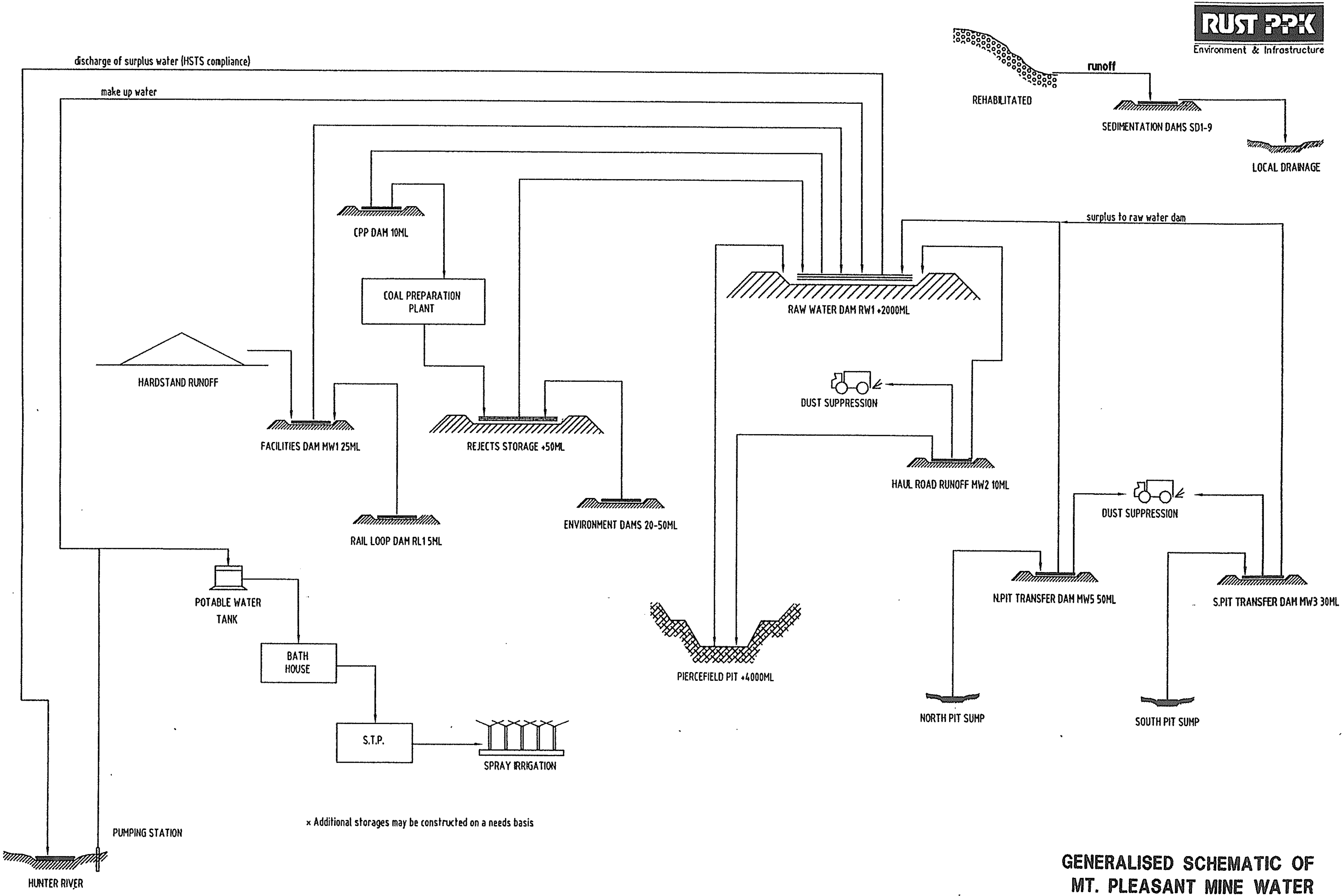
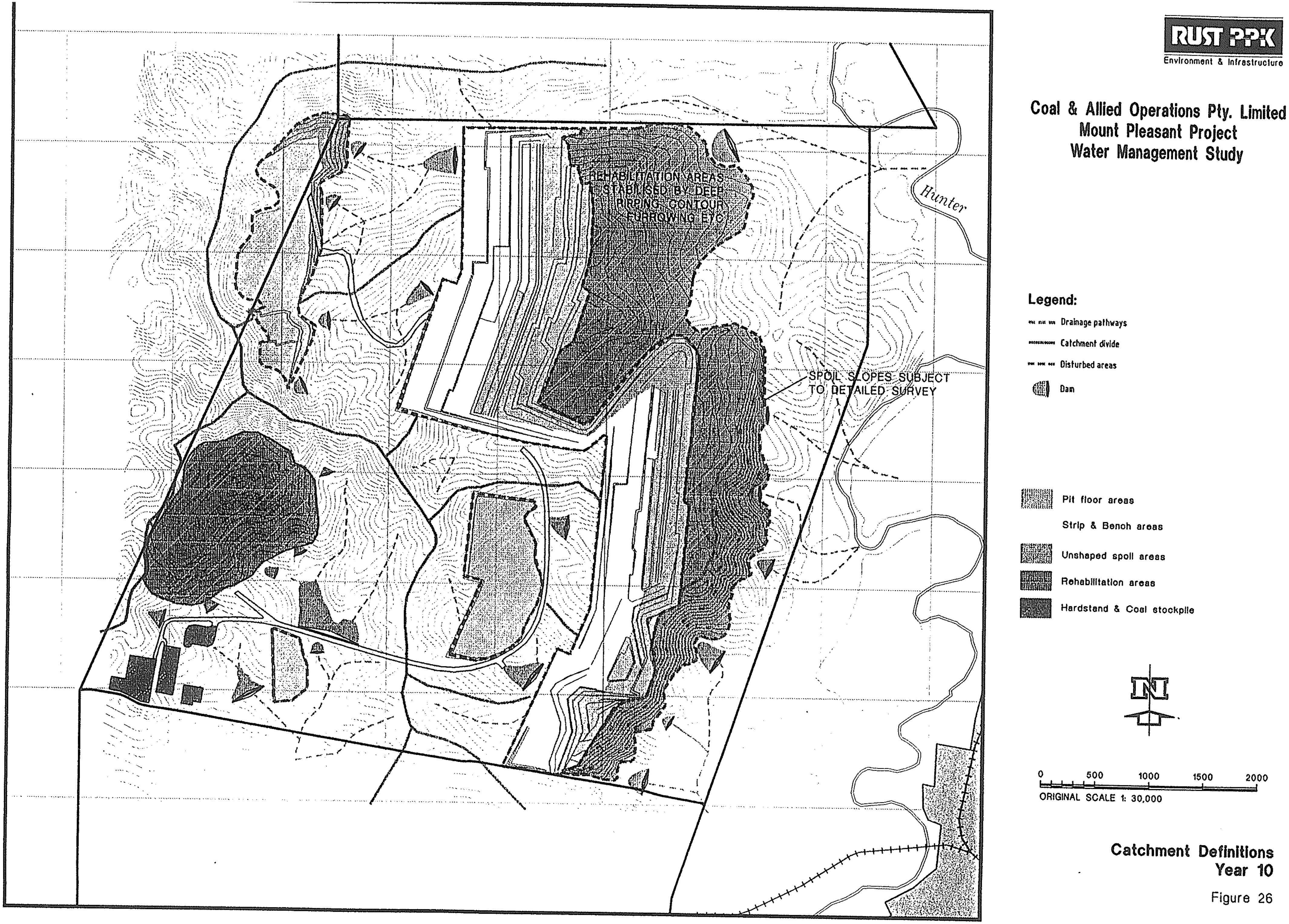


GENERALISED SCHEMATIC OF MT. PLEASANT MINE WATER MANAGEMENT SYSTEM

Figure 25

RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study

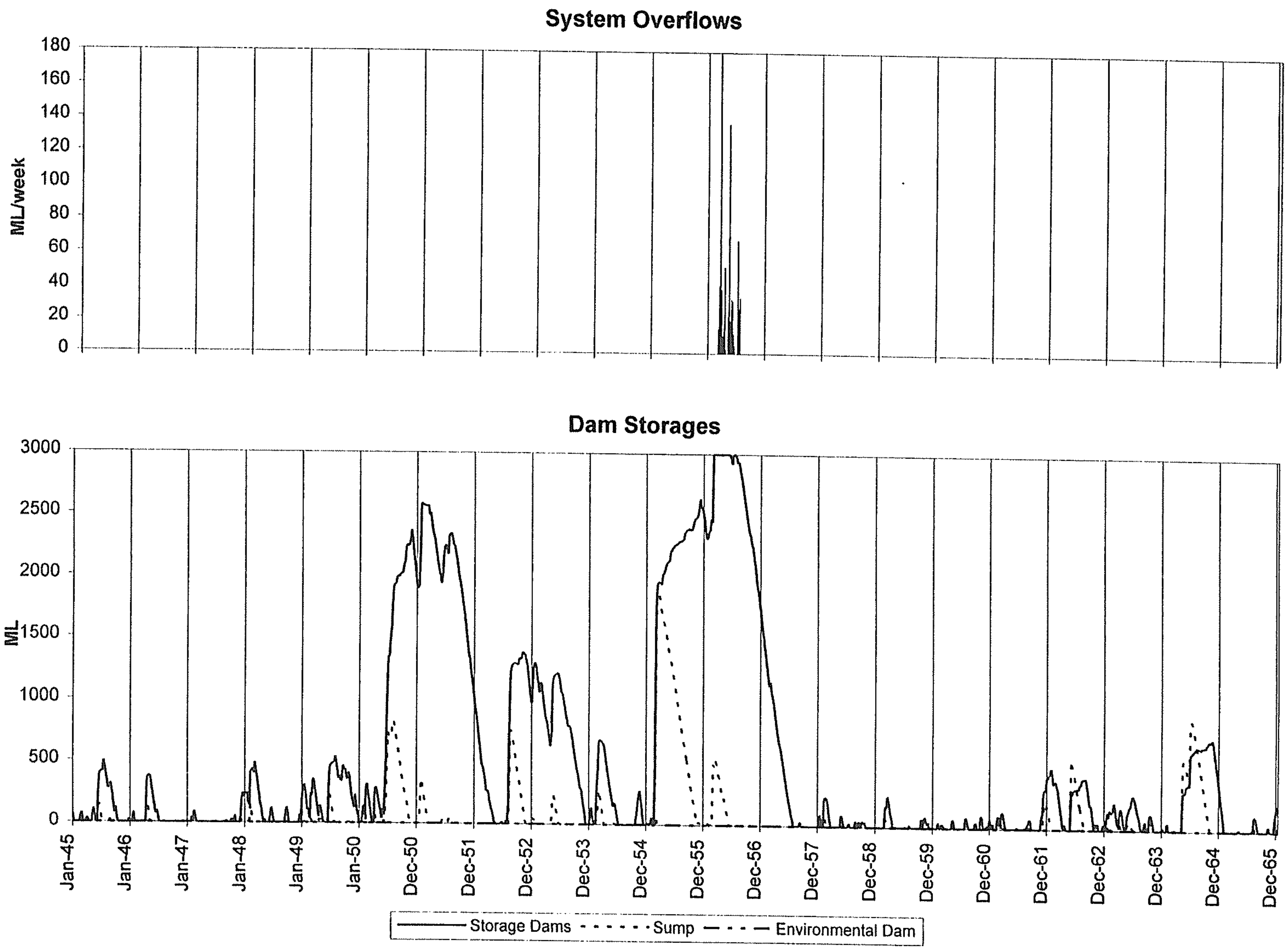


Catchment Definitions
Year 10

Figure 26

Mt. Pleasant Mine - Water Management Simulations

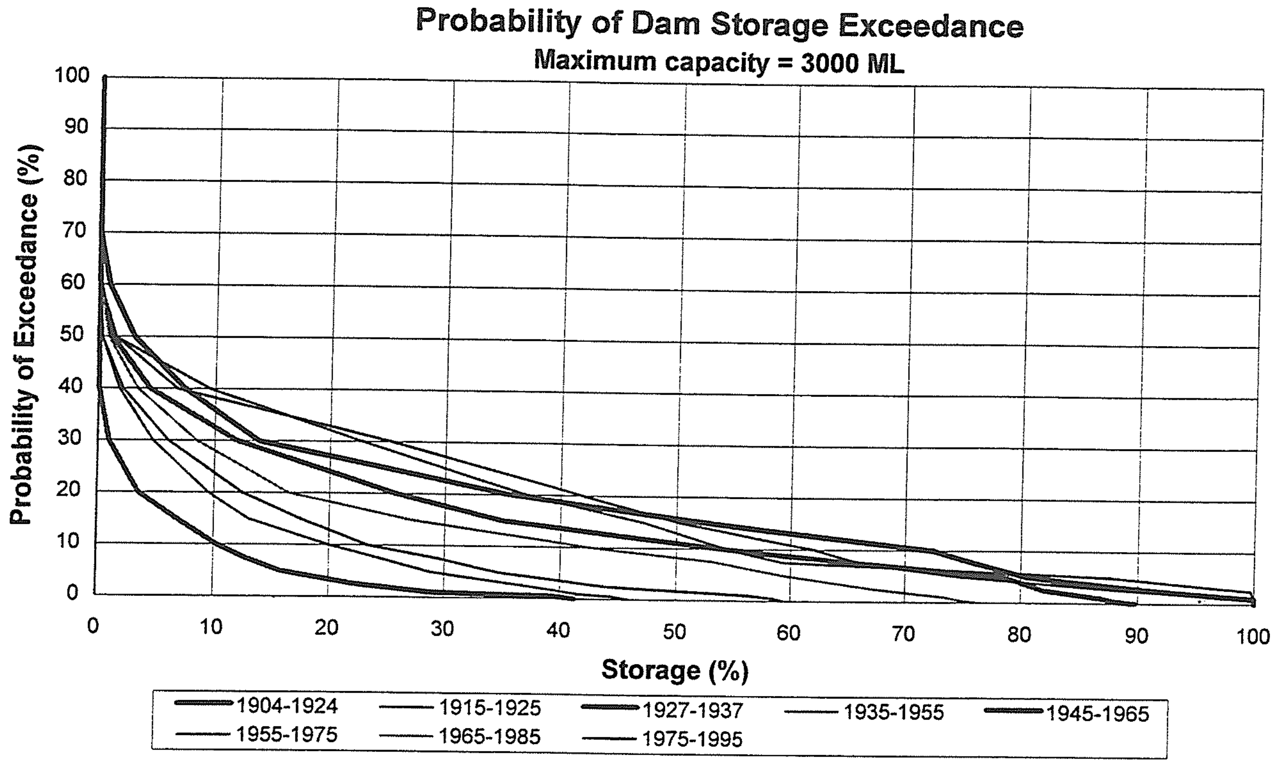
1/01/45 to 31/12/65



RUST PPK Environment & Infrastructure

Figure 27

Mt. Pleasant Coal Mine - Water Management



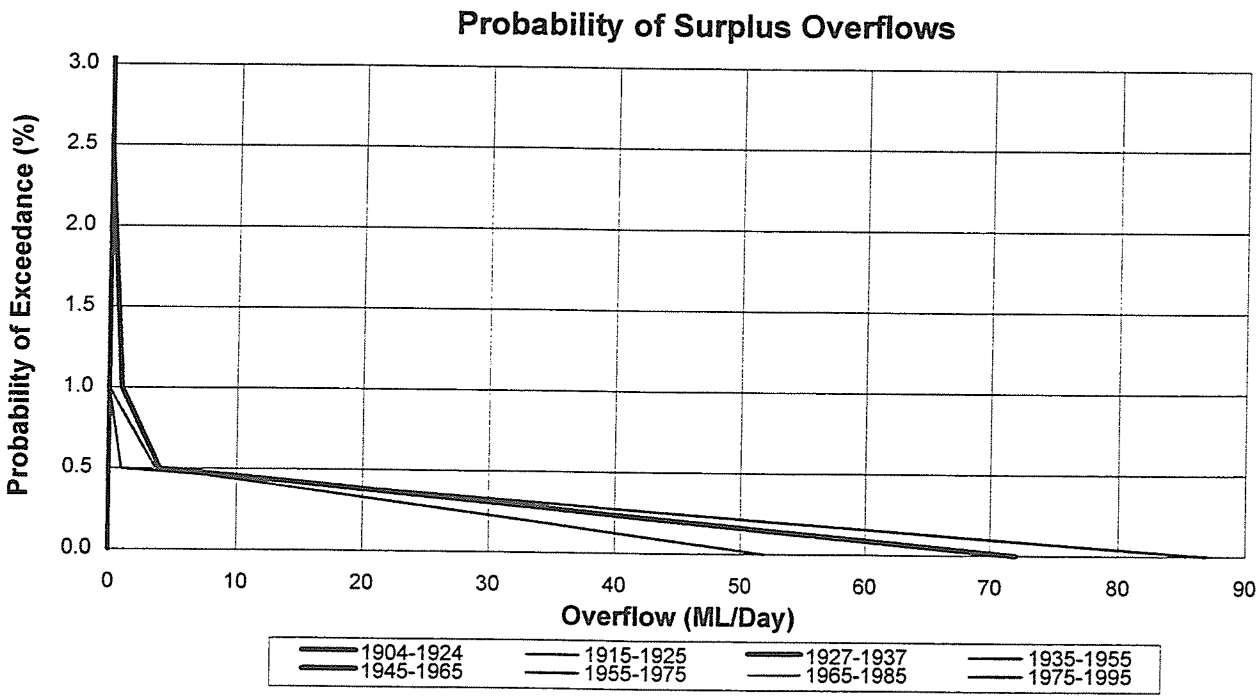


Figure 28

RUST PPK
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Mt. Pleasant Coal Mine - Water Management

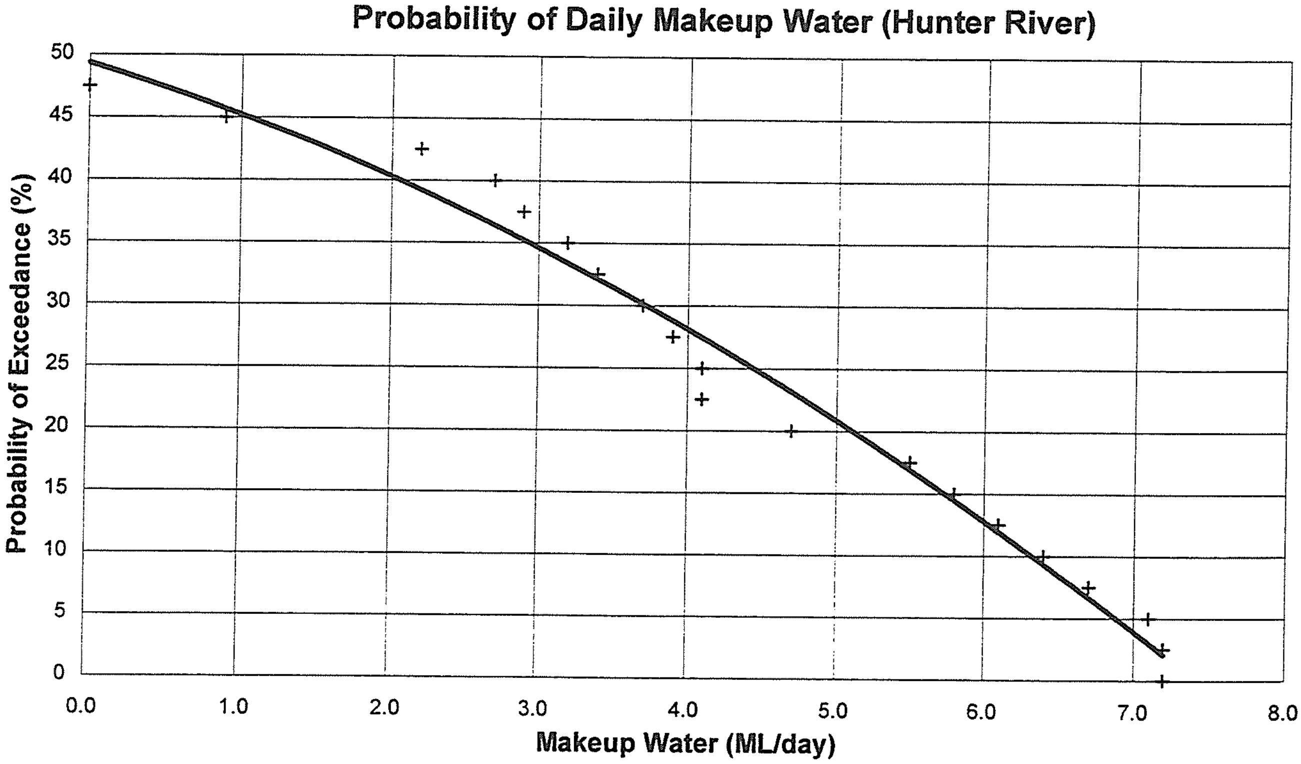


Figure 29

RUST PPK
Environment & Infrastructure

Appendix A

DLWC Boremaster Registered Borehole Data

MOUNT PLEASANT DATABASE

Mt Pleasant Database

DWR Ref NO	Easting (AMG)	Northing (AMG)	Depth (m)	SWL (MBTOC)	Yield (L/s)	Salinity Class/ppm	Collar (AHD)	SWL (AHD)	Top of gravel	Base of gravel	Penetrate gravel ?	Aquifer	Use
11225	298865	6433060	51.8	29.3	0.02	Brackish	190	161				Coal & sandstone	Stock
11295	290420	6424960	29	6.9	0.429		210	203	2.44	3.35	yes	Clay &Gravel	Stock
11314	299420	6434490	10.4	8.5			162	154					Stock
11316	398340	6433890	18.3	17.1				0					
11360	302290	6431075	7.9	4.9	10.1	Good	148	143	5.79	7.92	no	Gravel	Industry
11361	302240	6431080	7.9	4.9	10.1	Good	149	144	5.79	7.92	no	Gravel	Industry
11536	300910	6429230	12.5	7.6	6.3	Hard	140	132	11.58	12.5	no	Sand & fine gravel	Industry
11537	300840	6429485	12.8	7.3	6.3	Hard	141	134	10.36	12.8	no	Gravel	Industry
11667	302070	6429295	8.5	4.9			180	175				Gravel	Irrigation
11953	298070	6428490	9.1				141.1	0					
13246	296770	6425710	9.8				141	0					Irrigation
13361	299310	6434740	9.8	7.6	2.5	S Brackish	164	156				Loam	Irrigation
13386	298750	6439875	8.5	3.4				0					Irrigation
13474	297225	6426275	11.3	8.8	18.945		145	136	8.84	11.28	no	Gravel	Irrigation
13969	302180	6433060	12.5	5.2	5.1		155	150					Stock & domestic
13971	303775	6433410	9.1	5.5				0					Disused
13972	303640	6433350	11.6	4.9		Stock		0					Stock
13980	303665	6433725	9.8	7.3				0					Disused
14162	301530	6450970	42.2	18.3	0.3			0					Stock & domesitc
14183	297270	6452415	13.5	9.1	11.4			0					
14356	300665	6431675	15.8	9.1	13.1	Potable	151	142	4.57	15.85	no	Sand & Gravel	Power generation
14357	300510	6431750	16.5	11.6	12.6	Potable	151	139	7.01	16.46	no	Gravel	Power generation
14358	300390	6431730	15.8	11.6	8.6	Potable	151	139	6.1	15.85	no	Gravel	Power generation
14359	300440	6431930	16.5	11.6	6.3	Potable	151	139	9.75	16.46	no	Gravel	Power generation
14360	300520	6432035	16.8	12.2	8.8	Potable	151	139	7.62	16.76	no	Gravel	Power generation
14361	300700	6431875	14.6	11.6	10.1	Potable	151	139	6.71	14.63	no	Gravel & sand	Power generation
15083	302680	6431730	8.5	4.9			150	145					Irrigation
15696	298980	6427760	11.6	0.6	15.156		141	140	7.62	11.58	no	Gravel	Irrigation
15880	298650	6427730	11	0.3	12.63	Good	141	141	7.62	10.97	no	Gravel	Irrigation
15881	299325	6427925	11	0.3	9.851	Good	141	141	5.49	10.97	no	Gravel	Irrigation
15882	298490	6427310	9.14			Good Stock	141	0	9.14		no	Alluvium	Stock
15883	298875	6427040	9.14	0.9		Good	141	140	6.1	9.14	no	Gravel	Stock
15884	299220	6426970	10.97		10.104	Good	141	0	7.62	10.97	no	Gravel	Irrigation
16110	299525	6434630	11	10.1	15.156	good	161	151					irrigation
16280	294740	6430175	21.6	9.1	0.8	501-1000	210	201					Stock
16288	299190	6440165	6.7	4.3	7.6			0					Irrigation
17904	306120	6426440	6.7	4.3	9.1	1001-3000		0	3.05	6.71	yes	Sand & Gravel	Irrigation
18298	294290	6423320	9.1	7.9			132	124					Irrigation
19116	295350	6424830	11.9	9.5	75.78	Good	132	123					Irrigation
20305	299390	6428610	13.4	10.4	9.7		145	135					irrigation
21508	297950	6426970	12.5	9.1	6.32	Fresh	141	132	12.5	12.51	no	Gravel	Irrigation
22223	299450	6428910	11.9	5.5	14.272		146	141					stock & domestic
22292	289115	6434200	3	0.6	1.3	1001-3000		0	3.05	3.06	no	Gravel	Stock & domestic
22334	297640	6449825	8.5	4.3	10.1	Good		0					Irrigation
23652	292200	6434225	39.6	20.1	0.2	Salty		0				Shale	Stock
23763	303560	6447515	63.1	21.3	0.3	Soft		0					Stock
24557	299030	6428890	14.1	10.6	11.367		146	135	10.97	13.71	yes	gravel	irrigation
24558	289000	6434350	1.2	0.6	1.3	Stock		0					Stock
24561	290110	6433460	24.9	4.8	0.1	Poor		0	2.43	2.74	yes	Shale	Stock
24569	300990	6431440	16.5					0	12.8	16.5	no?	gravel	irrigation
24700	295480	6423080					138	0					Abandoned
24727	302025	1432075						0					abandoned
24728	301750	1432085						0					abandoned
24729	301360	6431150						0					abandoned
24730	301150	1432175						0					abandoned
24731	300775	1432250						0					abandoned
25964	299740	6434470	16.8		1.01		160	0	10.36	16.76	yes	gravel	abandoned
26137	299730	6434430	11		1.01		160	0	8.84	11	no?	gravel	abandoned
26295	296450	6434960	10.3	45.7	0.4		226	180					General
26327	305760	6442670	9.8	5.3	15.2			0					
27311	292035	6422600	11.6	9.4	1.516		123	114	6.1	11.58	no	Gravel	Irrigation
27410	302500	6431010	12.2	8.2	good	good	148	140					irrigation

MOUNT PLEASANT DATABASE

Mt Pleasant Database

DWR Ref NO	Easting (AMG)	Northing (AMG)	Depth (m)	SWL (MBTOC)	Yield (L/s)	Salinity Class/ppm	Collar (AHD)	SWL (AHD)	Top of gravel	Base of gravel	Penetrate gravel ?	Aquifer	Use
27411	302550	6430990	12.2	8.2	insuf.			0					abandoned
27411	302550	6430990	12.2	8.2			148	140					Abondoned
28510	298555	6428915	12	10.4		501-1000	147	137	8.53	12.04	no	gravel	abandoned
29518	293380	6434480	38.1	10.7	0.316		290	279				sandstone & shale	stock
30745	295940	6422650	220.0		6.00		142	0				Sandstone & coal	Coal Exploration
31050	311025	6440240	61	25	1.5	Fresh		0					Stock
31623				18.3	0.25			0	25.3	25.3		Basalt	Stock
31623				18.3	0.76			0	29.3	29.3		Basalt	Stock
31623	294015	6417270	38.1	18.3	0.13		227	209	23.8	23.8		Basalt	Stock
31623				18.3	2.27			0	34.7	34.7		Clay & Shale	Stock
32077				33.5	0.13			0				Sandstone	
32077	294150	6416595	53.3	28.7	1.52		228	199				Sandstone	
32512	294275	6418450	33.5	12.2	1.36	see chem.	185	173	21.9	21.9		Sandstone	Stock
32729	299925	6429070	12.2	11	good		145	134	6.1	12.19	no?	gravel	stock & domestic
32890	289635	6433580	19.8	2.7		Salty		0	1.22	3.05	yes	Sandstone	Stock & domestic
33193				12.8	0.88			0				Shale	
33193	293590	6416845	46.9	21.6	0.11		239	217				Shale	
33213	296865	6455680	16.2	7.2	13.3	0-500		0					Disused
33609	300625	6429225	12.2	10.2			143	133					domestic
33610	299475	6429825	14	12			147	135					stock
33725	292310	6434210	57.9	24.4	0.3	Brackish		0				Sandstone	Stock
33915	294080	6419320	39.6	21.0	0.32		170	149				Coal & sandstone	Stock
34015	300370	6429300	14					0					
34302	300210	6429450	12	10.7			145	134					
34303	299270	6429695	14.1	12.5	15.156		148	136					stock & domestic
37305	299815	6436040	14.3	9.4	25.3	C1		0	14.32			Gravel & sand	Irrigation
37319	302025	6433575	12.1	9.7	17.7	C3	154	144	9.75	12.19	no	Gravel	Irrigation
37365	297000	6445100	9.6	3	26.7	C2		0					Irrigation
37479	299300	6434425	10.6	9.4	35.4	C4	162	153	7.92	10.67	no	Gravel	Stock
37481	298625	6428305	15.2	10.6	5.052	good	145	134					not used
37729	305180	6451010	8.5	5.4	39.1	C1		0				Gravel	Irrigation
37774	298555	6428915	13.5	11.7			147	135	7.62	13.56	no?	gravel	stock & domestic
37826	300950	6430225	9.7				142	0	9.14	9.7	no?	gravel	irrigation
37827	301225	6430530	11.27		22.734		145	0	10.66	11.27	no?	gravel	irrigation
37828	301450	6430325	11.8	7.9	15.2	C1	145	137	11.27	11.88	no	Gravel	Irrigation
37832	299715	6430185	13.71	12.1	3.789		145	133	10.36	13.71	no?	gravel	irrigation
37888	300160	6427300	11.6				144	0	11.58	11.58	no	Gravel	Recreation
37953	300625	6435930	14.3	10.9	20.2	C1	162	151					Irrigation
37954	300220	6435990	13.7	9.7	17.4	C1	162	152					Irrigation
37964	300845	6429125	12.4	10	7.578		141	131					irrigation
37980	297525	6441730	20.1	5.4	15.2			0					
38369	298690	6435350	31.3	7.9			169	161				Sandstone	Stock & domestic
38582	295700	6434020	29.2	8.5	0.7	Hard	205	197				Sandstone	Stock
38607	290110	6420720	13.4	11.5	0.378	Stock	133	122	13.41	13.41	no	Gravel	Stock
38752	293960	6436530	28.9	10.6	0.8	Hard		0					Stock
40539	299630	6429570	12.7	11.4			147	136					abandoned
42631	300550	6435170	12.8	10.3		Good	161	151					Irrigation
42670	296725	6444225	10.9	2.9				0					Irrigation
42701	298710	6428380	14	9.7			145	135	9.75	14.02	no?	gravel	irrigation
42927	298625	6428305	14.3				145	0	10.36	14.33	no?	gravel	
43426	300115	6429200	12.1	10.3	0.378		145	135	6.4	12.19	no?	gravel	stock & domestic
43981	301575	6430500	9.1	1.8		501-1000	148	146	8.53	9.14	no	Gravel	Stock & domestic
44228	304350	6456620	14.3		0.4	Fresh		0					Stock & domestic
44822	291920	6428115	30.5				265	0	16.67	18.29	yes	Gravel	Stock
44912	292900	6428575	15.5	3.4	0.152		210	207	11.58	12.19	yes	Gravel	Stock
45435	299530	6430630	11.5	10.9	0.6	Good	148	137				Loam	General
45469	295440	6420350	49.1	33.1	0.253	Stock	180	147				Sandstone & coal	Stock
45625	306950	6434675	9.8	3.7	0.9	Hard		0					Stock & domestic
45983	296590	6456310	11.3	7.3	5.1			0					Stock & domestic
45990	301240	6434620	46	24.7	0.8	1001-3000	180	155	11.7	11.7		Sandstone	Domestic
46710	306475	6450780	7.3	4.2	0.2			0					Stock
46737	291680	6427000	74.7				225	0				Sandstone	Stock
47216	298045	6428160	11.3	7.9	12		146	138					Stock & Irrigation
47277	298440	6428430	12.2		3.789			0					irrigation
47522	298415	6428120	13.4	2.9			145	142	7.92	13.41	no	Gravel	Irrigation
47863	289300	6428720	6	3.6			175	171					Stock & Domestic
47996	300013	6434900	12	8	6.4	501-1000	162	154	12			Gravel	Abandoned
47997	305250	6449300	11.6	7.6				0					Irrigation
48754	299360	6430310	12.4	10.7			149	138	10.7	12.4	no	Gravel	General

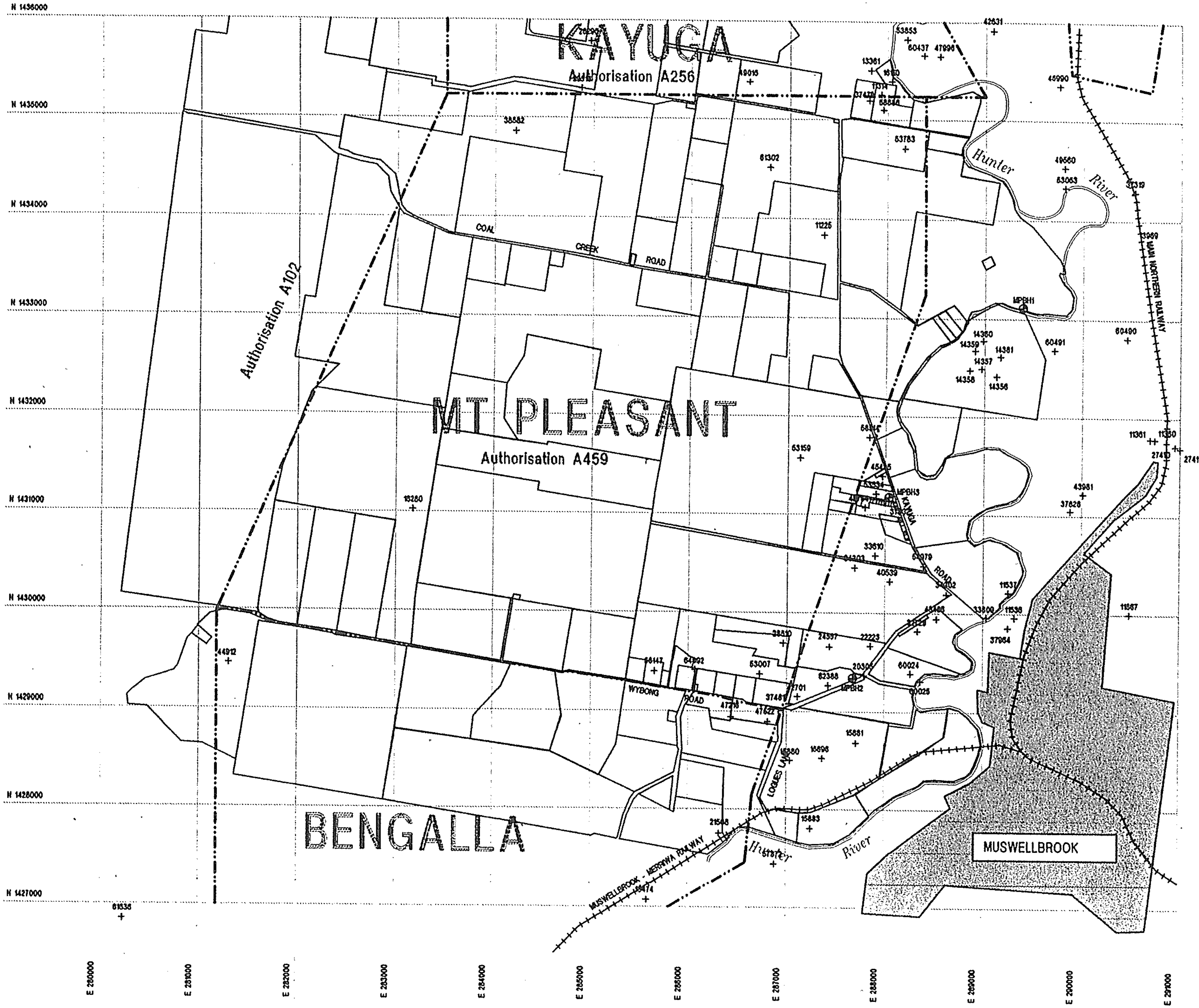
MOUNT PLEASANT DATABASE

Mt Pleasant Database

DWR Ref NO	Easting (AMG)	Northing (AMG)	Depth (m)	SWL (MBTOC	Yield (L/s)	Salinity Class./ppm	Collar (AHD)	SWL (AHD)	Top of gravel	Base of gravel	Penetrate gravel ?	Aquifer	Use
48769	296140	6456570	36.5	6	2.5			0					
49015	298070	6434590	51.8	7.9	0.4	Stock	166	158				Sandstone?	Stock
49098	298395	6426525	10.67				140	0	4.27	5.18	yes	Gravel	Stock & Domestic
49098								0	7.62	10.67	no	Gravel	Stock & Domestic
49501	297060	6434375	9.1					0					
49560	301310	6433800	12.7	9.7			151	141					General
49783	303700	6449940	30.4	7	0.2			0					Stock & domestic
50612	310390	6431670	4.5	0.5				0					Stock
51123	307200	6453840	7	3	12.6			0					Stock & domestic
52617	289665	6433575	7.5	3.6				0	3.6	7.5	no	Gravel	Stock
52673	309690	6443325	5	3	15.2	Good		0					Stock & Domestic
53007	298325	6428600	12.5	8.5	6.5		147	139					irrigation
53053	301320	6433600	6	3		0-500	151	148	1	6	no	Gravel	
53098	305315	6452325	11.7	7.6	6.3			0	5.8	11.7		Gravel	Irrigation
53159	298680	6430795	14.6	12.2		1001-3000	177	165					stock $ domestic
53233	291240	6422970	11.2	8	80	Good	120	112	8	11.2	yes	Gravel	Irrigation
53282	300080	6434430	84		4.4	1001-3000	160	0				shale & coal	stock & domestic
53299	291030	6422920	10.1	2.5		1001 - 3000	120	118					Stock & Domestic
53487	299250	6429870	15.2				149	0	9.14	15.24	no?	gravel	abandoned
53490	300095	6427205	22.0				144	0					Abandoned
53534	299470	6430450	15	4		501-1000	148	144	6.71	14.63		Gravel	Irrigation
53558	305220	6453395	18.6	14.6	9.1	501-1000		0					Irrigation
53572	291830	6422580	10.5	8		501 - 1000	123	115	7	10.5	no	Gravel	Irrigation
53576	301010	6440320	12.5	6.4	37.9			0	9.14	12.19	yes?	Gravel	Industry
53579	297255	6453450	13.1	8.2		501-1000		0					
53581	300275	6435500	13.4	9.8		0-500	161	151	13.41			Gravel	Irrigation
53615	299145	6436100	13.3	10	10.1	501-1000		0					Irrigation
53700	291362	6423062	8	6			120	114	6	8	no	Gravel	Irrigation
53701	291375	6423015	8.4			1001 - 3000	120	0					Stock & Domestic
53756	299255	6426215	9.8				140	0	9.75	9.75	no	Gravel	
53783	299675	6433950	13	9	18.9	1001-3000	158	149	9	13	no	Gravel	Stock & Domestic
53823	294825	6454895	9.1	4.3	6.1			0					
53867	292980	6454465	11.6	8	15.2	Good		0					Irrigation
54979	299970	6429730	14	9			146	137	6	14	no?	gravel	domestic
56284	288465	6425990	8.2				159	0					Stock
56514	299385	6431025	14	11.4			155	144	11.43	14.02	no	Gravel	Stock & Domestic
56561	306445	6449330	13.7	12				0					Stock
57372	298517	6426675	11	1.5			141	140					Stock & Domestic
57807	294787	6424262	10	7	15.156		131	124	7	10	no	Gravel	Irrigation
58147	297250	6428600	26	20			167	147					abandoned
58686	299445	6434335	11.9	9.3			162	153	9.3	11.9	no	Gravel	Stock
59131	294850	6424750	11.6	8.4	insf	1001 - 3000	138	130					Abandoned
60024	299865	6428640	13	10	10	0-500	143	133	9	13	no?	gravel	irrigation
60025	299965	6428565	7	3.5			142	139					abandoned
60282	292485	6422420	16			salty	130	0					Abandoned
60437	299850	6434905	12	9	10		162	153	8	12	no?	gravel	irrigation
60490	301980	6432090	16	10	13		150	140					Irrigation
60491	301250	6431955	16	12			152	140					Irrigation
61281	298750	6434250	31.7					0				shale & coal	abandoned
61302	298300	6433725	41.1	10.7	1		173	162				Shale	Stock & Domestic
61361	296430	6456585	30.4	12.2	0.5	Good		0					Stock & Domestic
61598	301000	6439940	14.6	9.1				0					Stock
61636	291875	6425950	42.7	12.2	0.47	1001 - 3000	194	182				Sandstone	Stock & Domestic
61684	295040	6451610	34.1	25.9	0.4			0					Domestic
62359	300110	6435565	14	9.8	1		161	151					Stock & Domestic
62360	300460	6435725	14	10	11.4		161	151					Irrigation
62361	300110	6435615	15	12	12.9		161	149					Irrigation
62362	300150	6435820	14.6	9.8	16.7		161	151	9.75	14.62	no	Gravel	Irrigation
62378	305940	6445640	7	2.6	18.2			0					Irrigation
62388	299025	6428500	10.7	9.1			144	135	9.14	10.67	no?	gravel	irrigation
62561	301450	6436000	32.6	18.3	0.4	Salty	170	152	12.2	12.2		Sandstone	Stock
63948	296040	6456410	51.2	30	0.1			0					Stock & Domestic
64092	297665	6428625	31.2	19.5	0.695		150	131					stock & domestic
								0					

RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



Legend

- Authorisation boundary
- 30454 + Bores registered with Department of Water Resources
- MPBH1 ⊕ Current study alluvial bores

Notes

Co-ordinates are Integrated Survey Grid (ISG)

0 500 1000 1500 2000 2500 Metres

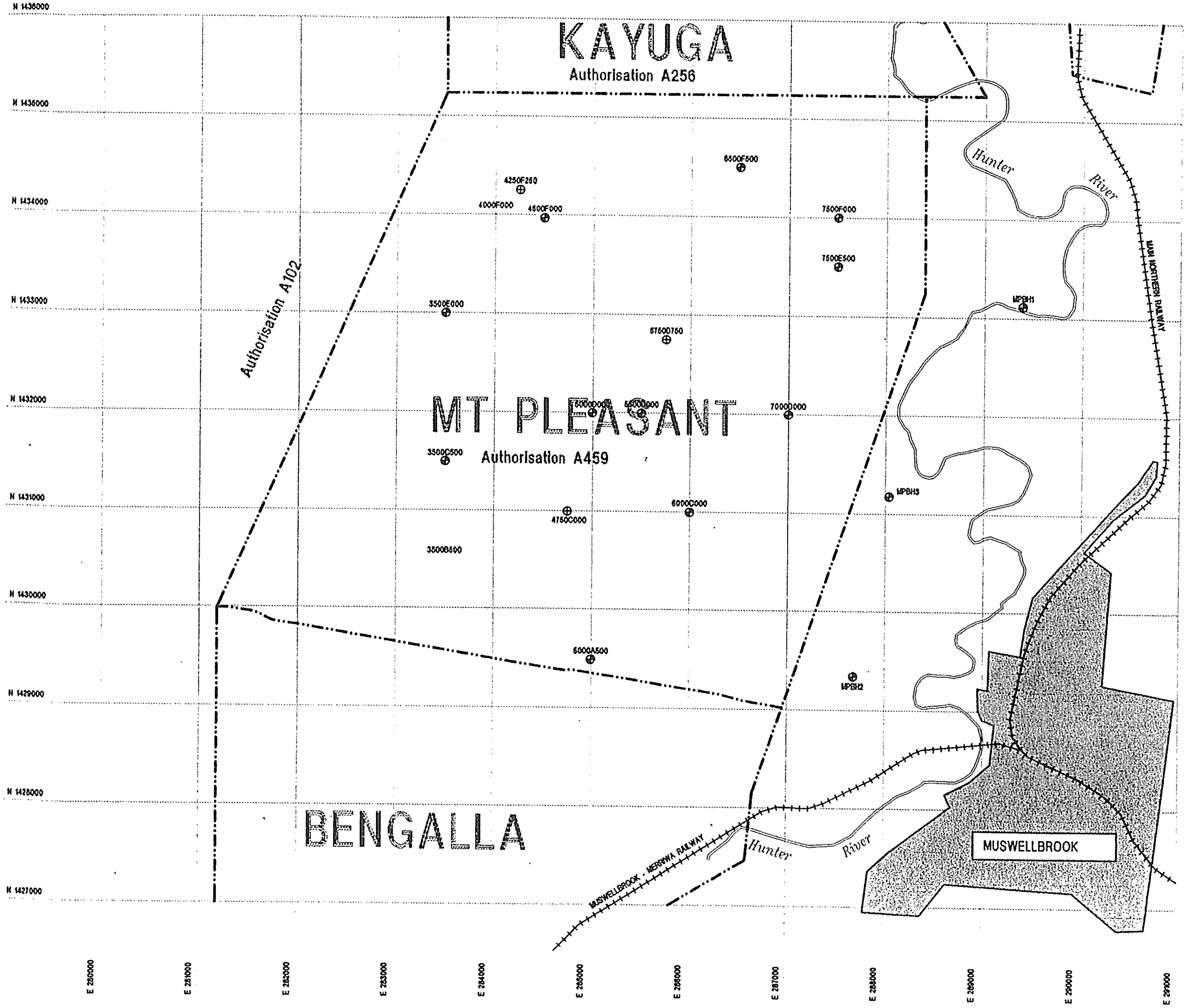
ORIGINAL SCALE 1: 40000

Location of Regional Boreholes Identified from DLWC Records

Figure A1

RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



Legend

-··-··-	Authorisation boundary
5750D750 ⊕	Packer test hole location
7500E500 ⊕	Piezometer location

Notes

Co-ordinates are Integrated Survey Grid (ISG)

Source of Data - Coal & Allied Operations Pty Limited

0 500 1000 1500 2000 2500 Metres

ORIGINAL SCALE 1: 40000

Monitoring Network
Borehole Locations

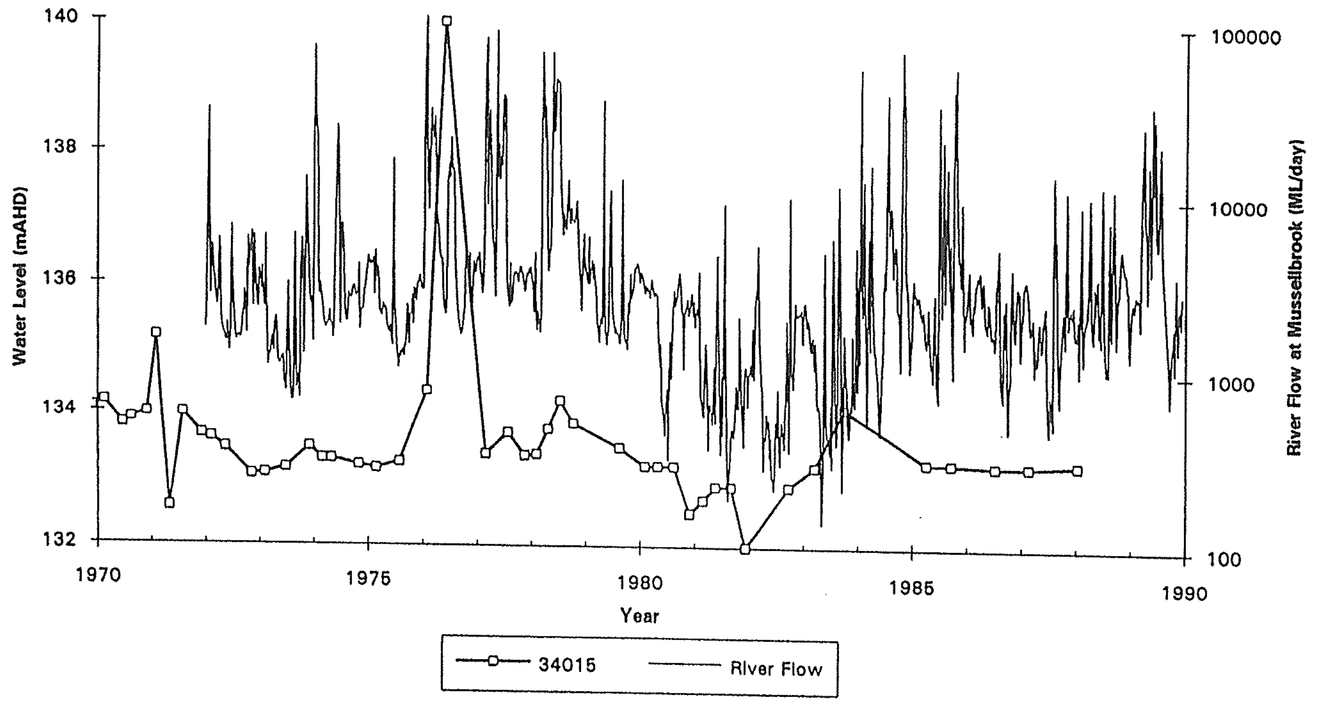
Figure A2

Appendix B

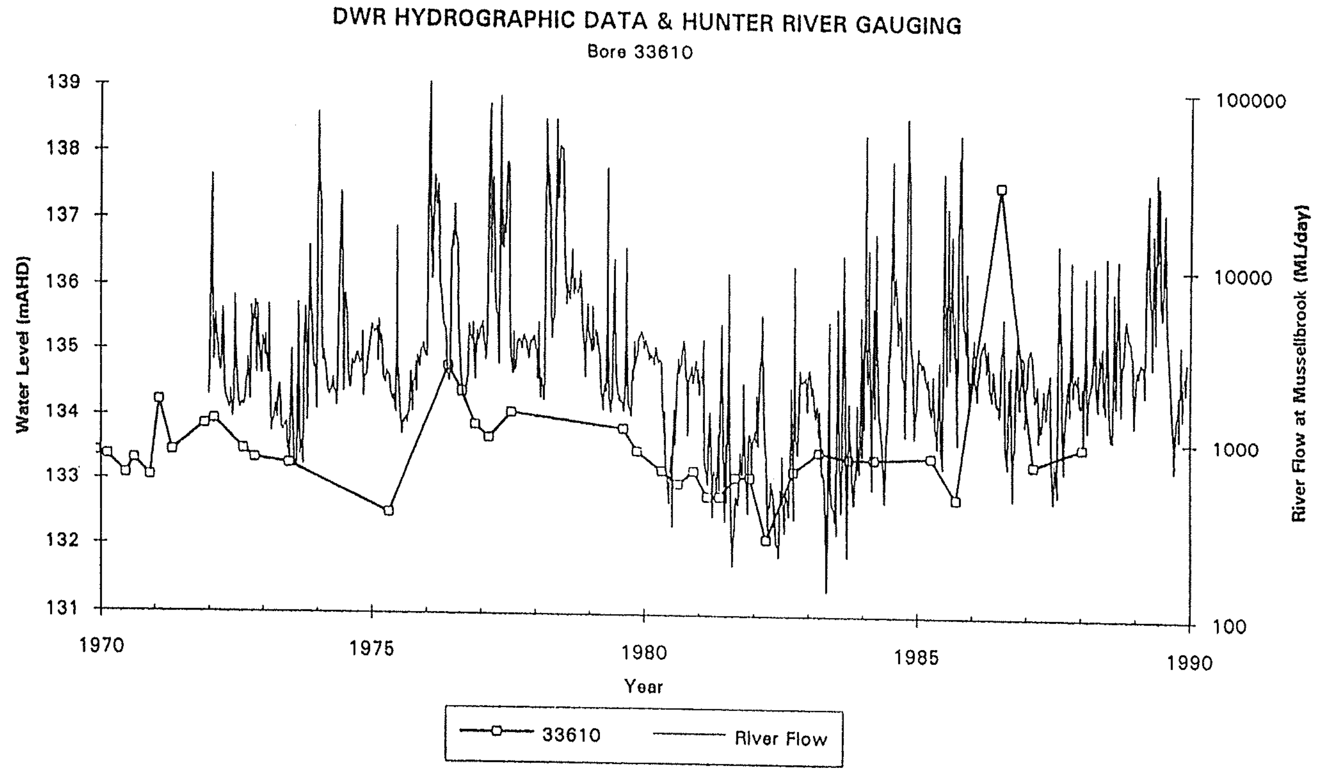
Hydrographs

DWR HYDROGRAPHIC DATA & HUNTER RIVER GAUGING

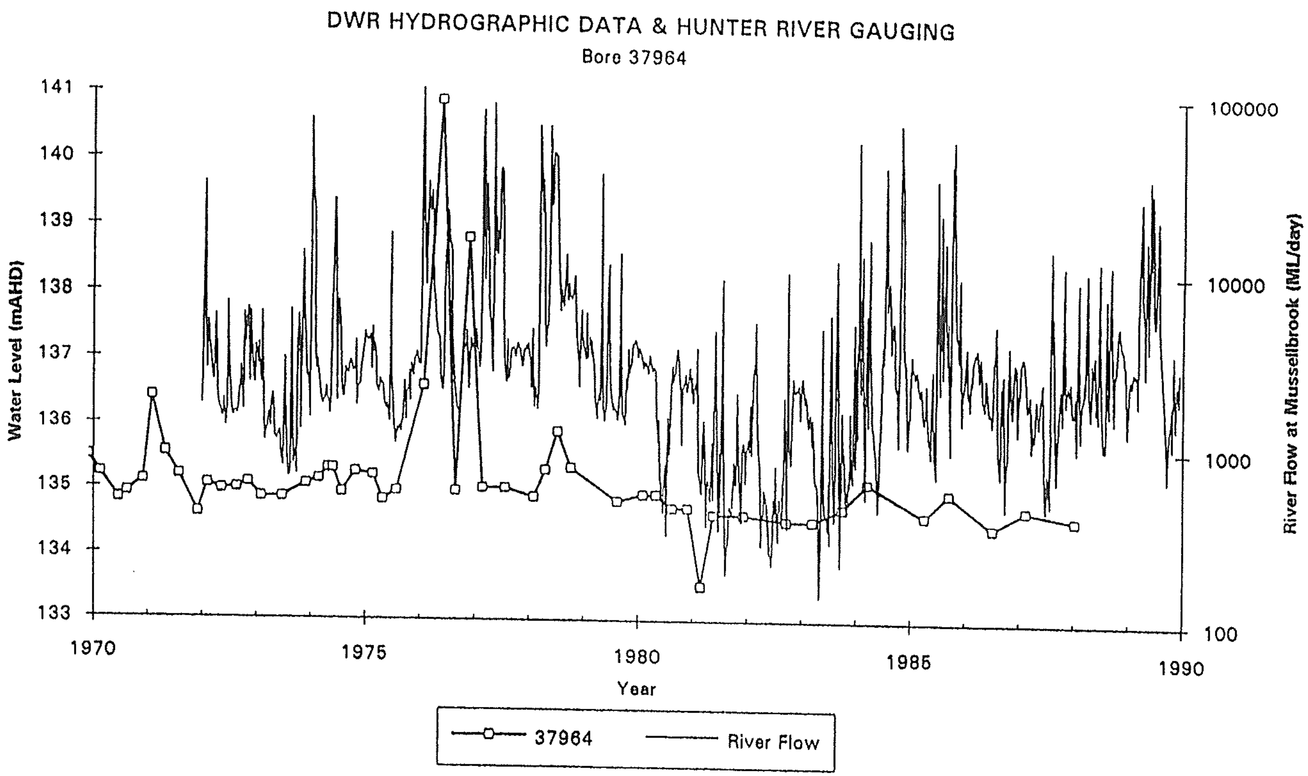
Bore 34015



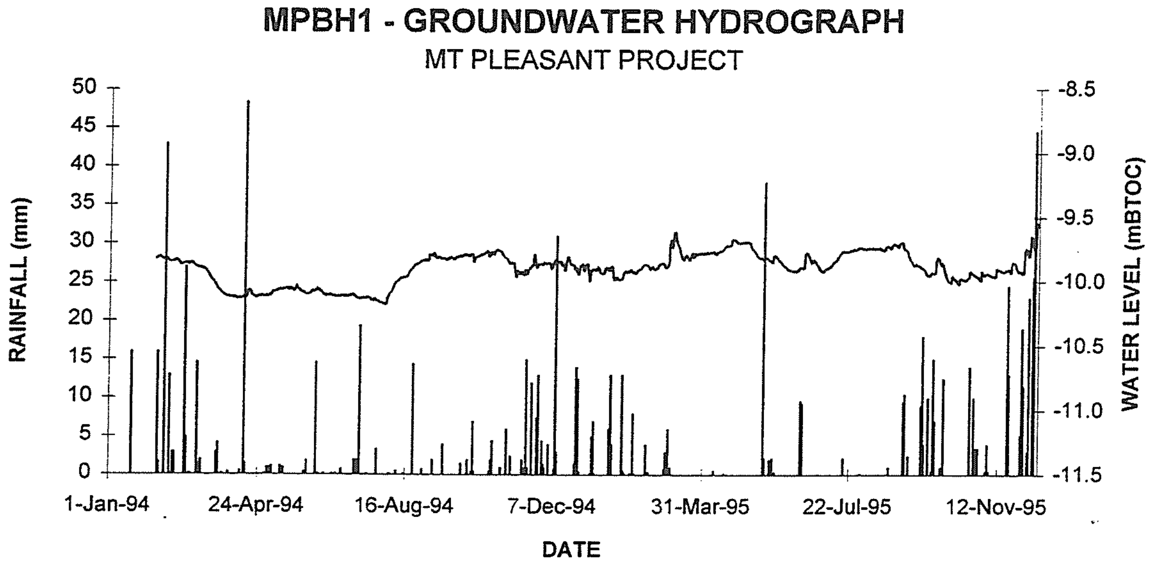
Environment & Infrastructure

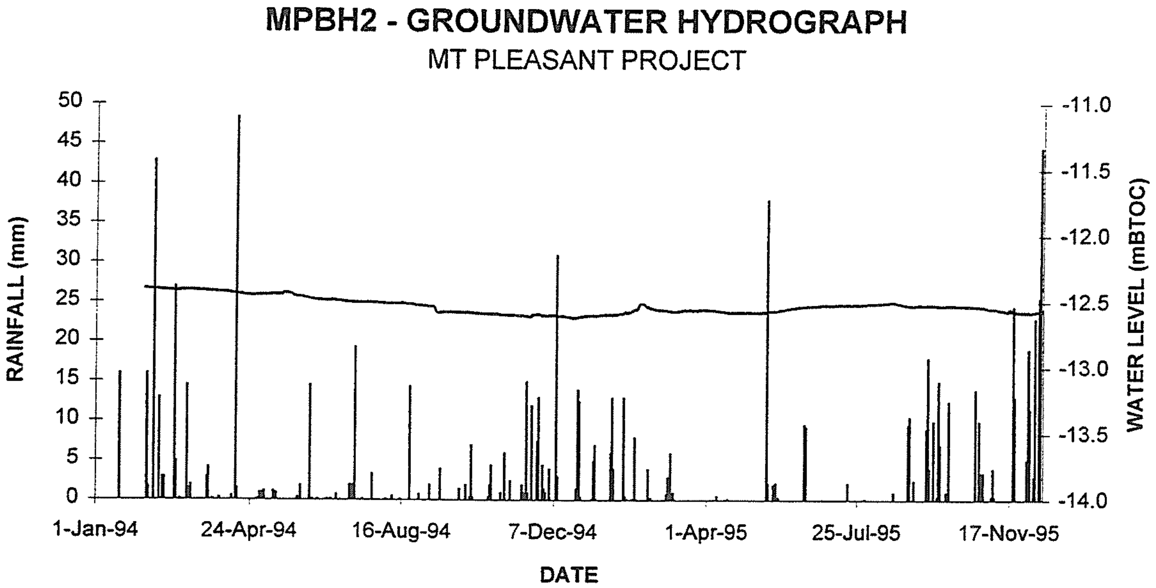


RUST PPK Environment & Infrastructure



RUST PPK Environment & Infrastructure





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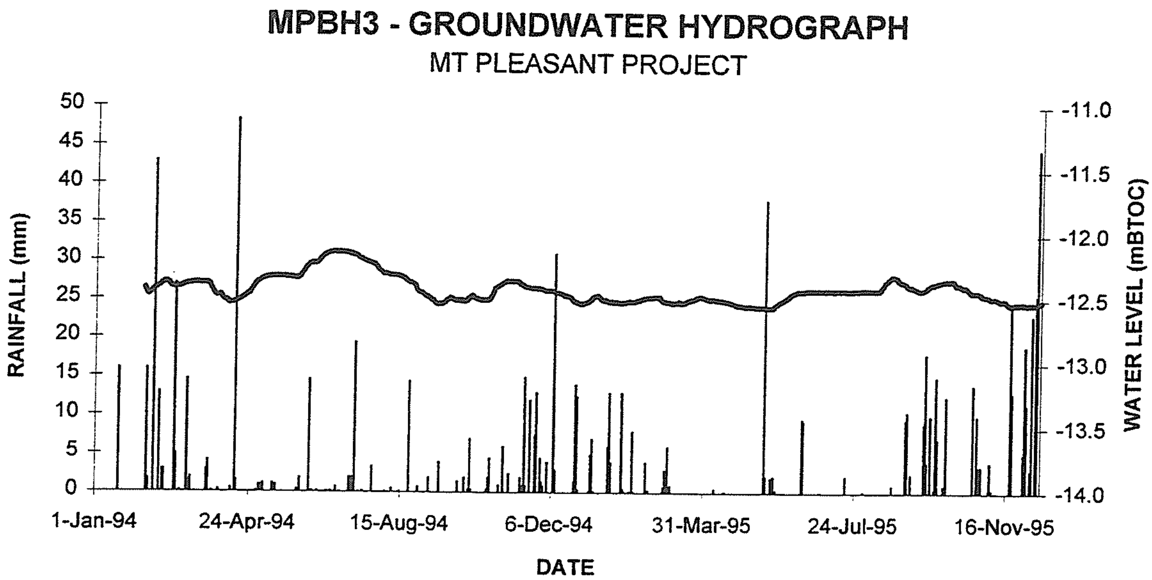

