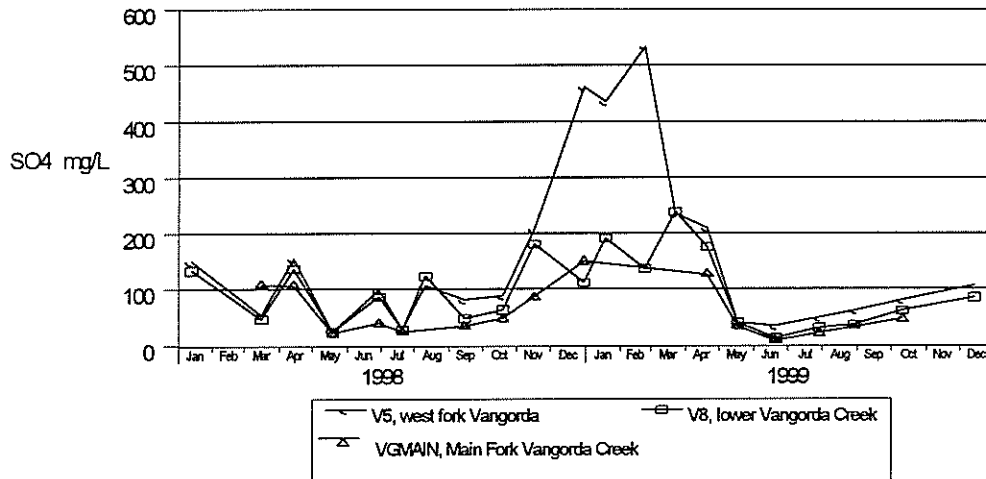
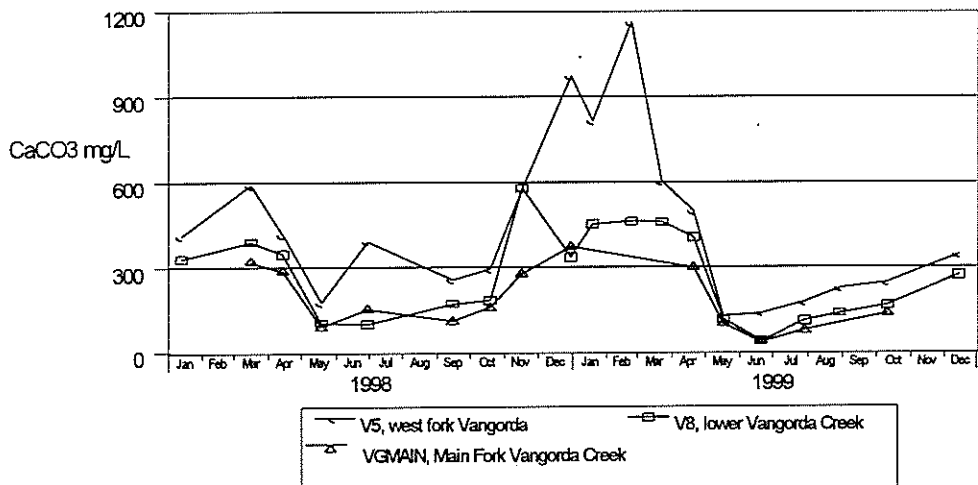


Figure 4.4 Lower Vangorda Creek Hardness



4.4 LONG TERM TRENDS IN LOWER VANGORDA CREEK

The longer term trends in water quality in lower Vangorda Creek from 1988 to 1999 indicate that mining activities on the Vangorda Plateau have had an influence on concentrations of total suspended solids, total zinc, total lead and ammonia in lower Vangorda Creek. It is also evident that water chemistry in the West Fork (V5) can have a significant effect on water chemistry in lower Vangorda Creek particularly for total suspended solids and sulphate and that the presence of these parameters in the West Fork is unrelated to current activities at the mine site. There are also likely sources of suspended sediments entering Vangorda Creek in the main fork below the minesite and in lower Vangorda Creek below the confluence of the main and west forks.

During the period 1988 to 1990 (3 years), there was a relatively small amount of work done in overburden stripping for the Grum Open Pit. Although relatively few water samples were collected during this period, the water quality at location V8 during this period could be taken as representative of conditions largely unaffected by mine operations. This is evident through relatively low concentrations of total suspended solids, total zinc, ammonia, total lead and arsenic although the concentration of total zinc was recorded at or just greater than the recommended guideline for the protection of freshwater aquatic life (CCREM) on two occasions. The average concentration of total suspended solids during this period was 12 mg/L with a peak value of 30 mg/L late in 1990. The average and peak concentrations of total zinc were 0.024 mg/L and 0.036 mg/L, respectively.

During 1991 and 1992, a substantial overburden stripping program was carried out on the Vangorda Plateau, mining was performed in the Vangorda Open Pit and the Vangorda ore haul road was constructed. The effect of this mining activity is reflected in the water quality in lower Vangorda Creek. The concentrations of total suspended solids, total zinc, total lead and ammonia all show an increase in average and peak values during this period. The average concentration of total suspended solids during this period was 62 mg/L with a peak value of 590 mg/L in spring 1991. Similarly, the average and peak concentrations of total zinc were 0.06 mg/L and 0.36 mg/L, respectively.

During 1993 and 1994, no mining operations were performed on the Vangorda Plateau. Although fewer water samples were collected during this period than during the previous operating period, reduced levels of total suspended solids and total zinc were observed in lower Vangorda Creek. The reduced levels were generally greater than those observed during the period preceding mine activities (1988 to 1990). The average concentration of total suspended solids during 1993 and 1994 was 40 mg/L with a peak value of 112 mg/L in spring 1994. Similarly, the average and peak concentrations of total zinc were 0.03 mg/L and 0.11 mg/L, respectively.

During 1995, 1996 and 1997, mining activities on the Vangorda Plateau were resumed including operation of and discharge of treated effluent from the water treatment plant. Even in light of the resumption of mine operations, water chemistry in lower Vangorda Creek during this period did not show a return to the chemistry observed during the previous period of mine operations on the Vangorda Plateau (1991 and 1992). The concentrations of total suspended solids, total zinc, total lead, ammonia and arsenic observed from 1995 through 1997 remained similar to those observed during the shut down period of 1993 and 1994. During the period from 1995 to 1997, the average concentration of total suspended solids was 29 mg/L with a peak value of 271 mg/L. Similarly, the average and peak concentrations of total zinc were 0.04 mg/L and 0.12 mg/L, respectively.

In 1998 and 1999, mining activities were again suspended including cessation of discharge of treated effluent from the water treatment plant. The water chemistry observed in lower Vangorda Creek during 1998 and 1999 was generally similar to that observed during the preceding period of mine operation (1995 through 1997) with the exception of the elevated concentrations of total suspended solids during May, June and July 1999 which, as described above, did not appear to originate from the mine developments. During the period from 1998 to 1999, the average concentration of total suspended solids

was 20 mg/L with a peak value of 184 mg/L. The average and peak concentrations of total zinc were 0.05 mg/L and 0.26 mg/L, respectively.

Long term water quality for selected parameters is illustrated on Figures 4.5 through 4.12.

Figure 4.5 Long Term Trends Vang. Ck. - TSS

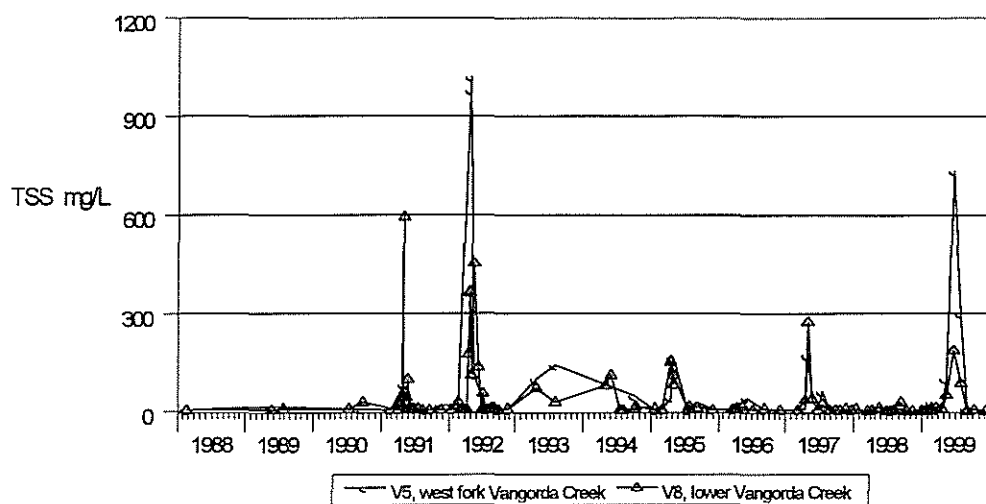


Figure 4.6 Long Term Trends Vang. Ck. - Zn-t

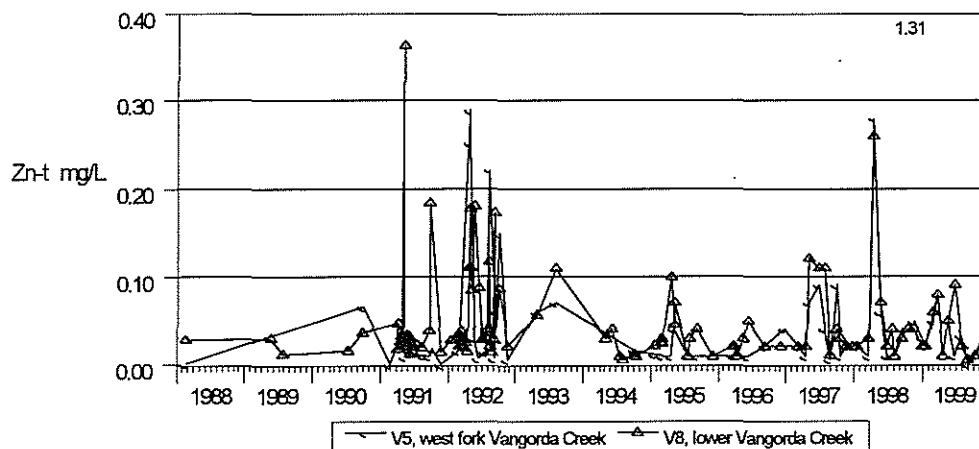


Figure 4.7 Long Term Trends Vang. Ck. - Pb-t

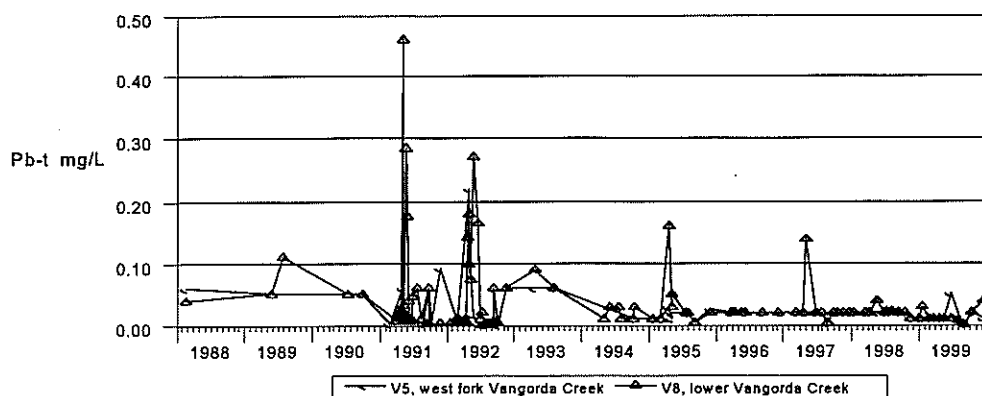


Figure 4.8 Long Term Trends Vang. Ck. - NH3

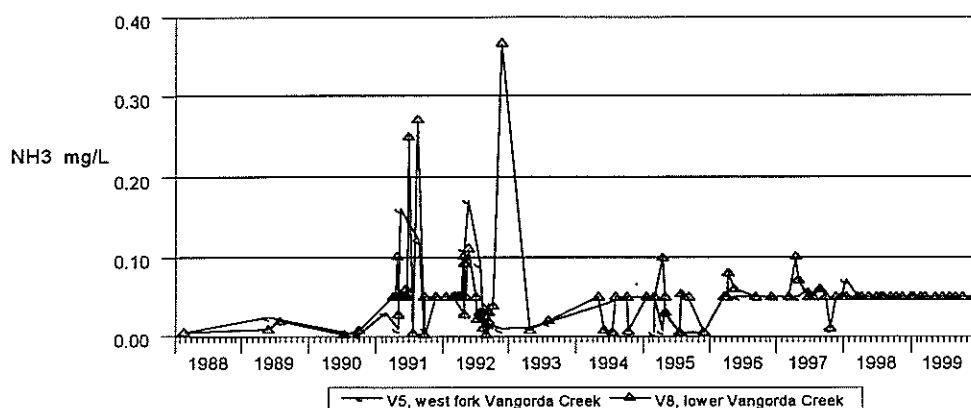


Figure 4.9 Long Term Trends Vang. Ck. - As-t

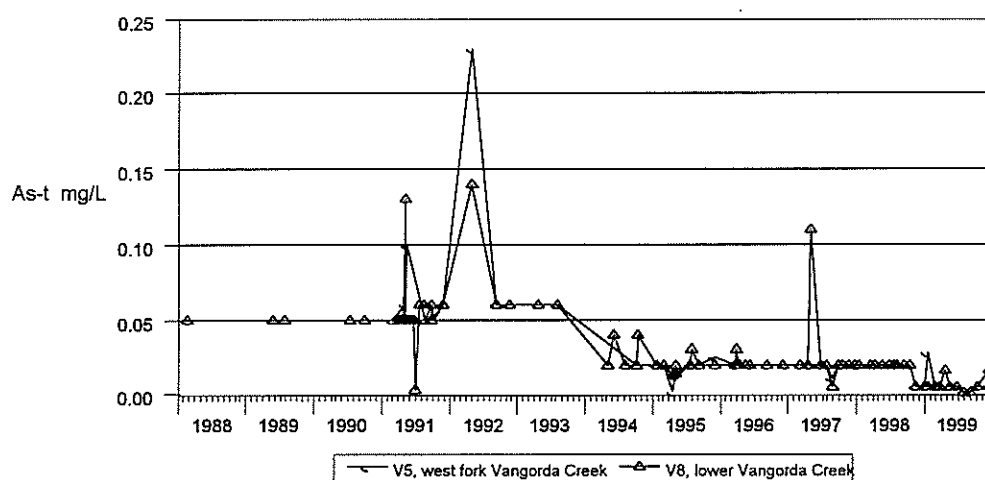


Figure 4.10 Long Term Trend Vang. Ck. - SO₄

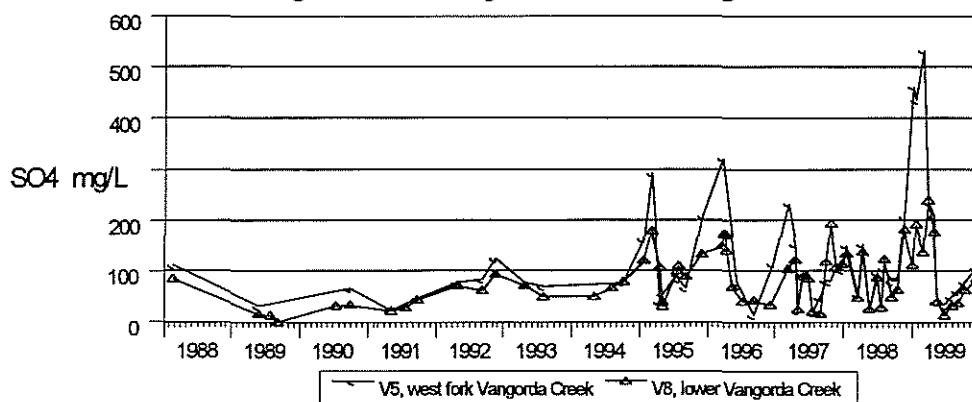


Fig. 4.11 Long Term Trend Vang Ck Hardness

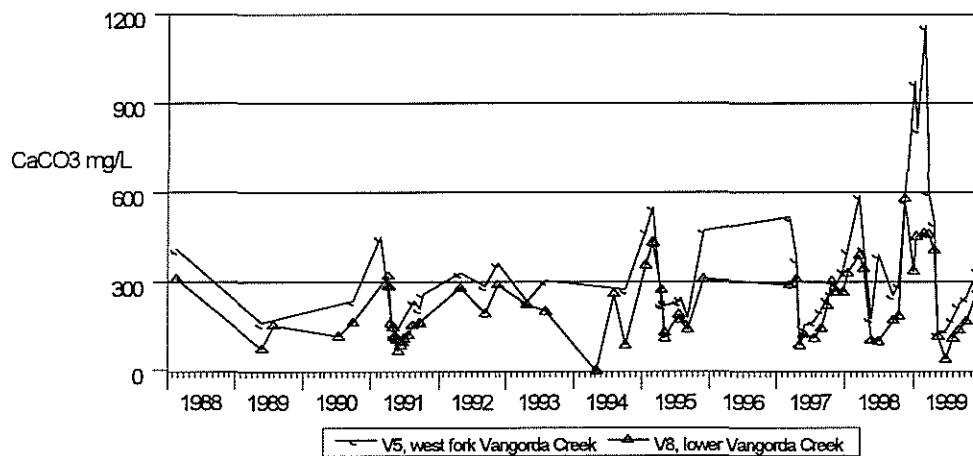
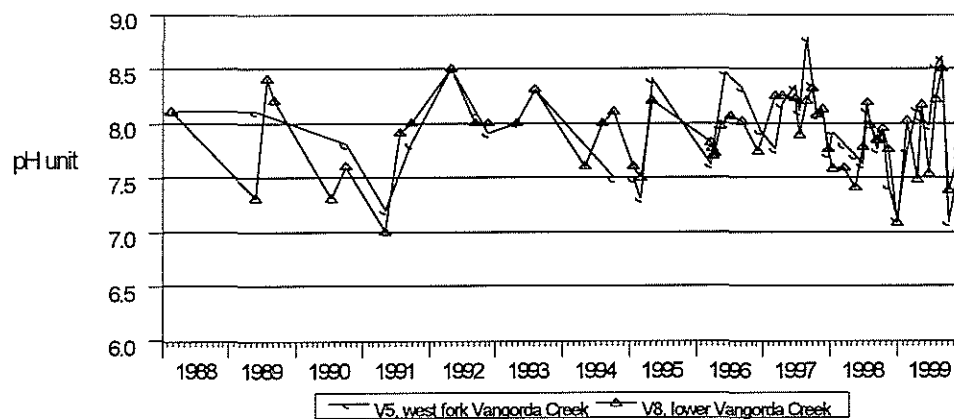


Figure 4.12 Long Term Trend Vang. Ck. - PH



Measured flow volumes in the West Fork (V5) and lower Vangorda Creek (V8) are illustrated on Figure 4.13. A total of 21 corresponding flow measurements at V5 and V8 spanning 1991 to 1999 are listed on Table 4.1 which indicate that, on average, the West Fork contributes 33% of flow to lower Vangorda Creek with a range from 21% to 49%.

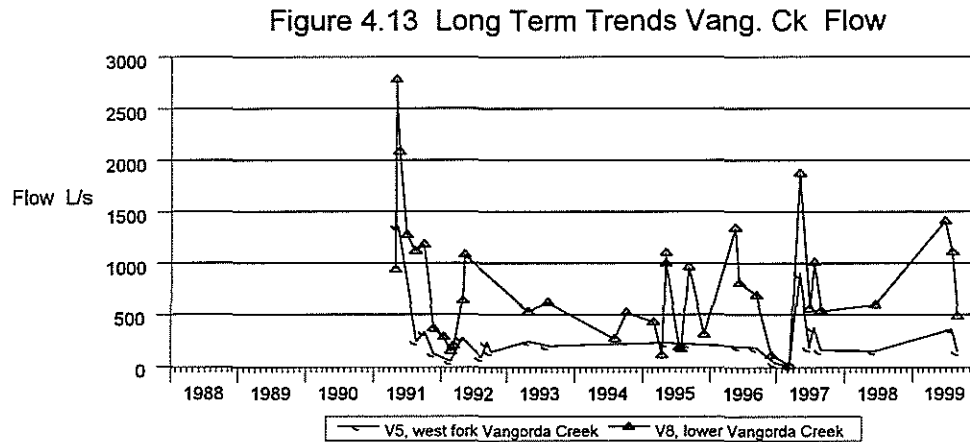


TABLE 4.1
COMPARISON OF MEASURED FLOWS AT V5 AND V8 TO END OF 1998

STATION: V5		STATION: V8		% V5/V8
Date	FLOW L/s	Date	FLOW L/s	
07/05/91	1358	07/05/91	2778	49%
22/08/91	249	15/08/91	1116	22%
11/10/91	334	04/10/91	1182	28%
26/11/91	131	25/11/91	372	35%
28/02/92	51	28/02/92	153	33%
28/04/92	280	28/04/92	634	44%
26/04/93	243	26/04/93	533	46%
02/08/93	207	02/08/93	620	33%
09/05/95	230	09/05/95	1096	21%
12/09/95	224	12/09/95	960	23%
11/06/96	195.3	11/06/96	801	24%
11/09/96	191.6	11/09/96	687	28%
19/12/96	35	05/12/96	110	32%
10/03/97	7	10/03/97	15	47%
05/05/97	892	05/05/97	1873	48%
30/06/97	185	30/06/97	566	33%
24/07/97	379	24/07/97	1007	38%
28/08/97	162	28/08/97	541	30%
10/06/98	152	10/06/98	594	26%
29/07/99	364	29/07/99	1101	33%
31/08/99	144	30/08/99	484	30%
				AVG 33%
				MAX 49%
				MIN 21%
				COUNT 21
				MEDIAN 33%

5. BENTHIC, SEDIMENT, AND WILDLIFE MONITORING

5.1 SEDIMENT MONITORING

Water licence IN89-002 requires monitoring of metal levels in sediments in Vangorda Creek every two years and this monitoring program was performed during 1999 by Laberge Environmental Services of Whitehorse. The available database of sediment metal concentrations in Vangorda Creek now includes 1991, 1993, 1995, 1996, 1997 and 1999 as listed on Table 5.1 and as described in the consultant report in Appendix 2.

The 1999 sediment sampling locations were the routine locations normally used for this program and included an upstream reference location (V1), locations downstream of mine activities in the main and west forks (V27 and V5, respectively) and lower Vangorda Creek in the juvenile fish rearing area near the creek mouth (V8).

The concentrations of copper, lead and zinc were compared to the CCME (1999) interim freshwater sediment quality guidelines (ISQG) and to the probable effects level (PEL) where generally concentrations greater than the PEL have a 50% incidence of creating adverse biological effects (Table 5.1). Concentrations of copper, lead and zinc at locations V1 and V5 are generally at or just above the ISQG levels. Concentrations of copper, lead and zinc at location V27 are generally the highest of all sampled locations and concentrations of lead and zinc at location V27 exceed the PEL level. Concentrations of copper, lead and zinc at location V8 in the fish habitat area are generally between the LEL and SEL levels with the exception of one anomalously high lead concentration in 1991.

TABLE 5.1 SEDIMENT METAL CONCENTRATIONS

Site	Cu						Pb						Zn					
	91	93	95	96	97	99	91	93	95	96	97	99	91	93	95	96	97	99
V1	-	24	33	23	53	39	-	30	43	40	58	45	-	119	177	118	132	141
V27	-	52	59	80	88	129	-	587	1305	870	1492	2069	-	435	519	732	652	921
V5	-	28	36	29	36	25	-	23	52	25	35	30	-	97	129	102	100	81
V8	57	37	48	54	36	29	1801	214	218	201	114	89	321	251	391	466	221	143
ISQG	36						35						123					
PEL	197						91						315					

NOTES: 1991 data from Environment Canada study referenced in the ICAP.

1993 through 1999 data collected by Laberge Environmental Services for the licensee.

Data shown for 1993, 1995, 1997 and 1999 are averages of triplicate sampling

Location V1 provides information representative of conditions upstream of the mine area. The concentrations of copper, lead and zinc at location V1 from 1991 through 1999 ranged from 23 to 53 ppm, 30 to 58 ppm, and 118 to 177 ppm, respectively. These concentrations are all close to the ISQG which are 36 ppm, 35 ppm and 123 ppm for copper, lead and zinc, respectively.

Sediment metal concentrations at V5 in the West Fork are close to the range of background concentrations defined at V1. This indicates that there has been no observable contamination of sediments in the West Fork. The concentrations of copper, lead and zinc at location V5 from 1991 through 1999 ranged from 28 to 36 ppm, 23 to 52 ppm, and 81 to 129 ppm, respectively. The consultant report attached in Appendix 2 makes the observation that the sediments at location V5 appeared, in 1999, to be finer than at other locations and that it appeared that significant deposition had occurred.

Sediment metal concentrations at V27 in the Main Fork below the minesite are notably elevated relative to the other monitored locations. It is likely that elevated sediment metal concentrations were present immediately below the mine area even prior to development of the mine site as a result of erosion of mineralized outcroppings. Anecdotal evidence relates that a gossan zone existed generally between locations V1 and V27 which could have supplied readily transportable gossan sediments into Vangorda Creek. The concentrations of copper at location V27 have increased over time from 52 ppm in 1993 to

129 ppm in 1999. The concentrations of lead at location V27 have also increased over time from 587 ppm in 1993 to 2,069 ppm in 1999 although the trend was not followed in 1996. The concentrations of zinc at location V27 have also increased over time from 435 ppm in 1993 to 921 ppm in 1999 although the trend was not followed in 1997. The concentrations of copper were all between the ISQG (36 ppm) and PEL (197 ppm) and the concentrations of lead and zinc were all greater than the PEL (91 ppm lead and 315 ppm zinc).

Sediment metal concentrations at V8 in lower Vangorda Creek are elevated above the upstream reference as defined at V1 and less than the concentrations observed at location V27 immediately downstream of the minesite. Physical redistribution of sediments from upstream locations may be a mechanism related to the observed metal concentrations at location V8. This is supported by anecdotal evidence which relates that a ditch was accidentally cut through the gossan zone referenced above which resulted in the accidental transport of metal rich sediments into Vangorda Creek in 1989 or 1990.

The sediment concentrations of copper and lead at location V8 in 1991 were the highest on record for this location. In fact, the 1991 sediment lead concentration of 1801 ppm is much greater than any recorded result for any of the sampled locations and is considered anomalous. Sediment copper concentrations at V8 from 1991 to 1999 were within the range observed at unaffected upstream reference location V1. Sediment lead concentrations at V8 have decreased from 214 ppm and 218 ppm in 1993 and 1995, respectively, to 89 ppm in 1999 which is less than the PEL (91 ppm). Sediment zinc concentrations at V8 have remained between the ISQG (123 ppm) and PEL (315 ppm) from 1991 through 1999 and have been decreasing from 1996 through 1999.

5.2 BENTHIC MONITORING

Water licence IN89-002 requires monitoring of benthic invertebrate populations in Vangorda Creek every two years and this monitoring program was performed during 1999 by Laberge Environmental Services of Whitehorse. The available database of benthic population data in Vangorda Creek now includes 1991, 1993, 1995, 1997 and 1999 as listed on Table 5.2 and described in the consultant report in Appendix 2.

The 1999 benthic sampling locations were the routine locations normally used for this program and included an upstream reference location (V1), locations downstream of mine activities in the main and west forks (V27 and V5, respectively) and lower Vangorda Creek in the juvenile fish rearing area near the creek mouth (V8).

The 1999 program verified that mining activities and some elevated sediment metal concentrations have not had an observable impact on benthic communities in Vangorda Creek and that "overall the community structure appears to be stable over time". The total abundance of organisms, the diversity of taxonomic groups and the number of pollution sensitive taxa present at each sampled location were similar to those observed in previous years as listed on Table 5.2.

In order to allow a meaningful comparison over time of data regarding taxonomic richness, the data for the years 1995, 1997 and 1999 were modified to correspond to the less detailed enumerations previously performed. This is reflected on Table 5.2 by presentation of two numbers for taxonomic richness for 1995, 1997 and 1999. The two numbers represent the actual reported number per the current more rigorous enumeration to a genera or species level and the modified number per the previously utilized and less detailed enumeration to a family level only. Refer to the consultant report in Appendix 2 for further information on this matter.

Location V5 in the west fork of Vangorda Creek displayed the greatest abundance of organisms in 1999 (1,284) and location V8 in lower Vangorda Creek displayed the lowest abundance of organisms in 1999 (1,025). The abundance results for all four monitored locations were within or close to the ranges observed from 1991 to 1997.

Location V5 also displayed the greatest taxonomic richness in 1999 (55) and location V1 upstream of the minesite displayed the lowest in 1999 (32). The taxonomic richness results for all four monitored locations were within or close to the ranges observed in 1995 and 1997. 1995 was the first year that similar calculation methodology was used as described above and in the consultant report in Appendix 2.

The number of pollution sensitive taxa enumerated in 1999 at all four monitored locations was within or close to the ranges observed from 1991 through 1997. Location V8 in lower Vangorda Creek displayed the greatest number of pollution sensitive taxa in 1999 (9 of 11 possible). Locations V1 and V27 displayed the lowest number of pollution sensitive taxa in 1999 (7 of 11 possible).

TABLE 5.2 BENTHIC MONITORING

Site	TA					TR					SEN				
	91	93	95	97	99	91	93	95*	97*	99*	91	93	95	97	99
V1	763	3090	1758	1663	1025	17	19	26(34)	29(42)	20(32)	6	7	8	9	7
V27	953	5952	4929	11751	1061	24	17	28(38)	29(37)	23(37)	6	5	9	8	7
V5	1298	2193	1550	9291	1284	29	21	28(42)	38(55)	32(55)	7	6	8	9	8
V8	594	3024	8340	904	1061	22	19	35(48)	25(41)	28(45)	6	6	8	6	9

NOTES: Data repeated from Laberge Environmental Services, March 1999.

"TA": total abundance; "TR": taxonomic richness; "SEN": number pollution sensitive taxa (11 possible)

"*": number in parentheses represents the true TR enumerated below the family level (refer to text).

5.3 WILDLIFE MONITORING

The Fannin Sheep were observed at the minesite during their seasonal migrations to and from the wintering grounds on Sheep Mountain. The sheep were primarily observed in the vicinity of the Sheep Pad pond. Sheep tracks were observed on the Grum Creek road below the Grum rock dump which agrees with observations in previous years of the sheep traveling down that road toward their winter range.

Bears, moose and foxes were sighted on and near the minesite on numerous occasions during 1999.

6. GEOTECHNICAL MONITORING

The annual physical monitoring program required under Part D Section 6 of the licence was performed in June 1999 by Mr. Peter Healey of SRK (Steffen, Robertson and Kirsten Inc.). The SRK report is appended as Appendix 3 and the following summary is provided.

The inspection looked at the geotechnical performance and stability of the following structures: Vangorda rock dump and seepage collection system, Little Creek Dam, Vangorda Creek diversion, Clarification Pond, Sheep Pad ponds and Grum rock dumps.

The recommendations resulting from the inspection are summarized as follows:

- maintenance work in the Vangorda rock dump seepage collection channel,
- maintenance work at Little Creek Dam,
- continue monitoring of piezometers and thermistors,
- monitor for tension cracking and seeps related to dams and dykes,
- install water control structures at approach to Little Creek Dam,
- place protective granular cover on crest of Little Creek Dam,
- repair various rip rap structures at culvert inlets and Vangorda Creek diversion,
- conduct a stability analysis of the rock wall overlooking the Vangorda Creek diversion flume,
- conduct a hydrology analysis of the capacity of the Vangorda Creek plunge pool,
- maintenance work and monitoring on Clarification and Sheep Pad pond dykes,
- maintenance and rip rap upgrading along the Grum interceptor ditch,
- removal or reclamation of culvert upstream of Sheep Pad ponds.

The SRK study included a review of all available data collected from monitoring of piezometers and thermistors related to the Vangorda rock dump and Little Creek Dam. No significant trends were identified and no concerns were noted.

The following physical maintenance tasks were completed in 1999 based on recommendations in the 1998 and 1999 SRK reports and best management planning:

- filled in small depression at south end of Little Creek Dam,
- constructed water diversion above Vangorda rock dump drain #6 and cleaned out gravel drain,
- installed outflow flume at the 1998 emergency overflow culvert at Little Creek Dam and increased rip rap protection associated with the emergency overflow structure,
- dressed erosion gullies along upstream face of Little Creek Dam,
- removed and reclaimed the culvert upstream of the Sheep Pad ponds.

7. WATER TREATMENT PLANT PERFORMANCE

The Water Treatment Plant was not operated during 1999. Therefore, no performance report on the operation of the plant is required for 1999.

The water treatment plant was shut down in an orderly manner at the cessation of mining activities in January 1998 such that all lines and tanks were drained of water. Electrical power to the plant was cut off at the time of shut down and remained disconnected through 1999.

8. TECHNICAL ADVISORY COMMITTEE

One TAC (Technical Advisory Committee) meeting was held in 1999 in June. The meeting was held in Faro and involved tours of the Faro and Vangorda Plateau minesites. The meeting was attended by representatives of:

Anvil Range Mining Corp. (Interim Receivership)
Deloitte & Touche Inc. as receivers for Anvil Range Mining Corporation
DIAND - Mineral Resources
DIAND - Mining Land Use
DIAND - Water Resources
Selkirk First Nation
Town of Faro
YTG - Economic Development
YTG - Renewable Resources

The topics discussed at the meeting were primarily concerned with current environmental issues and on-going environmental management of the minesites during the interim receivership.

A list of the attendees, agenda and minutes for the meeting are included in Appendix 4.

9. PHYSICAL MAINTENANCE WORK

9.1 LITTLE CREEK DAM EMERGENCY OVERFLOW

An emergency overflow system for Little Creek Dam was designed and constructed during 1998 and was described in the 1998 Annual Environmental Report for the Vangorda Plateau.

At the recommendation of Steffen Robertson Kirsten Inc. as designers of the system, an addition was made in 1999. A ½ culvert exit flume was installed at the outflow from the buried overflow pipe in order to ensure that water flowing out of the overflow pipe would impact on the plunge pool water and not on the rip rap approach to the plunge pool.

Additional rip rap was added at the upstream and downstream ends of the buried overflow pipe as per the recommendations of SRK and the lowest section of the exit channel was upgraded with additional rip rap.

This work is also described with photographs in the consultant report in Appendix 3.

9.2 VANGORDA CREEK DIVERSION FLUME

A fall of rock occurred in June 1999 from the sub vertical rock wall which overlooks one section of the Vangorda Creek diversion flume. The fall of rock blocked creek flow and damaged several of the 2.4 metre diameter ½ culvert flume sections. The rock debris was removed and a length of approximately 39 metres of the flume sections were replaced as soon as possible following the rock fall. The rock face was scaled from the bottom using the CAT235 excavator at that time.

In September 1999, additional rock debris sloughed into the flume at the same location as the rock fall of June 1999. In September 1999, however, there was no significant damage to the flume sections, the sloughed material was removed and normal creek flow was resumed.

Details regarding the work that was completed in 1999 and recommendations for follow up work are described in a report on the subject which is included in Appendix 7.

9.3 VANGORDA ROCK DUMP TILL BERM WATER CONTROL DITCH

A water control ditch was constructed in July 1999 in the area above transverse drains #5 and #6. The till berm was reconstructed and a ditch was constructed to pass runoff water around the area. Over past years, a lack of drainage control had allowed water to seep into the soil and significant sloughing and deformation of the berm had occurred such that water chemistry data from transverse drain #6 was not useful and there was a risk that several piezometers in the till berm would be lost.

10. LICENCE ISSUES

10.1 AMENDMENTS

An application for amendment to Water Licence IN89-002 was outstanding at year end. The application was filed in 1995 by Anvil Range Mining Corporation and an update to the application was filed in 1996. The proposed amendments are primarily "housekeeping" issues.



APPENDIX 1

**1999 Complete Water Quality Listing
With Statistical Summaries**

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V1, Vangorda Creek, upstrm of mine & Blind Cr. Rd

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
17/03/99	7.12			13	3	<0.05			124	56			ice layer
18/06/99	8.08		7	3	2	<0.05				10			
29/07/99	7.44		3	6	1	<0.05		2	35.2	9	11.7	534	
31/08/99	7.7		3.9	7	1	<0.05		26	55.5	22	13.6	293	
12/10/99	6.75		1	10	1	<0.05				17			

JAN 1999 - DEC 1999

Mean	7.42		3.7	8	2	0.05		14	71.6	23	12.7	414	
Std. Devia	0.51		2.5	4	1	0		17	46.5	19	1.3	170	
Minimum	6.75		1	3	1	0.05		2	35.2	9	11.7	293	
Maximum	8.08		7	13	3	0.05		26	124	56	13.6	534	
Num. Val	5		4	5	5	5		2	3	5	2	2	

STATION: V2, Grum Creek, upstr. of Vangorda Ck

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
17/03/99	7.67			202	11	<0.05			945				muddy ice hole
18/06/99	7.64		6	180	8	<0.05						1	
10/09/99	7.76		5	169	5	<0.05			810			1	
12/10/99	6.95		2	191	4	<0.05			775			1.5	
13/12/99	7.06		0	146	6	<0.05			800			0.5	

JAN 1999 - DEC 1999

Mean	7.42		3	178	7	0.05			832			1	
Std. Devia	0.38		3	22	3	0			76			0.4	
Minimum	6.95		0	146	4	0.05			775			0.5	
Maximum	7.76		6	202	11	0.05			945			1.5	
Num. Val	5		4	5	5	5			4			4	

STATION: V2A, Grum Creek Diversion to Moose Pond

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
03/07/99	7.81		6	379	7	<0.05						2	Moose pond mt
10/09/99	7.58		4	370								0.5	
12/10/99	7.13		1	269								0.5	
13/12/99												0	

JAN 1999 - DEC 1999

Mean	7.51		4	339	7	0.05						0.8	
Std. Devia	0.35		3	61	0	0						0.9	
Minimum	7.13		1	269	7	0.05						0	
Maximum	7.81		6	379	7	0.05						2	
Num. Val	3		3	3	1	1						4	

STATION: V4, Shrimp Creek, upstr. of Vangorda Creek

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
16/03/99		8.17		134	5	<0.05			800	458			wide ice cap
18/06/99	8.06		<9	40	46	<0.05				259			
29/07/99	8.42		4.9	43	10	<0.05			442	255	11.2	64	
12/10/99	8.09		1	66	3					322			

JAN 1999 - DEC 1999

Mean	8.19	8.17	5	71	16	0.05			621	324	11.2	64	
Std. Devia	0.2	0	4	44	20	0			253	95	0	0	
Minimum	8.06	8.17	1	40	3	0.05			442	255	11.2	64	
Maximum	8.42	8.17	9	134	46	0.05			800	458	11.2	64	
Num. Val	3	1	3	4	4	3			2	4	1	1	

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V5, west fork Vangorda Creek

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
19/01/99		8.37		435	2	<0.05				810		
23/02/99	7.75		0	532	29	<0.05				1161		ice layer
23/03/99		7.47		235	5	<0.05				602		ice crack
20/04/99	8.14		2	208	13					498		@waterfall
18/05/99	8.04		2	39	100	<0.05				126		ice crack u/s culvert
20/06/99	7.97		6	34	731	<0.05				134		
29/07/99	8.53		5.8	49	300	<0.05		22	328	174	11.5	364
31/08/99	8.6		5.9	60	7	<0.05		187	431	226	13.4	144
12/10/99	7.09		2	79	5	<0.05				245		
14/12/99	7.68		0	105	3					340		u/s of culvert

JAN 1999 - DEC 1999

Mean	7.98	7.92	3	178	120	0.05		104	380	432	12.4	254
Std. Devia	0.49	0.64	2.6	177	234	0		117	73	340	1.3	156
Minimum	7.09	7.47	0	34	2	0.05		22	328	126	11.5	144
Maximum	8.6	8.37	6	532	731	0.05		187	431	1161	13.4	364
Num. Val	8	2	8	10	10	8		2	2	10	2	2

STATION: V6A, AEX Creek

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
22/03/99		7.93		46	13	<0.05						v. low flow @ ice crack
03/07/99	8.45		8	10	7	<0.05						
10/09/99	7.69		7	14	1	<0.05			159			
12/10/99	7.23		1	16	1	<0.05			178			
14/12/99	7.45		0	21	1	<0.05			250			

JAN 1999 - DEC 1999

Mean	7.7	7.93	4	21	5	0.05			196			
Std. Devia	0.53	0	4	14	5	0			48			
Minimum	7.23	7.93	0	10	1	0.05			159			
Maximum	8.45	7.93	8	46	13	0.05			250			
Num. Val	4	1	4	5	5	5			3			

STATION: VGMAIN, Main Fork Vangorda Creek

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
20/04/99				126	3					298		
18/05/99	8.01		1	33	42	0.06				100		
20/06/99	7.58		7	7	125	0.07				34		
29/07/99	7.99		10	20	4	<0.05				74		
12/10/99	7.48		2	46	<1	<0.05				134		

JAN 1999 - DEC 1999

Mean	7.76		5	46	35	0.06				128		
Std. Devia	0.27		4	47	53	0.01				102		
Minimum	7.48		1	7	1	0.05				34		
Maximum	8.01		10	126	125	0.07				298		
Num. Val	4		4	5	5	4				5		

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V8, lower Vangorda Creek

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
19/01/99		8.3		190	3	<0.05				451			ped. bridge
23/02/99	8.02		0	136	5	<0.05				462			ped bridge
23/03/99		7.84		238	12	<0.05				458			ped bridge
20/04/99	7.48		3	174	7					404			ped bridge
18/05/99	8.16		1	39	47	<0.05				116			ped bridge
20/06/99	7.53		7	12	184	<0.05				37			
25/06/99												1403	
29/07/99	8.21		7.7	31	85	<0.05		13	203	107	11.1	1101	
30/08/99	8.5		7.3	36	3	<0.05		112	264	135		484	
12/10/99	7.38		2	61	5	<0.05		144	380	164			
14/12/99	7.78		0	85	1	<0.05		190	505	271			1/2 way between bridges

JAN 1999 - DEC 1999

Mean	7.88	8.07	3.5	100	35	0.05		115	338	260	11.1	996	
Std. Devia	0.4	0.33	3.3	79	59	0		75	133	169	0	468	
Minimum	7.38	7.84	0	12	1	0.05		13	203	37	11.1	484	
Maximum	8.5	8.3	7.7	238	184	0.05		190	505	462	11.1	1403	
Num. Val	8	2	8	10	10	9		4	4	10	1	3	

STATION: V15, Sulphide cell sump, Grum Dump

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
17/03/99	8.48			200	6	<0.05		348	935				wide ice cap
03/07/99	8.02		10	215	8	<0.05						1	
10/09/99	7.58		6	240	5	<0.05		380	1230			1	
12/10/99	7.69		2	320	3	<0.05		462	1240			0.5	
13/12/99	7.67			330	5	<0.05		459	1340			0.5	