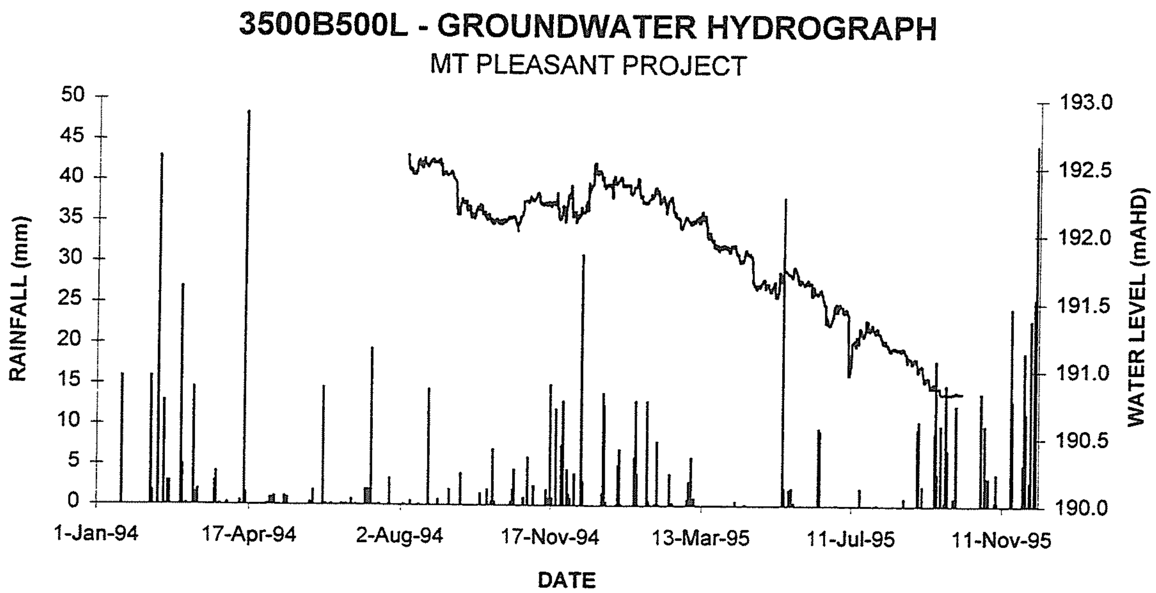

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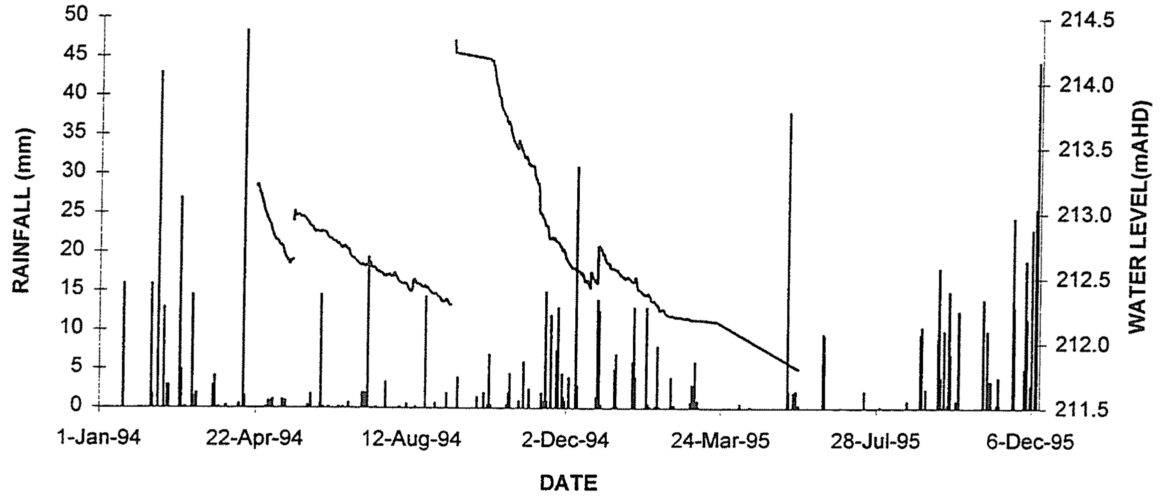
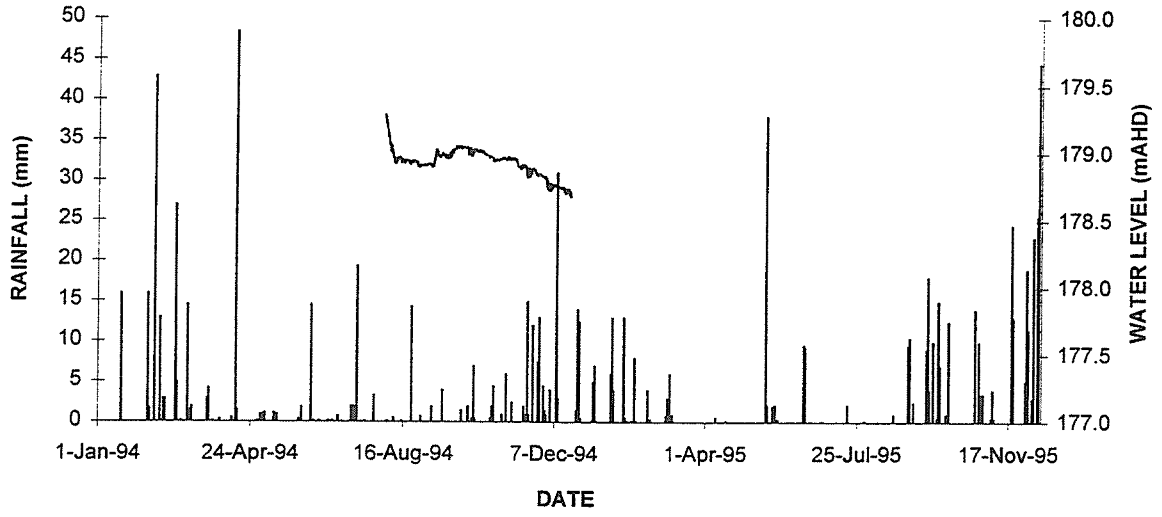
3500C500L - GROUNDWATER HYDROGRAPH
MT PLEASANT PROJECT



4500F000 - GROUNDWATER HYDROGRAPH
MT PLEASANT PROJECT



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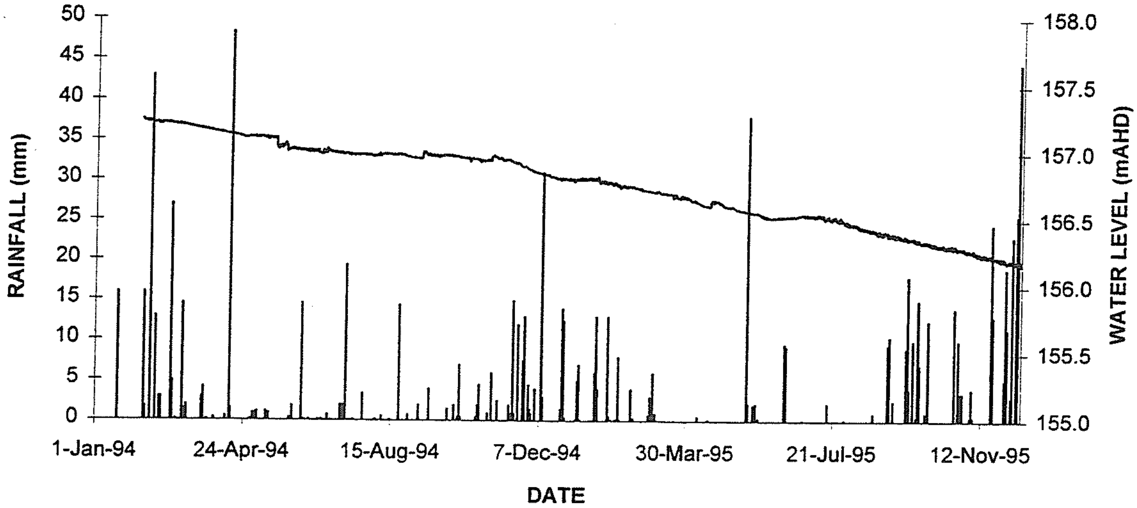
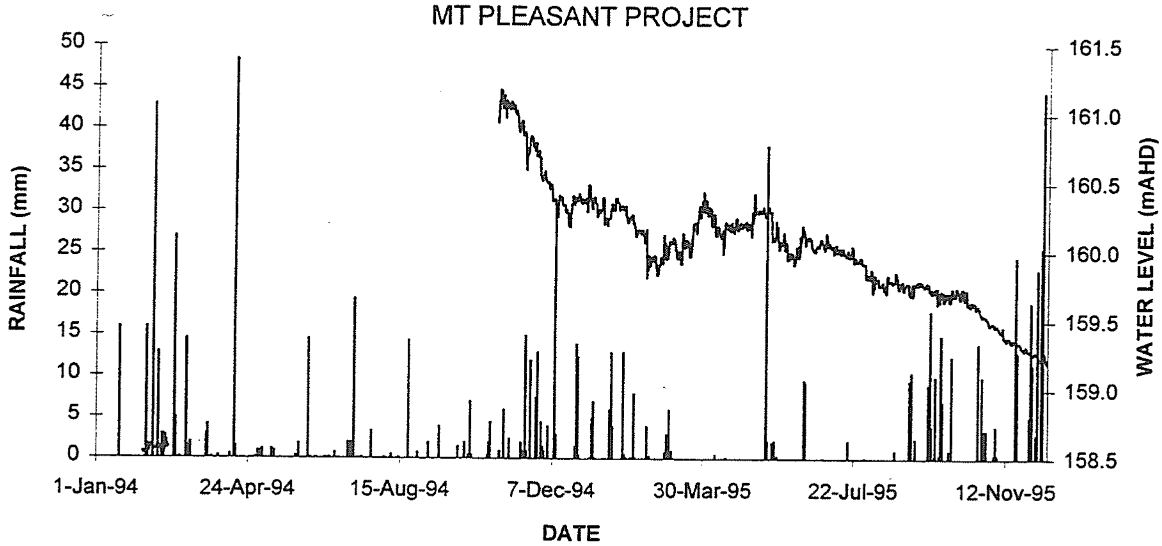
5000A500 - GROUNDWATER HYDROGRAPH

MT PLEASANT PROJECT



5500D000 - GROUNDWATER HYDROGRAPH

MT PLEASANT PROJECT



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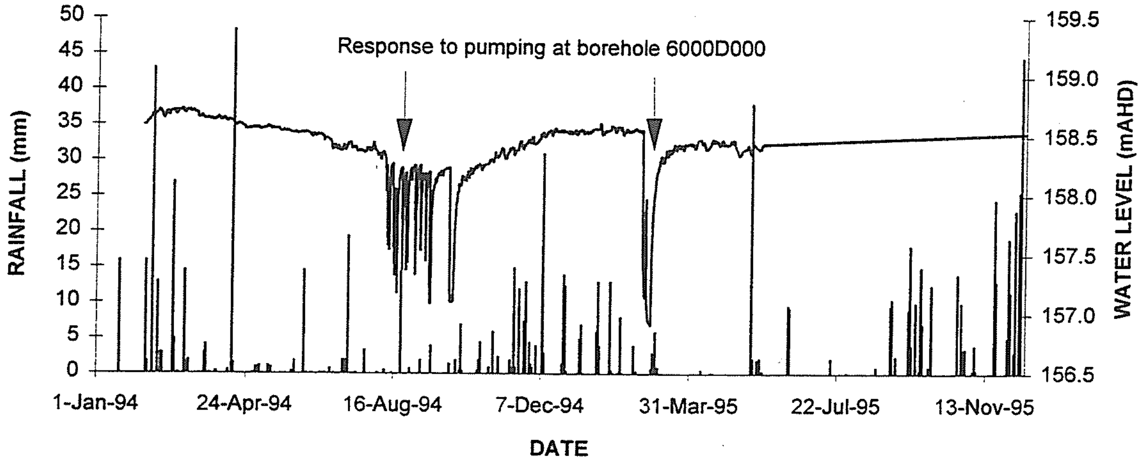
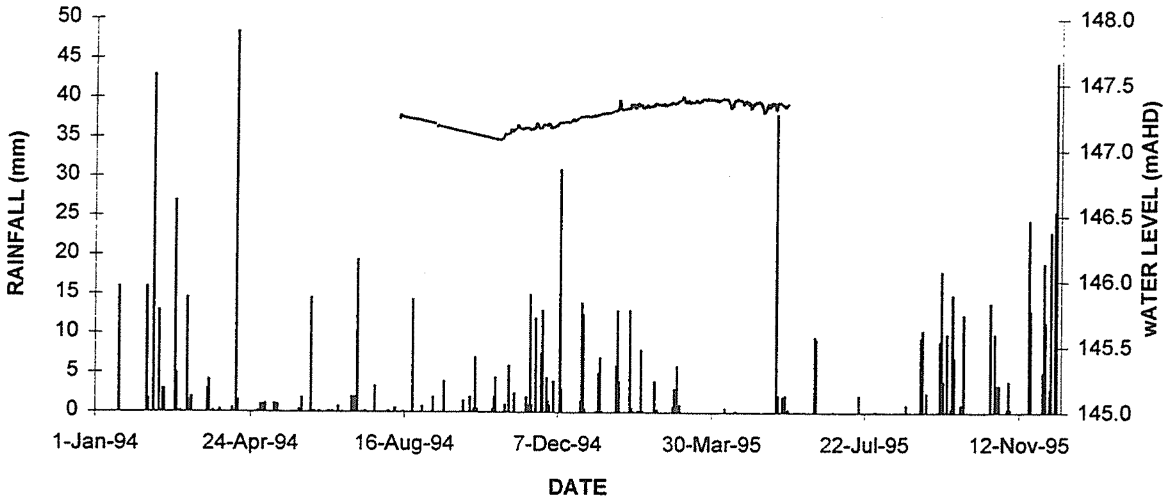
7000D000 - GROUNDWATER HYDROGRAPH

MT PLEASANT PROJECT



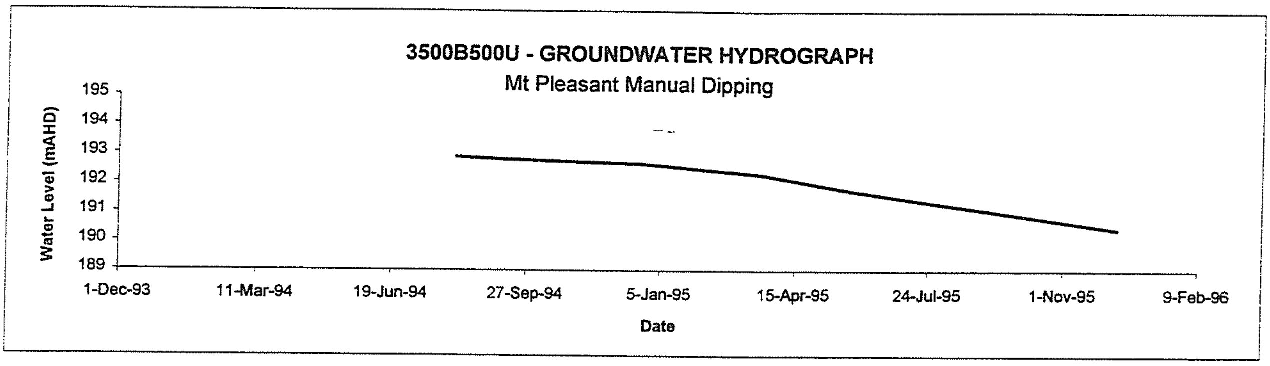
7500F000 - GROUNDWATER HYDROGRAPH

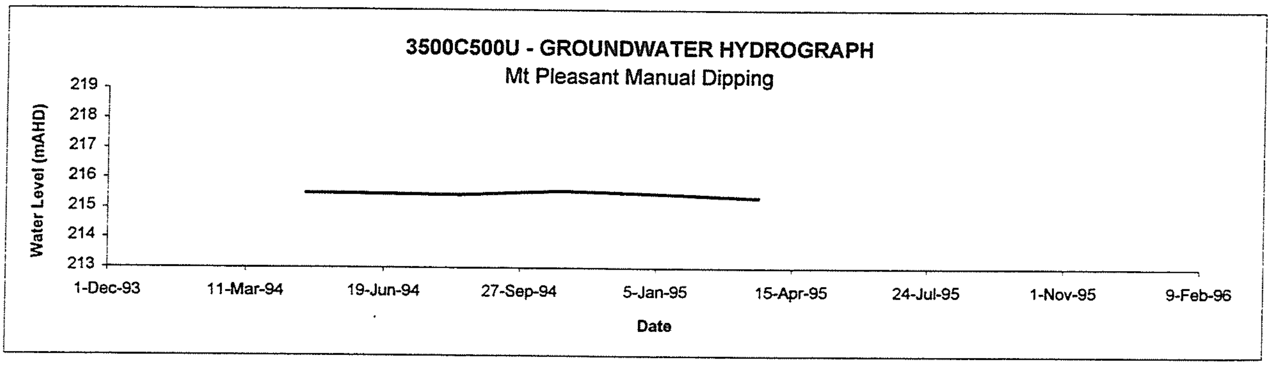
MT PLEASANT PROJECT

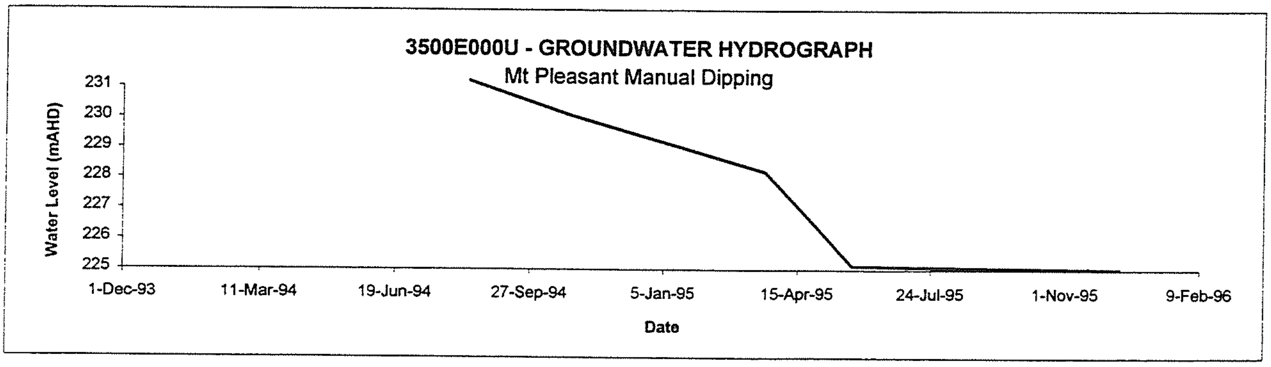


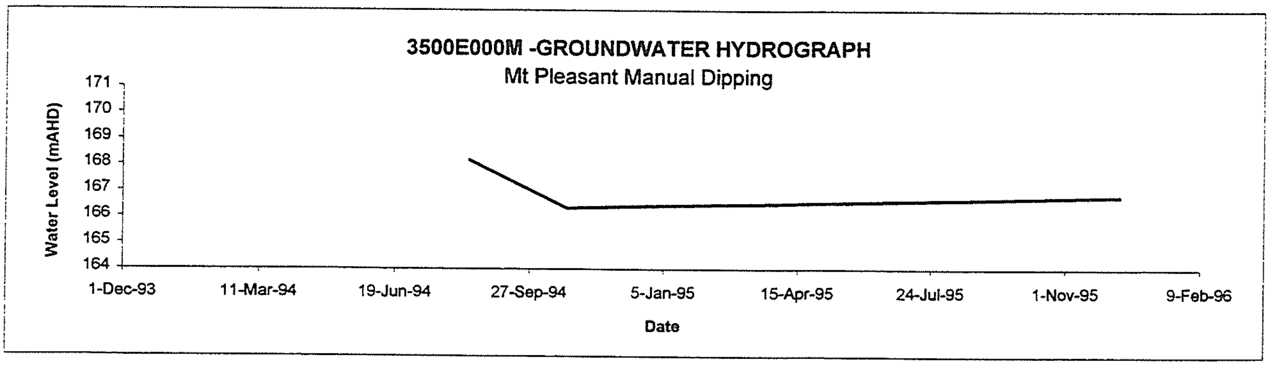
RUST PPK

Environment & Infrastructure









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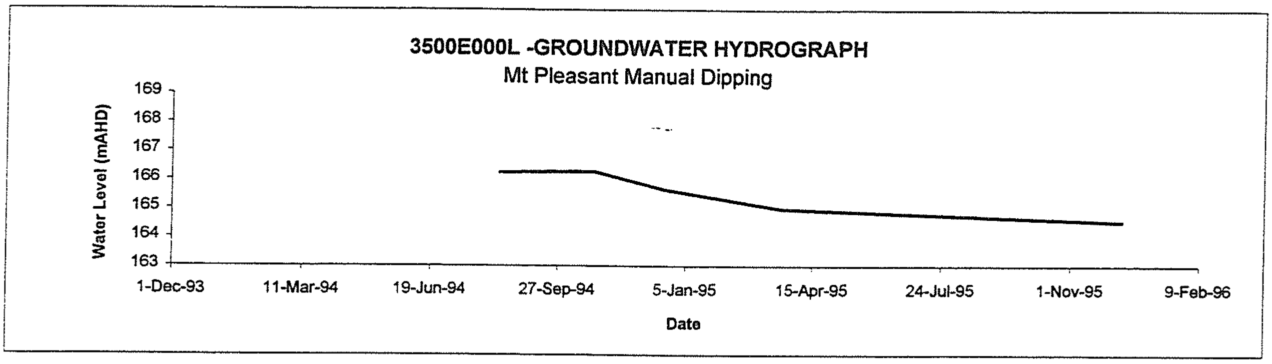
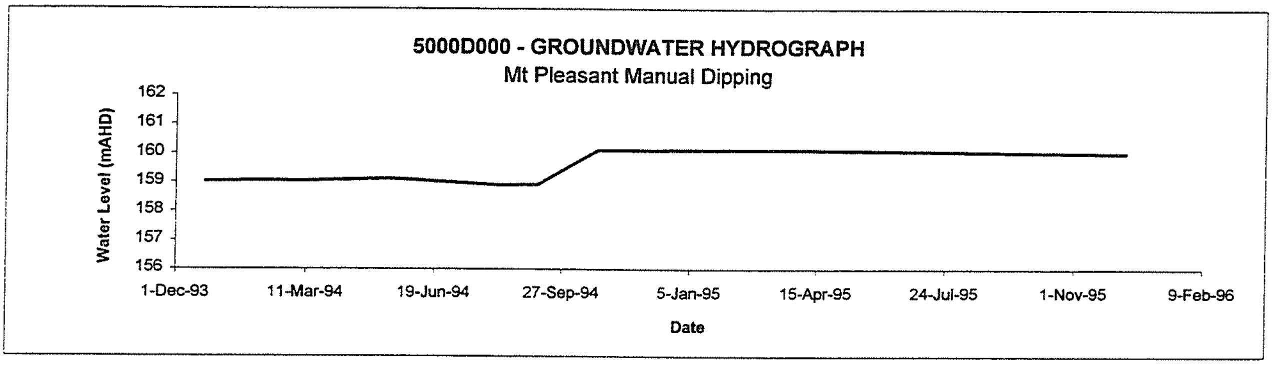
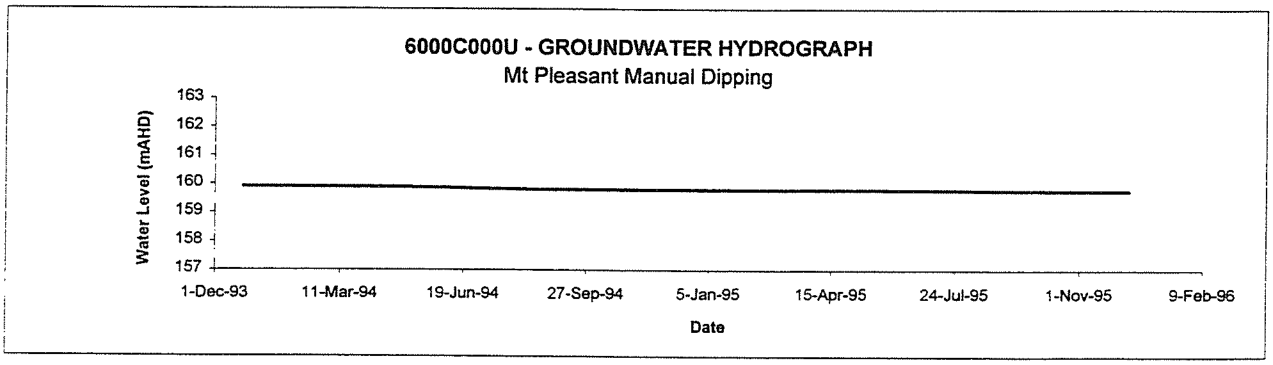
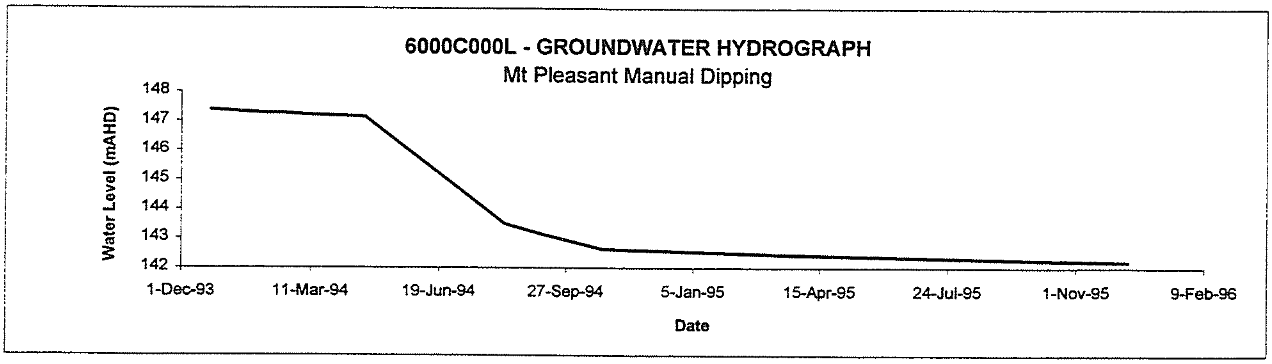
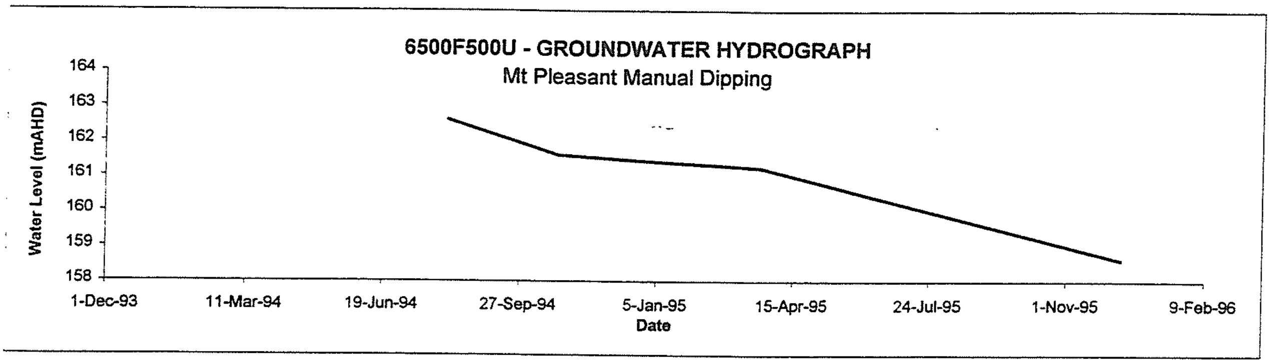


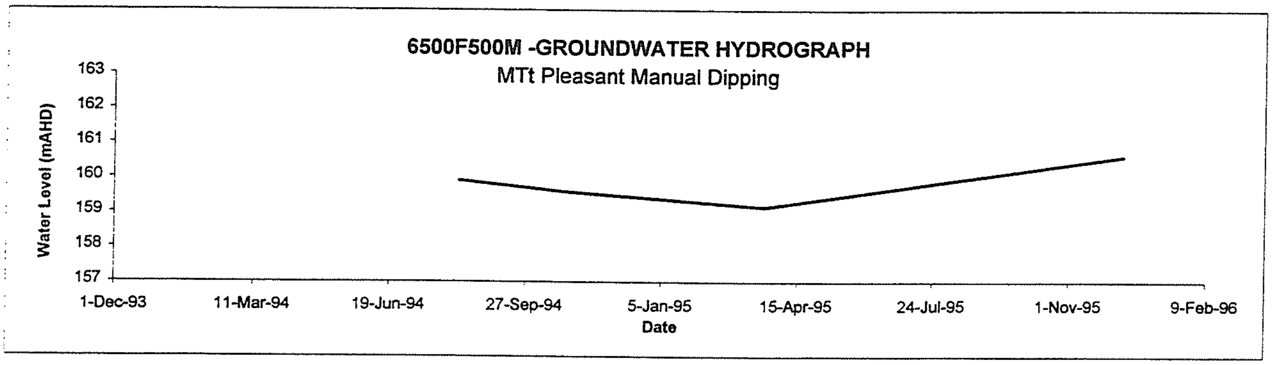


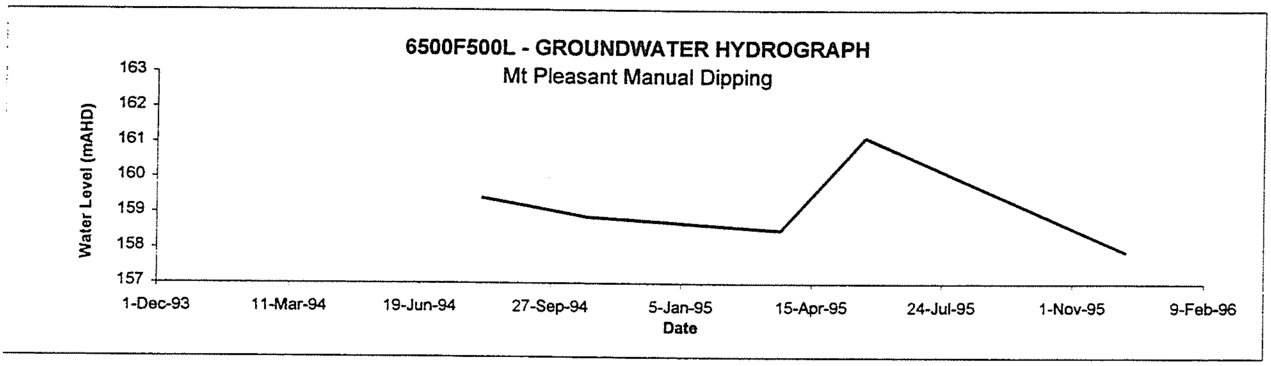


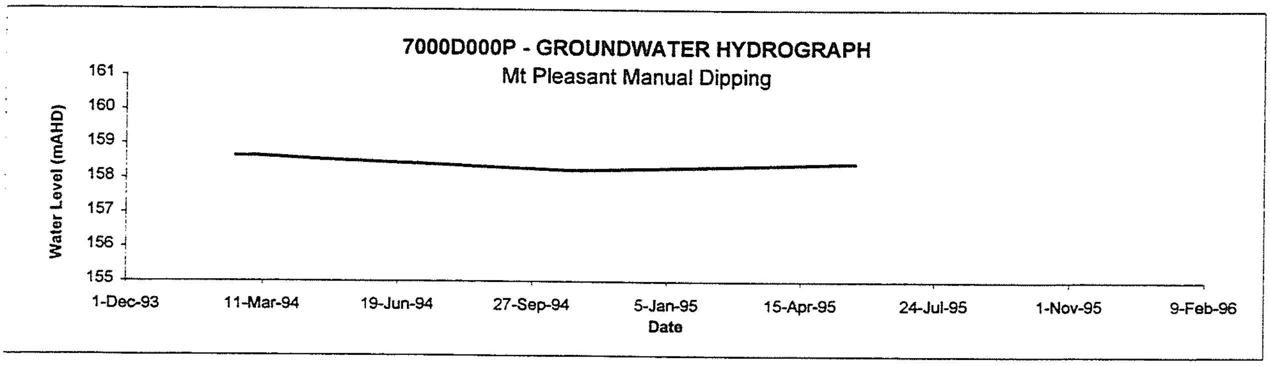


RUST PPK
Environment & Infrastructure









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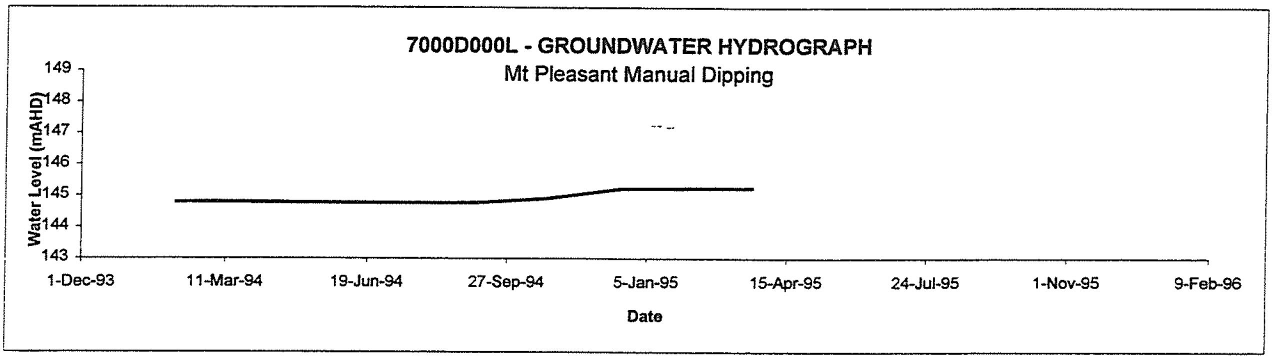

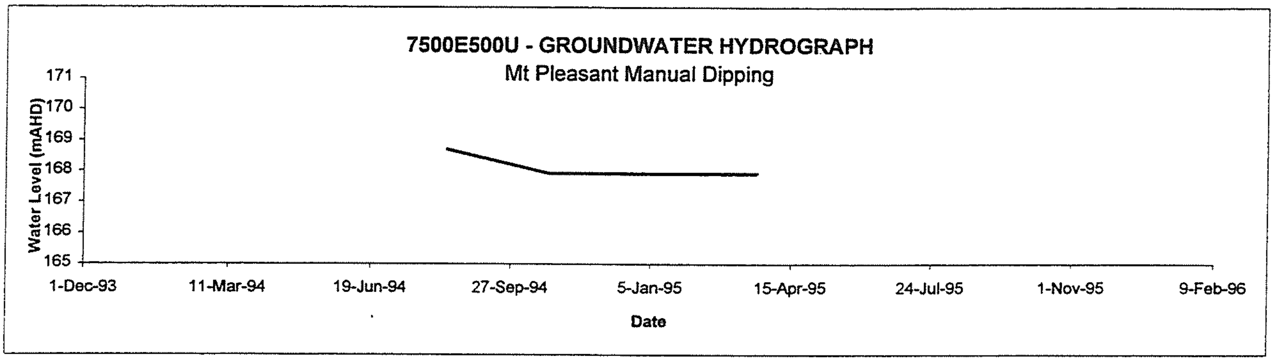

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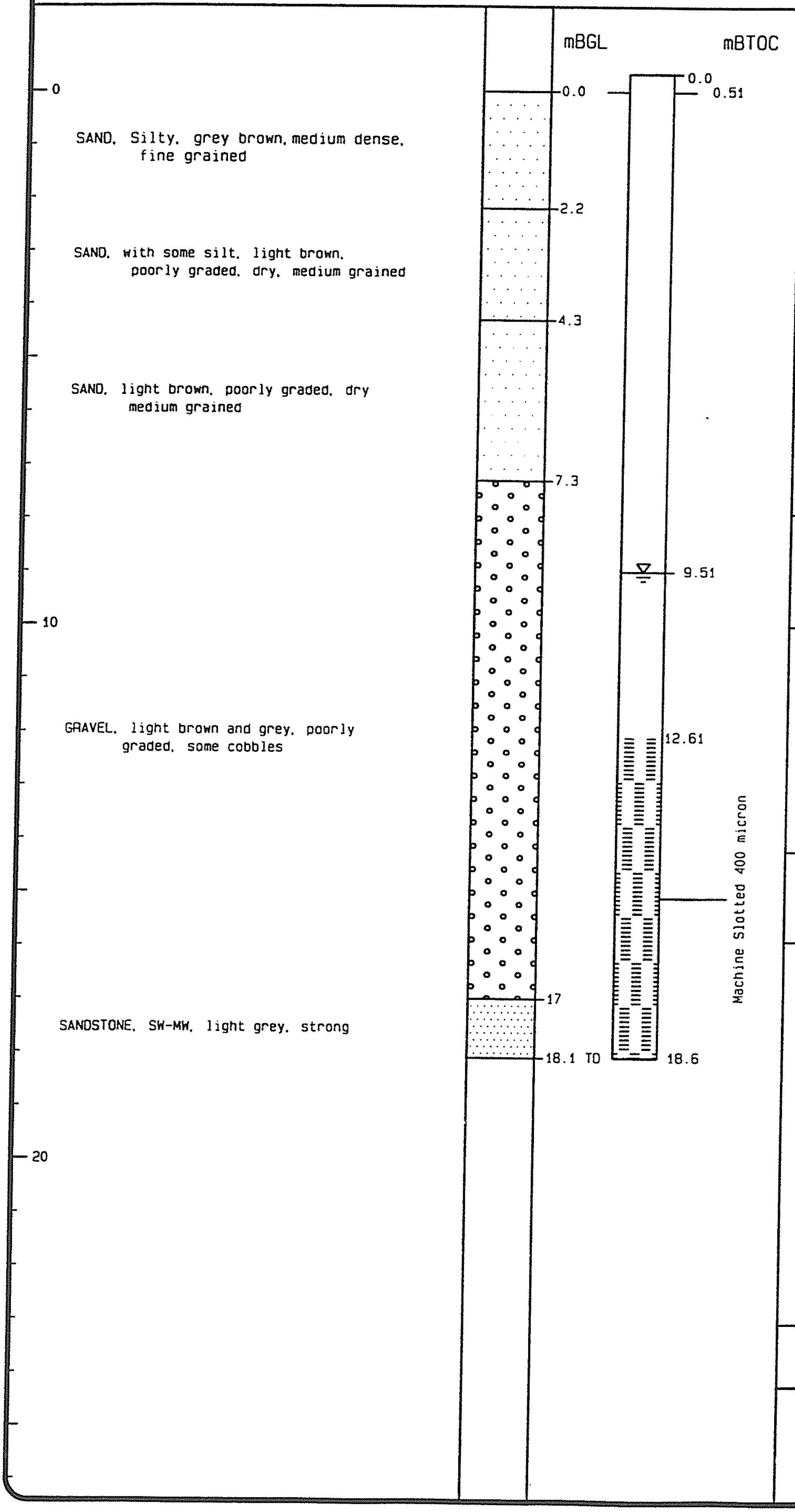
Appendix C

Borehole Completion Logs

BORE COMPLETION DETAILS - MP-BH1

MT PLEASANT

STRATIGRAPHIC DESCRIPTION LOG -- DEPTH



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : 'NEGOA'. Rayuga Road
Rig Type : Simcas
Date Drilled : 28-Jan-94
Coordinates : mE mN
Casing R.L. : mAHD
Top of Casing : 0.51 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 100 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 10.6m to 18.6mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 9.61m to 10.6mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 9.51mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : 6.99 Temp.: 22.8°C
Conductivity : 680 μS/cm

NOTES

NOTE: COLLAR SHORTENED TO 0.31mAGL on 18/2/94

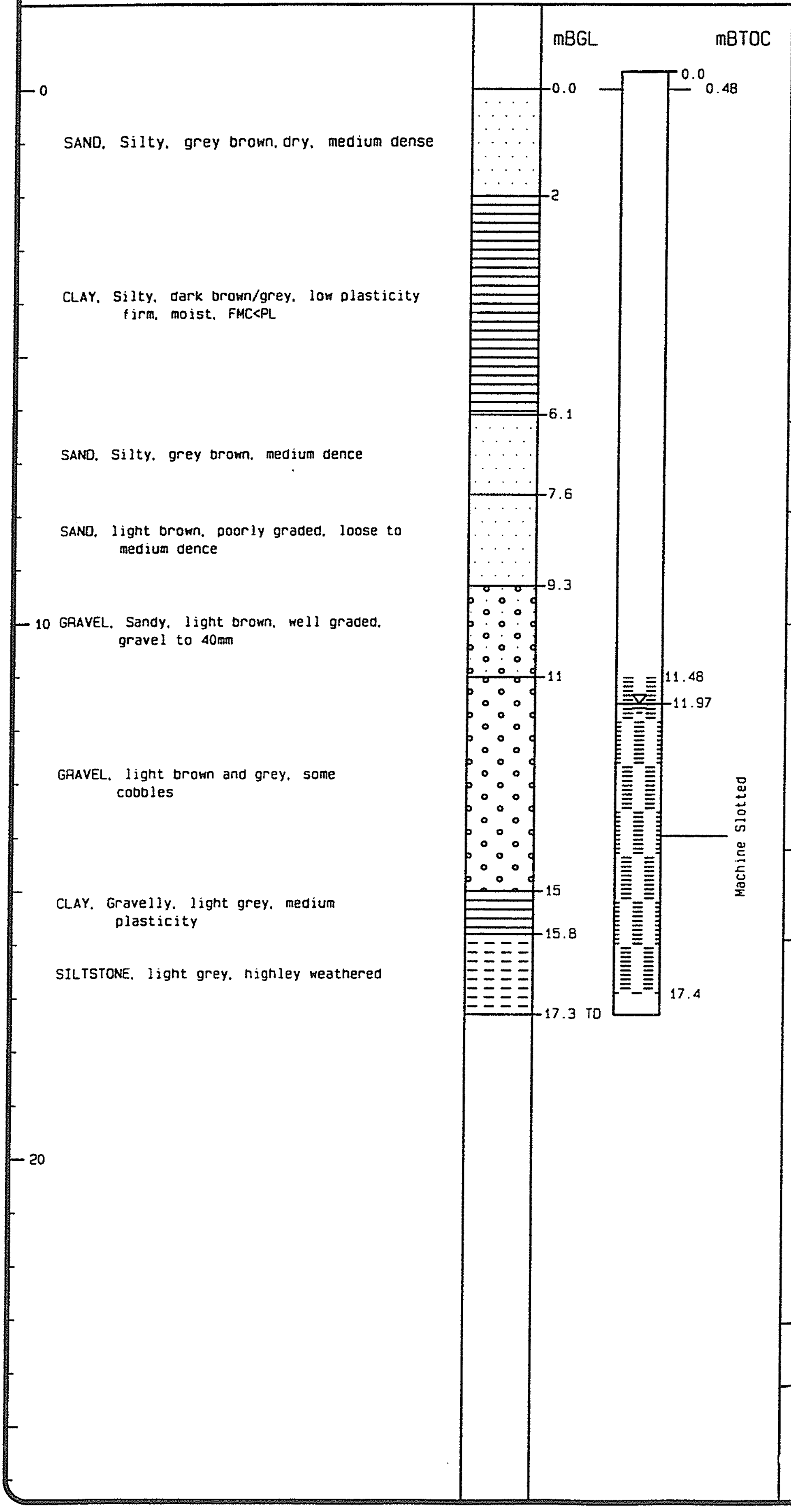
RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - MP-BH2

MT PLEASANT

STRATIGRAPHIC DESCRIPTION	Depth to (mBGL)
SAND, Silty, grey brown, dry, medium dense	2
CLAY, Silty, dark brown/grey, low plasticity firm, moist, FMC<PL	6.1
SAND, Silty, grey brown, medium dence	7.6
SAND, light brown, poorly graded, loose to medium dence	9.3
GRAVEL, Sandy, light brown, well graded, gravel to 40mm	11
GRAVEL, light brown and grey, some cobbles	15
CLAY, Gravelly, light grey, medium plasticity	15.8
SILTSTONE, light grey, highley weathered	17.3 TD

LOG -- DEPTH



DETAILS

GENERAL INFORMATION

Location : RMB 211 Wybong Road
Driller : McDermott Drilling
Rig Type : Simcas
Date Drilled : 28-Jan-94
Coordinates : mE mN
Casing R.L. : mAHD
Top of Casing : 0.48 mAGL

COMPLETION NOTES

Screen Type : Slotted
Material : Class 9 PVC 100mm
Diameter : 100 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 9.48m to 17.4mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 8.48m to 9.48mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 11.97mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : 7.19 Temp.: 22.9°C
Conductivity : 811 µS/cm

NOTES

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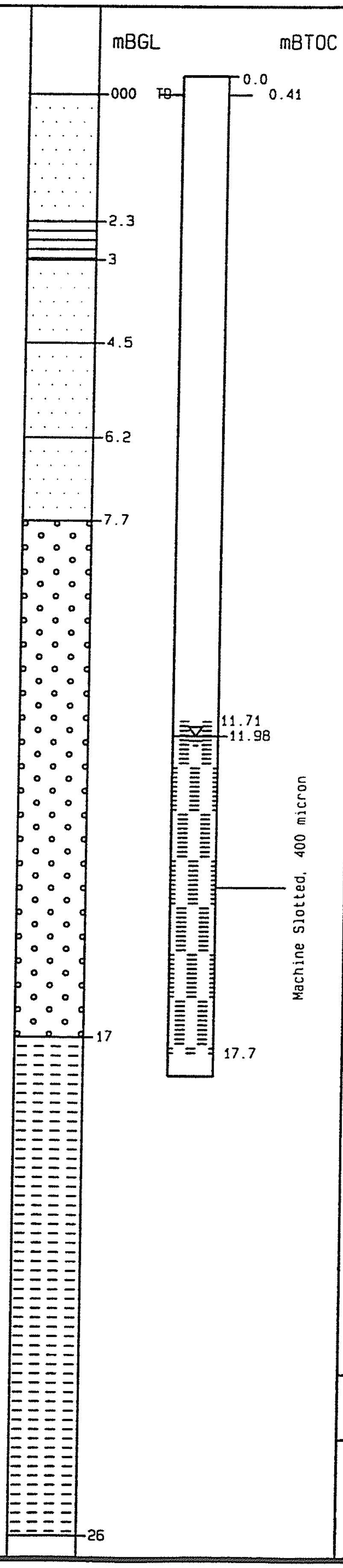
BORE COMPLETION DETAILS - MP-BH3

MT PLEASANT

STRATIGRAPHIC DESCRIPTION | LOG -- DEPTH

Depth (m)	Stratigraphic Description
0	SAND. Silty. grey brown. medium to fine grained
	CLAY. silty. grey brown. highly plastic
	SAND. silty. grey brown dry. fine to medium grained
	SAND. some silt. light brown. medium grained
	SAND. gravelly. light brown. medium grained sand. gravel to 15mm
10	GRAVEL. light brown. poorly graded
20	SILTSTONE. light grey. slightly weathered



DETAILS

GENERAL INFORMATION
Location : Kayuga Road
Driller : McDermott Drilling
Rig Type : Simcas
Date Drilled : 28-Jan-94
Coordinates : mE mN
Casing R.L. : mAHD
Top of Casing : 0.41 mAGL

COMPLETION NOTES
Screen Type : Slotted
Material : Class 9 PVC 100mm
Diameter : 100 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL
3 - 5mm gravel
from 9.71m to 19.7mBTOC

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal 8.71m to 9.71mBTOC

HYDRAULIC DATA
Top of Aquifer :
Static W.L.: 11.98mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : 7.59 Temp.: 22.0°C
Conductivity : 663 µS/cm

NOTES
NOTE: COLLAR REPLACED 18/2/94
NEW HEIGHT 0.43mAGL

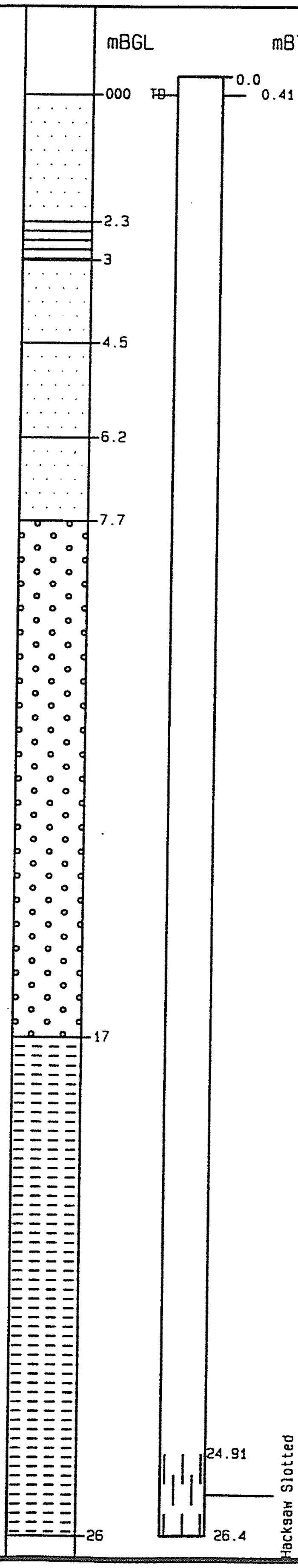
RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - MP-BH3P

MT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG	DEPTH

Depth (m)	Stratigraphic description
0 – 2.3	SAND. Silty, grey brown, medium to fine grained
2.3 – 3	CLAY. silty, grey brown, highly plastic
3 – 4.5	SAND. silty, grey brown dry, fine to medium grained
4.5 – 6.2	SAND. some silt, light brown, medium grained
6.2 – 7.7	SAND. gravelly, light brown, medium grained sand, gravel to 15mm
7.7 – 17	GRAVEL. light brown, poorly graded
17 – 26	SILTSTONE. light grey, slightly weathered



DETAILS

GENERAL INFORMATION
Location : Kayuga Rd., Lot 52, DP
Driller : McDermott Drilling
Rig Type : Simcas
Date Drilled : 28-Jan-94
Coordinates : mE mN
Casing R.L. : mAHD
Top of Casing : 0.41 mAGL

COMPLETION NOTES
Screen Type : Slotted
Material : Nylon 20mm
Diameter : 20mm mm
Slots : Hacksaw slotted
Open Area : %

FILTER PACK MATERIAL
3 - 5mm gravel
from 22.9m to 26.4mBTOC

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal 21.91m to 22.91mBTOC

HYDRAULIC DATA
Top of Aquifer :
Static W.L.:
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : 7.59 Temp.: 22.0°C
Conductivity : 663 µS/cm

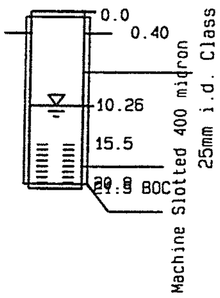
NOTES
NOTE: COLLAR REPLACED 18/2/94
NEW HEIGHT 0.43mAGL

RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 3500B500U

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	DEPTH (mBGL)
	0.0
SANDSTONE, light grey-brown soil top 40cm	4.8
SILTSTONE, minor SMUT	8.75
SILTSTONE and SANDSTONE	11.36
core loss	13.66
SANDSTONE, SILTSTONE and MUDSTONE Depth of weathering	20.95
SILTSTONE, SANDSTONE and MUDSTONE	28.62
COAL (WKH)	32.13
SANDSTONE, SILTSTONE and MUDSTONE	36.99
SANDSTONE	40.71
SANDSTONE and SILTSTONE	44.28
MUDSTONE	48.32
SILTSTONE and SANDSTONE	49.76
COAL (MTA)	56.18
SANDSTONE and SILTSTONE, minor MUDSTONE	60.72
COAL (PFD)	62.7
SANDSTONE and SILTSTONE	66.87
SANDSTONE	75.67
SANDSTONE and SILTSTONE	79.28
COAL (PFD)	82.46
SANDSTONE and SILTSTONE	85.25
SANDSTONE	93.84
SANDSTONE and SILTSTONE	98.62
SILTSTONE	100.56
COAL (VAU)	105.26
SILTSTONE and SANDSTONE	112.64
SANDSTONE and CONGLOMERATE	123.88
SANDSTONE and SILTSTONE	125.84
COAL (VAU)	126.78
SILTSTONE and SANDSTONE	130.3
SANDSTONE and SILTSTONE	138.14
SILTSTONE and MUDSTONE	140.8
COAL (BRN)	141.86
SANDSTONE and SILTSTONE	146.86
COAL (BRN)	148.46
MUDSTONE, SILTSTONE and SANDSTONE	150.68
SANDSTONE	154.56
SANDSTONE and SILTSTONE	159.82
CARBONACEOUS MUDSTONE, SANDSTONE, SILTSTONE	163.82
COAL (BAY)	175.68
SILTSTONE and MUDSTONE	177.14
SANDSTONE	182.92
COAL (BAY)	185.16
SANDSTONE	186.68
CARBONACEOUS MUDSTONE and SANDSTONE	187.6
CORE LOSS	190.5TD



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 03/05/94
Coordinates : 283500 mE 1430500mN
Casing R.L. : 203.0 mAHD
Top of Casing : 0.40 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 25 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 13.5m to 23.5mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 12.5m to 13.5mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 10.26mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : Temp.:
Conductivity :

NOTES

Static water levels for October 1994.

Bail-out test conducted on 9/9/94.

Recovery: 5.312m in 25 min

k = 0.00635 kl/day/m2

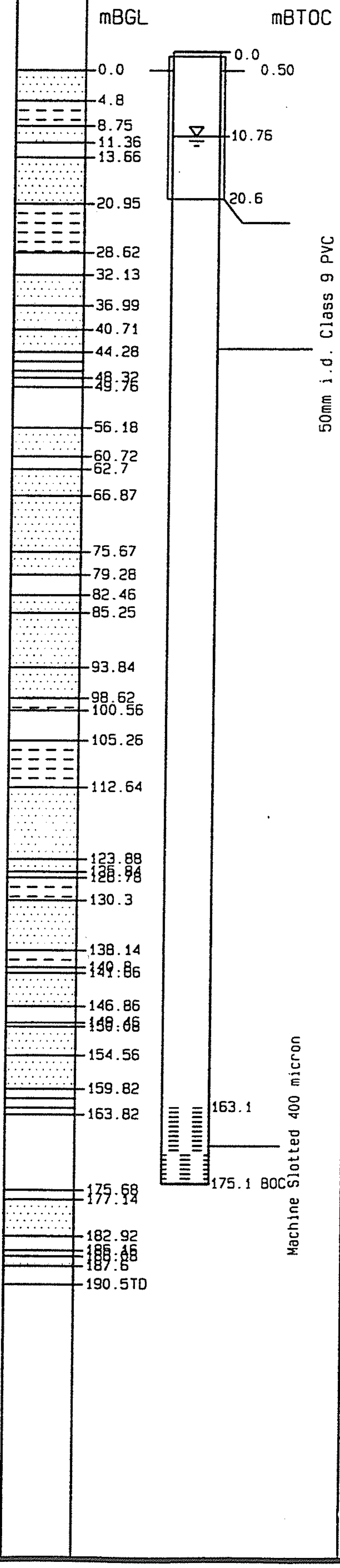
RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 3500B500L

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION | LOG | DEPTH

- SANDSTONE, light grey-brown soil top 40cm
- SILTSTONE, minor SMUT
- SILTSTONE and SANDSTONE
- core loss
- SANDSTONE, SILTSTONE and MUDSTONE
- Depth of weathering
- SILTSTONE, SANDSTONE and MUDSTONE
- COAL (WKH)
- SANDSTONE, SILTSTONE and MUDSTONE
- SANDSTONE
- SANDSTONE and SILTSTONE
- MUDSTONE
- SILTSTONE and SANDSTONE
- COAL (MTA)
- SANDSTONE and SILTSTONE, minor MUDSTONE
- COAL (PFD)
- SANDSTONE and SILTSTONE
- SANDSTONE
- SANDSTONE and SILTSTONE
- COAL (PFD)
- SANDSTONE and SILTSTONE
- SANDSTONE
- SANDSTONE and SILTSTONE
- SILTSTONE
- COAL (VAU)
- SILTSTONE and SANDSTONE
- SANDSTONE and CONGLOMERATE
- SANDSTONE and SILTSTONE
- COAL (VAU)
- SILTSTONE and SANDSTONE
- SANDSTONE and SILTSTONE
- SILTSTONE and MUDSTONE
- COAL (BRN)
- SANDSTONE and SILTSTONE
- COAL (BRN)
- MUDSTONE, SILTSTONE and SANDSTONE
- SANDSTONE
- SANDSTONE and SILTSTONE
- CARBONACEOUS MUDSTONE, SANDSTONE, SILTSTONE
- COAL (BAY)
- SILTSTONE and MUDSTONE
- SANDSTONE
- COAL (BAY)
- CARBONACEOUS MUDSTONE and SANDSTONE
- SANDSTONE
- CORE LOSS



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 03/05/94
Coordinates : 283500 mE 1430500mN
Casing R.L. : 202.9 mAHD
Top of Casing : 0.50 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 50 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 160m to 177mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 160m to 161mBTOC

HYDRAULIC DATA

Top of Aquifer : 163.8mBGL
Static W.L.: 10.76mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : 7.1 Temp.:
Conductivity : 390 µS/cm

NOTES

Static water levels for October 1994.

Logger No. 39380.

Bail out test conducted on 9/9/94.

k = 0.017 kl/day/m2

RUST PPK
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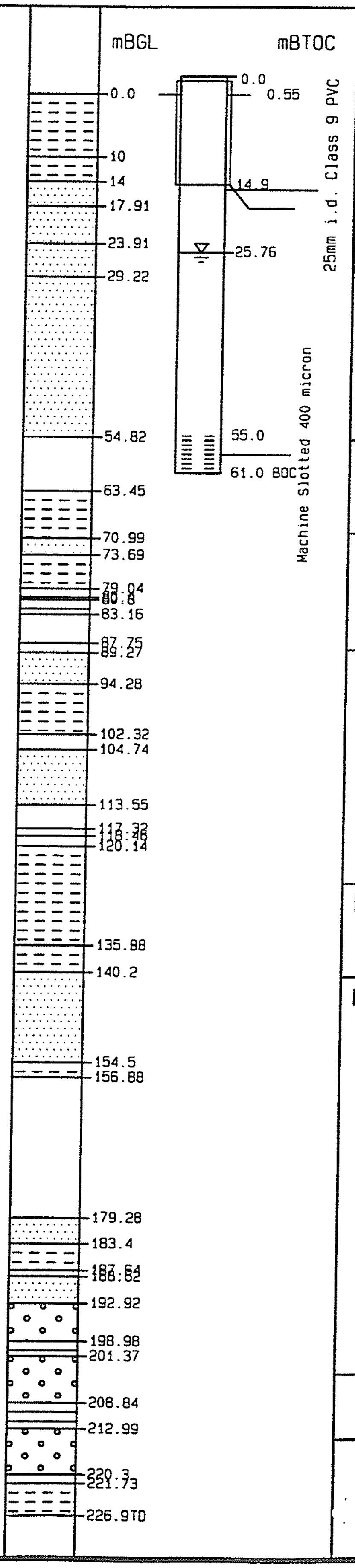
BORE COMPLETION DETAILS - 3500C500U

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION — LOG — DEPTH

- 0 SILTSTONE
- 10 SILTSTONE and SANDSTONE
- SANDSTONE
- 20 SANDSTONE and SILTSTONE
- SANDSTONE
- 30
- 40 SANDSTONE and SILTSTONE
- 50
- 60 COAL (WKH), minor claystone and mudstone
- SILTSTONE and SANDSTONE
- 70 SANDSTONE
- SILTSTONE and SANDSTONE
- 80 MUDSTONE and CARBONACEOUS MUDSTONE
- COAL (MTA)
- CLAYSTONE
- COAL (MTA)
- SILTSTONE and SANDSTONE, minor MUDSTONE
- 90 SANDSTONE, SILTSTONE and CLAYSTONE
- 100 SILTSTONE and SANDSTONE
- COAL (PFD)
- 110 SANDSTONE and SILTSTONE
- COAL (PFD), minor MUDSTONE and CLAYSTONE
- SILTSTONE, CARBONACEOUS MUDSTONE, SANDSTONE
- 120 COAL (VAU)
- 130 SILTSTONE, SANDSTONE, CARBONACEOUS MUDSTONE
- COAL (VAU)
- 140 SILTSTONE and SANDSTONE
- SANDSTONE and CONGLOMERATE
- 150
- SILTSTONE and SANDSTONE
- 160
- 170 COAL (BRN)
- 180 SANDSTONE
- SILTSTONE and SANDSTONE
- COAL (BAY) with carbonaceous mudstone
- 190 SANDSTONE and SILTSTONE
- CONGLOMERATE and SANDSTONE
- 200 CARBONACEOUS MUDSTONE, SILTSTONE, SANDSTONE minor COAL
- CONGLOMERATE and SANDSTONE
- 210 CARBONACEOUS MUDSTONE and SANDSTONE
- CONGLOMERATE, SANDSTONE and MUDSTONE
- 220 COAL (WYN), minor CLAYSTONE and MUDSTONE
- SILTSTONE and SANDSTONE
- 230



DETAILS

GENERAL INFORMATION
Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 08/03/94
Coordinates : 283500 mE 1431500mN
Casing R.L. : 239.2 mAHD
Top of Casing : 0.55 mAGL

COMPLETION NOTES
Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 25 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL
3 - 5mm gravel
from 53.0m to 63.0mBTOC

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal 52.0m to 53.0mBTOC

HYDRAULIC DATA
Top of Aquifer :
Static W.L.: 25.76mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : 7.4 Temp.:
Conductivity : 340 µS/cm

NOTES
Static water levels for October 1994.

Logger No. 39378.

Bail-in test conducted on 9/9/94.

T = 0.529 kl/day/m

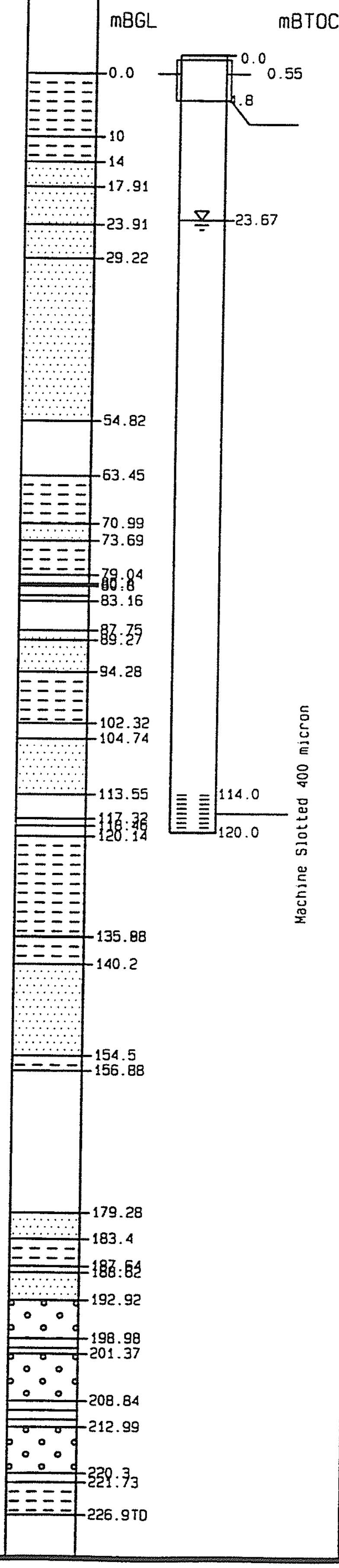
Apparent connection between uppe and lower piezometers.

RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 3500C500L

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG	DEPTH (mBGL)
SILTSTONE		0.0
SILTSTONE and SANDSTONE		10
SANDSTONE		14
SANDSTONE and SILTSTONE		17.91
SANDSTONE		23.91
SANDSTONE and SILTSTONE		29.22
COAL (WKH), minor claystone and mudstone		54.82
SILTSTONE and SANDSTONE		63.45
SANDSTONE		70.99
SILTSTONE and SANDSTONE		73.69
COAL (MTA) MUDSTONE and CARB. MUDSTONE CLAYSTONE		79.04 / 80.8
COAL (MTA)		83.16
SILTSTONE and SANDSTONE, minor MUDSTONE		87.75
SANDSTONE, SILTSTONE and CLAYSTONE		89.27
SILTSTONE and SANDSTONE		94.28
COAL (PFD)		102.32
SANDSTONE and SILTSTONE		104.74
COAL (PFD), minor MUDSTONE and CLAYSTONE		113.55
SILTSTONE, CARBONACEOUS MUDSTONE, SANDSTONE		117.32
COAL (VAU)		118.46
SILTSTONE, SANDSTONE, CARBONACEOUS MUDSTONE		120.14
COAL (VAU)		135.88
SILTSTONE and SANDSTONE		140.2
SANDSTONE and CONGLOMERATE		
SILTSTONE and SANDSTONE		154.5
COAL (BRN)		156.88
SANDSTONE		179.28
SILTSTONE and SANDSTONE		183.4
COAL (BAY) with carbonaceous mudstone		187.64
SANDSTONE and SILTSTONE		188.82
CONGLOMERATE and SANDSTONE		192.92
CARBONACEOUS MUDSTONE, SILTSTONE, SANDSTONE minor COAL		198.98
CONGLOMERATE and SANDSTONE		201.37
CARBONACEOUS MUDSTONE and SANDSTONE		208.84
CONGLOMERATE, SANDSTONE and MUDSTONE		212.99
COAL (WYN), minor CLAYSTONE and MUDSTONE		220.3
SILTSTONE and SANDSTONE		221.73
		226.9TD



DETAILS

GENERAL INFORMATION
Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 08/03/94
Coordinates : 283500 mE 1431500mN
Casing R.L. : 39.2 mAHD
Top of Casing : 0.55 mAGL

COMPLETION NOTES
Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 50 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL
3 - 5mm gravel
from 112.0m to 122.0mBTOC

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal 111.0m to 112.0mBTOC

HYDRAULIC DATA
Top of Aquifer :
Static W.L.: 23.67mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : 6.9 Temp.:
Conductivity : 1463 µS/cm

NOTES
Static water levels for October 1994.

Bail-in test conducted on 9/9/94.

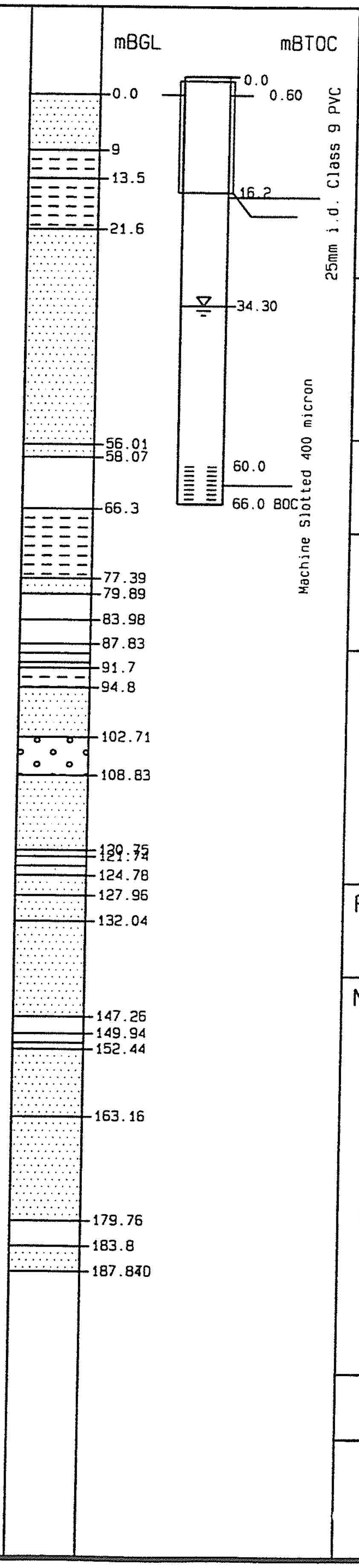
T = 0.4355 kl/day/m

RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 3500E000U

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG - DEPTH (mBGL)
SANDSTONE	0.0 – 9
SILTSTONE	9 – 13.5
SILTSTONE and SANDSTONE	13.5 – 21.6
SANDSTONE	21.6 – 56.01
SANDSTONE and SILTSTONE	56.01 – 58.07
COAL (WKH), minor CARBONACEOUS MUDSTONE	58.07 – 66.3
SILTSTONE and SANDSTONE	66.3 – 77.39
SANDSTONE	77.39 – 79.89
CLAYSTONE	79.89 – 83.98
COAL (MTA), minor CLAYSTONE and MUDSTONE	83.98 – 87.83
CARBONACEOUS MUDSTONE, SILTSTONE, SANDSTONE	87.83 – 91.7
SILTSTONE and SANDSTONE	91.7 – 94.8
SANDSTONE and SILTSTONE	94.8 – 102.71
CONGLOMERATE AND SANDSTONE	102.71 – 108.83
SANDSTONE, SILTSTONE and CONGLOMERATE	108.83 – 120.75
COAL (PFD)	120.75 – 121.74
MUDSTONE, minor COAL	121.74 – 124.78
SANDSTONE and SILTSTONE	124.78 – 127.96
SANDSTONE	127.96 – 132.04
SANDSTONE and SILTSTONE	132.04 – 147.26
COAL (PFD)	147.26 – 149.94
CARBONACEOUS MUDSTONE	149.94 – 152.44
SANDSTONE and SILTSTONE	152.44 – 163.16
SANDSTONE	163.16 – 179.76
COAL (VAU)	179.76 – 183.8
SANDSTONE and SILTSTONE	183.8 – 187.840



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 08/06/94
Coordinates : 283500 mE 1433000mN
Casing R.L. : 264.4 mAHD
Top of Casing : 0.60 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 25 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 58.0m to 68.0mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 57.0m to 58.0mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 34.30mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : Temp.:
Conductivity :

NOTES

Static water levels for October 1994.

Bail-out test conducted on 6/9/94.

Recovery: 11.04m in 29 min.

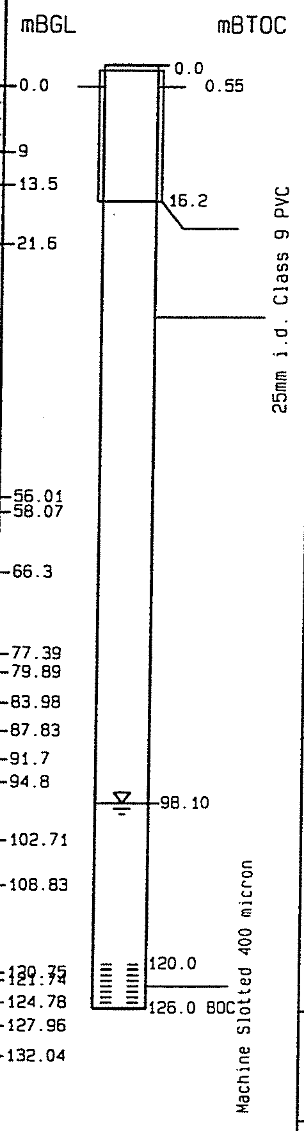
k = 0.022 kl/day/m2

RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 3500E000M

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG - DEPTH (mBGL)
SANDSTONE	0.0 – 9
SILTSTONE	9 – 13.5
SILTSTONE and SANDSTONE	13.5 – 21.6
SANDSTONE	21.6 – 56.01
SANDSTONE and SILTSTONE	56.01 – 58.07
COAL (WKH), minor CARBONACEOUS MUDSTONE	58.07 – 66.3
SILTSTONE and SANDSTONE	66.3 – 77.39
SANDSTONE	77.39 – 79.89
CLAYSTONE	79.89 – 83.98
COAL (MTA), minor CLAYSTONE and MUDSTONE	83.98 – 87.83
CARBONACEOUS MUDSTONE, SILTSTONE, SANDSTONE	87.83 – 91.7
SILTSTONE and SANDSTONE	91.7 – 94.8
SANDSTONE and SILTSTONE	94.8 – 102.71
CONGLOMERATE AND SANDSTONE	102.71 – 108.83
SANDSTONE, SILTSTONE and CONGLOMERATE	108.83 – 120.75
COAL (PFO)	120.75 – 121.74
MUDSTONE, minor COAL	121.74 – 124.78
SANDSTONE and SILTSTONE	124.78 – 127.96
SANDSTONE	127.96 – 132.04
SANDSTONE and SILTSTONE	132.04 – 147.26
COAL (PFO)	147.26 – 149.94
CARBONACEOUS MUDSTONE	149.94 – 152.44
SANDSTONE and SILTSTONE	152.44 – 163.16
SANDSTONE	163.16 – 179.76
COAL (VAU)	179.76 – 183.8
SANDSTONE and SILTSTONE	183.8 – 187.84 TD



DETAILS

GENERAL INFORMATION
Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 08/06/94
Coordinates : 283500 mE 1433000mN
Casing R.L. : 264.4 mAHD
Top of Casing : 0.55 mAGL

COMPLETION NOTES
Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 25 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL
3 - 5mm gravel
from 118.0m to 128.0mBTOC

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal 117.0m to 118.0mBTOC

HYDRAULIC DATA
Top of Aquifer :
Static W.L.: 98.10mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : Temp.:
Conductivity :

NOTES
Static water levels for October 1994.

Bail-out test conducted on 6/9/94.

Recovery: 23.182m in 26 min

k = 0.00401 kl/day/m2

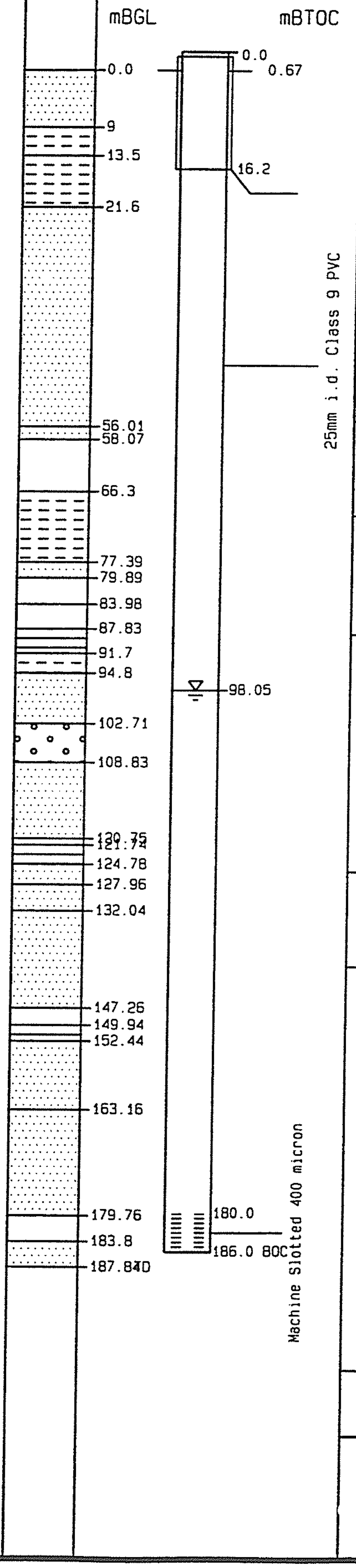
RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 3500E000L

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION | LOG | DEPTH

SANDSTONE
SILTSTONE
SILTSTONE and SANDSTONE
SANDSTONE
SANDSTONE and SILTSTONE
COAL (WKH), minor CARBONACEOUS MUDSTONE
SILTSTONE and SANDSTONE
SANDSTONE
CLAYSTONE
COAL (MTA), minor CLAYSTONE and MUDSTONE
CARBONACEOUS MUDSTONE, SILTSTONE, SANDSTONE
SILTSTONE and SANDSTONE
SANDSTONE and SILTSTONE
CONGLOMERATE AND SANDSTONE
SANDSTONE, SILTSTONE and CONGLOMERATE
COAL (PFO)
MUDSTONE, minor COAL
SANDSTONE and SILTSTONE
SANDSTONE
SANDSTONE and SILTSTONE
COAL (PFO)
CARBONACEOUS MUDSTONE
SANDSTONE and SILTSTONE
SANDSTONE
COAL (VAU)
SANDSTONE and SILTSTONE



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 08/06/94
Coordinates : 283500 mE 1433000mN
Casing R.L. : 264.3 mAHD
Top of Casing : 0.67 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 25 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 178.0m to 187.0mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 177.0m to 178.0mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 98.05mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : Temp.:
Conductivity :

NOTES

Static water levels for October 1994.

Bail-in test conducted on 6/9/94.

Recovery: 0.283m in 21.1 min

T = 0.692 kl/day/m

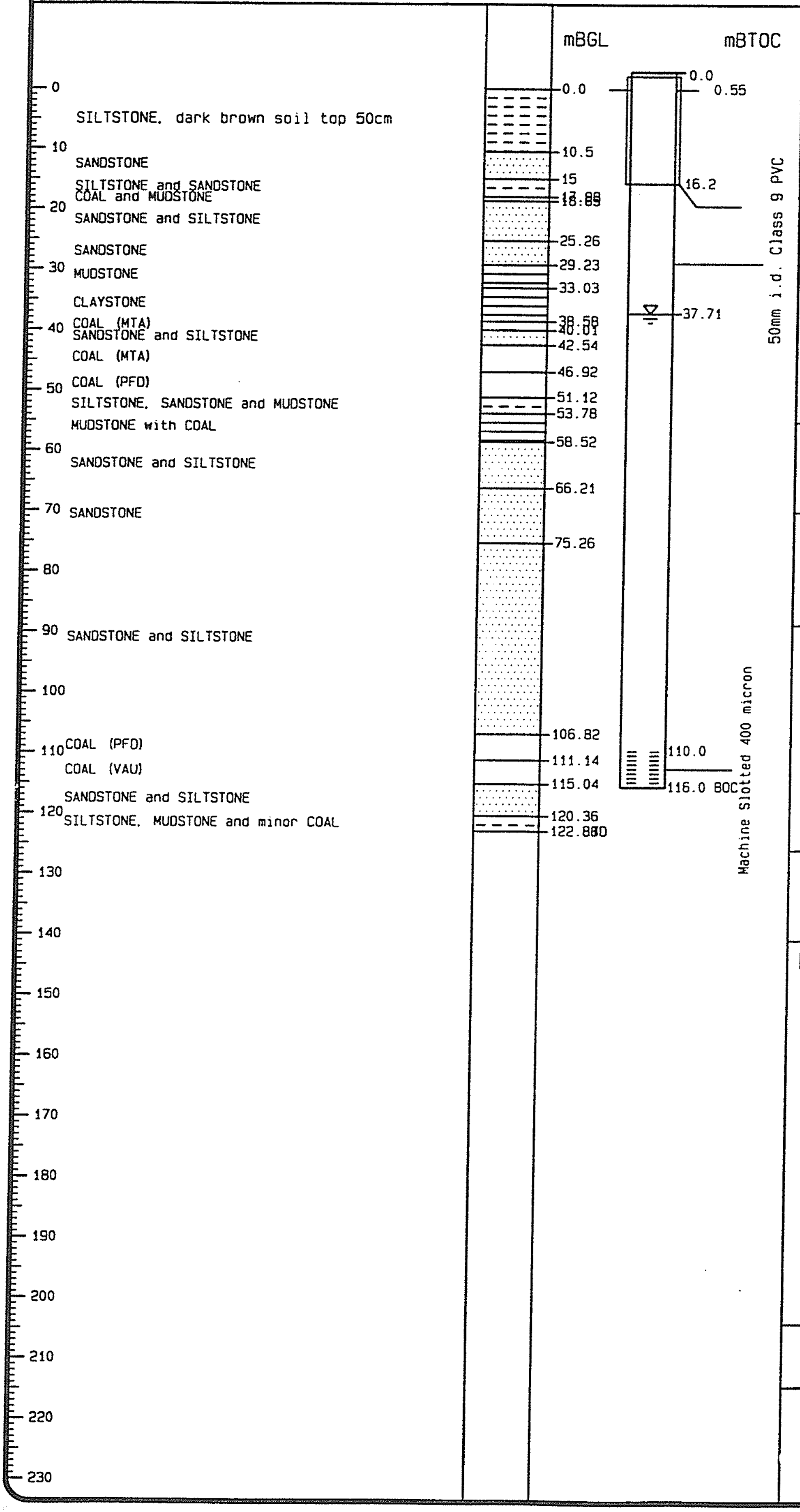
RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 4500F000

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION | LOG | DEPTH

SILTSTONE. dark brown soil top 50cm
SANDSTONE
SILTSTONE and SANDSTONE
COAL and MUDSTONE
SANDSTONE and SILTSTONE
SANDSTONE
MUDSTONE
CLAYSTONE
COAL (MTA)
SANDSTONE and SILTSTONE
COAL (MTA)
COAL (PFD)
SILTSTONE, SANDSTONE and MUDSTONE
MUDSTONE with COAL
SANDSTONE and SILTSTONE
SANDSTONE
SANDSTONE and SILTSTONE
COAL (PFD)
COAL (VAU)
SANDSTONE and SILTSTONE
SILTSTONE, MUDSTONE and minor COAL



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 14/06/94
Coordinates : 284500 mE 1434000mN
Casing R.L. : 216.6 mAHD
Top of Casing : 0.55 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 50 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 108.0m to 118.0mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 107.0m to 108.0mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 37.71mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : 7.2 Temp.:
Conductivity : 773 µS/cm

NOTES

Static water levels for October 1994.

Logger No. 12153B.

Bail-in test conducted on 6/9/94.

Recovery: 18.70m in 44.45 min.

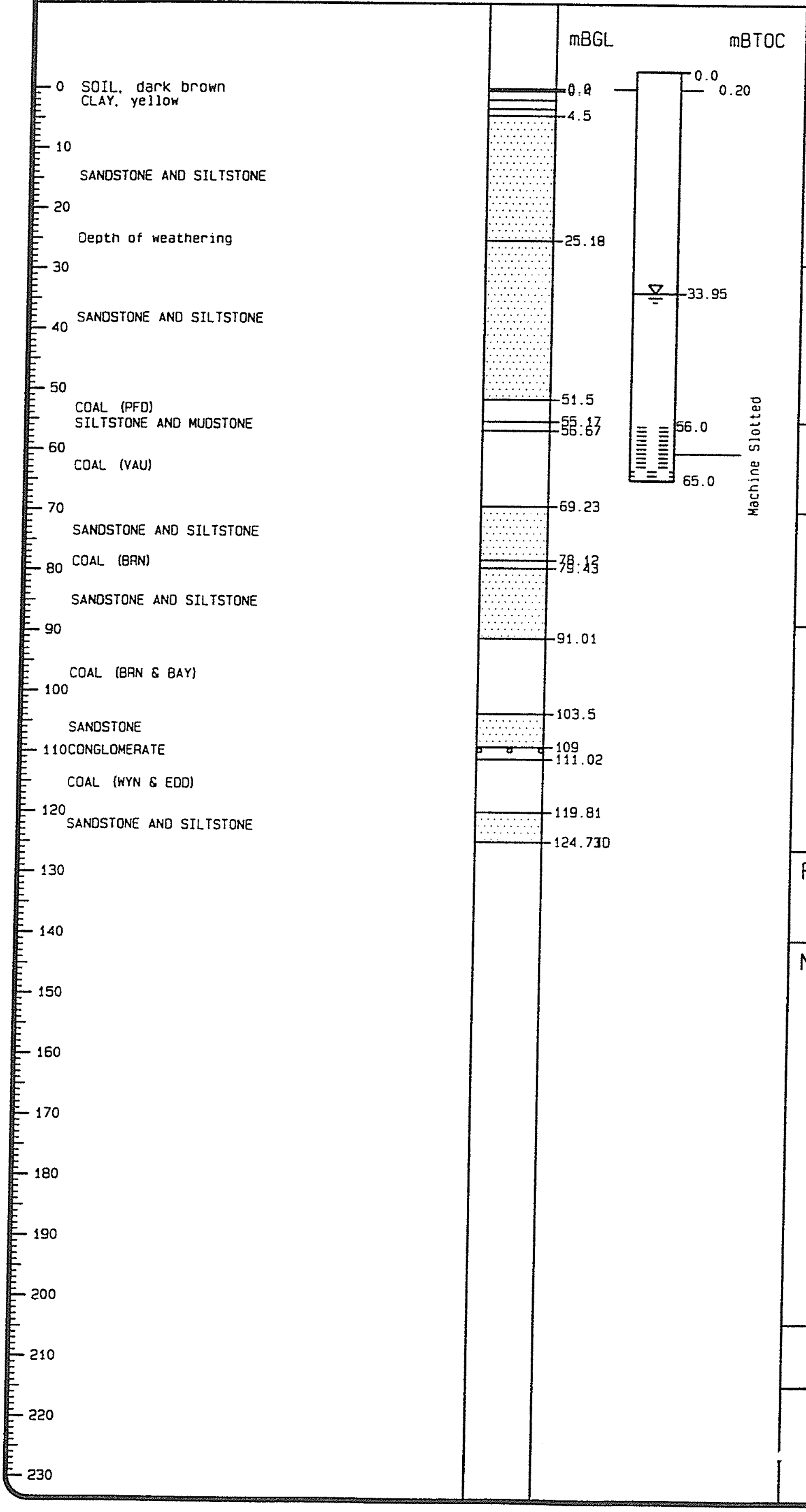
T = 0.0835 kl/day/m

RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 5000A500

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION LOG - DEPTH



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 23/12/93
Coordinates : 284997 mE 1429496mN
Casing R.L. : 200.3 mAHD
Top of Casing : 0.20 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC, 50mm
Diameter : 50 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 54.0m to 67.0mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 53.0m to 54.0mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 33.95mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : Temp.:
Conductivity :

NOTES

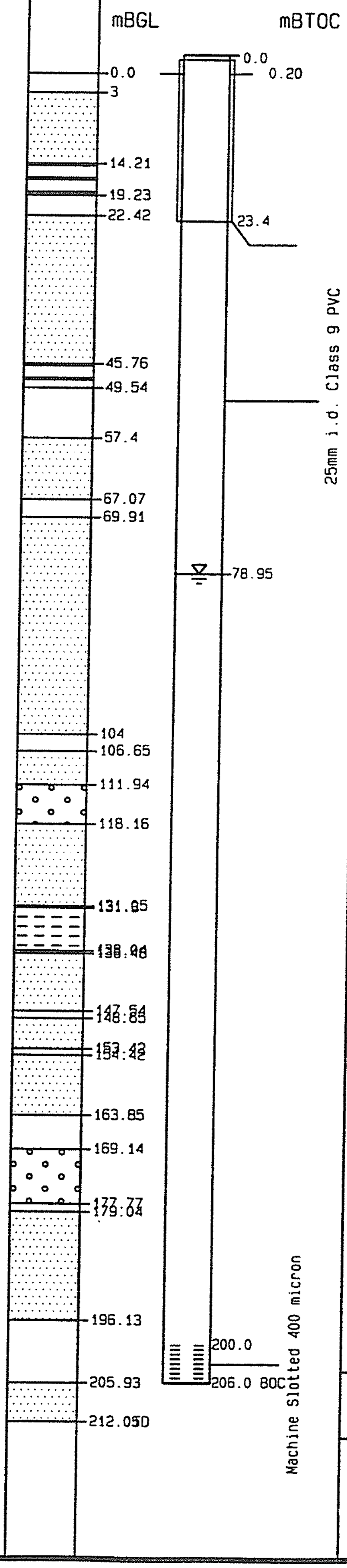
RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 5000D000

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION | LOG | DEPTH

Depth scale (m)	Stratigraphic description
0	SOIL, sandy
10	SANDSTONE
	CLAYSTONE AND MUDSTONE
20	COAL (WKH)
30	SANDSTONE AND SILTSTONE
40	
	CLAYSTONE
50	COAL (MTA & PFD)
60	SANDSTONE AND SILTSTONE
70	COAL (PFD)
80	
90	SANDSTONE AND SILTSTONE
100	
	COAL (VAU)
110	SANDSTONE AND SILTSTONE
	SANDSTONE CONGLOMERATE
120	
	SANDSTONE AND SILTSTONE
130	COAL (BRN)
	SILTSTONE AND SANDSTONE
140	COAL (BRN)
	SANDSTONE AND SILTSTONE
	COAL (BRN)
150	SANDSTONE AND SILTSTONE
	COAL AND MUDSTONE (BRN)
160	SANDSTONE AND SILTSTONE
	COAL (BAY)
170	CONGLOMERATE AND SANDSTONE 0.63m igneous layer at base
180	COAL (WYN)
190	SANDSTONE AND SILTSTONE
200	COAL (WYN & EDD)
210	SANDSTONE AND SILTSTONE
220	
230	



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 13/12/93
Coordinates : 284999 mE 1431998mN
Casing R.L. : 240.9 mAHD
Top of Casing : 0.20 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 25 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 198.0m to 208.0mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 197.0m to 198.0mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 78.95mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : Temp.:
Conductivity :

NOTES

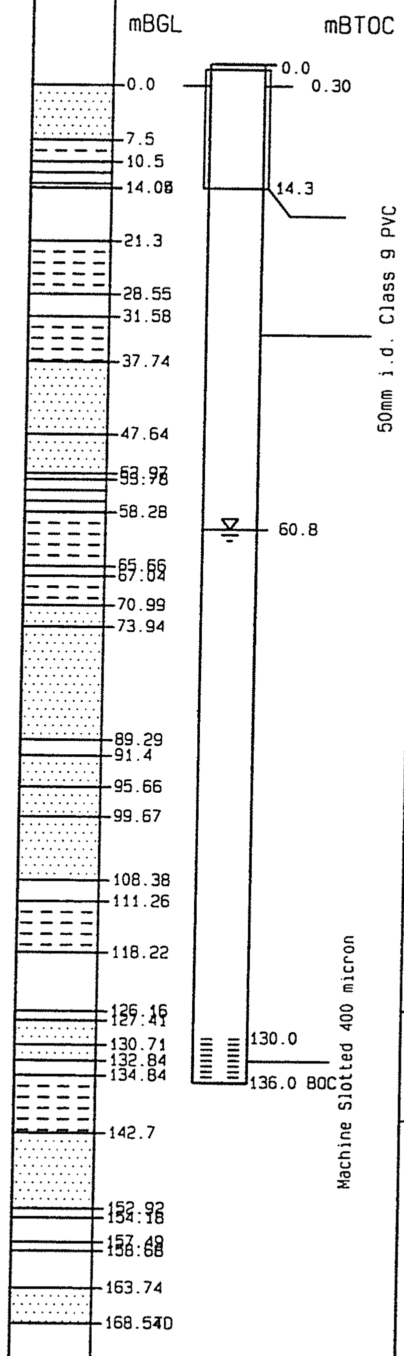
RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 5500D000

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION   LOG   - DEPTH

Depth scale	Stratigraphic description
0	SANDSTONE
10	SILTSTONE and CLAYSTONE
	CLAYSTONE
	Depth of Weathering
	COAL (MTA & PFD)
20	SILTSTONE and SANDSTONE
30	COAL (PFD)
	SILTSTONE and SANDSTONE and minor mudstone
40	SANDSTONE
50	SANDSTONE and SILTSTONE
	CARB. MUDSTONE, minor coal (VAU)
	CARB. MUDSTONE and SANDSTONE
60	SILTSTONE and SANDSTONE
	COAL (VAU)
70	SILTSTONE and SANDSTONE
	SANDSTONE
80	SANDSTONE and SILTSTONE, minor carb. mudstone
90	COAL (BRN)
	SANDSTONE and SILTSTONE
	SANDSTONE
100	SANDSTONE and SILTSTONE
110	COAL (BRN)
	SILTSTONE and SANDSTONE
120	COAL (BAY)
	SANDSTONE and CONGLOMERATE
130	SANDSTONE
	SANDSTONE and CONGLOMERATE
	COAL (WYN)
140	SILTSTONE and SANDSTONE
	SANDSTONE
150	SANDSTONE and SILTSTONE
	COAL (WYN)
	SILTSTONE minor claystone
160	COAL (EDD)
	SANDSTONE and SILTSTONE
170	
180	
190	
200	
210	
220	
230	



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 27/01/94
Coordinates : 285500mE 1432000mN
Casing R.L. : 221.7 mAHD
Top of Casing : 0.30 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 50 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 128.0m to 138.0mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 127.0m to 128.0mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 60.8mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : 7 Temp.:
Conductivity : 393 μS/cm

NOTES

Static water level for October 1994.

Bail-in test conducted on 9/9/94.

Recovery: 2.459m in 19.83 min

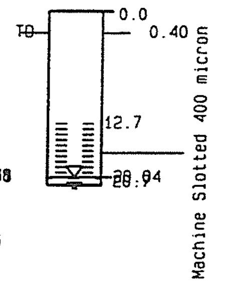
T = 0.285 kl/day/m

RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS - 6000C000U

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG -- DEPTH (mBGL)
SOIL, dark brown	000
SILTSTONE	3.1
SANDSTONE	6.8
SILTSTONE Depth of Weathering SANDSTONE AND SILTSTONE	19.38 / 19.5
COAL (BRN & BAY)	28.5
CONGLOMERATE/SANDSTONE	40.07
COAL (WYN)	48.99
SANDSTONE, MUDSTONE AND SILTSTONE	54.88
COAL (EDO)	56.89
SANDSTONE AND SILTSTONE	61.3
COAL (CLN & BNG)	73.83
SANDSTONE AND SILTSTONE, minor coal layers	77.54
COAL AND CLAYSTONE	102.29
SANDSTONE AND SILTSTONE	106.7
COAL AND SILTSTONE (EGA)	123.37
SANDSTONE AND SILTSTONE	125.62
COAL	134.82
SANDSTONE AND SILTSTONE	136.08
COAL (EGA)	139.56
SANDSTONE AND SILTSTONE	143.42
	147



DETAILS

GENERAL INFORMATION
Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 23/12/93
Coordinates : 286000 mE 1431000mN
Casing R.L. : 179.9 mAHD
Top of Casing : 0.40 mAGL

COMPLETION NOTES
Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 25 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL
3 - 5mm gravel
from 10.7m to 22.7mBTOC

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal 9.7m to10.7mBTOC

HYDRAULIC DATA
Top of Aquifer :
Static W.L.: 20.04mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : Temp.:
Conductivity :

NOTES

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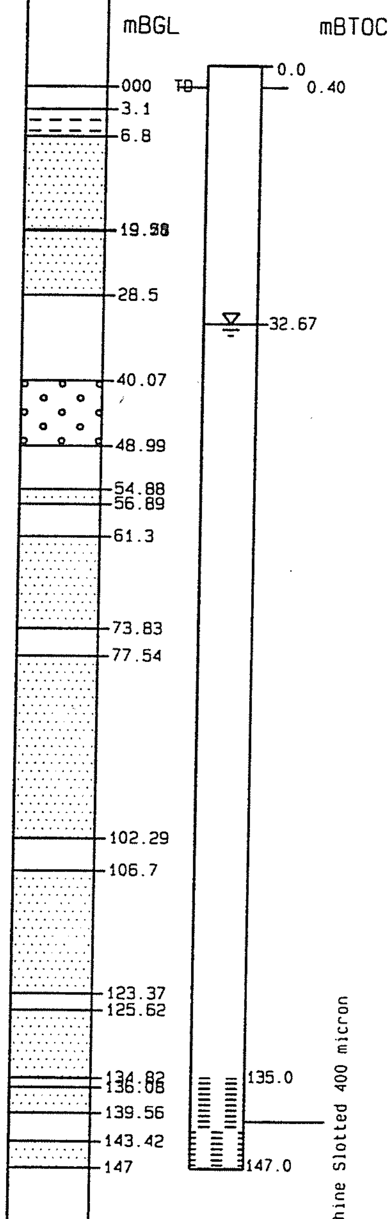
BORE COMPLETION DETAILS - 6000C000L

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION | LOG - DEPTH

Stratigraphic description (depth scale 0–230 m):

- SOIL, dark brown
- SILTSTONE
- SANDSTONE
- SILTSTONE
- Depth of Weathering
- SANDSTONE AND SILTSTONE
- COAL (BRN & BAY)
- CONGLOMERATE/SANDSTONE
- COAL (WYN)
- SANDSTONE, MUDSTONE AND SILTSTONE
- COAL (EDD)
- SANDSTONE AND SILTSTONE
- COAL (CLN & BNG)
- SANDSTONE AND SILTSTONE, minor coal layers
- COAL AND CLAYSTONE
- SANDSTONE AND SILTSTONE
- COAL AND SILTSTONE (EGA)
- SANDSTONE AND SILTSTONE
- COAL
- SANDSTONE AND SILTSTONE
- COAL (EGA)
- SANDSTONE AND SILTSTONE



DETAILS

GENERAL INFORMATION
Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 20/12/93
Coordinates : 286000 mE 1431000mN
Casing R.L. : 179.9 mAHD
Top of Casing : 0.40 mAGL

COMPLETION NOTES
Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 50 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL
3 - 5mm gravel
from 133.0m to 149.0mBTOC

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal 132.0m to 133.0mBTOC

HYDRAULIC DATA
Top of Aquifer :
Static W.L.: 32.67mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : Temp.:
Conductivity :

NOTES

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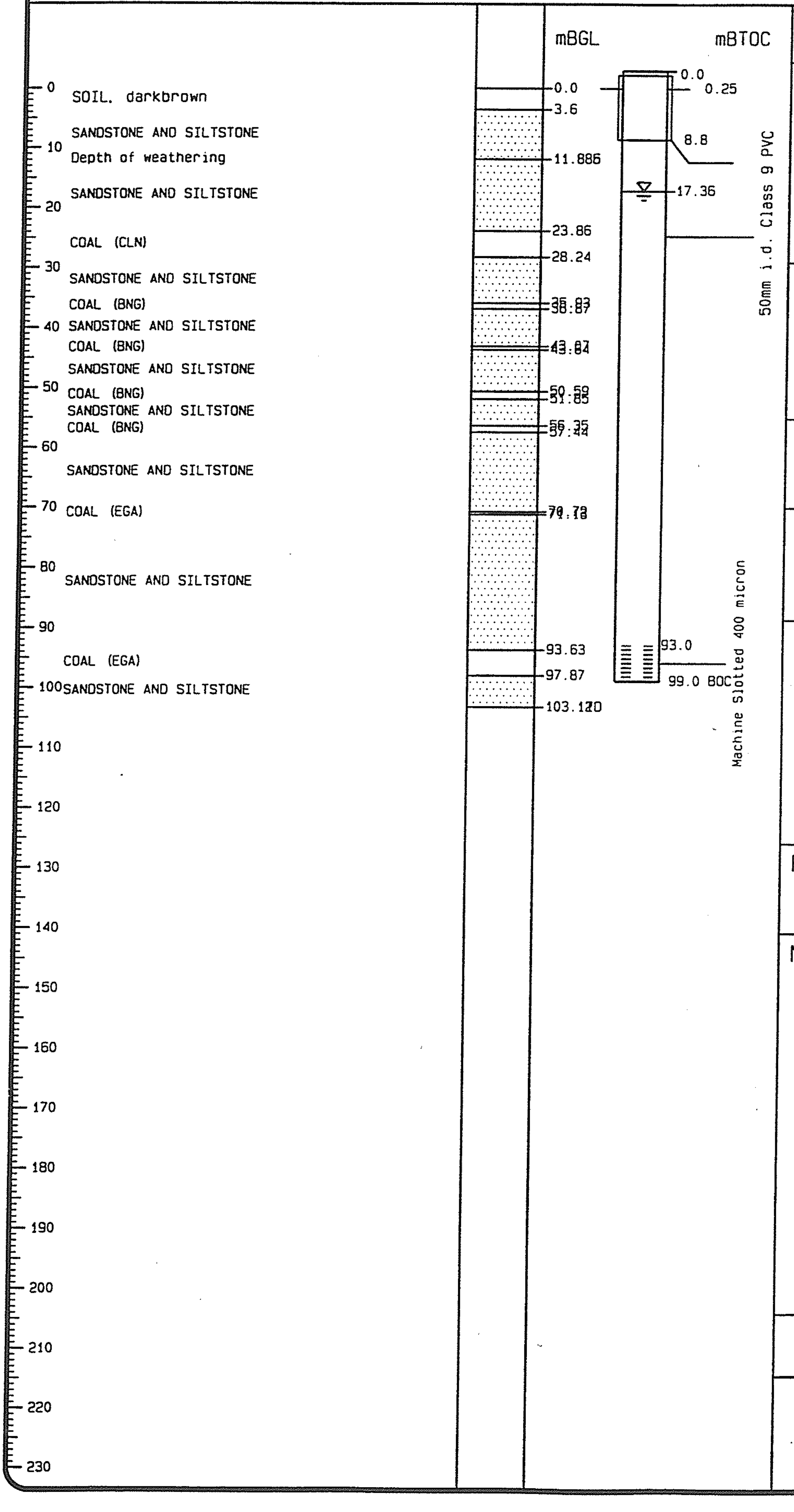
BORE COMPLETION DETAILS - 7000D000L

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION LOG -- DEPTH



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 23/12/93
Coordinates : 287000 mE 1431999mN
Casing R.L. : 162.1 mAHD
Top of Casing : 0.25 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 50 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3-5mm gravel
from 91.0m to 101.0mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 90.0m to 91.0mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 17.36mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : Temp.:
Conductivity :

NOTES

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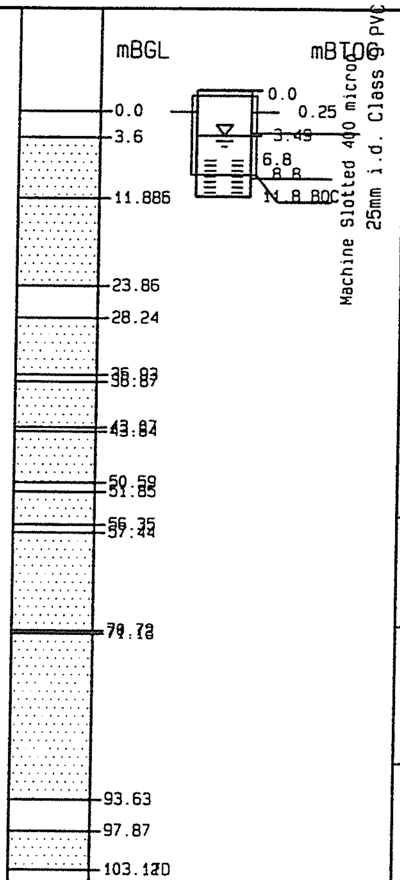
BORE COMPLETION DETAILS - 7000D000U

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG	DEPTH

Depth scale (m)	Stratigraphic description
0	SOIL, darkbrown
	SANDSTONE AND SILTSTONE
10	Depth of weathering
	SANDSTONE AND SILTSTONE
20	
	COAL (CLN)
30	SANDSTONE AND SILTSTONE
	COAL (BNG)
40	SANDSTONE AND SILTSTONE
	COAL (BNG)
	SANDSTONE AND SILTSTONE
50	COAL (BNG)
	SANDSTONE AND SILTSTONE
	COAL (BNG)
60	
	SANDSTONE AND SILTSTONE
70	COAL (EGA)
80	SANDSTONE AND SILTSTONE
90	
	COAL (EGA)
100	SANDSTONE AND SILTSTONE
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 23/12/93
Coordinates : 287000 mE 1431999mN
Casing R.L. : 162.1 mAHD
Top of Casing : 0.25 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 25 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3-5mm gravel
from 3.80m to 13.8mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 2.8m to 3.8mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 3.49mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : Temp.:
Conductivity :

NOTES

Bail-out test conducted on 7/9/94.

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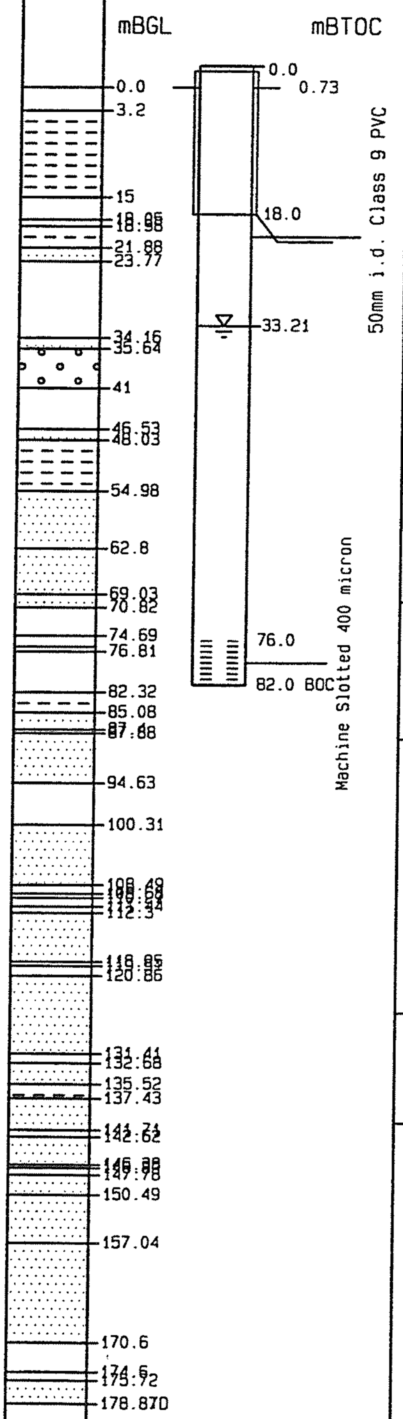
BORE COMPLETION DETAILS - 7500F000

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG	DEPTH

Depth scale (m): 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230

- SOIL and CLAY
- SILTSTONE
- core loss
- SANDSTONE and SILTSTONE
- SILTSTONE and SANDSTONE
- SANDSTONE and SILTSTONE
- COAL (BAY)
- SANDSTONE
- CONGLOMERATE and SANDSTONE
- COAL (WYN)
- SANDSTONE and SILTSTONE
- SILTSTONE, minor COAL and MUDSTONE
- SANDSTONE and SILTSTONE
- SANDSTONE
- SANDSTONE and SILTSTONE
- COAL (WYN)
- CARB. MUDSTONE, MUDSTONE, SILTSTONE
- COAL (EDD), MUDSTONE at top
- SILTSTONE and SANDSTONE, minor COAL
- COAL (EDD) SANDSTONE, SILTSTONE at base
- SANDSTONE and SILTSTONE, minor COAL
- COAL (CLN) Interbedded with carb. mudstone sandstone and siltstone
- SANDSTONE and SILTSTONE
- SILTSTONE / COAL (BNG) MUDSTONE, CARBONACEOUS MUDSTONE
- SANDSTONE
- SILTSTONE / COAL (BNG)
- SANDSTONE, SILTSTONE and MUDSTONE
- COAL (BNG)
- SANDSTONE and SILTSTONE
- SILTSTONE and SANDSTONE, SIDERITE at base
- SANDSTONE and SILTSTONE
- COAL (BNG)
- SANDSTONE and SILTSTONE
- SILTSTONE, CARBONACEOUS MUDSTONE at base
- SANDSTONE and SILTSTONE
- SANDSTONE
- SANDSTONE and SILTSTONE
- COAL (EGA)
- SILTSTONE
- SANDSTONE AND SILTSTONE



DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Paterick & Zeija
Rig Type : Diamond
Date Drilled : 19/07/94
Coordinates : 287500 mE 1434000mN
Casing R.L. : 180.2 mAHD
Top of Casing : 0.73 mAGL

COMPLETION NOTES

Screen Type : Machine slotted
Material : Class 9 PVC
Diameter : 50 mm
Slots : 400 micron apertures
Open Area : %

FILTER PACK MATERIAL

3 - 5mm gravel
from 74.0m to 84.0mBTOC

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal 73.0m to 74.0mBTOC

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 33.21mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : 7.0 Temp.:
Conductivity : 644 µS/cm

NOTES

Static water levels for October 1994.

Logger No. 39374.

Bail-in test conducted on 7/9/94

Recovery: 3.98m in 24 min.

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BORE COMPLETION DETAILS - 4250F250

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG - DEPTH (mBGL)
	0.0
SANDSTONE, brown soil top 70cm	5.28
COAL (BFD)	7.12
SANDSTONE and SILTSTONE	[illegible]
[illegible]	[illegible]
COAL (WKH)	22.66
SANDSTONE and SILTSTONE	33.53
CLAYSTONE	37.5
COAL (MTA)	39.24
SANDSTONE	45.34
SANDSTONE and SILTSTONE	61.28
SANDSTONE	70.48
SANDSTONE and SILTSTONE	85.98
COAL (PFD)	92.83
SILTSTONE	95.26
SANDSTONE and SILTSTONE	100.76
SANDSTONE	145.63
COAL (PFD)	149.76
COAL (VAU)	152.82
SANDSTONE and SILTSTONE	[illegible]
COAL (VAU)	[illegible]
SANDSTONE and SILTSTONE	173.92
COAL (BRN)	176.34
SILTSTONE and CARBONACEOUS MUDSTONE	180.14
SANDSTONE and SILTSTONE	187.38
COAL (BRN)	190.24
SANDSTONE and SILTSTONE	192.22
COAL (BAY)	193.8
SANDSTONE and SILTSTONE	196.92
SANDSTONE	209.42
SANDSTONE and CONGLOMERATE	221.06
COAL (BAY)	225.8
SANDSTONE	231.8TD

mBTOC: 0.0, 6.0; water level 64.10

DETAILS

GENERAL INFORMATION

Location : MOUNT PLEASANT
Driller : Hunter
Rig Type : Diamond
Date Drilled : 15/09/94
Coordinates : 284250 mE 1434250mN
Casing R.L. : mAHD
Top of Casing : mAGL

COMPLETION NOTES

Screen Type :
Material :
Diameter : mm
Slots :
Open Area : %

FILTER PACK MATERIAL

NIL GRAVEL
from to

CEMENT DETAILS

Surface Casing Cemented
from to
Bentonite Seal to

HYDRAULIC DATA

Top of Aquifer :
Static W.L.: 64.10mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS

pH : Temp.:
Conductivity :

NOTES

OPEN HOLE FOR PACKER TESTING.

Bail-in test conducted

Bulk T = 0.249 kl/day/m

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BORE COMPLETION DETAILS - 4750C000

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION LOG - DEPTH

Stratigraphic description (depth scale 0–230 m):

SANDSTONE
COAL (BFD) and CARBONACEOUS MUDSTONE
CARBONACEOUS MUDSTONE
COAL (WKH)
Depth of weathering
COAL (WKH)
SANDSTONE and SILTSTONE
SILTSTONE
MUDSTONE and CLAYSTONE
COAL (MTA)
SANDSTONE and SILTSTONE, very minor coal
SANDSTONE
SANDSTONE and SILTSTONE
COAL (PFD)
SANDSTONE and SILTSTONE
COAL (VAU)
SANDSTONE and SILTSTONE
COAL and CARBONACEOUS MUDSTONE
SILTSTONE
SANDSTONE
SANDSTONE and SILTSTONE
COAL (BRN) with SILTSTONE
SANDSTONE and SILTSTONE
COAL (BRN)
SANDSTONE
SILTSTONE
COAL (BAY)
CONGLOMERATE, minor SANDSTONE and MUDSTONE
SANDSTONE and CARBONACEOUS MUDSTONE
COAL and CLAYSTONE
SANDSTONE and SILTSTONE
SANDSTONE
SANDSTONE and SILTSTONE
SANDSTONE
SILTSTONE
COAL (WYN)
SILTSTONE and siderite
COAL (EDD)
SILTSTONE and SANDSTONE

Depth mBGL: 0.0, 10.2, 11.89, 14.76, 17.38, 20.67, 24.78, 29.28, 33.05, 37.82, 47.22, 51.02, 66.41, 72.41, 84, 90.36, 101.68, 102.8, 105.4, 109.6, 123.28, 125.03, 134.51, 137.16, 142.76, 145.88, 152.61, 155.51, 158.78, 159.48, 161.48, 164.48, 166.48, 174.98, 177.98, 181.55, 183.18, 187.23, 190.94 TD

mBTOC: 0.0; 20.5; static water level 48.26

DETAILS

GENERAL INFORMATION
Location : MOUNT PLEASANT
Driller : HD
Rig Type : Diamond
Date Drilled : 30/08/94
Coordinates : 284750 mE 1431000mN
Casing R.L. : mAHD
Top of Casing : mAGL

COMPLETION NOTES
Screen Type :
Material :
Diameter : mm
Slots :
Open Area : %

FILTER PACK MATERIAL
from to

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal to

HYDRAULIC DATA
Top of Aquifer :
Static W.L.: 48.26mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : Temp.:
Conductivity :

NOTES
OPEN HOLE FOR PACKER TESTING

Bail-in test conducted on 7/9/94.

Recovery: 30.122m in 21.5min.

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BORE COMPLETION DETAILS - 5750D750

MOUNT PLEASANT

STRATIGRAPHIC DESCRIPTION	LOG - DEPTH (mBGL)
SOIL and CLAY	0.0 – 1
SANDSTONE	1 – 20
SILTSTONE, SANDSTONE and SIDERITE	20 – 22.92
COAL (PFD)	22.92 – 31.39
MUDSTONE and SILTSTONE	31.39 – 34.42
COAL (VAU), MUDSTONE at base	34.42 – 38.01
SANDSTONE	38.01 – 40.51
SILTSTONE, MUDSTONE at base	40.51 – 43.01
SANDSTONE and SILTSTONE	43.01 – 47.01
SANDSTONE	47.01 – 51.01
SILTSTONE, minor COAL (VAU)	51.01 – 54.84
SANDSTONE	54.84 – 56.8
COAL (VAU) and CARBONACEOUS MUDSTONE	56.8 – 59.82
SANDSTONE and SILTSTONE	59.82 – 65.02
SANDSTONE	65.02 – 72.02
SANDSTONE and SILTSTONE	72.02 – 74.02
SANDSTONE	74.02 – 77.02
SANDSTONE and SILTSTONE	77.02 – 81.98
COAL (BRN)	81.98 – 86.36
SILTSTONE and SANDSTONE	86.36 – 91.3
COAL (BAY)	91.3 – 96.61
CONGLOMERATE and SANDSTONE	96.61 – 99.94
SANDSTONE and CONGLOMERATE, minor COAL (BAY)	99.94 – 103.51
SANDSTONE	103.51 – 106.1
COAL (WYN)	106.1 – 108.24
SANDSTONE and SILTSTONE	108.24 – 113.51
SANDSTONE	113.51 – 132.66
COAL (WYN)	132.66 – 135.97

mBTOC: casing 0.0 – 6.0; water level 26.21

DETAILS

GENERAL INFORMATION
Location : MOUNT PLEASANT
Driller : Hunter
Rig Type : Diamond
Date Drilled : 07/09/94
Coordinates : 285750 mE 1432750mN
Casing R.L. : mAHD
Top of Casing : mAGL

COMPLETION NOTES
Screen Type :
Material :
Diameter : mm
Slots :
Open Area : %

FILTER PACK MATERIAL
from to

CEMENT DETAILS
Surface Casing Cemented
from to
Bentonite Seal to

HYDRAULIC DATA
Top of Aquifer :
Static W.L.: 26.21mBTOC
Product Level :
Test Pumped:
Test Start :
Discharge :
Duration :
Drawdown :

FIELD WATER ANALYSIS
pH : Temp.:
Conductivity :

NOTES
OPEN BORE FOR PACKER TESTING

Bail-in test conducted

Recovery: 0.47m in 11 min

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Appendix D

Aquifer Test Results

D1 Slug & injection Testing

Slug and injection testing was undertaken on piezometers and bores where the diameter of the holes and/or significant depth to the water table did not permit installation of pumping equipment.

Slug testing consisted of adding a small volume (slug) of water to a piezometer and monitoring the recovery of the water level. Permeabilities were determined using standard Hvorslev analysis where the time (To) corresponding to a water level recovery equal to 37% of the initial change in water level, is incorporated into the Hvorslev equation.

Injection testing entailed pumping water at a constant rate into a piezometer, and recording the recovery of the water level following pump turn-off. The resultant data was analysed using the standard Thiess recovery method.

Table D1: Summary of Slug and Injection Testing

Piezometer	Test Undertaken	Transmissivity (kL/day/m)	Hydraulic Conductivity (kL/day/m^2)
3500B500L	Slug	-	0.017
3500B500U	Slug	-	0.0064
3500C500L	Injection	0.44	0.090*
3500C500U	Injection	0.51	0.085*
3500E000U	Slug	-	0.022
3500E000M	Slug	-	0.0040
3500E000L	Injection	0.69	0.18*
4500F000	Injection	0.084	0.014*
5000A500	Injection	1.35	0.15*
5000D000	Injection	0.077	0.013*
5500D000	Injection	0.28	0.14*
6000C000U	Dry Bore	-	-
6000C000L	Slug	-	0.0046*
6500F500U	Injection	0.14	0.046*
6500F500M	Injection	0.10	0.030
6500F500L	Slug	-	0.042
7000D000L	Slug	-	0.84
7000D000U	Slug	-	0.05
7500E500L	Dry Bore	-	-
7500F000	Injection	0.43	0.078*

Note: * = indicated hydraulic conductivity value calculated from transmissivity and formation thickness

D2 Test Pumping

Test pumping of two alluvial bores was conducted using standard pump and recover methods. Water was pumped from the bores at a constant rate using jet pump apparatus while water level measurements were obtained by manual dipping with an electrical dipper during the pumping phase, and pressure transducer during the recovery phase. The resultant data was analysed using the Jacob straight line method.