JAN 1999 - DEC 1999

Mean	7.89		6	261	5	0.05		412	1186			0.8	
Std. Devia	0.37		4	60	2	0		57	175			0.3	
Minimum	7.58		2	200	3	0.05		348	935			0.5	
Maximum	8.48		10	330	8	0.05		462	1340			1	
Num. Val	5		3	5	5	5		4	4			4	

STATION: V17A, Runoff from ore transfer pad

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
03/07/99	7.89		9	6	8	<0.05						5	
10/09/99	7.64		7	7								3	

JAN 1999 - DEC 1999

Mean	7.76		8	6	8	0.05						4	
Std. Devia	0.18		1	1	0	0						1	
Minimum	7.64		7	6	8	0.05						3	
Maximum	7.89		9	7	8	0.05						5	
Num. Val	2		2	2	1	1						2	

STATION: V19, Vangorda pit, NW interceptor ditch

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
18/05/99	8.02		2	29	25	0.07						1	

JAN 1999 - DEC 1999

Mean	8.02		2	29	25	0.07						1	
Std. Devia	0		0	0	0	0						0	
Minimum	8.02		2	29	25	0.07						1	
Maximum	8.02		2	29	25	0.07						1	
Num. Val	1		1	1	1	1						1	

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V19CULVERT, Vangorda Cr below haul road crossing

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/05/99					38					46		
JAN 1999 - DEC 1999												
Mean					38					46		
Std. Devia					0					0		
Minimum					38					46		
Maximum					38					46		
Num. Val					1					1		

STATION: V21A, VG Dump Collector Ditch @ LCD

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/05/99	7.31		2	292	9	<0.05						0.5
JAN 1999 - DEC 1999												
Mean	7.31		2	292	9	0.05						0.5
Std. Devia	0		0	0	0	0						0
Minimum	7.31		2	292	9	0.05						0.5
Maximum	7.31		2	292	9	0.05						0.5
Num. Val	1		1	1	1	1						1

STATION: V22, Vangorda pit water

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/06/99	7.48		18	247	19	0.1						
10/09/99	7.43		11	513	7		129	66	1120			
12/10/99	6.48		3	635	9	0.55		85	1180			
JAN 1999 - DEC 1999												
Mean	7.13		11	465	12	0.33	129	76	1150			
Std. Devia	0.56		8	198	6	0.32	0	13	42			
Minimum	6.48		3	247	7	0.1	129	66	1120			
Maximum	7.48		18	635	19	0.55	129	85	1180			
Num. Val	3		3	3	3	2	1	2	2			

STATION: V23, Grum Pit Water

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
10/09/99	7.64		9	266	4		<5	190	885			
12/10/99	7.12		4	344	5	0.54		190	935			
JAN 1999 - DEC 1999												
Mean	7.38		6	305	4	0.54	5	190	910			
Std. Devia	0.37		4	55	1	0	0	0	35			
Minimum	7.12		4	266	4	0.54	5	190	885			
Maximum	7.64		9	344	5	0.54	5	190	935			
Num. Val	2		2	2	2	1	1	2	2			

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V25BSP, Below Sheep Pond at the weir

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
18/05/99	7.95		2	68	129	0.07						3	weir abut leak
27/05/99				63	148								
18/06/99												0.5	
03/07/99	8.21		14	38	15	<0.05				73		5	
12/08/99			18	145	3	<0.05							
10/09/99	7.83		10	136								1	@ waterfall

JAN 1999 - DEC 1999

Mean	8		11	90	74	0.06				73		2.4	
Std. Devia	0.19		7	48	75	0.01				0		2.1	
Minimum	7.83		2	38	3	0.05				73		0.5	
Maximum	8.21		18	145	148	0.07				73		5	
Num. Val	3		4	5	4	3				1		4	

STATION: V27, Vangorda Creek, just upstr. of Shrimp

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
16/03/99		7.92		46	5	<0.05		118	298	149			
18/06/99	8.33		<8	5	4	<0.05				18			
29/07/99	7.74		4.4	14	5	<0.05		5	46.3	36	11.4	785	
31/08/99	7.97		5.2	16	3	<0.05		46	114	49	13.3	348	
12/10/99	8.41		3	27	<1			59	162	69			

JAN 1999 - DEC 1999

Mean	8.11	7.92	5.1	22	4	0.05		57	155.1	64	12.3	566	
Std. Devia	0.31	0	2.1	16	2	0		47	106.4	51	1.3	309	
Minimum	7.74	7.92	3	5	1	0.05		5	46.3	18	11.4	348	
Maximum	8.41	7.92	8	46	5	0.05		118	298	149	13.3	785	
Num. Val	4	1	4	5	5	4		4	4	5	2	2	

STATION: V29, Vangorda Dump drain #2

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
18/05/99												0	

JAN 1999 - DEC 1999

Mean												0	
Std. Devia												0	
Minimum												0	
Maximum												0	
Num. Val												1	

STATION: V30, Vangorda Dump drain #3

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s	
18/05/99	5.52		2	2788		5.46						0.14	
18/06/99	5.85		11	4281		6.55						0.025	
12/08/99	6.54		20	3259								0.014	
12/10/99	5.14		0	3367		7.24	2570	243	4550			0.006	
13/12/99	6.31			2637									

JAN 1999 - DEC 1999

Mean	5.87		8	3266		6.42	2570	243	4550			0.046	
Std. Devia	0.57		9	645		0.9	0	0	0			0.063	
Minimum	5.14		0	2637		5.46	2570	243	4550			0.006	
Maximum	6.54		20	4281		7.24	2570	243	4550			0.14	
Num. Val	5		4	5		3	1	1	1			4	

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V31, Vangorda Dump drain #4

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/05/99												0
JAN 1999 - DEC 1999												
Mean												0
Std. Devia												0
Minimum												0
Maximum												0
Num. Val												1

STATION: V32, Vangorda Dump drain #5

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/05/99	5.82			9365		1.36						0.01
18/06/99	4.61		12	9550		0.29						0.018
12/08/99	4.81		19	17010								0.019
12/10/99	3.04		1	16970		<0.05	22796	<5	15200			0.03
13/12/99	3.98			14645								
JAN 1999 - DEC 1999												
Mean	4.45		11	13508		0.57	22796	5	15200			0.019
Std. Devia	1.03		9	3820		0.7	0	0	0			0.008
Minimum	3.04		1	9365		0.05	22796	5	15200			0.01
Maximum	5.82		19	17010		1.36	22796	5	15200			0.03
Num. Val	5		3	5		3	1	1	1			4

STATION: V33, Vangorda Dump drain #6

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/05/99	7.04		2	470		0.12						0.025
JAN 1999 - DEC 1999												
Mean	7.04		2	470		0.12						0.025
Std. Devia	0		0	0		0						0
Minimum	7.04		2	470		0.12						0.025
Maximum	7.04		2	470		0.12						0.025
Num. Val	1		1	1		1						1

STATION: V34, groundwater well GW94-01

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	SWL meters
18/06/99	7.85		5	23		<0.05						6.88
12/10/99	6.79		2	26		<0.05	<1	489	815			6.61
JAN 1999 - DEC 1999												
Mean	7.32		4	24		0.05	1	489	815			6.75
Std. Devia	0.75		2	2		0	0	0	0			0.19
Minimum	6.79		2	23		0.05	1	489	815			6.61
Maximum	7.85		5	26		0.05	1	489	815			6.88
Num. Val	2		2	2		2	1	1	1			2

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V35, groundwater well GW94-02

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	SWL meters
18/06/99	7.21		3	768		<0.05						9.24
12/10/99	6.77		1	142		<0.05	<1	374	910			7.58

JAN 1999 - DEC 1999

Mean	6.99		2	455		0.05	1	374	910			8.41
Std. Devia	0.31		1	443		0	0	0	0			1.17
Minimum	6.77		1	142		0.05	1	374	910			7.58
Maximum	7.21		3	768		0.05	1	374	910			9.24
Num. Val	2		2	2		2	1	1	1			2

STATION: V36, groundwater well GW94-03

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	SWL meters
18/06/99	7.29		3	271		<0.05						10.24
12/10/99	6.27		1	313		0.06	<1	394	1200			8.81

JAN 1999 - DEC 1999

Mean	6.78		2	292		0.05	1	394	1200			9.53
Std. Devia	0.72		1	30		0.01	0	0	0			1.01
Minimum	6.27		1	271		0.05	1	394	1200			8.81
Maximum	7.29		3	313		0.06	1	394	1200			10.24
Num. Val	2		2	2		2	1	1	1			2

STATION: V37, groundwater well GW94-04

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	SWL meters
18/06/99	7.48		3	66		<0.05						10.18
12/10/99	6.07		1	62		<0.05	<1	426	775			8.79

JAN 1999 - DEC 1999

Mean	6.78		2	64		0.05	1	426	775			9.49
Std. Devia	1		1	3		0	0	0	0			0.98
Minimum	6.07		1	62		0.05	1	426	775			8.79
Maximum	7.48		3	66		0.05	1	426	775			10.18
Num. Val	2		2	2		2	1	1	1			2

STATION: 96-9A, Groundwater at the toe of Grum dump

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	SWL meters
18/06/99	6.96		4	181		<0.05						5.41
12/10/99				168		<0.05	<1	157	650			

JAN 1999 - DEC 1999

Mean	6.96		4	174		0.05	1	157	650			5.41
Std. Devia	0		0	9		0	0	0	0			0
Minimum	6.96		4	168		0.05	1	157	650			5.41
Maximum	6.96		4	181		0.05	1	157	650			5.41
Num. Val	1		1	2		2	1	1	1			1

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: 96-9B, Groundwater at toe of Grum dump

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	SWL meters
18/06/99	7.67		3	190		<0.05						0
12/10/99				167		0.11	<1	151	620			
JAN 1999 - DEC 1999												
Mean	7.67		3	178		0.08	1	151	620			0
Std. Devia	0		0	16		0.04	0	0	0			0
Minimum	7.67		3	167		0.05	1	151	620			0
Maximum	7.67		3	190		0.11	1	151	620			0
Num. Val	1		1	2		2	1	1	1			1

STATION: GD1, Grum Dump toe seep just west of V15

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
03/07/99				578								
JAN 1999 - DEC 1999												
Mean				578								
Std. Devia				0								
Minimum				578								
Maximum				578								
Num. Val				1								

STATION: GD2, seep/marsh near west end of Grum dump toe road

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
03/07/99				33								
JAN 1999 - DEC 1999												
Mean				33								
Std. Devia				0								
Minimum				33								
Maximum				33								
Num. Val				1								

STATION: INSPOND, Inflow to the Sheep Pad Pond

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/05/99					299							
JAN 1999 - DEC 1999												
Mean					299							
Std. Devia					0							
Minimum					299							
Maximum					299							
Num. Val					1							

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: LCD, Little Creek Dam Pond Water

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/06/99	7.47		17	299		0.53						
JAN 1999 - DEC 1999												
Mean	7.47		17	299		0.53						
Std. Devia	0		0	0		0						
Minimum	7.47		17	299		0.53						
Maximum	7.47		17	299		0.53						
Num. Val	1		1	1		1						

STATION: VGSEEP, VG pit ramp ditch/seepage

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
18/06/99	6.24		15	5048		1.8						0.5 VG pit ramp seep
JAN 1999 - DEC 1999												
Mean	6.24		15	5048		1.8						0.5
Std. Devia	0		0	0		0						0
Minimum	6.24		15	5048		1.8						0.5
Maximum	6.24		15	5048		1.8						0.5
Num. Val	1		1	1		1						1

STATION: VGGR, VG Creek at Grum turn off

Date	PH-F pH unit	PH-Lab pH unit	TEMP-C	SO4-T mg/L	TSS mg/L	NH3-N mg/L	ACIDITY mg/L	ALK-T mg/L	COND µS/cm	HARD-T mg/L	D.O. mg/L	FLOW L/s
20/06/99	7.54		5	6	33					20		
JAN 1999 - DEC 1999												
Mean	7.54		5	6	33					20		
Std. Devia	0		0	0	0					0		
Minimum	7.54		5	6	33					20		
Maximum	7.54		5	6	33					20		
Num. Val	1		1	1	1					1		

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V1, Vangorda Creek, upstrm of mine & Blind Cr. Rd

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
17/03/99	<.003	0.24	<.005	0.22	0.043	<.001	<.04	17.7	<.001	<.005	<.005	0.025	0.09	<1	<.005	2.9	<.01	<.002	4	<.005	<.04	<.01	4	<.03	<.03	4.2	<.01	0.083	<.005	<.005	<.03	0.04
18/06/99	<.003	0.15	<.005	0.08	0.095	<.001	<.04	4.1	0.002	0.007	<.005	0.007	4.18	1	<.005	0.8	<.01	0.021	2	<.005	0.77	0.11	2	<.03	<.03	1.9	<.01	0.049	0.104	<.005	<.03	0.24
29/07/99	<.0001	0.03	<.001	0.01	0.0167	<.0001	<.001	2.9	<.0001	<.0002	<.0002	0.002	0.07	0.4	<.0002	0.61	0.001	<.0001	0.8	<.0002	<.002	<.001	1.4	<.001	<.001	2.46	<.0004	0.0237	0.004	<.0002	<.001	0.002
31/08/99	<.0001	0.038	<.001	0.017	0.0245	<.0001	<.001	8.073	0.0051	<.0002	<.0002	0.0113	0.421	0.42	<.0002	0.698	0.0017	0.0009	2.43	8E-04	<.002	<.001	2.59	<.001	<.001	2.702	<.0004	0.0385	0.022	0.001	<.001	0.0015
12/10/99	<.003	0.05	<.005	<.05	0.131	<.001	<.04	9.8	0.001	<.005	<.005	0.013	0.2	<1	<.005	1.6	<.01	<.002	3	<.005	<.04	<.01	3	<.03	<.005	4.3	<.01	0.051	0.028	<.005	<.03	0.01

JAN 1999 - DEC 1999

Mean	0.0018	0.102	0.003	0.075	0.062	0.0006	0.024	8.515	0.0018	0.0035	0.0031	0.0117	0.992	0.76	0.003	1.322	0.0085	0.0052	2.45	0.003	0.171	0.026	2.6	0.018	0.013	3.112	0.0062	0.049	0.033	0.003	0.018	0.0587
Std. Devia	0.0016	0.091	0.002	0.086	0.0492	0.0005	0.021	5.857	0.0019	0.0031	0.0026	0.0086	1.787	0.32	0.003	0.966	0.0047	0.0089	1.19	0.003	0.336	0.047	0.99	0.016	0.015	1.079	0.0053	0.0219	0.041	0.002	0.016	0.1026
Minimum	0.0001	0.03	0.001	0.01	0.0167	0.0001	0.001	2.9	0.0001	0.0002	0.0002	0.002	0.07	0.4	2E-04	0.61	0.001	0.0001	0.8	2E-04	0.002	0.001	1.4	0.001	0.001	1.9	0.0004	0.0237	0.004	2E-04	0.001	0.0015
Maximum	0.003	0.24	0.005	0.22	0.131	0.001	0.04	17.7	0.0051	0.007	0.005	0.025	4.18	1	0.005	2.9	0.01	0.021	4	0.005	0.77	0.11	4	0.03	0.03	4.3	0.01	0.083	0.104	0.005	0.03	0.24
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
17/03/99	<.003	<.05	<.005	0.08	0.005	<.001	<.04	17.1	<.001	<.005	0.48	0.007	<.01	<1	<.005	2.9	<.01	<.002	3	<.005	<.04	<.01	5	<.03	<.03	3.7	<.01	0.076	<.005	<.005	<.03	<.01
18/06/99	<.003	<.05	<.005	<.05	<.002	<.001	<.04	2.7	<.001	<.005	<.005	<.002	0.07	<1	<.005	0.7	<.01	<.002	<1	<.005	<.04	<.01	1	<.03	<.03	0.1	<.01	0.04	<.005	<.005	<.03	<.01
29/07/99	<.0001	0.05	<.001	0.05	0.008	<.0001	<.001	2.78	<.0001	<.0002	0.007	0.0014	0.014	0.2	3E-04	0.58	0.001	<.0001	1	0.002	<.002	<.001	1.9	<.001	<.001	3.23	<.0004	0.027	0.001	<.0002	<.001	0.002
31/08/99	<.0001	0.006	<.001	0.075	0.0035	<.0001	<.001	7.725	<.0001	<.0002	<.0002	0.001	<.001	0.2	<.0002	0.668	<.0004	0.0002	2.32	<.0002	<.002	<.001	2.48	<.001	<.001	3.538	<.0004	0.0282	0.001	<.0002	<.001	<.0004
12/10/99	<.003	<.05	<.005	<.05	0.002	<.001	<.04	5.2	<.001	<.005	<.005	<.002	0.01	<1	<.005	1.1	<.01	<.002	2	<.005	<.04	<.01	3	<.03	<.005	3	<.01	0.034	<.005	<.005	<.03	<.01

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Mean	0.0018	0.041	0.003	0.061	0.0041	0.0006	0.024	7.101	0.0006	0.0031	0.0994	0.0027	0.021	0.68	0.003	1.19	0.0063	0.0013	1.86	0.003	0.025	0.006	2.68	0.018	0.013	2.714	0.0062	0.0408	0.004	0.003	0.018	0.0065
Std. Devia	0.0016	0.02	0.002	0.015	0.0025	0.0005	0.021	5.959	0.0005	0.0026	0.2128	0.0025	0.028	0.44	0.003	0.977	0.0051	0.001	0.87	0.002	0.021	0.005	1.5	0.016	0.015	1.486	0.0053	0.0198	0.002	0.003	0.016	0.0049
Minimum	0.0001	0.006	0.001	0.05	0.002	0.0001	0.001	2.7	0.0001	0.0002	0.0002	0.001	0.001	0.2	2E-04	0.58	0.0004	0.0001	1	2E-04	0.002	0.001	1	0.001	0.001	0.1	0.0004	0.027	0.001	2E-04	0.001	0.0004
Maximum	0.003	0.05	0.005	0.08	0.008	0.001	0.04	17.1	0.001	0.005	0.48	0.007	0.07	1	0.005	2.9	0.01	0.002	3	0.005	0.04	0.01	5	0.03	0.03	3.7	0.01	0.075	0.005	0.005	0.03	0.01
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

STATION: V2, Grum Creek, upstr. of Vangorda Ck

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
17/03/99	<.003	0.57	<.005	0.21	0.352	<.001	<.04	141.3	<.001	<.005	0.335	0.036	0.5	3	<.005	49.4	0.02	<.002	10	<.005	1.27	<.01	67	<.03	<.03	5.7	<.01	0.721	0.017	<.005	<.03	0.07
18/06/99	<.003	0.3	<.005	0.11	0.342	0.001	<.04	137.5	<.001	<.005	<.005	0.032	1.61	4	0.076	44.3	<.01	0.031	11	<.005	0.12	0.02	52	0.04	<.03	6.2	<.01	0.667	0.056	0.015	<.03	0.11
10/09/99	<.003	0.11	<.005	<.05	0.234	<.001	<.04	88.4	<.001	<.005	<.005	0.017	0.03	2	0.015	22.4	0.1	0.004	5	<.005	0.18	<.01	56	<.03	<.005	3.2	<.01	0.425	0.013	0.013	<.03	0.24
12/10/99	<.003	0.16	<.005	0.05	0.308	<.001	<.04	110.8	0.005	<.005	<.005	0.027	0.18	3	<.005	29.1	<.01	<.002	8	0.007	<.04	0.03	59	<.03	<.005	5.1	<.01	0.528	0.035	<.005	<.03	<.01
13/12/99	<.003	0.49	<.005	0.09	0.328	<.001	<.04	132.3	0.003	<.005	<.005	0.036	0.06	4	0.006	32.9	0.01	<.002	6	0.018	<.04	0.02	64	<.03	<.005	3.7	<.01	0.592	0.01	0.013	<.03	0.05

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Mean	0.003	0.33	0.005	0.1	0.313	0.001	0.04	122.1	0.002	0.005	0.071	0.03	0.48	3	0.021	35.6	0.03	0.008	8	0.008	0.33	0.02	60	0.03	0.015	4.8	0.01	0.587	0.026	0.01	0.03	0.1
Std. Devia	0	0.2	0	0.06	0.047	0	0	22.2	0.002	0	0.148	0.008	0.86	1	0.031	11.1	0.04	0.013	3	0.006	0.53	0.01	6	0	0.014	1.3	0	0.116	0.019	0.005	0	0.09
Minimum	0.003	0.11	0.005	0.05	0.234	0.001	0.04	88.4	0.001	0.005	0.005	0.017	0.03	2	0.005	22.4	0.01	0.002	5	0.005	0.04	0.01	52	0.03	0.005	3.2	0.01	0.425	0.01	0.005	0.03	0.01
Maximum	0.003	0.57	0.005	0.21	0.352	0.001	0.04	141.3	0.005	0.005	0.335	0.036	1.61	4	0.076	49.4	0.1	0.031	11	0.018	1.27	0.03	67	0.04	<.03	6.2	0.01	0.721	0.056	0.015	0.03	0.24
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

	AG-D	AL-D	AS-D	B-D	BA-D	BE-D	BI-D	CA-D	CD-D	CO-D	CR-D	CU-D	FE-D	K-D	LA-D	MG-D	MN-D	MO-D	NA-D	NI-D	P-D	PB-D	S-D	SB-D	SE-D	SI-D	SN-D	SR-D	TI-D	V-D	W-D	ZN-D
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
17/03/99	<.003	0.11	<.005	0.1	0.095	<.001	<.04	110.9	<.001	<.005	0.319	0.017	<.01	3	<.005	45.7	<.01	<.002	10	<.005	0.5	<.01	70	<.03	<.03	4.6	<.01	0.631	<.005	<.005	<.03	<.01
18/06/99	<.003	<.05	<.005	<.05	0.124	<.001	<.04	105.6	0.002	<.005	<.005	0.013	0.04	3	0.009	35.7	0.11	0.006	9	<.005	<.04	<.01	60	0.05	<.03	5	<.01	0.692	<.005	<.005	<.03	<.01
10/09/99	<.003	<.05	<.005	<.05	0.038	<.001	<.04	61.8	<.001	<.005	<.005	0.007	<.01	1	<.005	18.6	0.03	<.002	4	0.008	<.04	<.01	64	<.03	<.005	2.6	<.01	0.313	<.005	<.005	<.03	0.07
12/10/99	<.003	<.05	<.005	<.05	0.071	<.001	<.04	103.8	<.001	<.005	<.005	0.012	0.02	3	<.005	29.3	<.01	0.004	8	0.008	<.04	<.01	64	<.03	<.005	4.4	<.01	0.5	0.013	<.005	<.03	<.01
13/12/99	<.003	0.11	<.005	<.05	0.214	<.001	<.04	98.6	<.001	<.005	<.005	0.009	<.01	3	<.005	25.3	<.01	<.002	4	<.005	<.04	<.01	49	<.03	<.005	2.7	<.01	0.448	<.005	<.005	<.03	<.01

STATION: V2A, Grum Creek Diversion to Moose Pond

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STATION: V4, Shrimp Creek, upstr. of Vangorda Creek

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1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION V5, west fork Vangorda Creek

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
19/01/99	<.003	0.27	0.028	0.25	0.16	0.001	<.04	182.5	0.006	<.005	0.086	0.039	0.18	3	<.005	86.2	<.01	0.005	11	<.005	<.04	<.01	145	<.03	<.03	6.3	<.01	0.844	0.022	<.005	<.03	0.02
23/02/99	0.007	0.47	<.005	0.25	0.098	<.001	<.04	244.2	<.001	<.005	0.299	0.036	0.1	4	0.031	134.2	<.01	0.009	16	<.005	3.1	<.01	177	<.03	<.03	9.3	<.01	1.081	0.027	<.005	<.03	0.05
23/03/99	<.003	0.37	<.005	0.25	0.128	<.001	<.04	140.3	0.001	<.005	0.6	0.031	0.08	3	0.019	79.6	0.27	<.002	9	<.005	1.55	<.01	86.3	<.03	<.03	4.9	<.01	0.716	0.009	0.007	<.03	0.08
20/04/99	<.003	0.31	<.005	0.14	0.095	0.001	<.04	95.5	<.001	<.005	<.005	0.024	0.44	2	<.005	53.6	0.03	0.009	8	<.005	0.1	<.01	65	<.03	<.03	4.5	<.01	0.404	0.029	<.005	<.03	0.01
18/05/99	<.003	1.24	<.005	<.05	0.166	0.002	<.04	31.8	<.001	<.005	<.005	0.016	2.15	2	<.005	12	0.08	0.003	3	0.009	3.16	<.01	<.03	<.03	4.2	<.01	0.149	0.019	0.009	<.03	0.05	
20/06/99	0.003	13.82	<.005	0.08	0.389	<.001	<.04	39.1	<.001	<.005	0.124	0.044	25.27	4	0.027	20.9	0.23	<.002	4	0.021	<.04	0.05	11	<.03	<.03	27	<.01	0.197	0.399	0.034	<.03	<.01
29/07/99	<.0001	4.67	<.001	0.01	0.157	0.0003	<.001	42.7	<.0001	<.0002	0.018	0.0204	7.337	1.4	0.005	18.2	0.111	<.0001	2.4	0.016	0.196	0.018	11.2	<.001	<.001	8.65	<.0004	0.1592	0.133	0.011	<.001	0.032
31/08/99	<.0001	0.082	<.001	0.045	0.0495	0.0002	<.001	58.09	0.0023	0.0004	<.0002	0.0092	0.242	0.81	<.0002	22.277	0.0088	0.0009	5.29	<.0002	<.002	<.001	20.83	<.001	<.001	2.795	<.0004	0.1679	0.013	<.0002	<.001	<.0004
12/10/99	<.003	0.2	<.005	<.05	0.152	<.001	<.04	61.5	<.001	0.007	<.005	0.024	0.8	2	0.008	24.9	0.02	<.002	5	<.005	<.04	0.02	25	<.03	<.005	4.7	<.01	0.253	0.023	<.005	<.03	<.01
14/12/99	<.003	0.26	<.005	<.05	0.14	<.001	<.04	78.1	0.002	<.005	<.005	0.025	0.06	5	<.005	28.9	0.01	<.002	4	0.02	<.04	<.01	32	<.03	<.005	3	<.01	0.282	0.008	0.008	<.03	0.03

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Mean	0.0028	2.169	0.007	0.118	0.1534	0.001	0.032	97.379	0.0016	0.0043	0.1147	0.0269	3.666	2.72	0.011	48.078	0.078	0.0035	6.77	0.009	0.827	0.015	63.7	0.024	0.019	7.534	0.0081	0.4253	0.068	0.009	0.024	0.0292
Std. Devia	0.0019	4.32	0.008	0.097	0.0906	0.0005	0.016	70.346	0.0016	0.0022	0.1946	0.0107	7.913	1.32	0.011	39.997	0.0974	0.0032	4.26	0.007	1.3	0.013	61.07	0.012	0.014	7.173	0.004	0.3343	0.122	0.009	0.012	0.0247
Minimum	0.0001	0.082	0.001	0.01	0.0495	0.0002	0.001	31.8	0.0001	0.0002	0.0002	0.0092	0.06	0.81	2E-04	12	0.0088	0.0001	2.4	2E-04	0.002	0.001	11	0.001	0.001	2.795	0.0004	0.149	0.008	2E-04	0.001	0.0004
Maximum	0.007	13.82	0.028	0.25	0.389	0.002	0.04	244.2	0.006	0.007	0.6	0.044	25.27	5	0.031	134.2	0.27	0.009	16	0.021	3.16	0.05	177	0.03	0.03	27	0.01	1.081	0.399	0.034	0.03	0.08
Num. Valu	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	10	10	10	10	10	10	10	10	10

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
23/02/99	<.003	0.18	<.005	0.2	0.031	<.001	<.04	180.1	<.001	0.008	0.04	0.015	<.01	3	<.005	106.5	0.7	0.019	12	<.005	2.81	<.01	<.03	<.03	6.9	<.01	0.825	0.014	<.005	<.03	<.01	
23/03/99	<.003	0.1	<.005	<.05	0.035	<.001	<.04	109.3	<.001	<.005	<.005	0.015	<.01	2	<.005	65.4	<.01	<.002	8	<.005	0.84	<.01	82.5	<.03	<.03	4	<.01	0.58	<.005	<.005	<.03	<.01
20/04/99	0.01	<.05	0.01	<.05	0.031	0.002	<.04	102.6	<.001	0.012	<.005	0.021	0.05	3	0.014	56.1	0.11	<.002	7	0.011	0.24	<.01	69	<.03	<.03	4.2	<.01	0.384	0.023	<.005	<.03	<.01
18/05/99	<.003	0.08	<.005	<.05	0.036	0.002	<.04	31.1	0.003	<.005	<.005	0.002	<.01	2	<.005	11.7	0.09	0.049	2	<.005	0.32	0.04	<.03	<.03	2.3	<.01	0.135	<.005	<.005	<.03	0.01	
20/06/99	<.003	0.94	<.005	<.05	0.03	<.001	<.04	32.9	<.001	<.005	<.005	0.006	0.94	2	0.009	12.6	0.24	0.003	3	<.005	<.04	<.01	11	0.03	<.03	5.3	<.01	0.139	0.028	<.005	<.03	0.03
29/07/99	<.0001	0.32	<.001	0.07	0.0357	0.0001	<.001	40.86	<.0001	<.0002	0.003	0.0101	0.01	0.7	<.0002	17.41	0.002	<.0001	2.4	0.001	<.002	0.002	16.3	<.001	<.001	2.72	<.0004	0.0892	0.002	0	<.001	<.0004
31/08/99	<.0001	0.022	<.001	0.61	0.0207	0.0001	<.001	55.598	0.0003	<.0002	<.0002	0.0029	0.004	0.79	<.0002	21.317	0.0025	0.0004	5.06	<.0002	<.002	<.001	19.93	<.001	<.001	3.295	<.0004	0.1459	0.002	<.0002	<.001	<.0004
12/10/99	<.003	<.05	<.005	<.05	0.025	<.001	<.04	58.5	<.001	<.005	<.005	0.007	0.01	2	<.005	24.1	<.01	<.002	5	0.008	<.04	<.01	26	<.03	<.005	4	<.01	0.254	0.007	<.005	<.03	<.01
14/12/99	<.003	<.05	<.005	<.05	0.108	<.001	<.04	82.3	<.001	<.005	<.005	0.006	<.01	1	<.005	31.3	<.01	<.002	3	<.005	<.04	<.01	35	<.03	<.005	3.4	<.01	0.303	<.005	<.005	<.03	<.01

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Mean	0.0031	0.199	0.005	0.131	0.0392	0.001	0.031	77.028	0.001	0.005	0.0081	0.0094	0.117	1.83	0.005	38.492	0.1305	0.0088	5.27	0.005	0.482	0.011	37.1	0.024	0.018	4.013	0.0079	0.3172	0.01	0.004	0.024	0.0101
Std. Devia	0.0029	0.293	0.003	0.185	0.0263	0.0007	0.017	48.108	0.0008	0.0036	0.0121	0.0064	0.309	0.86	0.004	31.713	0.2277	0.0161	3.26	0.003	0.914	0.011	27.73	0.013	0.014	1.393	0.0042	0.2454	0.009	0.002	0.013	0.0085
Minimum	0.0001	0.022	0.001	0.05	0.0207	0.0001	0.001	31.1	0.0001	0.0002	0.0002	0.002	0.004	0.7	2E-04	11.7	0.002	0.0001	2	2E-04	0.002	0.001	11	0.001	0.001	2.3	0.0004	0.0892	0.002	0	0.001	0.0004
Maximum	0.01	0.94	0.01	0.61	0.108	0.002	0.04	180.1	0.003	0.012	0.04	0.021	0.94	3	0.014	106.5	0.7	0.049	12	0.011	2.81	0.04	82.5	0.03	0.03	6.9	0.01	0.825	0.028	0.005	0.03	0.03
Num. Valu	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	7	9	9	9	9	9	9	9	9	9	9

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V6A, AEX Creek

	AG-T	AL-T	AS-T	B-T	BA-T	BE-T	BI-T	CA-T	CD-T	CO-T	CR-T	CU-T	FE-T	K-T	LA-T	MG-T	MN-T	MO-T	NA-T	NI-T	P-T	PB-T	S-T	SB-T	SE-T	SI-T	SN-T	SR-T	TI-T	V-T	W-T	ZN-T	
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
22/03/99	<.003	0.38	<.005	0.21	0.107	<.001	<.04	69.4	<.001	<.005	0.395	0.027	0.11	3	<.005	16.7	0.03	<.002	4	<.005	0.72	0.02	16.8	<.03	<.03	7	<.01	0.317	0.006	0.008	<.03	0.08	
03/07/99	<.003	0.46	<.005	0.49	0.041	<.001	<.04	15.4	<.001	<.005	<.005	0.009	1	<1	<.005	2.6	0.01	<.002	1	<.005	<.04	<.01	4	<.03	<.03	6.1	<.01	0.088	<.005	0.01	<.03	0.03	
10/09/99	<.003	0.12	<.005	<.05	0.12	<.001	<.04	24.4	<.001	0.007	<.005	0.014	0.3	<1	<.005	3.9	0.02	0.037	2	0.008	<.04	<.01	8	0.05	<.005	3.6	<.01	0.118	0.011	<.005	<.03	0.04	
12/10/99	<.003	0.08	<.005	<.05	0.139	<.001	<.04	25.1	0.001	<.005	<.005	0.014	0.3	<1	<.005	4.5	<.01	<.002	3	<.005	<.04	<.01	5	<.03	<.005	5.7	<.01	0.125	0.015	<.005	<.03	0.01	
14/12/99	<.003	0.22	<.005	0.07	0.125	<.001	<.04	35.8	0.005	<.005	<.005	0.032	0.29	8	0.014	5.9	0.04	0.005	2	0.032	0.07	0.06	7	0.03	<.005	3.2	<.01	0.15	0.009	0.022	<.03	0.06	
JAN 1999 - DEC 1999																																	
Mean	0.003	0.25	0.005	0.17	0.106	0.001	0.04	34	0.002	0.005	0.083	0.019	0.4	3	0.007	6.7	0.02	0.01	2	0.011	0.18	0.02	8.2	0.03	0.015	5.1	0.01	0.16	0.009	0.01	0.03	0.04	
Std. Devia	0	0.16	0	0.19	0.038	0	0	21.1	0.002	0.001	0.174	0.01	0.35	3	0.004	5.7	0.01	0.015	1	0.012	0.3	0.02	5.1	0.01	0.014	1.6	0	0.091	0.004	0.007	0	0.03	
Minimum	0.003	0.08	0.005	0.05	0.041	0.001	0.04	15.4	0.001	0.005	0.005	0.009	0.11	1	0.005	2.6	0.01	0.002	1	0.005	0.04	0.01	4	0.03	0.005	3.2	0.01	0.088	0.005	0.005	0.03	0.01	
Maximum	0.003	0.46	0.005	0.49	0.139	0.001	0.04	69.4	0.005	0.007	0.395	0.032	1	8	0.014	16.7	0.04	0.037	4	0.032	0.72	0.06	16.8	0.05	0.03	7	0.01	0.317	0.015	0.022	0.03	0.08	
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	

	AG-D	AL-D	AS-D	B-D	BA-D	BE-D	BI-D	CA-D	CD-D	CO-D	CR-D	CU-D	FE-D	K-D	LA-D	MG-D	MN-D	MO-D	NA-D	NI-D	P-D	PB-D	S-D	SB-D	SE-D	SI-D	SN-D	SR-D	TI-D	V-D	W-D	ZN-D	
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		
22/03/99	<.003	0.07	<.005	<.05	0.023	<.001	<.04	57.8	<.001	<.005	0.114	0.012	<.01	3	<.005	14.7	<.01	<.002	3	<.005	0.46	<.01	16.3	<.03	<.03	5.6	<.01	0.254	<.005	<.005	<.03	<.01	
03/07/99	<.003	<.05	<.005	0.28	0.007	<.001	<.04	11.7	<.001	<.005	<.005	0.002	0.54	<1	<.005	2.7	0.03	<.002	<1	<.005	<.04	<.01	3	<.03	<.03	4.5	<.01	0.025	<.005	<.005	<.03	<.01	
10/09/99	<.003	<.05	<.005	<.05	0.019	<.001	<.04	21.2	<.001	<.005	<.005	0.003	0.04	<1	<.005	4	<.01	<.002	2	<.005	<.04	<.01	5	<.03	<.005	4.1	<.01	0.106	<.005	0.008	<.03	<.01	
12/10/99	<.003	<.05	<.005	<.05	0.008	<.001	<.04	24.2	<.001	<.005	<.005	<.002	0.03	<1	<.005	5.1	<.01	<.002	3	<.005	<.04	<.01	5	<.03	<.005	4.3	<.01	0.123	<.005	<.005	<.03	<.01	
14/12/99	<.003	<.05	<.005	<.05	0.09	<.001	<.04	38.7	<.001	<.005	<.005	0.008	0.09	1	<.005	6.3	<.01	<.002	1	0.009	<.04	<.01	7	<.03	<.005	3.6	<.01	0.163	<.005	0.014	<.03	<.01	
JAN 1999 - DEC 1999																																	
Mean	0.003	0.05	0.005	0.1	0.029	0.001	0.04	30.7	0.001	0.005	0.027	0.005	0.14	1	0.005	6.6	0.01	0.002	2	0.006	0.12	0.01	7.3	0.03	0.015	4.4	0.01	0.134	0.005	0.007	0.03	0.01	
Std. Devia	0	0.01	0	0.1	0.035	0	0	18	0	0	0.049	0.004	0.22	1	0	4.7	0.01	0	1	0.002	0.19	0	5.2	0	0.014	0.7	0	0.084	0	0.004	0	0	
Minimum	0.003	0.05	0.005	0.05	0.007	0.001	0.04	11.7	0.001	0.005	0.005	0.002	0.01	1	0.005	2.7	0.01	0.002	1	0.005	0.04	0.01	3	0.03	0.005	3.6	0.01	0.025	0.005	0.005	0.03	0.01	
Maximum	0.003	0.07	0.005	0.28	0.09	0.001	0.04	57.8	0.001	0.005	0.114	0.012	0.54	3	0.005	14.7	0.03	0.002	3	0.009	0.46	0.01	16.3	0.03	0.03	5.6	0.01	0.254	0.005	0.014	0.03	0.01	
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	

STATION: VGMAIN, Main Fork Vangorda Creek

	AG-T	AL-T	AS-T	B-T	BA-T	BE-T	BI-T	CA-T	CD-T	CO-T	CR-T	CU-T	FE-T	K-T	LA-T	MG-T	MN-T	MO-T	NA-T	NI-T	P-T	PB-T	S-T	SB-T	SE-T	SI-T	SN-T	SR-T	TI-T	V-T	W-T	ZN-T	
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
20/04/99	<.003	0.06	<.005	0.14	0.074	<.001	<.04	55.5	0.002	<.005	<.005	0.014	0.03	1	<.005	26.2	0.02	0.011	5	<.005	0.6	<.01	36	<.03	<.03	3	<.01	0.274	0.014	<.005	<.03	0.02	
18/05/99	<.003	0.74	<.005	<.05	0.137	0.002	<.04	25.8	<.001	<.005	<.005	0.021	1.48	1	0.007	8.6	0.05	0.04	2	0.007	0.74	<.01	<.03	<.03	3.3	<.01	0.129	<.005	<.005	<.03	0.08		
20/06/99	<.003	0.65	<.005	0.06	0.105	<.001	<.04	10.5	0.002	<.005	0.049	0.009	1.78	1	0.007	3.8	0.02	<.002	2	<.005	1.92	<.01	3	<.03	<.03	2.8	<.01	0.084	0.02	<.005	<.03	0.12	
29/07/99	<.0001	0.11	<.001	0.02	0.0327	<.0001	<.001	20.08	<.0001	<.0002	0.009	0.0166	0.206	0.4	<.0002	6.65	0.005	<.0001	1.3	0.002	0.061	0.005	5.1	<.001	<.001	3.09	<.0004	0.0708	0.005	<.0002	<.001	0.024	
12/10/99	<.003	0.1	0.005	<.05	0.149	<.001	<.04	36.8	0.002	0.005	<.005	0.022	0.15	2	0.006	12.5	<.01	<.002	4	0.018	<.04	<.01	14	<.03	<.005	3.9	<.01	0.17	0.018	<.005	<.03	0.03	
JAN 1999 - DEC 1999																																	
Mean	0.0024	0.33	0.004	0.06	0.0995	0.001	0.032	29.74	0.0014	0.004	0.015	0.0165	0.729	1.1	0.005	11.55	0.021	0.011	2.9	0.007	0.672	0.009	14.5	0.024	0.019	3.22	0.0081	0.1456	0.012	0.004	0.024	0.055	
Std. Devia	0.0013	0.33	0.002	0.05	0.0474	0.0007	0.017	17.27	0.0009	0.0021	0.019	0.0053	0.832	0.6	0.003	8.78	0.017	0.0167	1.6	0.006	0.765	0.002	15.1	0.013	0.015	0.42	0.0043	0.0818	0.007	0.002	0.013	0.044	
Minimum	0.0001	0.06	0.001	0.02	0.0327	0.0001	0.001	10.5	0.0001	0.0002	0.005	0.009	0.03	0.4	2E-04	3.8	0.005	0.0001	1.3	0.002	0.04	0.005	3	0.001	0.001	2.8	0.0004	0.0708	0.005	2E-04	0.001	0.02	
Maximum	0.003	0.74	0.005	0.14	0.149	0.002	0.04	55.5	0.002	0.005	0.049	0.022	1.78	2	0.007	26.2	0.05	0.04	5	0.018	1.92	0.01	36	0.03	0.03	3.9	0.01	0.274	0.005	0.005	0.03	0.12	
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	