D3 Packer Testing

Packer testing of hardrock open holes was conducted using a straddle packer assemble which permitted sealing and testing of 3 metre intervals. Dual inflatable straddle packers were used to isolate both coal seams and interburden lithologies. The straddle assemble was lowered into position after checking of bore logs for correct depths. Reference was also made to borehole geophysical gamma, sonic and calliper logs to confirm test lithologies and ensure the borehole walls presented a relatively smooth surface for seating the packer assembly. Once located, each packer was carefully inflated using nitrogen gas. Injection testing over a range of pressures was then undertaken on each test section. Packer pressure was closely monitored and where necessary adjusted to ensure an hydraulic seal was maintained during testing. A total of 24 separate intervals were isolated and tested in this manner.

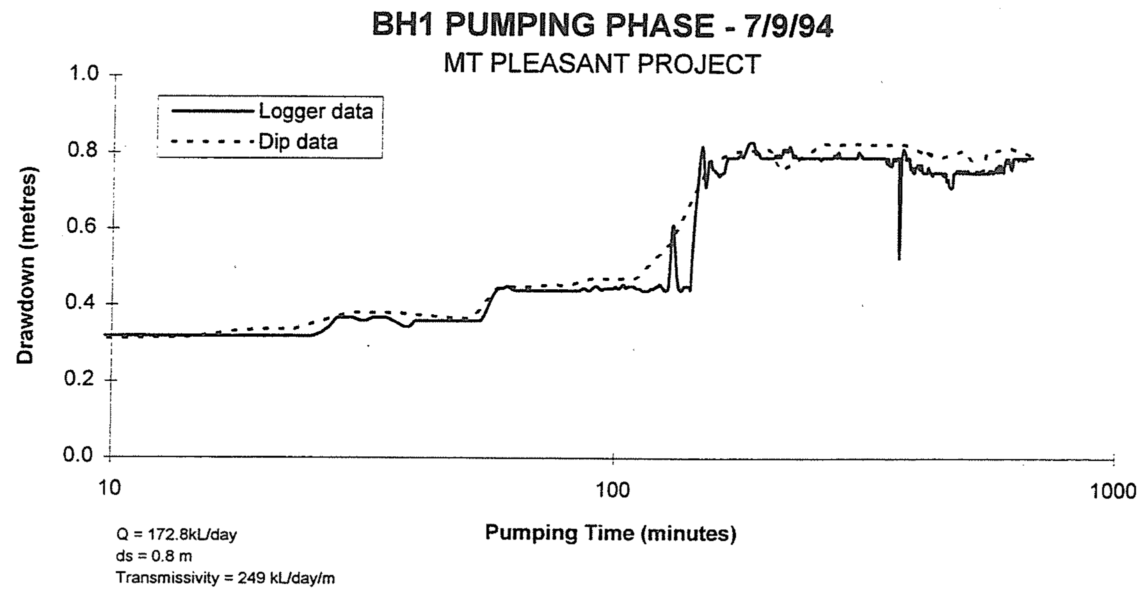
Table D2 provides a summary of the results obtained from the packer testing program. Field derived values for flow rate (Q) were plotted against excess head (h_e) and reviewed to assess the effects of clogging, dilation, and other phenomena. The ratio Q/h_e was obtained for the stable range of Q for each test, and utilised to determine the permeability (k) of the straddled section using the formula:

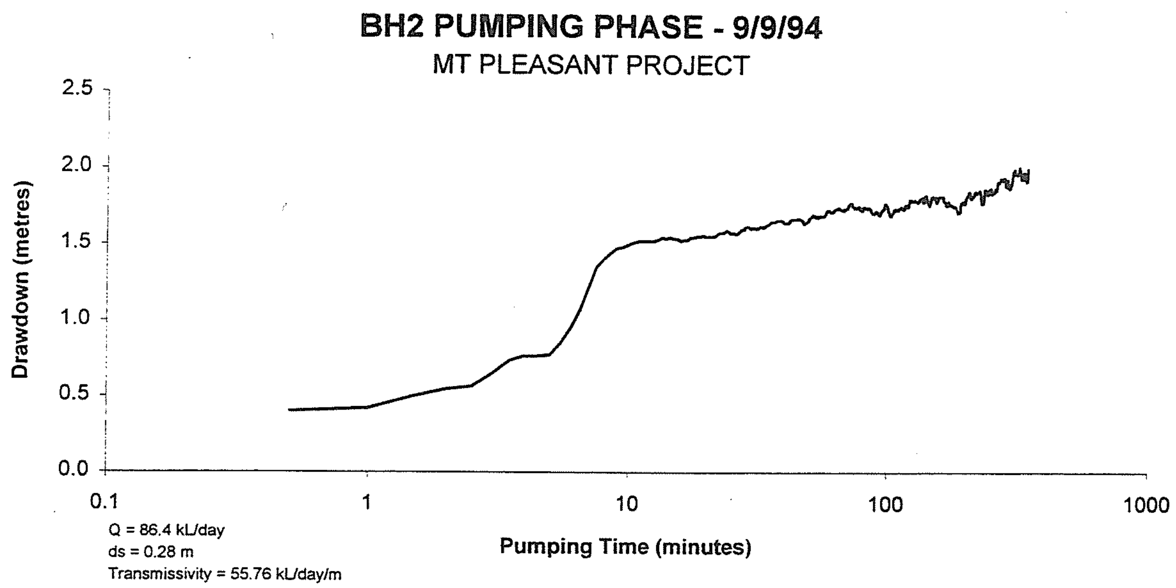
$$k = (5.833/\pi L) \times (Q/h_e) \times 10^{-5}$$

where Q = flow rate in litres/minute,
h_e = excess head, and
L = length of test section.

Table D2: Summary of Packer Testing Results

Borehole	Test Interval (m)	Lithology	Hydraulic Conductivity (m/day)
4250F250	150.0 - 153.0	Coal - VAU	0.1479
4750C000	70.5 - 73.5	Coal - PFD	0.1415
5750D750	91.0 - 94.0	Coal - BAY	0.1132
5750D750	106.0- 109.0	Coal - WYN	0.1029
4250F250	191.5 - 194.5	Coal - BAY	0.0958
5750D750	133.0 - 136.0	Coal - WYN	0.0801
5750D750	141.0 - 144.0	Coal - EDD	0.0630
5750D750	56.0 - 59.0	Coal - BRN	0.0370
4750C000	135.0 - 138.0	Coal - BRN	0.0336
4250F250	86.0 - 89.0	Coal - PFD	0.0145
5750D750	124.0 - 127.0	Interburden	0.0064
5750D750	72.0 - 75.0	Interburden	0.0062
5750D750	83.0 - 86.0	Coal and interburden	0.0053
4750C000	153.5 - 156.5	Interburden	0.0033
5750D750	113.0 - 116.0	Interburden	0.0032
4750C000	111.0 - 114.0	Interburden	0.0030
4250F250	173.5 - 176.5	Interburden and coal	0.0030
4250F250	127.0 - 130.0	Interburden	0.0026
4250F250	211.0 - 214.0	Interburden	0.0024
4750C000	164.5 - 167.5	Interburden	0.0017
4750C000	52.0 - 55.0	Interburden	0.0011
4750C000	97.5 - 100.5	Interburden	0.0011
4750C000	77.0 - 80.0	Interburden	0.0008
5750D750	87.0 - 90.0	Interburden	<0.0001





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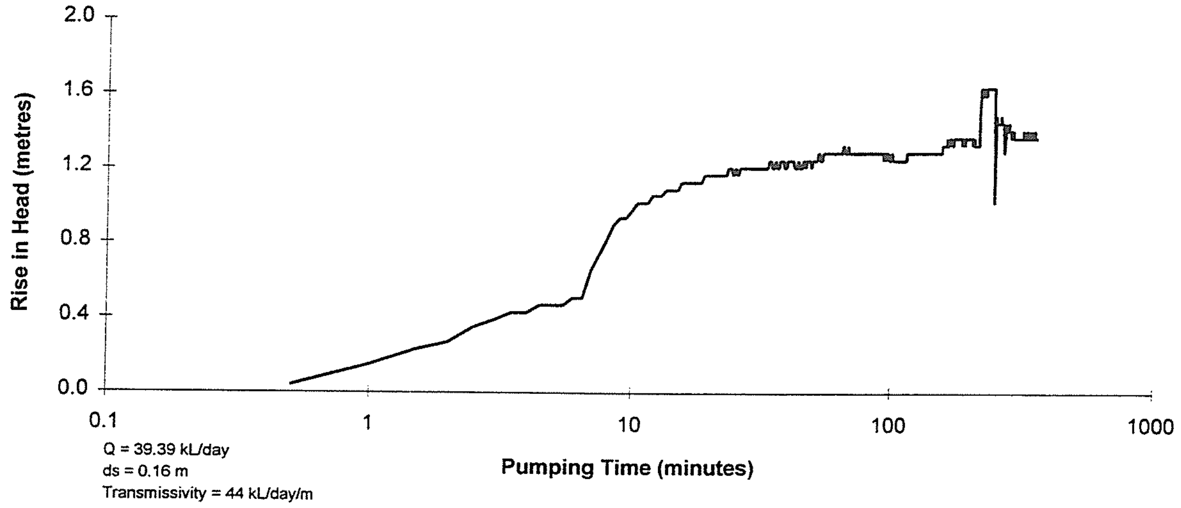
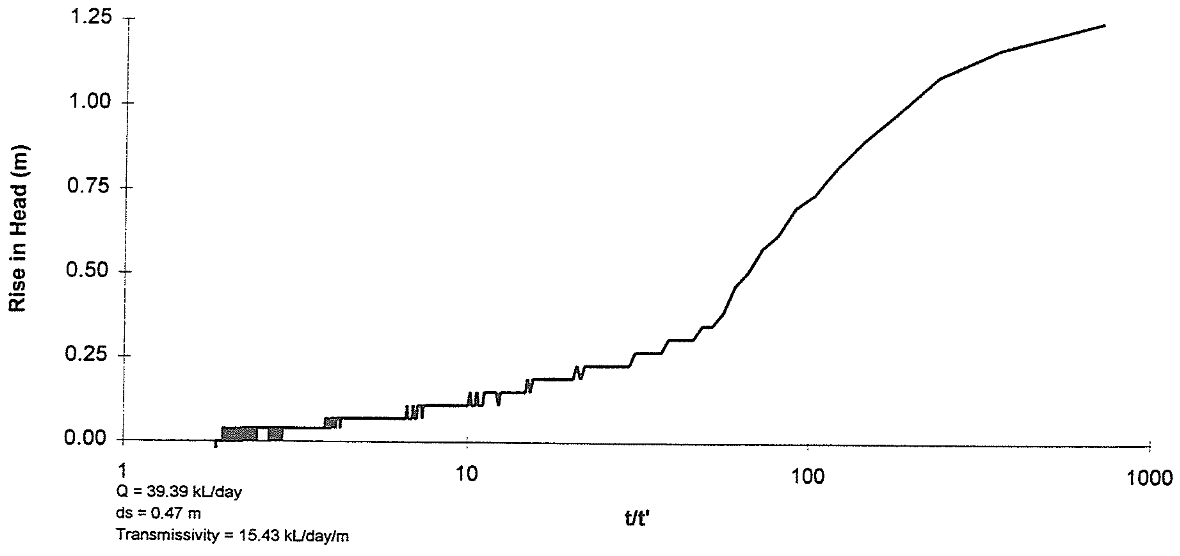
BH3 INJECTION PHASE - 8/9/94

MT PLEASANT PROJECT



BH3 RECOVERY PHASE - 8/9/94 TO 9/9/94

MT PLEASANT PROJECT



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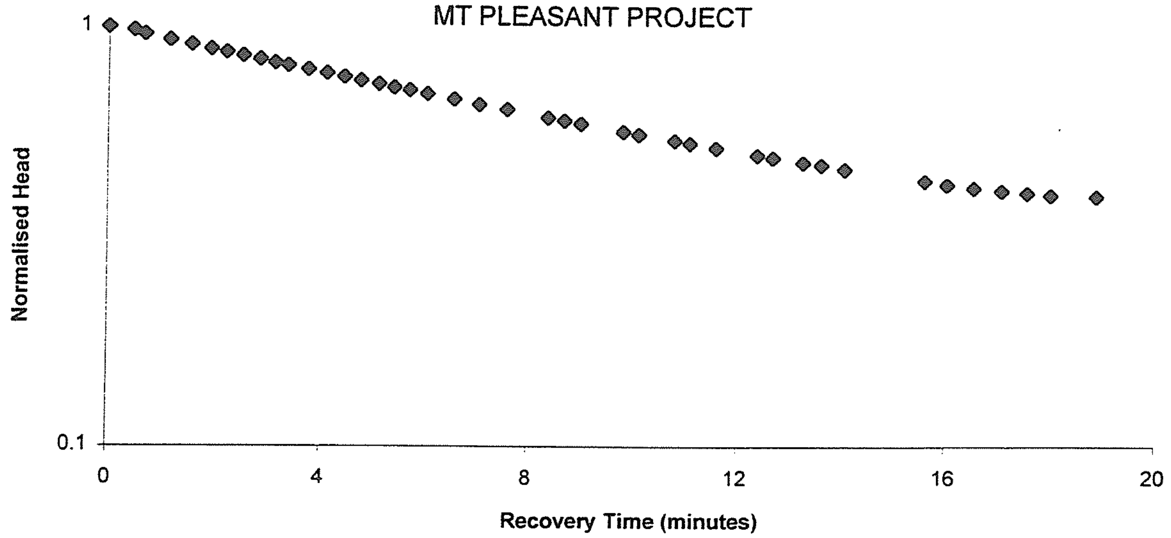
3500B500L HVORSLEV TEST

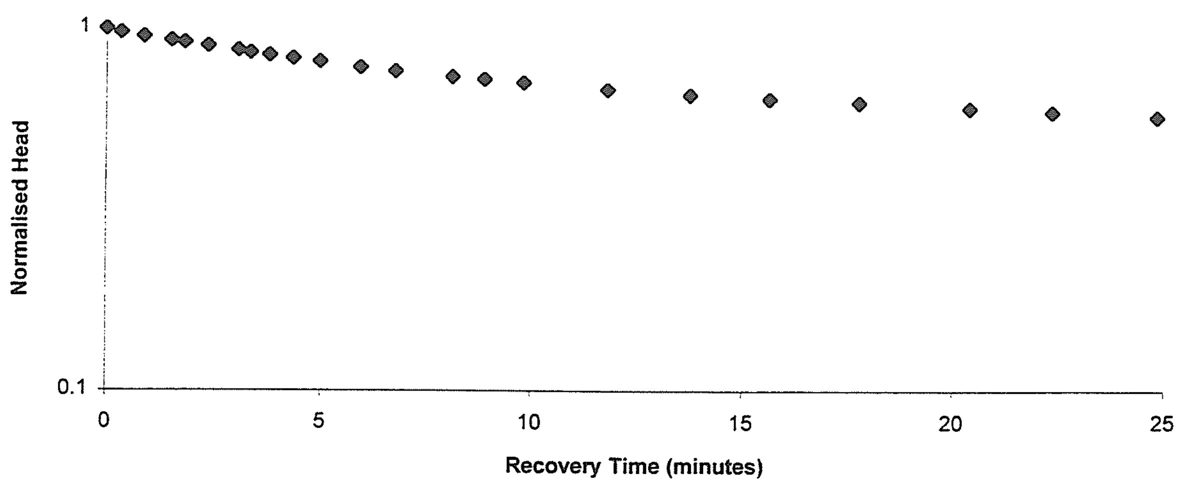
MT PLEASANT PROJECT



T_o = 16.3 minutes
Hydraulic Conductivity = 0.011 m/day

3500B500U HVORSLEV TEST

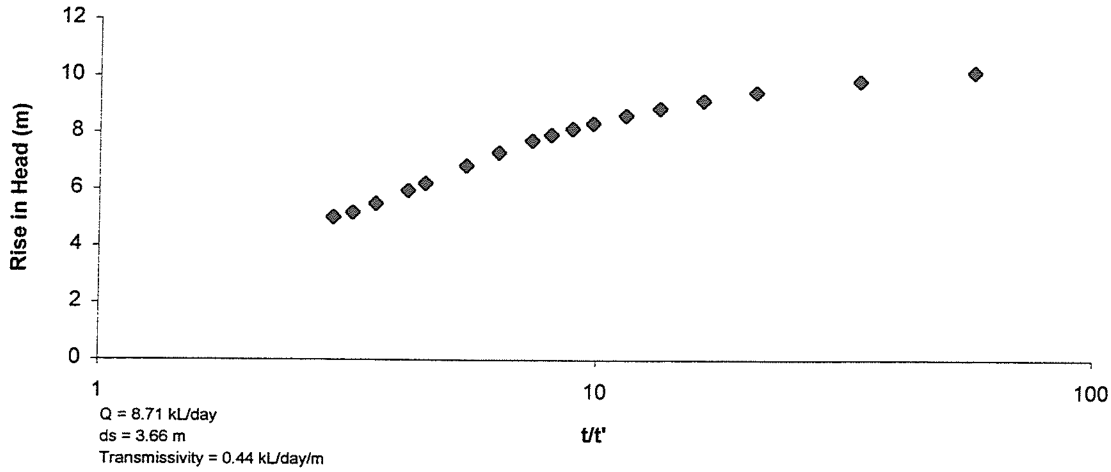
MT PLEASANT PROJECT



T_o = 25.5 minutes
Hydraulic Conductivity = 0.00635 m/day

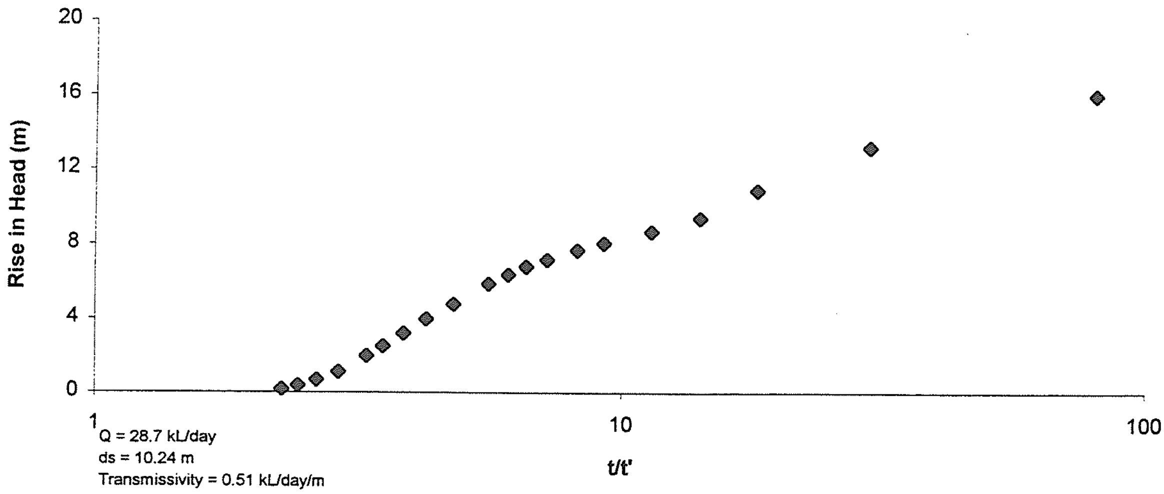
3500C500L INJECTION TEST RECOVERY

MT PLEASANT PROJECT



3500C500U INJECTION TEST RECOVERY

MT PLEASANT PROJECT



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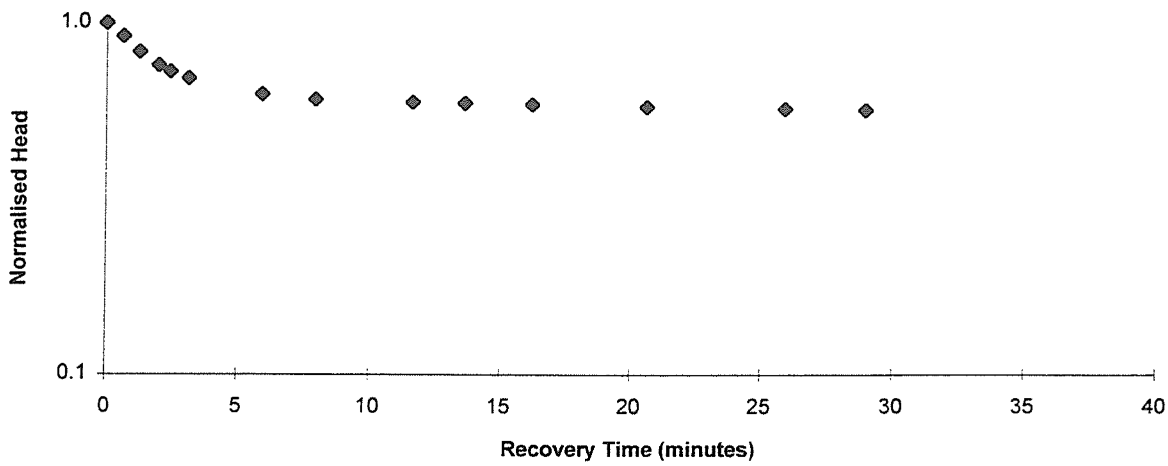
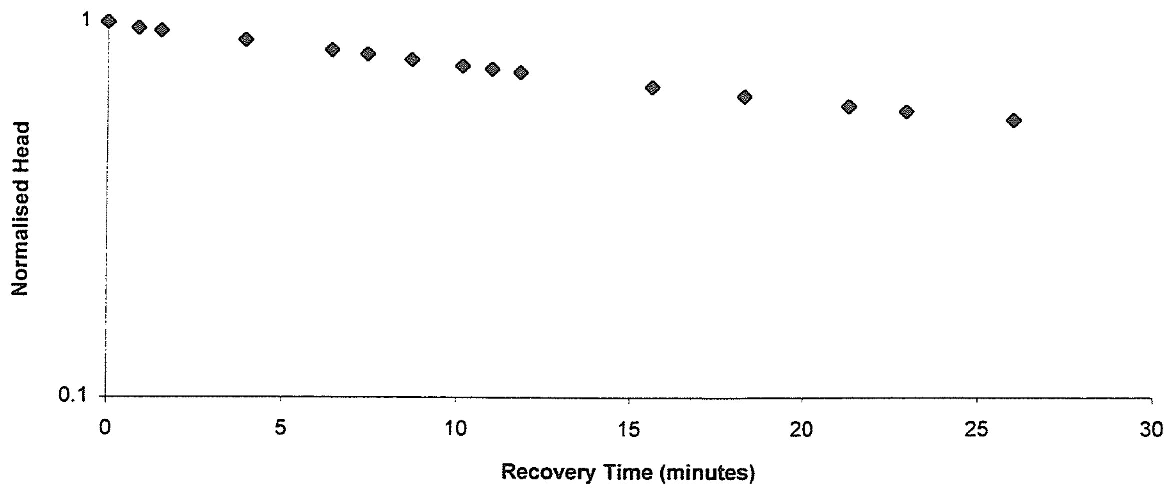
3500E000U HVORSLEV TEST
MT PLEASANT PROJECT



T_o = 7.4 minutes
Hydraulic Conductivity = 0.022 m/day

3500E000M HVORSLEV TEST
MT PLEASANT PROJECT



T_o = 40.4 minutes
Hydraulic Conductivity = 0.004 m/day

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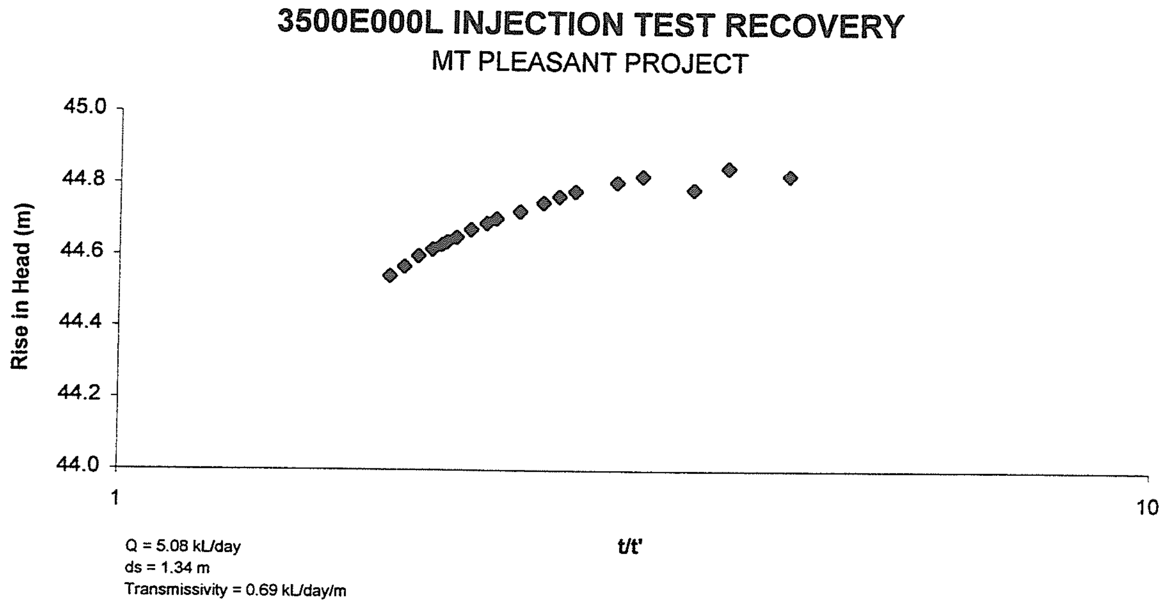

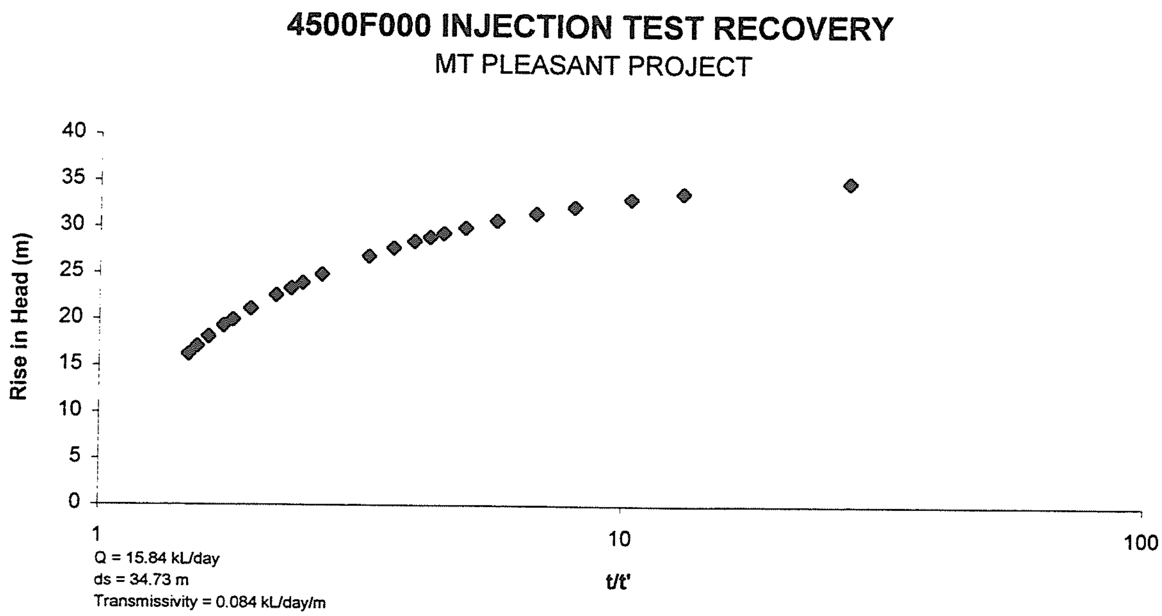

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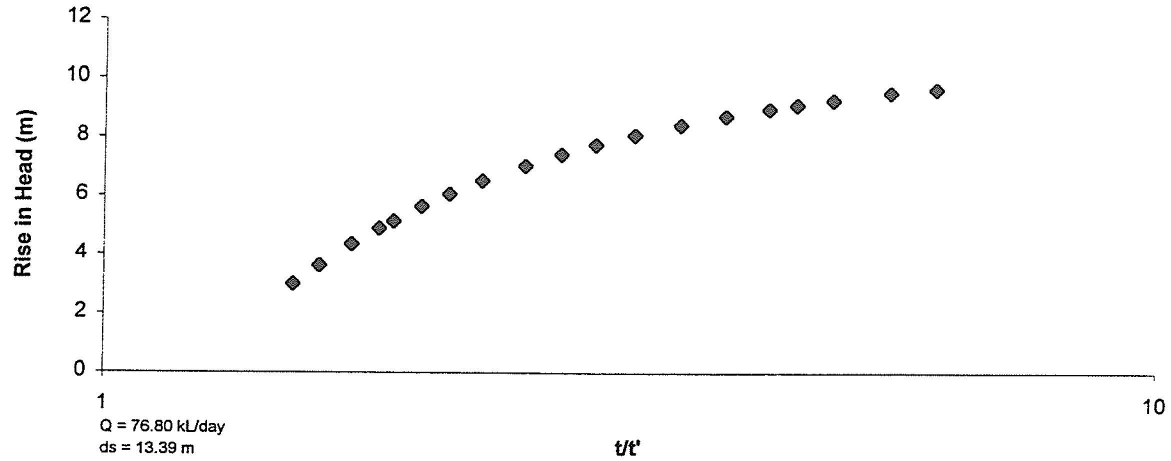
5000A500 INJECTION TEST RECOVERY

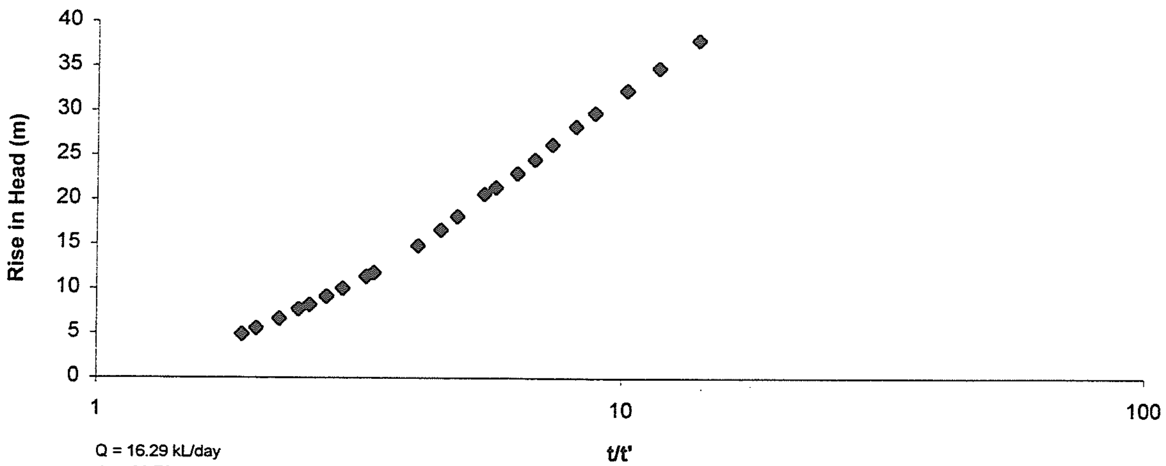
MT PLEASANT PROJECT



Q = 76.80 kL/day
ds = 13.39 m
Transmissivity = 1.35 kL/day/m

5000D000 INJECTION TEST RECOVERY

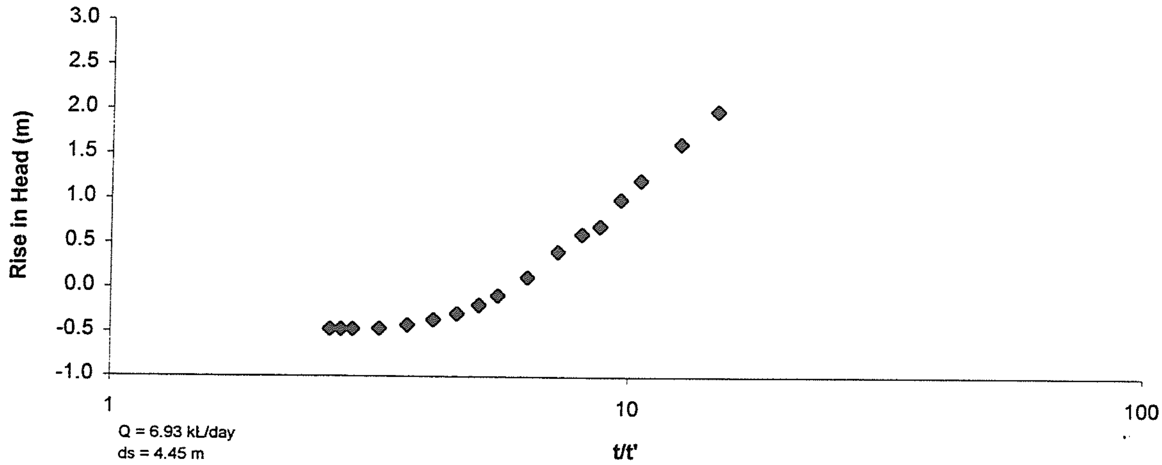
MT PLEASANT PROJECT



Q = 16.29 kL/day
ds = 38.76 m
Transmissivity = 0.077 kL/day/m

5500D000 INJECTION TEST RECOVERY

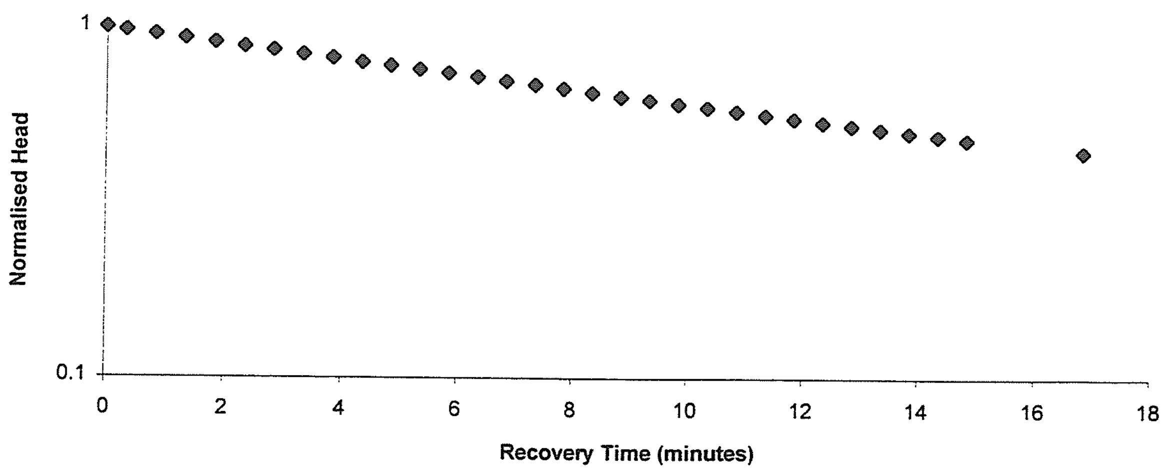
MT PLEASANT PROJECT



Q = 6.93 kL/day
ds = 4.45 m
Transmissivity = 0.28 kL/day/m

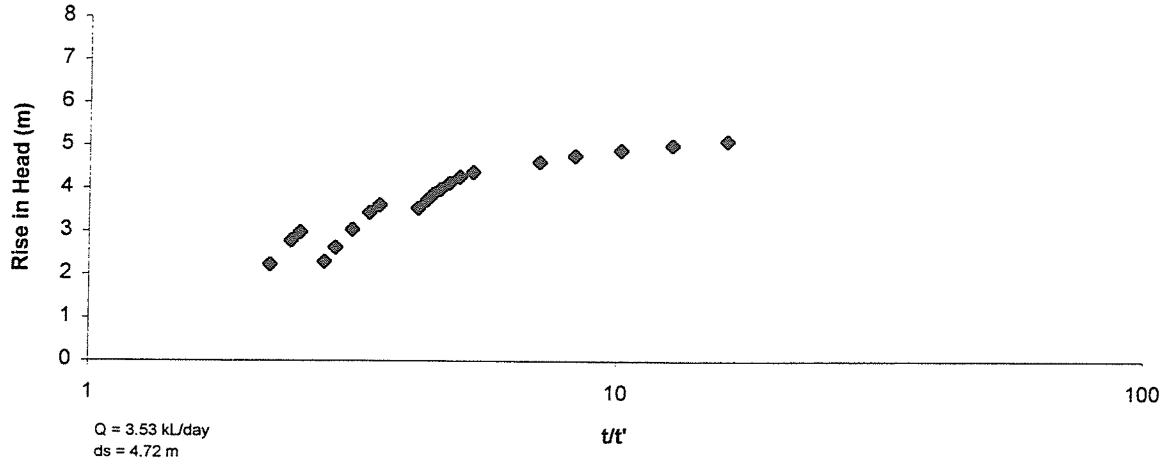
6000C000L HVORSLEV TEST

MT PLEASANT PROJECT



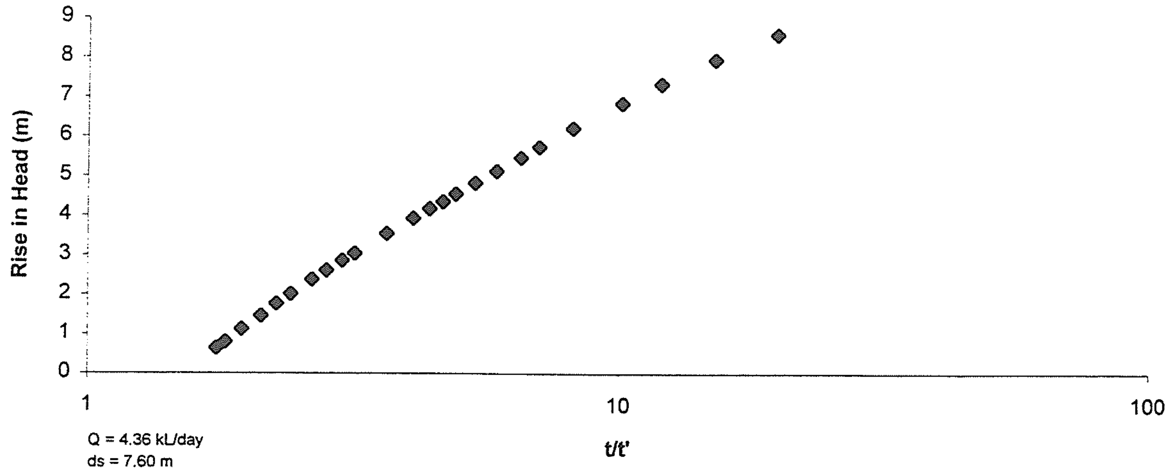
T_o = 19.4 minutes
Hydraulic Conductivity = 0.0046 m/day

6500F500U INJECTION TEST RECOVERY
MT PLEASANT PROJECT



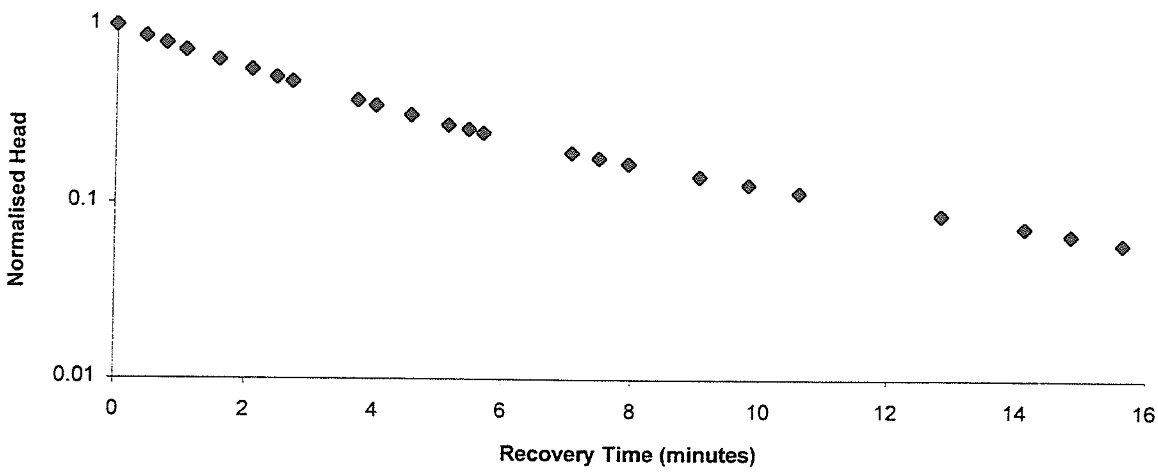
Q = 3.53 kL/day
ds = 4.72 m
Transmissivity = 0.14 kL/day/m

6500F500M INJECTION TEST RECOVERY
MT PLEASANT PROJECT



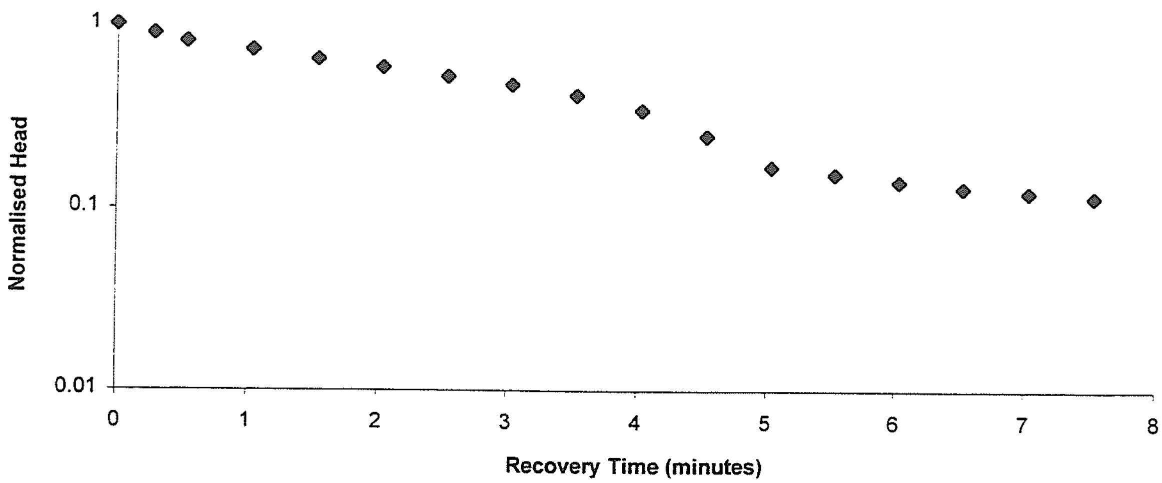
Q = 4.36 kL/day
ds = 7.60 m
Transmissivity = 0.10 kL/day/m

6500F500L HVORSLEV TEST
MT PLEASANT PROJECT



T_o = 3.86 minutes
Hydraulic Conductivity = 0.042 m/day

7000D000U HVORSLEV TEST
MT PLEASANT PROJECT



T_o = 3.75 minutes
Hydraulic Conductivity = 0.050 m/day

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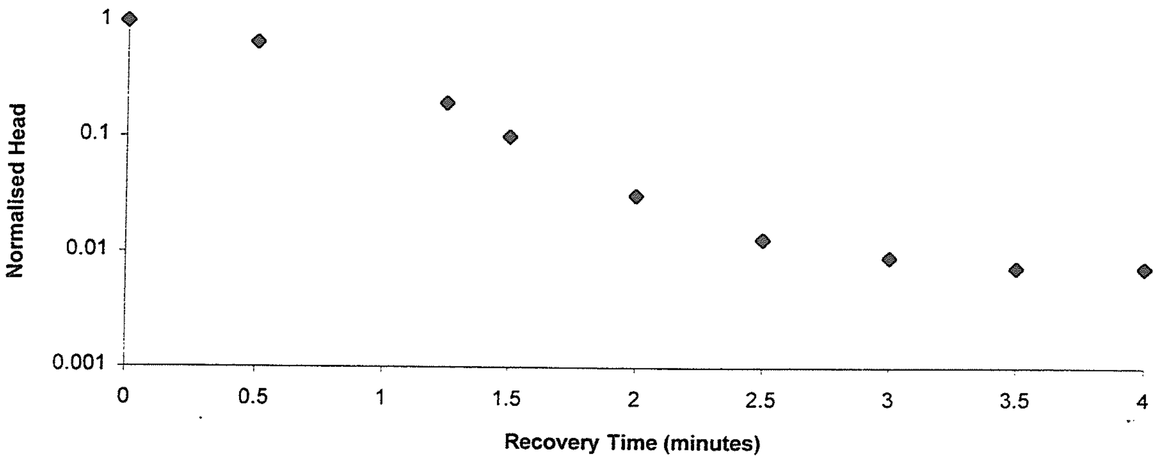
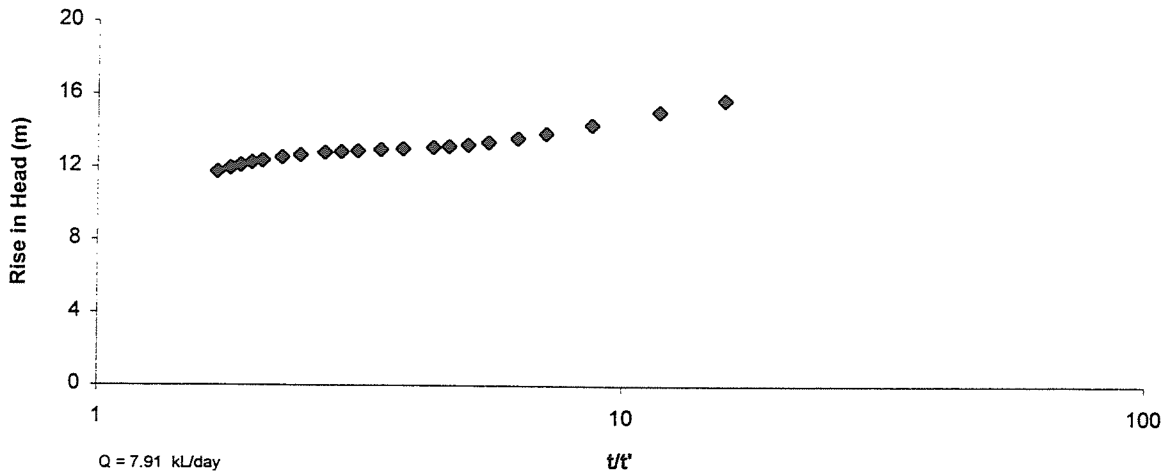
7000D000L HVORSLEV TEST
MT PLEASANT PROJECT



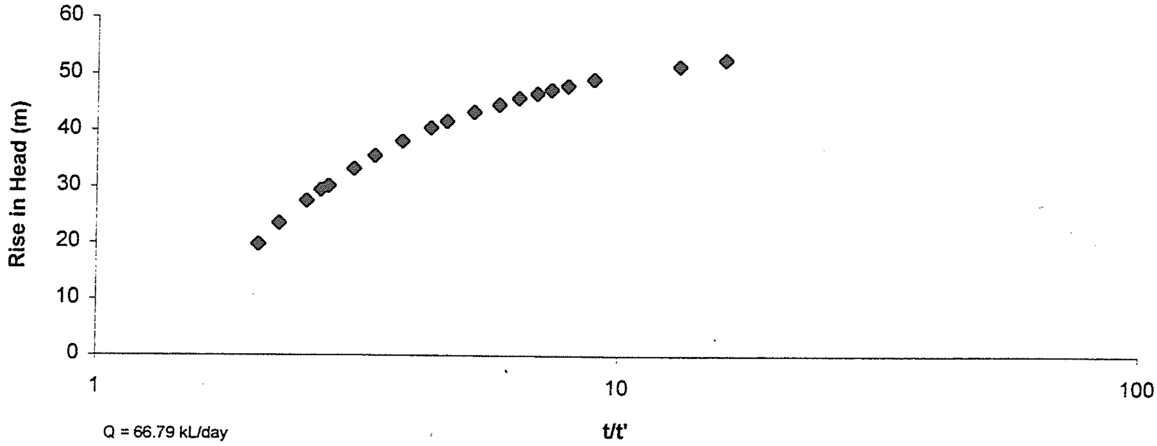
T_o = 0.60 minutes
Hydraulic Conductivity = 0.84 m/day

7500F000 INJECTION TEST RECOVERY
MT PLEASANT PROJECT



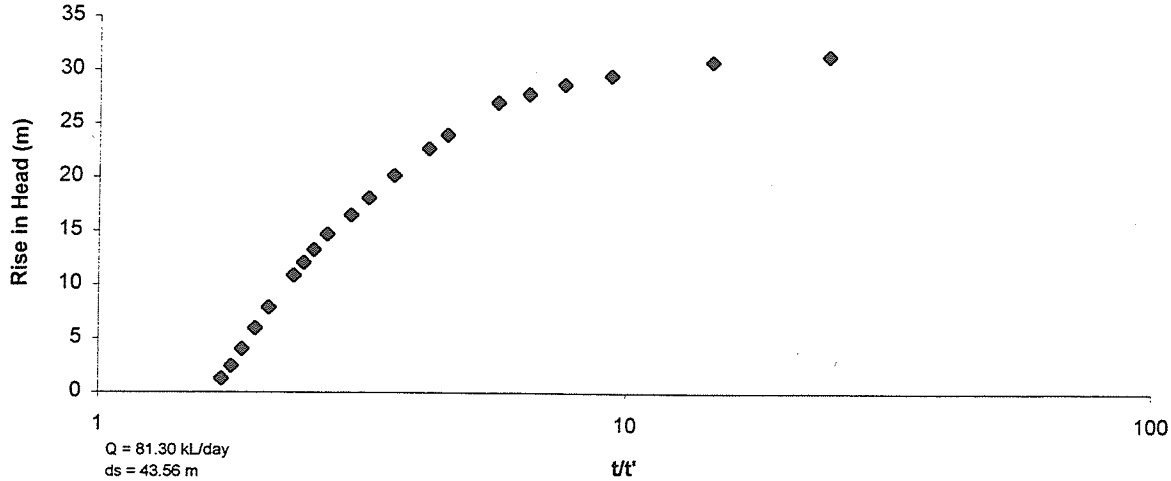
Q = 7.91 kL/day
ds 3.36 m
Transmissivity = 0.43 kL/day/m

4250F250 INJECTION TEST RECOVERY
MT PLEASANT PROJECT



Q = 66.79 kL/day
ds = 49.03 m
Transmissivity = 0.25 kL/day/m

4750C000 INJECTION TEST RECOVERY
MT PLEASANT PROJECT



Q = 81.30 kL/day
ds = 43.56 m
Transmissivity = 0.34 kL/day/m

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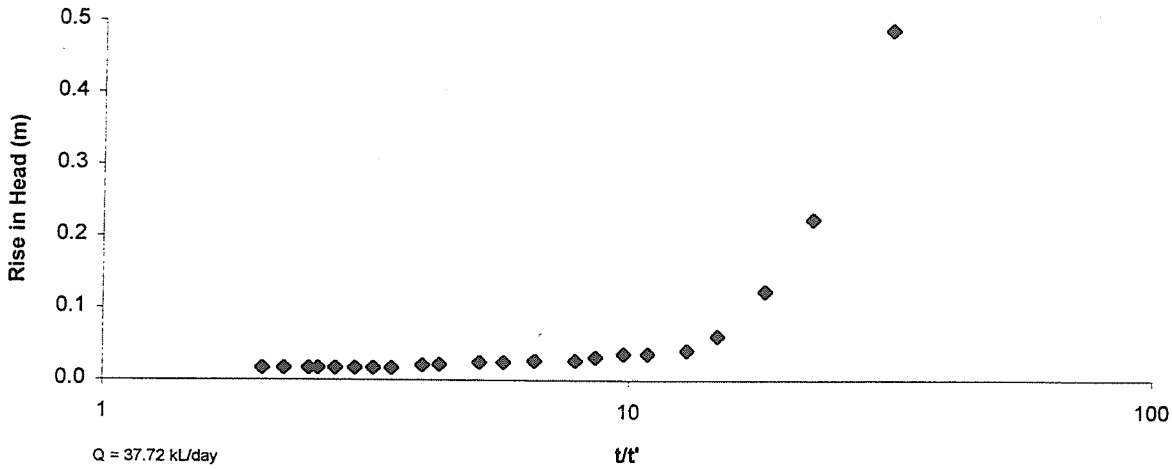
5750D750 INJECTION TEST RECOVERY

MT PLEASANT PROJECT



Q = 37.72 kL/day
ds = 0.029 m
Transmissivity = 238 kL/day/m

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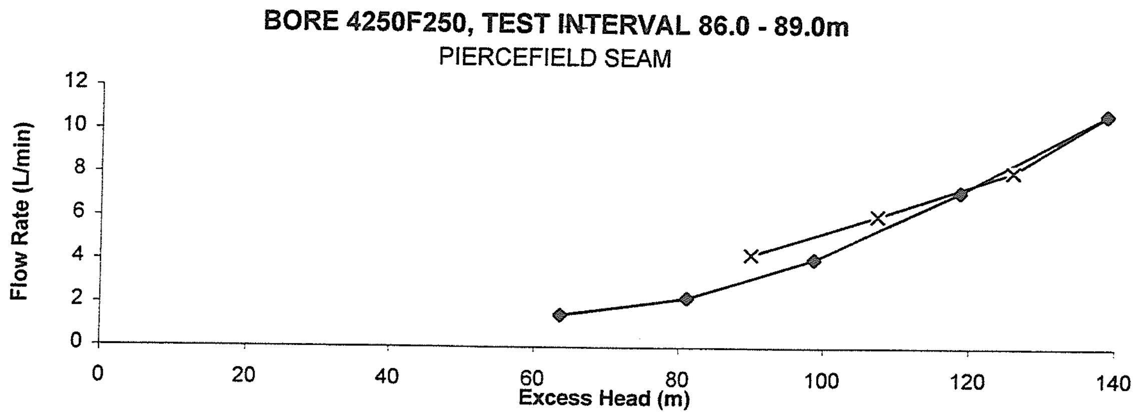
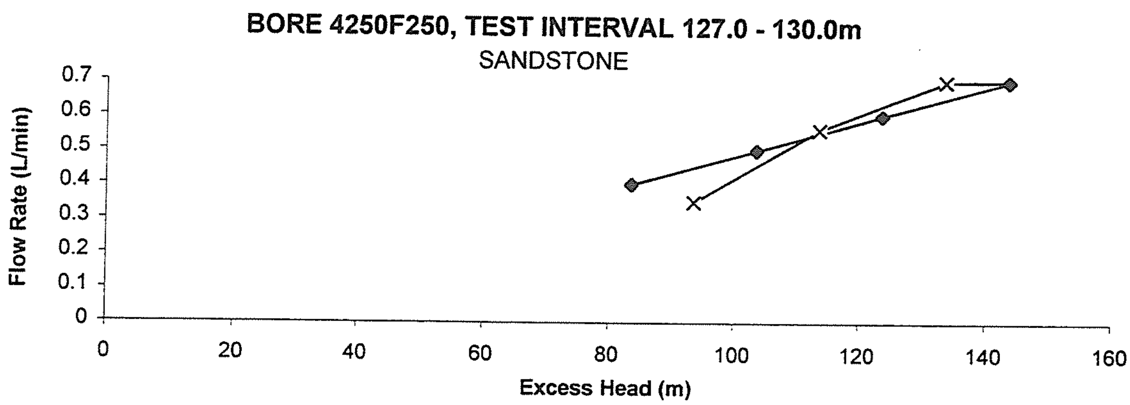
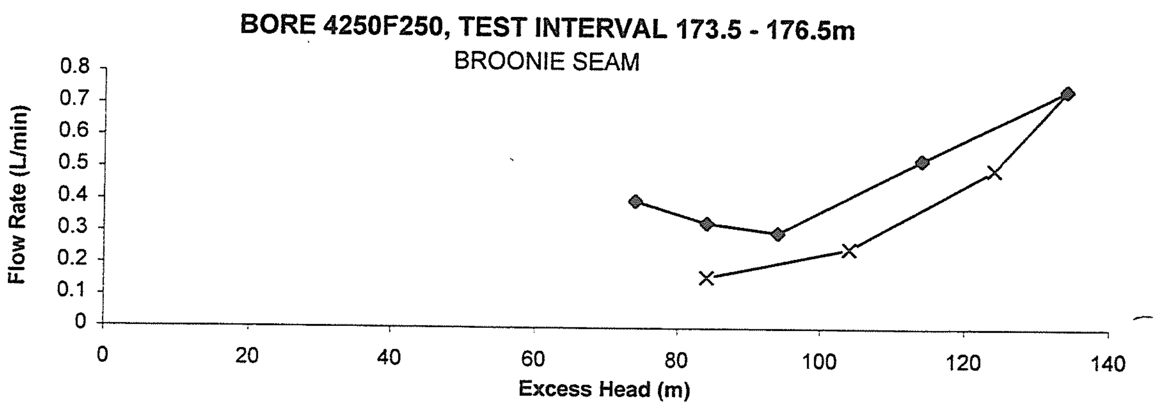
PACKER TESTING







NOTES: Solid marker denotes readings obtained with rising pressures.
"X" denotes readings obtained with descending pressures

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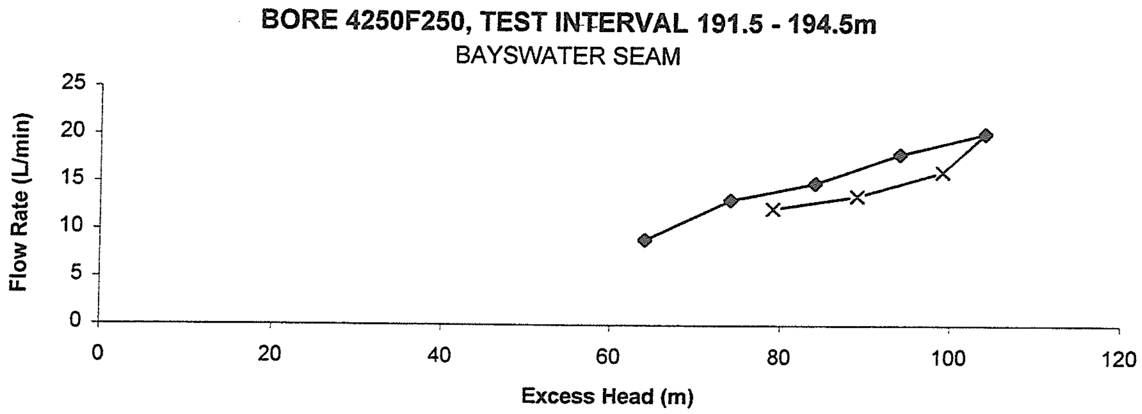
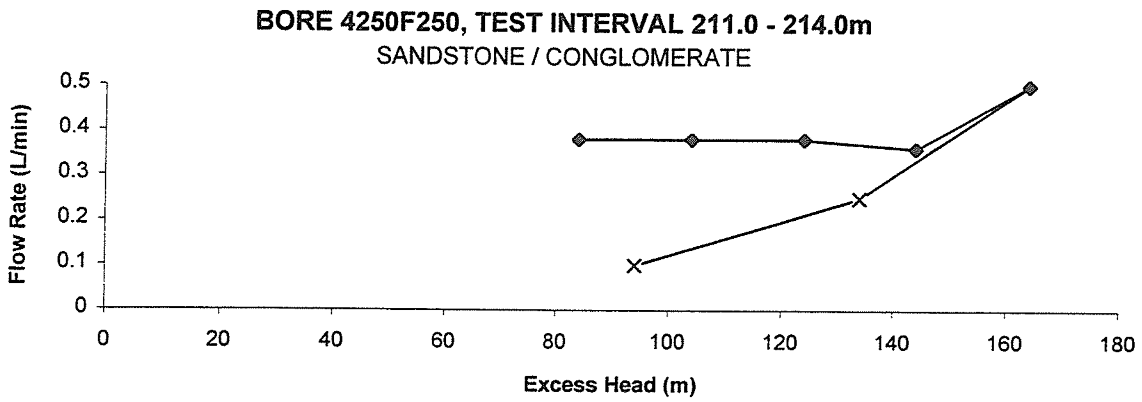
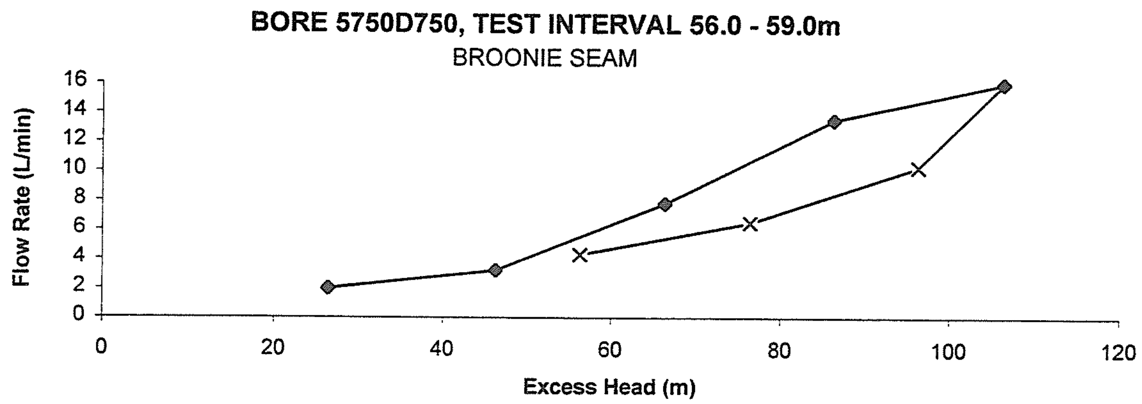
PACKER TESTING