	AG-D	AL-D	AS-D	B-D	BA-D	BE-D	BI-D	CA-D	CD-D	CO-D	CR-D	CU-D	FE-D	K-D	LA-D	MG-D	MN-D	MO-D	NA-D	NI-D	P-D	PB-D	S-D	SB-D	SE-D	SI-D	SN-D	SR-D	TI-D	V-D	W-D	ZN-D
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
20/04/99	<.003	<.05	<.005	<.05	0.025	0.001	<.04	65.2	<.001	<.005	<.005	0.009	<.01	2	<.005	31.5	0.07	<.002	5	<.005	0.86	<.01	42	<.03	<.03	3.2	<.01	0.307	0.011	<.005	<.03	<.01
18/05/99	<.003	0.06	<.005	<.05	0.03	0.002	<.04	25.9	<.001	<.005	<.005	0.003	<.01	1	<.005	8.6	0.06	0.01	2	<.005	1.25	<.01	<.03	<.03	2.3	<.01	0.12	<.005	0.005	<.03	0.02	
20/06/99	<.003	<.05	<.005	<.05	<.002	<.001	<.04	8.8	<.001	<.005	<.005	<.002	0.13	<1	<.005	2.9	0.06	<.002	2	<.005	<.04	<.01	2	<.03	<.03	1.1	<.01	0.067	<.005	<.005	<.03	0.03
29/07/99	<.0001	0.02	<.001	0.03	0.0145	0.0001	<.001	19.21	<.0001	<.0002	<.0002	0.0054	0.008	0.4	<.0002	6.37	0.001	<.0001	1.3	0.001	<.002	0.001	6.8	<.001	<.001	3.66	<.0004	0.0638	0.002	0.001	<.001	<.0004
12/10/99	<.003	<.05	<.005	<.05	0.024	<.001	<.04	34.6	<.001	<.005	<.005	<.002	0.2	1	<.005	11.6	<.01	<.002	4	<.005	<.04	<.01	15	<.03	<.005	3.3	<.01	0.189	<.005	<.005	<.03	<.01

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V8, lower Vangorda Creek

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
19/01/99	<.003	0.13	<.005	0.2	0.095	<.001	<.04	100.9	0.001	<.005	0.089	0.034	0.04	3	<.005	48.5	0.54	<.002	8	<.005	<.04	0.03	63	<.03	<.03	5	<.01	0.474	0.012	<.005	<.03	0.02
23/02/99	0.011	0.3	<.005	0.4	0.082	<.001	<.04	107.3	<.001	0.005	<.005	0.026	<.01	2	0.009	47.3	0.98	0.005	7	0.01	1.21	<.01	45	<.03	<.03	5.3	<.01	0.511	0.018	<.005	<.03	0.06
23/03/99	<.003	0.33	<.005	0.23	0.11	<.001	<.04	109.7	<.001	<.005	0.099	0.034	0.28	3	0.006	71.4	0.39	<.002	9	<.005	1.26	<.01	88	<.03	<.03	4.7	<.01	0.543	<.005	<.005	<.03	0.08
20/04/99	<.003	0.13	0.016	0.14	0.077	0.001	0.04	75.9	<.001	0.009	<.005	0.02	0.09	2	<.005	40.6	0.1	0.008	6	<.005	0.34	0.01	52	<.03	<.03	3.4	<.01	0.354	0.02	<.005	<.03	<.01
18/05/99	<.003	0.46	<.005	<.05	0.132	0.002	<.04	28.5	<.001	<.005	<.005	0.017	0.97	2	<.005	10.1	0.05	<.002	2	0.01	0.96	<.01		<.03	<.03	3.1	<.01	0.138	<.005	0.006	<.03	0.05
20/06/99	<.003	2.57	<.005	<.05	0.134	<.001	<.04	14.5	<.001	<.005	0.098	0.005	4.55	2	<.005	6.4	0.07	<.002	2	<.005	3.46	<.01	4	<.03	<.03	5.6	<.01	0.104	0.066	<.005	<.03	0.09
29/07/99	<.0001	1.09	<.001	0.01	0.0577	0.0002	<.001	27.35	<.0001	<.0002	0.012	0.0204	1.745	0.6	0	10.5	0.036	<.0001	1.6	0.004	<.002	0.007	7.3	<.001	<.001	4.23	<.0004	0.0988	0.033	0.002	<.001	0.021
30/08/99	<.0001	0.065	<.001	0.008	0.0421	0.0001	<.001	35.718	0.0007	0.0002	<.0002	0.0081	0.157	0.76	<.0002	12.658	0.0178	0.0005	3.8	<.0002	<.002	<.001	12.42	<.001	<.001	2.91	<.0004	0.1238	0.009	<.0002	<.001	0.0054
12/10/99	<.003	0.12	<.005	<.05	0.151	<.001	<.04	49.1	0.002	0.009	<.005	0.02	0.18	2	<.005	19	0.05	<.002	5	0.008	<.04	0.02	20	<.03	<.005	4.5	<.01	0.23	0.016	<.005	<.03	<.01
14/12/99	<.003	0.26	0.016	0.05	0.138	<.001	<.04	59.4	0.005	<.005	<.005	0.034	0.05	7	0.034	21.5	0.06	<.002	3	0.034	0.14	0.04	25	0.06	<.005	2.6	<.01	0.234	0.011	0.01	<.03	0.04

JAN 1999 - DEC 1999

Mean	0.0032	0.545	0.006	0.119	0.1019	0.0009	0.032	60.837	0.0014	0.0048	0.0323	0.0219	0.807	2.44	0.007	28.796	0.2294	0.0026	4.74	0.009	0.745	0.015	35.19	0.027	0.019	4.134	0.0081	0.2811	0.02	0.005	0.024	0.0386
Std. Devia	0.003	0.771	0.005	0.125	0.037	0.0005	0.016	35.689	0.0014	0.0029	0.0437	0.0104	1.427	1.78	0.01	21.809	0.3168	0.0023	2.67	0.009	1.082	0.012	28.6	0.017	0.014	1.064	0.004	0.1759	0.018	0.003	0.012	0.0304
Minimum	0.0001	0.065	0.001	0.008	0.0421	0.0001	0.001	14.5	0.0001	0.0002	0.0002	0.005	0.01	0.6	0	6.4	0.0178	0.0001	1.6	2E-04	0.002	0.001	4	0.001	0.001	2.6	0.0004	0.0988	0.005	2E-04	0.001	0.0054
Maximum	0.011	2.57	0.016	0.4	0.151	0.002	0.04	109.7	0.005	0.009	0.099	0.034	4.55	7	0.034	71.4	0.98	0.008	9	0.034	3.46	0.04	88	0.06	0.03	5.6	0.01	0.543	0.066	0.01	0.03	0.09
Num. Valu	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	10	10	10	10	10	10	10	10	10

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
23/02/99	<.003	0.07	<.005	0.25	0.025	<.001	<.04	94.1	<.001	<.005	0.04	0.007	<.01	1	<.005	43.1	0.63	<.002	6	<.005	1.11	<.01		<.03	<.03	4.7	<.01	0.45	0.008	<.005	<.03	<.01
23/03/99	<.003	0.1	<.005	<.05	0.031	<.001	<.04	104.7	0.003	<.005	0.035	0.022	<.01	2	<.005	56.2	0.09	<.002	8	<.005	0.53	<.01	79.7	<.03	<.03	4.4	<.01	0.488	<.005	<.005	<.03	<.01
20/04/99	<.003	<.05	0.055	<.05	0.023	0.001	<.04	82.1	0.001	<.005	<.005	0.011	<.01	2	<.005	46.3	0.1	<.002	7	<.005	0.55	<.01	58	<.03	<.03	3.6	<.01	0.386	0.014	0.011	<.03	<.01
18/05/99	<.003	<.05	<.005	<.05	0.033	0.002	<.04	29.3	0.002	<.005	<.005	<.002	<.01	2	0.031	10.4	0.06	0.004	2	0.008	<.04	<.01		<.03	<.03	2.2	<.01	0.134	<.005	<.005	<.03	0.02
20/06/99	<.003	0.07	<.005	<.05	<.002	<.001	<.04	9.5	<.001	<.005	<.005	<.002	0.21	<.01	<.005	3.3	0.07	<.002	<.01	<.005	<.04	<.01	4	<.03	<.03	0.7	<.01	0.064	<.005	<.005	<.03	0.03
29/07/99	<.0001	0.15	<.001	0.07	0.0223	<.0001	<.001	26.17	<.0001	<.0002	0.005	0.005	0.003	0.5	<.0002	10.05	0.001	<.0001	1.7	0.001	<.002	<.001	10.2	<.001	<.001	3.11	<.0004	0.065	0.001	0.001	<.001	<.0004
30/08/99	<.0001	0.009	<.001	0.28	0.0089	<.0001	<.001	34.18	0.0002	<.0002	<.0002	0.0011	0.001	0.56	<.0002	12.113	0.0016	0.0001	3.64	2E-04	<.002	<.001	11.88	<.001	<.001	3.448	<.0004	0.0791	0.001	2E-04	<.001	<.0004
12/10/99	<.003	<.05	<.005	<.05	0.021	<.001	<.04	40.5	<.001	<.005	<.005	0.006	0.05	2	<.005	15.3	0.01	<.002	3	0.009	<.04	0.01	20	<.03	<.005	2.9	<.01	0.184	0.006	<.005	<.03	<.01
14/12/99	<.003	<.05	<.005	<.05	0.114	<.001	<.04	66.6	<.001	<.005	<.005	0.011	<.01	2	<.005	24.3	0.05	<.002	3	0.007	<.04	<.01	28	<.03	<.005	3.2	<.01	0.265	<.005	<.005	<.03	<.01

JAN 1999 - DEC 1999

Mean	0.0024	0.067	0.01	0.1	0.0311	0.0009	0.031	54.128	0.0011	0.0039	0.0117	0.0075	0.035	1.45	0.007	24.563	0.1125	0.0018	3.93	0.005	0.262	0.008	30.25	0.024	0.018	3.14	0.0079	0.235	0.006	0.005	0.024	0.0112
Std. Devia	0.0013	0.04	0.017	0.094	0.0326	0.0006	0.017	33.665	0.0009	0.0021	0.0148	0.0066	0.067	0.67	0.009	19.109	0.1975	0.0012	2.48	0.003	0.388	0.004	28.15	0.013	0.014	1.185	0.0042	0.1693	0.004	0.003	0.013	0.0092
Minimum	0.0001	0.009	0.001	0.05	0.002	0.0001	0.001	9.5	0.0001	0.0002	0.0002	0.0011	0.001	0.5	2E-04	3.3	0.001	0.0001	1	2E-04	0.002	0.001	4	0.001	0.001	0.7	0.0004	0.064	0.001	2E-04	0.001	0.0004
Maximum	0.003	0.15	0.055	0.28	0.114	0.002	0.04	104.7	0.003	0.005	0.04	0.022	0.21	2	0.031	56.2	0.63	0.004	8	0.009	1.11	0.01	79.7	0.03	0.03	4.7	0.01	0.488	0.014	0.011	0.03	0.03
Num. Valu	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	7	9	9	9	9	9	9	9	9	9	9

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V15, Sulphide cell sump, Grum Dump

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
17/03/99	<.003	0.29	<.005	0.19	0.316	<.001	<.04	133.6	0.001	<.005	0.496	0.032	0.06	2	<.005	48.1	<.01	<.002	9	<.005	1.25	<.01	67	<.03	<.03	5.1	<.01	0.735	0.006	<.005	<.03	0.03
03/07/99	<.003	0.51	<.005	0.51	0.404	<.001	<.04	154.3	0.001	<.005	<.005	0.027	0.91	3	0.051	53.2	0.01	0.003	8	<.005	<.04	0.02	72	0.04	<.03	7.7	<.01	0.986	<.005	0.016	<.03	0.02
10/09/99	<.003	0.21	<.005	<.05	0.44	<.001	<.04	153.8	<.001	<.005	<.005	0.023	0.05	3	<.005	56.4	0.03	0.006	7	<.005	0.24	<.01	84	<.03	<.005	5.2	<.01	0.897	0.019	0.018	<.03	0.04
12/10/99	<.003	0.21	0.007	<.05	0.412	<.001	<.04	171.5	0.006	<.005	<.005	0.035	0.13	4	<.005	64	<.01	0.008	8	0.023	<.04	<.01	102	0.03	<.005	5.7	<.01	0.962	0.027	<.005	<.03	<.01
13/12/99	<.003	0.64	<.005	<.05	0.34	<.001	<.04	180.5	0.002	<.005	<.005	0.038	0.14	8	<.005	60.3	0.01	<.002	6	0.022	<.04	<.01	97	<.03	<.005	3.8	<.01	0.865	0.011	0.02	<.03	0.04
JAN 1999 - DEC 1999																																
Mean	0.003	0.37	0.005	0.17	0.382	0.001	0.04	158.7	0.002	0.005	0.103	0.031	0.26	4	0.014	56.4	0.01	0.004	8	0.012	0.32	0.01	84	0.03	0.015	5.5	0.01	0.889	0.014	0.013	0.03	0.03
Std. Devia	0	0.19	0.001	0.2	0.052	0	0	18.1	0.002	0	0.22	0.006	0.37	2	0.021	6.2	0.01	0.003	1	0.01	0.53	0	15	0	0.014	1.4	0	0.099	0.009	0.007	0	0.01
Minimum	0.003	0.21	0.005	0.05	0.316	0.001	0.04	133.6	0.001	0.005	0.005	0.023	0.05	2	0.005	48.1	0.01	0.002	6	0.005	0.04	0.01	67	0.03	0.005	3.8	0.01	0.735	0.005	0.005	0.03	0.01
Maximum	0.003	0.64	0.007	0.51	0.44	0.001	0.04	180.5	0.006	0.005	0.496	0.038	0.91	8	0.051	64	0.03	0.008	9	0.023	1.25	0.02	102	0.04	0.03	7.7	0.01	0.986	0.027	0.02	0.03	0.04
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
17/03/99	<.003	0.07	<.005	0.06	0.098	<.001	<.04	95.1	<.001	<.005	0.302	0.012	<.01	2	<.005	45.1	<.01	<.002	9	<.005	0.62	<.01	70	<.03	<.03	4.4	<.01	0.628	<.005	<.005	<.03	<.01
03/07/99	<.003	0.14	<.005	0.21	0.157	<.001	<.04	106.9	0.002	<.005	<.005	0.015	0.49	2	<.005	48.2	0.12	0.003	7	<.005	<.04	<.01	72	<.03	<.03	6.5	<.01	0.776	<.005	0.014	<.03	<.01
10/09/99	<.003	0.11	<.005	<.05	0.154	<.001	<.04	139.9	<.001	<.005	<.005	0.017	<.01	3	<.005	56.9	<.01	0.005	7	0.009	<.04	<.01	97	<.03	<.005	5.4	<.01	0.842	0.009	0.006	<.03	<.01
12/10/99	<.003	0.08	<.005	<.05	0.16	<.001	<.04	165.5	<.001	<.005	<.005	0.019	0.05	4	<.005	65.9	<.01	0.006	9	0.016	<.04	<.01	107	<.03	<.005	5.6	<.01	0.986	0.013	<.005	<.03	<.01
13/12/99	<.003	0.52	<.005	<.05	0.319	<.001	<.04	199.7	<.001	<.005	<.005	0.016	<.01	4	<.005	67.6	<.01	<.002	6	<.005	<.04	<.01	110	<.03	<.005	4.5	<.01	0.978	<.005	<.005	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.18	0.005	0.08	0.178	0.001	0.04	141.4	0.001	0.005	0.064	0.016	0.11	3	0.005	56.7	0.03	0.004	8	0.008	0.16	0.01	91	0.03	0.015	5.3	0.01	0.842	0.007	0.007	0.03	0.01
Std. Devia	0	0.19	0	0.07	0.083	0	0	42.8	0	0	0.133	0.003	0.21	1	0	10.1	0.05	0.002	1	0.005	0.26	0	19	0	0.014	0.9	0	0.149	0.004	0.004	0	0
Minimum	0.003	0.07	0.005	0.05	0.098	0.001	0.04	95.1	0.001	0.005	0.005	0.012	0.01	2	0.005	45.1	0.01	0.002	6	0.005	0.04	0.01	70	0.03	0.005	4.4	0.01	0.628	0.005	0.005	0.03	0.01
Maximum	0.003	0.52	0.005	0.21	0.319	0.001	0.04	199.7	0.002	0.005	0.302	0.019	0.49	4	0.005	67.6	0.12	0.006	9	0.016	0.62	0.01	110	0.03	0.03	6.5	0.01	0.986	0.013	0.014	0.03	0.01
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

STATION: V17A, Runoff from ore transfer pad

	AG-T	AL-T	AS-T	B-T	BA-T	BE-T	BI-T	CA-T	CD-T	CO-T	CR-T	CU-T	FE-T	K-T	LA-T	MG-T	MN-T	MO-T	NA-T	NI-T	P-T	PB-T	S-T	SB-T	SE-T	SI-T	SN-T	SR-T	TI-T	V-T	W-T	ZN-T
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
03/07/99	<.003	0.33	<.005	0.34	0.03	<.001	<.04	10.2	<.001	<.005	<.005	0.005	1.1	<1	<.005	1.4	0.02	<.002	<1	<.005	<.04	<.01	2	<.03	<.03	5.8	<.01	0.066	<.005	0.012	<.03	0.03
10/09/99	<.003	0.1	<.005	<.05	0.135	<.001	<.04	18.3	<.001	0.007	<.005	0.009	0.28	<1	<.005	2.3	0.05	<.002	3	0.007	<.04	<.01	3	<.03	<.005	4.9	<.01	0.088	0.01	0.018	<.03	0.06
JAN 1999 - DEC 1999																																
Mean	0.003	0.22	0.005	0.2	0.083	0.001	0.04	14.2	0.001	0.006	0.005	0.007	0.69	1	0.005	1.8	0.04	0.002	2	0.006	0.04	0.01	2	0.03	0.017	5.4	0.01	0.077	0.007	0.015	0.03	0.04
Std. Devia	0	0.16	0	0.21	0.074	0	0	5.7	0	0.001	0	0.003	0.58	0	0	0.6	0.02	0	1	0.001	0	0	1	0	0.018	0.6	0	0.016	0.004	0.004	0	0.02
Minimum	0.003	0.1	0.005	0.05	0.03	0.001	0.04	10.2	0.001	0.005	0.005	0.005	0.28	1	0.005	1.4	0.02	0.002	1	0.005	0.04	0.01	2	0.03	0.005	4.9	0.01	0.066	0.005	0.012	0.03	0.03
Maximum	0.003	0.33	0.005	0.34	0.135	0.001	0.04	18.3	0.001	0.007	0.005	0.009	1.1	1	0.005	2.3	0.05	0.002	3	0.007	0.04	0.01	3	0.03	0.03	5.8	0.01	0.088	0.01	0.018	0.03	0.06
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Date	AG-D	AL-D	AS-D	B-D	BA-D	BE-D	BI-D	CA-D	CD-D	CO-D	CR-D	CU-D	FE-D	K-D	LA-D	MG-D	MN-D	MO-D	NA-D	NI-D	P-D	PB-D	S-D	SB-D	SE-D	SI-D	SN-D	SR-D	TI-D	V-D	W-D	ZN-D
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
03/07/99	<.003	<.05	<.005	0.07	0.007	<.001	<.04	7.8	<.001	<.005	<.005	<.002	0.56	<1	<.005	1.7	0.01	<.002	<1	<.005	<.04	<.01	2	<.03	<.03	4.2	<.01	0.015	<.005	<.005	<.03	<.01
10/09/99	<.003	<.05	<.005	<.05	0.021	<.001	<.04	15.1	<.001	<.005	<.005	0.003	0.1	<1	<.005	2.6	<.01	<.002	2	<.005	<.04	<.01	3	<.03	<.005	4.3	<.01	0.087	<.005	0.007	<.03	0.02
JAN 1999 - DEC 1999																																
Mean	0.003	0.05	0.005	0.06	0.014	0.001	0.04	11.5	0.001	0.005	0.005	0.003	0.33	1	0.005	2.1	0.01	0.002	2	0.005	0.04	0.01	2	0.03	0.017	4.2	0.01	0.051	0.005	0.006	0.03	0.01
Std. Devia	0	0	0	0.01	0.01	0	0	5.2	0	0	0	0.001	0.33	0	0	0.6	0	0	1	0	0	0	1	0	0.018	0.1	0	0.051	0	0.001	0	0.01
Minimum	0.003	0.05	0.005	0.05	0.007	0.001	0.04	7.8	0.001	0.005	0.005	0.002	0.1	1	0.005	1.7	0.01	0.002	1	0.005	0.04	0.01	2	0.03	0.005	4.2	0.01	0.015	0.005	0.005	0.03	0.01
Maximum	0.003	0.05	0.005	0.07	0.021	0.001	0.04	15.1	0.001	0.005	0.005	0.003	0.56	1	0.005	2.6	0.01	0.002	2	0.005	0.04	0.01	3	0.03	0.03	4.3	0.01	0.087	0.005	0.007	0.03	0.02
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V19, Vangorda pit, NW Interceptor ditch

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L	
18/05/99	<.003	0.51	<.005	<.05	0.148	0.002	<.04	19.9	<.001	<.005	0.007	0.015	0.82	1	<.005	3.3	0.02	<.002	2	<.005	2.13	<.01		<.03	<.03	5	<.01	0.099	<.005	0.009	<.03	0.19	
JAN 1999 - DEC 1999																																	
Mean	0.003	0.51	0.005	0.05	0.148	0.002	0.04	19.9	0.001	0.005	0.007	0.015	0.82	1	0.005	3.3	0.02	0.002	2	0.005	2.13	0.01		0.03	0.03	5	0.01	0.099	0.005	0.009	0.03	0.19	
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	
Minimum	0.003	0.51	0.005	0.05	0.148	0.002	0.04	19.9	0.001	0.005	0.007	0.015	0.82	1	0.005	3.3	0.02	0.002	2	0.005	2.13	0.01		0.03	0.03	5	0.01	0.099	0.005	0.009	0.03	0.19	
Maximum	0.003	0.51	0.005	0.05	0.148	0.002	0.04	19.9	0.001	0.005	0.007	0.015	0.82	1	0.005	3.3	0.02	0.002	2	0.005	2.13	0.01		0.03	0.03	5	0.01	0.099	0.005	0.009	0.03	0.19	
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	
Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L	
18/05/99	<.003	0.19	<.005	<.05	0.053	0.002	<.04	22.5	<.001	<.005	<.005	<.002	<.01	1	<.005	3.9	0.04	0.019	2	0.008	1.44	<.01		<.03	<.03	5.4	<.01	0.112	<.005	0.03	<.03	0.09	
JAN 1999 - DEC 1999																																	
Mean	0.003	0.19	0.005	0.05	0.053	0.002	0.04	22.5	0.001	0.005	0.005	0.002	0.01	1	0.005	3.9	0.04	0.019	2	0.008	1.44	0.01		0.03	0.03	5.4	0.01	0.112	0.005	0.03	0.03	0.09	
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	
Minimum	0.003	0.19	0.005	0.05	0.053	0.002	0.04	22.5	0.001	0.005	0.005	0.002	0.01	1	0.005	3.9	0.04	0.019	2	0.008	1.44	0.01		0.03	0.03	5.4	0.01	0.112	0.005	0.03	0.03	0.09	
Maximum	0.003	0.19	0.005	0.05	0.053	0.002	0.04	22.5	0.001	0.005	0.005	0.002	0.01	1	0.005	3.9	0.04	0.019	2	0.008	1.44	0.01		0.03	0.03	5.4	0.01	0.112	0.005	0.03	0.03	0.09	
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	

STATION: V21A, VG Dump Collector Ditch @ LCD

	AG-T	AL-T	AS-T	B-T	BA-T	BE-T	BI-T	CA-T	CD-T	CO-T	CR-T	CU-T	FE-T	K-T	LA-T	MG-T	MN-T	MO-T	NA-T	NI-T	P-T	PB-T	S-T	SB-T	SE-T	SI-T	SN-T	SR-T	TI-T	V-T	W-T	ZN-T	
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
18/05/99	<.003	0.08	<.005	<.05	0.119	0.002	<.04	76.4	0.002	<.005	<.005	0.026	0.17	1	<.005	29	0.04	<.002	2	0.019	1.65	<.01		<.03	<.03	1.1	<.01	0.313	<.005	<.005	<.03	0.14	
JAN 1999 - DEC 1999																																	
Mean	0.003	0.08	0.005	0.05	0.119	0.002	0.04	76.4	0.002	0.005	0.005	0.026	0.17	1	0.005	29	0.04	0.002	2	0.019	1.65	0.01		0.03	0.03	1.1	0.01	0.313	0.005	0.005	0.03	0.14	
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	
Minimum	0.003	0.08	0.005	0.05	0.119	0.002	0.04	76.4	0.002	0.005	0.005	0.026	0.17	1	0.005	29	0.04	0.002	2	0.019	1.65	0.01		0.03	0.03	1.1	0.01	0.313	0.005	0.005	0.03	0.14	
Maximum	0.003	0.08	0.005	0.05	0.119	0.002	0.04	76.4	0.002	0.005	0.005	0.026	0.17	1	0.005	29	0.04	0.002	2	0.019	1.65	0.01		0.03	0.03	1.1	0.01	0.313	0.005	0.005	0.03	0.14	
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	
Date	AG-D	AL-D	AS-D	B-D	BA-D	BE-D	BI-D	CA-D	CD-D	CO-D	CR-D	CU-D	FE-D	K-D	LA-D	MG-D	MN-D	MO-D	NA-D	NI-D	P-D	PB-D	S-D	SB-D	SE-D	SI-D	SN-D	SR-D	TI-D	V-D	W-D	ZN-D	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
18/05/99	<.003	<.05	<.005	<.05	0.043	0.002	<.04	77.5	0.001	0.007	<.005	0.002	<.01	1	<.005	29.7	0.37	0.007	2	0.009	1.44	<.01		<.03	<.03	1.1	<.01	0.301	<.005	0.013	<.03	0.1	
JAN 1999 - DEC 1999																																	
Mean	0.003	0.05	0.005	0.05	0.043	0.002	0.04	77.5	0.001	0.007	0.005	0.002	0.01	1	0.005	29.7	0.37	0.007	2	0.009	1.44	0.01		0.03	0.03	1.1	0.01	0.301	0.005	0.013	0.03	0.1	
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	
Minimum	0.003	0.05	0.005	0.05	0.043	0.002	0.04	77.5	0.001	0.007	0.005	0.002	0.01	1	0.005	29.7	0.37	0.007	2	0.009	1.44	0.01		0.03	0.03	1.1	0.01	0.301	0.005	0.013	0.03	0.1	
Maximum	0.003	0.05	0.005	0.05	0.043	0.002	0.04	77.5	0.001	0.007	0.005	0.002	0.01	1	0.005	29.7	0.37	0.007	2	0.009	1.44	0.01		0.03	0.03	1.1	0.01	0.301	0.005	0.013	0.03	0.1	
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V22, Vangorda pit water

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
18/06/99	<.003	0.54	<.005	0.09	0.125	<.001	<.04	68.7	0.017	0.052	<.005	0.095	1.15	3	0.02	25.8	3.13	0.013	5	0.11	<.04	0.04	75	0.1	<.03	2	<.01	0.737	0.027	0.007	<.03	11.21
10/09/99	<.003	0.19	0.065	<.05	0.105	<.001	<.04	119.6	0.058	0.216	<.005	0.022	0.28	3	<.005	45.4	9.94	0.081	5	0.261	3.29	0.13	171	0.17	<.005	1.8	<.01	1.047	0.016	0.012	<.03	22.59
12/10/99	<.003	0.23	<.005	<.05	0.122	<.001	<.04	135.9	0.061	0.199	<.005	0.034	0.39	4	<.005	52.1	10.77	0.071	6	0.278	<.04	0.17	189	0.13	<.005	2.8	<.01	1.226	0.024	<.005	<.03	37.36

JAN 1999 - DEC 1999

Mean	0.003	0.32	0.025	0.06	0.117	0.001	0.04	108.1	0.045	0.156	0.005	0.05	0.61	3	0.01	41.1	7.95	0.055	5	0.216	1.12	0.11	145	0.13	0.013	2.2	0.01	1.003	0.022	0.008	0.03	23.72
Std. Devia	0	0.19	0.035	0.02	0.011	0	0	35.1	0.025	0.09	0	0.039	0.47	1	0.009	13.7	4.19	0.037	1	0.092	1.88	0.07	61	0.04	0.014	0.5	0	0.247	0.006	0.004	0	13.11
Minimum	0.003	0.19	0.005	0.05	0.105	0.001	0.04	68.7	0.017	0.052	0.005	0.022	0.28	3	0.005	25.8	3.13	0.013	5	0.11	0.04	0.04	75	0.1	0.005	1.8	0.01	0.737	0.016	0.005	0.03	11.21
Maximum	0.003	0.54	0.065	0.09	0.125	0.001	0.04	135.9	0.061	0.216	0.005	0.095	1.15	4	0.02	52.1	10.77	0.081	6	0.278	3.29	0.17	189	0.17	0.03	2.8	0.01	1.226	0.027	0.012	0.03	37.36
Num. Valu	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/06/99	<.003	0.35	<.005	<.05	0.104	<.001	<.04	69.6	0.006	0.037	<.005	0.047	0.43	2	0.009	25.6	2.11	0.018	4	0.062	1.4	<.01	82	0.06	<.03	1.5	<.01	0.68	0.006	<.005	<.03	3.52
10/09/99	<.003	0.07	<.005	<.05	0.136	<.001	<.04	113.6	0.011	0.123	<.005	0.016	0.03	3	<.005	41.4	7.56	0.01	4	0.142	<.04	<.01	182	<.03	<.005	1.4	<.01	0.968	0.007	<.005	<.03	3.66
12/10/99	<.003	0.05	<.005	<.05	0.171	<.001	<.04	109.8	0.02	0.128	<.005	0.013	0.06	3	<.005	39.3	7.09	0.013	4	0.175	<.04	0.07	212	<.03	<.005	0.7	<.01	0.901	0.01	<.005	<.03	8.67

JAN 1999 - DEC 1999

Mean	0.003	0.16	0.005	0.05	0.137	0.001	0.04	97.7	0.012	0.096	0.005	0.025	0.17	3	0.006	35.4	5.59	0.014	4	0.126	0.49	0.03	159	0.04	0.013	1.2	0.01	0.85	0.008	0.005	0.03	5.28
Std. Devia	0	0.17	0	0	0.034	0	0	24.4	0.007	0.051	0	0.019	0.22	1	0.002	8.6	3.02	0.004	0	0.058	0.79	0.03	68	0.02	0.014	0.4	0	0.151	0.002	0	0	2.93
Minimum	0.003	0.05	0.005	0.05	0.104	0.001	0.04	69.6	0.006	0.037	0.005	0.013	0.03	2	0.005	25.6	2.11	0.01	4	0.062	0.04	0.01	82	0.03	0.005	0.7	0.01	0.68	0.006	0.005	0.03	3.52
Maximum	0.003	0.35	0.005	0.05	0.171	0.001	0.04	113.6	0.02	0.128	0.005	0.047	0.43	3	0.009	41.4	7.56	0.018	4	0.175	1.4	0.07	212	0.06	0.03	1.5	0.01	0.968	0.01	0.005	0.03	8.67
Num. Valu	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

STATION: V23, Grum Pit Water

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
10/09/99	<.003	0.22	<.005	<.05	0.15	<.001	<.04	82.4	0.01	0.057	<.005	0.017	0.18	4	<.005	46	0.37	0.019	12	0.177	<.04	<.01	89	0.09	<.005	2.7	<.01	0.868	0.015	0.011	<.03	3.42
12/10/99	<.003	0.16	<.005	<.05	0.12	<.001	<.04	73.8	0.019	0.044	<.005	0.029	0.14	4	<.005	41.7	0.46	0.013	11	0.174	<.04	0.04	103	0.04	<.005	2.4	<.01	0.761	0.017	<.005	<.03	5.91

JAN 1999 - DEC 1999

Mean	0.003	0.19	0.005	0.05	0.135	0.001	0.04	78.1	0.014	0.05	0.005	0.023	0.16	4	0.005	43.9	0.42	0.016	12	0.175	0.04	0.02	96	0.07	0.005	2.6	0.01	0.814	0.016	0.008	0.03	4.66
Std. Devia	0	0.04	0	0	0.021	0	0	6.1	0.006	0.009	0	0.008	0.03	0	0	3	0.06	0.004	1	0.002	0	0.02	10	0.04	0	0.2	0	0.076	0.001	0.004	0	1.76
Minimum	0.003	0.16	0.005	0.05	0.12	0.001	0.04	73.8	0.01	0.044	0.005	0.017	0.14	4	0.005	41.7	0.37	0.013	11	0.174	0.04	0.01	89	0.04	0.005	2.4	0.01	0.761	0.015	0.005	0.03	3.42
Maximum	0.003	0.22	0.005	0.05	0.15	0.001	0.04	82.4	0.019	0.057	0.005	0.029	0.18	4	0.005	46	0.46	0.019	12	0.177	0.04	0.04	103	0.09	0.005	2.7	0.01	0.868	0.017	0.011	0.03	5.91
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
10/09/99	<.003	0.06	<.005	<.05	0.05	<.001	<.04	73.8	0.003	0.027	<.005	0.009	<.01	3	<.005	41.1	0.36	0.003	10	0.052	0.32	<.01	100	<.03	<.005	1.9	<.01	0.729	<.005	<.005	<.03	0.2
12/10/99	<.003	<.05	<.005	<.05	0.103	<.001	<.04	90.1	0.006	0.038	<.005	0.008	0.06	5	<.005	52	0.43	<.002	14	0.112	<.04	<.01	115	<.03	<.005	2.3	<.01	0.975	0.006	0.006	<.03	1.3

JAN 1999 - DEC 1999

Mean	0.003	0.05	0.005	0.05	0.077	0.001	0.04	82	0.005	0.032	0.005	0.008	0.03	4	0.005	46.5	0.4	0.003	12	0.082	0.18	0.01	108	0.03	0.005	2.1	0.01	0.852	0.005	0.005	0.03	0.75
Std. Devia	0	0.01	0	0	0.037	0	0	11.5	0.002	0.008	0	0.001	0.04	1	0	7.7	0.05	0.001	3	0.042	0.2	0	11	0	0	0.3	0	0.174	0.001	0.001	0	0.78
Minimum	0.003	0.05	0.005	0.05	0.05	0.001	0.04	73.8	0.003	0.027	0.005	0.008	0.01	3	0.005	41.1	0.36	0.002	10	0.052	0.04	0.01	108	0.03	0.005	1.9	0.01	0.729	0.005	0.005	0.03	0.2
Maximum	0.003	0.06	0.005	0.05	0.103	0.001	0.04	90.1	0.006	0.038	0.005	0.009	0.06	5	0.005	52	0.43	0.003	14	0.112	0.32	0.01	115	0.03	0.005	2.3	0.01	0.975	0.006	0.006	0.03	1.3
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V25BSP, Below Sheep Pond at the weir

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
18/05/99	<.003	5.26	<.005	<.05	0.225	0.002	<.04	29.1	<.001	<.005	<.005	0.074	9.34	3	<.005	7.4	0.27	0.013	3	0.024	1.68	0.13		<.03	<.03	8.4	<.01	0.15	0.124	0.019	<.03	0.19
27/05/99	<.003	6.93	0.011	<.05	0.215	<.001	<.04	32.3	0.009	<.005	<.005	0.052	11.65	3	<.005	9	0.15	0.005	4	0.015	<.04	0.07		<.03	<.03	10.6	<.01	0.161	0.23	0.006	<.03	0.1
03/07/99	<.003	1.01	<.005	0.42	0.058	<.001	<.04	23.5	0.008	<.005	<.005	0.023	1.79	2	0.026	4.6	0.02	0.006	1	<.005	<.04	<.01	13	<.03	<.03	6.1	<.01	0.142	<.005	<.005	<.03	0.06
12/08/99	<.003	<.05	<.005	0.06	0.146	<.001	<.04	55.6	<.001	0.049	<.005	0.026	0.04	<1	<.005	11.7	0.26	<.002	3	<.005	<.04	<.01	50	<.03	<.005	7.9	<.01	0.275	<.005	<.005	<.03	0.38
10/09/99	<.003	0.2	<.005	<.05	0.119	<.001	<.04	41.7	0.002	0.043	0.017	0.044	0.03	2	0.032	8.7	0.33	0.007	4	0.011	0.52	<.01	45	<.03	<.005	4.3	<.01	0.195	0.009	<.005	<.03	0.27
JAN 1999 - DEC 1999																																
Mean	0.003	2.69	0.006	0.13	0.153	0.001	0.04	36.4	0.004	0.021	0.007	0.044	4.57	2	0.015	8.3	0.21	0.007	3	0.012	0.46	0.05	36	0.03	0.02	7.5	0.01	0.185	0.075	0.008	0.03	0.2
Std. Devia	0	3.18	0.003	0.16	0.069	0	0	12.6	0.004	0.023	0.005	0.021	5.52	1	0.013	2.6	0.12	0.004	1	0.008	0.71	0.05	20	0	0.014	2.4	0	0.054	0.101	0.006	0	0.13
Minimum	0.003	0.05	0.005	0.05	0.058	0.001	0.04	23.5	0.001	0.005	0.005	0.023	0.03	1	0.005	4.6	0.02	0.002	1	0.005	0.04	0.01	13	0.03	0.005	4.3	0.01	0.142	0.005	0.005	0.03	0.06
Maximum	0.003	6.93	0.011	0.42	0.225	0.002	0.04	55.6	0.009	0.049	<.005	0.026	11.65	3	0.032	11.7	0.33	0.013	4	0.024	1.68	0.13	50	0.03	0.03	10.6	0.01	0.275	0.023	0.019	0.03	0.38
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/05/99	<.003	0.27	<.005	<.05	0.039	0.002	<.04	23.5	<.001	<.005	<.005	0.065	0.04	2	0.031	5.2	0.06	<.002	3	0.011	0.33	<.01		<.03	<.03	1.1	<.01	0.112	<.005	0.014	<.03	0.05
27/05/99	<.003	3.49	<.005	<.05	0.058	<.001	<.04	30	0.008	<.005	<.005	0.034	2.71	3	<.005	6.6	0.12	<.002	10	0.007	<.04	<.01	21	<.03	<.03	6.9	<.01	0.13	0.128	<.005	<.03	0.07
03/07/99	<.003	0.42	<.005	0.59	0.036	<.001	<.04	22.1	0.004	<.005	<.005	0.011	0.82	<1	<.005	4.4	0.03	<.002	2	<.005	<.04	<.01	13	<.03	<.03	5.7	<.01	0.1	<.005	<.005	<.03	<.01
12/08/99	<.003	<.05	<.005	0.06	0.085	<.001	<.04	52.3	0.007	0.028	<.005	0.013	<.01	8	0.011	11	0.23	<.002	5	0.007	<.04	<.01	48	<.03	<.005	7.1	<.01	0.266	0.009	0.016	<.03	0.72
10/09/99	<.003	<.05	<.005	<.05	0.028	<.001	<.04	36.7	<.001	0.012	<.005	0.012	<.01	1	0.014	8.2	0.32	<.002	3	0.011	<.04	<.01	52	<.03	<.005	3.4	<.01	0.212	<.005	<.005	<.03	0.16
JAN 1999 - DEC 1999																																
Mean	0.003	0.86	0.005	0.16	0.049	0.001	0.04	32.9	0.004	0.011	0.005	0.027	0.72	3	0.013	7.1	0.15	0.002	5	0.008	0.1	0.01	34	0.03	0.02	4.8	0.01	0.164	0.03	0.009	0.03	0.2
Std. Devia	0	1.48	0	0.24	0.023	0	0	12.3	0.003	0.01	0	0.023	1.17	3	0.011	2.6	0.12	0	3	0.003	0.13	0	19	0	0.014	2.6	0	0.072	0.055	0.006	0	0.29
Minimum	0.003	0.05	0.005	0.05	0.028	0.001	0.04	22.1	0.001	0.005	0.005	0.011	0.01	1	0.005	4.4	0.03	0.002	2	0.005	0.04	0.01	13	0.03	0.005	1.1	0.01	0.1	0.005	0.005	0.03	0.01
Maximum	0.003	3.49	0.005	0.59	0.085	0.002	0.04	52.3	0.008	0.028	<.005	0.065	2.71	8	0.031	11	0.32	0.002	10	0.011	0.33	0.01	52	0.03	0.03	7.1	0.01	0.266	0.128	0.016	0.03	0.72
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5

STATION: V27, Vangorda Creek, just upstr. of Shrimp

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	TI-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L
16/03/99	<.003	0.25	<.005	0.22	0.081	<.001	<.04	42.9	<.001	<.005	0.069	0.024	0.07	<1	<.005	10.3	<.01	<.002	4	<.005	0.39	<.01	15	<.03	<.03	4.2	<.01	0.197	<.005	<.005	<.03	0.07
18/06/99	<.003	0.19	<.005	0.11	0.1	<.001	<.04	5.9	<.001	<.005	0.227	0.015	0.5	<1	<.005	1.5	<.01	<.002	2	<.005	0.08	<.01	1	0.06	<.03	1.8	<.01	0.053	0.007	0.012	<.03	0.06
29/07/99	<.0001	0.08	<.001	0.02	0.0289	<.0001	<.001	10.73	0.0002	<.0002	<.0002	0.0261	0.17	0.3	<.0002	2.6	0.005	<.0001	1.1	0.004	<.002	<.001	3.1	<.001	<.001	3.73	<.0004	0.0464	0.004	<.0002	<.001	0.04
31/08/99	<.0001	0.048	<.001	0.057	0.0366	<.0001	<.001	14.778	0.0009	<.0002	<.0002	0.0076	0.134	0.42	<.0002	3.355	0.0032	<.0001	2.42	9E-04	<.002	<.001	5.68	<.001	<.001	3.442	<.0004	0.0703	0.006	<.0002	<.001	0.0283
12/10/99	<.003	0.08	<.005	<.05	0.13	<.001	<.04	21.5	<.001	<.005	<.005	0.018	0.2	<1	<.005	4.9	<.01	<.002	3	<.005	<.04	<.01	8	<.03	<.005	4	<.01	0.111	0.012	<.005	<.03	0.07
JAN 1999 - DEC 1999																																
Mean	0.0018	0.13	0.003	0.091	0.0753	0.0006	0.024	19.162	0.0008	0.0031	0.0603	0.0181	0.215	0.74	0.003	4.531	0.0076	0.0012	2.5	0.004	0.103	0.006	6.56	0.024	0.013	3.434	0.0062	0.0955	0.007	0.005	0.018	0.0537
Std. Devia	0.0016	0.085	0.002	0.079	0.0427	0.0005	0.021	14.45	0.0003	0.0026	0.0077	0.0074	0.167	0.35	0.003	3.454	0.0033	0.001	1.09	0.002	0.164	0.005	5.41	0.025	0.015	0.957	0.0053	0.062	0.003	0.005	0.016	0.0187
Minimum	0.0001	0.048	0.001	0.02	0.0289	0.0001	0.001	5.9	0.0002	0.0002	0.0002	0.0076	0.07	0.3	2E-04	1.5	0.0032	0.0001	1.1	9E-04	0.002	0.001	1	0.001	0.001	1.8	0.0004	0.0464	0.004	2E-04	0.001	0.0283
Maximum	0.003	0.25	0.005	0.22	0.13	0.001	0.04	42.9	0.001	0.005	0.227	0.0261	0.5	1	0.005	10.3	0.01	0.002	4	0.005	0.39	0.01	15	0.06	0.03	4.2	0.01	0.197	0.012	0.012	0.03	0.07
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