NOTES: Solid marker denotes readings obtained with rising pressures.
"X" denotes readings obtained with descending pressures

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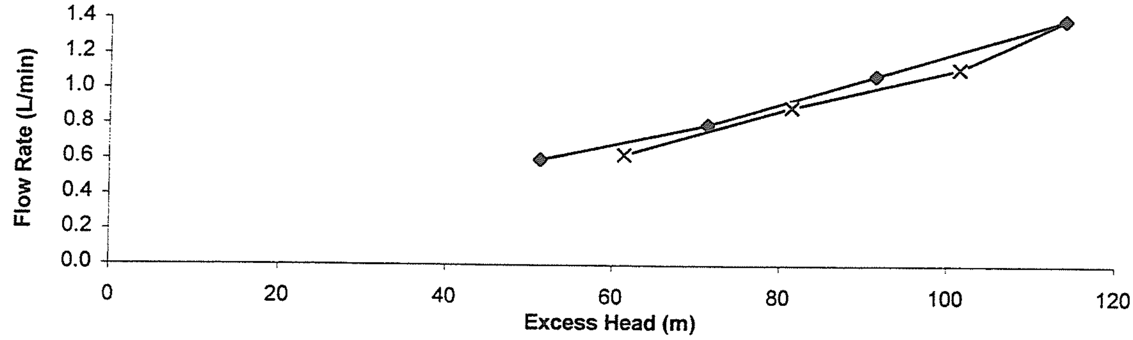
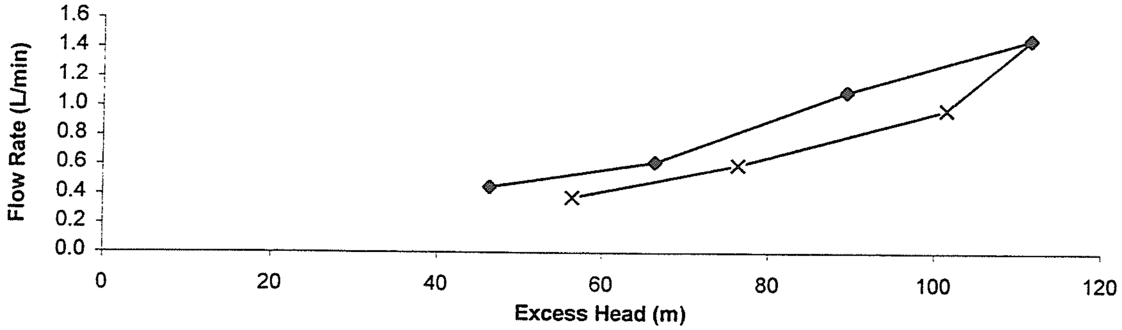
PACKER TESTING

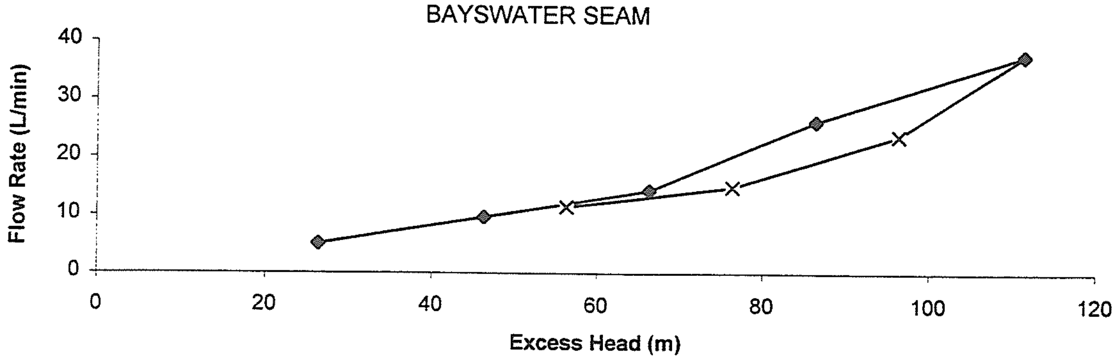
BORE 5750D750, TEST INTERVAL 72.0 - 75.0m
INTERBEDDED SILTSTONE AND SANDSTONE



BORE 5750D750, TEST INTERVAL 83.0 - 86.0m
BROONIE SEAM



BORE 5750D750, TEST INTERVAL 91.0 - 94.0m
BAYSWATER SEAM



NOTES: Solid marker denotes readings obtained with rising pressures.
"X" denotes readings obtained with descending pressures

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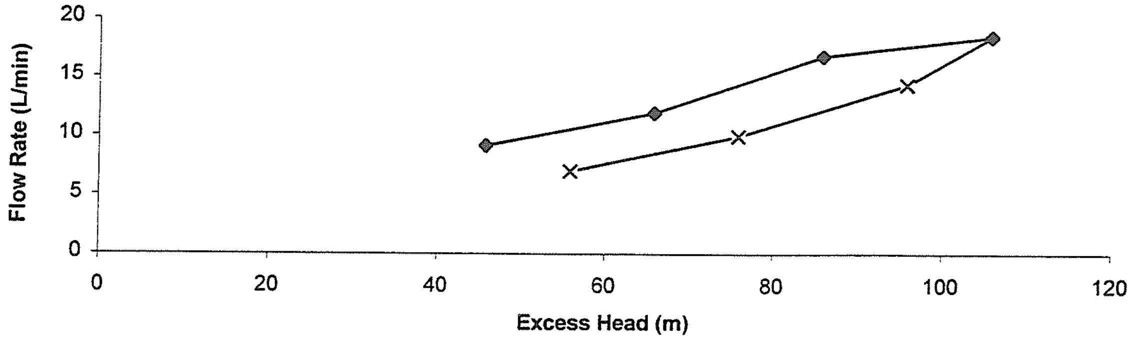
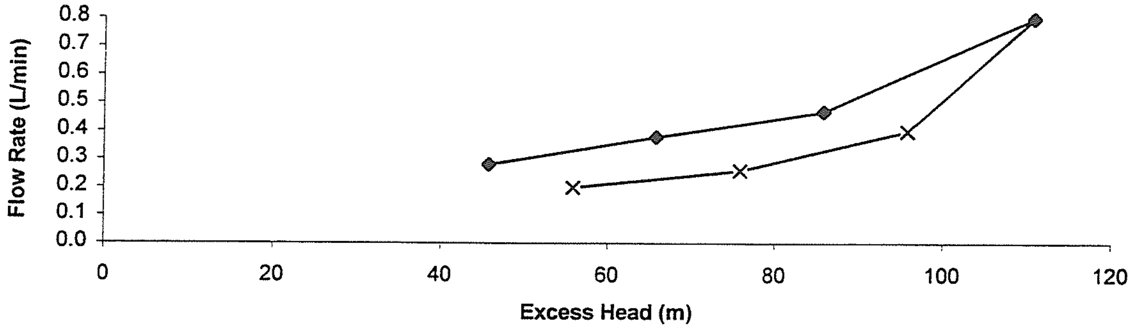
PACKER TESTING

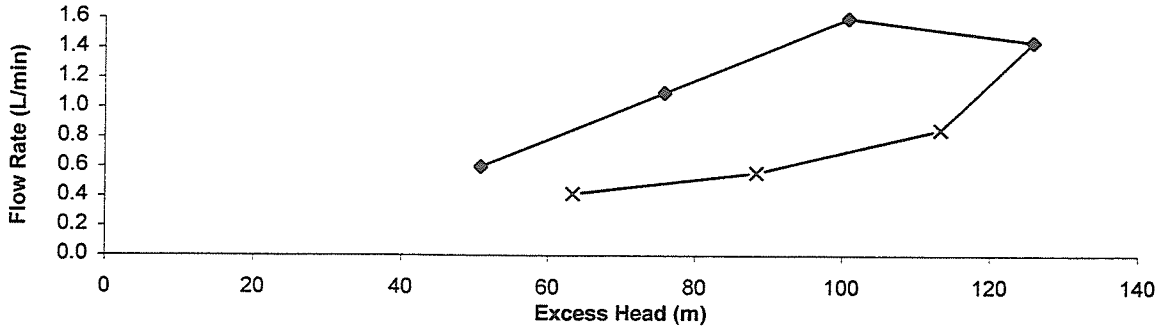
BORE 5750D750, TEST INTERVAL 106.0 - 109.0m
WYNN SEAM



BORE 5750D750, TEST INTERVAL 113.0 - 116.0m
SANDSTONE



BORE 5750D750, TEST INTERVAL 124.0 - 127.0m
SANDSTONE



NOTES: Solid marker denotes readings obtained with rising pressures.
"X" denotes readings obtained with descending pressures

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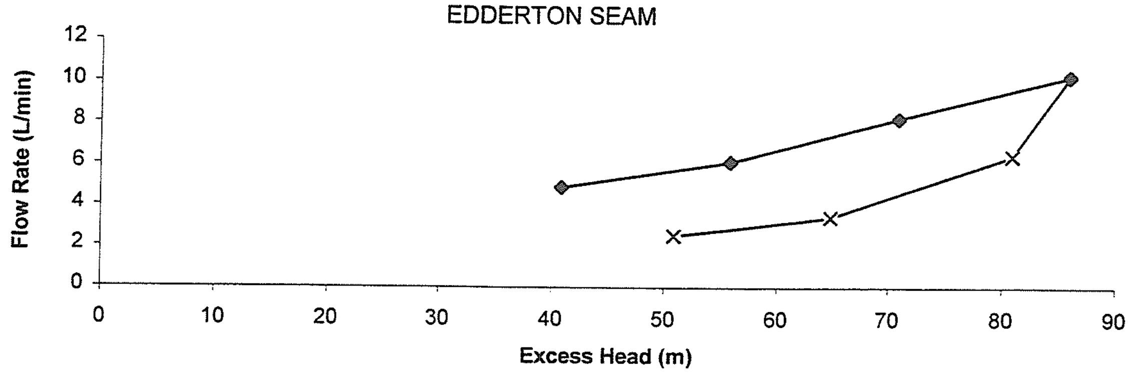
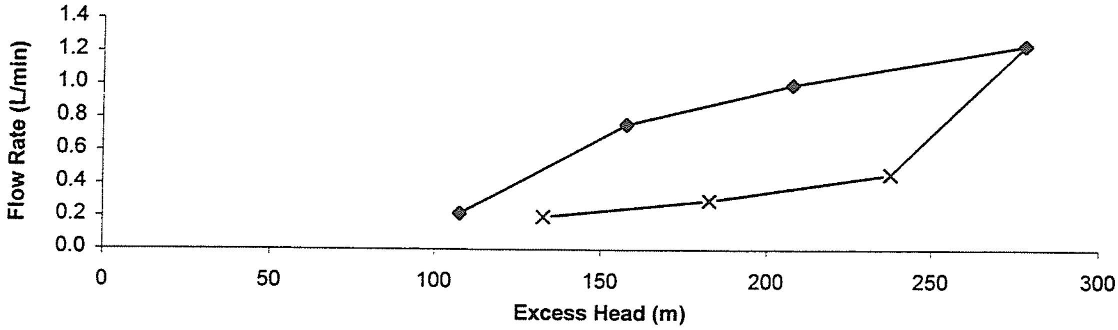
PACKER TESTING

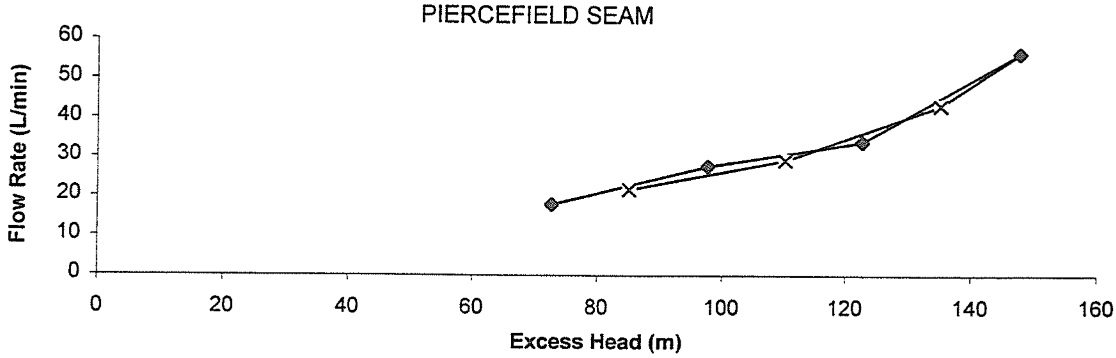
BORE 5750D750, TEST INTERVAL 141.0 - 144.0m
EDDERTON SEAM



BORE 4750C000, TEST INTERVAL 52.0 - 55.0m
SANDSTONE WITH SILTSTONE



BORE 4750C000, TEST INTERVAL 70.5 - 73.5m
PIERCEFIELD SEAM



NOTES: Solid marker denotes readings obtained with rising pressures.
"X" denotes readings obtained with descending pressures

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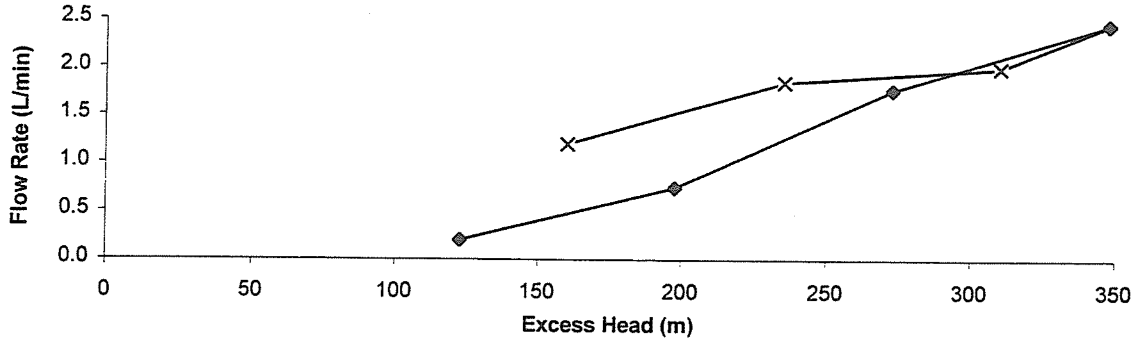
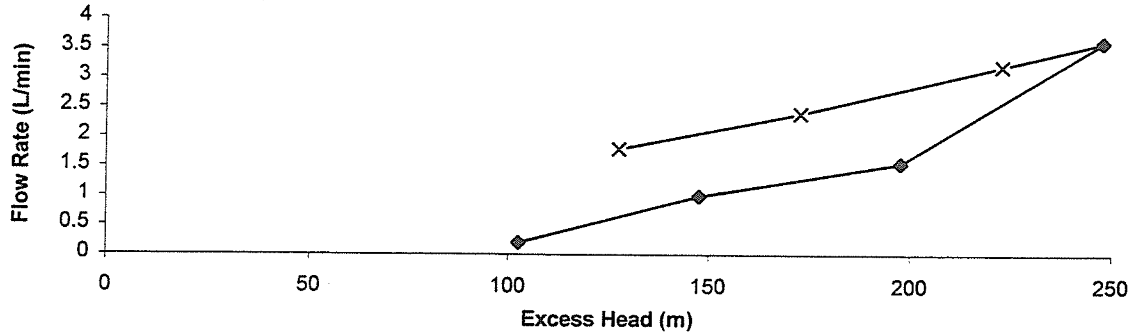
58E047A - 23/1/96

PACKER TESTING

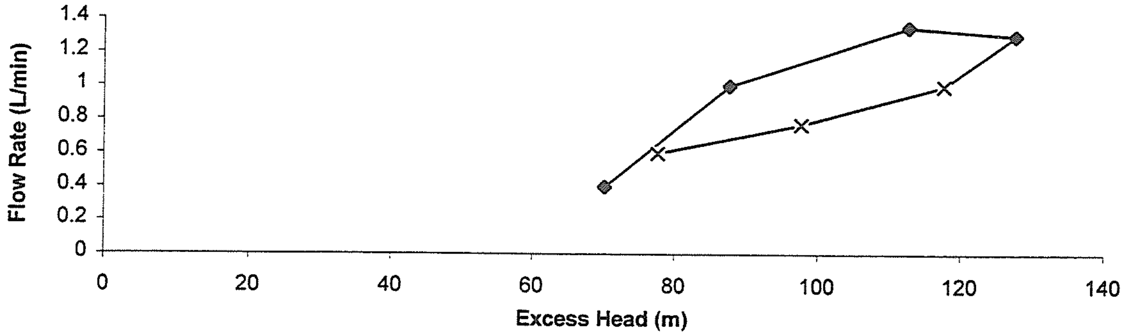
BORE 4750C000, TEST INTERVAL 77.0 - 80.0m
INTERBEDDED SANDSTONE AND SILTSTONE



BORE 4750C000, TEST INTERVAL 97.5 - 100.5m
INTERBEDDED SANDSTONE AND SILTSTONE



BORE 4750C000, TEST INTERVAL 111.0 - 114.0m
SILTSTONE



NOTES: Solid marker denotes readings obtained with rising pressures.
"X" denotes readings obtained with descending pressures

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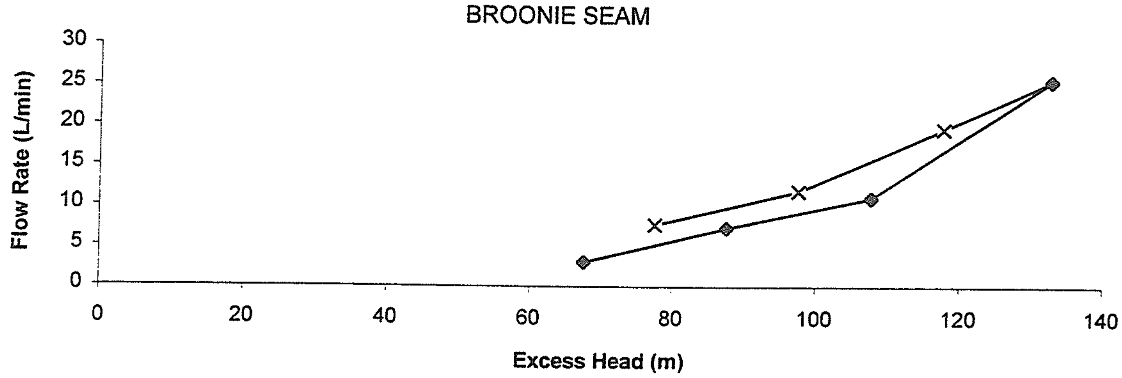
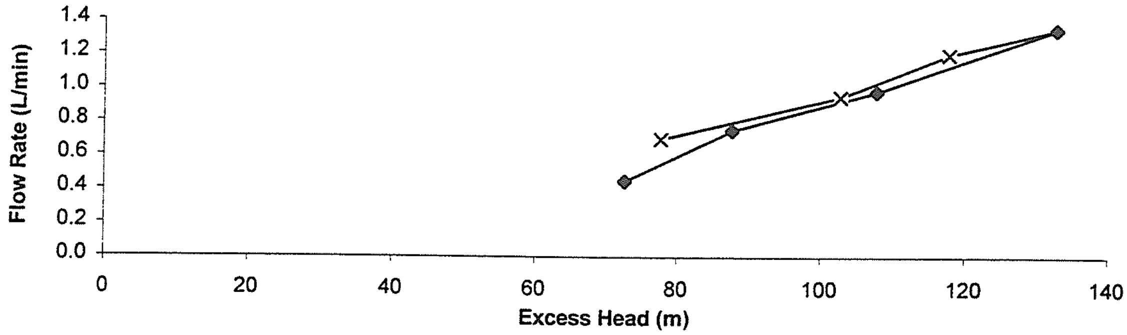
PACKER TESTING

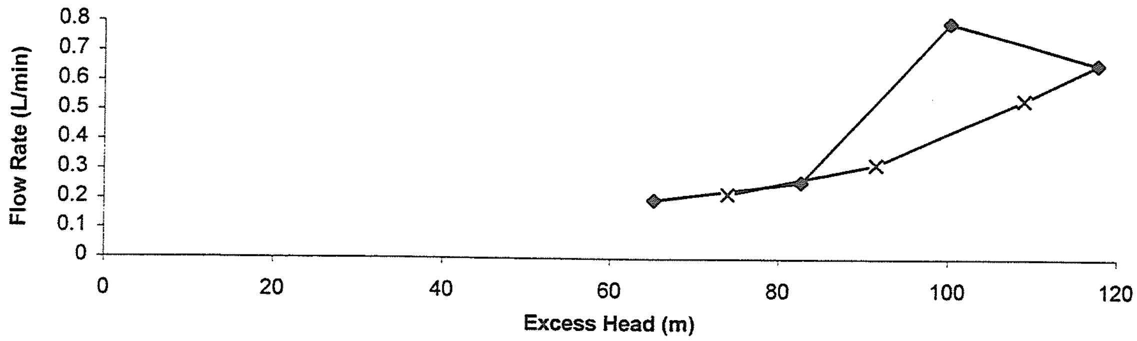
BORE 4750C000, TEST INTERVAL 135.0 - 138.0m
BROONIE SEAM



BORE 4750C000, TEST INTERVAL 153.5 - 156.5m
CONGLOMERATE



BORE 4750C000, TEST INTERVAL 164.5 - 167.5m
INTERBEDDED SANDSTONE AND SILTSTONE



NOTES: Solid marker denotes readings obtained with rising pressures.
"X" denotes readings obtained with descending pressures

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Appendix E

Chemical Analyses and Field Parameter Measurements

Summary of Regional Water Quality Analyses

Sample Source	pH	TDS (mg/L)	Ca (mg/l)	Mg (mg/l)	K (mg/l)	Na (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)
Piercefield (1)			7.2	8.6	7.8	490	560	380	49
Vaux			102	220	8.2	350	1250	590	34
Bayswater			62	78	14.5	760	1110	540	6
Interburden - 8			92	165	10.2	1180	1200	1360	270
Interburden - 7			62	102	12.7	900	1160	860	80
Broonie Bayswater * (1)	7.4	942	20	31	6.4	275	290	240	96
Wynn *	7.6	2600	64	118	6.6	680	520	980	108
Wynn Edderton * (1)	7.4	468	36	31	3.5	76	140	100	76
Broonie *	7.2	3380	130	220	12.5	760	980	1170	290
Wynn Piercefield *	7.4	3120	130	225	9.4	700	990	1070	165
Broonie *	7.4	3510	150	225	8.2	800	1000	1250	285
Alluvium			72	39	1.7	35	270	40	27
Alluvium			94	52	1.1	40	320	50	30
Alluvium			66	38	1.5	47	270	40	24
Mean Estimates									
Alluv.sed. (Mt. Pleasant)	7.2	380	77.3	43.0	1.4	40.7	286.7	43.3	27.0
Coal Meas. (Mt. Pleasant)	7.0	2440	65.0	114.7	10.6	736.0	1056.0	746.0	87.8

* indicates sample from adjacent Bengalla Authorisation (source: Bengalla EIS)
(1) shallow rainfall recharge suspected

ELEMENTS	UNITS	BOREHOLE							
		3500C500L	5000 A500	5500 D000	6000 C000L	7000 D000L	MP BH1	MP BH2	MP BH3
Na	mg/l	490.0	350.0	760.0	1180.0	900.0	35.0	40.0	47.0
Mg	mg/l	8.6	220.0	78.0	165.0	102.0	39.0	52.0	38.0
P	mg/l	0.1	0.2	x	0.3	0.4	0.7	2.1	1.1
Cl	mg/l	380	590	540	1360	860	40	50	40
K	mg/l	7.8	8.2	14.5	10.2	12.5	1.7	1.1	1.5
Ca	mg/l	7.20	102.00	62.00	92.00	62.00	72.00	94.00	66.00
Cr	mg/l	x	x	x	x	x	x	x	x
Mn	mg/l	0.07	0.21	0.33	1.55	1.50	0.58	4.40	2.85
Fe-Sol	mg/l	1.30	1.12	1.20	1.25	0.23	3.60	8.00	5.20
Co	mg/l	x	0.001	0.001	0.001	x	0.006	0.042	0.012
Cu	mg/l	x	x	x	x	x	0.01	0.02	0.01
Zn	mg/l	0.03	0.05	0.11	0.04	0.01	0.04	0.08	0.04
Cd	ug/l	x	x	x	x	x	x	x	x
Ba	mg/l	0.084	0.330	0.250	0.295	0.300	0.096	0.370	0.114
Pb	mg/l	0.026	0.042	0.048	0.006	0.006	0.014	0.020	0.026
TDSEva	mg/Kg	1280	2100	2380	3780	2640	340	460	340
N-NO3	mg/l	0.2	x	0.8	2.0	2.0	1.2	5.0	0.4
OH	mg/l	0	0	0	0	0	0	0	0
CO3	mg/l	0	0	0	0	0	0	0	0
HCO3	mg/l	560	1250	1110	1200	1160	270	320	270
TotALK	mg/l	560	1250	1110	1200	1160	270	320	270
SO4	mg/l	49.0	34.0	6.0	270.0	80.0	27.0	30.0	24.0

"x" = Less than detection limit

Chemical Analysis Results

DATE SAMPLED	BOREHOLE																					
	3000C500		3500C500L		3500B500		4500F000		5000A500		5500D000		7000D000U		7500F000		MP BH1		MP BH2		MP BH3	
	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)	pH	EC (uS/cm)
18/02/94	nd	nd	nd	nd	nd	nd	nd	nd	7.1	2850	7.4	3930	7.5	7240	nd	nd	7.0	680	7.2	811	7.6	663
22/04/94	6.8	1448	nd	nd	nd	nd	nd	nd	5.6	3190	7.5	3820	5.7	8040	nd	nd	7.5	670	5.6	878	6.0	670
18/05/94	6.9	1587	nd	nd	nd	nd	nd	nd	5.8	2860	7.3	5590	6.2	5820	nd	nd	7.6	532	5.6	992	6.4	653
12/08/94	6.9	1463	7.1	8440	6.9	1463	nd	nd	7.2	3390	7.8	4100	7.3	7180	7.1	4990	7.1	693	7.3	846	7.4	705
28/10/94	nd	nd	7.4	340*	7.1	390*	7.2	773*	7.0	600*	7.0	393*	6.7	7220	7.0	644*	7.0	650	6.9	800	7.8	530
19/12/94	nd	nd	7.0	351*	6.9	417*	6.7	767*	6.7	598*	6.6	602*	6.6	7150	7.0	651*	6.8	645	6.8	805	7.6	550
22/03/95	nd	nd	7.3	370*	7.3	442*	6.9	780*	6.9	634*	7.0	410*	6.7	7300	6.9	680*	7.0	680	6.9	830	7.2	578
25/05/95	nd	nd	7.7	384*	7.8	461*	7.7	800*	7.6	518*	7.4	408*	7.3	7090	7.7	680*	7.7	683	7.7	763	7.7	678
12/12/95	nd	nd	6.7	388*	7.0	583*	7.2	880*	7.0	3060	6.9	504*	7.8	7680	6.9	723*	7.2	877	7.0	821	7.4	758
12/03/96	nd	nd	7.0	377*	7.8	625*	6.9	915*	6.7	720*	6.6	535*	6.6	7450	6.9	820*	7.0	855	7.0	725	7.8	577

NOTES: * indicates water sampled from shallow depth.

Field measured groundwater chemical parameters

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ATTENTION T GLEESON
RUST-PPK
PO BOX 115
SINGLETON NSW 2330
AUSTRALIA
..

ANALYTICAL REPORT.

COMMENTS : ATTENTION: T GLEESON....
COMMENTS : SOLN....

JOB INFORMATION

JOB CODE	:86.4/942784
NO. SAMPLES	:8
ELEMENTS	:22
CLIENT O/N	:58E047A
DATE RECEIVED	:20/05/94
DATE COMPLETED	:31/05/94

LEGEND

'X' = LESS THAN DETECTION LIMIT
'N/L' = SAMPLE NOT RECEIVED
'*' = RESULTS CHECKED
'( )' = RESULTS STILL TO COME
'I/S' = INSUFFICIENT SAMPLE FOR ANALYSIS
'E6' = RESULT x 1,000,000

SAMPLE PREPARATION DETAILS

SAMPLE STATE(S) & SAMPLE PREPARATION(S)

NR

Abbreviations used for Preparation codes :

CP	: Coarse Pulverise	CR	: Crush	DR	: Dry
CUT	: Diamond Saw Cut	FP	: Fine Pulverise	HM	: Hammer Mill
SSMG	: Single Stage Mix & Grind	MS	: Mix & Split	O	: Other
NR	: Not Required	QTZ	: Quartz Clean Between	COMPS	: Composite
2X	: Two Splits				

Abbreviations used for Sample States :

CONC	: Concentrates	COST	: Costeans	CRJCT	: Coarse Rejects
D/CHIP	: Drill Chip	D/CORE	: Drill Core	D/CUT	: Drill Cuttings
HMC	: Heavy Mineral Concentrates	PERC	: Percussion Chip	PISLIT	: Pisolite
RC	: Reverse Circulation	R/CHIP	: Rock Chip	NR	: Not Required
SOLN	: Solutions	STRSED	: Stream Sediments	UNSPEC	: Unspecified
V/CHIP	: Vacuum Chip	V/DRIL	: Vacuum Drill	XCRJCT	: Ex Coarse Rejects

SAMPLE STORAGE OF SOLIDS :

BULK RESIDUES AND PULPS WILL BE STORED FOR 60 DAYS WITHOUT CHARGE. AFTER THIS TIME ALL BULK RESIDUES AND PULPS WILL BE STORED AT A RATE OF $1.20/cubic metre/day UNTIL YOUR WRITTEN ADVICE REGARDING COLLECTION OR DISPOSAL IS RECEIVED. EXPENSES RELATED TO THE RETURN OR DISPOSAL OF SAMPLES WILL BE CHARGED TO YOU AT COST.

SAMPLE STORAGE OF SOLUTIONS :

SAMPLES RECEIVED AS LIQUIDS ,WATERS OR SOLUTIONS WILL BE HELD FOR 6 WEEKS FREE OF CHARGE THEN DISPOSED OF , UNLESS WRITTEN ADVICE FOR RETURN OR COLLECTION IS RECEIVED.

Abbreviations Used In Water Analysis Reports.

TDSEva	:/GRAV	TDS ex Evaporation @ 180 degrees C.
Fe-Sol	:/OES	Soluble Iron.
TotAlk	:/CALC	Total Alkalinity (as $CaCO_3$).
OH	:/VOL	Hydroxide (as $CaCO_3$)
CO3	:/VOL	Carbonate (as $CaCO_3$)
HCO3	:/VOL	Bicarbonate (as $CaCO_3$)
Cl	:/VOL	Chloride
SO4	:X/OES	Sulphate
N-NO3	:/COL	Nitrate (as N)

ELEMENTS	Na	Mg	P	Cl	K	Ca	Cr	Mn	Fe-Sol	Co	Cu
UNITS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
DETECTION	0.1	0.1	0.1	10	0.1	0.01	0.01	0.01	0.01	0.001	0.01
METHOD	/OES	/OES	/OES	/VOL	/OES	/OES	/OES	/OES	/OES	/MS	/OES
SAMPLE NUMBERS											
1 3000C:500L	490.0	8.6	0.1	380	7.8	7.20	X	0.07	1.30	X	X
2 5000A:500	350.0	220.0	0.2	590	8.2	102.00	X	0.21	1.12	0.001	X
3 5500D:000	760.0	78.0	X	540	14.5	62.00	X	0.33	1.20	0.001	X
4 6000C:000L	1180.0	165.0	0.3	1360	10.2	92.00	X	1.55	1.25	0.001	X
5 7000D:000L	900.0	102.0	0.4	860	12.5	62.00	X	1.50	0.23	X	X
6 MPBH1	35.0	39.0	0.7	40	1.7	72.00	X	0.58	3.60	0.006	0.01
7 MPBH2	40.0	52.0	2.1	50	1.1	94.00	X	4.40	8.00	0.042	0.02
8 MPBH3	47.0	38.0	1.1	40	1.5	66.00	X	2.85	5.20	0.012	0.01
Ch.0001(3000C:500L)	490.0	8.2	0.1	380	8.0	7.20	X	0.08	1.35	X	X
STD: SOLN	175.0	22.5	0.8		7.6	19.00	0.54	1.06	2.15		0.50
STD: SOLN										0.085	
STD: SOLN											

ELEMENTS	Zn	Cd	Ba	Pb	TDSEva	N-NO3	OH	CO3	HCO3	TotAlk	SO4
UNITS	mg/l	ug/l	mg/l	mg/l	mg/Kg	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
DETECTION	0.01	0.5	0.001	0.002	20	0.2			10	10	0.3
METHOD	/OES	/MS	/MS	/MS	/GRAV	/COL	/VOL	/VOL	/VOL	/CALC	X/OES
SAMPLE NUMBERS											
1 3000C:500L	0.03	X	0.084	0.026	1280	0.2	0	0	560	560	49.0
2 5000A:500	0.05	X	0.330	0.042	2100	X	0	0	1250	1250	34.0
3 5500D:000	0.11	X	0.250	0.048	2380	0.8	0	0	1110	1110	6.0
4 6000C:000L	0.04	X	0.295	0.006	3780	2.0	0	0	1200	1200	270.0
5 7000D:000L	0.01	X	0.300	0.006	2640	2.0	0	0	1160	1160	80.0
6 MPBH1	0.04	X	0.096	0.014	340	1.2	0	0	270	270	27.0
7 MPBH2	0.08	X	0.370	0.020	460	5.0	0	0	320	320	30.0
8 MPBH3	0.04	X	0.114	0.026	340	0.4	0	0	270	270	24.0
Ch.0001(3000C:500L)	0.03	X	0.096	0.024	1260	0.2	0	0	550	550	48.0
STD: SOLN	0.54										
STD: SOLN		94.0	0.110	0.110							
STD: SOLN											24.0

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<< END OF REPORT >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

Appendix F

Summary Plots - Regional Groundwater Depressurisation

RUST PPK
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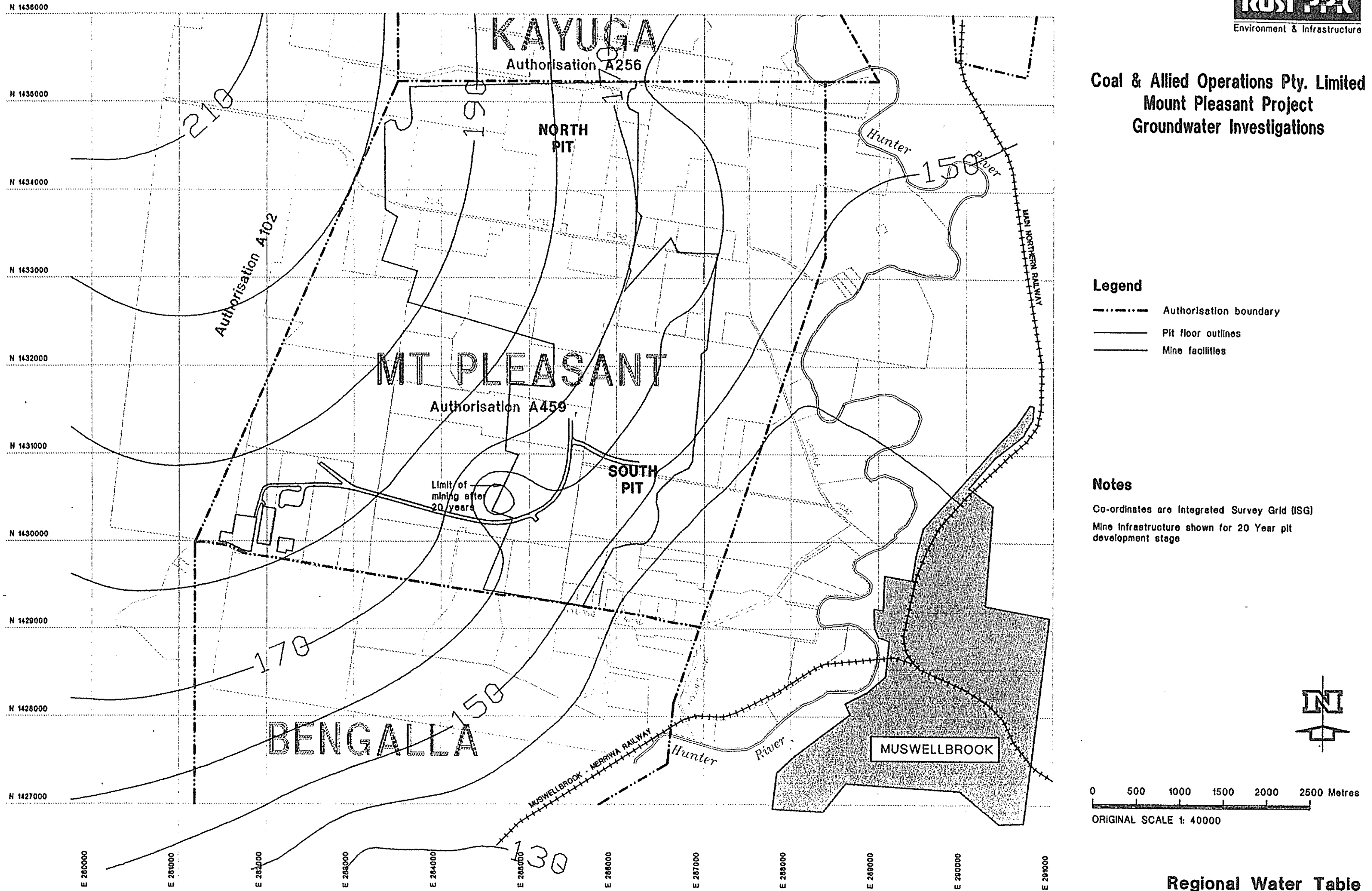
Mount Pleasant Project
Groundwater Investigations



Legend

- Authorisation boundary
- Pit floor outlines
- Mine facilities

Notes

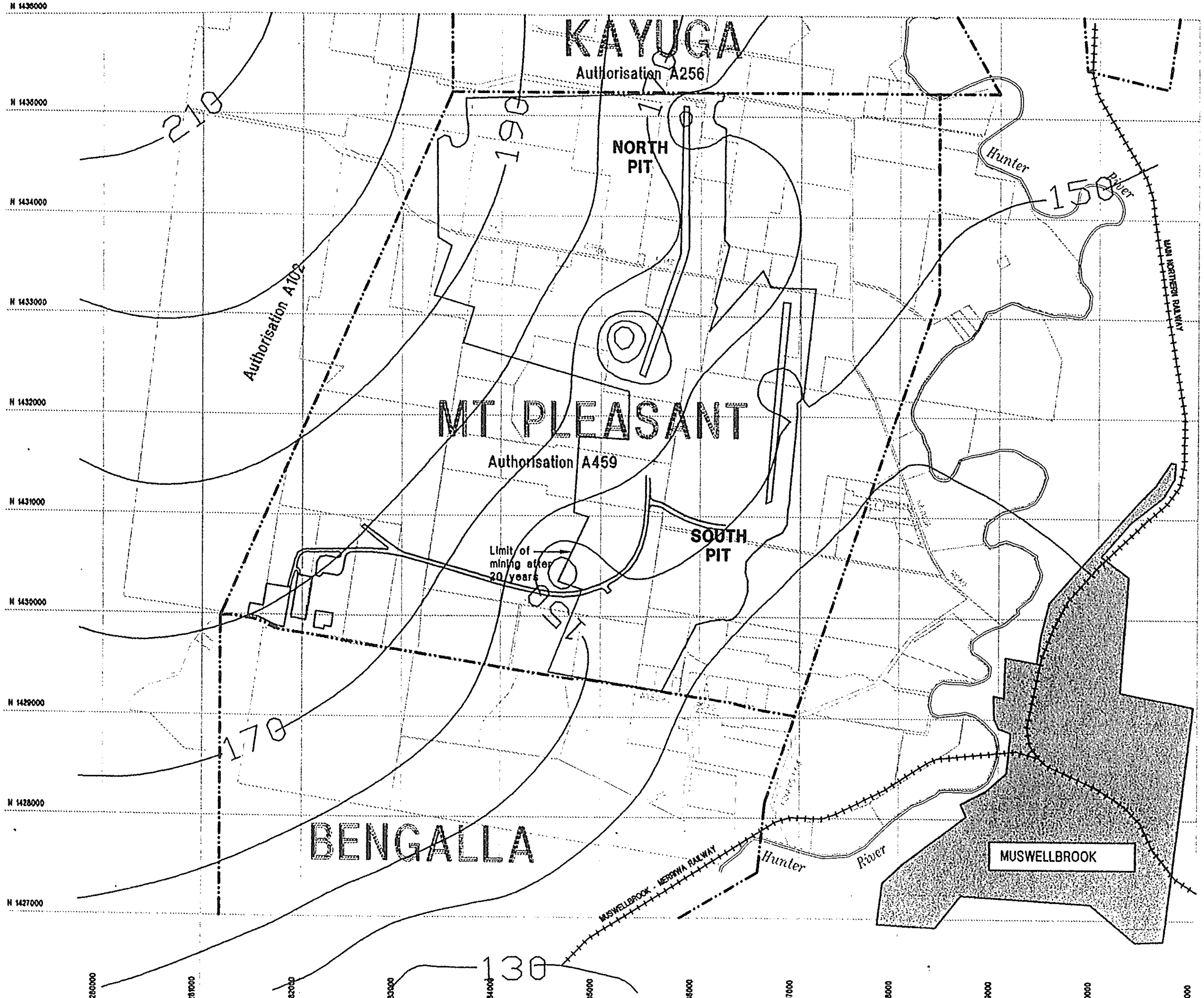
Co-ordinates are Integrated Survey Grid (ISG)

Mine infrastructure shown for 20 Year pit development stage

Regional Water Table
2 Year Mine Development Scenario

Figure F1

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



Legend

- Authorisation boundary
- Pit floor outlines
- Mine facilities

Notes

Co-ordinates are Integrated Survey Grid (ISG)

Mine infrastructure shown for 20 Year pit development stage

0 500 1000 1500 2000 2500 Metres

ORIGINAL SCALE 1: 40000

Regional Water Table
5 Year Mine Development Scenario

Figure F2

RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study

Legend

- Authorisation boundary
- Pit floor outlines
- Mine facilities

Notes

Co-ordinates are Integrated Survey Grid (ISG)

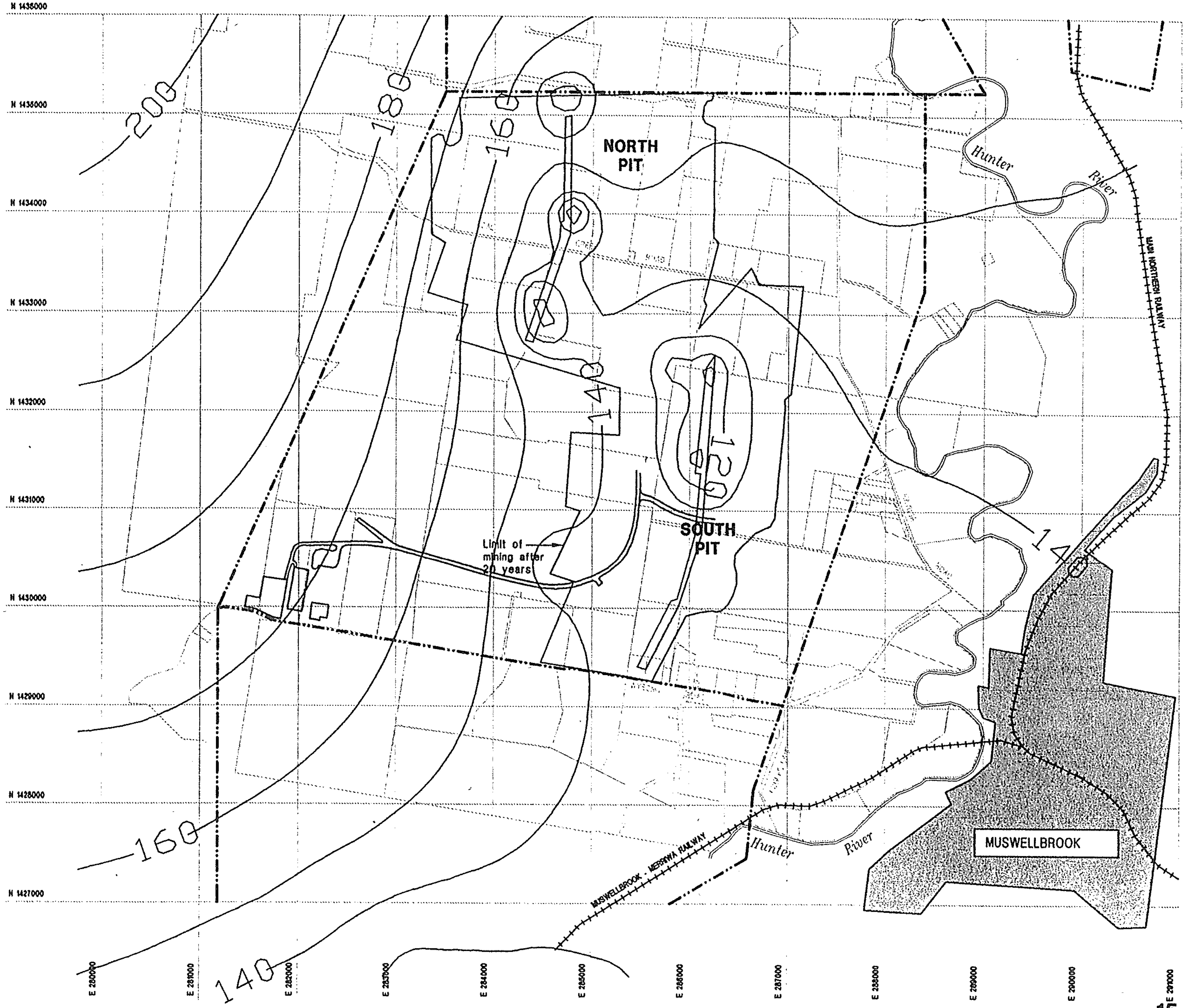
Mine infrastructure shown for 20 Year pit development stage

Regional Water Table
10 Year Mine Development Scenario

Figure F3

RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



Legend

- Authorisation boundary
- Pit floor outlines
- Mine facilities

Notes

Co-ordinates are Integrated Survey Grid (ISG)

Mine Infrastructure shown for 20 Year pit development stage

0 500 1000 1500 2000 2500 Metres

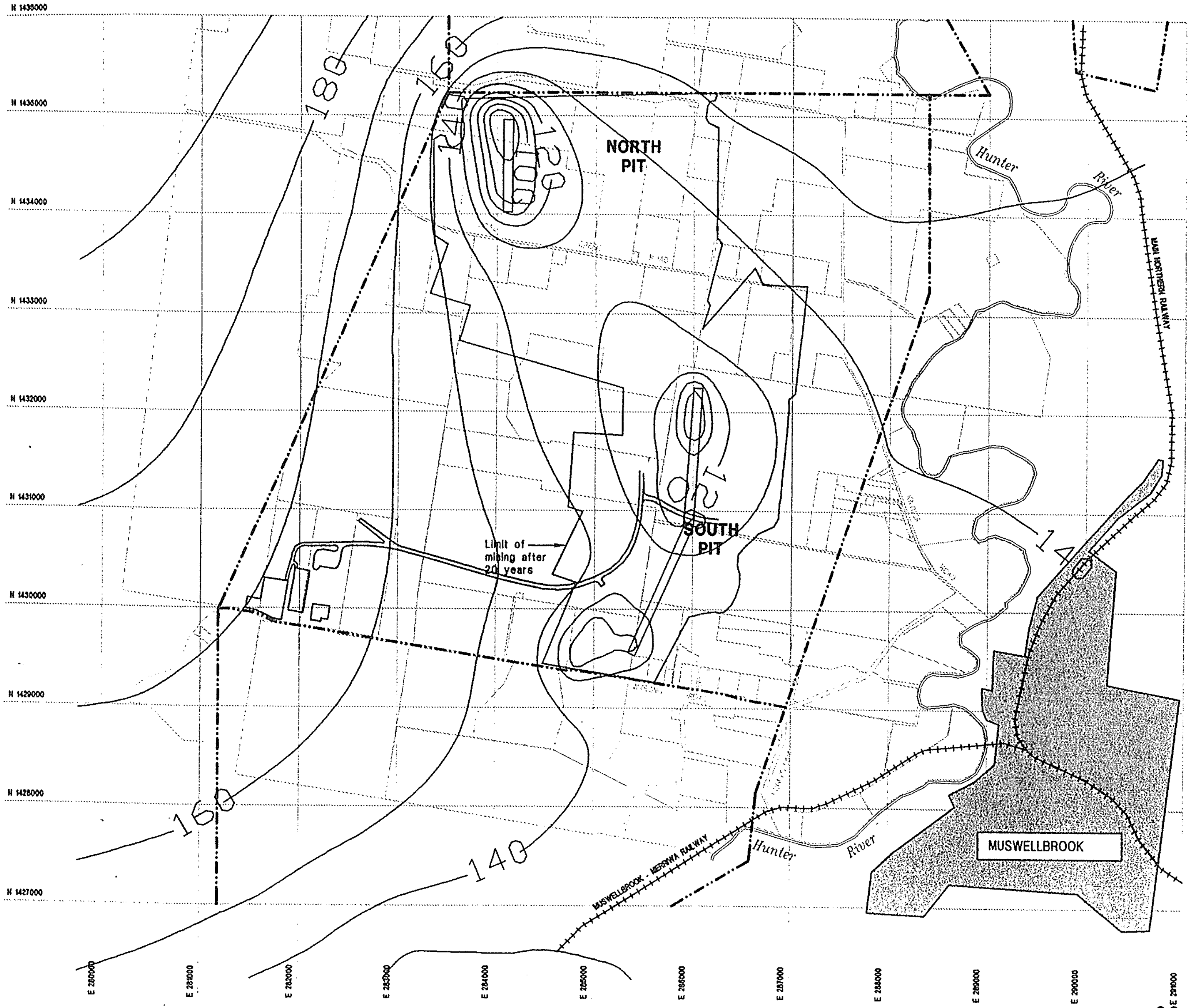
ORIGINAL SCALE 1: 40000

Regional Water Table
15 Year Mine Development Scenario

Figure F4

RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



Legend

- Authorisation boundary
- Pit floor outlines
- Mine facilities

Notes

Co-ordinates are Integrated Survey Grid (ISG)

Mine Infrastructure shown for 20 Year pit development stage

0 500 1000 1500 2000 2500 Metres

ORIGINAL SCALE 1: 40000

Regional Water Table
20 Year Mine Development Scenario

Figure F5

Appendix G

Waste Management Simulation Model

G1 Surface Water Management

Water management studies have been conducted to develop an overall water management plan having regard for surface and groundwater within the Authorisation and in the rejects storage facility. The studies have encompassed the diversion, collection, storage and treatment of both surface waters and groundwaters. The approach adopted combines a probabilistic assessment of channels and storages using the accepted Rational method for establishing design parameters, with historical rainfall and runoff in a deterministic model to establish operational aspects of mine storage. In this manner, both instantaneous and antecedent conditions are taken into account.

G2 Dam and Channel Design - Rational Method

The widely used Rational method adopts a probabilistic approach in setting minimum design aspects for dams, contour banks and diversions. This method assumes certain storm criteria and if rainfall is exceeded, then the structure may overtop. Such overtopping to natural drainages may be acceptable providing the quality of water in receiving channels is not impaired.

Surface water runoff will arise from both undisturbed natural catchment areas and from areas disturbed by mining operations. Runoff from undisturbed catchments will be directed via contour banks and channels to dams or natural drainages. Where banks and drains are installed, runoff will be directed through silt traps or sedimentation dams until such time as grassing within drains is re-established and sediment load is acceptable. In some areas, deep ripping and contour furrowing will be employed to minimise erosion potential over large areas.

The location of dams, contour banks and channels are shown on Figures H1 to H6 for the period of mine development. In certain areas, the locations are nominal and subject to detailed analysis and design. Banks and channels will be constructed to contain peak runoff discharge rates for a 1 in 5 year Average Recurrence Interval (ARI) storm event. Channels will be excavated to a conventional trapezoidal section with sectional area and hydraulic grades designed to ensure non erosive flow velocities of less than 2 m/sec in undisturbed catchments, and less than 1 m/sec in rehabilitated areas. In any area where the integrity of the bank or channel is critical to erosion control (subject to detailed survey), a design storm higher than 1 in 5 ARI will apply and alternate stabilisation procedures may be invoked.

All dams will be designed in accordance with established engineering design principles and Dam Safety Committee requirements. At certain locations, dam water will be pumped to channels for conveyance, while other dams will have an outlet structure for release to existing drainages. Catchment runoffs for a design 1 in 20 year event have been calculated using the Rational method. All dam structures will have the capacity to retain the design storm - sedimentation dams will have spillway capacity to convey a 1 in 10 year (time of concentration) storm event. The raw water dam RW1 will be designed to permit discharge at a minimum rate of 50ML per hour (subject to detailed design) to meet HSTS discharge criteria.

The following Table provides nominal design storage capacities for mine water storage dams shown on Figures G1 to G5 and environmental dams located in the fine rejects emplacement area.

Table G1: Nominal Dam Storage Size Based on Design Rainfall Events

Dam	Catchment sq.km	Minimum Volume ML	Design Volume ML
RW1	2.356	80	2000
CPP	0.091	0.5	30
RL1	-	-	5
MW1	1.244	21	25
MW2	0.980	35	25
MW3	1.044	27	30
MW4	1.664	55	5
MW5	1.547	45	50
ED1	1.050	30	524
ED2	0.366	18	935
ED3	0.401	21	345

G3 Water Management Computer Simulation Model

The deterministic (historical rainfall) model incorporates parameters which characterise each of 6 catchment types in terms of interception storage, soil moisture storage, groundwater percolation capacity etc. While no specific field measured parameters are available for catchment characterisation at Mt. Pleasant, some parameters have been obtained through model simulation of other catchments in the region.

Fundamentally, the model balances the water budget for each of the nominated mine catchments in variable time steps with a maximum daily increment. The catchment areas are adjusted on a stepwise basis as mining progresses. Daily rainfall data for Muswellbrook has been used as the main input. For days in the historical rainfall record where no rain was received, a one-day time step is used. When a rain-day occurred, the duration and temporal distribution of the rainfall have been estimated by a predetermined relationship and calculations then allowed to proceed at one-hour intervals through a process of disaggregation of the daily rainfall.

Operation of the model is as follows:

- Rainfall received within a particular catchment must first fill interception storage. A nominal volume is assigned to retention on grasses from which water evaporates at the regionally defined potential rate before any infiltration to the soil can occur. Remaining rainfall is then assessed as part of the runoff calculation.
- The amount of runoff is determined after accounting for interception storage. Surface runoff is controlled by three parameters comprising the proportion of impervious catchment directly linked to drainage pathways, the nominal minimum

and maximum rainfall/soil infiltration capacities in mm/h for the remaining catchment surface, and the prevailing soil moisture condition. Impervious catchment permits immediate runoff while the remaining catchment is controlled by the soil moisture conditions described below.

- Of the water that penetrates the soil, the balance between that which evaporates and that which percolates to groundwater is determined by the potential evaporation together with the balance in the soil moisture and several additional model parameters including the rate at which evaporation from shallow soil zones is permitted to remove soil moisture storage. The value of soil moisture is repeatedly determined by satisfying the water balance of the specified catchment. Any surplus is either directed to runoff or permitted to infiltrate to groundwater - the process being repeated for each catchment.
- Attenuation of surface runoff is achieved by routing through a linear reservoir with a storage constant equal to a specified number of days.
- Surface runoffs and shallow groundwater seepages which could potentially provide base flow in drainages (not including pit water contributions) for each catchment are combined to form a total runoff contribution to the mine water circuit. Each catchment runoff and groundwater seepage from the pits is directed to specific storages.
- Finally all planned water usages are applied to the water storages on a daily basis and the water balance, calculated.

G4 Model Parameters

The following parameters are employed in the modelling process:

POW: Power of soil moisture-runoff equation

The parameter POW determines the rate at which runoff diminishes as soil moisture is decreased. POW therefore has a significant effect on both the seasonal distribution and reliability of flow as well as total yield. The lower the value of POW, the higher will be all flows when soil moisture is not fully saturated, especially dry-season flows and dry year runoffs.

SL: Soil moisture storage capacity below which no runoff occurs

There is a definable soil moisture state below which runoff ceases but the runoff curve is generally so flat in this region that sufficiently accurate mathematical representation may be obtained by setting SL to zero.

ST: Maximum soil moisture capacity

The parameter ST (mm) is of major importance in that it determines the ability of the catchments to regulate the output (runoff) for a given input (rainfall). The higher the value of ST, the greater will be the rainfall absorbed by the catchment during wet periods. Consequently catchments exhibiting a high ST will yield less runoff during these wet periods than those associated with a smaller ST (eg. unshaped spoils).

FT: Percolation from soil moisture at full capacity

Together with the parameter POW, FT controls the rate of runoff from the soil for any given moisture state. Fortunately POW has been found to be constant over large areas and its subsequent regionalisation apparently satisfactorily delineated. For given values of POW and ST, the balance between evaporation and runoff is determined by the value adopted for FT. As FT is increased catchment evaporation is decreased at the expense of runoff and consequently, the total yield of the catchment is increased.

GW: Maximum Groundwater runoff and lag of groundwater runoff (GL)

The parameter GW allows the soil moisture storage to be subdivided into an upper and lower zone in order that different values may be assigned to the lag of runoff from these zones. The parameters GW and GL have virtually no effect on the simulated annual runoff, hence mean annual runoff and standard deviation are not influenced, but they do affect the seasonal distribution of runoff. The higher the value of GW in relation to FT and the greater the lag GL, the more sustained will be the simulated runoff during the dry season.