	AG-D	AL-D	AS-D	B-D	BA-D	BE-D	BI-D	CA-D	CD-D	CO-D	CR-D	CU-D	FE-D	K-D	LA-D	MG-D	MN-D	MO-D	NA-D	NI-D	P-D	PB-D	S-D	SB-D	SE-D	SI-D	SN-D	SR-D	TI-D	V-D	W-D	ZN-D
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
16/03/99	<.003	<.05	<.005	0.05	0.032	<.001	<.04	38.7	<.001	<.005	<.005	0.01	<.01	<1	<.005	10	<.01	<.002	3	<.005	0.14	<.01	18	<.03	<.03	3.5	<.01	0.197	<.005	<.005	<.03	<.01
18/06/99	<.003	<.05	<.005	<.05	<.002	<.001	<.04	5	<.001	<.005	<.005	<.002	0.08	<1	<.005	1.3	0.07	<.002	2	<.005	<.04	<.01	2	<.03	<.03	1.3	<.01	0.052	<.005	<.005	<.03	<.01
29/07/99	<.0001	0.03	<.001	0.03	0.0133	0.0001	<.001	10.27	<.0001	<.0002	<.0002	0.0008	0.015	0.3	<.0002	2.49	0.003	<.0001	1.2	0.001	<.002	<.001	4.6	<.001	<.001	4.84	<.0004	0.0637	0.002	<.0002	<.001	0.02
31/08/99	<.0001	0.012	<.001	1.056	0.0056	<.0001	<.001	14.142	0.0005	<.0002	<.0002	0.0018	<.001	0.34	<.0002	3.21	0.001	0.0001	2.31	3E-04	<.002	<.001	5.43	<.001	<.001	8.119	<.0004	0.0592	0.001	0.001	<.001	<.0004
12/10/99	<.003	<.05	<.005	<.05	0.024	<.001	<.04	20	<.001	<.005	<.005	<.002	0.06	<1	<.005	4.7	<.01	<.002	3	<.005	<.04	<.01	9	<.03	<.005	3	<.01	0.123	<.005	<.005	<.03	0.02

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V30, Vangorda Dump drain #3

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/05/99	0.02	0.24	<.005	0.5	0.143	0.004	<.04	243.9	0.233	2.126	<.005	0.086	7.03	9	<.005	227.4	76.61	0.181	15	3.662	31.54	1.17		0.43	<.03	3.5	<.01	0.96	<.005	<.005	0.07	229.88
18/06/99	<.003	0.8	<.005	<.05	0.212	0.005	<.04	455.2	0.308	3.876	<.005	0.063	69.8	23	0.229	589.3	152.29	0.66	24	6.438	70.18	2.14	1427	2.59	<.03	7.7	<.01	2.173	<.005	0.02	<.03	565.17
12/08/99	<.003	0.57	0.322	<.05	0.039	0.003	<.04	406.6	0.201	2.655	<.005	0.058	5.55	13	0.016	425.7	132.21	0.499	11	5.44	26.46	1.37	1086	1.12	<.005	4.8	<.01	1.899	0.042	0.015	<.03	370
12/10/99	<.003	0.48	0.043	<.05	0.473	0.002	<.04	437.9	0.158	1.92	<.005	0.041	8.48	14	<.005	398.6	83.73	0.406	14	3.407	1.11	0.92	1122	0.9	<.005	5.7	<.01	1.592	0.028	<.005	<.03	228
13/12/99	<.003	<.05	<.005	0.05	0.438	0.017	<.04	405.1	0.031	2.097	<.005	0.104	23.25	7	<.005	336.7	84.68	<.002	<.1	3.899	1.18	<.01	879	<.03	<.005	4.7	<.01	1.387	<.005	<.005	<.03	226.75
JAN 1999 - DEC 1999																																
Mean	0.006	0.43	0.076	0.14	0.261	0.006	0.04	389.7	0.186	2.535	0.005	0.07	22.82	13	0.052	395.5	105.9	0.35	13	4.569	26.09	1.12	1128	1.01	0.015	5.3	0.01	1.602	0.017	0.01	0.04	323.96
Std. Devia	0.008	0.29	0.138	0.2	0.188	0.006	0	84.3	0.103	0.798	0	0.025	27.21	6	0.099	132.5	34.07	0.26	8	1.311	28.36	0.77	226	0.98	0.014	1.6	0	0.467	0.017	0.007	0.02	148.16
Minimum	0.003	0.05	0.005	0.05	0.039	0.002	0.04	243.9	0.031	1.92	0.005	0.041	5.55	7	0.005	227.4	76.61	0.002	1	3.407	1.11	0.01	879	0.03	0.005	3.5	0.01	0.96	0.005	0.005	0.03	226.75
Maximum	0.02	0.8	0.322	0.5	0.473	0.017	0.04	455.2	0.308	3.876	0.005	0.104	69.8	23	0.229	589.3	152.29	0.66	24	6.438	70.18	2.14	1427	2.59	0.03	7.7	0.01	2.173	0.042	0.02	0.07	565.17
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5

STATION: V32, Vangorda Dump drain #5

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/05/99	0.103	1.38	0.048	<.05	0.177	0.007	<.04	349.5	2.025	9.669	<.005	0.199	128	15	<.005	767	419.04	0.839	14	5.943	119.6	4.99		1.49	<.03	9.3	<.01	0.688	0.022	<.005	0.41	1155.8
18/06/99	<.003	2.22	<.005	<.05	0.523	0.009	<.04	400.2	2.909	11.939	0.177	0.11	224.3	28	0.349	1038.1	661.68	3.064	22	7.451	257.1	9.6	3183	9.06	<.03	11.5	<.01	1.029	<.005	<.005	<.03	2243.3
12/08/99	0.517	0.94	2.414	2.44	1.655	0.038	<.04	455.4	6.316	15.582	<.005	0.087	167.3	<.1	0.294	1740	1245.8	1.792	<.1	11.64	18.9	6.8	5670	16.03	<.005	28.7	<.01	0.711	<.005	0.503	<.03	4044
12/10/99	<.003	6.03	<.005	0.06	0.382	0.006	<.04	394.1	5.496	9.901	<.005	0.114	123.7	14	<.005	1581.1	979.15	5.188	12	9.756	19.38	4.71	5657	5.26	<.005	12.2	<.01	0.677	0.068	<.005	<.03	2886
13/12/99	<.003	6.2	0.419	2.23	0.979	0.135	<.04	406.6	4.359	22.105	<.005	0.375	189.9	8	<.005	1498.6	<.01	98.693	17	9.578	9.11	1.62	4882	5.52	<.005	19.5	<.01	0.763	<.005	<.005	<.03	3102
JAN 1999 - DEC 1999																																
Mean	0.126	3.35	0.578	0.97	0.743	0.039	0.04	401.2	4.221	13.839	0.039	0.177	166.4	13	0.132	1325	661.14	21.915	13	8.874	84.82	5.54	4848	7.47	0.015	16.2	0.01	0.774	0.021	0.105	0.11	2686.2
Std. Devia	0.223	2.56	1.041	1.25	0.589	0.055	0	37.7	1.773	5.193	0.077	0.119	42.29	10	0.174	406.7	484.43	42.951	8	2.21	106.4	2.93	1170	5.48	0.014	8	0	0.147	0.027	0.223	0.17	1071.8
Minimum	0.003	0.94	0.005	0.05	0.177	0.005	0.04	349.5	2.025	9.669	0.005	0.087	123.7	1	0.005	767	0.01	0.839	1	5.943	9.11	1.62	3183	1.49	0.005	9.3	0.01	0.677	0.005	0.005	0.03	1155.8
Maximum	0.517	6.2	2.414	2.44	1.655	0.135	0.04	455.4	6.316	22.105	0.177	0.375	224.3	28	0.349	1740	1245.8	98.693	22	11.64	257.1	9.6	5670	16.03	0.03	28.7	0.01	1.029	0.068	0.503	0.41	4044
Num. Valu	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5

STATION: V33, Vangorda Dump drain #6

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/05/99	<.003	<.05	<.005	<.05	0.063	0.003	<.04	99.3	0.012	0.014	<.005	0.006	<.01	2	<.005	42.2	2.81	<.002	3	0.063	<.04	0.05		<.03	<.03	<.1	<.01	0.305	<.005	<.005	<.03	6.4
JAN 1999 - DEC 1999																																
Mean	0.003	0.05	0.005	0.05	0.063	0.003	0.04	99.3	0.012	0.014	0.005	0.006	0.01	2	0.005	42.2	2.81	0.002	3	0.063	0.04	0.05		0.03	0.03	0.1	0.01	0.305	0.005	0.005	0.03	6.4
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	0.003	0.05	0.005	0.05	0.063	0.003	0.04	99.3	0.012	0.014	0.005	0.006	0.01	2	0.005	42.2	2.81	0.002	3	0.063	0.04	0.05		0.03	0.03	0.1	0.01	0.305	0.005	0.005	0.03	6.4
Maximum	0.003	0.05	0.005	0.05	0.063	0.003	0.04	99.3	0.012	0.014	0.005	0.006	0.01	2	0.005	42.2	2.81	0.002	3	0.063	0.04	0.05		0.03	0.03	0.1	0.01	0.305	0.005	0.005	0.03	6.4
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

STATION: V34, groundwater well GW94-01

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/06/99	<.003	0.06	<.005	<.05	0.031	<.001	<.04	56.2	0.006	<.005	<.005	0.01	0.03	6	<.005	82.6	0.06	0.016	8	<.005	<.04	<.01	8	0.05	<.03	5.4	<.01	0.596	0.016	<.005	<.03	<.01
12/10/99	<.003	<.05	<.005	<.05	0.018	<.001	<.04	44.8	<.001	<.005	<.005	0.005	<.01	4	<.005	55.9	<.01	<.002	5	<.005	<.04	<.01	9	<.03	<.005	3	<.01	0.456	0.006	<.005	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.05	0.005	0.05	0.024	0.001	0.04	50.5	0.004	0.005	0.005	0.007	0.02	5	0.005	69.2	0.03	0.009	6	0.005	0.04	0.01	8	0.04	0.017	4.2	0.01	0.526	0.011	0.005	0.03	0.01
Std. Devia	0	0.01	0	0	0.009	0	0	8.1	0.004	0	0	0.004	0.01	1	0	18.9	0.04	0.01	2	0	0	0	1	0.01	0.018	1.7	0	0.099	0.007	0	0	0
Minimum	0.003	0.05	0.005	0.05	0.018	0.001	0.04	44.8	0.001	0.005	0.005	0.005	0.01	4	0.005	55.9	0.01	0.002	5	0.005	0.04	0.01	8	0.03	0.005	3	0.01	0.456	0.006	0.005	0.03	0.01
Maximum	0.003	0.06	0.005	0.05	0.031	0.001	0.04	56.2	0.006	0.005	0.005	0.01	0.03	6	0.005	82.6	0.06	0.016	8	0.005	0.04	0.01	9	0.05	0.03	5.4	0.01	0.596	0.016	0.005	0.03	0.01
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: V35, groundwater well GW94-02

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/06/99	<.003	0.24	<.005	<.05	0.031	0.002	<.04	228.3	<.001	<.005	<.005	0.032	0.09	6	0.026	187.1	0.22	<.002	13	<.005	<.04	<.01	256	<.03	<.03	6.4	<.01	1.085	0.012	<.005	<.03	<.01
12/10/99	<.003	<.05	<.005	<.05	0.029	<.001	<.04	86.8	0.001	0.014	<.005	0.01	0.04	3	<.005	51.2	0.24	<.002	6	0.01	<.04	<.01	47	<.03	<.005	3.1	<.01	0.515	0.006	<.005	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.14	0.005	0.05	0.03	0.002	0.04	157.6	0.001	0.01	0.005	0.021	0.07	4	0.016	119.2	0.23	0.002	10	0.007	0.04	0.01	152	0.03	0.017	4.8	0.01	0.8	0.009	0.005	0.03	0.01
Std. Devia	0	0.13	0	0	0.001	0.001	0	100.1	0	0.006	0	0.016	0.04	2	0.015	96.1	0.01	0	5	0.004	0	0	148	0	0.018	2.3	0	0.403	0.004	0	0	0
Minimum	0.003	0.05	0.005	0.05	0.029	0.001	0.04	85.8	0.001	0.005	0.005	0.01	0.04	3	0.005	51.2	0.22	0.002	6	0.005	0.04	0.01	47	0.03	0.005	3.1	0.01	0.515	0.006	0.005	0.03	0.01
Maximum	0.003	0.24	0.005	0.05	0.031	0.002	0.04	228.3	0.001	0.014	0.005	0.032	0.09	6	0.026	187.1	0.24	0.002	13	0.01	0.04	0.01	256	0.03	0.03	6.4	0.01	1.085	0.012	0.005	0.03	0.01
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

STATION: V36, groundwater well GW94-03

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/06/99	<.003	0.12	<.005	<.05	0.014	0.001	<.04	115.9	<.001	<.005	<.005	0.019	0.08	8	0.014	104.1	0.09	0.012	13	<.005	1.04	<.01	90	0.07	<.03	7.9	<.01	0.629	<.005	<.005	<.03	0.01
12/10/99	<.003	0.11	0.047	<.05	0.026	<.001	<.04	119.4	0.005	0.006	<.005	0.016	0.06	6	<.005	94.3	0.17	0.007	10	0.017	<.04	<.01	104	<.03	<.005	5.9	<.01	0.654	0.012	0.008	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.11	0.026	0.05	0.02	0.001	0.04	117.7	0.003	0.005	0.005	0.018	0.07	7	0.01	99.2	0.13	0.01	12	0.011	0.54	0.01	97	0.05	0.017	6.9	0.01	0.641	0.008	0.007	0.03	0.01
Std. Devia	0	0.01	0.03	0	0.008	0	0	2.5	0.003	0.001	0	0.002	0.01	1	0.006	6.9	0.06	0.004	2	0.008	0.71	0	10	0.03	0.018	1.4	0	0.018	0.005	0.002	0	0
Minimum	0.003	0.11	0.005	0.05	0.014	0.001	0.04	115.9	0.001	0.005	0.005	0.016	0.06	6	0.005	94.3	0.09	0.007	10	0.005	0.04	0.01	90	0.03	0.005	5.9	0.01	0.629	0.005	0.005	0.03	0.01
Maximum	0.003	0.12	0.047	0.05	0.026	0.001	0.04	119.4	0.005	0.006	0.005	0.019	0.08	8	0.014	104.1	0.17	0.012	13	0.017	1.04	0.01	104	0.07	0.03	7.9	0.01	0.654	0.012	0.008	0.03	0.01
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

STATION: V37, groundwater well GW94-04

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/06/99	<.003	0.08	<.005	<.05	0.092	<.001	<.04	57.4	<.001	<.005	<.005	0.015	0.09	12	0.028	82.9	0.06	0.014	31	<.005	<.04	<.01	22	<.03	<.03	3.1	<.01	0.54	<.005	0.008	<.03	0.01
12/10/99	<.003	<.05	<.005	<.05	0.059	<.001	<.04	48.9	0.008	0.011	0.039	0.008	0.05	8	<.005	63.3	0.09	0.011	23	0.008	<.04	<.01	21	0.04	<.005	1.9	<.01	0.478	0.006	<.005	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.06	0.005	0.05	0.076	0.001	0.04	53.2	0.005	0.008	0.022	0.012	0.07	10	0.017	73.1	0.08	0.013	27	0.007	0.04	0.01	22	0.03	0.017	2.5	0.01	0.509	0.005	0.007	0.03	0.01
Std. Devia	0	0.02	0	0	0.023	0	0	6	0.005	0.004	0.024	0.005	0.03	3	0.016	13.9	0.02	0.002	6	0.002	0	0	1	0.01	0.018	0.8	0	0.044	0.001	0.002	0	0
Minimum	0.003	0.05	0.005	0.05	0.059	0.001	0.04	48.9	0.001	0.005	0.005	0.008	0.05	8	0.005	63.3	0.06	0.011	23	0.005	0.04	0.01	21	0.03	0.005	1.9	0.01	0.478	0.005	0.005	0.03	0.01
Maximum	0.003	0.08	0.005	0.05	0.092	0.001	0.04	57.4	0.008	0.011	0.039	0.015	0.09	12	0.028	82.9	0.09	0.014	31	0.008	0.04	0.01	22	0.04	0.03	3.1	0.01	0.54	0.006	0.008	0.03	0.01
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

STATION: 96-9A, Groundwater at the toe of Grum dump

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/06/99	<.003	0.29	<.005	<.05	0.078	<.001	<.04	67.8	<.001	<.005	<.005	0.012	0.21	4	<.005	34.9	0.62	0.011	53	<.005	<.04	0.01	60	<.03	<.03	5.6	<.01	1.029	<.005	<.005	<.03	<.01
12/10/99	<.003	<.05	<.005	<.05	0.027	<.001	<.04	43.3	0.001	<.005	0.011	<.002	0.11	2	<.005	22.3	0.04	<.002	45	0.005	0.06	<.01	56	<.03	<.005	3	<.01	1.058	<.005	<.005	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.17	0.005	0.05	0.053	0.001	0.04	55.6	0.001	0.005	0.008	0.007	0.16	3	0.005	28.6	0.33	0.007	49	0.005	0.05	0.01	58	0.03	0.017	4.3	0.01	1.044	0.005	0.005	0.03	0.01
Std. Devia	0	0.17	0	0	0.036	0	0	17.3	0	0	0.004	0.007	0.07	1	0	8.9	0.41	0.006	6	0	0.01	0	3	0	0.018	1.8	0	0.021	0	0	0	0
Minimum	0.003	0.05	0.005	0.05	0.027	0.001	0.04	43.3	0.001	0.005	0.005	0.002	0.11	2	0.005	22.3	0.04	0.002	45	0.005	0.04	0.01	56	0.03	0.005	3	0.01	1.029	0.005	0.005	0.03	0.01
Maximum	0.003	0.29	0.005	0.05	0.078	0.001	0.04	67.8	0.001	0.005	0.011	0.012	0.21	4	0.005	34.9	0.62	0.011	53	0.005	0.06	0.01	60	0.03	0.03	5.6	0.01	1.058	0.005	0.005	0.03	0.01
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: 96-9B, Groundwater at toe of Grum dump

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
18/05/99	<.003	0.17	<.005	<.05	0.042	<.001	<.04	66	<.001	<.005	<.005	0.017	0.12	4	0.026	35.9	0.21	0.019	76	<.005	0.1	<.01	63	0.05	<.03	6.6	<.01	1.444	<.005	<.005	<.03	<.01
12/10/99	<.003	0.14	<.005	<.05	0.026	<.001	<.04	44.9	<.001	0.006	0.005	0.004	0.09	2	<.005	22.3	0.06	<.002	47	<.005	0.05	<.01	56	<.03	<.005	3.7	<.01	1.12	0.006	<.005	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.16	0.005	0.05	0.034	0.001	0.04	55.5	0.001	0.005	0.005	0.011	0.11	3	0.016	29.1	0.13	0.01	62	0.005	0.08	0.01	60	0.04	0.017	5.1	0.01	1.282	0.005	0.005	0.03	0.01
Std. Devia	0	0.02	0	0	0.011	0	0	14.9	0	0.001	0	0.009	0.02	1	0.015	9.6	0.11	0.012	21	0	0.04	0	5	0.01	0.018	2.1	0	0.229	0.001	0	0	0
Minimum	0.003	0.14	0.005	0.05	0.026	0.001	0.04	44.9	0.001	0.005	0.005	0.004	0.09	2	0.005	22.3	0.06	0.002	47	0.005	0.05	0.01	56	0.03	0.005	3.7	0.01	1.12	0.005	0.005	0.03	0.01
Maximum	0.003	0.17	0.005	0.05	0.042	0.001	0.04	66	0.001	0.006	0.005	0.017	0.12	4	0.026	35.9	0.21	0.019	76	0.005	0.1	0.01	63	0.05	0.03	6.6	0.01	1.444	0.006	0.005	0.03	0.01
Num. Valu	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

STATION: GD1, Grum Dump toe seep just west of V15

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
03/07/99	<.003	0.22	<.005	0.2	0.175	<.001	<.04	181.1	<.001	0.006	<.005	0.021	0.53	4	0.024	66.9	0.08	0.009	8	<.005	<.04	<.01	193	<.03	<.03	5.3	<.01	0.905	<.005	0.006	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.22	0.005	0.2	0.175	0.001	0.04	181.1	0.001	0.006	0.005	0.021	0.53	4	0.024	66.9	0.08	0.009	8	0.005	0.04	0.01	193	0.03	0.03	5.3	0.01	0.905	0.005	0.006	0.03	0.01
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	0.003	0.22	0.005	0.2	0.175	0.001	0.04	181.1	0.001	0.006	0.005	0.021	0.53	4	0.024	66.9	0.08	0.009	8	0.005	0.04	0.01	193	0.03	0.03	5.3	0.01	0.905	0.005	0.006	0.03	0.01
Maximum	0.003	0.22	0.005	0.2	0.175	0.001	0.04	181.1	0.001	0.006	0.005	0.021	0.53	4	0.024	66.9	0.08	0.009	8	0.005	0.04	0.01	193	0.03	0.03	5.3	0.01	0.905	0.005	0.006	0.03	0.01
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

STATION: GD2,seep/marsh near west end of Grum dump toe road

Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	TI-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L
03/07/99	<.003	0.07	<.005	0.24	0.054	<.001	<.04	68.1	<.001	<.005	<.005	0.011	0.5	<1	<.005	16.1	0.03	<.002	1	<.005	<.04	<.01	11	<.03	<.03	4	<.01	0.31	<.005	<.005	<.03	<.01
JAN 1999 - DEC 1999																																
Mean	0.003	0.07	0.005	0.24	0.054	0.001	0.04	68.1	0.001	0.005	0.005	0.011	0.5	1	0.005	16.1	0.03	0.002	1	0.005	0.04	0.01	11	0.03	0.03	4	0.01	0.31	0.005	0.005	0.03	0.01
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum	0.003	0.07	0.005	0.24	0.054	0.001	0.04	68.1	0.001	0.005	0.005	0.011	0.5	1	0.005	16.1	0.03	0.002	1	0.005	0.04	0.01	11	0.03	0.03	4	0.01	0.31	0.005	0.005	0.03	0.01
Maximum	0.003	0.07	0.005	0.24	0.054	0.001	0.04	68.1	0.001	0.005	0.005	0.011	0.5	1	0.005	16.1	0.03	0.002	1	0.005	0.04	0.01	11	0.03	0.03	4	0.01	0.31	0.005	0.005	0.03	0.01
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

1999 WATER QUALITY LISTING FOR THE VANGORDA PLATEAU MINESITE

STATION: LCD, Little Creek Dam Pond Water

Date	AG-T mg/L	AL-T mg/L	AS-T mg/L	B-T mg/L	BA-T mg/L	BE-T mg/L	BI-T mg/L	CA-T mg/L	CD-T mg/L	CO-T mg/L	CR-T mg/L	CU-T mg/L	FE-T mg/L	K-T mg/L	LA-T mg/L	MG-T mg/L	MN-T mg/L	MO-T mg/L	NA-T mg/L	NI-T mg/L	P-T mg/L	PB-T mg/L	S-T mg/L	SB-T mg/L	SE-T mg/L	SI-T mg/L	SN-T mg/L	SR-T mg/L	Ti-T mg/L	V-T mg/L	W-T mg/L	ZN-T mg/L					
18/06/99	<.003	0.22	<.005	0.12	0.12	<.001	<.04	82.5	0.006	0.027	<.005	0.02	0.36	3	<.005	29.4	1.33	0.016	4	0.044	0.49	0.02	90	<.03	<.03	1.5	<.01	0.43	0.012	0.007	<.03	7.25					
JAN 1999 - DEC 1999																																					
Mean	0.003	0.22	0.005	0.12	0.12	0.001	0.04	82.5	0.006	0.027	0.005	0.02	0.36	3	0.005	29.4	1.33	0.016	4	0.044	0.49	0.02	90	0.03	0.03	1.5	0.01	0.43	0.012	0.007	0.03	7.25					
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Minimum	0.003	0.22	0.005	0.12	0.12	0.001	0.04	82.5	0.006	0.027	0.005	0.02	0.36	3	0.005	29.4	1.33	0.016	4	0.044	0.49	0.02	90	0.03	0.03	1.5	0.01	0.43	0.012	0.007	0.03	7.25					
Maximum	0.003	0.22	0.005	0.12	0.12	0.001	0.04	82.5	0.006	0.027	0.005	0.02	0.36	3	0.005	29.4	1.33	0.016	4	0.044	0.49	0.02	90	0.03	0.03	1.5	0.01	0.43	0.012	0.007	0.03	7.25					
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
Date	AG-D mg/L	AL-D mg/L	AS-D mg/L	B-D mg/L	BA-D mg/L	BE-D mg/L	BI-D mg/L	CA-D mg/L	CD-D mg/L	CO-D mg/L	CR-D mg/L	CU-D mg/L	FE-D mg/L	K-D mg/L	LA-D mg/L	MG-D mg/L	MN-D mg/L	MO-D mg/L	NA-D mg/L	NI-D mg/L	P-D mg/L	PB-D mg/L	S-D mg/L	SB-D mg/L	SE-D mg/L	SI-D mg/L	SN-D mg/L	SR-D mg/L	Ti-D mg/L	V-D mg/L	W-D mg/L	ZN-D mg/L					
18/06/99	<.003	<.05	<.005	<.05	0.007	<.001	<.04	64.7	0.007	<.005	<.005	0.004	0.03	2	<.005	22.3	0.85	<.002	3	0.02	<.04	<.01	100	<.03	<.03	<.1	<.01	0.315	<.005	<.005	<.03	4.77					
JAN 1999 - DEC 1999																																					
Mean	0.003	0.05	0.005	0.05	0.007	0.001	0.04	64.7	0.007	0.005	0.005	0.004	0.03	2	0.005	22.3	0.85	0.002	3	0.02	0.04	0.01	100	0.03	0.03	0.1	0.01	0.315	0.005	0.005	0.03	4.77					
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Minimum	0.003	0.05	0.005	0.05	0.007	0.001	0.04	64.7	0.007	0.005	0.005	0.004	0.03	2	0.005	22.3	0.85	0.002	3	0.02	0.04	0.01	100	0.03	0.03	0.1	0.01	0.315	0.005	0.005	0.03	4.77					
Maximum	0.003	0.05	0.005	0.05	0.007	0.001	0.04	64.7	0.007	0.005	0.005	0.004	0.03	2	0.005	22.3	0.85	0.002	3	0.02	0.04	0.01	100	0.03	0.03	0.1	0.01	0.315	0.005	0.005	0.03	4.77					
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					

STATION: VGSEEP, VG pit ramp ditch/seepage

	AG-T	AL-T	AS-T	B-T	BA-T	BE-T	BI-T	CA-T	CD-T	CO-T	CR-T	CU-T	FE-T	K-T	LA-T	MG-T	MN-T	MO-T	NA-T	NI-T	P-T	PB-T	S-T	SB-T	SE-T	SI-T	SN-T	SR-T	Ti-T	V-T	W-T	ZN-T	
Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
18/06/99	0.063	3.29	<.005	0.12	0.923	0.009	<.04	428.7	3.144	7.565	<.005	0.733	408.7	21	0.263	464.5	278.93	1.628	20	5.398	125.8	7.55	162	5.85	<.03	11.1	<.01	1.206	0.06	0.061	<.03	1183.2	
JAN 1999 - DEC 1999																																	
Mean	0.063	3.29	0.005	0.12	0.923	0.009	0.04	428.7	3.144	7.565	0.005	0.733	408.7	21	0.263	464.5	278.93	1.628	20	5.398	125.8	7.55	162	5.85	0.03	11.1	0.01	1.206	0.06	0.061	0.03	1183.2	
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Minimum	0.063	3.29	0.005	0.12	0.923	0.009	0.04	428.7	3.144	7.565	0.005	0.733	408.7	21	0.263	464.5	278.93	1.628	20	5.398	125.8	7.55	162	5.85	0.03	11.1	0.01	1.206	0.06	0.061	0.03	1183.2	
Maximum	0.063	3.29	0.005	0.12	0.923	0.009	0.04	428.7	3.144	7.565	0.005	0.733	408.7	21	0.263	464.5	278.93	1.628	20	5.398	125.8	7.55	162	5.85	0.03	11.1	0.01	1.206	0.06	0.061	0.03	1183.2	
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Date	AG-D	AL-D	AS-D	B-D	BA-D	BE-D	BI-D	CA-D	CD-D	CO-D	CR-D	CU-D	FE-D	K-D	LA-D	MG-D	MN-D	MO-D	NA-D	NI-D	P-D	PB-D	S-D	SB-D	SE-D	SI-D	SN-D	SR-D	Ti-D	V-D	W-D	ZN-D	
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
18/06/99	<.003	1.86	<.005	<.05	0.243	0.005	<.04	383.1	2.615	6.749	<.005	0.498	344.3	13	0.309	436.5	256.64	1.369	17	4.67	117.1	5.06	1683	4.31	<.03	9.7	<.01	1.068	<.005	<.005	<.03	1059.5	
JAN 1999 - DEC 1999																																	
Mean	0.003	1.86	0.005	0.05	0.243	0.005	0.04	383.1	2.615	6.749	0.005	0.498	344.3	13	0.309	436.5	256.64	1.369	17	4.67	117.1	5.06	1683	4.31	0.03	9.7	0.01	1.068	0.005	0.005	0.03	1059.5	
Std. Devia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Minimum	0.003	1.86	0.005	0.05	0.243	0.005	0.04	383.1	2.615	6.749	0.005	0.498	344.3	13	0.309	436.5	256.64	1.369	17	4.67	117.1	5.06	1683	4.31	0.03	9.7	0.01	1.068	0.005	0.005	0.03	1059.5	
Maximum	0.003	1.86	0.005	0.05	0.243	0.005	0.04	383.1	2.615	6.749	0.005	0.498	344.3	13	0.309	436.5	256.64	1.369	17	4.67	117.1	5.06	1683	4.31	0.03	9.7	0.01	1.068	0.005	0.005	0.03	1059.5	
Num. Valu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

APPENDIX 2

Biological Monitoring Program at Vangorda Creek, Faro, YT, 1999

B.E. Burns, Laberge Environmental Services, February 2000

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BIOLOGICAL MONITORING PROGRAM

AT

VANGORDA CREEK, FARO, Y.T.

1999

Submitted to:

DELOITTE & TOUCHE INC

Prepared by:

B. E. Burns

LABERGE ENVIRONMENTAL SERVICES

February, 2000

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1.0 INTRODUCTION

On November 8, 1994 Anvil Range Mining Corporation (Anvil) was officially assigned Licence Number IN89-002, which was originally issued to Curragh Resources Inc by the Yukon Territory Water Board.

The mine has not operated since January 1998. Low metal prices (zinc and lead) and financial difficulties experienced by Anvil indicated that this closure had the potential to be long term. On April 21, 1998, Deloitte & Touch Inc were appointed as the interim receivers for the Faro Mine property, operations and assets.

To maintain the water license in good standing, requirements are to be met during temporary shut down. Deloitte & Touche Inc contracted Laberge Environmental Services (LES) to conduct various monitoring programs during 1999. To comply with Part D, Section 2 of the licence, a biological monitoring program is to be conducted every two years on the Vangorda Creek system. The Schedule states that three replicate samples of benthic macro-invertebrate fauna are to be collected from four sites located on Vangorda Creek. These benthic organisms are then to be identified, enumerated and the data evaluated. Water samples are also to be collected at the sites to aid in the data interpretation.

Under Part D, Section 3, of the water licence, triplicate sediment samples are to be collected concurrently with the benthic monitoring program.

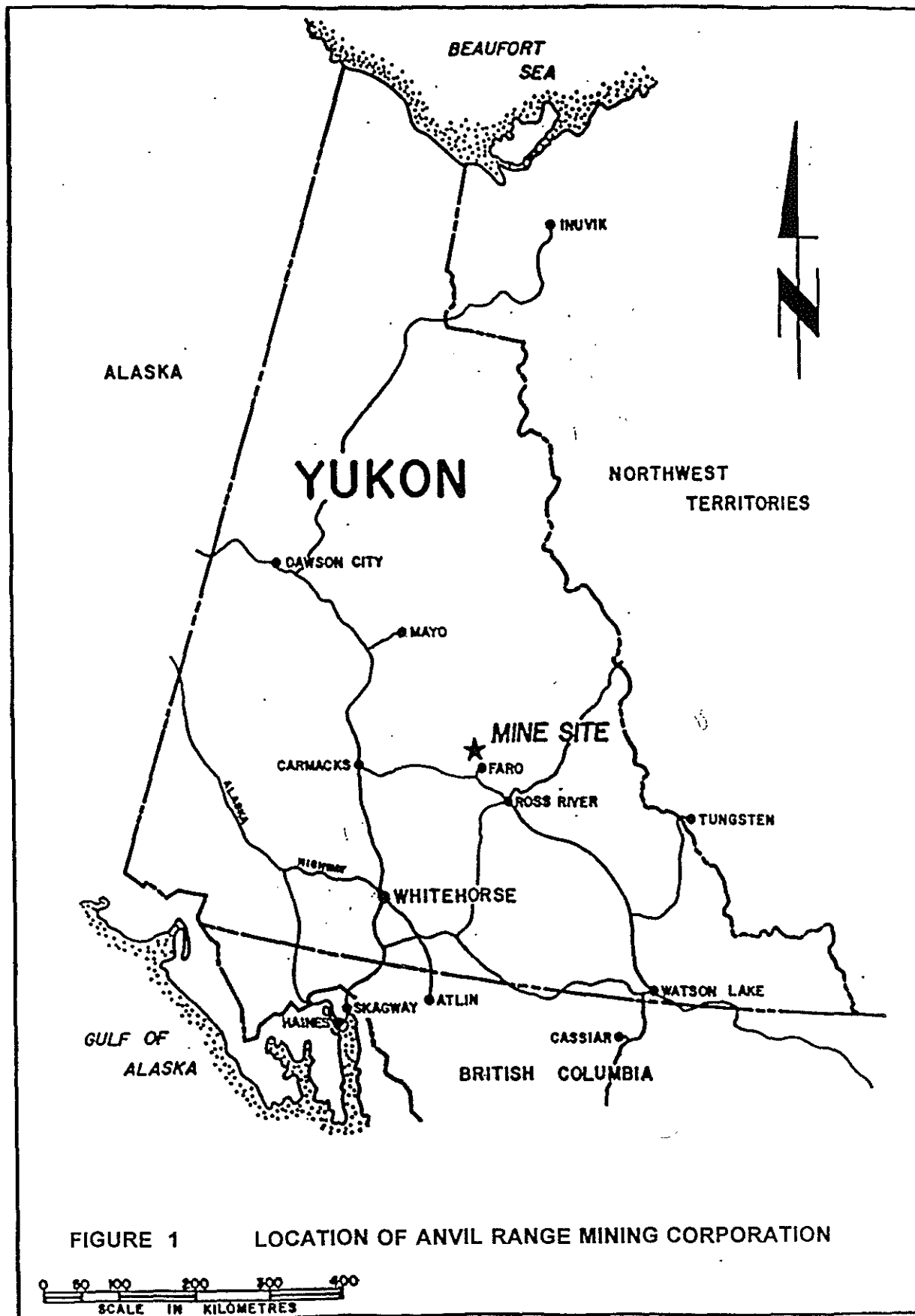
This report contains all data collected during the 1999 surveys with some comparisons made with past monitoring programs.

2.0 STUDY AREA

The lead-zinc mine near Faro, located at approximately 62° 20' N and 133° 25' W (Figure 1), consists of three open pits. Of the three open pits developed on the mine site, two (Faro and Vangorda) are depleted of economic ore reserves while the third (Grum) contains up to five years of mineable ore reserves.

The Grum and Vangorda deposits were extracted within the Vangorda Creek watershed and the ore was transported via the haul road to the mill for concentrating. The following four sampling stations are located upstream and downstream of the mined area (Figure 2):

- V1: Vangorda Creek upstream of the Blind Creek Road and the Vangorda pit.
- V27: Vangorda Creek just upstream of the confluence with Shrimp Creek and downstream of all mining related activity.
- V5: West Fork of Vangorda Creek upstream of the mine access road.
- V8: Vangorda Creek upstream of the bridge to the Faro town water supply, and approximately 500 metres upstream of the confluence with the Pelly River.



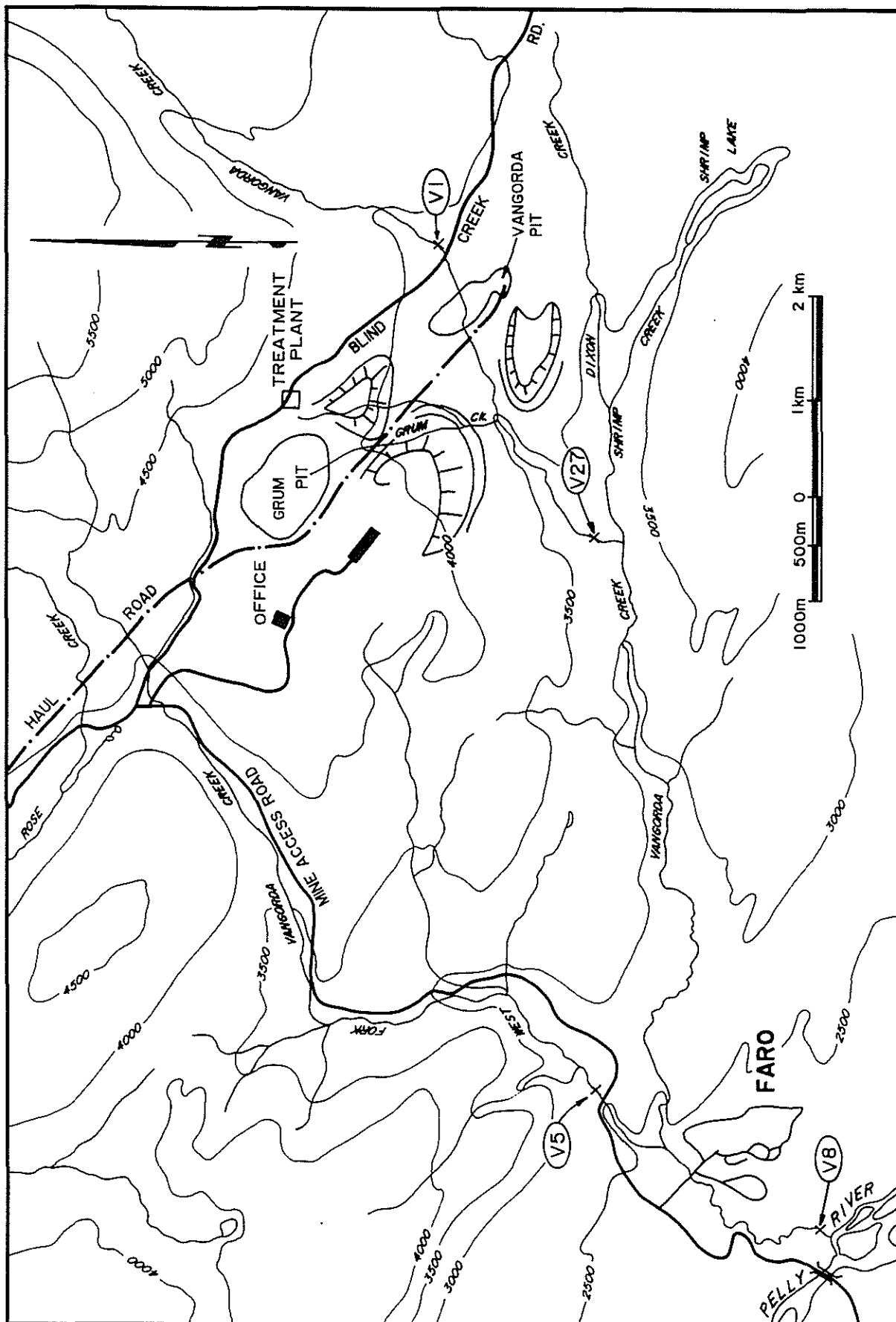


FIGURE 2 : LOCATION OF SAMPLE SITES ON VANGORDA CREEK, FARO

(VI) SAMPLE SITE

3.0 METHODS

3.1 Water Quality

Water quality samples were collected on two occasions during the biological monitoring program; on July 29, and on August 30 and 31, 1999.

3.1.1 Field Measurements

In-situ measurements were taken at each site during both surveys. Conductivity and temperature were determined with an Orion conductivity meter model 126. Dissolved oxygen readings were obtained using an Orion oxygen meter model 820 and pH measurements were taken using an Accumet pH meter.

3.1.2 Chemical Analyses

Water samples to be analyzed for total and dissolved metals (copper, iron, lead and zinc) were collected in acid washed 250 ml polyethylene bottles preserved with 1.25 ml of HNO₃. The dissolved metals samples were filtered in the field using a millipore filter kit prior to preservation. Samples to be analyzed for total hardness were obtained from the total metals bottle.

Samples to be analyzed for sulphate, ammonia, alkalinity, and suspended solids were collected in one litre polyethylene bottles.

All chemical analyses were conducted by Cavendish Analytical Laboratory Ltd in Burnaby, British Columbia following the methods as outlined in *Standard Methods for the Examination of Water and Wastewater* 18th Edition (Clesceri et al 1989) and U.S. EPA protocols.

3.2 Water Quantity

Discharge was measured at each of the sites on both visits. An area with a uniform cross section was chosen and the velocity and depth were measured using either a AA Price or Price mini meter. Ten or more readings were taken across the profile of the stream. Total discharge was calculated as the sum of these individual discharges (area x velocity).

3.3 Stream Sediment Sampling

Triplicate sediment samples were collected from the four sites (V1, V27, V5 and V8) during the July visit. Sample sites were selected from an exposed area of the stream bank, generally characterized by the finest grain size evident at the site. Samples were collected with a teflon trowel and placed in zip-lock plastic bags. The samples were packed on ice when shipped to Cavendish Analytical Laboratory in B.C.

The samples were dried, passed through a 100 mesh (0.15 mm) stainless steel sieve, and then run through an ICP analysis to determine levels of metals, using methods found in *Standard Methods for the Examination of Water and Wastewater 18th Edition* (Clesceri et al 1989) and U.S. EPA protocols found in *Test Methods for Evaluating Solid Waste, Physical Chemical Method, SW846*.

3.4 Benthic Invertebrate Sampling

Artificial substrate samplers were used for benthic invertebrate sampling. The basket samplers were cylindrical in shape, measured 26 cm long with a diameter of 17 cm, and were constructed of galvanized wire with a 1 cm mesh. Each substrate sampler was filled with washed indigenous gravels collected from the stream bed or the bank at each sample site. The surface area provided by this 'artificial substrate' was approximately $6000 \pm 1000 \text{ cm}^2$ (Baker 1979). Three rock filled samplers were submerged in riffle areas of the stream at each site on July 29, 1999. These samplers were left to colonize for five weeks. On August 30 and 31, 1999, the artificial substrate samplers were retrieved by placing a screened bucket with a 300 micron mesh, downstream and under the basket. On shore the basket was opened in the bucket. Individual rocks were then carefully washed in the screened bucket to remove and collect all invertebrates from that sample. The debris and benthic invertebrates remaining in the bucket were placed in a one litre nalgene bottle and preserved with 10% formalin. These samples were sent to Charles Low PhD, an entomologist in Victoria, B.C. for enumeration and identification.

All samples were washed through two screens with mesh sizes 1 millimetre and 180 microns. All of the organisms retained by the coarse screen were counted and identified, whereas the organisms on the 180 micron screen were subsampled as necessary. A Folsom plankton splitter was used for the subsampling. The majority of the benthos were identified to the genus level.

4.0 RESULTS AND DISCUSSION

To aid in interpretation, site V27 has been placed after V1 and prior to V5 in all of the tables and graphs. V27 is geographically located below V1 but is upstream of the confluence with the West Fork of Vangorda Creek.

4.1 Water Quality

Water quality samples were collected in July and August, 1999, at the four sites. The analytical results are presented in Appendix A. Eight parameters were below the method detection limit: ammonia, silver (Ag), arsenic (As), bismuth (Bi), antimony (Sb), selenium (Se), tin (Sn) and tungsten (W).

Part D, Section 2(c) and (d) specifically requests the analysis of total hardness, alkalinity, sulphate, suspended solids, ammonia, and total and dissolved copper, iron, lead and zinc. The results for these parameters are presented in Table 1.

4.1.1 Temperature

The temperature values reflected the diurnal and seasonal timing of the sampling, ranging from 3.0°C at V1 in July to 7.7°C in July at V8.

4.1.2 Conductivity

Conductivity, a measure of the total concentration of ionic constituents in water, was low at V1 and V27, and significantly higher at V5 and V8. The highest value of 431 uS/cm occurred at V5 in August.

4.1.3 pH

All values were slightly alkaline.

4.1.4 Alkalinity

Alkalinity values were significantly lower in July than in August. It is suspected, although it was not confirmed, that the July values were one magnitude lower than they should be. Problems

TABLE 1
WATER QUALITY DATA AT VANGORDA CREEK, 1999

Sample Site	V1		V27		V5		V8	
Date, 1999	July 29	Aug 31	July 29	Aug 31	July 29	Aug 31	July 29	Aug 30
Temp °C	3.0	3.9	4.4	5.2	5.8	5.9	7.7	7.3
Conductivity (uS/cm)	35	56	46	114	328	431	203	264
pH	7.44	7.70	7.74	7.97	8.53	8.60	8.21	8.50
Dissolved Oxygen (mg/L)	11.7	13.6	11.4	13.3	11.5	13.4	11.1	---
Alkalinity mg/L as CaCO ₃	2	26	5	46	22	187	13	112
Cu: total	0.0020	0.0113	0.0261	0.0076	0.0204	0.0092	0.0204	0.0081
Cu: dissolved	0.0014	0.0010	0.0008	0.0018	0.0101	0.0029	0.0050	0.0011
Pb: total	<0.001	<0.001	<0.001	<0.001	0.018	<0.001	0.007	<0.001
Pb: dissolved	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Zn: total	0.002	0.0015	0.040	0.0283	0.032	<0.0004	0.021	0.0054
Zn: dissolved	0.002	<0.0004	0.020	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Fe: total	0.070	0.421	0.170	0.134	7.337	0.242	1.745	0.157
Fe: dissolved	0.014	<0.001	0.015	<0.001	0.010	0.004	0.003	0.001
Sulphate	6	7	14	16	49	60	31	36
Ammonia	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
NFR	1	1	5	3	300	7	85	3
Total Hardness mg/L as CaCO ₃	9	22	36	49	174	226	107	135
Flow m ³ /sec	0.534	0.293	0.785	0.348	0.364	0.144	1.101	0.484

NOTE: All units are expressed as mg/L unless indicated otherwise.

were encountered with the reporting of alkalinity in 1997, but the alkalinity values recorded in the summer months of 1995 were comparable to the August 1999 values.

4.1.5 Dissolved Oxygen

All sites were well aerated, ranging from 11.1 mg/L dissolved oxygen at V8 to 13.6 mg/L at V1.

4.1.6 Sulphate

Sulphate levels were generally low at all sites. The highest concentration of 60 mg/L occurred at V5 in August. Sulphate concentrations normally vary from 10 to 80 mg/L in surface waters (Canadian Council of Resource and Environment Ministers (CCREM) 1987).

4.1.7 Ammonia

Ammonia levels were below the method detection limit of 0.05 mg/L in July and in August.

4.1.8 Non-filterable Residue (NFR)

Non-filterable residue (suspended solids) was very low in August at all of the sites. The water at V5 in July was very turbid (see Figure 3) resulting in a NFR value of 300 mg/L. This effected the downstream site of V8 with a NFR reading of 85 mg/L.

4.1.9 Total Hardness

Calcium and magnesium are considered to be the primary contributors to hardness but other cations such as strontium, barium, manganese, iron and aluminum also contribute to total hardness. The hardness varied at each of the sites: V1 and V27 was very soft, V8 was hard and V5 was very hard.

4.1.10 Total and Dissolved Metals

Most metal concentrations were low where detected. The Canadian Council of Ministry of the Environment (CCME) has established recommended guidelines for the protection of freshwater aquatic life. Note that these guidelines have generally been established under laboratory conditions or at southern locations, usually using aquatic species exotic to the Yukon. As such,



Figure 3 Turbid water conditions at V5 on July 29, 1999.

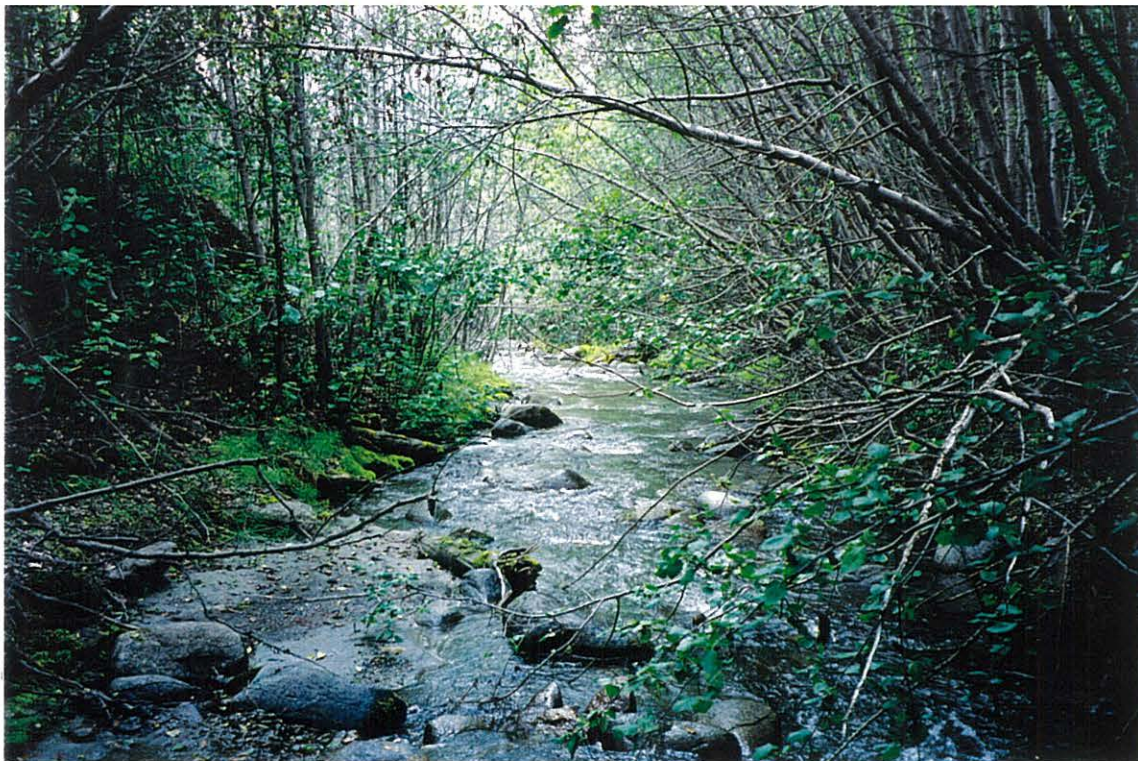


Figure 4 In August at V5, the water was clear and levels were considerably lower.

the levels recommended for aquatic life are simply guidelines, and not standards. The guidelines for copper and lead vary with hardness (Table 2) as these metals tend to be more toxic to aquatic life in softer waters.

TABLE 2 CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE					
HARDNESS as CaCO ₃ mg/L		COPPER mg/L	LEAD mg/L	IRON mg/L	ZINC mg/L
0 - 60	soft	0.002	0.001	0.3	0.030
60 - 120	medium soft	0.002	0.002	0.3	0.030
120 - 180	hard	0.003	0.004	0.3	0.030
>180	very hard	0.004	0.007	0.3	0.030

Most of the samples analyzed for dissolved copper met the recommended guideline, however, for the analysis of total copper, the guideline was exceeded at all of the sites, at least on one occasion. The highest concentration of 0.0261 mg/L occurred at V27 in July.

Lead was detected at V5 and V8 in July. The guideline was exceeded in these samples for the analysis of total lead.

The guideline for zinc is 0.030 mg/L irrelevant of hardness. This guideline was slightly exceeded in July at V27 and V5.

The guideline for iron is 0.3 mg/L. This guideline was significantly exceeded in the July samples at V5 and V8 and corresponds to the turbid conditions encountered at these sites during the sampling event.

4.2 Water Quantity

Flows were measured at each of the sites in July and August. These data are presented with the water quality data in Table 1. Flows decreased over the sampling period and were notably lower in August (Figure 4).

4.3 Stream Sediment Quality

4.3.1 Metal Analyses for the 1999 Survey

Triplicate stream sediment samples were collected from each of the sites in July. The triplicates were averaged, and standard deviation was calculated to determine the spread of the triplicates (Appendix B). Generally the replicates showed little spread and thus were representative samples of the sites. Of the 31 metals analyzed, four were below the method detection limit in all samples: bismuth (Bi), selenium (Se), tin (Sn) and tungsten (W).

To conform with past studies, the metals copper, iron, lead and zinc were examined in greater detail. The mean concentrations of these metals were compared to the CCME(1999) interim freshwater sediment quality guidelines (ISQG) and to the probable effects levels (PEL) where generally concentrations greater than the PEL have a 50% incidence of creating adverse biological effects (see Table 3).

The highest concentration of the four metals was reported at V27, which would be expected as it is the most directly affected site of those sampled. The upstream site, V1 had slightly higher concentrations than at V5, the West Fork of Vangorda Creek. As V1 is not affected by mining activity, the results indicate an area of natural mineralization. The substrate at V5 is composed of much finer material than at V1. During sample collection it appeared that significant deposition had occurred. The downstream site, V8, had similar sediment concentrations to the background site, V1.

TABLE 3					
SUMMARY OF STREAM SEDIMENT METAL CONCENTRATIONS, 1999					
STATION NUMBER	STATION DESCRIPTION	COPPER (ug/g)	IRON (%)	LEAD (ug/g)	ZINC (ug/g)
V1	Vangorda Cr u/s all mining activity	39.2	4.0	44.7	141
V27	Vangorda Cr d/s activity & u/s Shrimp Cr	129	4.3	2069	921
V5	West Fork of Vangorda Cr	24.9	1.8	30.4	80.9
V8	Vangorda Cr approx 500m u/s Pelly R	29.0	2.0	89.0	148
ISQG		35.7	---	35.0	123
PEL		197.0	---	91.3	315
Note: ISQG = Interim Freshwater Sediment Quality Guidelines PEL = Probable Effects Level (>50% of adverse effects occur above this level)					

The PEL was exceeded at V27 for all of the metals examined. All of the metals exceeded the ISQG but were below the PEL at V1. Copper was below the ISQG at V8, but lead and zinc slightly exceeded it. All of the metals examined at V5 fell below the ISQG.

4.3.2 Comparisons with Past Data

Stream sediments were collected at these sites in 1993 (Burns, 1993), in 1995 (Burns, 1996) and in 1997 (Burns, 1998) as a requirement of the company's water licence. The data for selected metals are presented in Table 4 and in Figures 5, 6, 7 and 8.

Metals in sediment are difficult to interpret because levels vary widely as a function of natural mineralization of local soils in a given water shed and it is difficult to obtain truly representative samples. The data over the years has fluctuated and no trends can readily be produced, however the following observations were noted:

- The concentrations of the examined metals are increasing at V27.
- Concentrations of lead and zinc were much greater at V27 than at the other sites.
- Iron is relatively similar throughout the years and at the sites, with V1 and V27 having the greatest concentrations.
- The concentrations of the metals examined were the lowest in the stream sediments at V5.

4.4 Benthic Invertebrates

Three phyla were found in the study area: Arthropoda, Annelida and Nematoda. A total of 73 different taxonomic groups were identified within these phyla. These data are presented in Appendix C.

4.4.1 Abundance and Taxonomic Richness

The number of organisms of the triplicates for each site was summed to give a total abundance value for that site. Population numbers were similar at each site, ranging from 1025 and V1 to 1284 at V5.

TABLE 4
COMPARISONS OF METALS IN STREAM SEDIMENTS
1993, 1995, 1997 AND 1999

Site	Year	Copper	Iron	Lead	Zinc
V1	1993	24 (4)	3.7 (4.6)	30 (8)	120 (13)
	1995	33 (2)	3.1 (2.6)	43 (14)	177 (40)
	1997	53 (19)	2.7 (1.0)	58 (35)	132 (71)
	1999	39 (2)	4.0 (0.1)	45 (16)	141 (12)
V27	1993	52 (4)	3.2 (1.5)	587 (518)	436 (126)
	1995	59 (11)	2.7 (4.0)	1305 (1215)	519 (43)
	1997	88 (12)	3.8 (7.0)	1492 (642)	652 (55)
	1999	129 (45)	4.3 (0.7)	2069 (375)	921 (290)
V5	1993	28 (1)	2.2 (0.6)	23 (1)	98 (5)
	1995	36 (2)	1.8 (0.3)	52 (2)	129 (4)
	1997	36 (2)	2.1 (0.6)	35 (3)	100 (5)
	1999	25 (1)	1.8 (0.0)	30 (2)	81 (2)
V8	1993	37 (0)	2.8 (0.3)	214 (11)	251 (12)
	1995	48 (4)	2.2 (1.0)	218 (70)	391 (111)
	1997	36 (5)	2.3 (0.6)	114 (6)	221 (25)
	1999	29 (2)	2.0 (0.1)	89 (40)	148 (40)
NOTE: Number in brackets is the standard deviation for that set.					

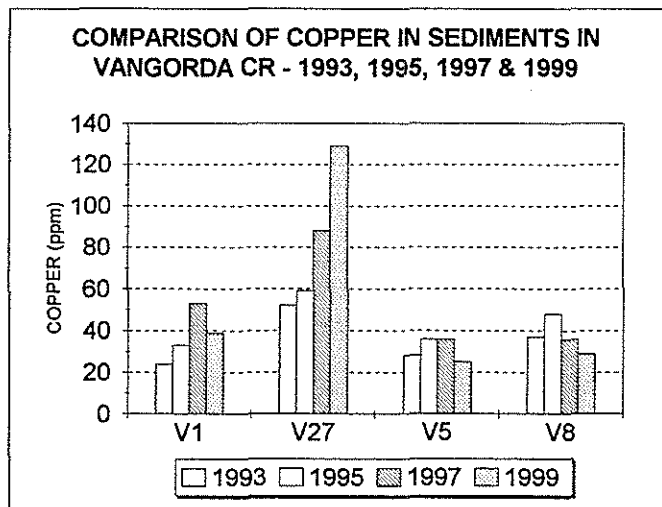


Figure 5 Comparison of copper in stream sediments

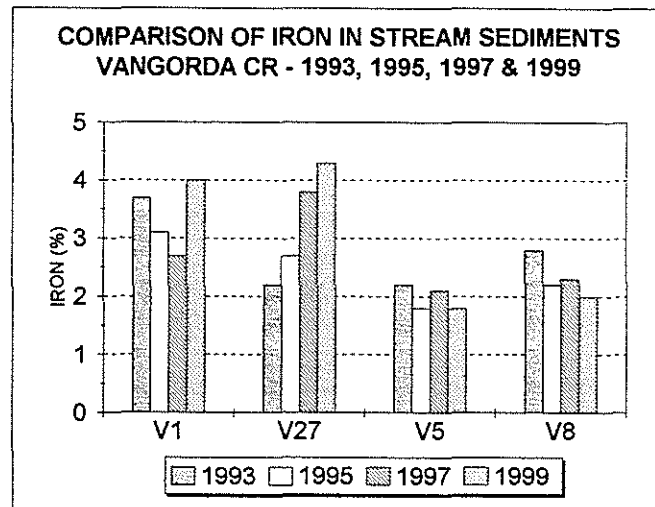


Figure 6 Comparison of iron in stream sediments

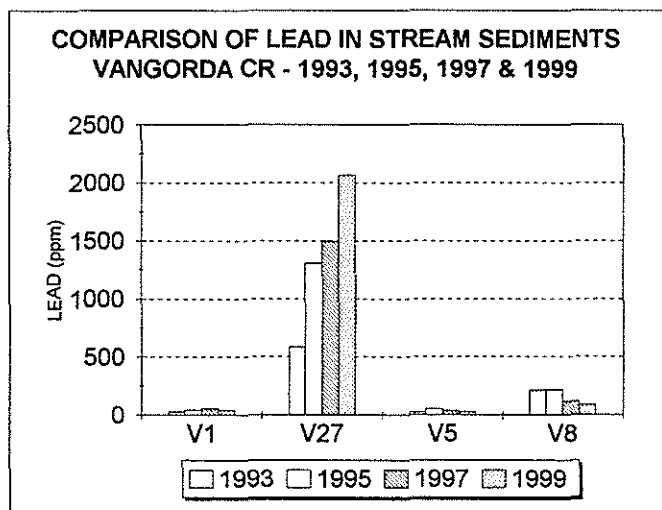


Figure 7 Comparison of lead in stream sediments

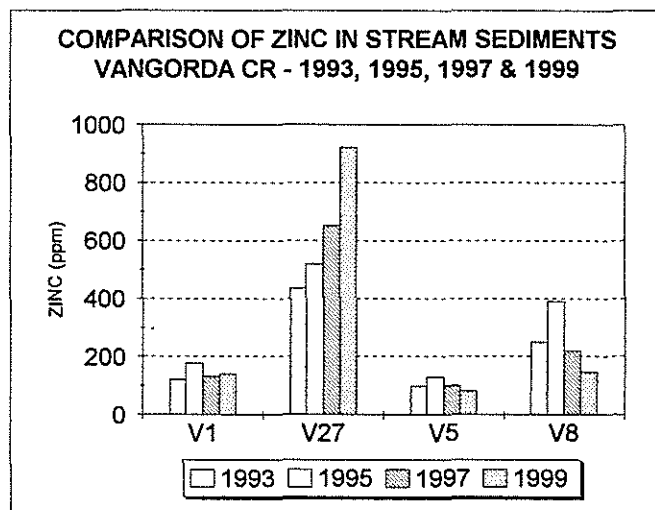


Figure 8 Comparison of zinc in stream sediments

Taxonomic richness was determined for each site by enumerating all the taxonomic groups identified from species to phylum as a measure of community diversity. The diversity ranged from 32 different taxonomic groups at V1 to 55 different taxonomic groups at V5.

Abundance and diversity values were plotted and are displayed in Figure 9.

Although V1 is the background site, the benthic community is not as abundant or diverse as the potentially impacted sites downstream at V27 and V8. Periphyton studies conducted at V1 in 1990 showed this site to have low productivity (Limnotek data files). Several benthic species feed on periphyton and this could explain their lower numbers. Elevation could also influence the productivity. The elevation at V1 is 4100 feet whereas at V8 it is 2100 feet. Unfortunately, the location of V1 as a background site is the only possible one to ensure that is located on Vangorda Creek and is upstream of any mining activity.

4.4.2 Distribution

The composition of the benthos communities was displayed as a percentage of the major taxonomic orders for each station (Table 5). Based on this, taxa were classified with respect to their dominance within the community (Table 6).

Diptera was the dominant taxa at all four sites and Plecoptera shared dominance at V1, V27 and V8. Ephemeroptera was subdominant at V27 and V8. The other sites did not have a subdominant group. The remaining taxa were either common or rare.

Ephemeroptera, Trichoptera and Plecoptera are sensitive to most types of pollution (Rosenberg and Resh, 1993) and Lehmkuhl (1979) has identified several groups within these insect orders which have very low tolerance to chemical pollution. Nine taxa (five taxa within Plecoptera, three taxa within Ephemeroptera and one taxa within Trichoptera) have been identified in the Vangorda watershed (Table 7). All nine sensitive taxa were recorded at V8. The sites V1 and V27 had seven out of the nine sensitive taxa present and eight were identified at V5. As there appears to be good representation of pollution sensitive species at the Vangorda sites, it can be assumed that the water and stream sediments are of good quality for the support of aquatic life.

The above statement appears contradictory to the results presented in Section 4.3. The concentrations of lead and zinc in the stream sediments at V27 were well over the probable effects level (PEL). According to CCME (1999), there should be severe adverse effects on the

SITE	LOCATION	ABUNDANCE	TAXONOMIC RICHNESS
V1	Vangorda Cr u/s all activity	1025	32
V27	Vangorda Cr d/s activity & u/s Shrimp Cr	1061	37
V5	West Fork of Vangorda Cr	1284	55
V8	Vangorda Cr approx 500m u/s Pelly R	1061	45

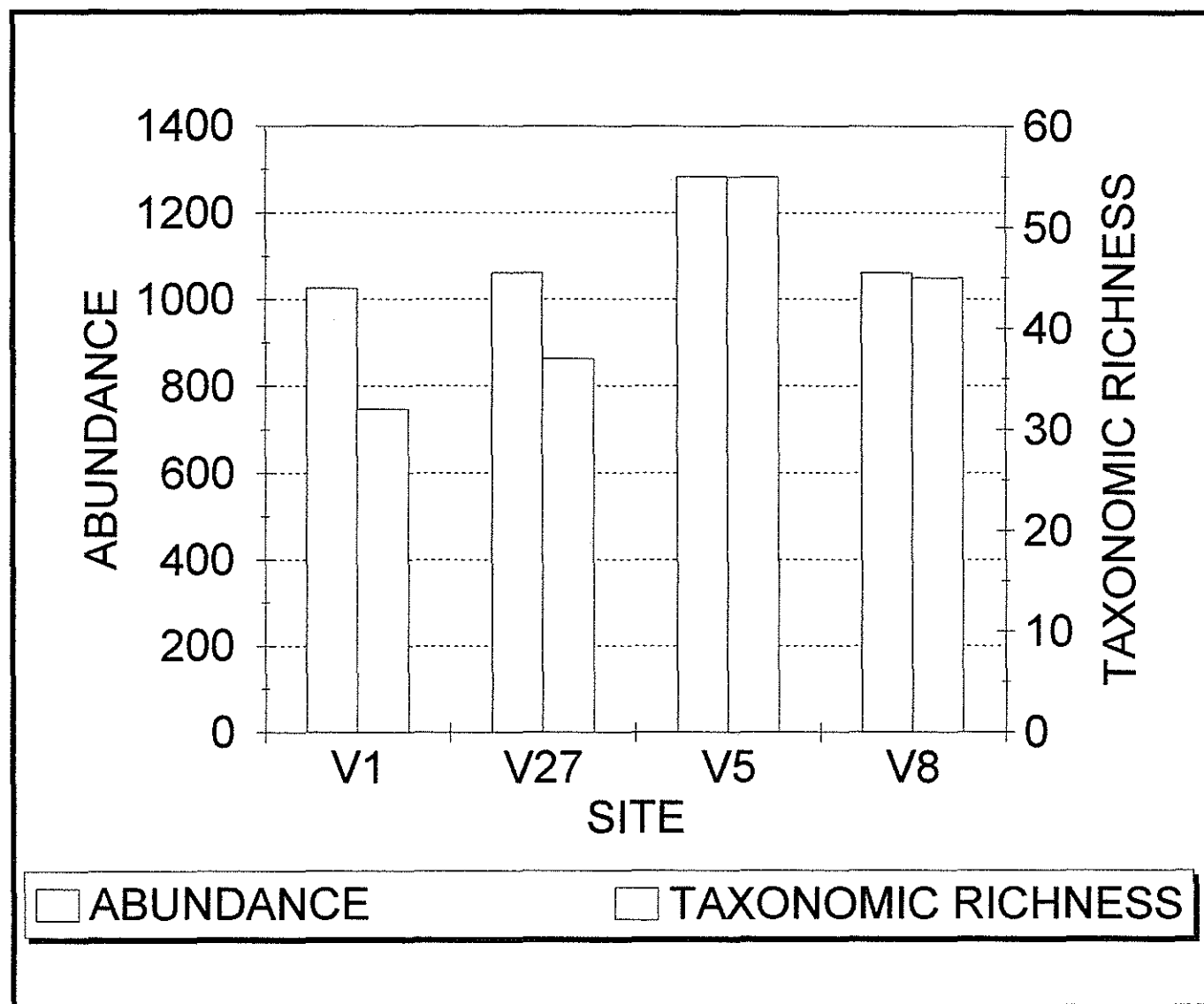


FIGURE 9 Abundance and Taxonomic Richness at Vangorda Creek, 1999

TABLE 5				
THE PERCENTAGE OF COMPOSITION OF DIFFERENT TAXONOMIC GROUPS AT EACH STATION				
TAXONOMIC GROUP	V1	V27	V5	V8
Ephemeroptera (mayflies)	9.8	16.0	7.9	16.7
Plecoptera (stoneflies)	40.1	31.5	26.5	4.3
Trichoptera (caddisflies)	2.2	8.7	0.8	1.9
Diptera (true flies)	40.5	42.0	57.4	67.4
Hydracarina (water mites)	6.5	1.0	5.0	7.1
Other *	0.8	0.8	2.4	2.6
* Other includes one or more of the following taxonomic groups:				
Nematoda	Aranaea	Coleoptera	Oligochaeta	
Hymenoptera	Ostracoda	Homoptera	Thysanoptera	
Lepidoptera	Copepoda	Colembola		

TABLE 6					
TAXONOMIC DISTRIBUTION OF BENTHIC INVERTEBRATES					
SITE	LOCATION	DOMINANT (≥25%)	SUBDOMINANT (10% to 24.9%)	COMMON (1.0% to 9.9%)	RARE (0.1% to 0.9%)
V1	Vangorda Cr u/s all mining activity	Diptera Plecoptera		Ephemeroptera Hydracarina Trichoptera	Other
V27	Vangorda Cr d/s mining activity & u/s Shrimp Cr	Diptera Plecoptera	Ephemeroptera	Trichoptera Hydracarina	Other
V5	West Fork of Vangorda Cr	Diptera Plecoptera		Ephemeroptera Hydracarina Other	Trichoptera
V8	Vangorda Cr approx 500 m u/s Pelly R	Diptera	Ephemeroptera	Hydracarina Plecoptera Other Trichoptera	

aquatic biota under these conditions. However, the benthic community structure, abundance and diversity were very similar to the other sites where metal concentrations in the stream sediments were well below the PEL. In addition, the same number of metal pollution sensitive insect taxa were present at V27 as at the upstream site of V1. This would indicate that although metals levels are very high at V27, the metals are not in a bioavailable form and thus are not impacting the benthos at this site.

TABLE 7				
Presence (+) and Absence (-) of Sensitive Taxa at Vangorda Creek, 1999				
Sensitive Taxa	V1	V27	V5	V8
Plecoptera				
Nemouridae	+	+	+	+
Perlodidae	+	-	+	+
Capniidae	-	+	+	+
Chloroperlidae	-	-	+	+
Taeniopterigidae	+	+	+	+
Ephemeroptera				
Epeorus	+	+	+	+
Ephemerellidae	+	+	+	+
Rhithrogena	+	+	-	+
Trichoptera				
Rhyacophilidae	+	+	+	+
Total # of sensitive taxa:	7	7	8	9
After Lehmkuhl (1979)				

4.4.3 Comparisons with Past Data

Benthic invertebrate monitoring has been conducted at the four sites on Vangorda Creek every two years commencing in 1991, as a requirement of the company's water licence. Artificial substrate samplers were used for each survey with a colonization period of five to six weeks. To assess the health of the benthic communities, abundance (total population), diversity (taxonomic richness), taxonomic dominance and presence of sensitive taxa were examined for each site per year (see Table 8). A healthy benthos community would be characterized by numerous individuals, many different types of organisms and the presence of pollution sensitive species.

The lowest population at each of the sites generally occurred in 1991, although the total abundance was slightly less at V5 in 1999. During 1991, the samplers were washed into shore during a flood event leaving the baskets at V5 and V8 only partially submerged (Burns, 1991). Consequently only the lower portion of the samplers were available for colonization which could account for the lower populations. Populations fluctuated during the other surveys. The highest populations occurred in 1997 at V5 and V27, in 1995 at V8 and in 1993 at V1. The variation in total abundance can be attributed to many natural factors such as climate, stream flow, life cycles of the various organisms, timing of the sampling, as well as the chemistry of the water and the stream sediments.

To enable comparisons between the surveys, taxonomic richness was determined by using the lowest common dominator. For example, in 1991 and 1993, some of the insect orders were identified to the family level only. If genera or species were identified within this family in 1995, 1997 and/or in 1999, they were lumped together and considered as one taxon. The total taxonomic richness for 1995, 1997 and 1999 are therefore lower in Table 8 than that determined in the individual studies. Overall populations appeared to be less diverse in 1999 than in recent years, but were not as low as the taxonomic richness recorded in 1993.

Diptera was the dominant or co-dominant group at all of the sites during each of the surveys. Plecoptera commonly shared dominance at each of the sites. The community at V1 was dominated by two insect orders for each of the studies. Overall the community structure appears to be stable over time.

The total number of sensitive taxa identified at the sites ranged from five to nine and indicates the presence of good water and sediment quality.

TABLE 8					
COMPARISONS OF BENTHIC DATA FOR THE YEARS 1991, 1993, 1995, 1997 & 1999					
Site	Year	Total Abundance	Taxonomic Richness	Dominant Taxa	Total # of Sensitive Taxa
V1	1991	763	17	Diptera & Ephemeroptera	6
	1993	3,090	19	Diptera & Plecoptera	7
	1995	1,758	26	Plecoptera & Diptera	8
	1997	1,663	29	Diptera & Plecoptera	9
	1999	1,025	20	Diptera & Plecoptera	7
V27	1991	953	24	Diptera	6
	1993	5,952	17	Plecoptera & Diptera	5
	1995	4,929	28	Plecoptera & Diptera	9
	1997	11,751	29	Diptera & Plecoptera & Ephemeroptera	8
	1999	1,061	23	Diptera & Plecoptera	7
V5	1991	1,298	29	Diptera	7
	1993	2,193	21	Diptera & Plecoptera	6
	1995	1,550	28	Diptera	8
	1997	9,291	38	Diptera	9
	1999	1,284	32	Diptera & Plecoptera	8
V8	1991	594	22	Diptera	6
	1993	3,024	19	Diptera & Plecoptera	6
	1995	8,340	35	Diptera	8
	1997	904	25	Diptera & Plecoptera	6
	1999	1,061	28	Diptera	9

5.0 SUMMARY

Water quality was generally good throughout. The water was turbid at V5 and V8 in July and was running clear in August. Although some of the metals exceeded the CCME guidelines for the protection of freshwater aquatic life, this appears to be a factor of the relatively high suspended solids in the water column experienced during the July sampling. All metals levels were low in the dissolved portion and in the August samples.

The levels of metals present in the stream sediments in upper Vangorda Creek show that it drains a mineralized area. V27, which is located downstream of the Vangorda deposit, shows increases in concentrations of copper, lead and zinc from 1993 to 1999. The high concentrations of these metals at V27 do not appear to have impacted the benthic community.

The benthic communities were very similar in abundance and structure at all of the sites in 1999. They were diverse with good representation from the major groups of organisms that are usually present in lotic waters, including several pollution sensitive species. The communities appear stable over time.

6.0 REFERENCES

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APPENDIX A

WATER QUALITY DATA

APPENDIX A ROUTINE WATER QUALITY ANALYSIS, VANGORDA CREEK, JULY 1999

Site	Alkalinity (ppm)	Hardness (ppm)	Ammonia (ppm)	Sulphate (ppm)	Total Suspended Solids (ppm)
V1	2	9	<0.05	6	1
V5	22	174	<0.05	49	300
V8	13	107	<0.05	31	85
V27	5	36	<0.05	14	5

APPENDIX A ROUTINE WATER QUALITY ANALYSIS, VANGORDA CREEK, AUGUST 1999

Site	Alkalinity (ppm)	Hardness (ppm)	Ammonia (ppm)	Sulphate (ppm)	Total Suspended Solids (ppm)
V1	26	22	<0.05	7	1
V5	187	226	<0.05	60	7
V8	112	135	<0.05	36	3
V27	46	49	<0.05	16	3

APPENDIX A

WATER QUALITY METALS DATA, VANGORDA CREEK, JULY 1999

METAL (ppm)	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	La	Mg
V1 Total	<.0001	0.03	<.001	0.01	0.0167	<.0001	<.001	2.90	<.0001	<.0002	<.0002	0.0020	0.070	0.4	<.0002	0.61
V1 Dissolved	<.0001	0.05	<.001	0.05	0.0080	<.0001	<.001	2.78	<.0001	<.0002	0.007	0.0014	0.014	0.2	0.000	0.58
V5 Total	<.0001	4.67	<.001	0.01	0.1570	0.0003	<.001	42.70	<.0001	<.0002	0.018	0.0204	7.337	1.4	0.005	18.20
V5 Dissolved	<.0001	0.32	<.001	0.07	0.0357	0.0001	<.001	40.86	<.0001	<.0002	0.003	0.0101	0.010	0.7	<.0002	17.41
V8 Total	<.0001	1.09	<.001	0.01	0.0577	0.0002	<.001	27.35	<.0001	<.0002	0.012	0.0204	1.745	0.6	0.000	10.50
V8 Dissolved	<.0001	0.15	<.001	0.07	0.0223	<.0001	<.001	26.17	<.0001	<.0002	0.005	0.0050	0.003	0.5	<.0002	10.05
V27 Total	<.0001	0.08	<.001	0.02	0.0289	<.0001	<.001	10.73	0.0002	<.0002	<.0002	0.0261	0.170	0.3	<.0002	2.60
V27 Dissolved	<.0001	0.03	<.001	0.03	0.0133	0.0001	<.001	10.27	<.0001	<.0002	<.0002	0.0008	0.015	0.3	<.0002	2.49
METAL (ppm)	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Si	Sn	Sr	Ti	V	W	Zn
V1 Total	0.001	<.0001	0.8	<.0002	<.002	<.001	1.4	<.001	<.001	2.46	<.0004	0.0237	0.0035	<.0002	<.001	0.002
V1 Dissolved	0.001	<.0001	1.0	0.002	<.002	<.001	1.9	<.001	<.001	3.23	<.0004	0.0270	0.0010	<.0002	<.001	0.002
V5 Total	0.111	<.0001	2.4	0.016	0.196	0.018	11.2	<.001	<.001	8.65	<.0004	0.1592	0.1330	0.011	<.001	0.032
V5 Dissolved	0.002	<.0001	2.4	0.001	<.002	0.002	16.3	<.001	<.001	2.72	<.0004	0.0892	0.0024	0.000	<.001	<.0004
V8 Total	0.036	<.0001	1.6	0.004	<.002	0.007	7.3	<.001	<.001	4.23	<.0004	0.0988	0.0329	0.002	<.001	0.021
V8 Dissolved	0.001	<.0001	1.7	0.001	<.002	<.001	10.2	<.001	<.001	3.11	<.0004	0.0650	0.0014	0.001	<.001	<.0004
V27 Total	0.005	<.0001	1.1	0.004	<.002	<.001	3.1	<.001	<.001	3.73	<.0004	0.0464	0.0039	<.0002	<.001	0.040
V27 Dissolved	0.003	<.0001	1.2	0.001	<.002	<.001	4.6	<.001	<.001	4.84	<.0004	0.0637	0.0024	<.0002	<.001	0.020

APPENDIX A

WATER QUALITY METALS DATA, VANGORDA CREEK, AUGUST 1999

METAL (ppm)	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	La	Mg
V1 Total	<.0001	0.038	<.001	0.017	0.0245	<.0001	<.001	8.073	0.0051	<.0002	<.0002	0.0113	0.421	0.42	<.0002	0.698
V1 Dissolved	<.0001	0.006	<.001	0.075	0.0035	<.0001	<.001	7.725	<.0001	<.0002	<.0002	0.0010	<.001	0.20	<.0002	0.668
V5 Total	<.0001	0.082	<.001	0.045	0.0495	0.0002	<.001	58.090	0.0023	0.0004	<.0002	0.0092	0.242	0.81	<.0002	22.277
V5 Dissolved	<.0001	0.022	<.001	0.610	0.0207	0.0001	<.001	55.588	0.0003	<.0002	<.0002	0.0029	0.004	0.79	<.0002	21.317
V8 Total	<.0001	0.065	<.001	0.008	0.0421	0.0001	<.001	35.718	0.0007	0.0002	<.0002	0.0081	0.157	0.76	<.0002	12.658
V8 Dissolved	<.0001	0.009	<.001	0.280	0.0089	<.0001	<.001	34.180	0.0002	<.0002	<.0002	0.0011	0.001	0.56	<.0002	12.113
V27 Total	<.0001	0.048	<.001	0.057	0.0366	<.0001	<.001	14.778	0.0009	<.0002	<.0002	0.0076	0.134	0.42	<.0002	3.355
V27 Dissolved	<.0001	0.012	<.001	1.056	0.0056	<.0001	<.001	14.142	0.0005	<.0002	<.0002	0.0018	<.001	0.34	<.0002	3.210
METAL (ppm)	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Si	Sn	Sr	Ti	V	W	Zn
V1 Total	0.0017	0.0009	2.43	0.0008	<.002	<.001	2.59	<.001	<.001	2.702	<.0004	0.0385	0.0221	0.0011	<.001	0.0015
V1 Dissolved	<.0004	0.0002	2.32	<.0002	<.002	<.001	2.48	<.001	<.001	3.538	<.0004	0.0282	0.0014	<.0002	<.001	<.0004
V5 Total	0.0088	0.0009	5.29	<.0002	<.002	<.001	20.83	<.001	<.001	2.795	<.0004	0.1679	0.0127	<.0002	<.001	<.0004
V5 Dissolved	0.0025	0.0004	5.06	<.0002	<.002	<.001	19.93	<.001	<.001	3.295	<.0004	0.1459	0.0023	<.0002	<.001	<.0004
V8 Total	0.0178	0.0005	3.80	<.0002	<.002	<.001	12.42	<.001	<.001	2.910	<.0004	0.1238	0.0091	<.0002	<.001	0.0054
V8 Dissolved	0.0016	0.0001	3.64	0.0002	<.002	<.001	11.88	<.001	<.001	3.448	<.0004	0.0791	0.0011	0.0002	<.001	<.0004
V27 Total	0.0032	<.0001	2.42	0.0009	<.002	<.001	5.68	<.001	<.001	3.442	<.0004	0.0703	0.0058	<.0002	<.001	0.0283
V27 Dissolved	0.0010	0.0001	2.31	0.0003	<.002	<.001	5.43	<.001	<.001	8.119	<.0004	0.0592	0.0014	0.0011	<.001	<.0004

APPENDIX B

STREAM SEDIMENT DATA

APPENDIX B

STREAM SEDIMENT DATA AT VANGORDA CREEK, 1999

Site	Ag (ppm)	Al (%)	As (ppm)	B (ppm)	Ba (ppm)	Be (ppm)	Bi (ppm)	Ca (%)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	K (%)	La (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Ni (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Se (ppm)	Si (%)	Sn (ppm)	Sr (ppm)	Ti (%)	V (ppm)	W (ppm)	Zn (ppm)
V1-A	<1	1.73	27	3	289	1.5	<3	0.52	0.6	21	60	41	4.17	0.18	26	0.73	1363	4	0.03	54	1112	62	<2	<1	0.03	<5	44	0.07	36	<2	153
V1-B	<1	1.72	29	3	292	1.6	<3	0.56	1.0	19	53	38	3.92	0.18	29	0.68	1583	2	0.03	47	1150	41	<2	<1	0.03	<5	47	0.07	37	<2	140
V1-C	<1	1.72	29	3	272	1.4	<3	0.51	0.4	20	66	39	3.98	0.17	27	0.75	1579	3	0.03	46	1067	31	<2	<1	0.03	<5	43	0.07	35	<2	129
MEAN	0.0	1.72	28.1	3.2	284	1.5	0.0	0.53	0.7	20.0	59.5	39.2	4.02	0.18	27.7	0.72	1508	3.0	0.03	49.1	1110	44.7	0.0	0.0	0.03	0.0	44.4	0.07	36.2	0.0	140.9
S.D.	0.0	0.00	1.0	0.3	10.6	0.1	0.0	0.03	0.3	0.9	6.8	1.7	0.13	0.00	1.5	0.04	126.1	1.2	0.00	4.6	41.4	16.2	0.0	0.0	0.00	0.0	2.1	0.00	0.8	0.0	12.1
V27-A	4.7	1.14	174	3	398	0.8	<3	0.55	2.5	22	42	159	4.66	0.07	35	0.81	666	7	0.03	56	1412	2486	10	<1	0.04	<5	53	0.03	25	<2	1102
V27-B	1.8	0.92	124	3	210	0.5	<3	0.76	1.3	21	44	77	3.51	0.05	20	0.89	576	4	0.02	50	1050	1761	3	<1	0.03	<5	44	0.04	26	<2	587
V27-C	3.7	1.26	159	3	491	0.9	<3	0.63	2.9	22	44	151	4.69	0.08	38	0.91	731	6	0.03	62	1484	1961	7	<1	0.04	<5	57	0.03	28	<2	1074
MEAN	3.4	1.109	152	3.036	366.4	0.73	0	0.645	2.3	21.64	43.3	128.9	4.286	0.067	31.17	0.87	657	5.708	0.026	56.02	1315	2069	6.713	0	0.036	0	51.45	0.034	26.06	0	921
S.D.	1.5	0.171	26	0.228	143.1	0.192	0	0.107	0.8	0.865	1.134	45.02	0.675	0.013	10.08	0.052	78	1.348	0.005	5.924	233	375	3.049	0	0.002	0	6.703	0.004	1.779	0	290
V5-A	<1	0.65	15	4	248	0.4	<3	1.83	0.3	10	35	26	1.79	0.06	16	0.90	408	2	0.03	47	1066	30	<2	<1	0.04	<5	69	0.03	24	<2	80
V5-B	<1	0.70	16	3	275	0.4	<3	1.54	<2	10	35	24	1.80	0.06	19	0.85	375	2	0.02	43	1123	32	<2	<1	0.03	<5	61	0.04	24	<2	80
V5-C	<1	0.75	12	3	286	0.4	<3	1.57	<2	10	35	25	1.85	0.06	20	0.84	371	2	0.03	43	1168	29	<2	<1	0.03	<5	63	0.04	25	<2	83
MEAN	0.0	0.70	14.5	3.3	269	0.4	0.0	1.65	0.1	9.9	34.8	24.9	1.81	0.06	18.1	0.86	384	2.1	0.03	44.6	1119	30.4	0.0	0.0	0.03	0.0	64.0	0.04	24.6	0.0	80.9
S.D.	0.0	0.05	1.8	0.3	19.6	0.0	0.0	0.18	0.2	0.4	0.2	1.2	0.03	0.00	2.1	0.04	20.0	0.2	0.00	2.4	51.3	1.5	0.0	0.0	0.00	0.0	4.1	0.00	0.6	0.0	1.9
V8-A	<1	0.84	15	3	247	0.4	<3	1.01	<2	10	32	28	2.00	0.07	19	0.74	437	1	0.03	40	994	71	<2	<1	0.03	<5	47	0.04	25	<2	134
V8-B	<1	0.79	16	3	255	0.4	<3	1.25	0.3	11	31	29	1.93	0.06	18	0.78	435	2	0.03	42	1092	61	<2	<1	0.04	<5	54	0.04	26	<2	117
V8-C	0.3	0.76	23	3	247	0.4	<3	0.90	0.3	11	37	31	2.07	0.06	17	0.75	444	2	0.02	41	881	135	<2	<1	0.03	<5	44	0.04	26	<2	194
MEAN	0.1	0.79	18.0	2.9	250	0.4	0.0	1.05	0.2	10.7	33.4	29.0	2.00	0.06	18.0	0.8	438.9	1.9	0.03	41.0	989	89	0.0	0.0	0.03	0.0	48.4	0.0	25.6	0.0	148.3
S.D.	0.2	0.04	4.4	0.1	4.9	0.0	0.0	0.18	0.2	0.4	2.8	1.7	0.07	0.00	1.0	0.0	4.5	0.5	0.00	0.9	105.4	40.0	0.0	0.0	0.00	0.0	5.4	0.0	0.1	0.0	40.1