AI: Impervious proportion of catchment

This parameter represents the proportion of the catchment area that is impervious and adjacent to or connected with stream channels. For all catchments the impervious proportion is negligible.

ZMIN: Minimum catchment absorption rate

ZMIN is the nominal minimum infiltration capacity of the soil in mm/hr. It determines the depth of rainfall required in any period to initiate surface runoff and thus has a strong influence on the yield and reliability of runoff. As ZMIN is increased the runoff will be decreased. The seasonal distribution will also be affected in that the high rainfall months will yield a greater proportion of runoff at the expense of the low rainfall months.

ZMAX: Maximum catchment absorption rate

ZMAX is the nominal maximum infiltration capacity of rainfall in mm/hr and, together with ZMIN, regulates the volume of surface runoff from a catchment. However, reliability of runoff and seasonal flow distribution are virtually independent of ZMAX.

PI: Interception storage

All moisture that is retained in interception storage on grasses, trees or in dams is assumed to evaporate at the potential rate; hence the overall evaporation will be increased (at the expense of runoff) if PI is increased. PI is assigned in mm

TL: Lag of runoff other than that from soil moisture below GW

The parameter TL is used to simulate the time delay and attenuation of runoff between the instantaneous catchment condition and the resulting flow at the outlet. This parameter affects only the seasonal distribution of flow; the larger the value of TL the greater the delay in runoff toward the end of wet periods and the lower will be the runoff in the peak day/month.

R: Parameter determining evaporation-soil moisture relationship

The parameter R determines the rate at which catchment evaporation diminishes as soil moisture is decreased. As R is increased the actual evaporation for any soil moisture state below full capacity is decreased, especially in respect of the low-evaporation (winter months).

QOBS: Initial catchment yield - starting condition (nominal)

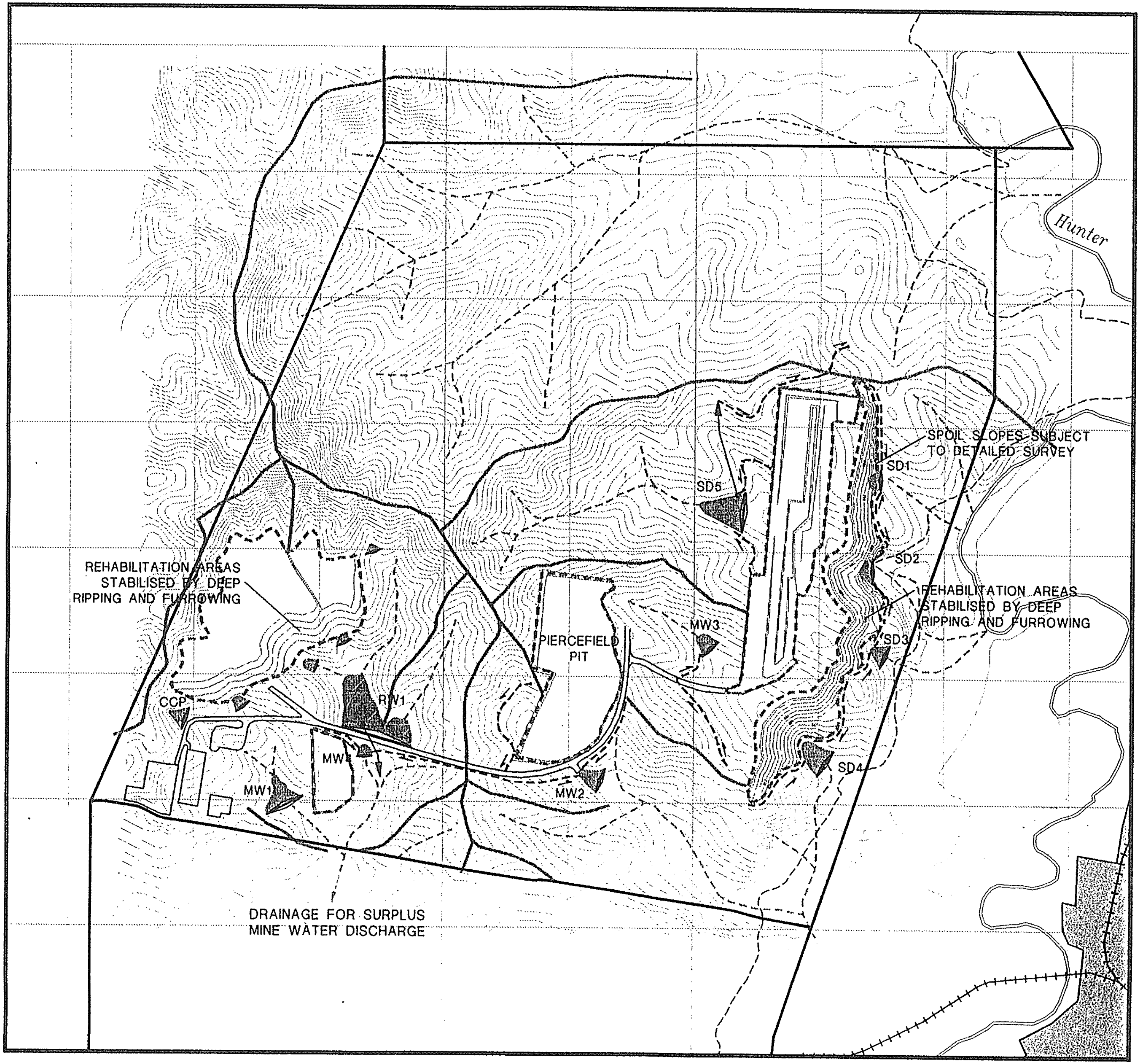
Table G2: Summary Parameters in Water Management Simulations

Variable	UD Undeveloped	PA Pit areas	HS Hardstand	SA Shaped spoils	RH Rehabilitated	PS Prestrip
POW	2.0	2.0	2.0	1.0	1.0	2.0
SI	0	0	0	0	0	0
St	70	10	5	80	50	90
Ft	0.5	0.01	0.0	0.35	0.1	0.1
Ai	0	0	0	0	0	0
Zmin	0	0	0	0	0	0
Zmax	9	5	1	30	6	20
Pi	1	1	1	1	1	1
TI	1	1	1	1	1	1
Lag	0	0	0	0	0	0
GI	0.3	1	1	0.7	0.5	1
R	0	0	0	0	0	0
Div	1	1	1	1	1	1
Qobs	.01	.001	.001	.001	.005	.001

G5 Model Results

Model simulations have been conducted utilising the catchment parameters given above (including Sandy Creek catchment) and the 100 year rainfall record for Muswellbrook. Catchment areas have been continually adjusted during the simulation as indicated on Figures G7 to G11. By adopting 8 different 21 year rainfall records, the runoff from different catchments and the overall storage response has been assessed for variable climatic conditions including extreme wet and dry periods. Simulation results are provided as Figures G12 to G19 for an overall mine water storage of 3000ML and G22 to G29 for a storage of 2000 ML. These plots provide a graph of the storage over the simulation period (lower plot) together with any overflows which would have occurred (upper plot) during the historical rainfall periods. Results of all simulations have been consolidated into a probability plot Figure G20 (Figure G30 for 2000 ML storage) showing the likelihood of storage exceedance (or depletion). The probabilities of overflows are also shown (Figure G20). Since storage is depleted for significant periods of time, the probability of make up water has been assessed and is provided as plots G21 and G31.

Modelling assumes consolidation of all storages into a single storage. Assessments of storage needs therefore assume that water can be transported efficiently between dams. This can be accomplished through the introduction of real time water management systems relying on telemetered data. Actual storage requirements are designed to include minimum storage capacity for 7 days operation without make up water - approximately 60 ML. During the first years of operations, a higher or lower minimum may be invoked as catchment runoff and storage monitoring data is gathered.



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Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study

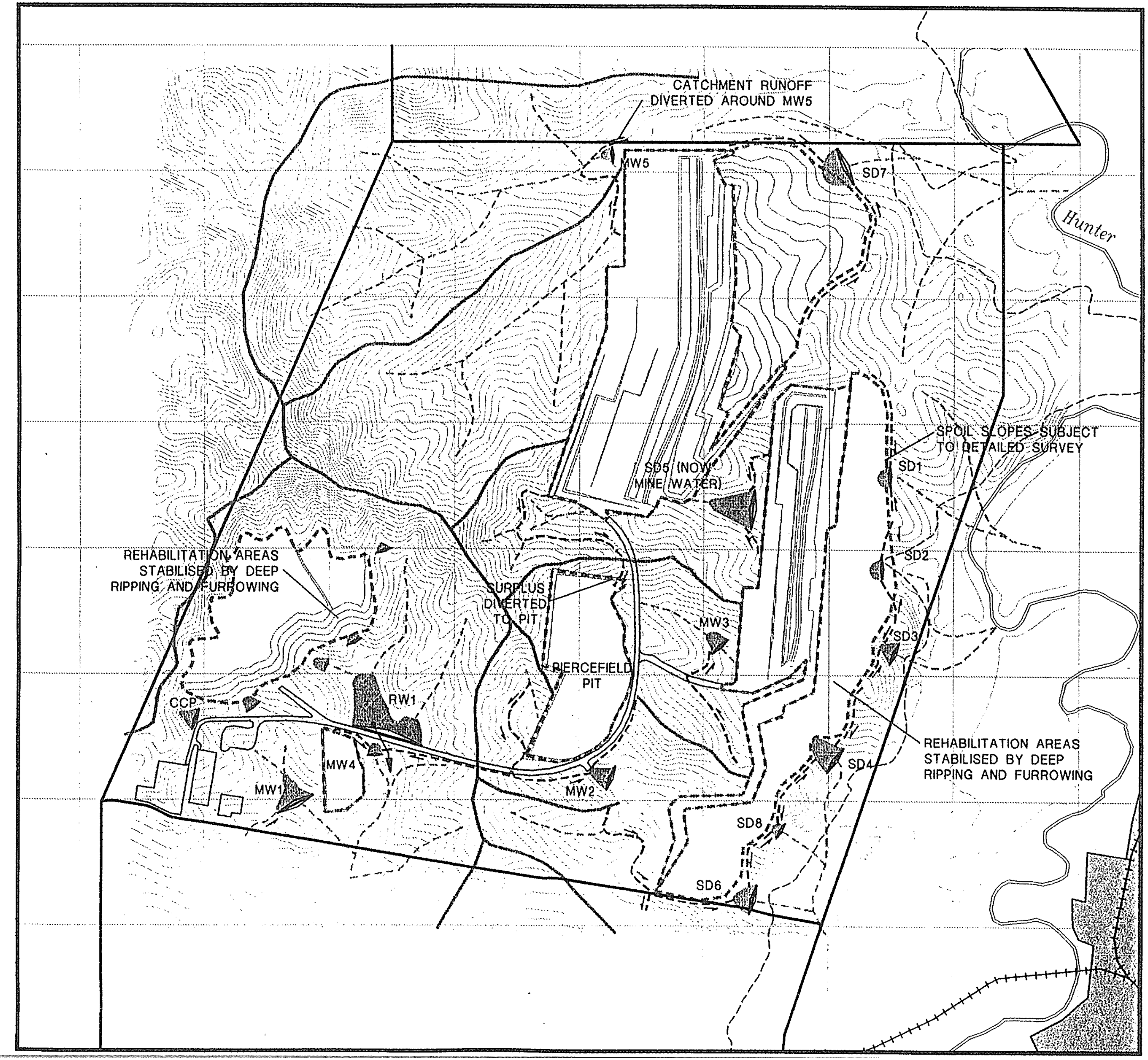
Legend:

- Drainage
- Contour banks
- Catch drains
- Catchment divide
- Disturbed areas
- Indicates pumping to drain or channel
- 1 in 100 year flood extent
- Dam

0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Surface Water Management Scheme - Year 2

Figure G1



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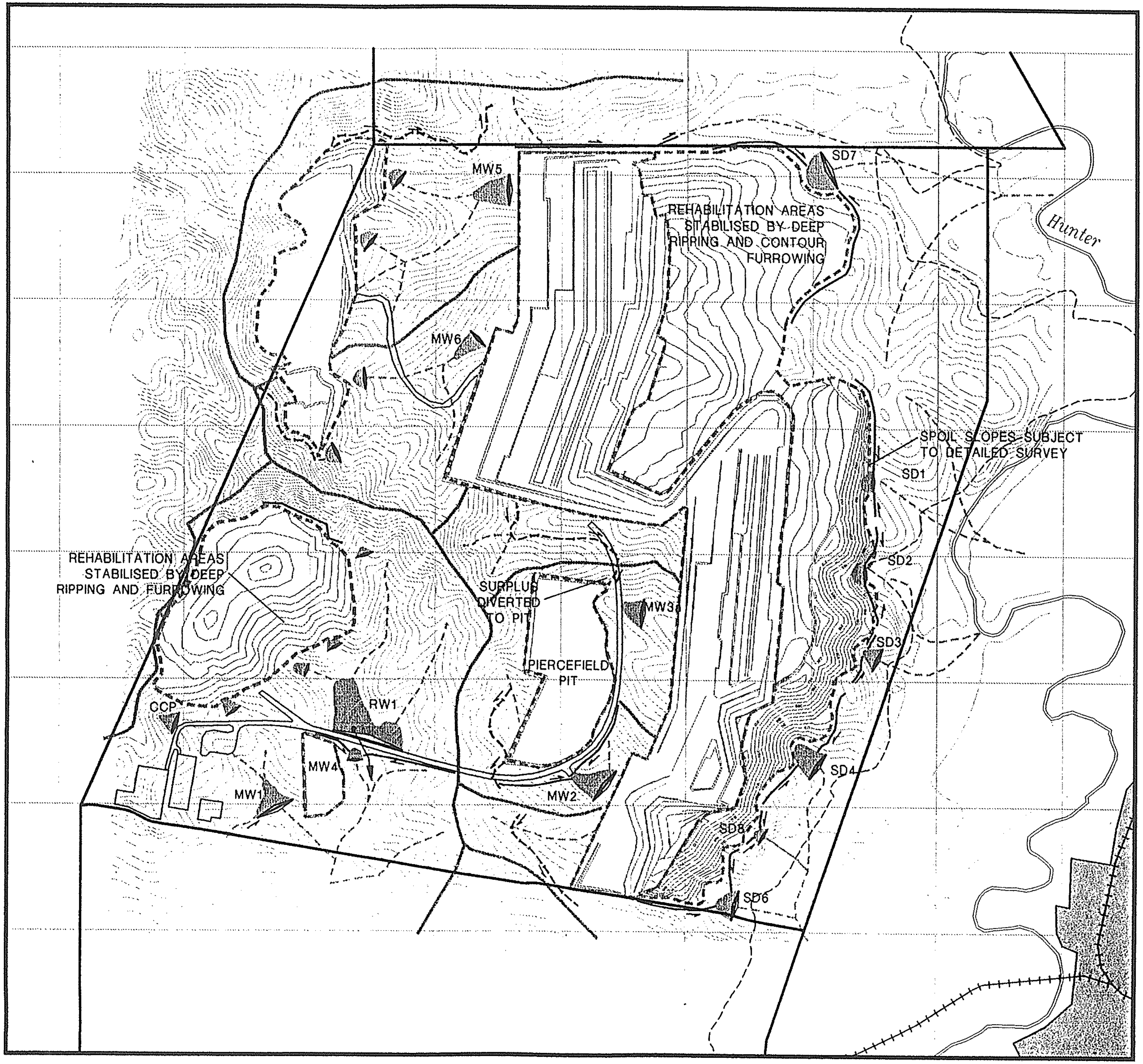
Mount Pleasant Project
Water Management Study

Surface Water Management Scheme - Year 5

Figure G2

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



Legend:

- Drainage pathways
- Contour drains
- Diversion channel
- Catchment divide
- Disturbed areas
- Indicates pumping to drain or channel
- 1 in 100 year flood extent
- Dam

0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Surface Water Management Scheme - Year 10

Figure G3

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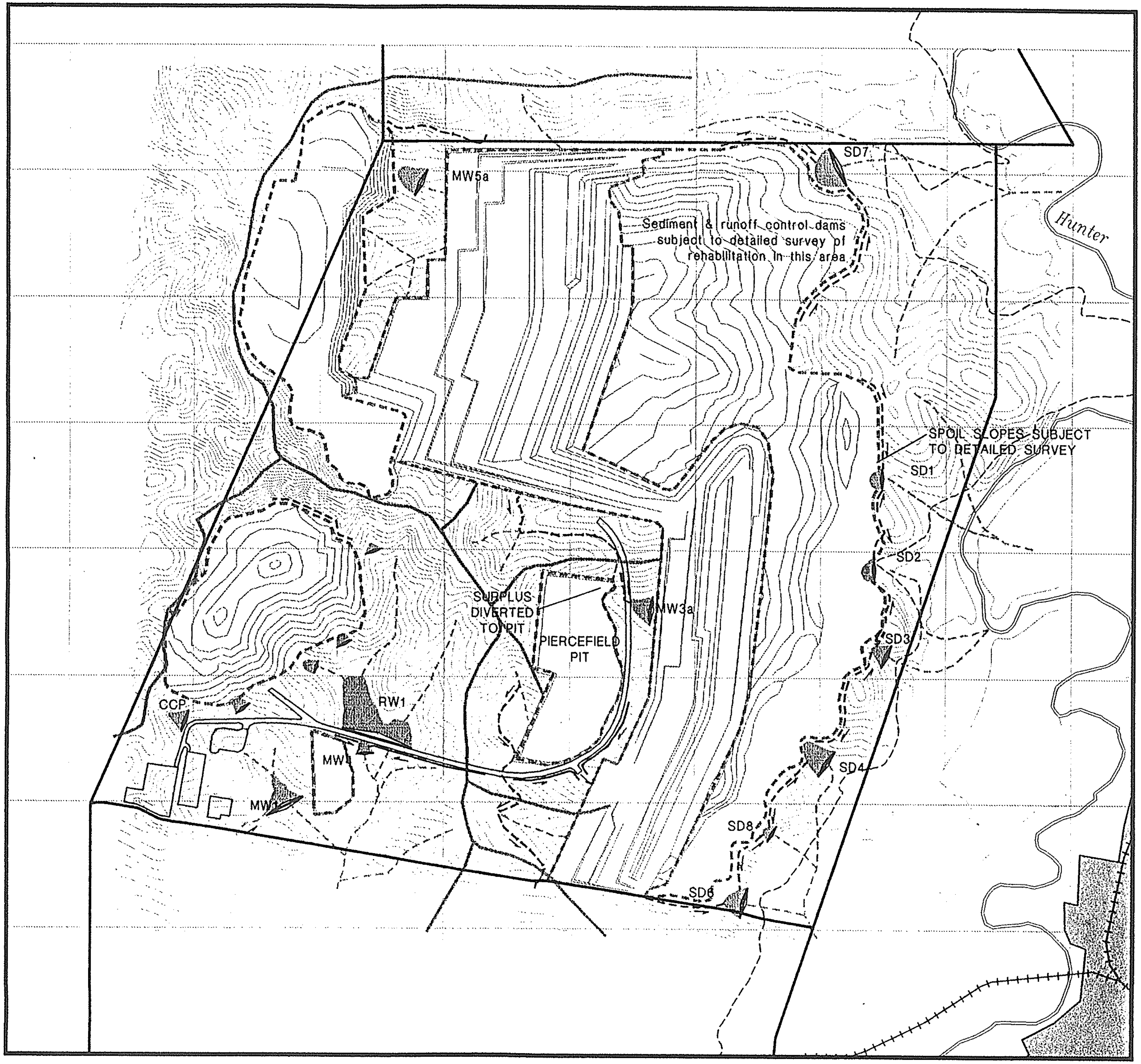
Mount Pleasant Project
Water Management Study



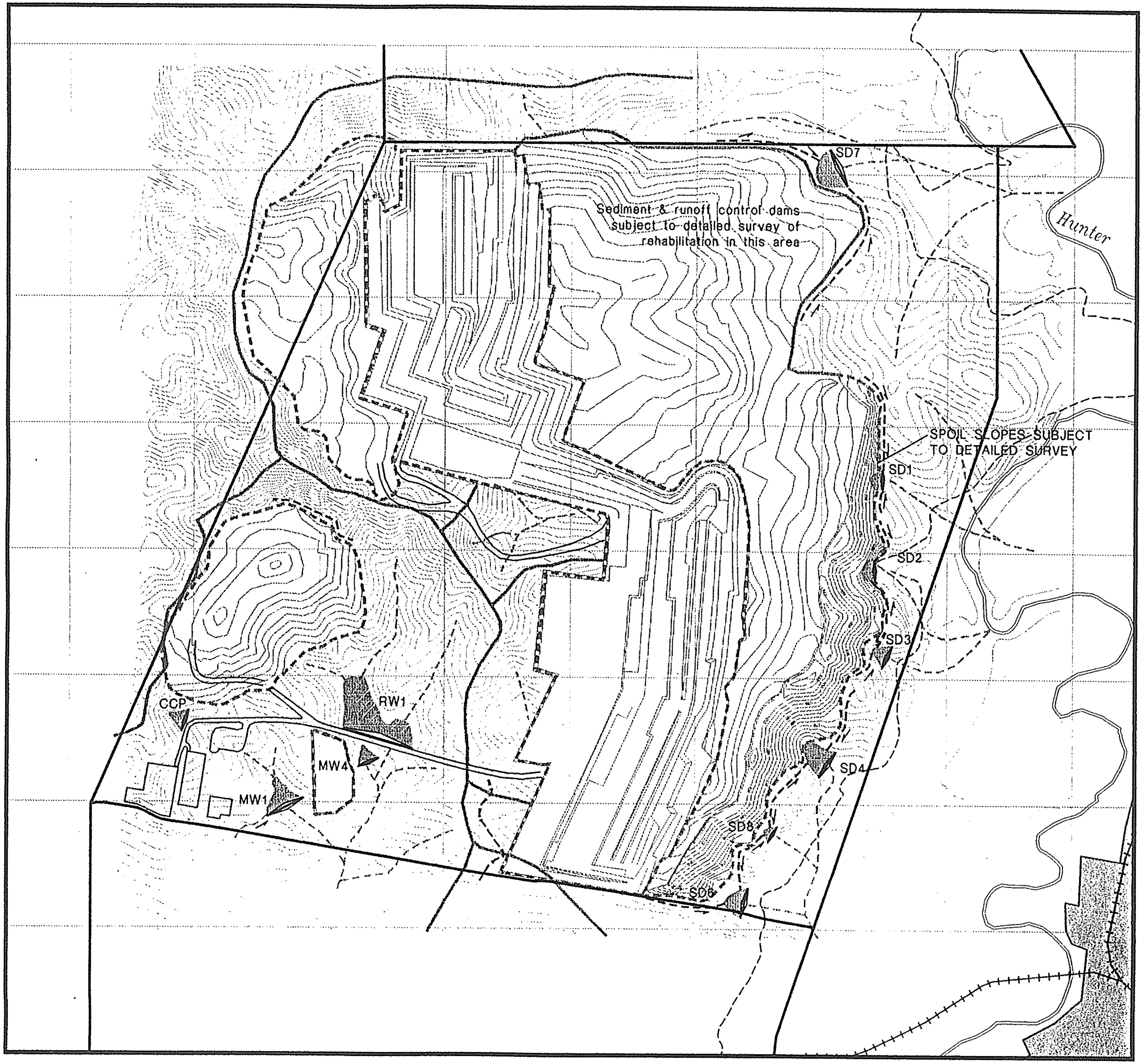
Legend:

- Drainage pathways
- Contour drains
- Diversion channel
- Catchment divide
- Disturbed areas
- Indicates pumping to drain or channel
- 1 in 100 year flood extent
- Dam

0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Surface Water Management
Scheme - Year 15

Figure G4



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Legend:

- Drainage pathways
- Contour drains
- Diversion channel
- Catchment divide
- Disturbed areas
- Indicates pumping to drain or channel
- 1 in 100 year flood extent
- Dam

N

0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Surface Water Management Scheme - Year 20

Figure G5

RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study

Legend:

- Drainage pathways
- Discharge
- Catchment divide
- Limit of data set
- Ponds

Notes

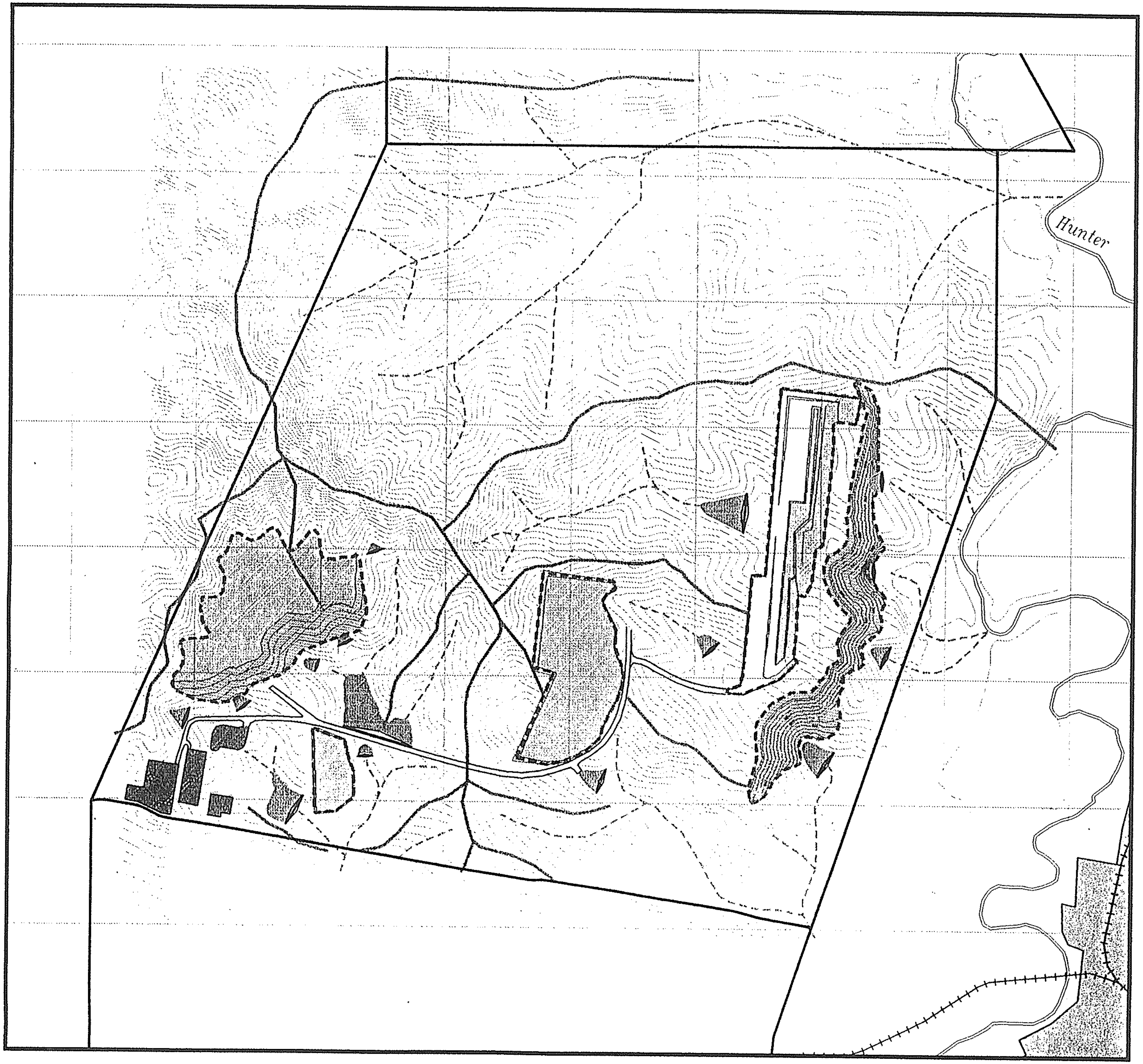
1. Pond shaded areas indicate approximate extent of recovered water levels.
2. All slopes rehabilitated

N

0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Surface Water Management
Final Rehabilitation Plan
Post Year 21

Figure G6



RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study

Legend:

- Drainage
- Catchment divide
- Disturbed areas
- Dam

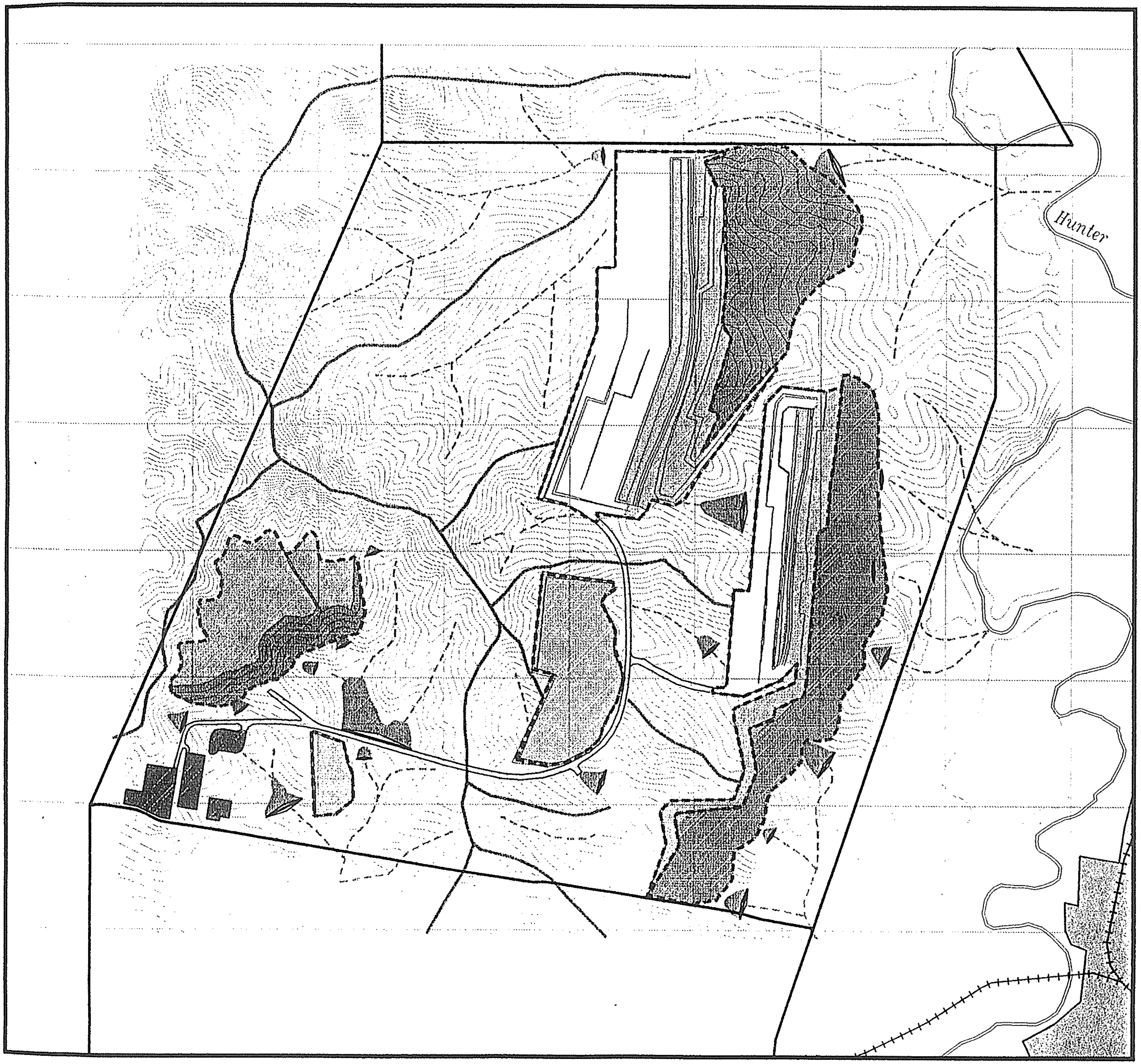
- Pit floor areas
- Strip & Bench areas
- Unshaped spoil areas
- Rehabilitation areas
- Hardstand & Coal stockpile

N

0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Catchment Definition
Year 2

Figure G7



RUST PPK
Environment & Infrastructure

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Mount Pleasant Project
Water Management Study

Legend:

- Drainage pathways
- Catchment divide
- Disturbed areas
- Dam

- Pit floor areas
- Strip & Bench areas
- Unshaped spoil areas
- Rehabilitation areas
- Hardstand & Coal stockpile

N

0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Catchment Definitions
Year 5

Figure G8

RUST PPK
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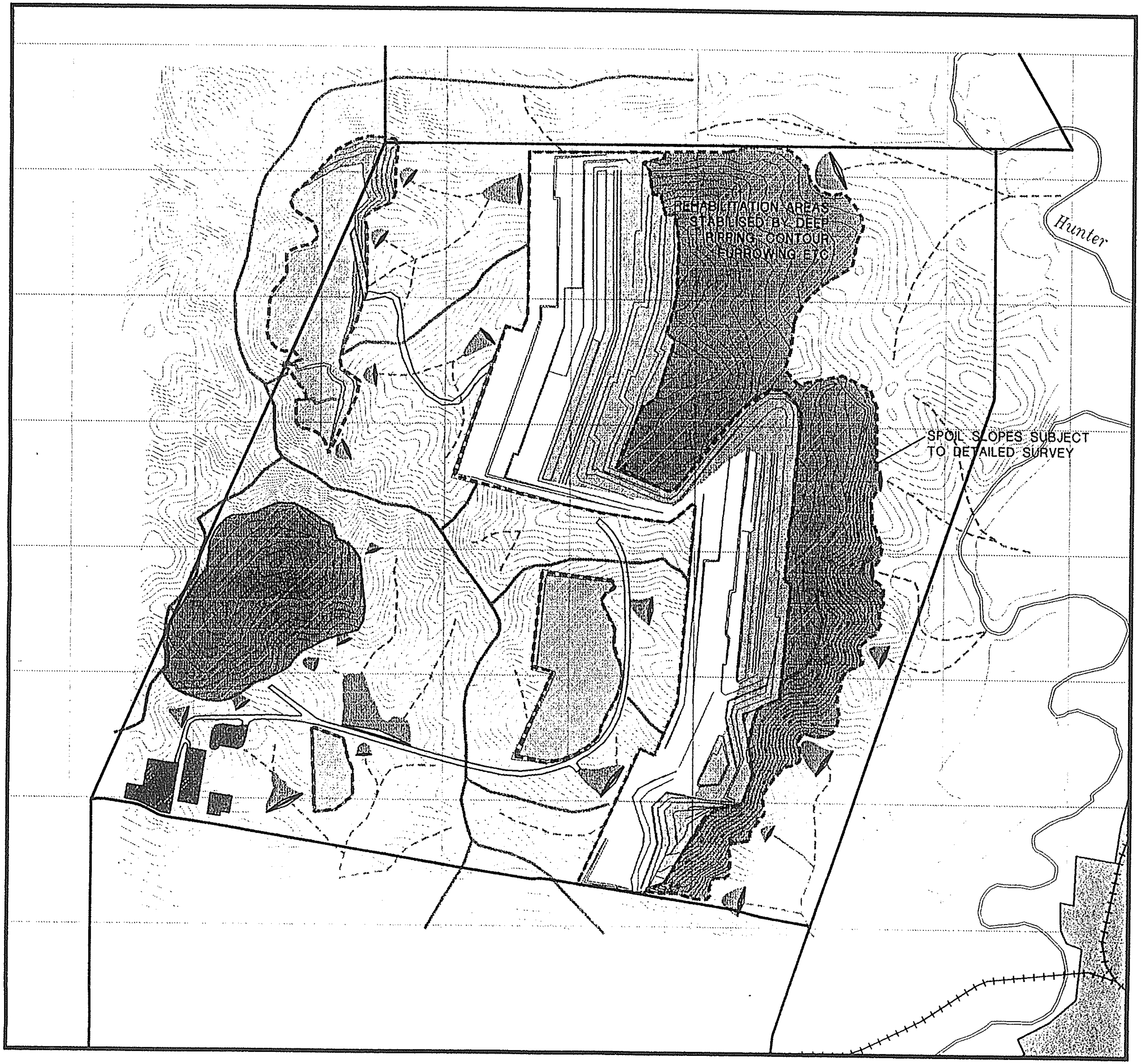
Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



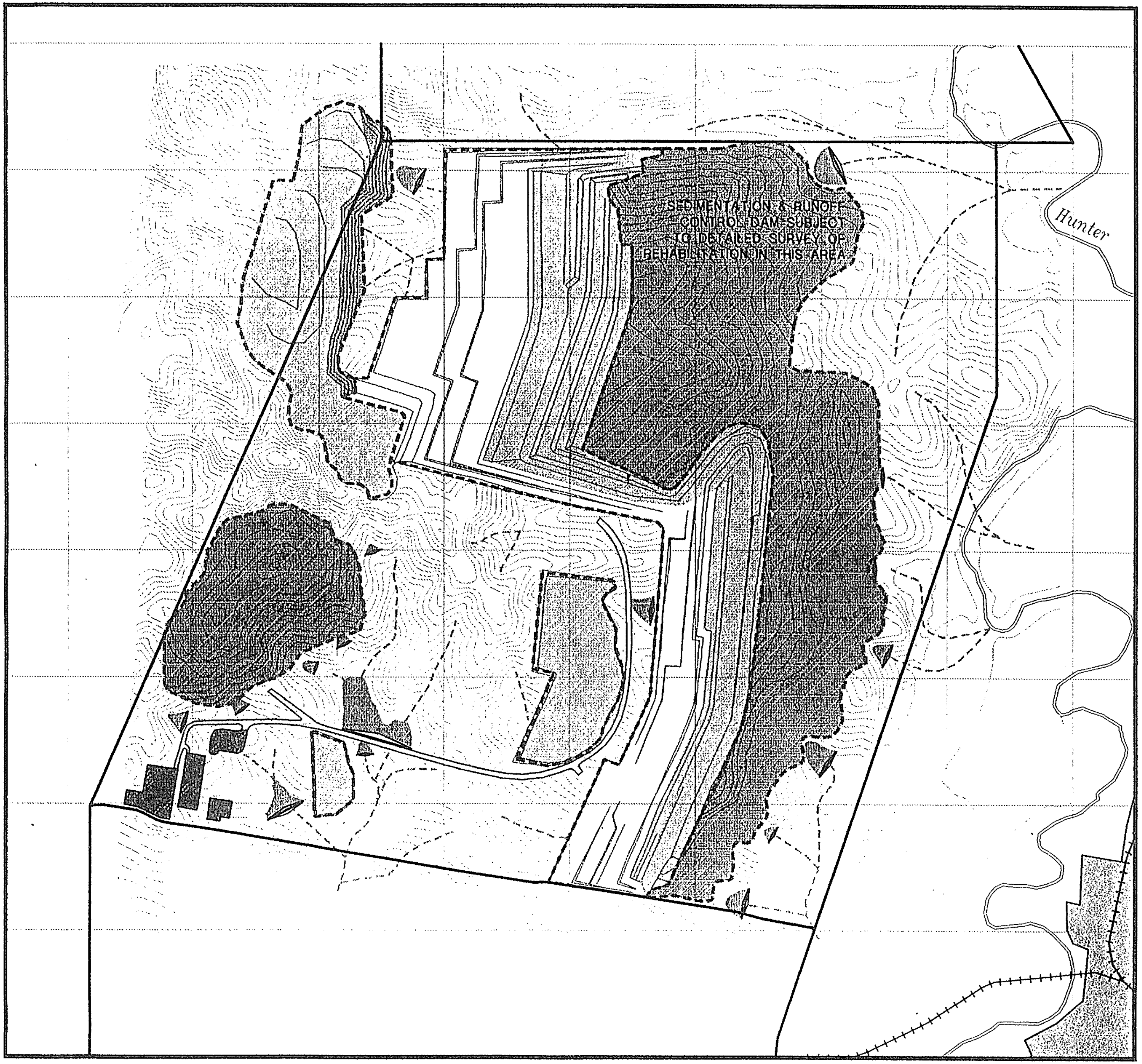
Legend:

- Drainage pathways
- Catchment divide
- Disturbed areas
- Dam

- Pit floor areas
- Strip & Bench areas
- Unshaped spoil areas
- Rehabilitation areas
- Hardstand & Coal stockpile

Catchment Definitions
Year 10

Figure G9



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Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study

Legend:

- Drainage pathways
- Catchment divide
- Disturbed areas
- Dam

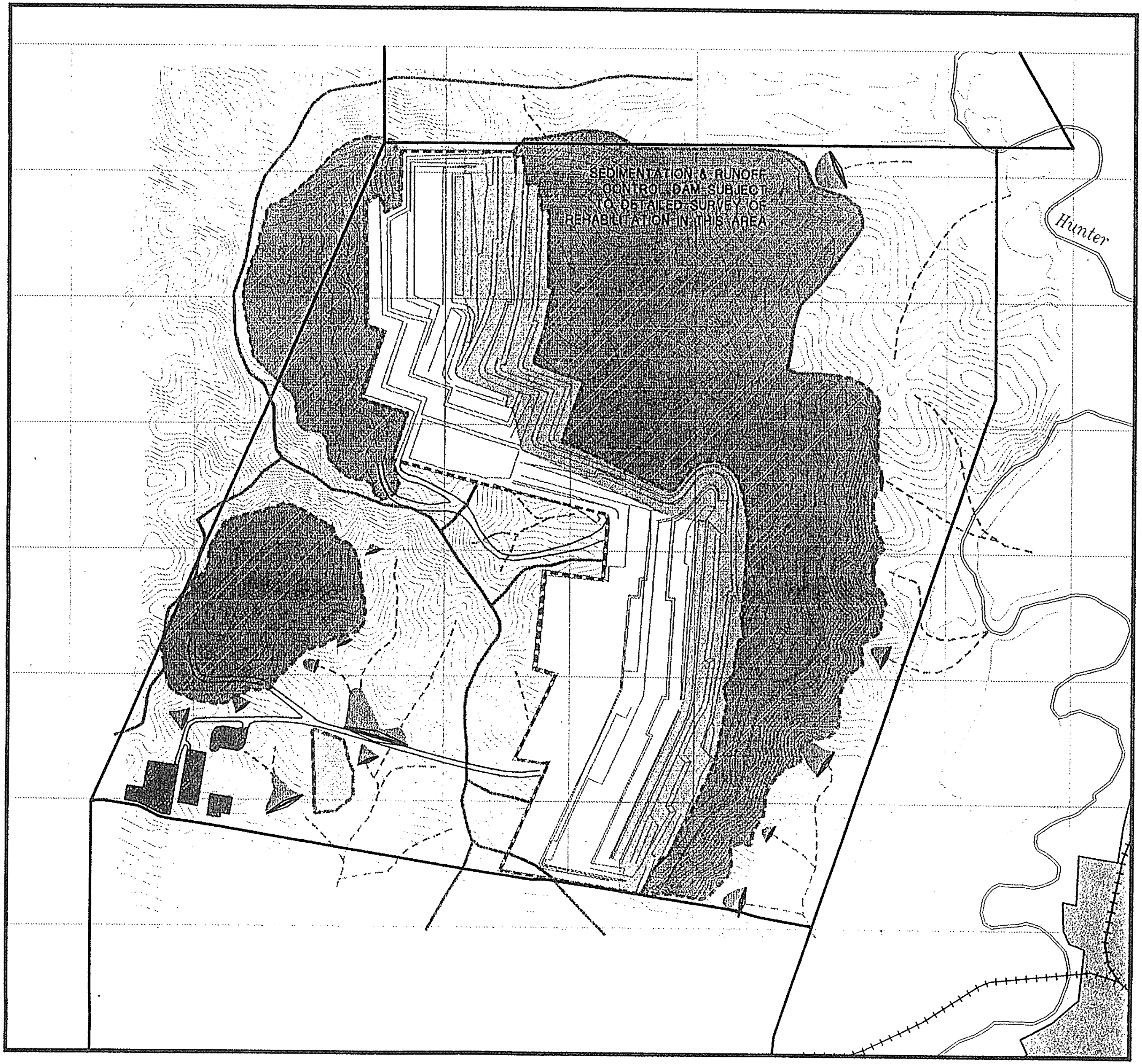
- Pit floor areas
- Strip & Bench areas
- Unshaped spoil areas
- Rehabilitation areas
- Hardstand & Coal stockpile

N

0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Catchment Definitions
Year 15

Figure G10



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Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study

Legend:

- Drainage pathways
- Catchment divide
- Disturbed areas
- Dam
- Pit floor areas
- Strip & Bench areas
- Unshaped spoil areas
- Rehabilitation areas
- Hardstand & Coal stockpile

N

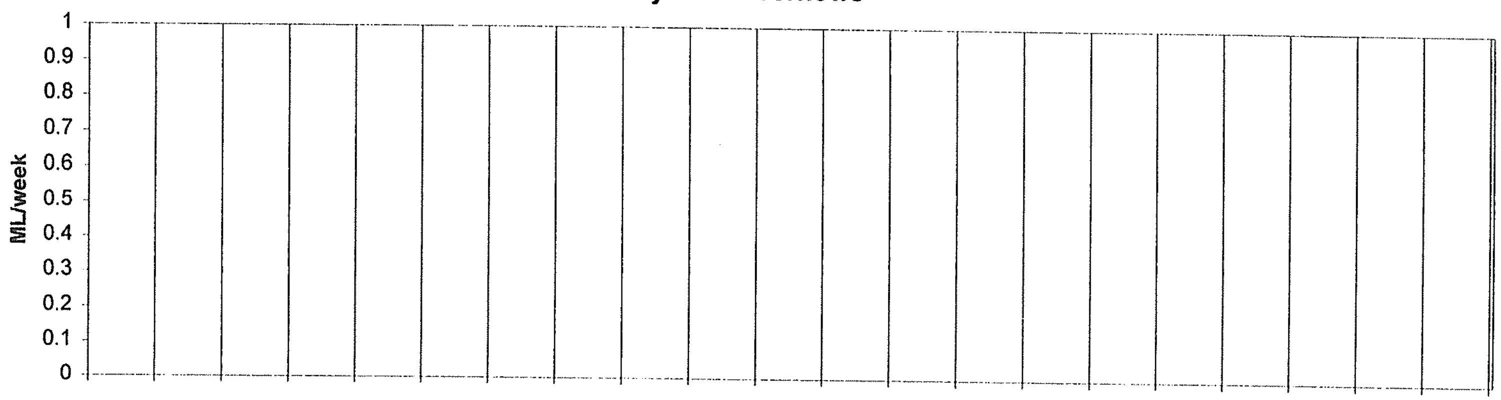
0 500 1000 1500 2000
ORIGINAL SCALE 1: 30,000

Catchment Definitions
Year 20

Figure G11

Mt. Pleasant Mine - Water Management Simulations

1/01/04 to 30/12/24



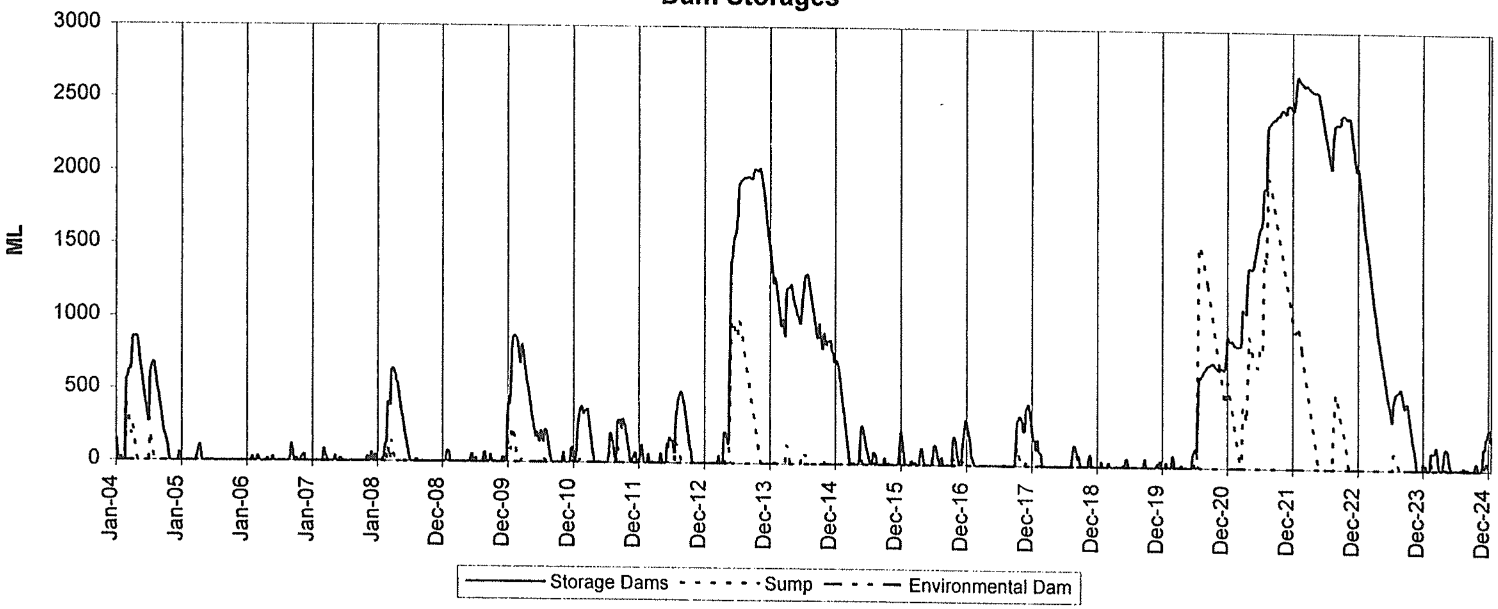


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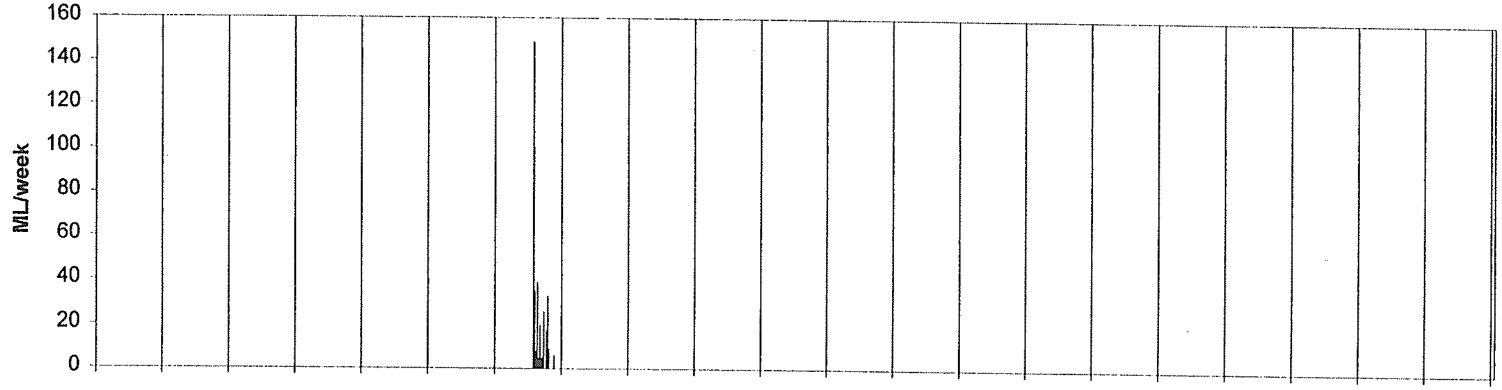
Figure G12

Mt. Pleasant Mine - Water Management Simulations

1/01/15 to 31/12/35

System Overflows



Dam Storages

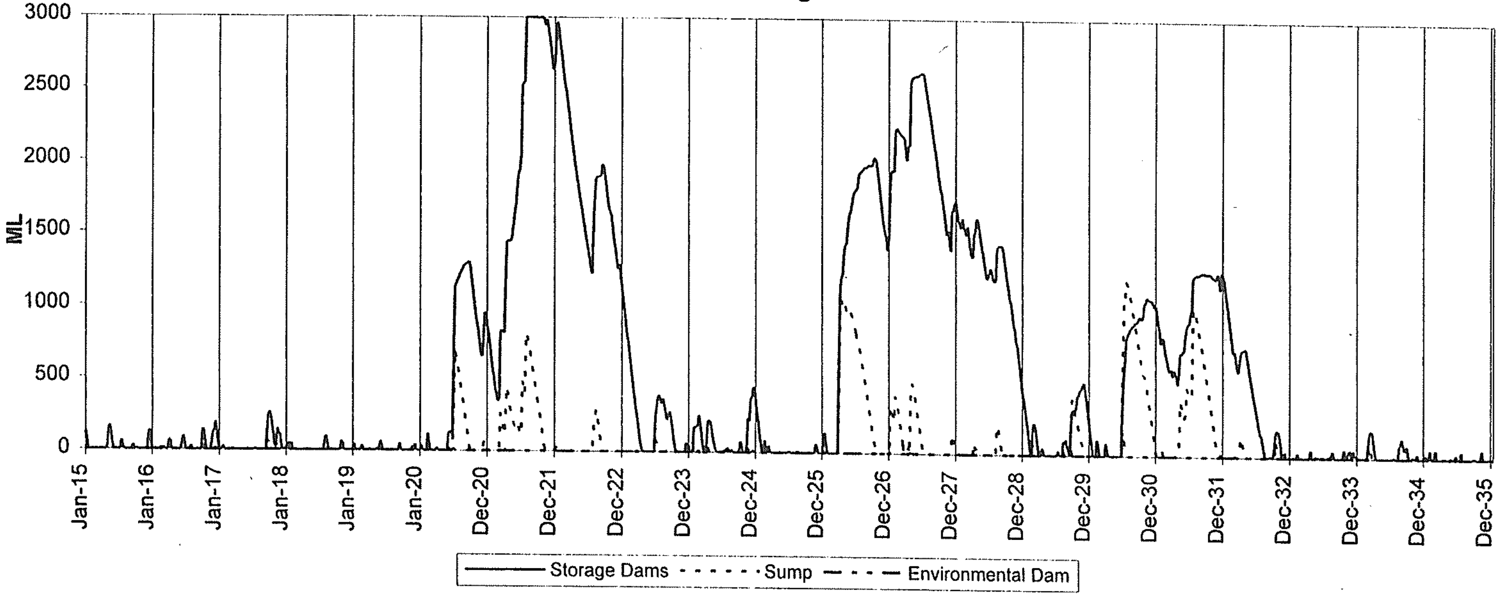


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Figure G13

Mt. Pleasant Mine - Water Management Simulations

1/01/27 to 31/12/47

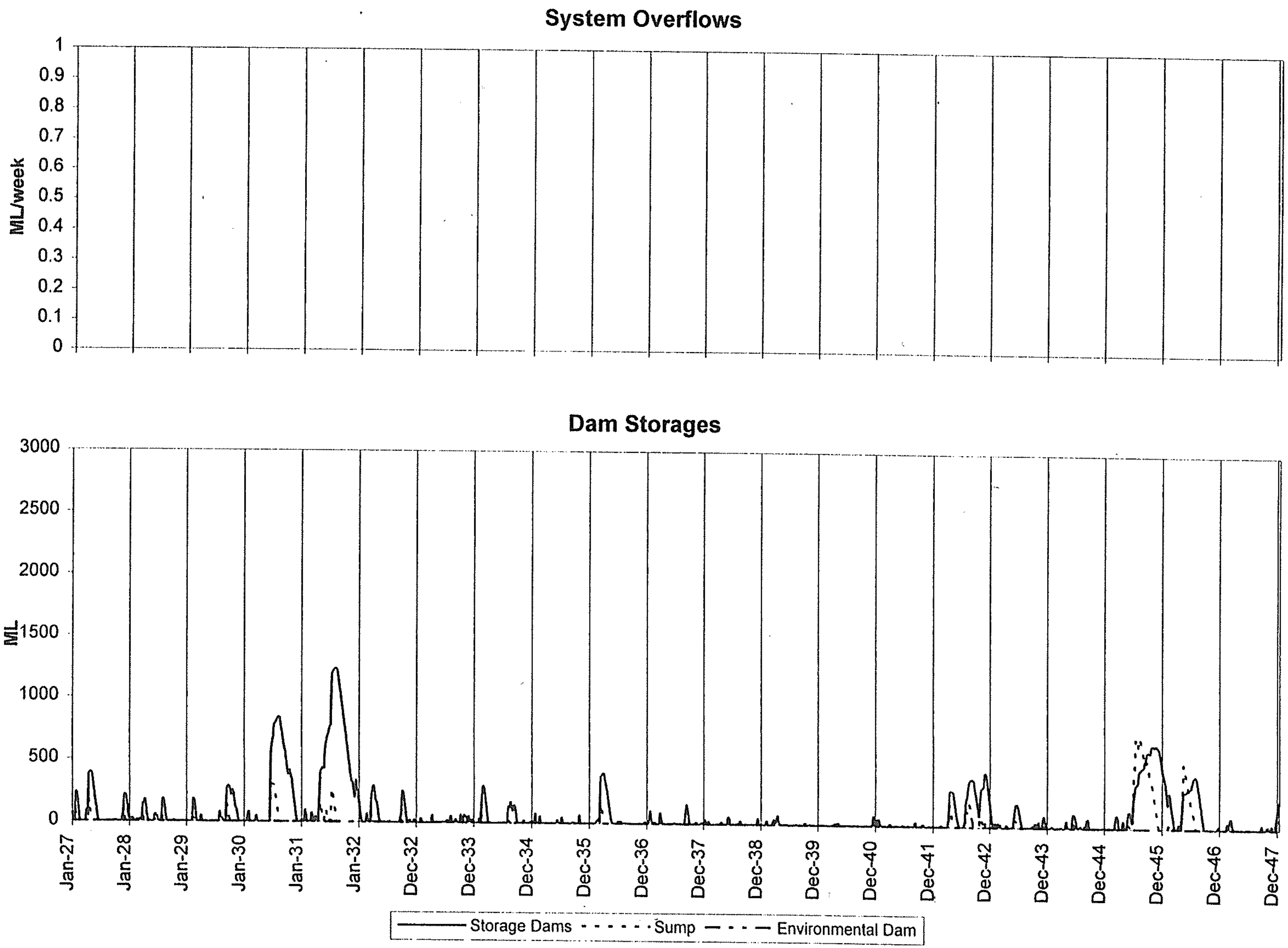

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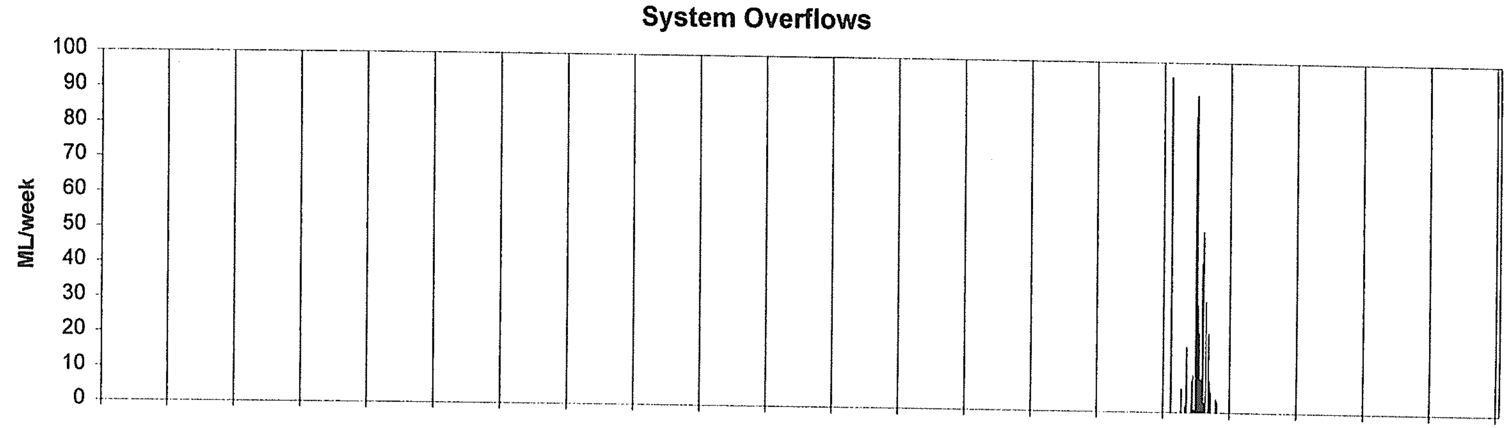
Figure G14