APPENDIX C

BENTHIC INVERTEBRATE DATA

APPENDIX C

BENTHIC INVERTEBRATE DATA, VANGORDA CREEK, 1999

Fine fraction split to:	V1a 1/2	V1b	V1c	V5a	V5b	V5c	V27a	V27b	V27c	V8b	V8c	V8a
PHYLUM ARTHROPODA												
Class Insecta												
Order Ephemeroptera												
Family Siphonuridae												
Ameletus sp				1	1			5				
Family Baetidae												
Baetis sp	20	1	1	1	1	6	2	9	25	16	61	39
Family Heptageniidae												
Cinygmula sp		7	9	28	15	33	3	95	8	1	4	3
Rhithrogena sp	6	9	13				3	2	6	1		3
Epeorus (Iron) sp	15	2	2	5	3	6	1		7	10	16	18
Family Ephemerellidae												
Ephemerella coloradensis	2	11	3	2				3			1	
Ephemerella doddsi									1		2	2
Order Plecoptera												
Plecoptera Unid Juv	1		4									
Family Capniidae												
Capnia sp				115	21	91			1		1	
Family Perlodidae												
Megarcys sp		1		1		2				2	1	2
Skwala paralella	1											
Family Taeniopterygidae												
Taenionema sp	1			9	1	3	9	6	15	4	5	13
Family Chloroperlidae												
Sweltsa sp gp				21	13	10				1		1
Family Nemouridae												
Zapada sp	358	14	31	30	3	20	44	48	211	2	7	7
Order Trichoptera												
Family Limnephilidae Unid J/D												
Ecclisomyia sp				1	1	1						
Dicosmoecus sp											1	
Family Arctopsychidae												
Arctopsyche sp	15	1	1				13	4	35		1	1
Family Glossosomatidae												
Glossosoma sp								3	1			
Family Hydroptilidae Juv												
Hydroptila sp										2	1	3
Family Rhyacophilidae												
Rhyacophila acropedes or vao				5	1		5	9	8	4	1	
Rhyacophila hyalinata	5		1		1		3	2	9		2	4
Family Diptera												
Diptera Unid A												
				1						1		1
Diptera Unid P												
											1	
Family Chironomidae												
Chironomidae Unid L	132		2	22	6	10	30	35	108	29	42	32
Chironomidae A				1	1					1		2
Chironomidae P	16	1		69	9	54	3		4	4	5	11
Sub Family Orthocladinae												
Brillia sp				1	1					7	23	17
Cardiocladius sp	21			1			1	1	2	9	6	2
Cricotopus sp	75			82	13	54	5	9	52	138	95	52
Diamesa sp	1			5		2	7	11	40	6	8	12
Eukiefferiella sp	100			120	30	89	30	20	48	67	78	45

unid = unidentified J = juvenile L = larvae A = adult P = pupae D = damaged

APPENDIX C

BENTHIC INVERTEBRATE DATA, VANGORDA CREEK, 1999

Fine fraction split to:	V1a 1/2	V1b	V1c	V5a	V5b	V5c	V27a	V27b	V27c	V8b	V8c	V8a
Euryhopsis sp						1		1				
Metriocnemus sp										1	1	1
Synorthocladius sp				1	1	2				2		4
Thienemanniella sp		1						2				
Thienemannimyia sp						1						
Family Deuterophlebiidae												
Deuterophlebia sp												6
Family Empididae												
Chelifera sp	1		8	1	3				1			
Clinocera sp				5		2						1
Family Psychodidae												
Pericoma sp				8	2	2			1	1		
Family Simuliidae												
Gymnopsis L									1			
Prosimulium sp L	22			1	9	60			7			
Prosimulium sp P				2	5	25						
Simulium sp L	33		1	4		2	6	6	15			
Simulium sp P	1			5								
Family Tipulidae												
Antocha sp				1								
Dicranota sp				6		6				2		2
Hexatoma sp						1						
Tipula sp				6	1	3						
Order Colembola												
Hypogastrura sp				1	1							
Isotoma sp					1	7						1
Order Coleoptera Unid L				1					1			
Coccinellidae L					1							
Order Homoptera												
Aphididae				1		2			1	6		1
Cicadellidae				1	1				1	2		
Order Hymenoptera A				2					1	1		
Family Formicidae				1			1					
Order Lepidoptera L				1								
Order Thysanoptera A						1						
Class Arachnida												
Order Aranaea				1		1	1					
Order Hydracarina												
Hydracarina Unid Juv	2					1			2	31		
Lebertia sp			1	3								
Sperchon sp	2			1						1		
Torrenticola sp	2			1		1				1		
Unioncola sp	58	1	1	21	5	25	1	3	5	3	25	12
Wandesia sp											1	
Oribatei				2	1	3				1		
Class Crustacea												
Sub Class Copepoda												
Sub Order Cyclopoida									1			

unid = unidentified J = juvenile L = larvae A = adult P = pupae D = damaged

APPENDIX C

BENTHIC INVERTEBRATE DATA, VANGORDA CREEK, 1999

	V1a 1/2	V1b	V1c	V5a	V5b	V5c	V27a	V27b	V27c	V8b	V8c	V8a
Fine fraction split to:												
Sub Order Harpacticoida	2			2								
Sub Class Ostracoda												
Candona sp	2											
PHYLUM ANNELIDA												
Class Oligochaeta												
Family Enchytraeidae	1			5						7	2	4
PHYLUM NEMATODA	2		1						1	1		3
Total per sample	897	49	79	605	152	527	168	274	619	365	391	305
Total per Site	1025			1284			1061			1061		
Taxonomic Richness per sample	28	11	17	48	30	33	19	21	32	35	28	31
Taxonomic Richness per Site	32			55			37			45		

unid = unidentified J = juvenile L = larvae A = adult P = pupae D = damaged

APPENDIX 3

1999 Annual Inspection, Waste and Water Management Facilities,
Vangorda Mine, Yukon Territory
Report No. 1CD003.02

Steffen Robertson & Kirsten (Canada) Inc.
December 1999

1CD003.02

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

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DECEMBER, 1999

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

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

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	V35	V36	V37	V38	V39	V40	V41	V42	V43	V44	V45	V46	V47
GW-94-01	GW-94-02	GW-94-03	GW-94-04	GW-94-05	P-94-01A	P-94-01B	P-94-02A	P-94-02B	P-94-02C	P-94-03A	P-94-03B	P-94-04A	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.

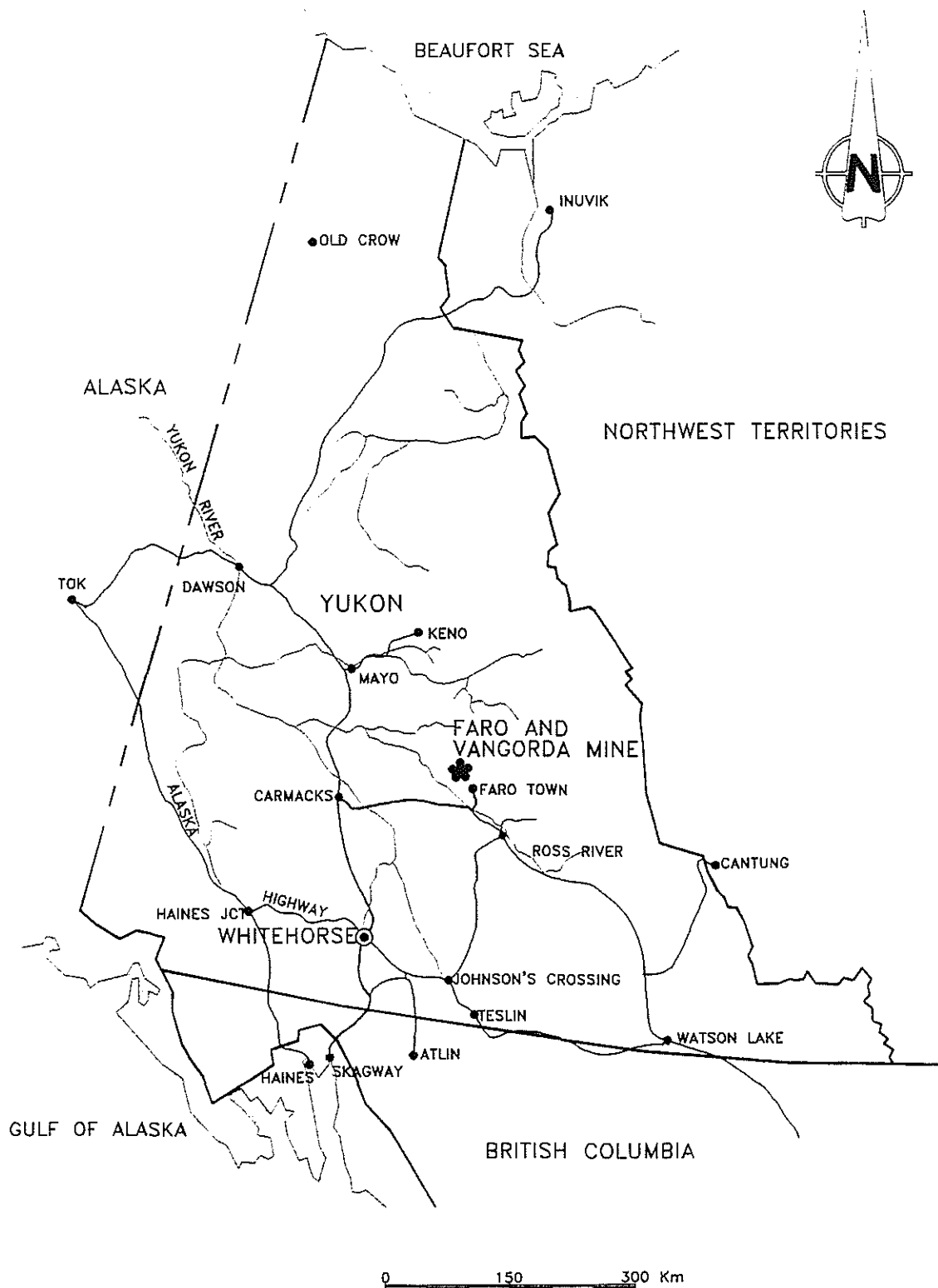
This Report, **1CD003.02 - 1999 Annual Inspection Waste and Water Management Facilities Vangorda Mine, Yukon Territories** has been prepared by:

STEFFEN ROBERTSON AND KIRSTEN (CANADA) INC.

Peter Healey, P.Eng.
Associate Principal

APPENDIX A

Photos



SRK CONSULTING
Consulting Engineers

DELOITTE & TOUCHE LTD.

VANGORDA PLATEAU MINE

LOCATION MAP

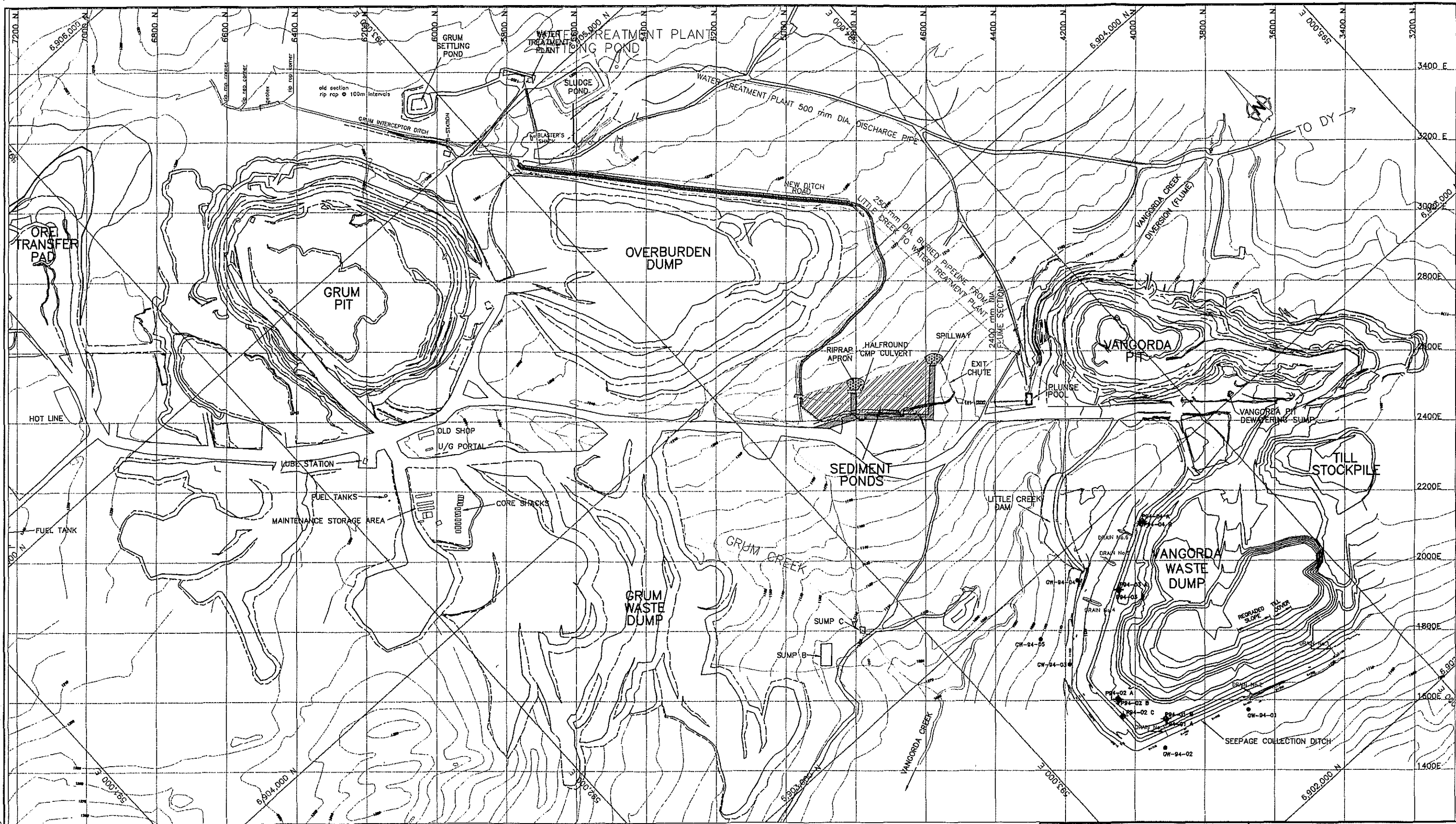
PROJECT NO.
1CA003.02

DATE
DEC. 1999

APPROVED

FIGURE

1



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

0 50 100 150 200 250 METERS
1:10000

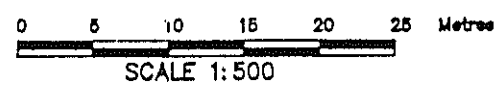
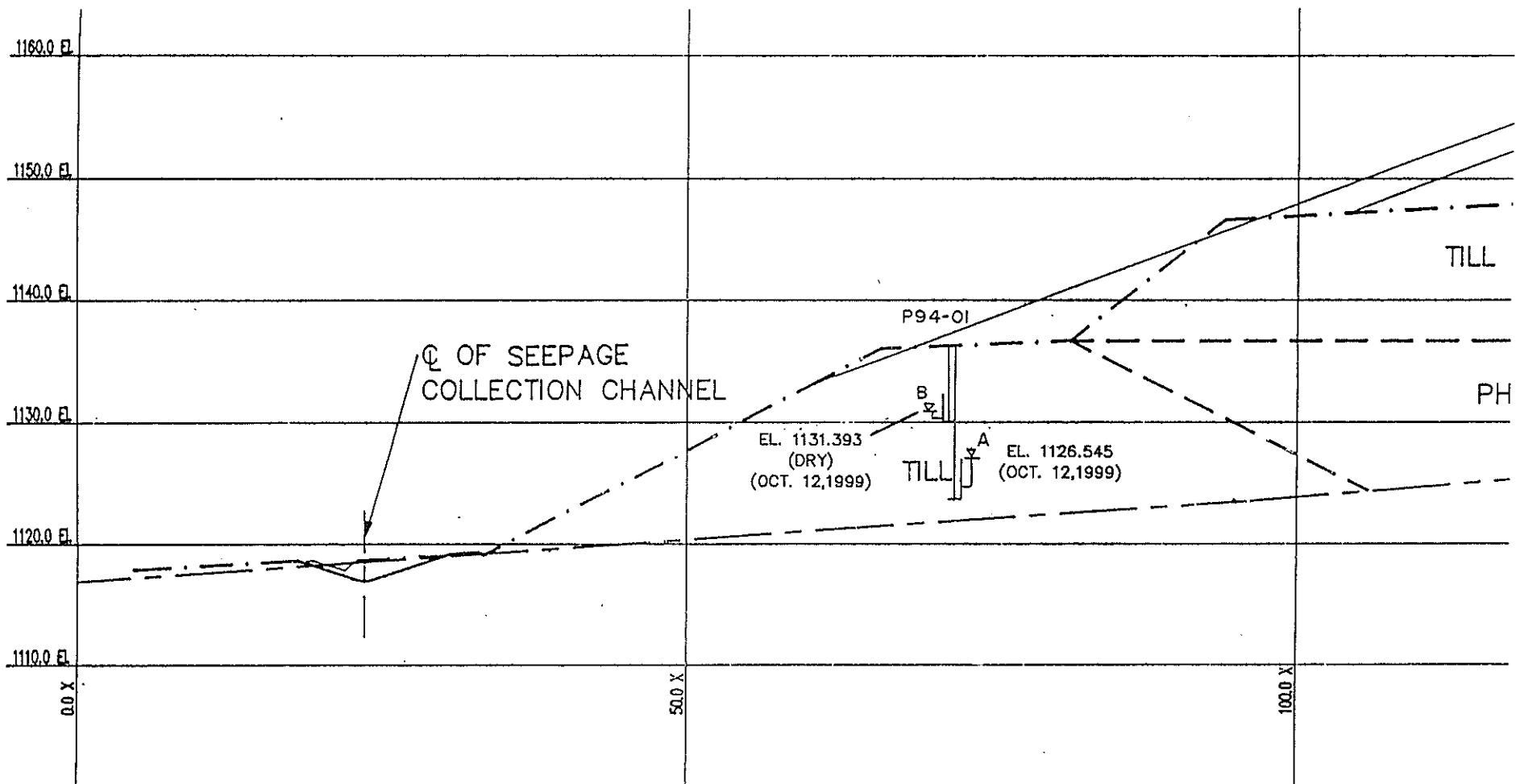
 **SRK CONSULTING**
Consulting Engineers

DELOITTE & TOUCHE LTD.

VANGORDA PLATEAU MINE

SITE PLAN

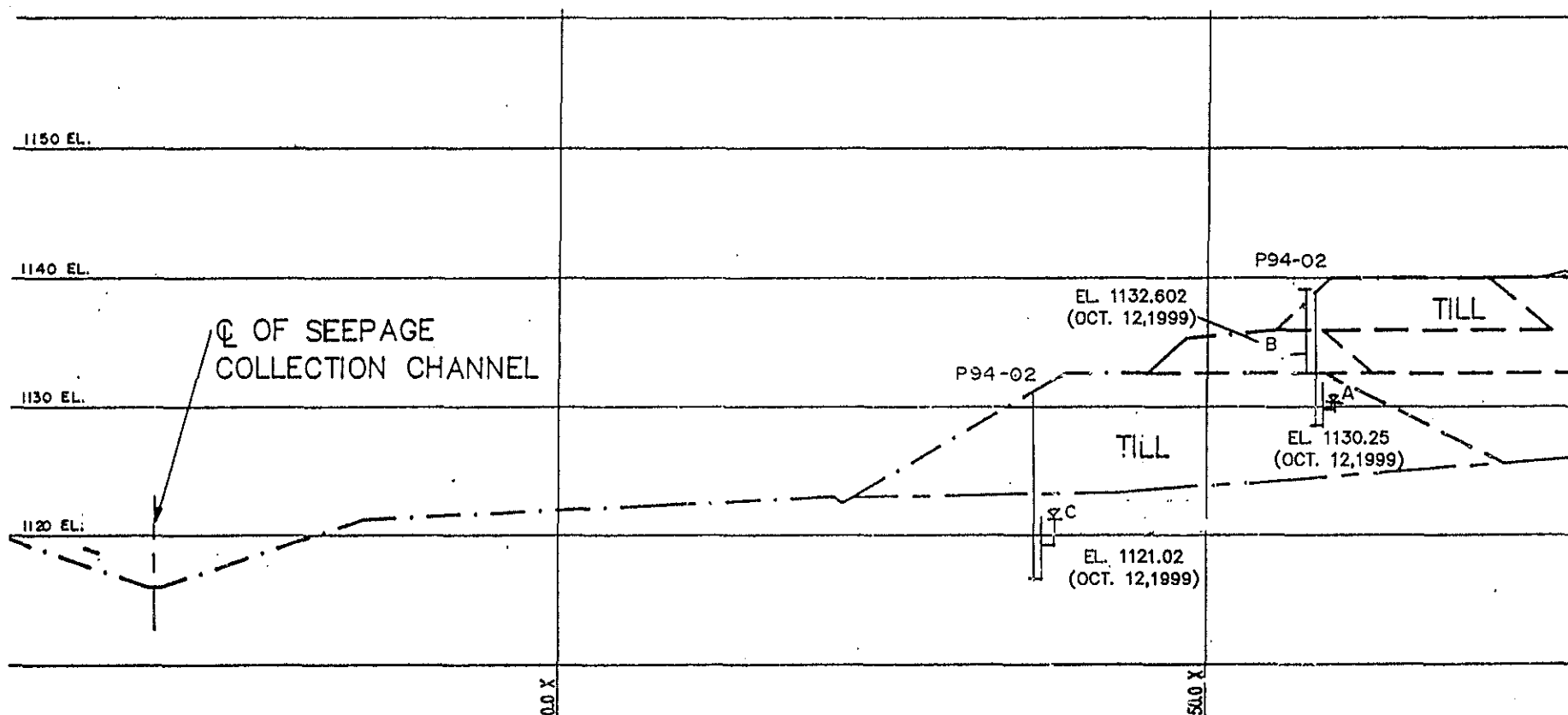
PROJECT NO.	DATE	DRAWING NO.	REV
1CA003.02	DEC. 1999	2	



NOTE : READINGS TAKEN NOV.16, 1998

 SRK CONSULTING Consulting Engineers	VANGORDA PLATEAU			
	SECTION D-3 CHANNEL STA. 4+80			
DELOITTE & TOUCHE LTD.	PROJECT NO.	DATE	APPROVED	FIGURE
	1CA003.02	DEC. 1999		3

FILE REF: SECT-D3



0 5 10 15 20 25 Metres
SCALE 1:500

NOTE: READINGS TAKEN NOV. 16, 1998



SRK CONSULTING
Consulting Engineers

DELOITTE & TOUCHE LTD.

VANGORDA PLATEAU

SECTION D-4
CHANNEL STA. 9+00

PROJECT NO.
1CA003.02

DATE
DEC. 1999

APPROVED

FIGURE

4

FIGURE 5: PIEZOMETER LEVELS - VANGORDA WASTE DUMP

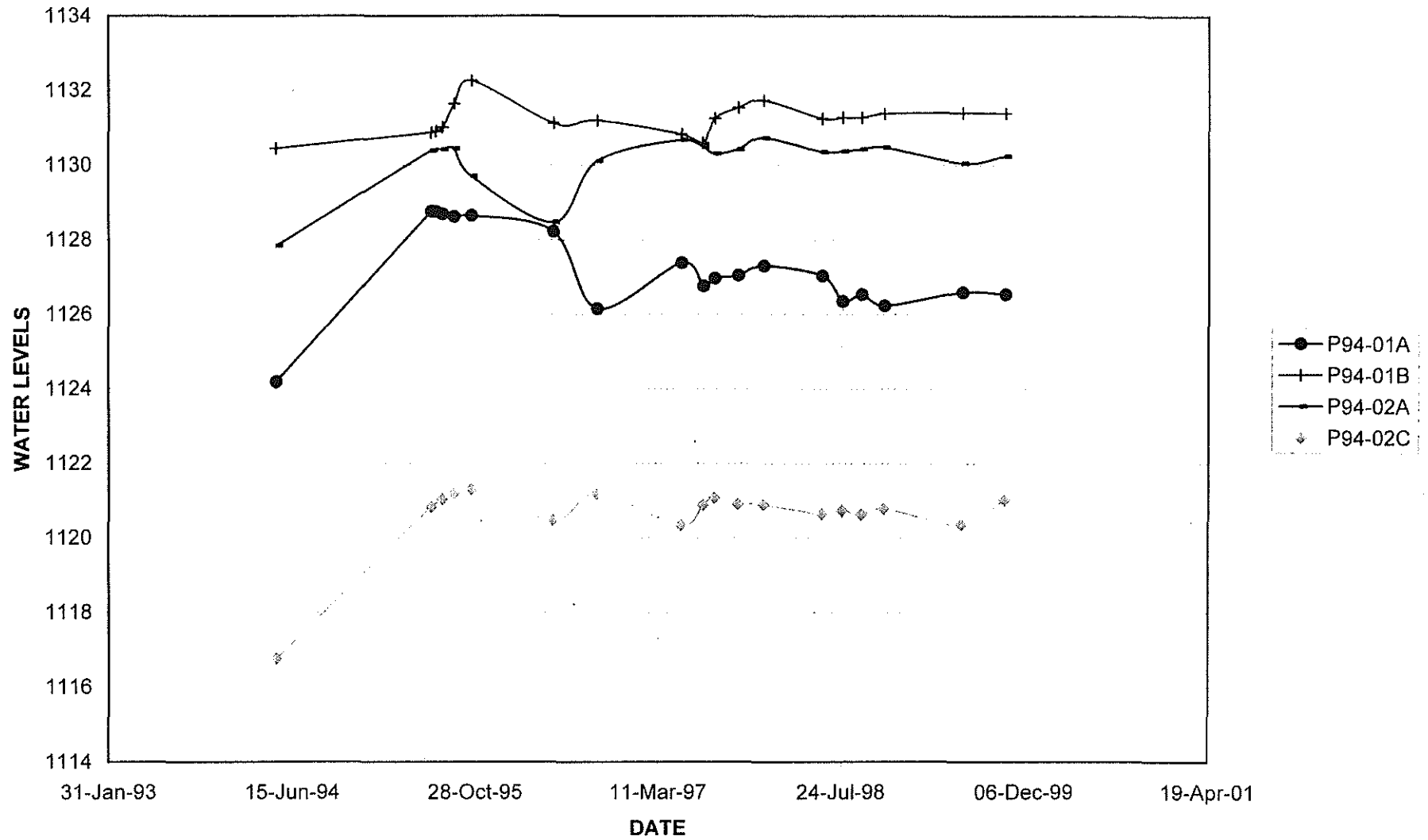
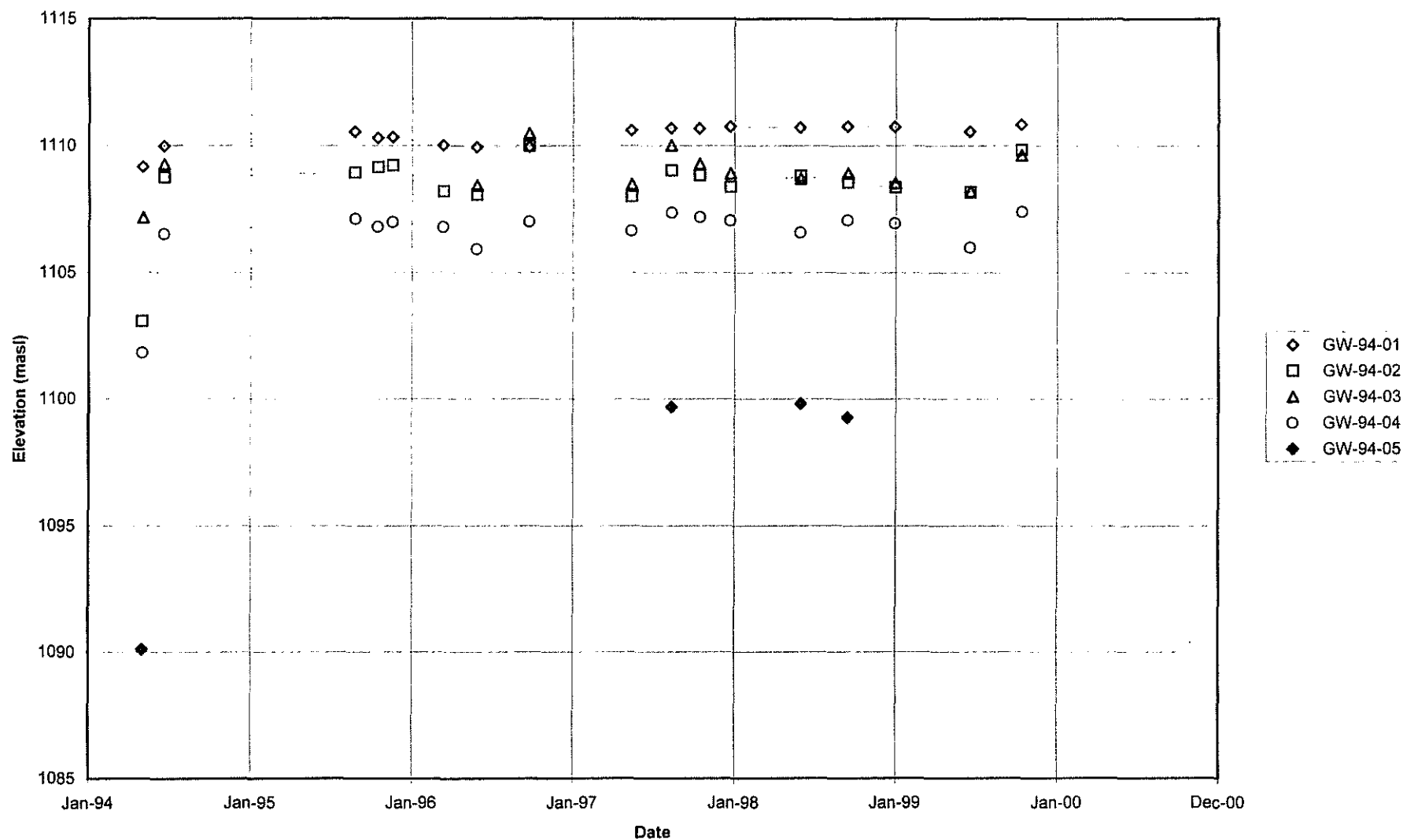
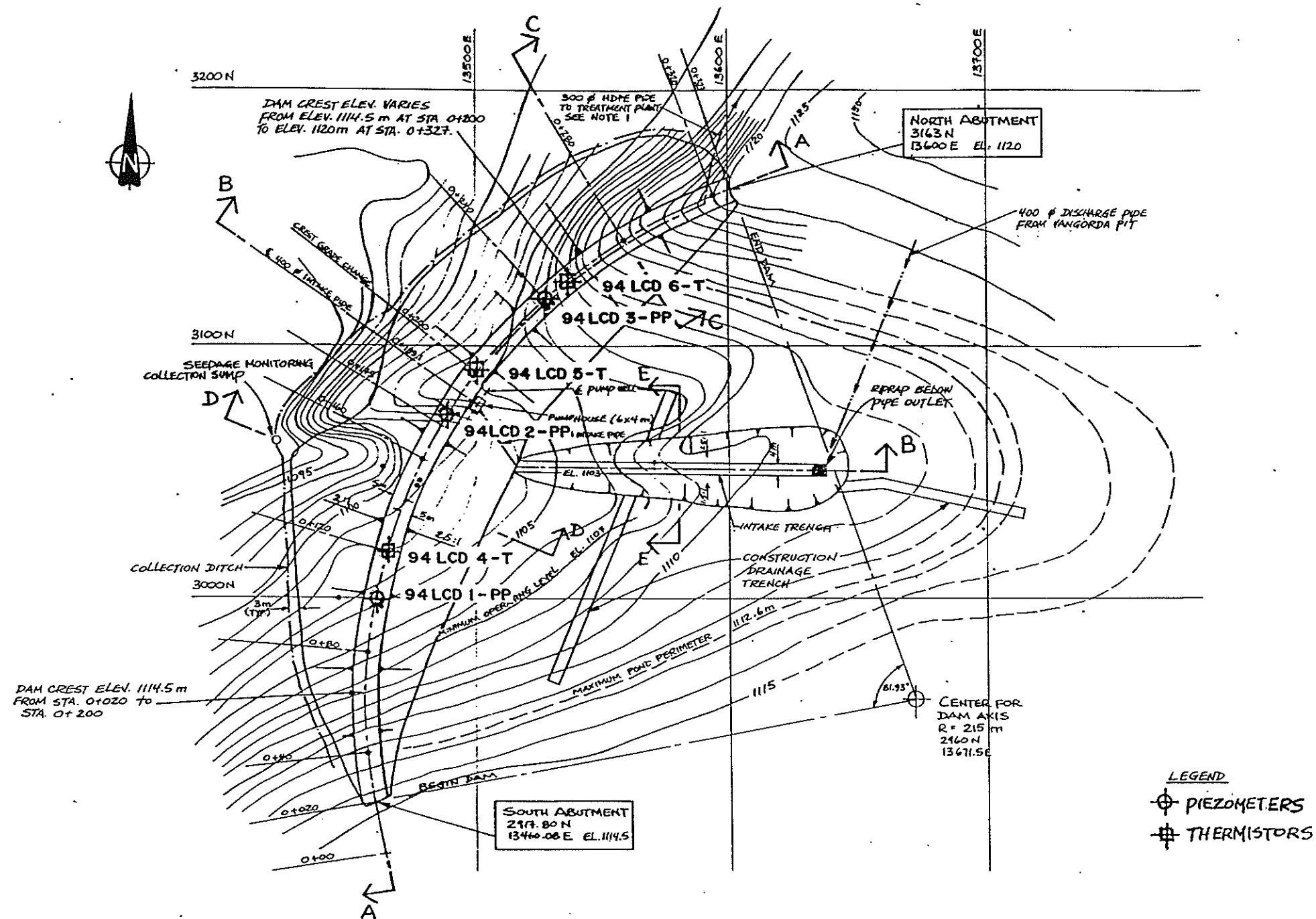


Figure 6: Vangorda Dump Toe Groundwater Elevations

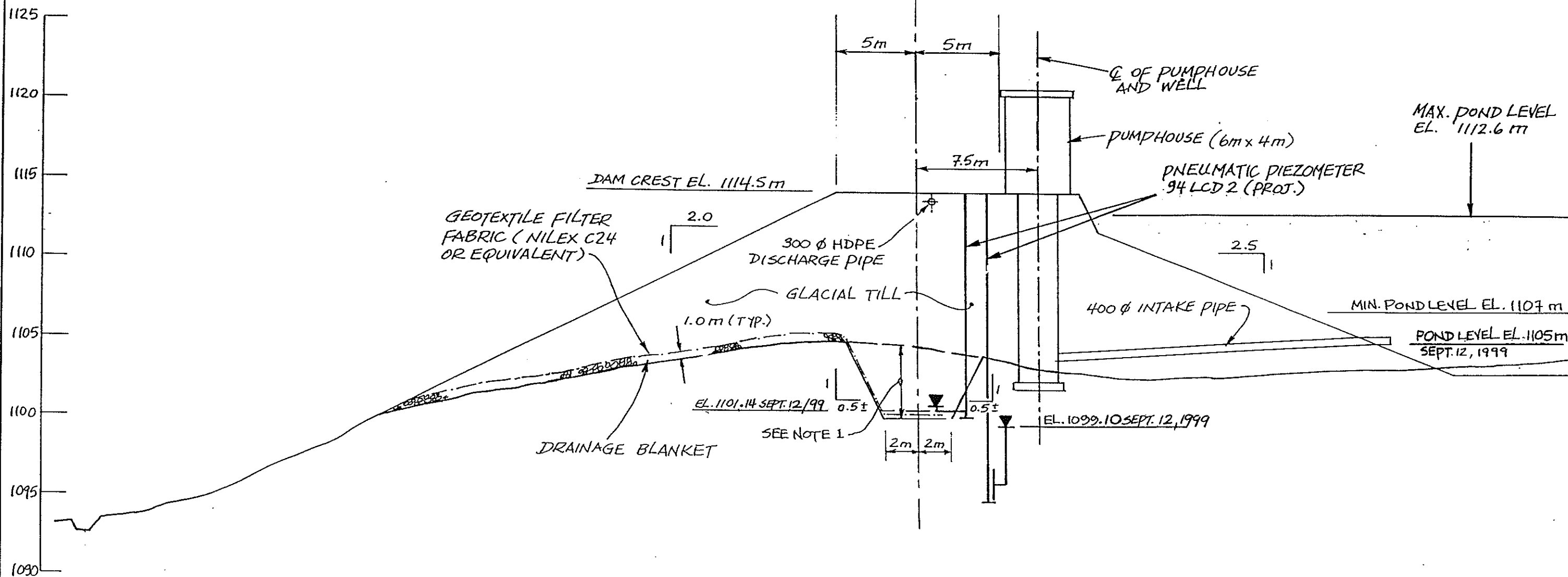


graph Chart 2



 SRK CONSULTING Consulting Engineers		VANGORDA PLATEAU MINE		
		LITTLE CREEK DAM GENERAL ARRANGEMENT PLAN		
DELOITTE & TOUCHE LTD.		PROJECT NO.	DATE	APPROVED
		1CA003.02	DEC. 1999	
		FIGURE	7	

ELEV. (m)



SECTION B-B (STA. 0+190)

SCALE - 1:250



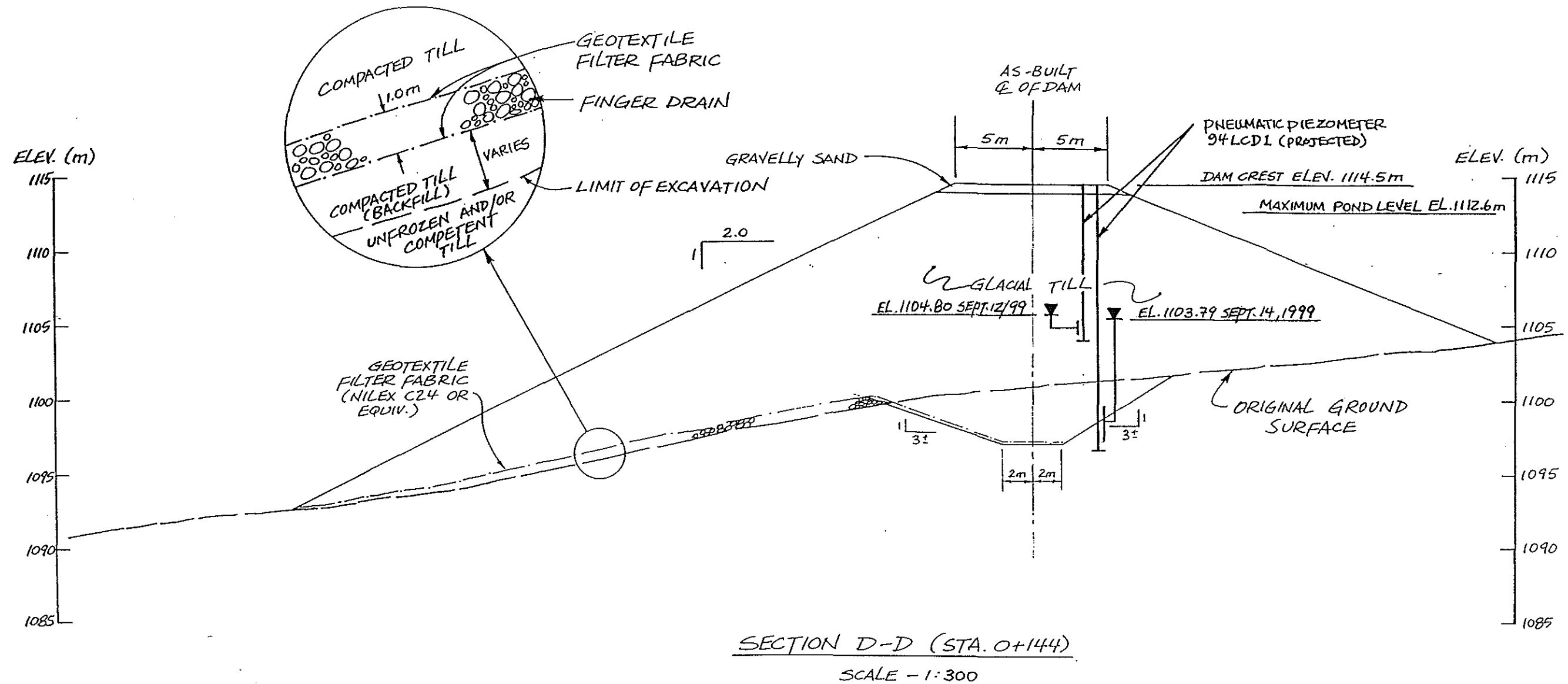
SRK CONSULTING
Consulting Engineers

DELOITTE & TOUCHE LTD.

VANGORDA PLATEAU MINE

LITTLE CREEK DAM
SECTION B-B

PROJECT NO. 1CA003.02	DATE DEC. 1999	APPROVED	FIGURE 8
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 SRK CONSULTING Consulting Engineers		VANGORDA PLATEAU MINE		
		LITTLE CREEK DAM SECTION D-D		
DELOITTE & TOUCHE LTD.		PROJECT NO. 1CA003.02	DATE DEC. 1999	APPROVED FIGURE 9

APPENDIX A

Photos



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

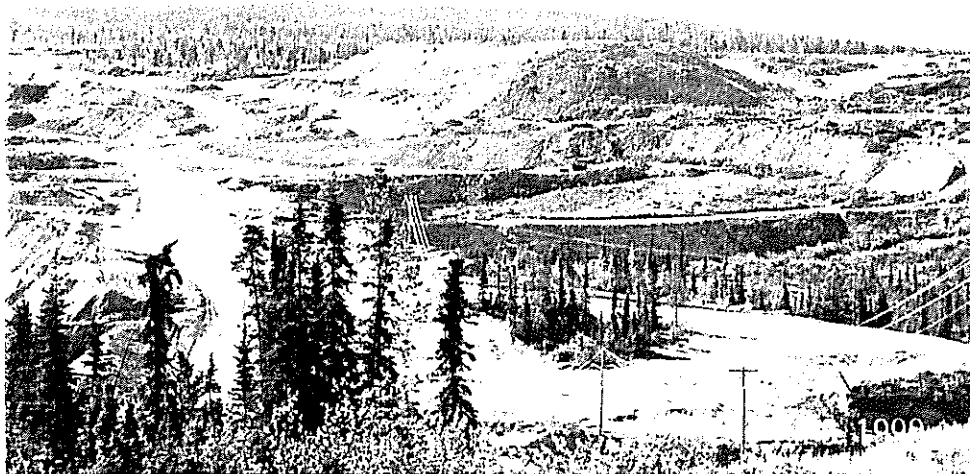


Photo 2: View of the Till Stockpile and Pelley Pond.

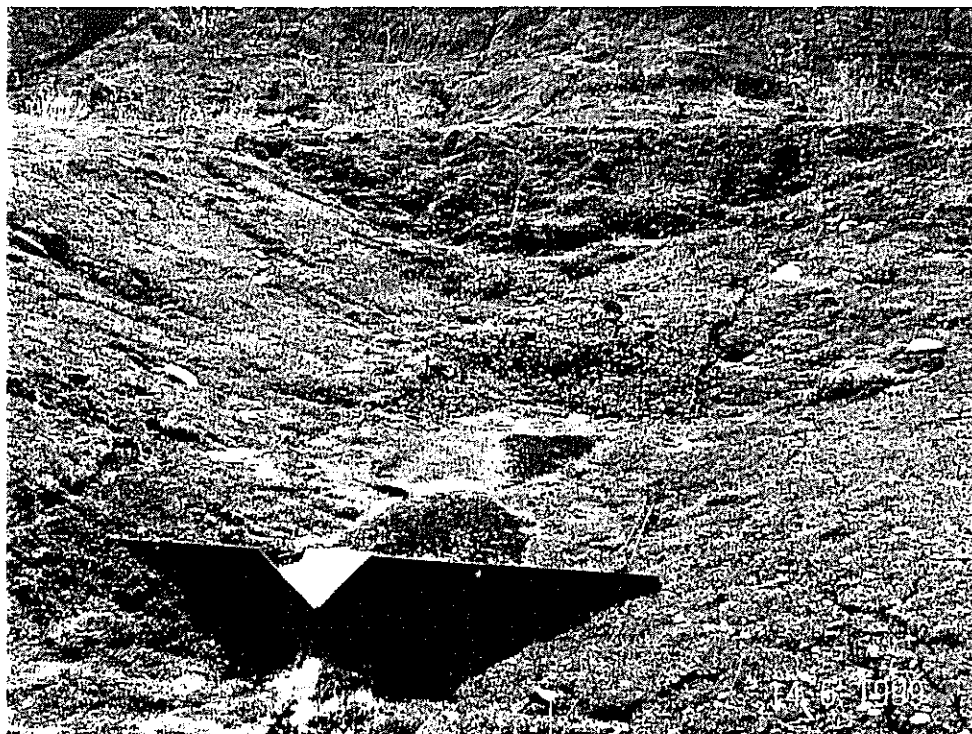


Photo 3: Weir at Drain 5



Photo 4: Erosion above Weir 6

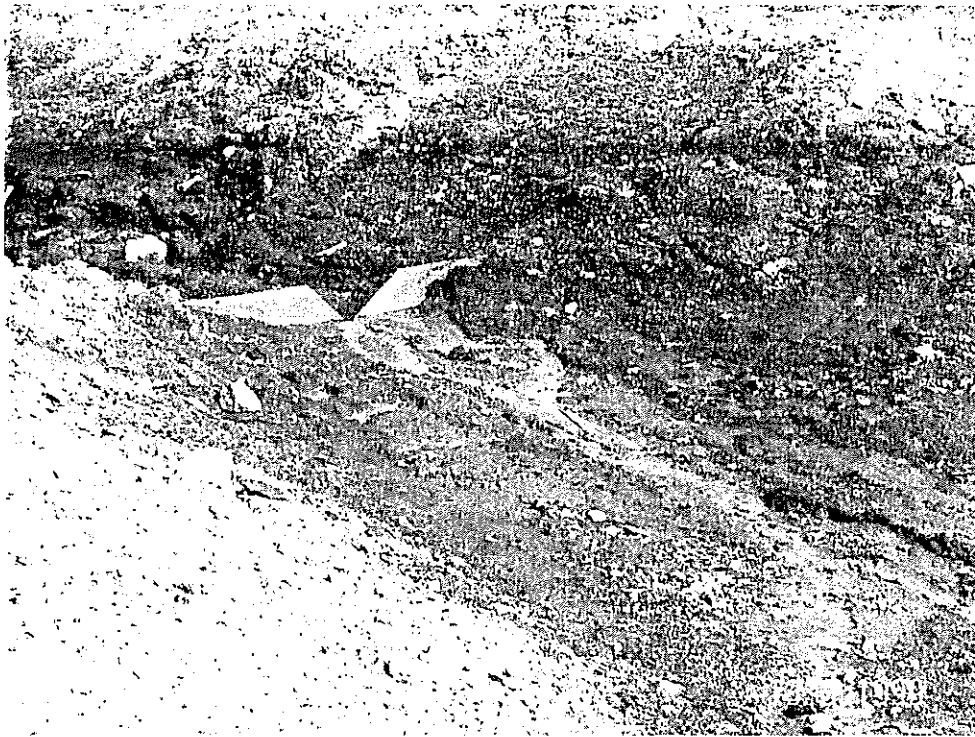


Photo 5: Weir 6



Photo 6: Weir 3



Photo 7: Seepage Collection Ditch on Northside of Waste Dump

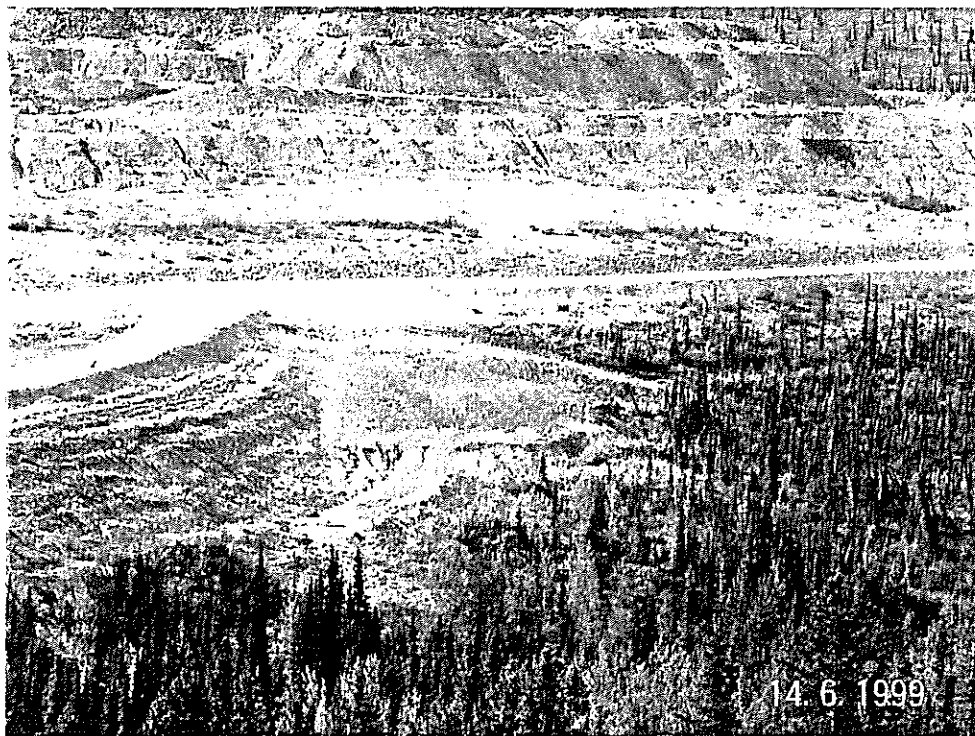


Photo 8: CSP Culvert Spillway in Little Creek Dam



Photo 9: Little Creek Dam

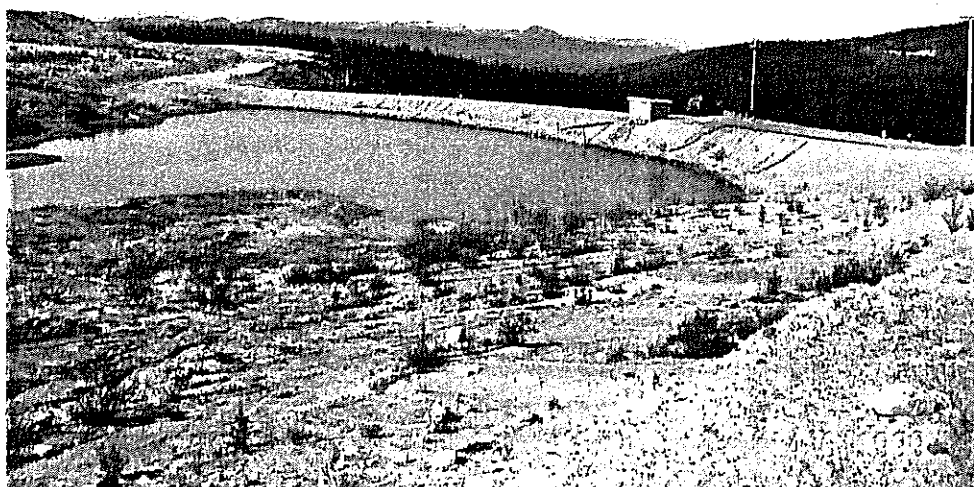


Photo 10: Ponded Water Behind Little Creek Dam



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 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

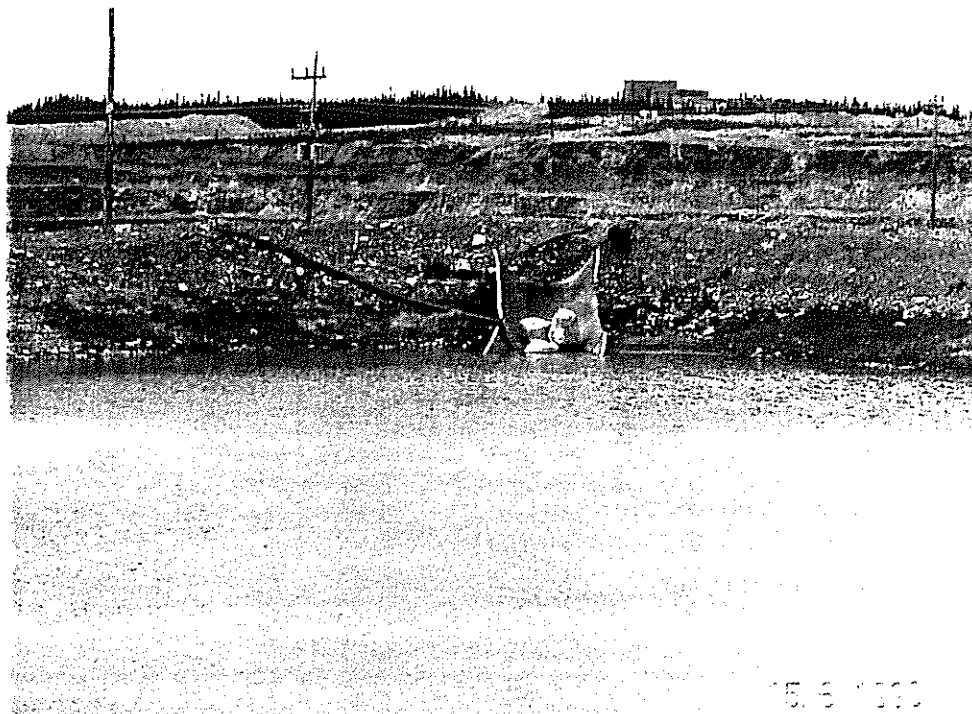


Photo 27: Croucho Pond (Grum Settling Pond)



Photo 28: Grum Interceptor Ditch above Treatment Plant



Photo 29: Erosion in GID Sideslopes below Treatment Plant



Photo 30: Grum Interceptor Ditch

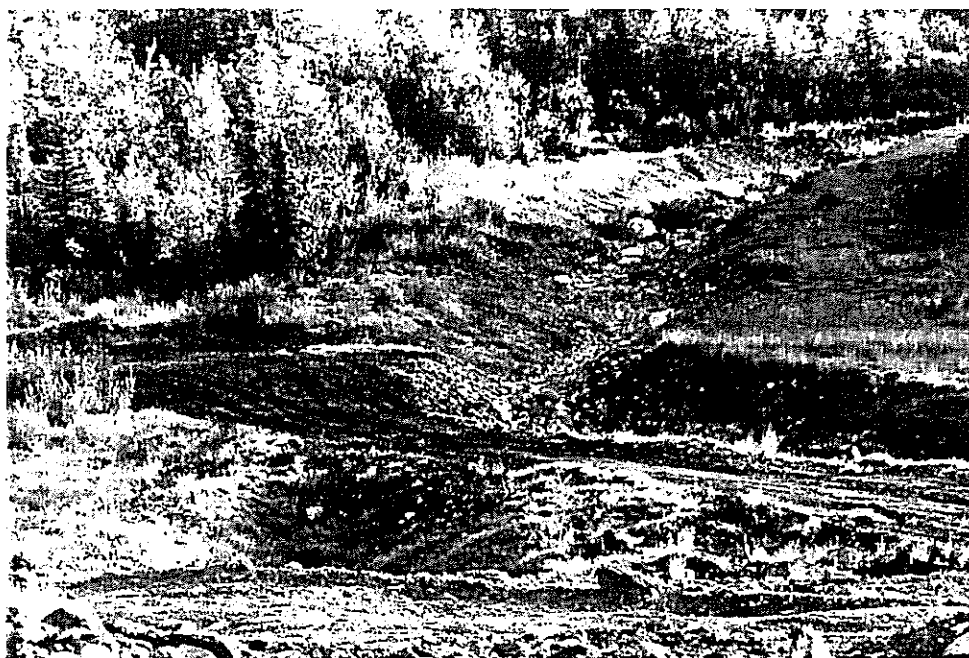


Photo 30: View of removed culvert at the end of the GID

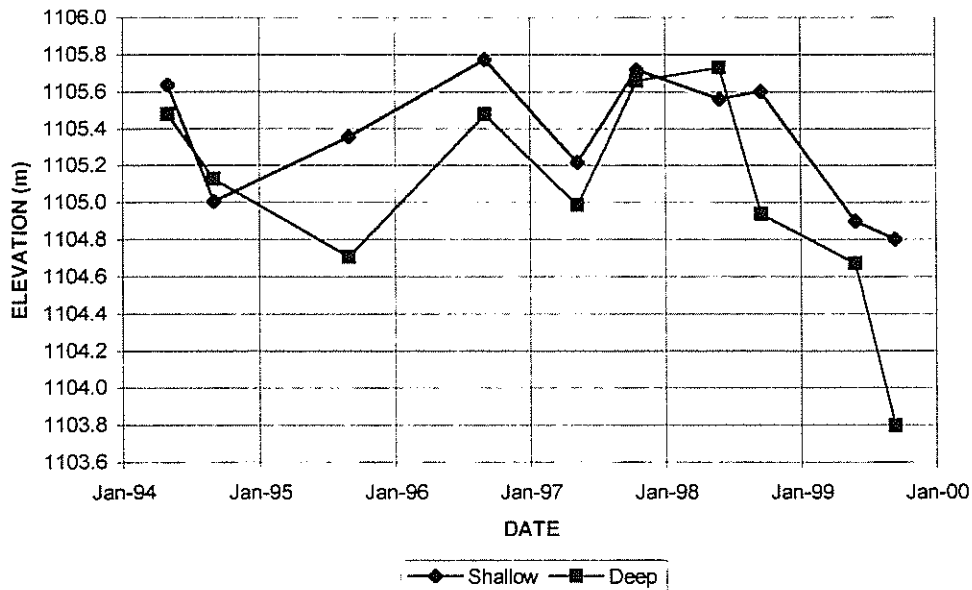
APPENDIX B

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	Surface Deep Tip Elevation : 1097.0	Protector: yes
Date	Reading (psi)	Piezometric Elevation (m)	Pond Level
	Shallow Deep	Shallow Deep	
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

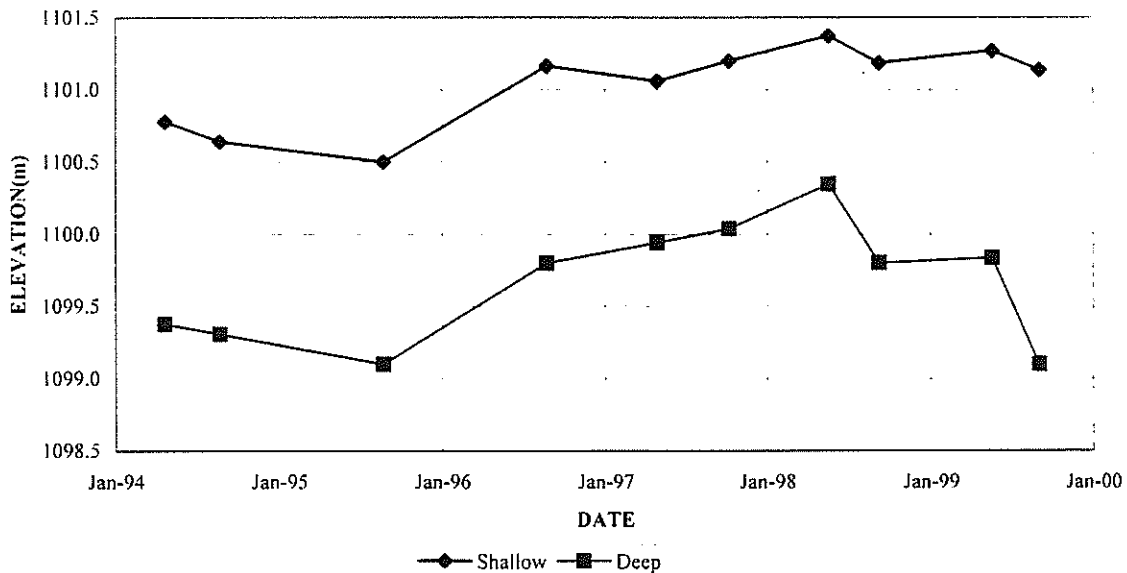
PNEUMATIC PIEZOMETER BH94 LCD1



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 Deep Tip Elevation : 1094.9		Surface Protector: yes		
Date	Reading (psi)		Piezometric Elevation (m)		Pond Level	
	Shallow	Deep	Shallow	Deep		
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	

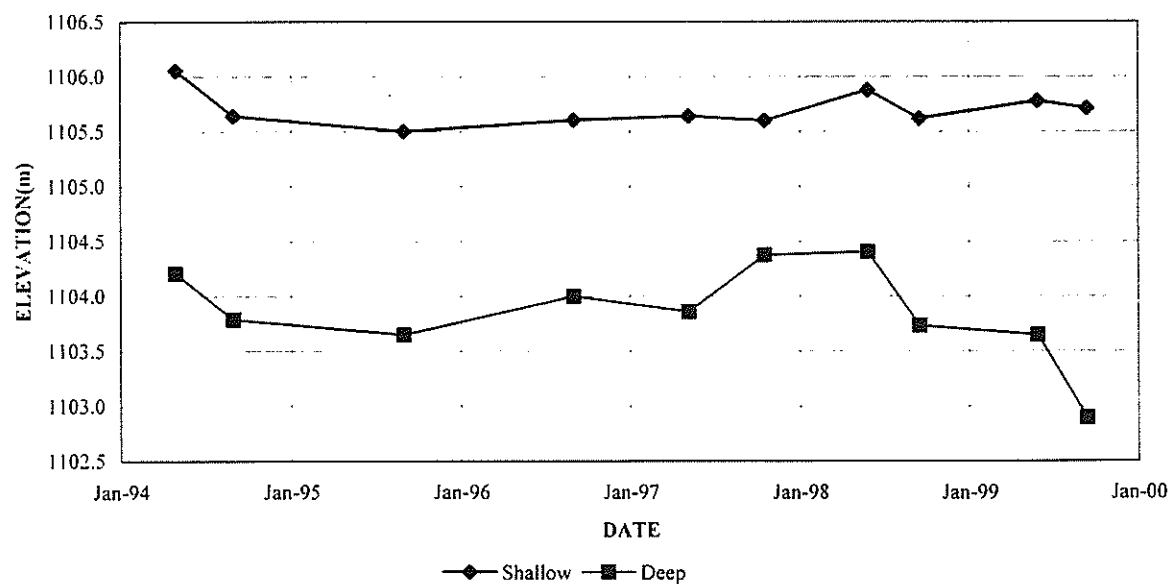
PNEUMATIC PIEZOMETER BH94 LCD2



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	Surface 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	

PNEUMATIC PIEZOMETER BH94 LCD3

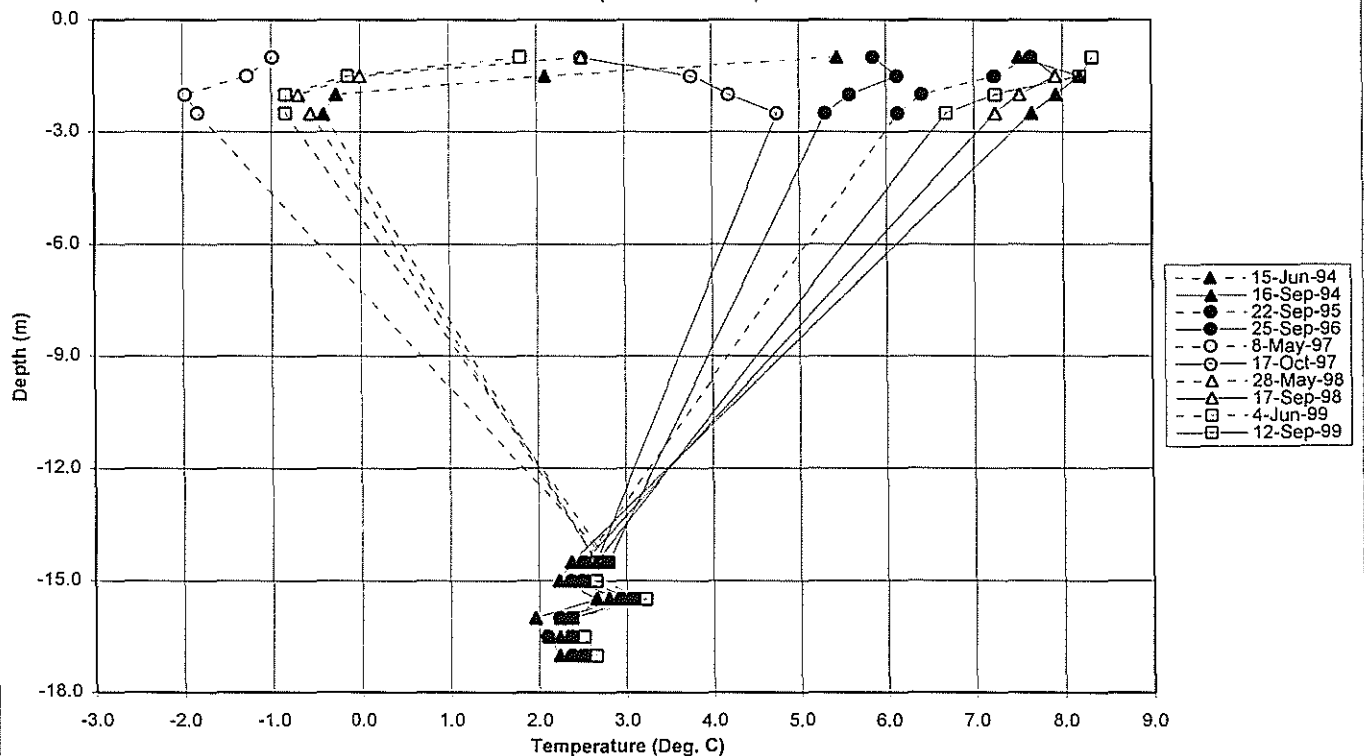


Little Creek Dam Thermistors

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

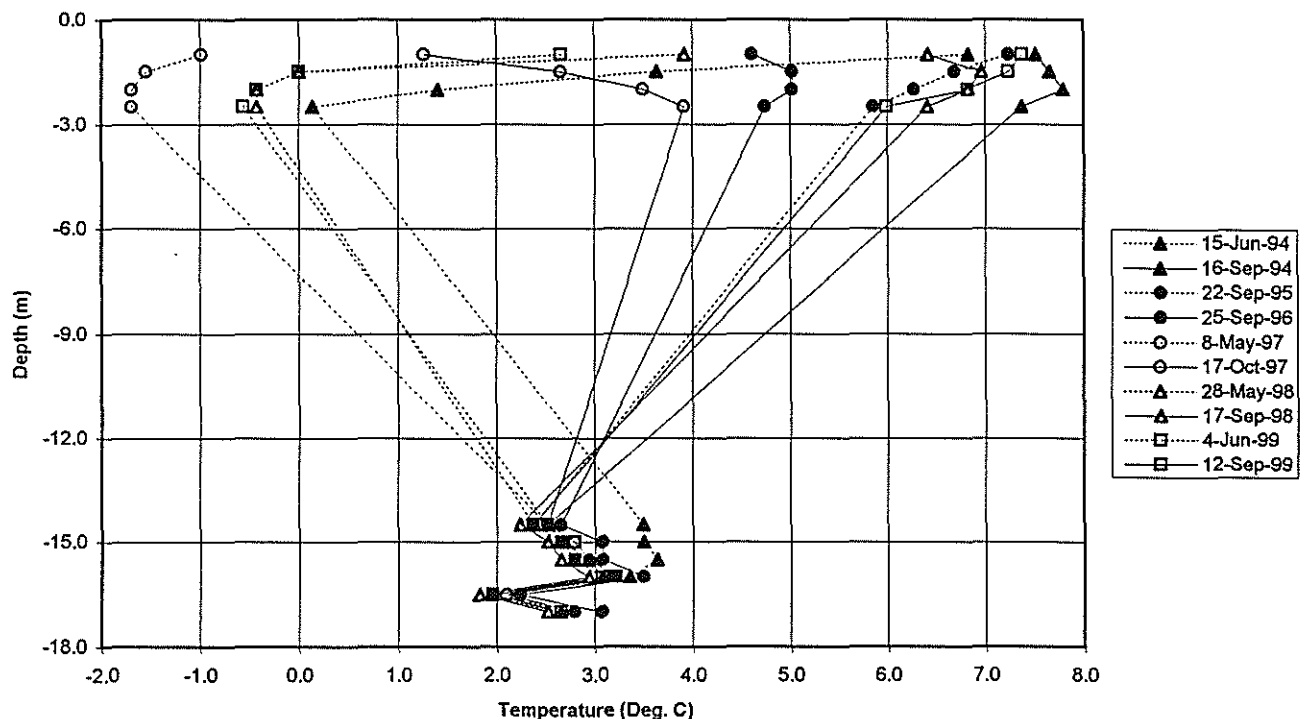
(installed 94/06/08)



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)



APPENDIX 4

1999 Technical Advisory Committee Meeting

Agendas, Attendees, Minutes

DELOITTE & TOUCHE INC.

**Interim Receiver for
ANVIL RANGE Mining Corporation**

*Postal Bag 1000, Faro, Yukon Y0B 1K0
Phone (867) 994-2459
Facsimile (867) 994-3483*

FAX MESSAGE TO: distribution attached

2 pages total

DATE: June 02, 1999

FROM: Eric Denholm
ph/fax: (867) 994-3057

RE: Technical Advisory Committee Meeting

MESSAGE: A T.A.C. Meeting has been scheduled for June 29 in Faro.

Please let me know if you will be attending.

Accommodations in Faro are very limited. Hoang's (previously Redmond's) at 994-2430 is the only hotel. Some bed & breakfasts may be available and Johnson Lake campground is also available. Rubber boots are recommended.

Regards,



RETURN FAX TO: Eric Denholm, 994-3057 (Faro)

FROM: _____

MESSAGE: I will attend: _____

I will not attend: _____

Additional items for the agenda or comments:

DELOITTE & TOUCHE INC.

*Interim Receiver for
ANVIL RANGE Mining Corporation*

*Postal Bag 1000, Faro, Yukon Y0B 1K0
Phone (867) 994-2459
Facsimile (867) 994-3483*

TECHNICAL ADVISORY COMMITTEE MEETING **(PRELIMINARY CIRCULAR)**

DATE: Tuesday June 29, 1999; 8:00 am to 5:00 pm

LOCATION: Faro guest house, 248 Dawson (large house, lower bench)

PROPOSED AGENDA:

1. BRIEF OVERVIEW OF: SITE MANAGEMENT
1998 ENVIRONMENTAL WORK
1999 ENV. WORK / ISSUES
2. SITE TOUR: FARO MAIN / ZONE II PITS
MILL / LIME MIXING
DOWN VALLEY / TAILINGS
VANGORDA PLATEAU
3. WRAP UP MEETING:

DISTRIBUTION:

Deloitte & Touche: Wes Treleaven (416) 601-6390
Deloitte & Touche: Doug Sedgwick (905) 803-5101
Deloitte and Touche: Greg Stevens (403) 263-2390
Deloitte & Touche: Dana Haggard, Faro
Dept. of Fisheries and Oceans: Brian Ferguson 393-6738
DIAND, Environment: Ian Church 667-3216
DIAND, Land Use: Marion DeJean 667-3193
DIAND, Mineral Resources: Allen Waroway 667-3193
DIAND, Mining Development: Hugh Copeland 667-3193
DIAND, Water Resources: Dave Sherstone 667-3195
Environment Canada: Vic Enns, Eric Soprovitch 667-7222
Ross River Dena Council: Chief Jim Smith 969-2405 ←
Selkirk First Nation: Don Trudeau 537-3902
Town of Faro, Jim McLaughlin, Faro
Yukon Conservation Society: Bob Van Dijken 668-6637
YTG, Economic Development: Rod Hill 667-8601
YTG, Renewable Resources: Jon Bowen 667-3641



Allan Carls

Sara Nielsen

Don Tundgren

Jim MacLellan

LORI WALTON

HUGH COPLAND

MARION DEJEAN

WES TREKERNEN

DAVID SHERSTONE

TONY POLYCK

Chuck Hubert

DIAND -

Ren. Res. YTV

SEZKIRK FIRST NATION

TOWN OF FARO

EC. Dev.

DIAND Minerals

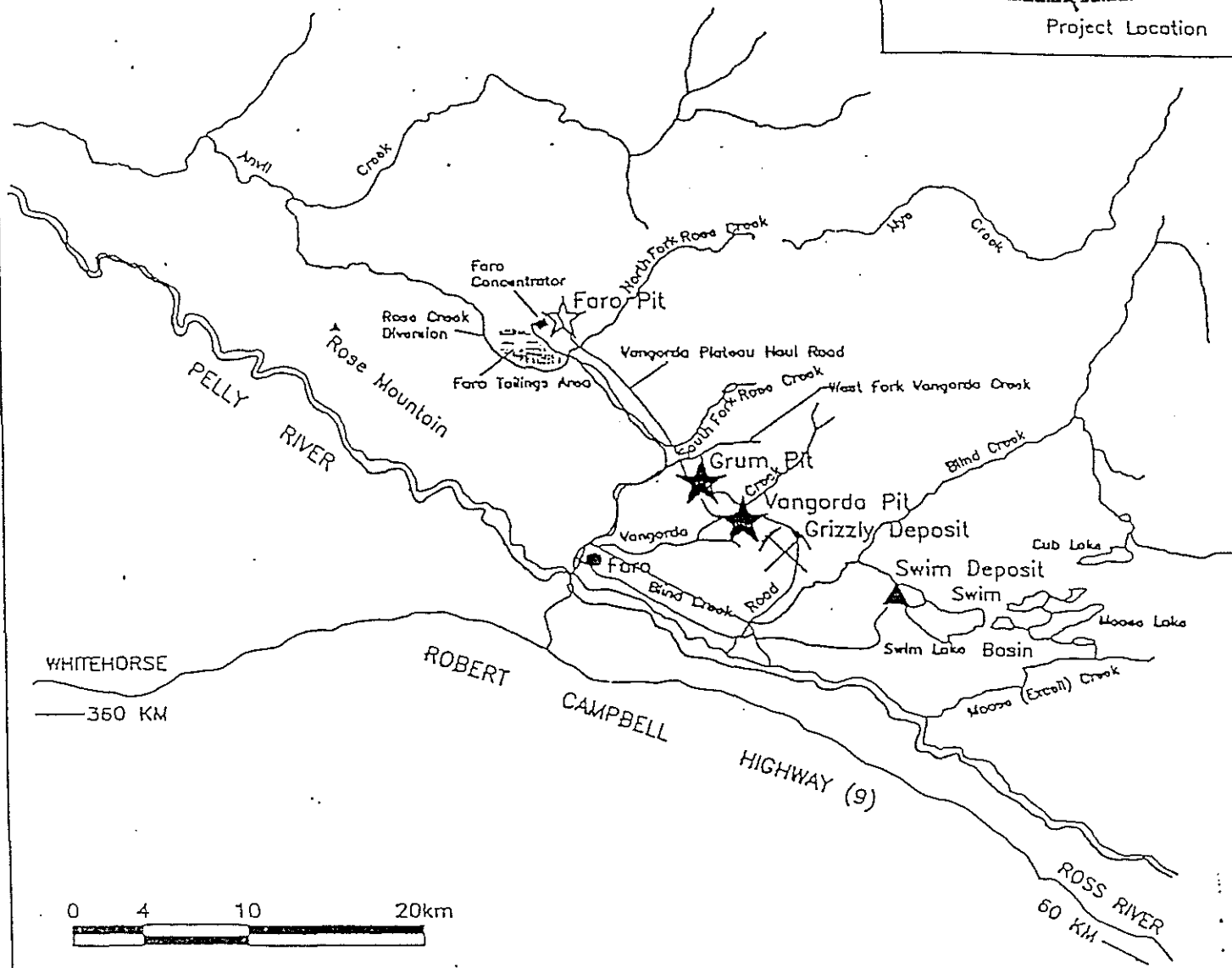
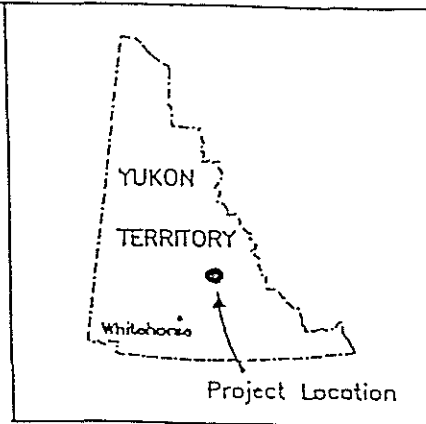
DIAND Mining Land Use & Reclamation

Deloitte & Touche

DIAND - WATER RESOURCES

DIAND - WATER RESOURCES.

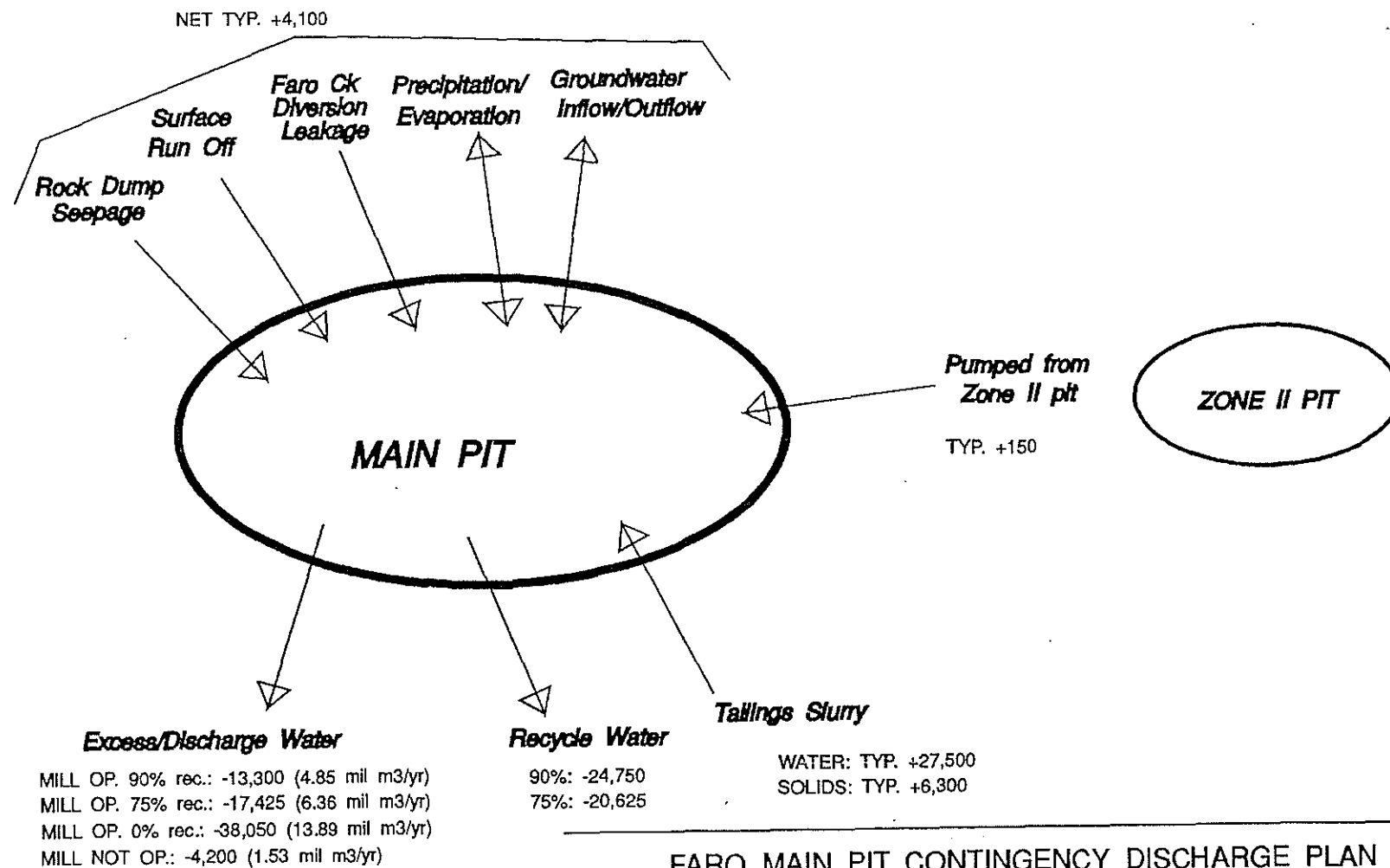
Ren. Res. YTV.