Mt. Pleasant Mine - Water Management Simulations

1/01/35 to 31/12/55



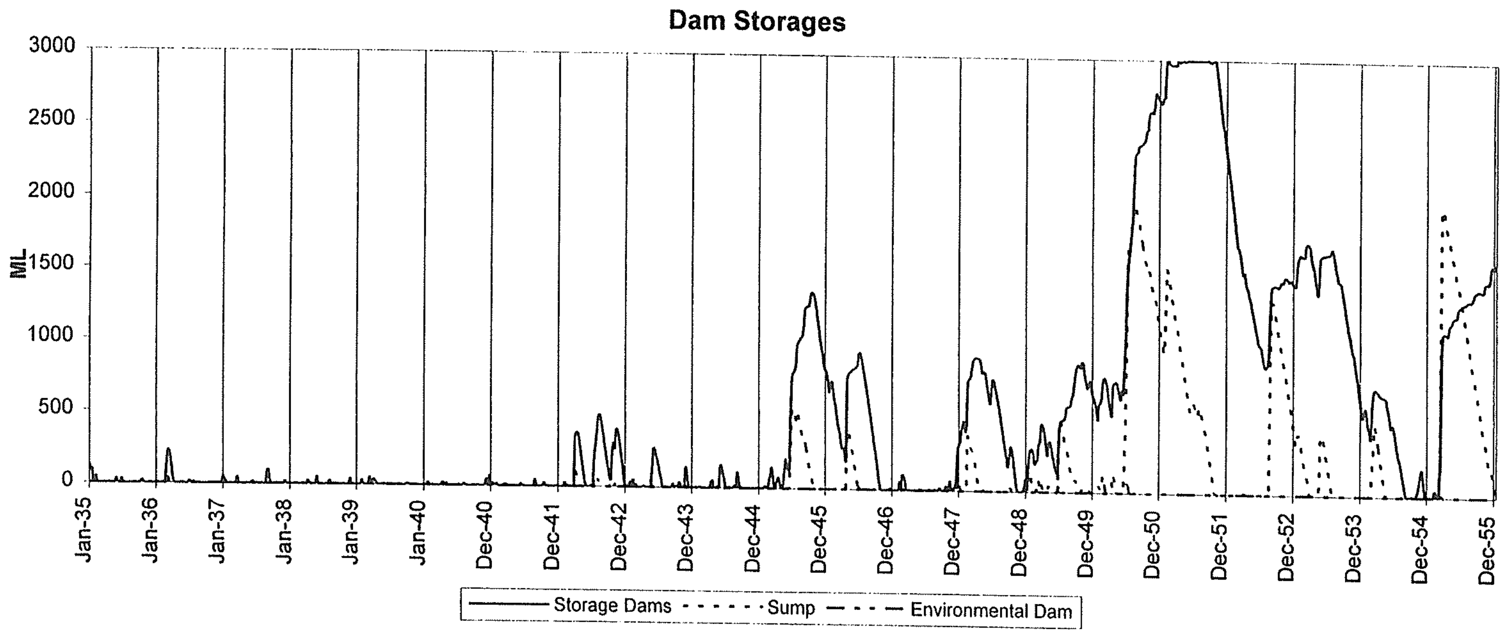


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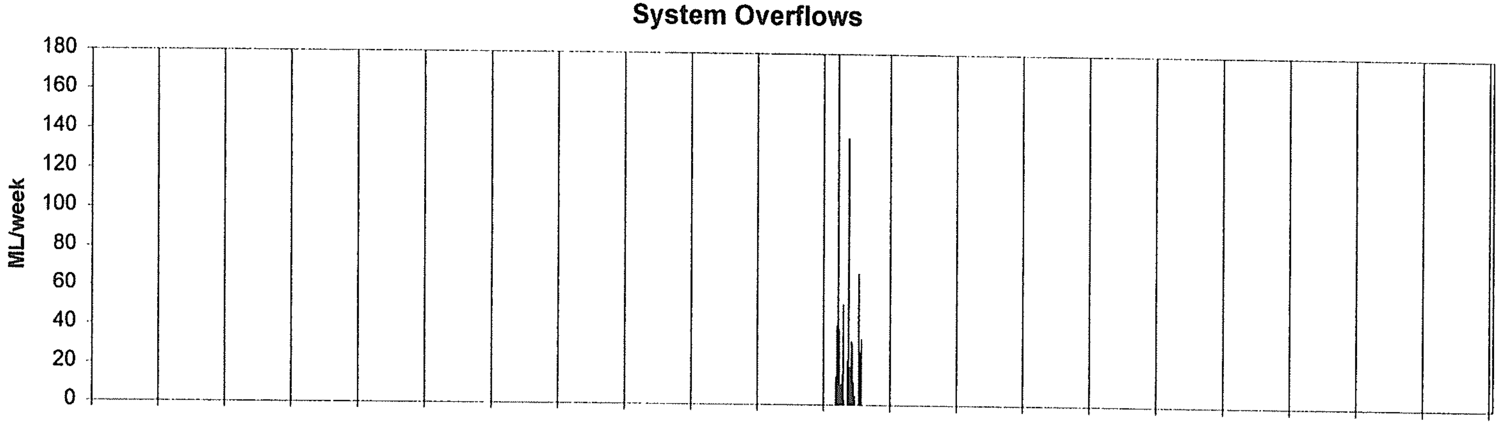
Figure G15

Mt. Pleasant Mine - Water Management Simulations

1/01/45 to 31/12/65



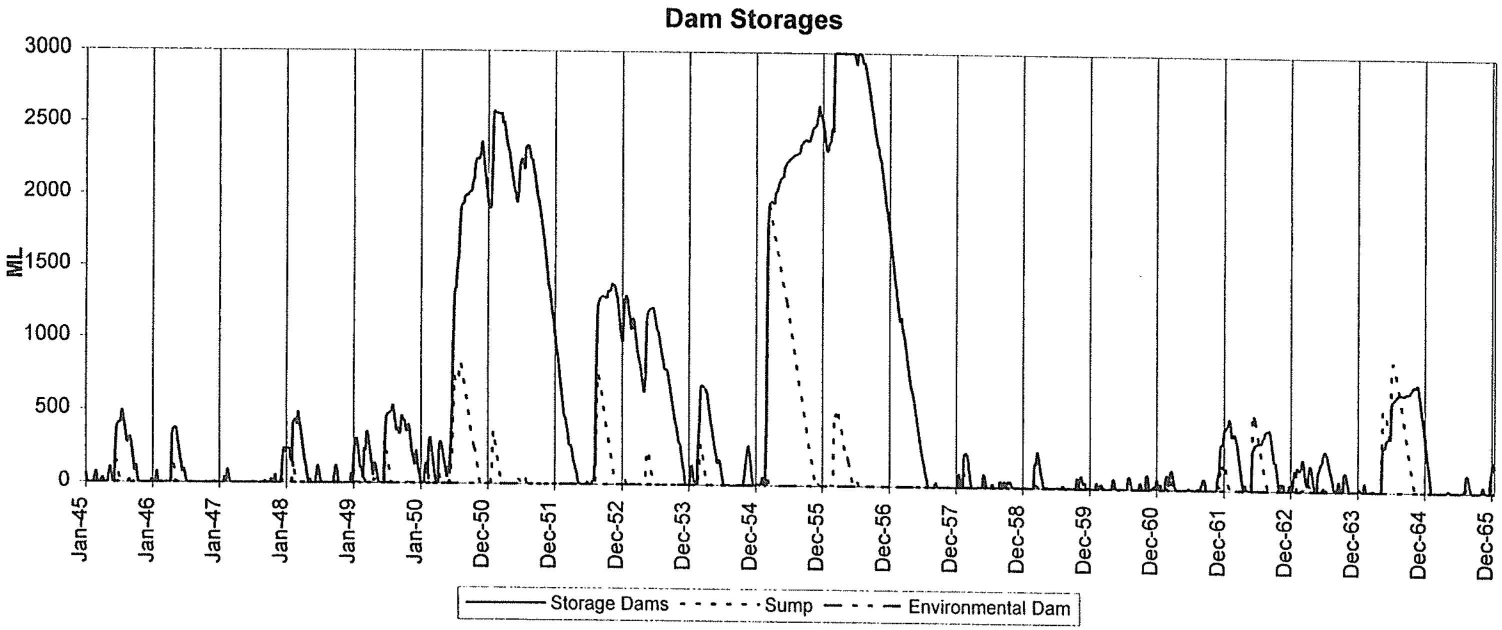


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Figure G16

Mt. Pleasant Mine - Water Management Simulations

1/01/55 to 31/12/75

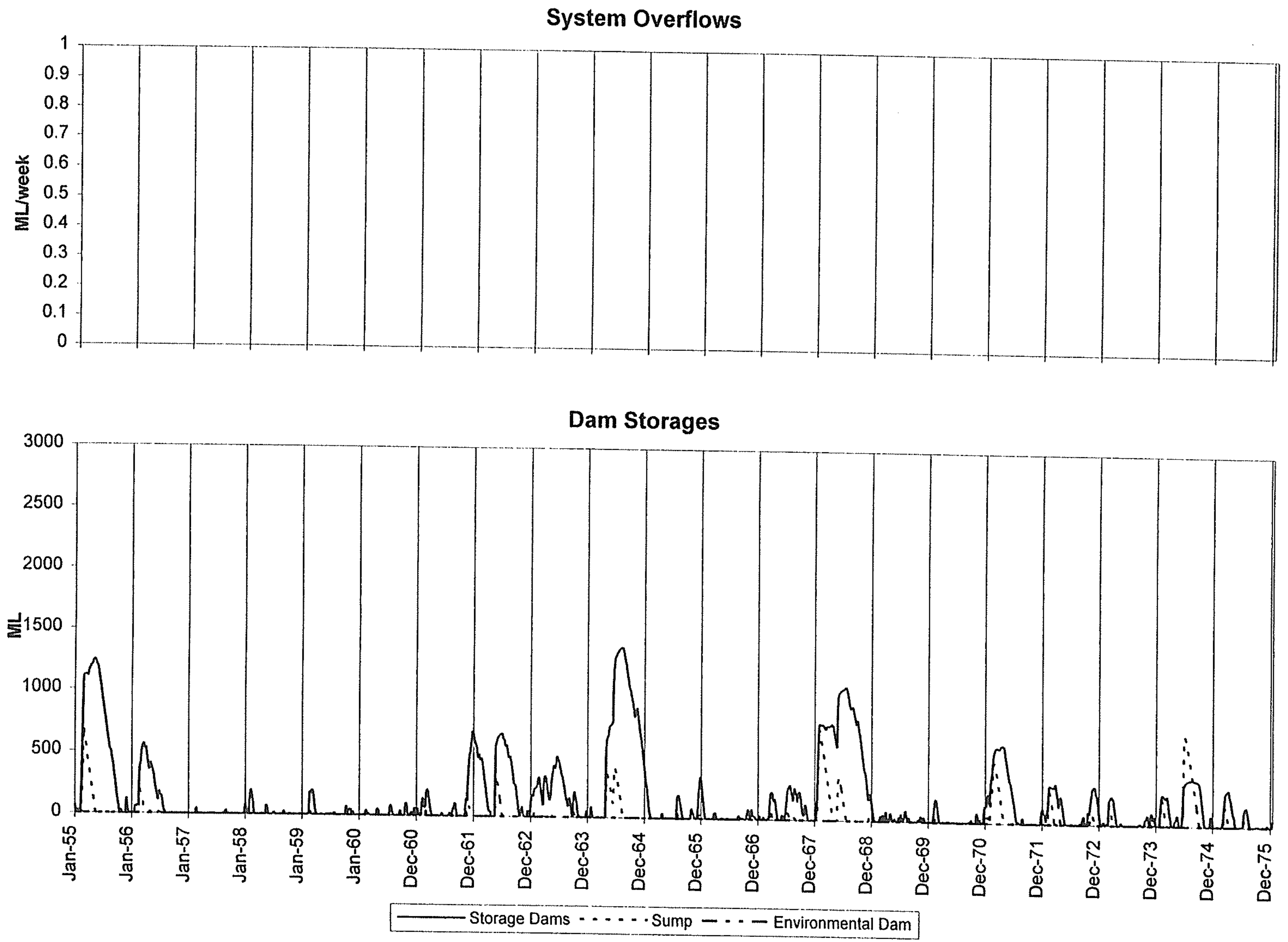

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Figure G17

Mt. Pleasant Mine - Water Management Simulations

1/01/65 to 31/12/85

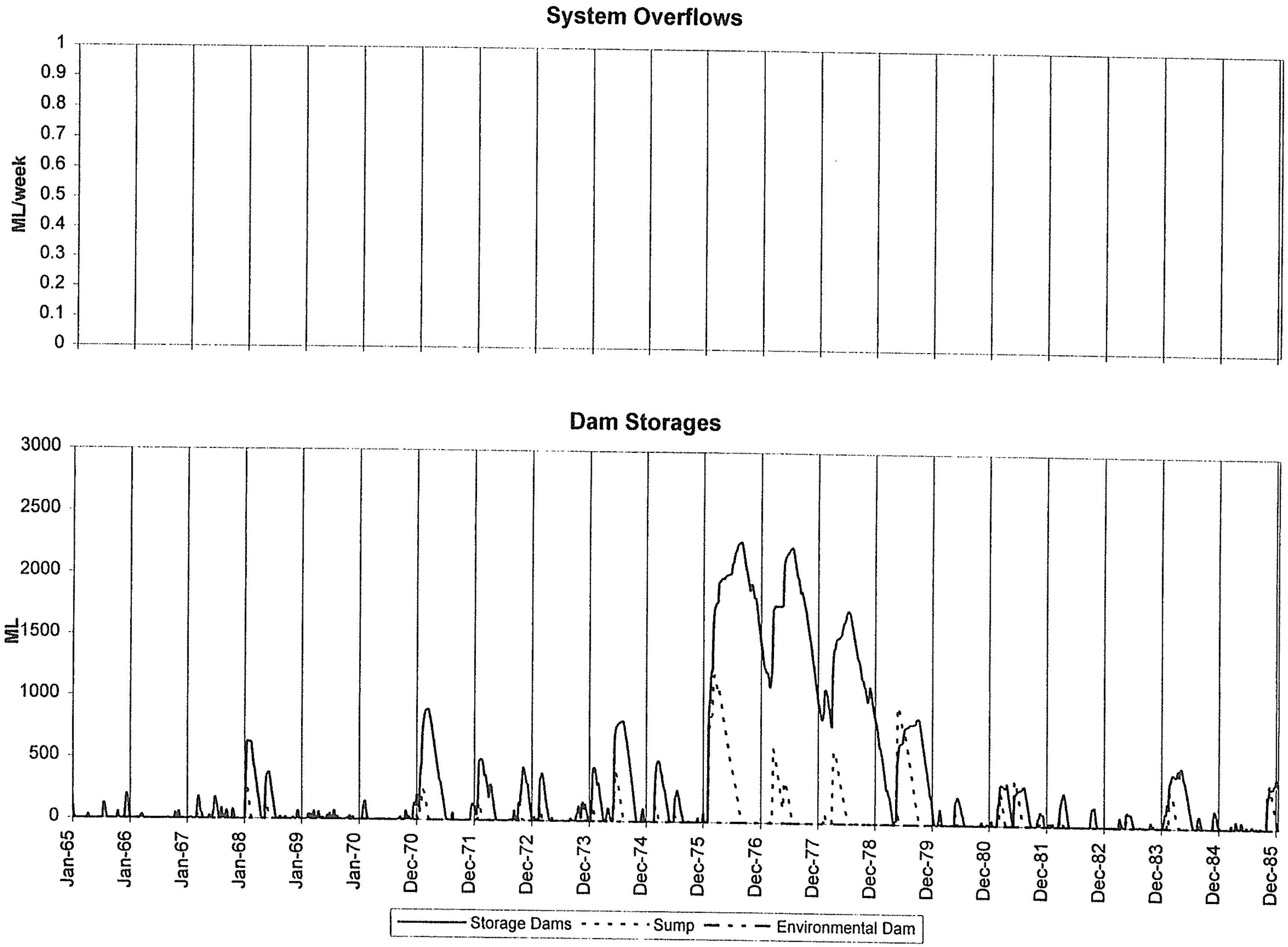

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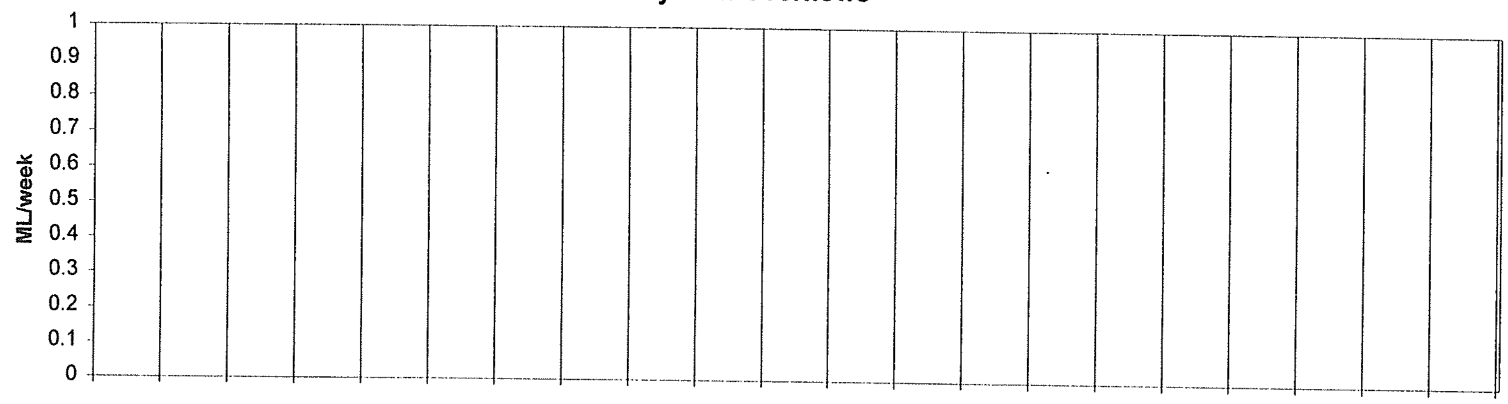
Figure G18

Mt. Pleasant Mine - Water Management Simulations

1/01/75 to 31/12/95



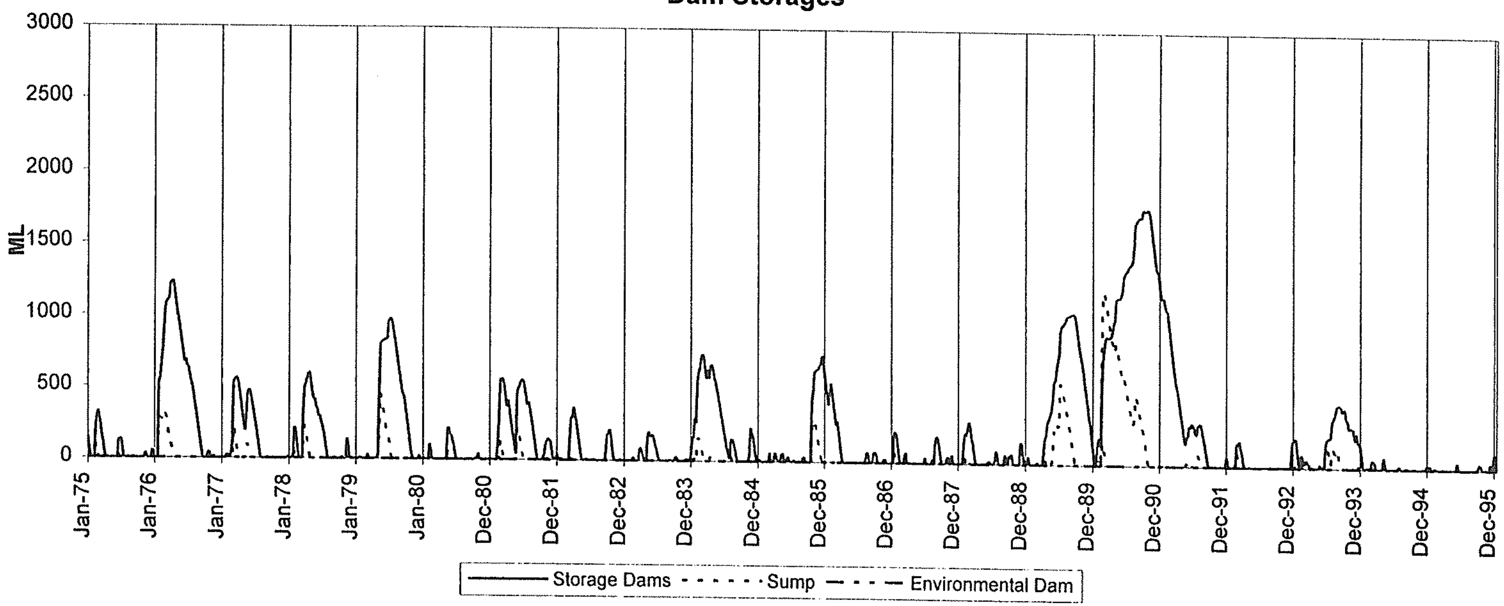


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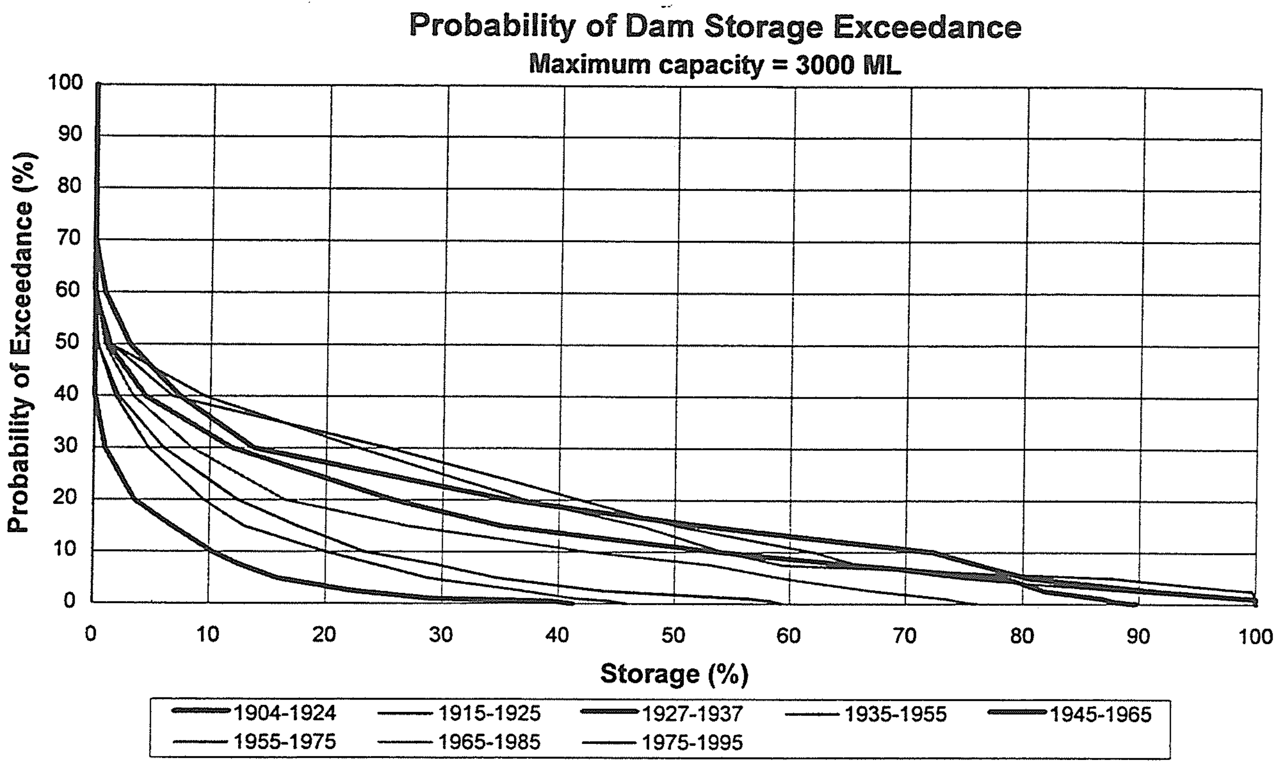
Figure G19

Mt. Pleasant Coal Mine - Water Management



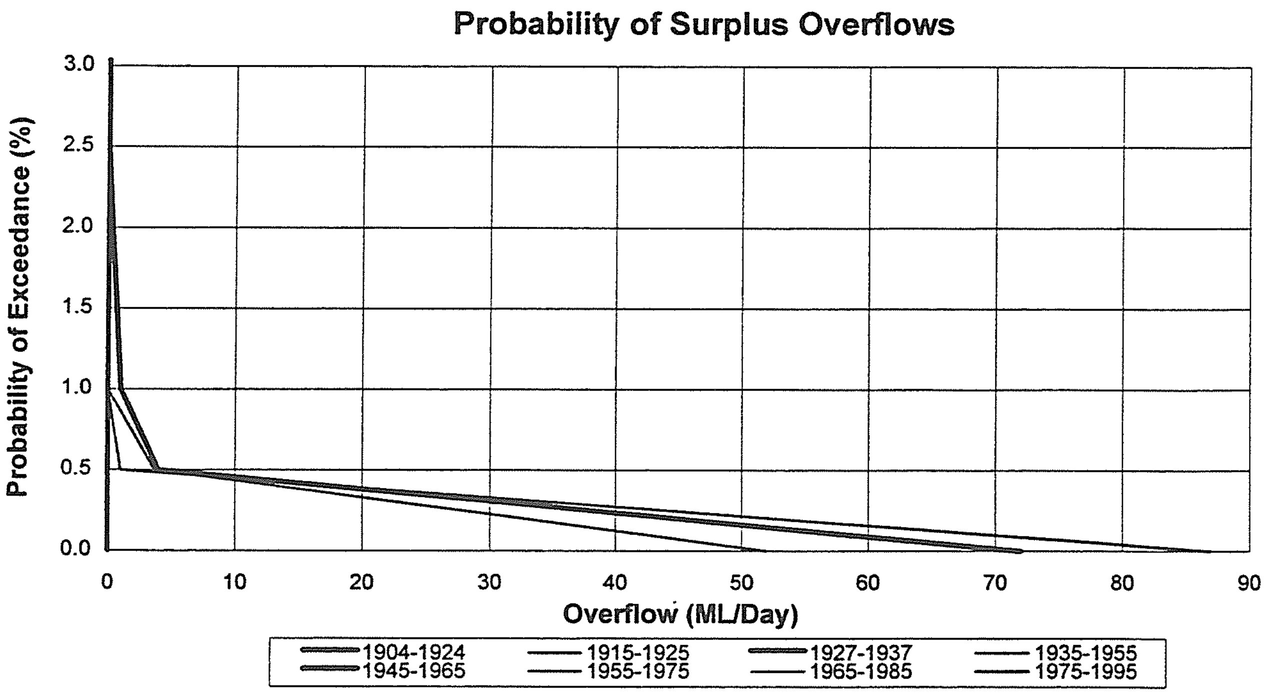


Figure G20

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Mt. Pleasant Coal Mine - Water Management

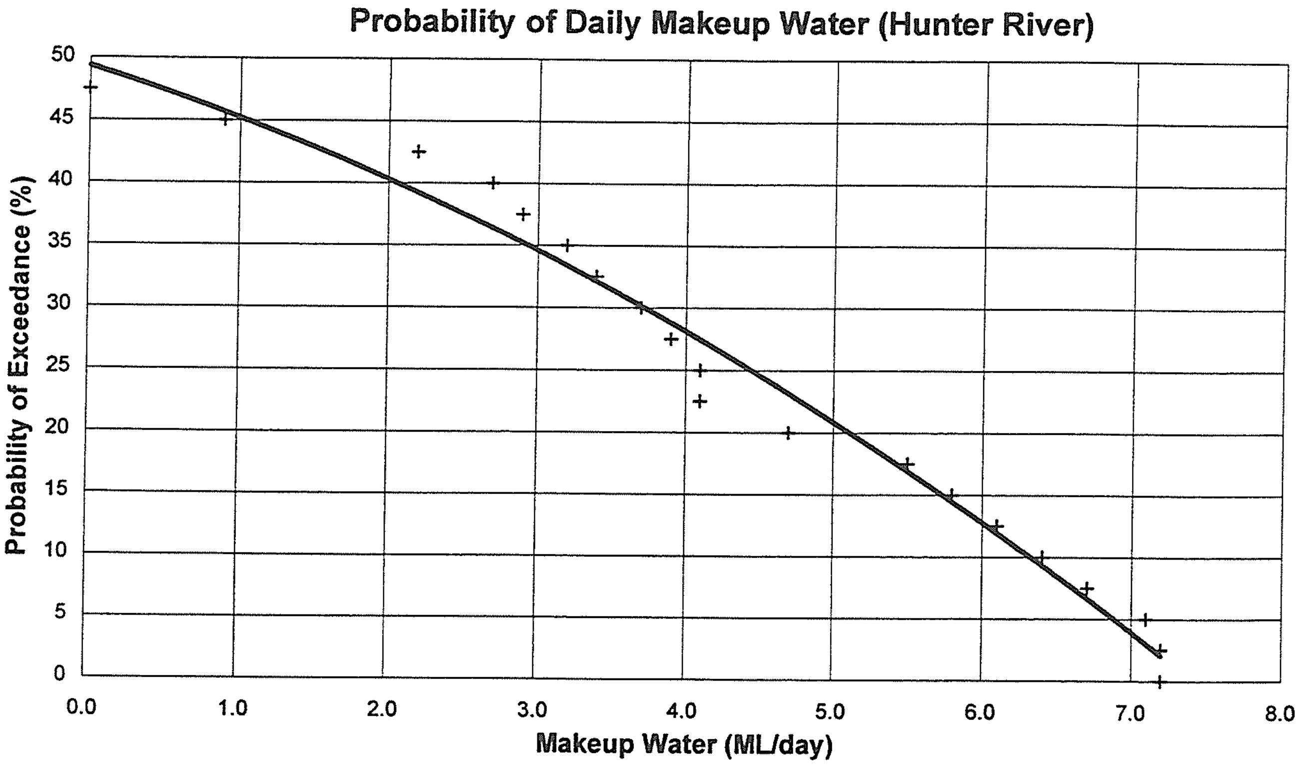

Figure G21

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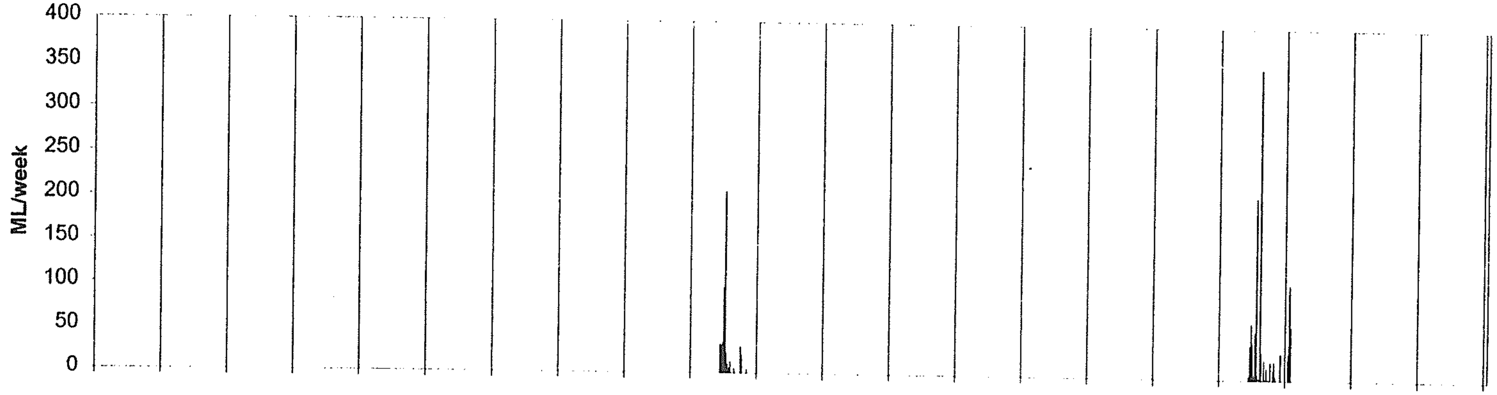
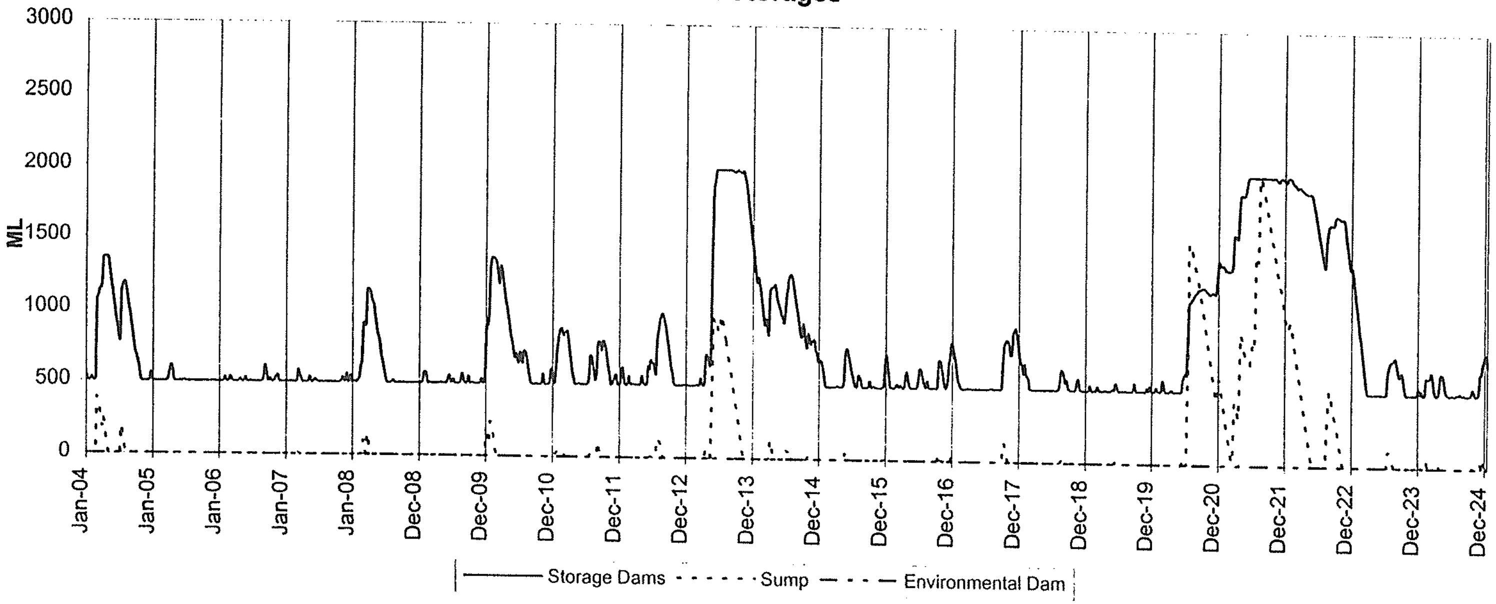
Mt. Pleasant Mine - Water Management Simulations

1/01/04 to 30/12/24

System Overflows



Dam Storages

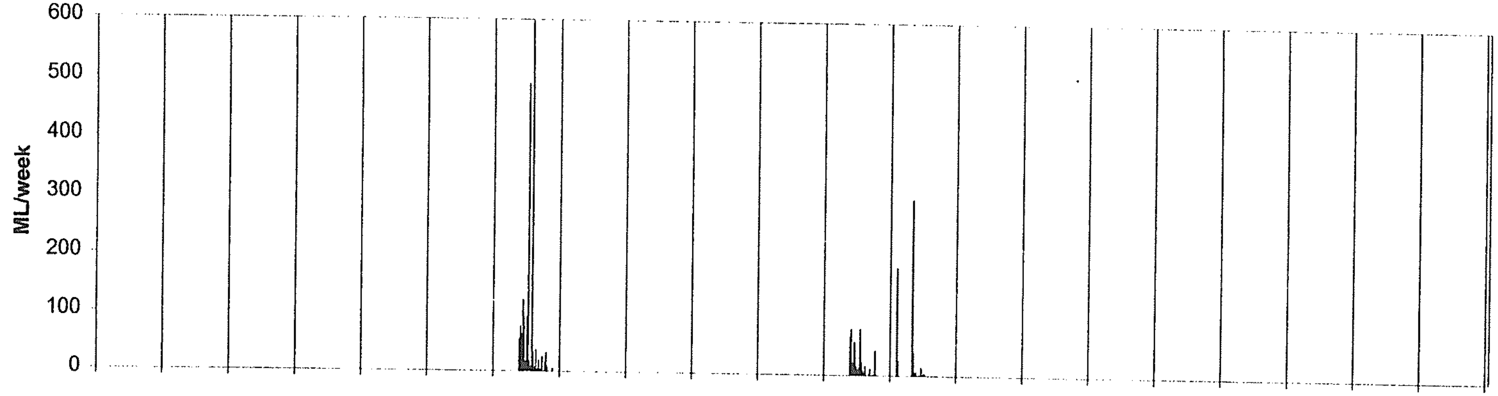


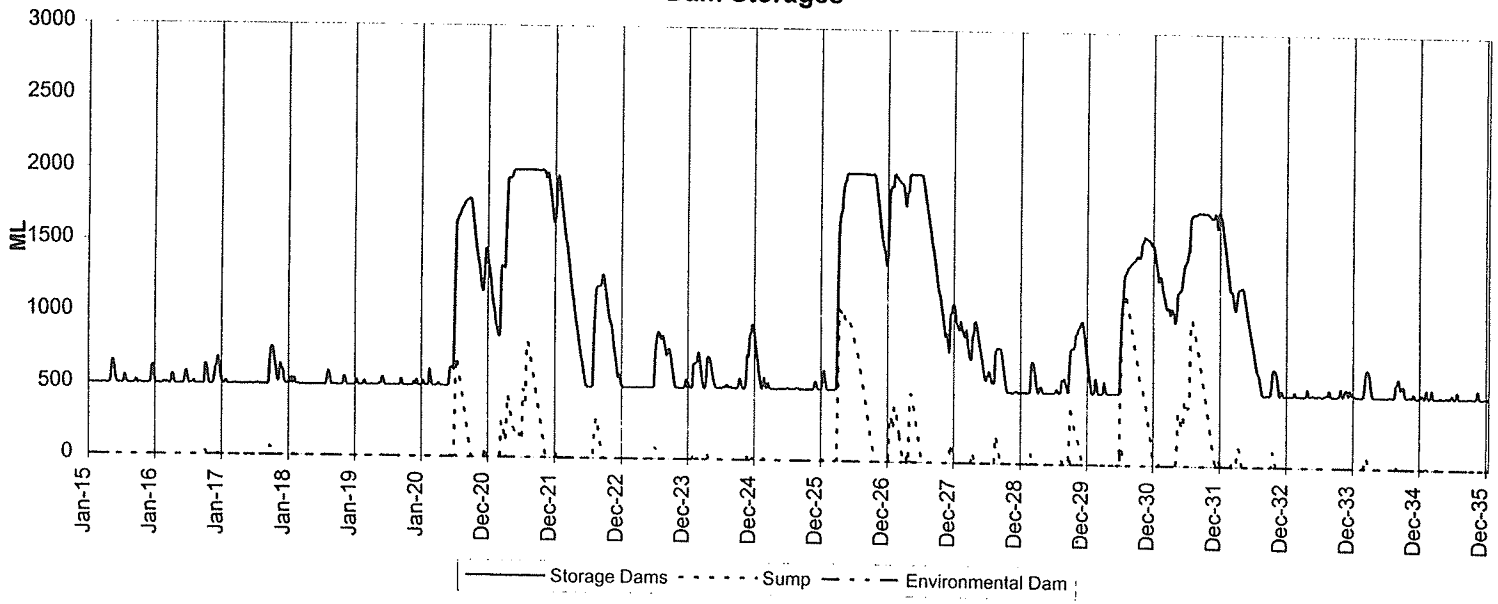
RUST PPK

Figure G22

Mt. Pleasant Mine - Water Management Simulations

1/01/15 to 31/12/35



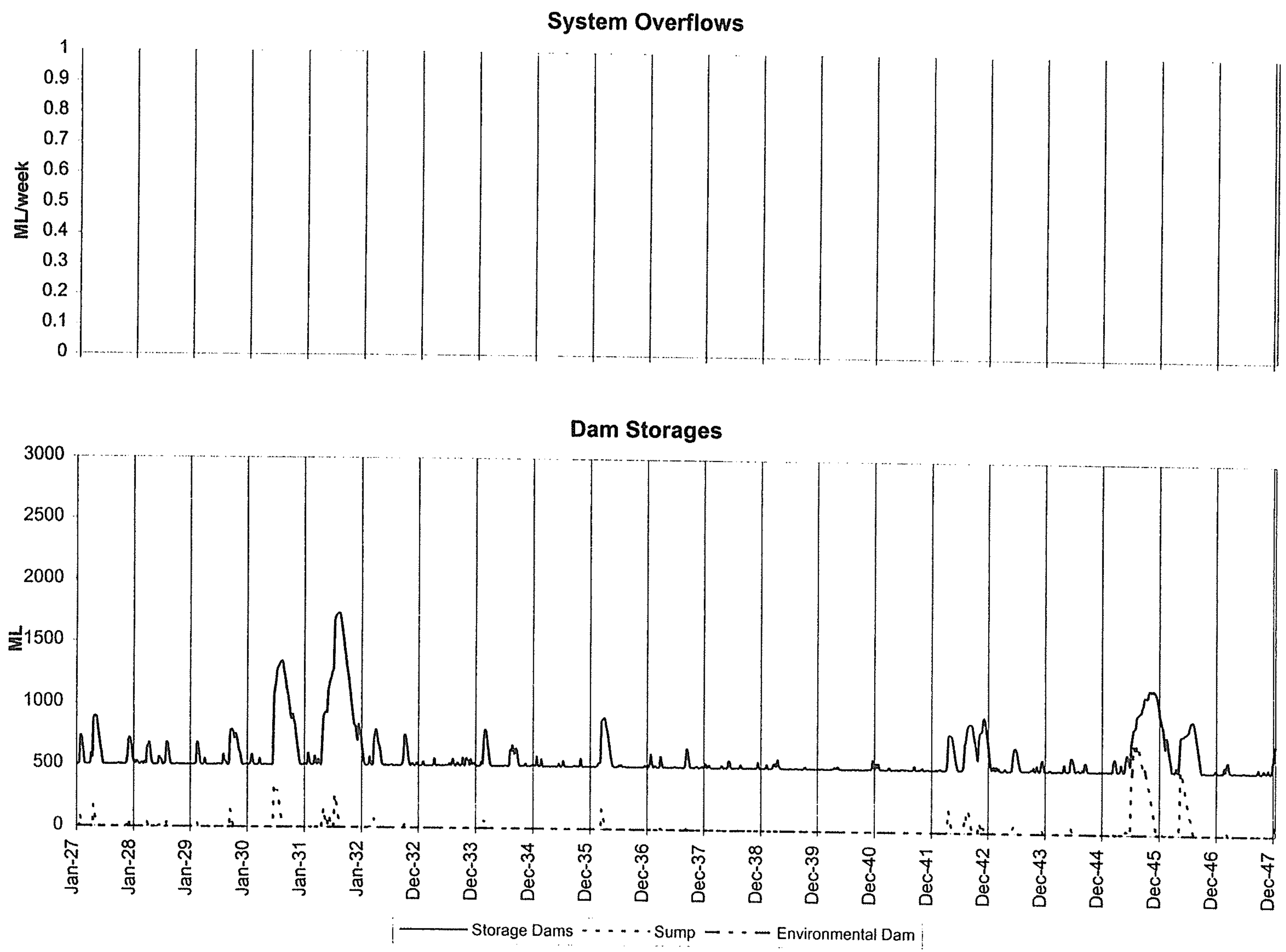


RUST PPK

Figure G23

Mt. Pleasant Mine - Water Management Simulations

1/01/27 to 31/12/47

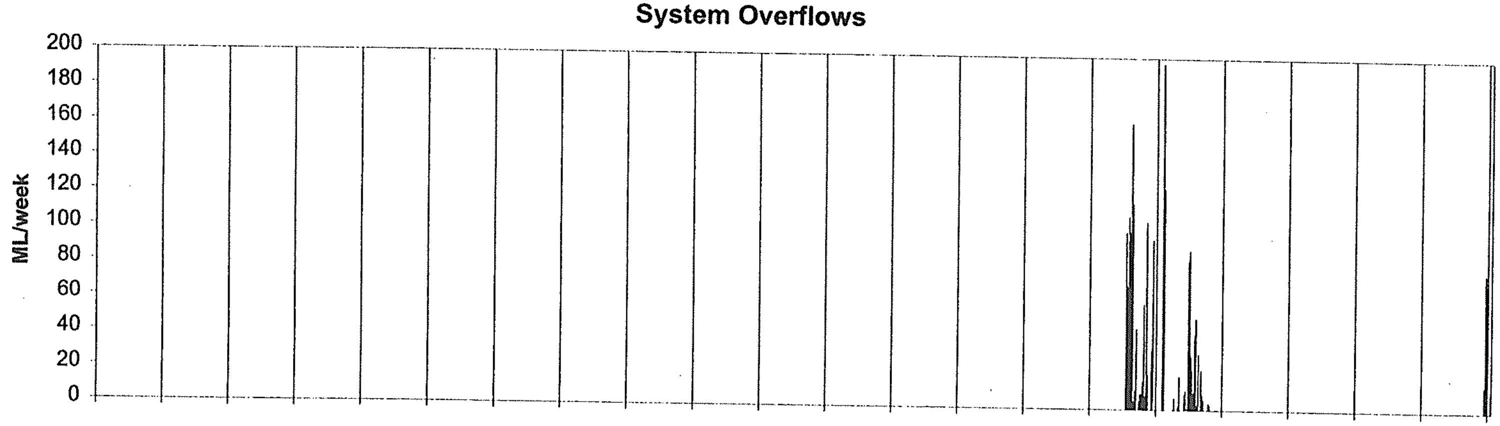


RUST PPK

Figure G24

Mt. Pleasant Mine - Water Management Simulations

1/01/35 to 31/12/55



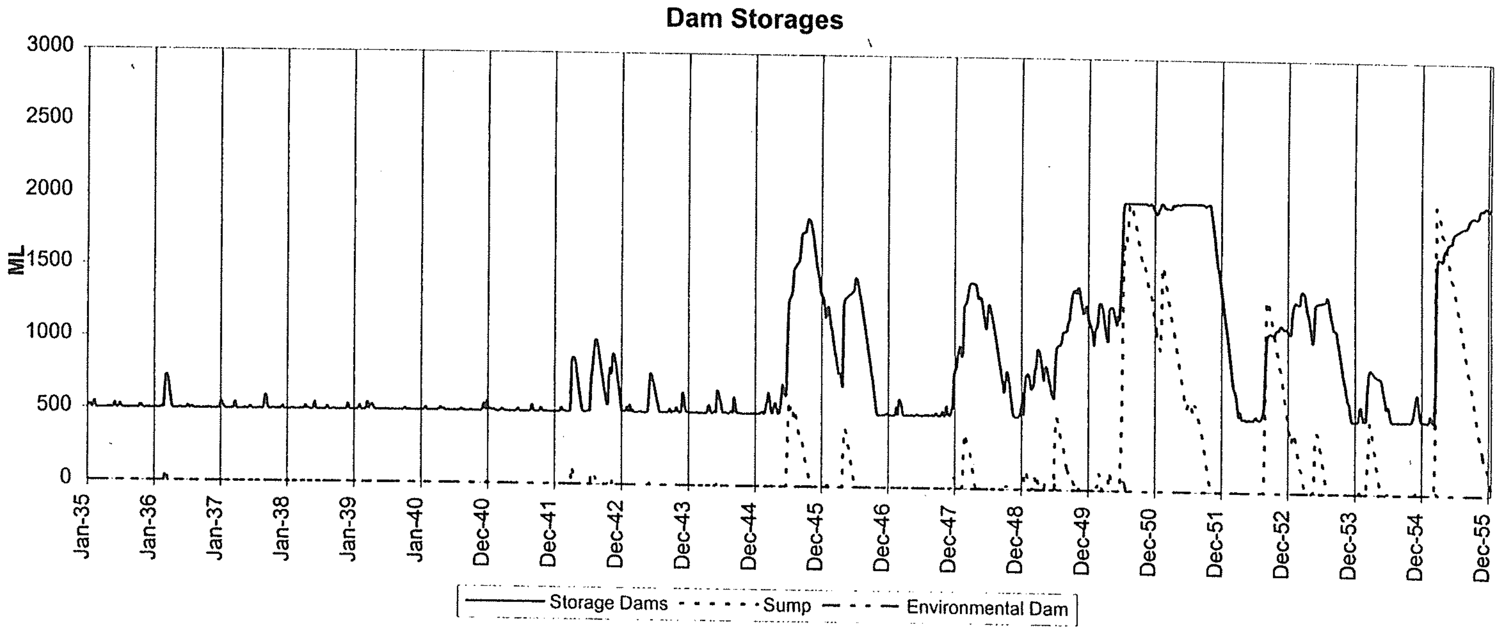


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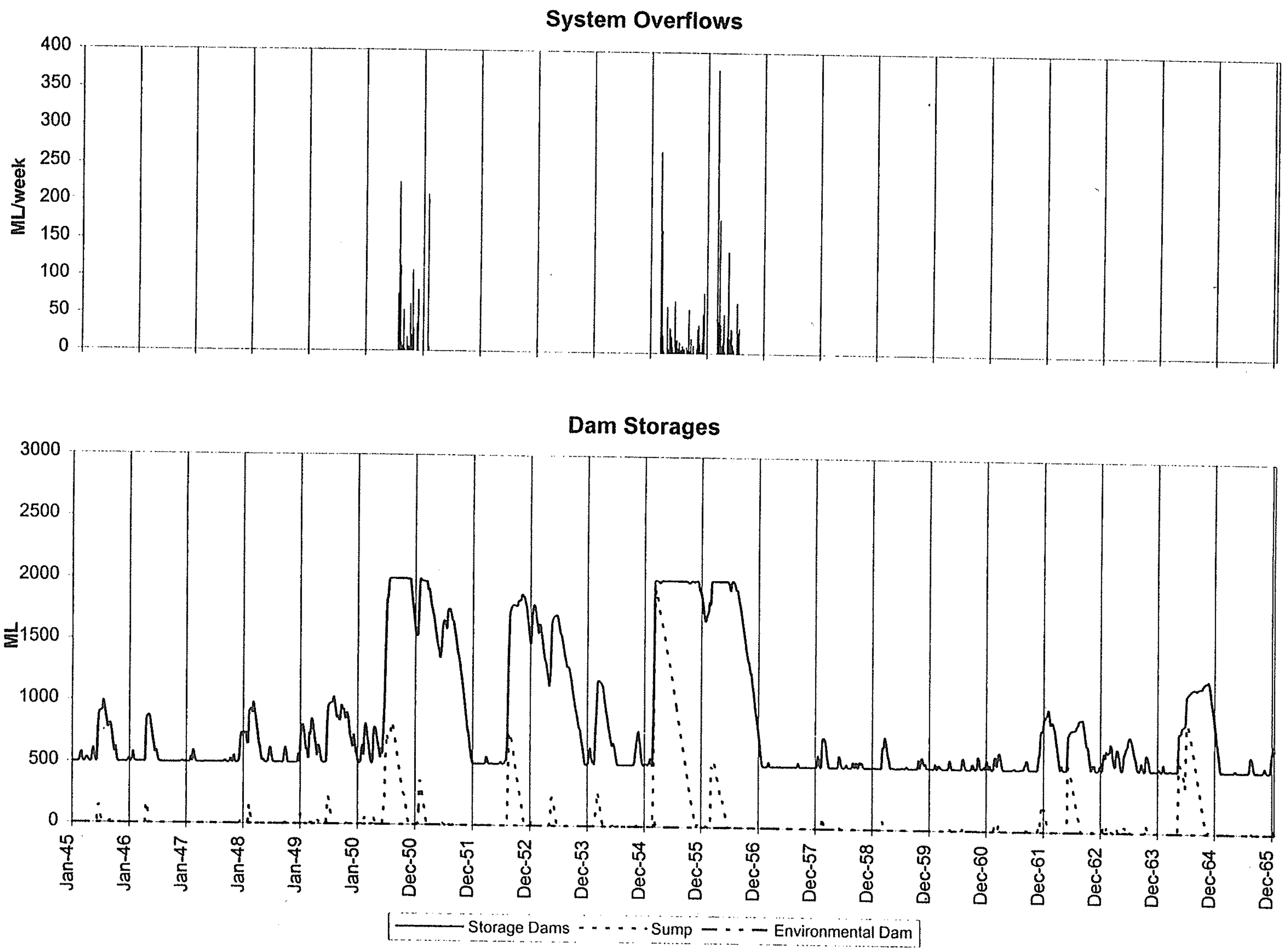
Figure G25

Mt. Pleasant Mine - Water Management Simulations

1/01/45 to 31/12/65

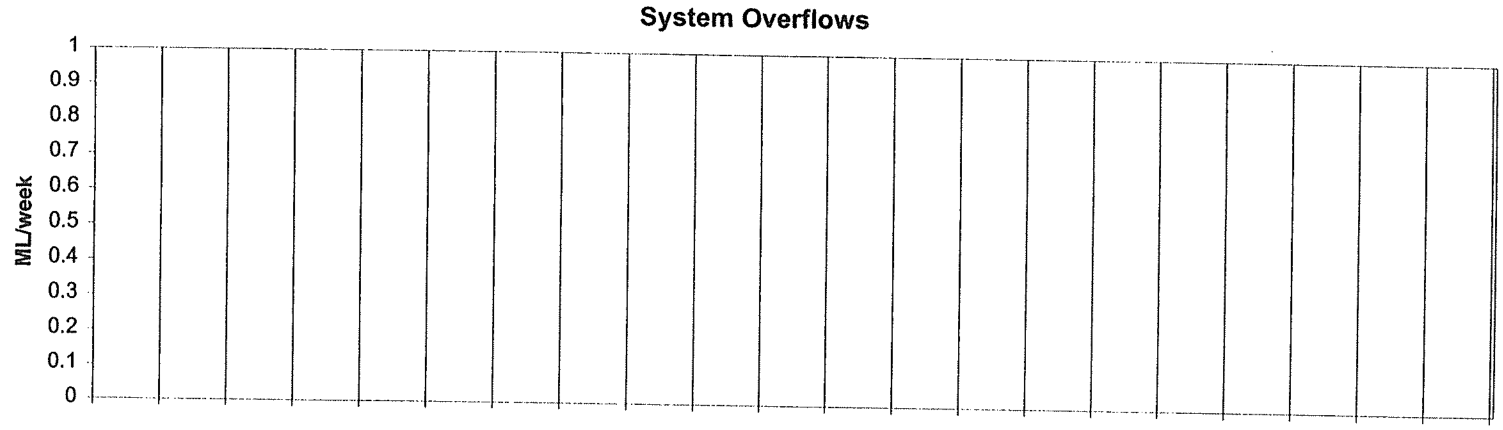


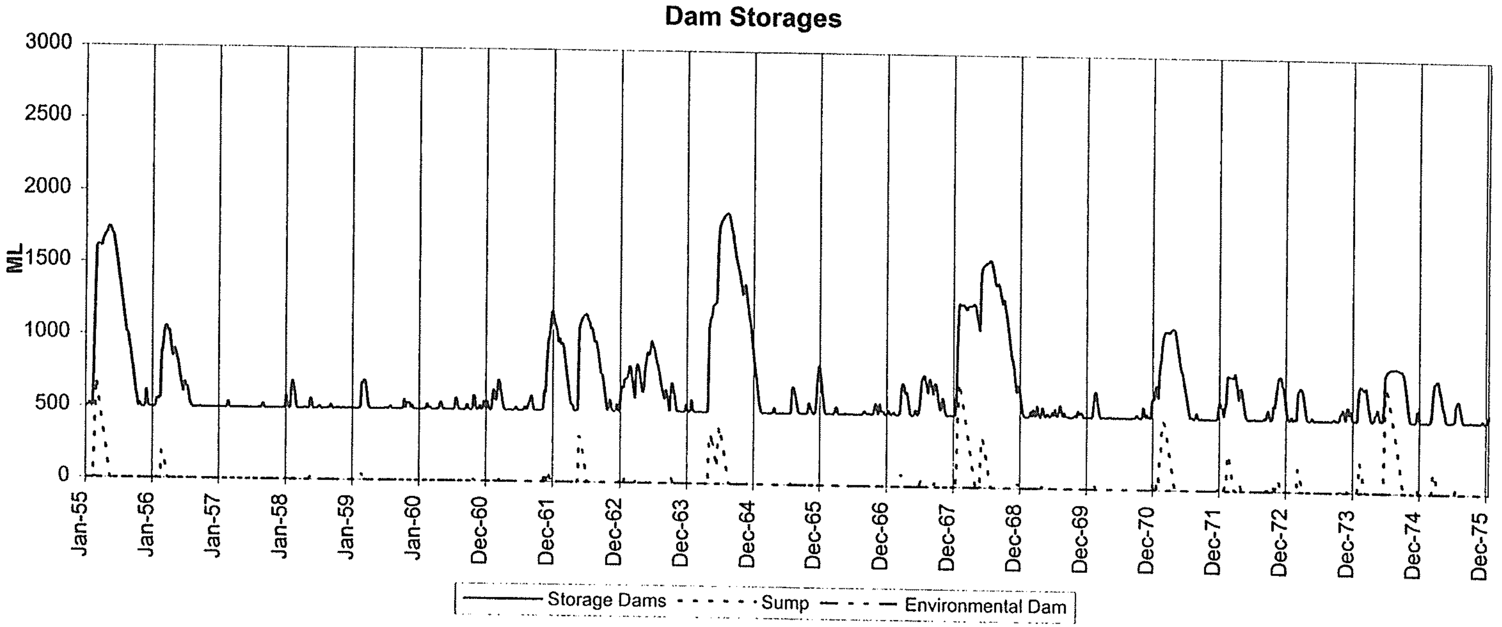
RUST PPK

Figure G26

Mt. Pleasant Mine - Water Management Simulations

1/01/55 to 31/12/75



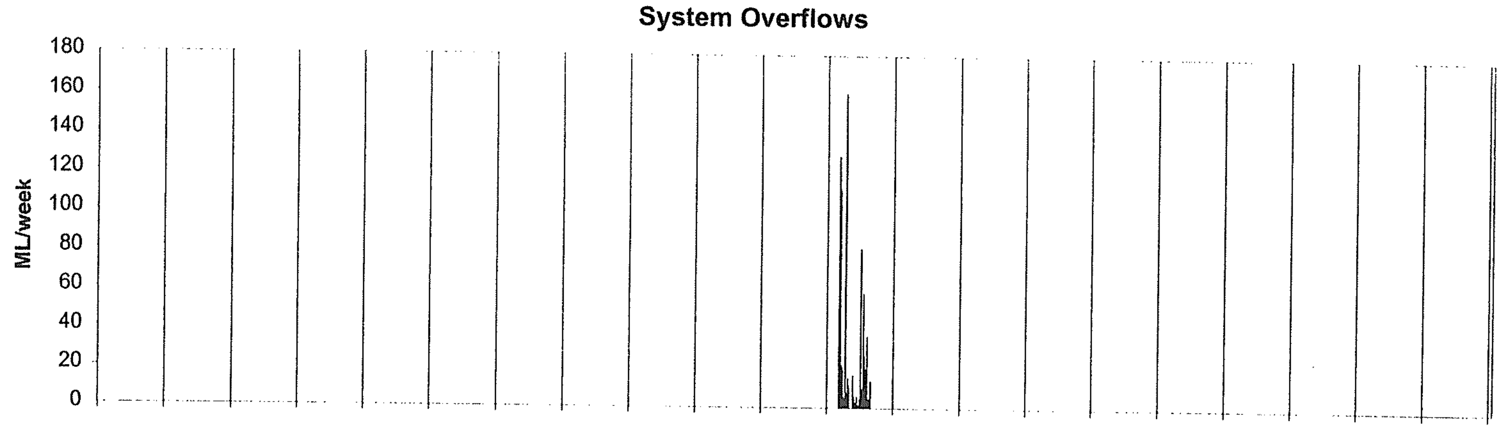


RUST PPK

Figure G27

Mt. Pleasant Mine - Water Management Simulations

1/01/65 to 31/12/85



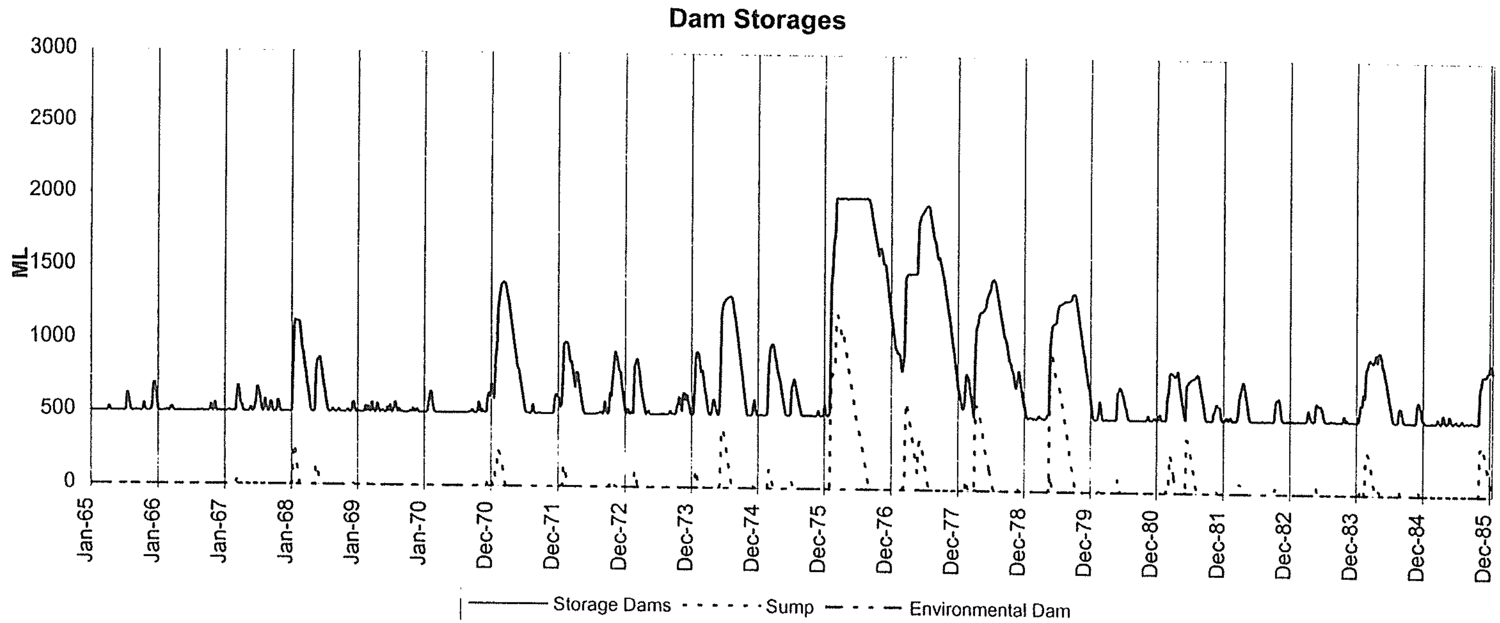


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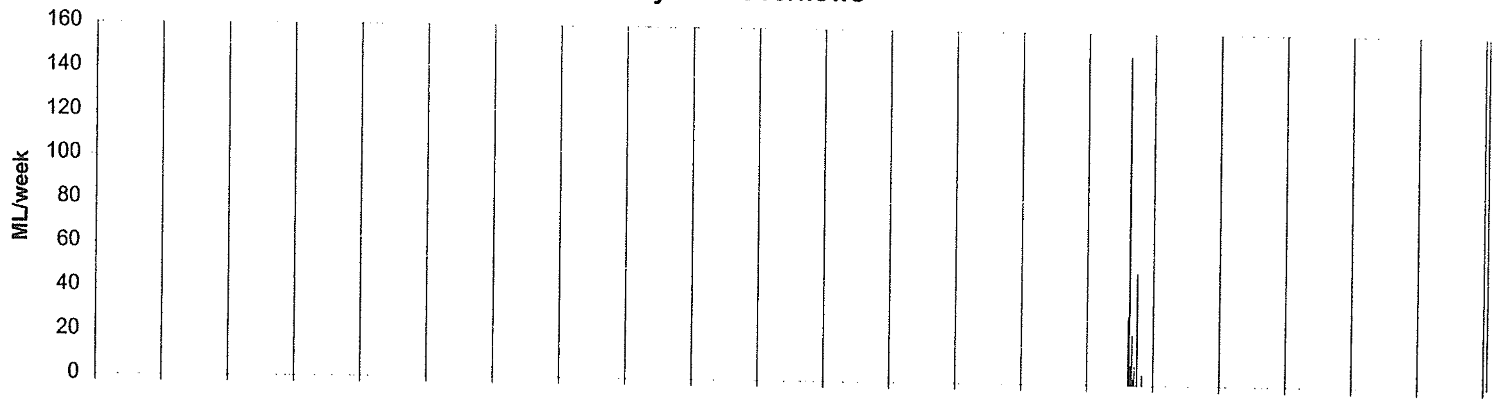
Figure G28