FARO OPERATIONS REGIONAL PLAN

UPDATED: OCTOBER 1996





FARO MAIN PIT CONTINGENCY DISCHARGE PLAN

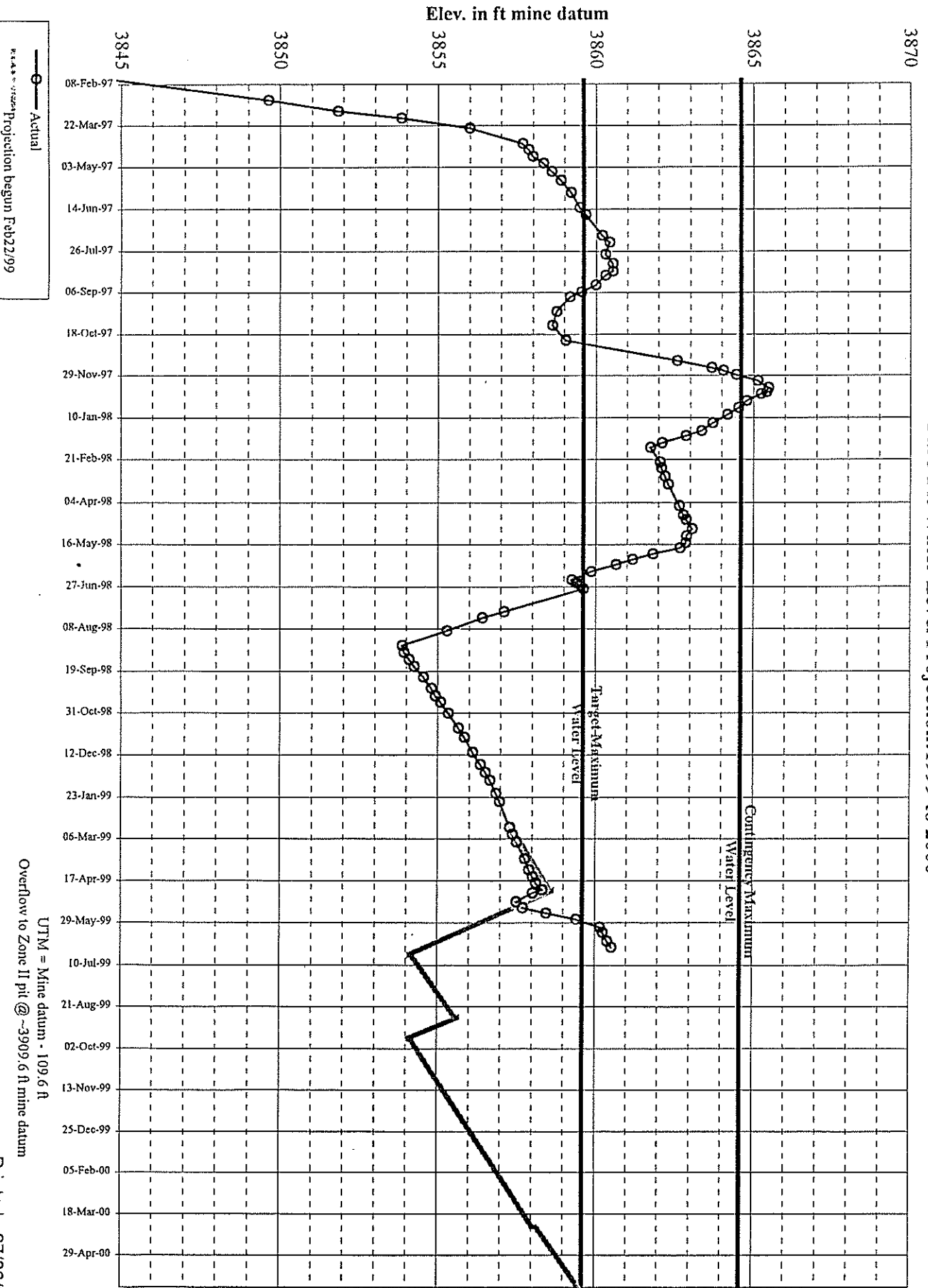
FIGURE 1.4
MAIN PIT TYPICAL ANNUAL WATER BALANCE

all units m3/day except where noted

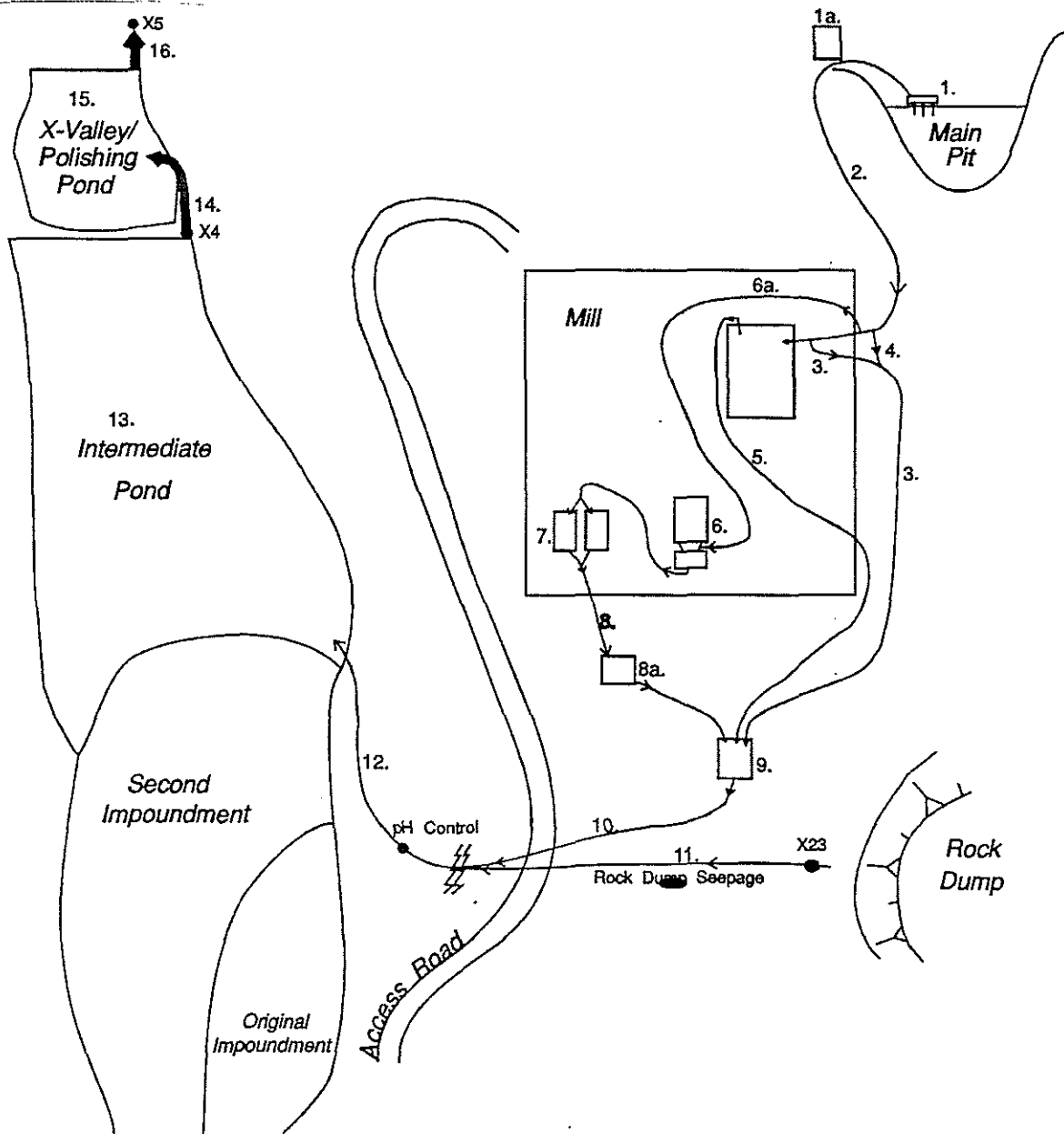
July 1998

ANVIL RANGE MINING CORPORATION
(INTERIM RECEIVERSHIP)

Faro Pit Water Level Projection: 1999 to 2000



UTM = Mine datum - 109.6 ft
 Overflow to Zone II pit @ ~3909.6 ft mine datum
 Printed: 27/06/99



Conveyance System

1. recycle pumps (3) / barge
- 1a. electrical switch house
2. 30" recycle pipeline
3. 20" effluent pipeline
4. 10" effluent bypass link
5. mill water tank overflow

Treatment System

6. lime silo / mixing tank
- 6a. lime mixing water supply line
7. lime slurry stock tanks (2)
8. lime slurry distribution line
- 8a. tailings pumpbox

9. effluent mixing / aeration box
10. 20" treated effluent pipeline
11. rock dump seepage flow (licence monitoring location X23)
12. treated effluent ditch (pH control location)
13. Intermediate (settlement) pond

Discharge System

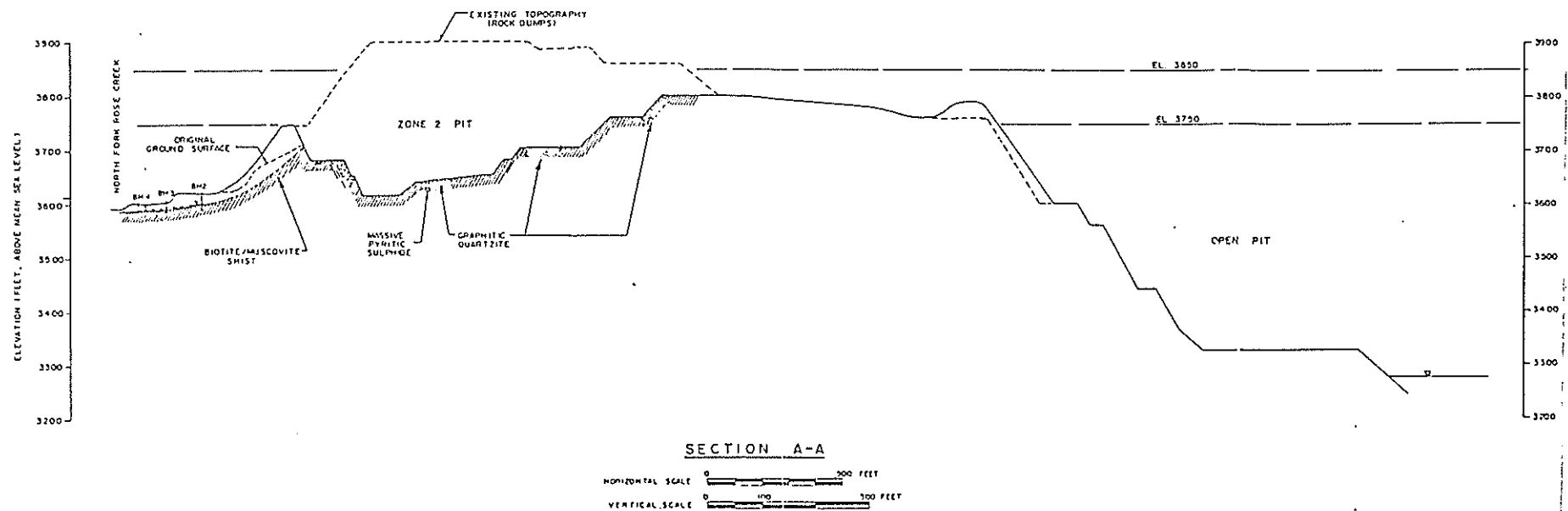
14. Intermediate pond overflow (licence monitoring location X4)
15. Cross Valley (Polishing) pond
16. Cross Valley pond outflow (licence monitoring location X5)

FARO MAIN PIT DISCHARGE CONTINGENCY PLAN

FIGURE 1.3
Schematic Overview of the
Systems for Conveyance,
Treatment and Discharge
of Excess Water

ANVIL RANGE Mining Corporation
(Interim Receivership)

July 1998

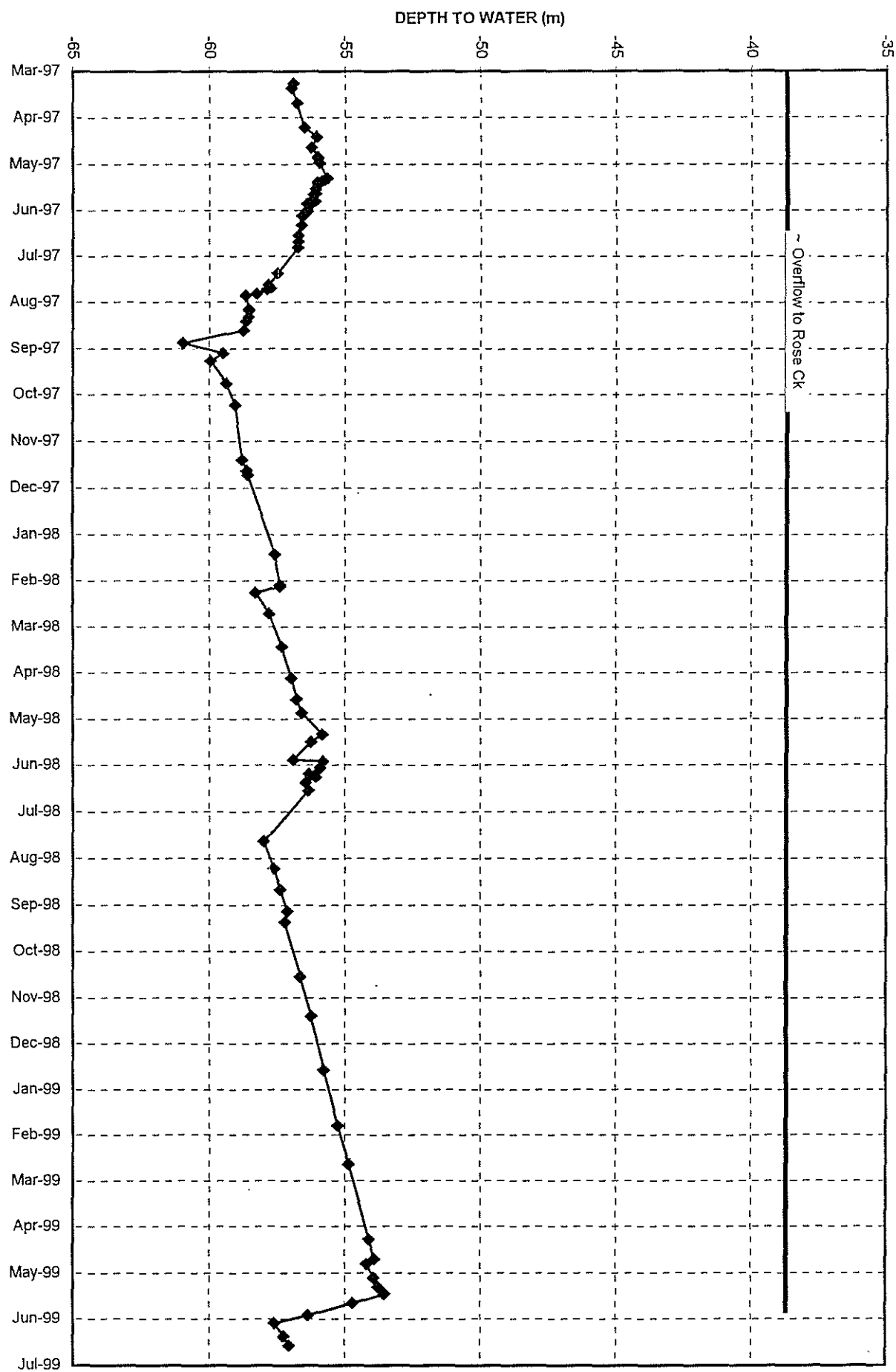


FARO MAIN PIT DISCHARGE CONTINGENCY PLAN

FIGURE 3.1 SECTION THROUGH FARO MAIN AND ZONE II PITS

(Reproduced from Kilborn, 1991, Figure A.4.3)

Measured Water Level in the Faro Zone II Pit



Depth Monitoring began March 1997.

VANGORDA ROCK DUMP LEGEND

DRAIN #1 = V28

DRAIN #2 = V29

DRAIN #3 = V30

DRAIN #4 = V31

DRAIN #5 = V32

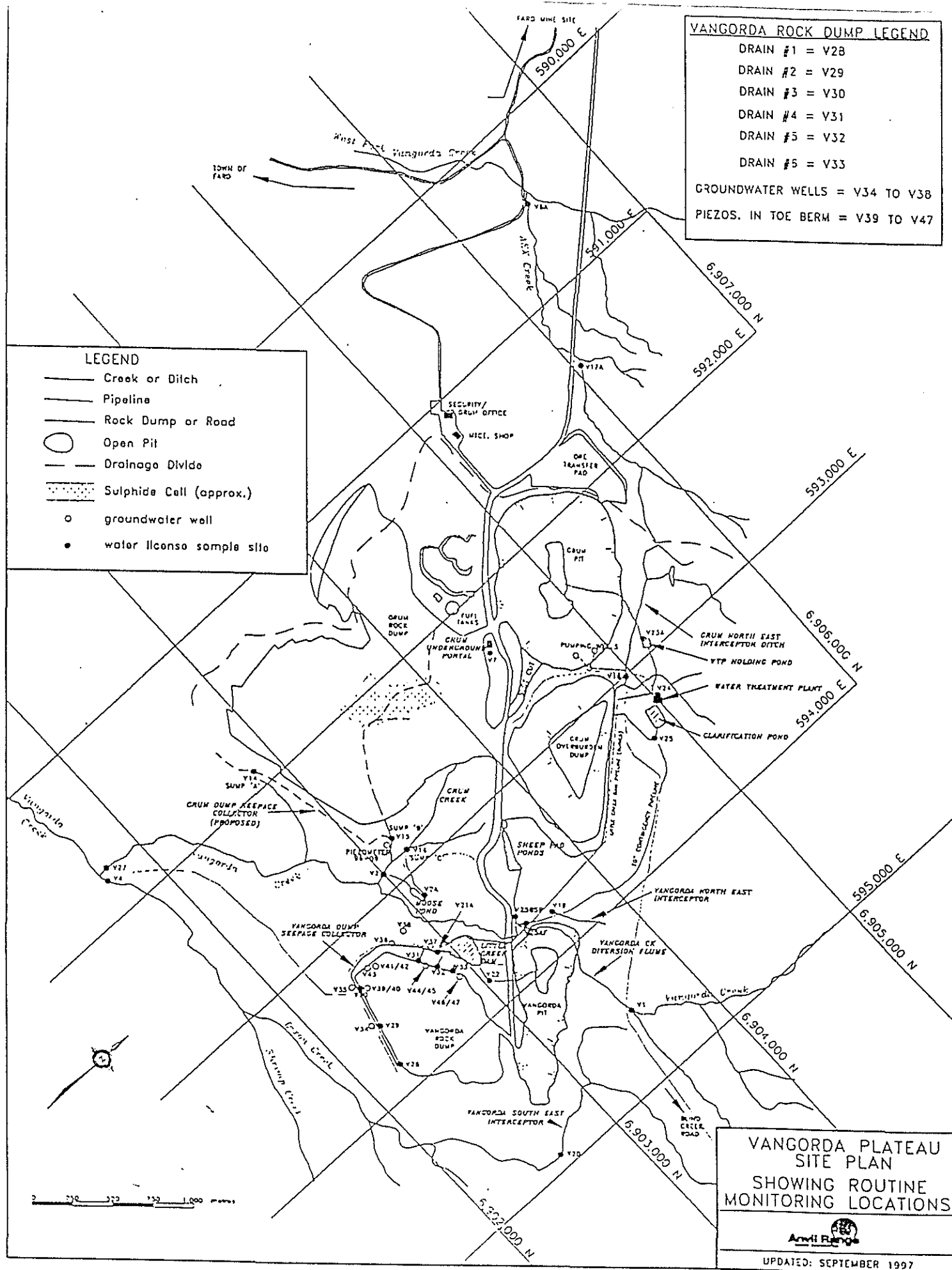
DRAIN #6 = V33

GROUNDWATER WELLS = V34 TO V38

PIEZOS. IN TOE BERM = V39 TO V47

LEGEND

- Creek or Ditch
- Pipeline
- Rock Dump or Road
- Open Pit
- Drainage Divide
- ⋯ Sulphide Cell (approx.)
- groundwater well
- water license sample site



VANGORDA PLATEAU
SITE PLAN
SHOWING ROUTINE
MONITORING LOCATIONS



UPDATED: SEPTEMBER 1997

APPENDIX 5

**Report on 1999 Maintenance Work at the Vangorda Creek Diversion Flume
with Recommendations for Future Preventative Maintenance Work**

Anvil Range Mining Corp. (Interim Receivership), October 1999

**REPORT ON 1999 MAINTENANCE WORK AT THE VANGORDA CREEK
DIVERSION FLUME WITH RECOMMENDATIONS FOR FUTURE
PREVENTATIVE MAINTENANCE WORK**

Prepared October 1999

PURPOSE

The purposes of this report are:

1. to document the remedial work performed in June and September 1999 at the Vangorda Creek diversion flume which was performed in response to a failure of the rock wall overlooking the flume, and
2. to present recommendations and conceptual costs for future preventative maintenance work at the Vangorda Creek diversion flume.

INTRODUCTION

The Vangorda Creek diversion flume was initially constructed in 1991. Approximately 25% of the length of the flume was relocated and re-constructed in 1992 to accommodate an enlarged design for the ultimate Vangorda open pit. The flume was initially required to pass Vangorda Creek water around the open pit in order to prevent contamination of the clean creek water and to minimize dewatering and treatment costs. The flume continues to be required to pass water around the open pit in order to prevent contamination of the clean creek water and to prevent rapid filling of the open pit with water in the absence of a plan for managing the fully flooded pit.

The design and construction supervision for the initial flume was performed by Steffen Robertson and Kirsten (SRK). The design of the relocation was performed by Kilborn Engineering with construction supervision performed by Curragh Resources. As-built reports for both the initial construction and the relocation project were prepared by SRK.

The flume is a series of 2.4 metre diameter by 6 metre long galvanized corrugated metal ½ culvert pipes laid on a compacted sand base in a channel seated in fractured bedrock which runs around the northern perimeter of the Vangorda open pit. The total length of the flume is approximately 940 metres. Beginning at approximately 5+17 metres, the flume is underlain by a 200mm diameter perforated corrugated steel pipe underdrain which is intended to collect seepage external to the ½ culvert flume sections. The underdrain directs water into the Vangorda pit near the downstream end of the flume.

The primary risks associated with the flume relate to the physical stability of the flume, the flume channel, the soil and rock walls which overlook the flume channel, and the rock wall

below the flume channel which is the north wall of the Vangorda open pit. A significant physical failure of any of these components could result in a negative environmental impact on Vangorda Creek and in costly remedial work.

Physical maintenance work has been performed in the past in order to minimize the chances of a significant physical failure of the system and this physical maintenance work has resulted in some structural damage to some of the flume sections over time. For example, it has been necessary during most spring seasons to dig a channel in the ice cap which forms over the flume sections during most winters. The damage to the flume sections is visible as bent, twisted or absent cross bars, and ripped, deformed or torn flume sections.

There was a failure of one section of the rock wall which overlooks the flume in June 1999 at approximate flume location 5+78 to 5+94. Rock debris including slabs up to approximately 1.5 metres in length sloughed from the near vertical rock wall and damaged several flume sections and partially blocked the passage of water such that Vangorda Creek water was in danger of flowing directly into the Vangorda open pit. The causes of the wall failure are thought to include the cumulative effects of repeated freeze-thaw cycles in a vertical wall of fractured rock with the presence of some surficial seepage water.

The June 1999 wall failure represented the most serious damage to the flume system documented over the life of the system. Repair work was quickly performed and there were no significant adverse environmental impacts on Vangorda Creek as a result of the wall failure. However, wall scaling with the CAT 235 backhoe was not able to remove a rock overhang which remained after the initial sloughing.

A small diversion ditch located generally upslope from the area of the June 1999 wall failure was repaired in 1999 and this may reduce the surface seepage which passes over the rock wall.

In September 1999, further minor sloughing of rock debris into the flume channel occurred in the same location as the June 1999 wall failure. This minor sloughing did not damage any flume sections and did not block the passage of water to as great a degree as was observed in June 1999. The sloughed material was removed from the channel and the normal passage of flow was restored.

The risk of future wall failures into the flume channel continues to exist and was not diminished by the 1999 emergency repair work. Water is observed to seep from the wall in the location of the recent failure and it is likely that on-going freeze-thaw cycles will result in another wall failure in the future. The rock type present at that location is conducive to sloughing and failure because of the physical characteristics of the rock.

The current contingency plan for the flume is to provide quick response to future incidents as was done in 1999. Sufficient materials are currently on-site or are locally available to perform another repair of the magnitude of the 1999 project.

This report presents a summary of the remedial work performed in 1999 including a photographic record. This report also presents a series of recommendations for further preventative maintenance work which may reduce the risks associated with the flume. The development of a current long term plan for the Vangorda open pit and diversion flume is considered to be a critical component for the successful management of the system.

The attached plan of the Vangorda Creek diversion flume is copied from the relocation as-built report prepared by SRK in 1992.

CHRONOLOGICAL SUMMARY OF 1999 EVENTS

Jun 29	wall failure first observed (chainage location approx. 5+78 to 5+94)
Jun 30 to Jul02	backhoe clears rock debris from flume channel and scales wall from bottom
Jul 03	attempt to scale wall from top with backhoe largely ineffective due to safety concerns
Jul01 to Jul07	prepare replacement flume sections; pre-assemble four sections
Jul05 to Jul08	haul rip rap rock to work area
Jul07 to Jul11	backhoe down for mechanical repairs
Jul12	divert Vangorda Creek into Vangorda pit (11 hours); final grading of channel bottom with backhoe; install replacement flume sections (installed length ~39 metres); restore creek flow into flume
Jul13	place geofabric filter cloth along both sides of the work area; begin placement of rip rap rock over filter fabric
Jul14to Jul15	complete placement of rip rap rock, complete removal of diversion materials from head of flume; remove rocks from flume culvert sections downstream of work area and at head of flume
Sep 11	minor slough of rock debris observed at same location with minor restriction of water flow and no significant damage to flume
Sep 16	remove sloughed rock debris and repair upslope diversion ditch

DETAILS REGARDING INSTALLATION OF REPLACEMENT FLUME SECTIONS, JULY 1999

The remedial work performed in July 1999 was performed by personnel hired directly by mine management and utilized on-site equipment owned by mine management. The cost of the July 1999 remedial work was estimated at approximately \$36,000. The project cost was minimized by use of on-site materials (esp. flume sections) and the project cost would have been greater had these materials not been immediately available on-site.

Vangorda Creek was diverted into the Vangorda pit immediately downstream of the headworks dam. The diversion was accomplished by placing sandbags and soil in the ½ culvert flume section and ditching across the access road such that water overflowed from the flume and passed into the old Vangorda Creek channel. The diversion was necessary to allow installation of the replacement flume sections.

A total of seven replacement flume sections were installed (each 6 metres in length) at approximate chainage location 5+71 to 6+13. The total installed length of the replacement flume sections was 39 metres. This task involved final grading of the channel bottom using the backhoe to provide a smooth base on top of which the replacement flume sections could be installed. This final grading was carefully monitored to ensure that the compacted sand layer underlying the flume channel was not disturbed. No signs of excavation of sandy material were observed and it was concluded that the underlying compacted sand layer containing the perforated 200mm diameter underdrain was not disturbed. One length of four pre-assembled flume sections was installed at the upstream end of the excavated area. The pre-assembly of these sections included installation of crossbars, bolting and tarring of the joints. Two individual sections were then installed from upstream to downstream in the remaining area. These sections were bolted and tarred in place with bolt holes cut to fit after placement of each section. The final replacement flume section was installed to fill the remaining 3 metres of excavated area. This section was not cut down from the original 6 metre length but was underlapped at the upstream end and overlapped at the downstream end to a total of 3 metres length. The final two joints for this section were also bolted and tarred in place with bolt holes cut to fit after placement of the section. All joints were completed such that the upstream section overlapped the downstream section (appropriate to passing flow smoothly) and all overlaps/underlaps were at least 0.5 metres in length (with the exception noted for the downstream replacement section which had greater overlap/underlap).

One joint between 2 replacement flume sections was observed to be leaking water out of the flume after installation and was effectively sealed with oakum rope.

Filter fabric intended to prevent the migration of fines into drainage rock was placed on the ground along both sides of the replacement flume sections to above the height of the flume sections. The cloth was placed under the flume as much as possible. Local rock material which had been excavated out of the flume channel was used as fill in the bottom of the channel and rip rap rock hauled from the Faro site was used as fill along the upper portion of the replacement sections. Rip rap rock was hauled from a borrow area previously established on the Faro site because the road to the Grum rip rap quarry was found to be impassable.

PHOTOGRAPHIC RECORD OF 1999 REMEDIAL WORK

1. initial condition of failed wall and partially blocked flume channel
2. location of work area wrt Vangorda pit
3. completed scaled rock wall

4. diversion of Vangorda Creek into Vangorda Pit
5. installation of replacement flume sections
6. placement of filter fabric and rip rap rock

CONTINGENCY PLAN

The contingency plan in-place for the Vangorda Creek diversion flume is to provide frequent monitoring and rapid response to future incidents.

There are currently 6 of the ½ culvert flume sections on-site which could be used to perform a repair of similar magnitude to that performed in 1999. These are located at the Grum water treatment plant. Additional ½ culvert flume sections could be ordered from Stelco in Hamilton, Ontario at an estimated cost of \$10,000 each f.o.b. minesite. Significant lead time would be required before an order would be received on-site.

Angle iron cross bars would need to be purchased for a future repair project but are locally (Yukon) available and could be delivered to the minesite without delaying the repair work. The estimated cost for purchase of cross bars f.o.b. minesite is \$100 per 3 metre length.

Filter fabric would have to be purchased for future repair projects. This product is readily available from suppliers in Edmonton and Vancouver and could be delivered to the minesite without delaying the repair project. The estimated cost for filter fabric f.o.b. minesite is \$10/m².

Clean rip rap rock can be produced on the minesite. The primary production location is an established rock/gravel borrow area near the north end of the Faro tailings impoundments. A secondary production location is a rock quarry at the west side of the Grum rock dump. In either case, it is beneficial that rock be passed through a cleaning screen to separate the fine material. The rock chips local to the Vangorda Creek diversion flume may be suitable for bulk fill but do not generally meet the specifications for clean rip rap rock. The estimated cost for screening and supply of rip rap rock to the flume using on-site equipment and manpower as was available in 1999 is \$20/m³.

RECOMMENDATIONS FOR FUTURE PREVENTATIVE MAINTENANCE WORK

Consultation with a professional engineering firm should be conducted prior to the implementation of any of the following recommendations. This will ensure that any work performed and money expended will have professional justification.

A thorough examination of the flume culvert sections was performed from July 12 to July 15 with the intention of identifying locations where damage to the flume sections had compromised the ability of the flume to serve its purpose. There are numerous crossbars, two substantial lengths of flume sections, and several individual flume sections which are

recommended to be replaced or repaired as detailed below under recommendations #1, 2, 3, 4, 5 and 6.

The physical stability of the rock wall below the flume should be considered as part of an assessment of the physical stability of the flume system since a significant failure of this rock wall could breach the flume channel and necessitate a complete relocation of the flume. The rock wall below the flume channel which forms the north wall of the Vangorda open pit shows visible signs of sloughing and degradation. Additionally, the buoyancy introduced at the toe of the rock wall due to flooding of the open pit may reduce the competence of the wall. A professional stability analysis with recommendations for improving the physical stability of the flume is recommended below as recommendation #7.

The long term environmental management plan for the Vangorda open pit should be considered as part of an assessment of the most appropriate actions to be taken regarding the long term stability of the diversion flume. The ultimate objective and timeframe for reclamation of the Vangorda open pit will have a significant impact on the long term plan for the diversion flume.

A list of individual recommendations are listed as follows (not in priority order):

1. a total of 45 cross bars should be replaced because they are badly bent, badly twisted, loose on one side or not present such that they are no longer providing any effective structural support for the flume sections
2. a total of 34 cross bars could be either repaired or replaced because they are somewhat bent or twisted but continue to provide some structural support for the flume sections
3. a total of 16 locations were identified where side rails should be repaired or replaced because they are loose, bent or not present
4. one continuous length of 7 flume sections located from approximate chainage locations 4+95 to 5+35 should be replaced because the flume sections are significantly damaged (flume sections ripped, cross bars damaged or not present, joints between flume sections loose or leaking); additionally, within this length, a ½ culvert patch of approximately 2 metres length has been improperly installed at some time in the past such that the upstream end of the patch was not overlapped to prevent leakage out of the joint; refer to photo #7
5. one continuous length of 6 flume sections located at the downstream end of the flume should be replaced because the flume sections are significantly damaged (flume sections ripped, cross bars damaged or not present, joints between flume sections loose or leaking); refer to photo #8
6. in addition to recommendations #4 and #5 above, a total of 5 locations were identified where repairs should be made to flume sections because the flume sections are significantly deformed, leaking or torn
7. an engineering study should be performed to identify various alternatives to reduce the risks associated with the relevant physical stability issues; the study should include

physical stability assessments of the rock walls above and below the flume; any recommended actions should be evaluated in light of long term env. management planning for the Vangorda open pit; refer to photo #9

**CONCEPTUAL COSTS FOR RECOMMENDED PREVENTATIVE
MAINTENANCE WORK**

The estimated unit costs for materials, equipment and labour (based on 1999 management, equipment and manpower availability) are as follows:

materials:	cross bars & side rails (2" angle)	\$100 / 3 metre length
(fob minesite)	flume sections (6 x 2.4 m galv CMP)	\$10,000 each
	filter fabric	\$10/m ²
	rip rap rock	\$20/m ³
equipment:	CAT 235 backhoe	\$80/hour loaded
	HIAB	\$55/hour loaded
	CAT 966 loader	\$55/hour loaded
	gravel truck	\$55/hour loaded
manpower:	labourer	\$17.53/hour
	welder/mechanic	\$25.93/hour
management:	field supervision	10%
	engineering/reporting	10%

The conceptual cost estimates for each of the recommendations given above are as follows:

recomm#1:	\$20,000
recomm#2 (assume cross bars to be replaced):	\$15,000
recomm#3:	\$15,000
recomm#4:	\$150,000
recomm#5:	\$130,000
recomm#6:	\$10,000
recomm#7:	\$50,000 to \$75,000



Photo #1A, initial condition of flume following wall failure



Photo #1B, initial condition of flume following wall failure



Photo #2, location of work area wrt Vangorda pit

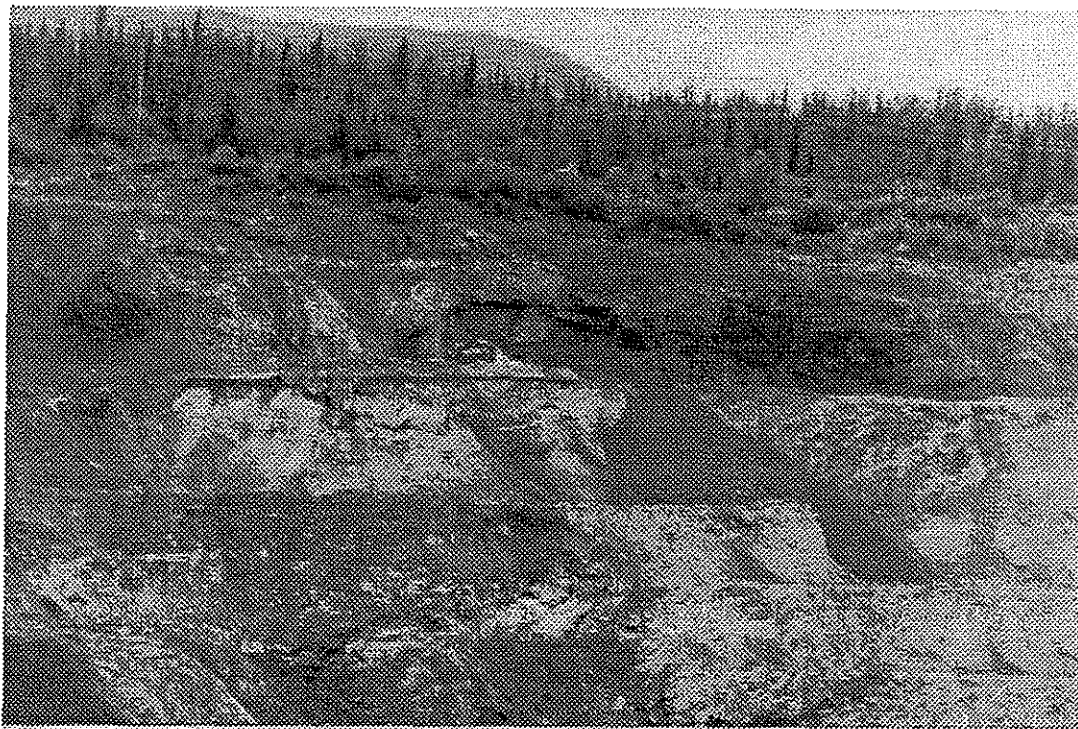


Photo #3, completed scaled rock wall



Photo #4a, diversion of Vangorda Creek into Vangorda pit via old creek channel



Photo #4b, Vangorda Creek flow restored into flume



Photo #5a, installation of replacement flume sections



Photo #5b, installation of replacement flume sections



Photo #6a, placement of filter fabric

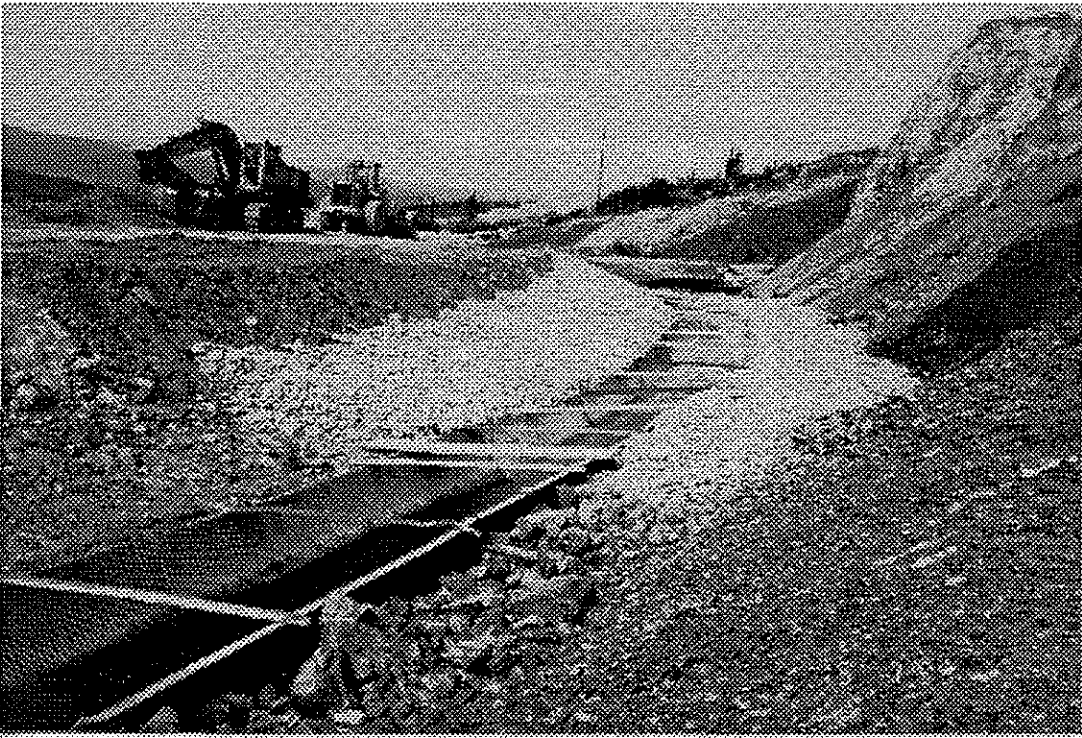


Photo #6b, completed placement of rip rap rock



Photo #7a, damaged sections approx. 4+95 to 5+35



Photo #7b, improperly installed patch at approx. 5+17

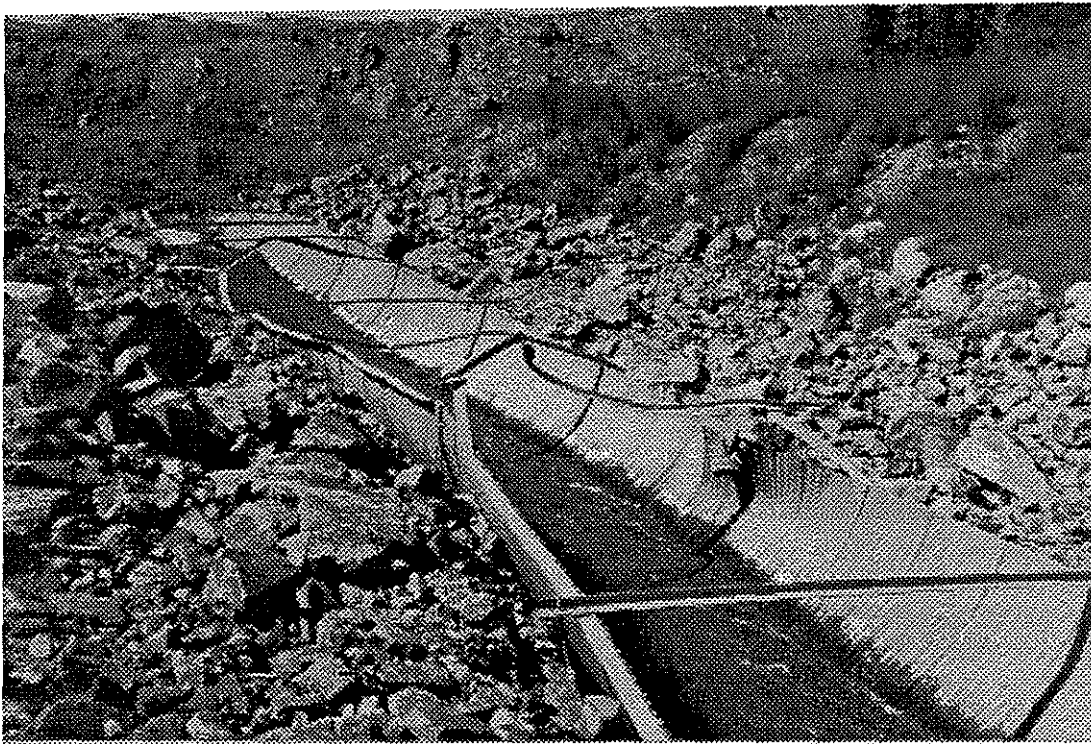


Photo #8, damaged sections at downstream end of flume

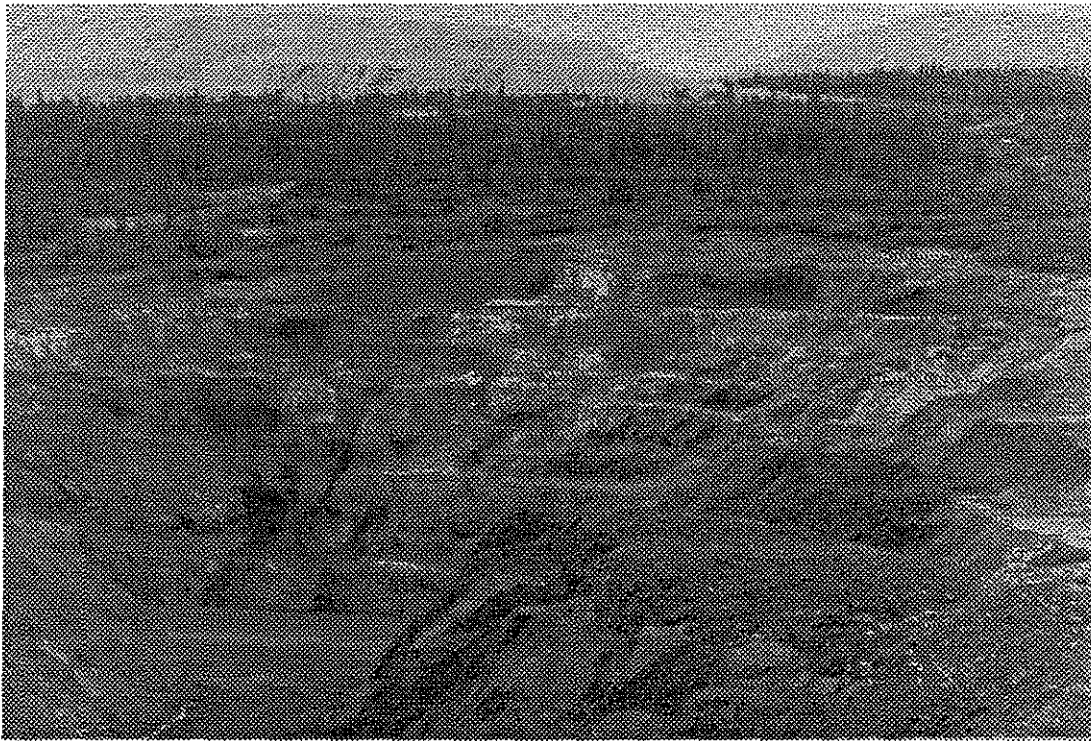


Photo #9, flume and pit wall