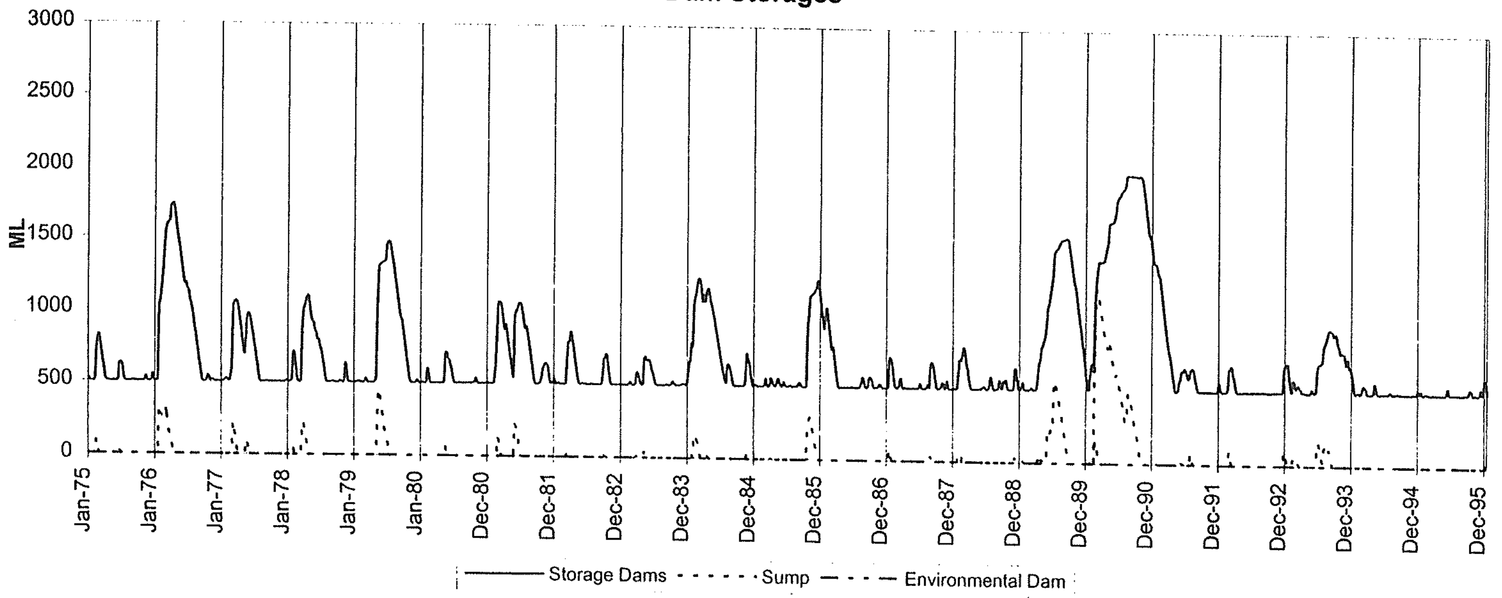
Mt. Pleasant Mine - Water Management Simulations

1/01/75 to 31/12/95

System Overflows



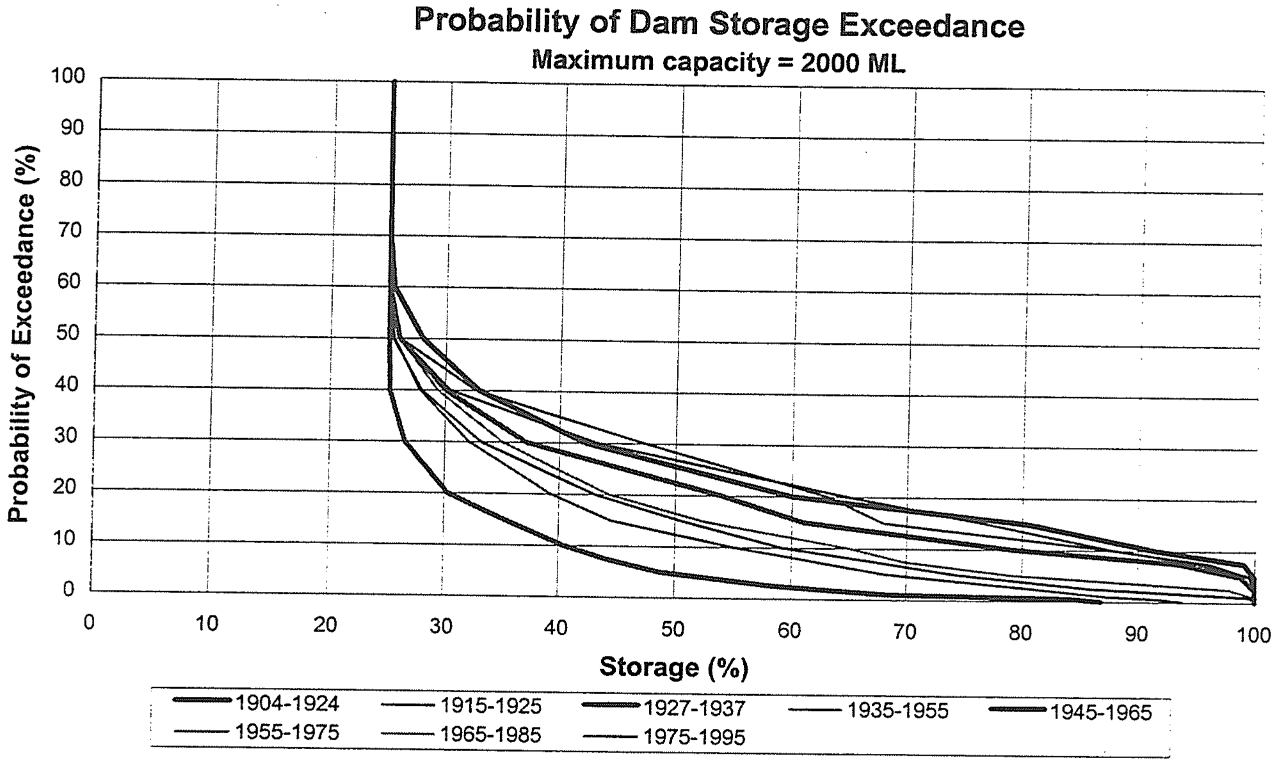
Dam Storages



RUST PPK

Figure G29

Mt. Pleasant Coal Mine - Water Management



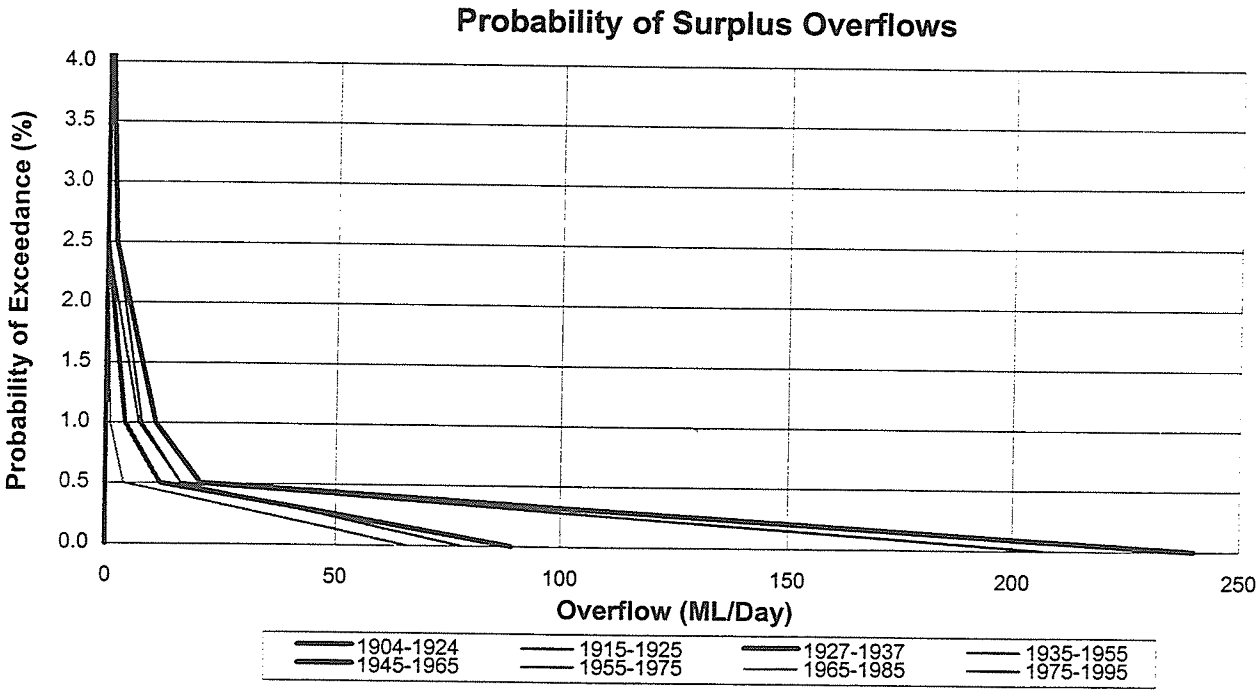


Figure G30

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Mt. Pleasant Coal Mine - Water Management

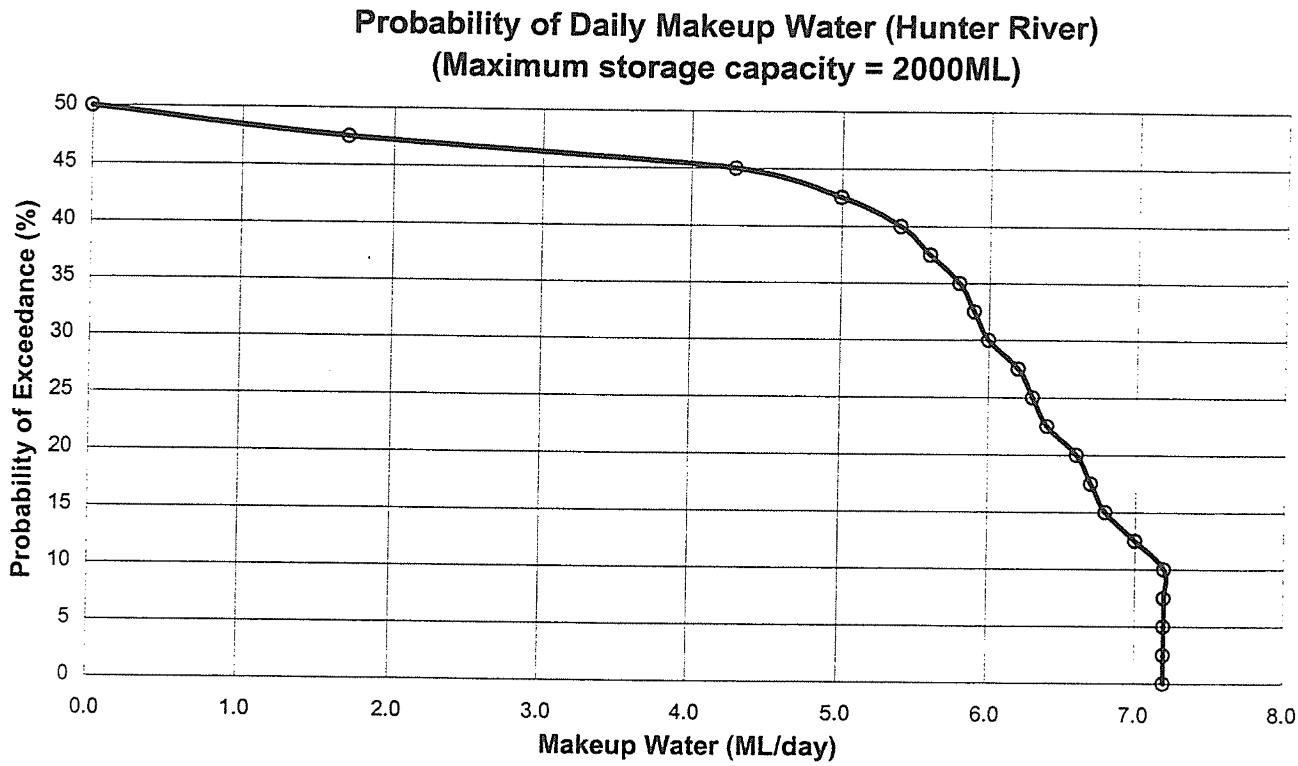

Figure G31

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Appendix H

Western Fine Rejects Storage Facility

H1 Loss of Runoff

Emplacement of fine rejects in catchments immediately west and southwest of Mt. Pleasant will result in loss of rainfall runoff from the natural undisturbed catchments. The loss in runoff is an unavoidable consequence of the need to contain runoff from disturbed areas within the mine water management system.

Figure H1 shows the catchments in a regional context. Catchments C1 and C2 represent the northern and southern catchments in which the rejects will be emplaced as a series of dams. Catchment C3 represents a small surface drainage isolated from C1 and C2. Runoff from these catchments enters Sandy Creek north of Wybong Road where a large catchment area north of the confluences of C1 and C2 (Sandy Creek catchment) provides significant flow to the creek.

Rejects emplacement dams will be constructed within catchments C1 and C2 as shown on Figure H2. The storages will be constructed from east to west in the northern catchment C1 first with construction in the southern catchment proceeding in the last 4 or 5 years of mining. Storages in the northern catchment will be developed as Storage 1 followed by Storages 2 and 3 (CMPS&F 1997) with an environmental dam located immediately beneath storage location 4. The dam will capture all shallow and surface seepage runoff from the storages.

Only the upper portion of the catchment (C1a) will be consumed during mining years 1 through 10 thereby minimising impact on the loss of natural catchment runoff. In following years, the remaining storages (catchment C1b) will retain runoff but storages 1, 2 and 3 will be progressively rehabilitated through to about year 13 or 14 and the runoff generated from these areas, returned to the catchment via a series of contour banks. Table H1 summarises applicable catchment areas.

Table H1: Co-disposal Emplacement Catchments Areas (km^2).

Catchment	Total Area	Contour Drain	Effected Area
C1 natural	4.193	N\A	N\A
C2 natural	4.894	N\A	N\A
C1a tailings	1.755	0.084	1.970
C1b tailings	1.388	0.117	0.848
C2a tailings	1.460	0.054	1.407

In order to determine the loss of catchment runoff, six simulations of the soil moisture accounting model have been conducted utilising historical daily rainfall data for Muswellbrook. Simulations included two scenarios each of; dry (ten percentile) years, average rainfall years, and wet (ten percentile) years, as summarised in Table H2.

Table H2: Statistical Analysis of Muswellbrook Rainfall From 1881 to 1995.

	Wet 10 Percentile (>842 mm)		Median Rainfall (623 mm)		Dry 10 Percentile (<401.8 mm)	
Year	1950	1978	1933	1983	1944	1957
Rainfall (mm)	1107.5	842	625.9	620	401.9	337

Calculated catchment runoff volumes at the confluence of respective catchments C1 And C2 for the various rainfall scenarios are tabulated in Table H3.

Table H3: Natural Catchment Yield (ML/year) For Wet, Median and Dry Years.

Catchment	Wet 10 Percentile		Median Rainfall		Dry 10 Percentile	
	1950	**1978**	**1933**	**1983**	**1944**	**1957**
C1	1617	714	279	283	206	78
C2	1883	831	324	329	239	90

Table H4 displays the volume of runoff estimated to be lost from the natural catchments, due to the development of the respective co-disposal emplacement areas.

Table H4: Loss of Yield (ML/year) For Wet, Median and Dry

Catchment	Wet 10 Percentile		Median Rainfall		Dry 10 Percentile	
	1950	**1978**	**1933**	**1983**	**1944**	**1957**
C1a (0-10 yrs)	700	307	121	123	91	36
C1b (11-20 yrs)	554	243	96	98	72	29
C2a	562	247	97	100	73	29

The typical volume of runoff lost from Table H4 above, is expressed as a proportion of their respective natural catchments in Table H5.

Table H5: Loss of Yield as a Percentage (%) of Total Runoff.

Catchment	Wet 10 Percentile		Median Rainfall		Dry 10 Percentile	
	1950	**1978**	**1933**	**1983**	**1944**	**1957**
C1a (0-10 yrs)	43.3	43.0	43.3	43.5	44.0	46.4
C1b (11-20 yrs)	34.3	34.1	34.3	34.8	35.0	37.1
C2a	29.8	29.7	29.9	30.3	30.5	32.6

Results show that for the first 9 or 10 years of co-disposal, losses in catchment runoff for catchment C1 to the confluence with Sandy Creek, range from 307 to 700 ML/year during wet years, approximately 122 ML/year for average years and 36 to 91 ML/year during dry years. These figures equate to approximately 43% during wet years to 46% during dry years.

For years 11 to 20, losses in catchment runoff for catchment C1 range from 243 to 554 ML/year during wet years, approximately 97 ML/year for average years and 29 to 72 ML/year during dry years. These figures equate to approximately 34% during wet years to 37% during dry years.

The loss in catchment runoff when emplacement in catchment C2 is occurring (years 19 to 21), range from 247 to 562 ML/year during wet years, approximately 100 ML/year for average years and 29 to 73 ML/year during dry years. These figures equate to a loss in total catchment runoff of approximately 30% during wet years to 33% during dry years.

H2 Surface Water Quality

Surface water quality in the proposed western emplacement catchments has been monitored for a period of approximately 6 months. Salinity measurement (water conductivity measured as EC) has been checked at a number of strategic locations including dams and the confluences of catchments with Sandy Creek in order to broadly characterise runoff.

Table H6 provides a summary of measurements at locations shown on Figure H2. Results indicate a generally poor quality water during low flow periods but improved quality water in the days and weeks following significant rainfall. This phenomena is characteristic of many of the local catchments where drainages accept seepage from the underlying coal measures (groundwater seepage) on a continuous basis. During dry periods the proportion of saline coal measures seepage is high in relation to soil moisture storage and bank seepage, but during and following rainfall, high rates of runoff and dilution provide a more acceptable water quality. First flushes often show particularly high salt levels due to prior evaporation and concentration of salts within the drainages. In general, creek flows indicate elevated salts while dams show much improved quality water as expected.

Upward seepage from underlying coal measures has been detected near the confluence of catchment C1 with Sandy Creek where creek salinity changes significantly over a distance of no more than 20 to 40 metres. Rock outcrop in this area confirms the likelihood of faulting acting as a conduit for upward seepage of saline water, with steep dips evident on the creek banks.

The development of rejects dams includes provision for collection of dam seepage via the environmental dams which will then pump to the mine water system. No seepage will be permitted to enter the natural drainages unless water quality characteristics comply with statutory requirements and licensing conditions.

Table H6: Measured Salinity in Surface Waters

Location		Average Salinity uS/cm	Average Salinity mg/L
A	Causeway (C2)	9,803*	6,372
B	Abandoned Bore	5,890*	3,828
C	C1 above confluence	5,370	3,490
D	Sandy Creek Bates ford	2,400	1,560
E	Sandy Creek above C1	2,064	1,341
F	Sandy Creek below C2	2,250	1,462

Refer to Figure H2 for locations. mg/L calculated using 0.65 factor

* may be influenced by single high value

H3 Computer Simulation of Seepage

Construction of fine rejects impoundments will create hydraulic conditions for potential downward seepage of leachate water. While most water will be captured via drainage to the environmental dams, a small component could seep directly into the underlying coal measures. The seepage process will be slow and governed by the hydraulic properties of the deposited fines, the hydraulic properties of the underlying soil zone and coal measures, and the prevailing water level in the storage.

Within the rejects dams, the tailings beaching process will develop a central axis of higher permeability (coarser) materials located approximately along the existing drainage line with more distant areas from the axis (valley slopes) comprised of finer materials offering a lower permeability. The coarser materials are intended to provide an internal drainage collector which will transport most seepage below each dam to the environmental dam. The fines will act to impede seepage and seal drainage pathways downwards into the underlying coal measures. Figure H3 provides a typical dam cross section showing the expected pattern of beaching and the gradation in materials.

Estimation of the potential seepage rates and pathways within the coal measures has been undertaken using a 3 dimensional, 6 layered computer model employing the finite difference method (MODFLOW) for solving the appropriate flow equations. The model has been designed as a 4000m long strip with approximate characteristics for a vertical section located along the drainage axis of the northern C1 catchment. Testing of interburden core at a number of locations in the region indicates very low sandstone and siltstone primary porosity (less than 10^{-5} m/day) with limited groundwater transmission occurring through joints and other defects. Hydraulic properties applied to the model layers included a bulk 'joint' permeability of 0.015 m/day consistent with properties determined for regional aquifers and coal measures to the east (Mt. Pleasant), and a confined storage of 1×10^{-4}.

An initial model steady state condition was based on measured groundwater pressures at the eastern limit of the model and water levels in Sandy Creek at the western extremity. Simulation has been applied for the 21 year mine life and 40 years post mining. Results are presented as Figures H4 and H5 for isotropic uniform permeability in the coal measures. Reference to Figure H4 shows the initial steady state condition at the commencement of mining (uniform westward flow) followed during year 2 by a split in flow directions beneath storage dam 1. At this time a small component of seepage migrates from beneath the impoundment, downwards through layers 2 and 3 of the model and then migrates westward at depth. Westerly flows would theoretically migrate upwards again to shallow zones in the vicinity of Sandy Creek, quite possibly within identified faulting in that area.

By year 5, the split of flow directions is maintained with a predominantly easterly flow towards the mine pit established. Most seepage from beneath the impoundments will migrate downwards to the coal measures at a very low rate of flow and will ultimately exit the system in the mine pit. Since coal measure pressures are reduced below the level in Sandy Creek for a minimum period of 80 years (simulated recovery of void waters), slow seepage will be sustained in an easterly direction from the Sandy Creek area as shown on Figure H5. Capping of impoundments and replanting is not expected to generate sufficient groundwater percolation to reconstitute a significant westerly flow of seepage.

The rate of seepage from the base of dams has been calculated for each storage based on an estimated tailings bulk permeability of 1 x 10^{-4} m/day represented as an equivalent leakage impedance at surface with applied hydraulic pressures equivalent to 1 metre positive head (expected supernatant head) and a maximum thickness of rejects of 25 metres. This estimate assumes vertical drainage into the coal measures across the entire contact area of each dam through materials offering some variability in permeability ranging from 10^{-3} to less than 10^{-6} m/day. Table H7 provides a summary of seepage rates calculated for each dam. Most of the seepage adopts a westerly flow (more than 90% after year 16 based on modelled flux rates) but for calculation purposes a conservative 75% is assumed to flow to the east and 25% to the west. Based on an average width of dams of 400 metres and assuming a uniform flow field towards the west and Sandy Creek, the maximum likely deep seepage would be of the order 20 kL/day over a creek length of 400 to 500 metres. Expected seepage water quality would represent a mix of rainfall recharge and seepage. Since the expected salinity of seepage is of the order of 4000 EC (2600 mg/L) based on washery and supernatant estimates, the maximum salt transfer rate is calculated to be of the order of 52 Kg per day without dilution from rainfall recharge. Surface water quality in drainages within the catchments contributing to Sandy Creek has been measured and found to range from 2064 to 9863 EC uS/cm. The potential contribution from seepage is therefore in a similar range and is not expected to change the prevailing groundwater or surface water salinity. As noted, eastward migration would enter the mine pit as highwall seepage.

A review of other water quality parameters (EGi, 1997) suggests trace elements will not be significant in any seepage waters.

Table H7: Calculated Seepage Rates (kL/day) From Beneath Storages

Dam	Area sq.m	Total flux $k = 1 \times 10^{-4}$ m/day	Potential 25%. flux to Sandy Creek
1	154,400	17.2	4.3
2	240,700	26.5	6.6
3	170,100	18.7	4.7
4	396,900	39.6	9.9
5	152,700	15.2	3.8
6	96,900	9.7	2.4
7	131,900	13.2	3.3
8	274,500	27.0	6.8
9	92,700	9.2	2.3

H4 Management of Seepage

Detailed site investigations will be undertaken prior to final design of the storage dams. Investigations will establish the localised geological structure of the weathered zone and underlying coal measures. Where as yet unidentified rock discontinuities are located, preliminary ground treatment may be employed to ensure low leakage potential to the coal measures during first filling of the impoundments. As fines are deposited, sealing will occur.

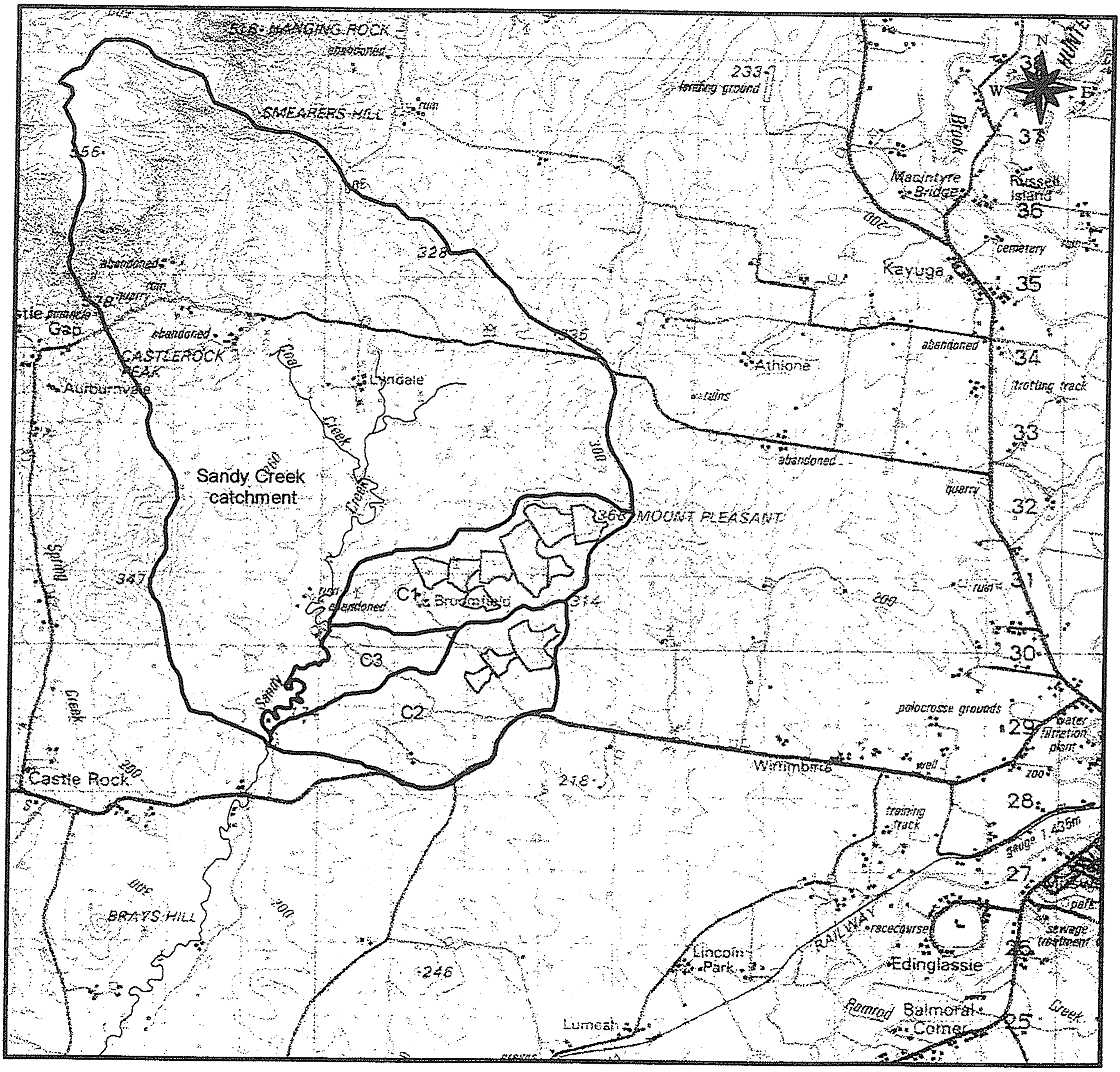
A number of regional observation bores will be installed prior to commissioning of the storage facilities. The bores will be designed to accurately monitor seepage and the changing aquifer pressures at depth which may lead to flow reversals (seepage towards the developing mine pit). Any extraneous seepage identified as having potential to migrate to the west and to significantly impact the groundwater or surface water quality within the catchments, will be carefully assessed and managed using shallow trenches or deep capture wells. In particular:

- drainage trenches will be installed below the environmental dams to contain and manage seepage in the shallow weathered zone,
- pumping boreholes will be installed below the environmental dams to attract seepage and inhibit regional migration;
- Grouting may be undertaken in areas where obvious structural disturbances have provided conduit pathways.

Seepage collection structures will return all seepage to the environmental dam during the mine operational period and during the aftercare period.

Following decommissioning of each dam, seepage rates are expected to decline as the internal water pressures reduce through gravity drainage and consolidation, and retention processes prevail. Capping will inhibit rainfall infiltration.

Detailed survey of dam surfaces will be undertaken during closure of each dam. Some reshaping may be undertaken to ensure surface rainfall runoff is managed effectively and erosion potential is minimised - runoff will be conveyed from each dam plateau away from steep slopes to a controllable discharge point. During the first few years of rehabilitation, runoff will be directed through the environmental dams which will act as sediment dams. When runoff water quality is acceptable (ie. low suspended solids), runoff will be returned to the natural drainages.



0 2000 4000 6000 8000 Meters

Sandy Creek
tailings dams
divide

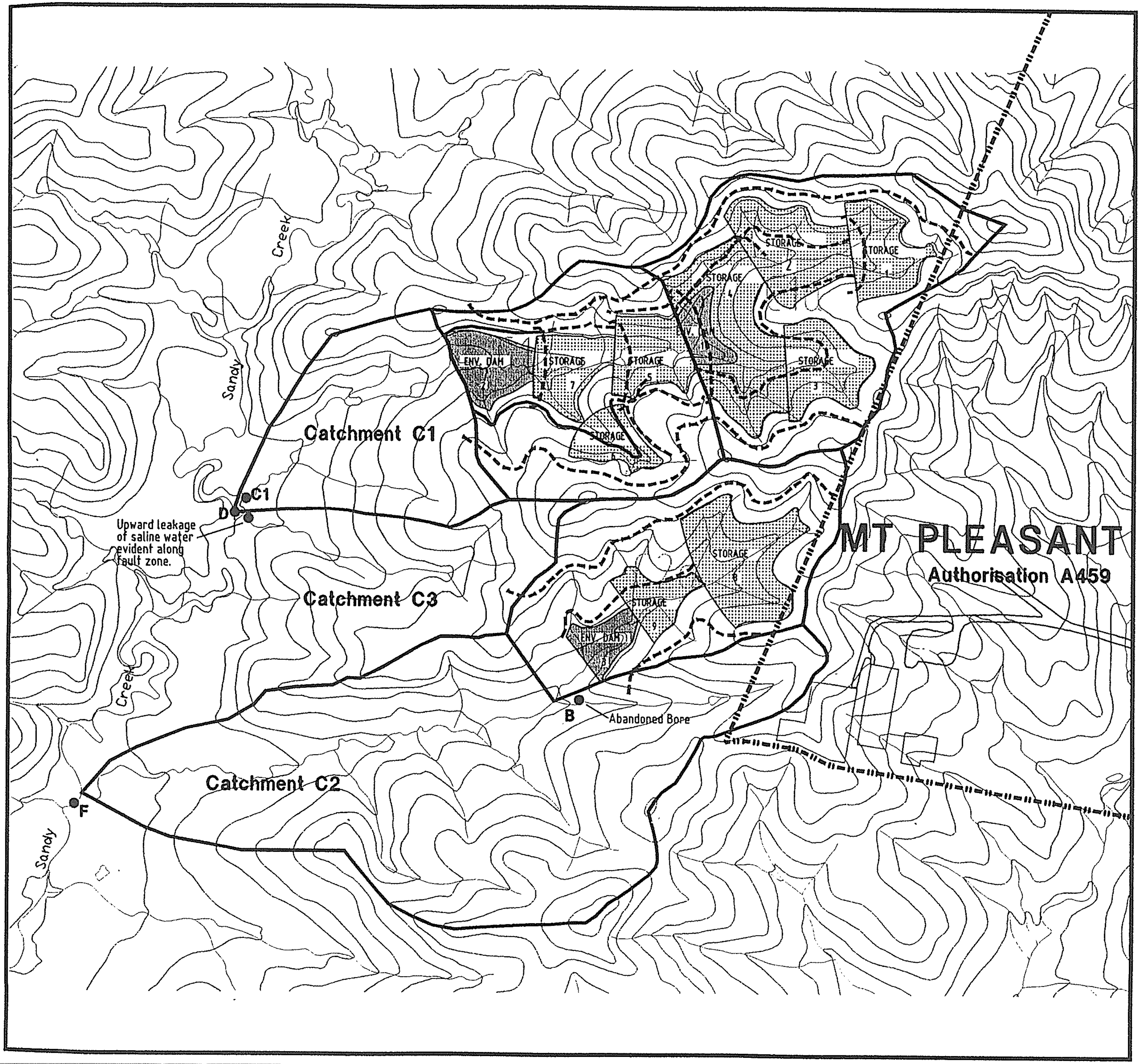
C1 northern catchment for rejects
C2 southern catchment for rejects
C3 small catchment between C1 and C2

SANDY CREEK CATCHMENTS ABOVE WYBONG ROAD

Figure H1

RUST PPK
Environment & Infrastructure

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



Legend:

- Mine Authorsation Boundary
- Graded Contour drains
- Drainage
- Mine facilities
- Catchment divide
- Topography
- Storage dam
- Dams
- Sample Locations

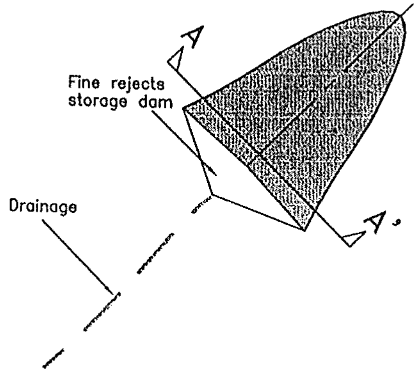
N

200 0 200 400 600 800 1000 Metres
ORIGINAL SCALE 1: 20000

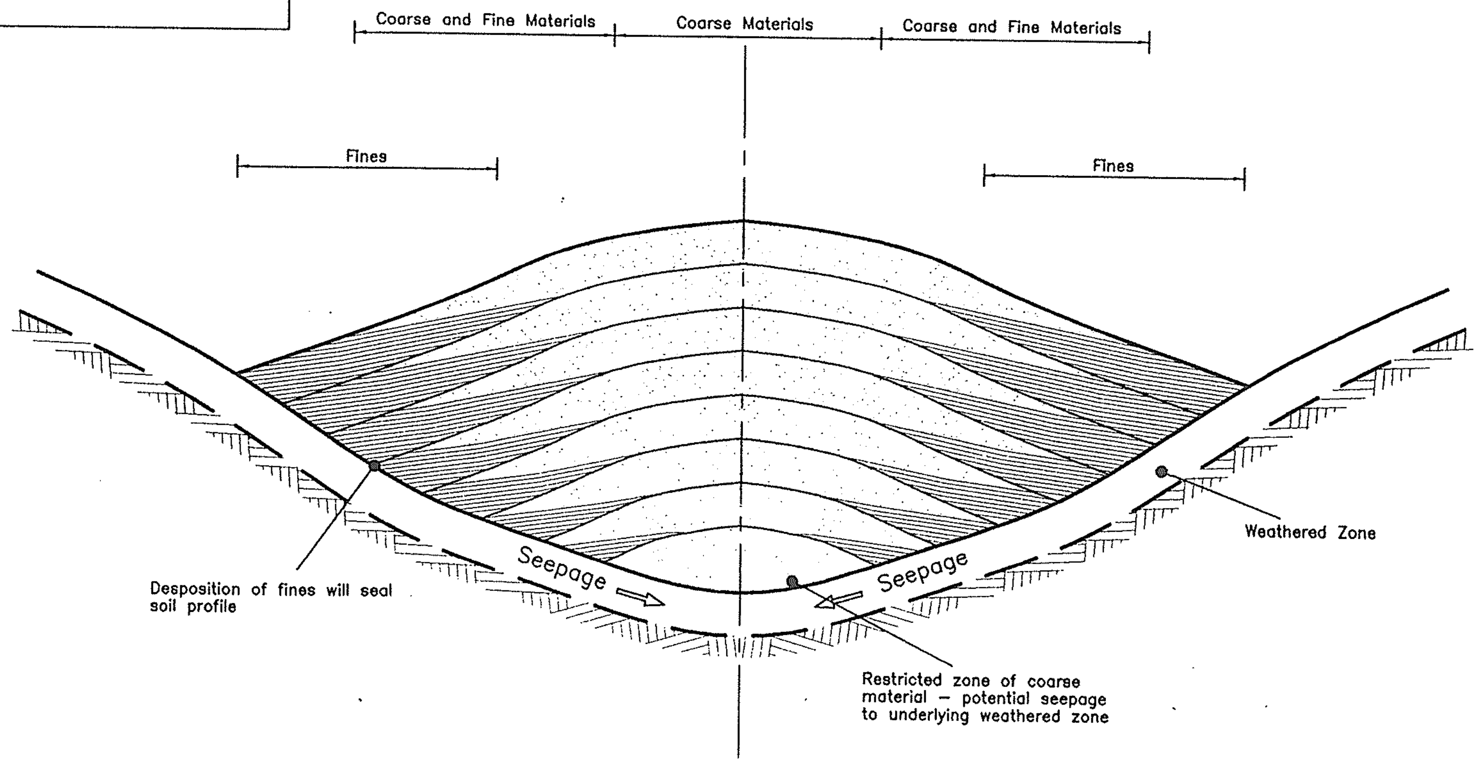
Western Rejects Emplacement Layout

Figure H2

Coal & Allied Operations Pty. Limited
Mount Pleasant Project
Water Management Study



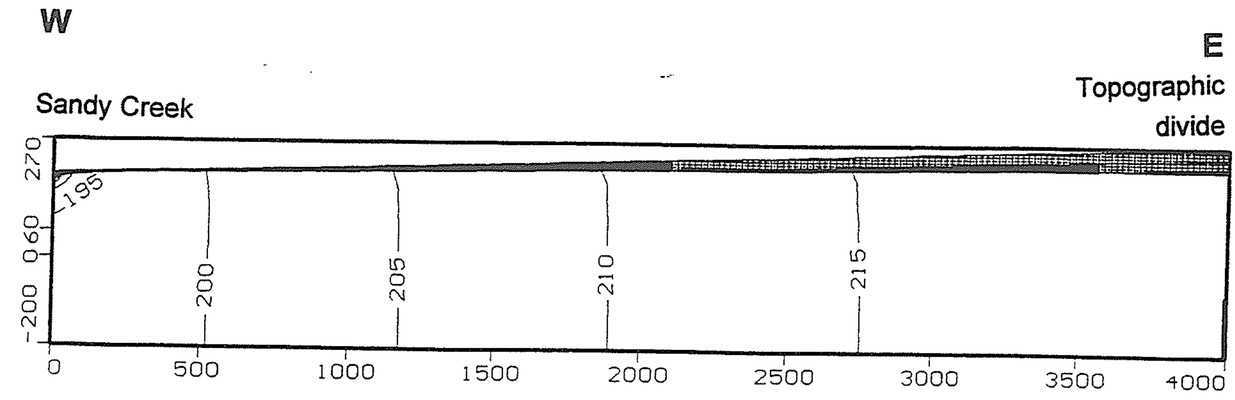
Plan View
not to scale



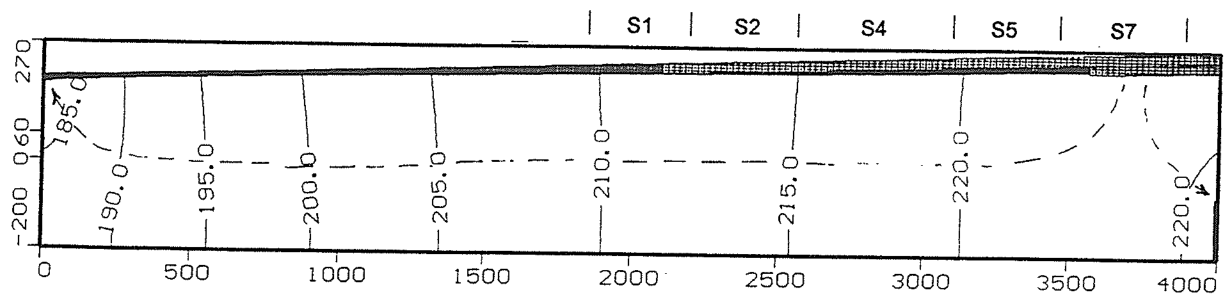
Section A – A'
not to scale

Conceptualised Rejects Depositonal Environment

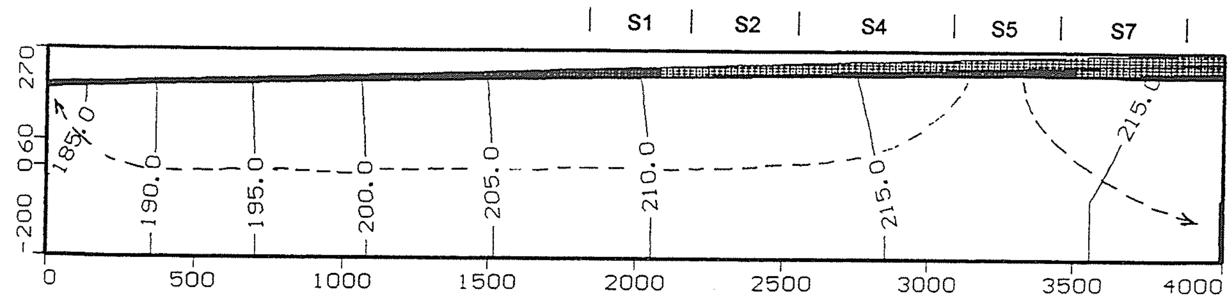
Figure H3



Steady State



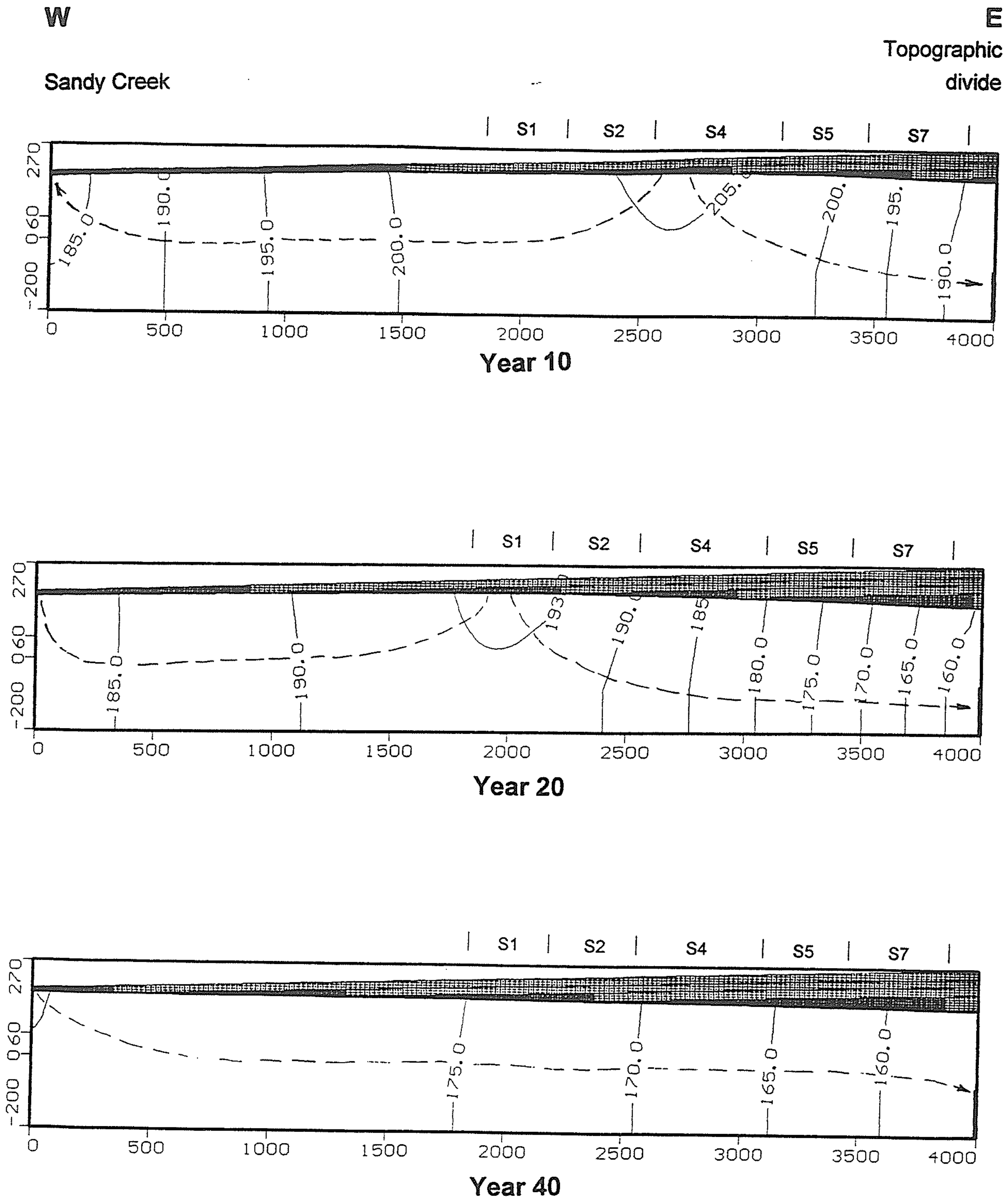
Year 2



Year 5

Western Fine Rejects
Computer Simulations Years 0 to 5
Figure H4

RUST PPK
Environment & Infrastructure



Western Fine Rejects
Computer Simulations Years 10 to 40
Figure H5

RUST PPK
Environment & Infrastructure

FINE REJECTS STORAGE FACILITY

4

REPORT

FOR

COAL FINE REJECT STORAGE FACILITY

TO

COAL & ALLIED OPERATIONS PTY LIMITED

FOR

MOUNT PLEASANT PROJECT

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20 June 1997

DOCUMENT NO: MQ0112-TR-C001

REPORT FOR

COAL FINE REJECT STORAGE FACILITY

Client: **Coal & Allied**

Project Title: **Mount Pleasant Project Studies**

Work Plan No: **MQ0112-WP1**

0	20/6/97	Issued for Use	SL	JET	JET	JET	
B	25/2/97	Issued for Review	SL	JET	JET	JET	
A	16/1/97	Issued for Approval	SL	JET			
Rev	Date	Description	By	Chk	Eng	Appd	Appd

TABLE OF CONTENTS

APPENDIX A

EARTHTECH LABORATORIES REPORT - MT PLEASANT COAL MINE DEVELOPMENT - PROPOSED COAL REJECT STORAGE DAM (1997)

APPENDIX B

MOUNT PLEASANT PROJECT GEOTECHNICAL ASPECTS OF PROPOSED FINE REJECTS DAM

1. EXECUTIVE SUMMARY

This report provides preliminary consideration of a fine reject disposal area and associated operating strategy at Coal and Allied's proposed Mt Pleasant Coal Mine. The report has been prepared by CMPS&F with specialist geotechnical input provided by Earthtech Laboratories and Sherwood Geotechnical and Research Services.

From aerial photography and contoured mapping, two gullies to the west of the proposed mine site have been chosen as topographically and geotechnically appropriate for permanent storage of the required volume of fine reject. It is proposed that each gully be sectioned into a series of separate storages and terraced at descending levels. Each storage will be filled with fine reject material pumped from the coal preparation plant. This material consists of desliming cyclone overflow and spiral rejects. The storages will be filled in sequence starting with the area at the top of the gully. Excess water will be drawn off via a decant system to enhance consolidation of the fine reject.

At the base of each gully a homogenous earthfill dam is to be constructed to contain stormwater runoff from the area of fine reject deposition and surrounding catchment. The storage arrangement is intended to facilitate progressive rehabilitation and maximise the storage capacity of both gullies.

A basic operating strategy to construct the storages is discussed, and is consistent with the preliminary forecast fine reject production volumes for the 25 year life of mine.

2. INTRODUCTION

2.1 BACKGROUND

Coal and Allied Operations Pty Ltd propose to develop at Mt Pleasant, a multiseam, multiply deposit by open cut methods to produce a low ash thermal coal for export. CMPS&F has undertaken feasibility studies of the coal preparation and coal handling facilities associated with the mine, leading to the current proposal for facilities to be located in the south west corner of the lease. An essential and integral part of these studies has been the method of disposal of coarse and fine reject from the coal washing operation.

The methods of disposal considered in earlier studies encompassed co-disposal of coarse and fine reject to settling ponds with rehandling back into the open cut workings or the use of belt press filters. The proposed location of the coal preparation plant in the south west corner of the lease facilitates the use of land to the west of the lease to store and dewater fine reject and operate a progressive rehabilitation programme.

The current proposal for mining at Mt Pleasant is for a 10.5 Mtpa (as received) run of mine coal operation over a 25 year period. The fine reject disposal scheme is based on this output. Other criteria used in developing this report are that coarse reject would be placed back in the open cut pit, the fine reject storages would be progressively rehabilitated, the storages must be environmentally acceptable, and the dams would meet or exceed the safety requirements of all relevant authorities.

2.2 CURRENT SCOPE OF INVESTIGATIONS

The scope of investigations includes preliminary engineering details to support and provide input to an Environmental Impact Study (EIS) currently being prepared by ERM Mitchell McCotter. On this basis the investigations are focused on selection of a suitable location for permanent fine reject disposal, fine reject material characteristics, proposed fine reject retaining structures, environmental protection systems and a preliminary methodology for material placement and rehabilitation.

Environmental dams servicing the fine reject storage areas have been located and sized to contain a volume of potentially contaminated stormwater runoff from the catchment. A risk analysis based on relevant legislation is presented in connection with the sizing and location of the environmental dams, and comments are provided as to the potential risk of loss of contaminants to the groundwater system.

Consideration has been given to coarse and fine reject material characteristics as they relate to the proposed storage scheme. This area of study includes a brief review of previous codisposal proposals, comment on the proposed disposal methodology and aspects of geotechnical stability of the proposed coarse material structures and fine reject deposition areas.

A preliminary strategy for progressive rehabilitation has been considered as part of the general operating plan, which will enable fine reject to be capped and revegetated on an ongoing basis during the life of the storage facility.

3. OPERATIONAL MANAGEMENT STRATEGY

3.1 INTRODUCTION

The proposed management strategy for fine reject disposal includes pumping of fine reject material to storages formed by the construction of storage walls using coarse reject material.

With reference to drawing Nos MQ0112-C01 and MQ0112-C02 a series of internal storage walls are proposed within the fine reject storage areas, commencing from the elevated upper limits of the gully and finishing with a storage near the base of the valley (located a sufficient distance away from the environmental dam to allow for the required volume of storm water storage). Drawing No. MQ0112-C02 shows the proposed fine reject storage arrangements to year 10, drawing No. MQ0112-C01 shows the proposed storage areas from year 10 to year 25. Storage volume requirements on an annual basis are presented in Table 1.

The internal storage walls are to be constructed from coarse reject material, transported to site and appropriately placed to form impounding structures. Such use of coarse reject material will consume approximately 5% of that produced each year, and can be transferred to a stockpile adjacent to the storage site to suit mining operations. The coarse reject material will be approximately half bath reject and half Dense Medium Cyclone (DMC) reject.

3.2 CONCEPT OF DISPOSAL METHOD

The concept of the proposed disposal method is based upon an industry proven method of mixing coarser particles with the slimes to form a more stable land form for reclamation. Coarse particles are deposited earlier when discharged from the pipeline and form a beach. As more material runs across this beach dewatering occurs, the thickened slurry slows and settling of fine solids occurs. The water from the settled slurry continues to travel across the storage and forms a pond area, which is then decanted and returned for reuse in the coal preparation plant. The method of operation of the deposition and recovery of water in the storages is be detailed in Section 4.0.

Using staged storages will allow rehabilitation of upper benches. This may be carried out after a settling period of approximately six months. The storages will be capped with a coarse reject layer in preparation for final reclamation. Based on an initial 1 m capping layer around a further 5% of the total plant coarse reject will be required for these purposes. The actual depth of capping layer will be subject to detailed design. Capping of the storage may start and advance from the road used for the fine rejects pipeline.

The first lift of the next storage wall will be constructed early in the life of the storage under use. In order to ensure a sound foundation for subsequent walls be achieved, ie seepage from the upstream wall be excluded from the construction area, a small coffer dam may be erected.

3.3 ENVIRONMENTAL ISSUES

3.3.1 Storage Wall/Environmental Dam Construction

The storage walls will be raised in staged lifts of approximately 5 metres to suit the operation of the storage and avoid the construction of a large storage wall in one operation. Consequently any noise and/or dust generated during construction will occur for limited periods and generally during daylight hours. Dust generation during hauling will be controlled by use of water truck spraying on the haul road and stockpile areas. The coarse reject storages are to be limited to one truckload high to minimise dust generation. During construction of the storage walls/environmental dams water truck spraying will be used to control dust in the area of operations.

Noise levels will vary according to the amount and size of equipment being used, and will be short term during storage wall/environmental dam construction.

When dam wall construction is in progress there will be two to three self powered scrapers, a water truck and a compactor operating, with trimming undertaken by a grader. A dozer may be required to assist the scrapers in loading stockpiled material. During the longer term operation of stockpiling of reject material it is likely that one haul truck will be operating on a cycle basis.

3.3.2 Rehabilitation of Storage Areas

After each storage has been filled and capped with a layer of coarse reject material followed by a layer of overburden and finally finished with a layer of topsoil, a relatively inert landform will remain.

Acid generation potential is controlled by excluding air from the reject material in the long term. Once all the storages have been capped and rehabilitated there is little likelihood of acid water generation.

In recognition of the advantages of progressive rehabilitation eg improved public perception and risk minimisation from the reduction of total catchment contamination yield etc, it is proposed that the natural gully profiles be utilised in constructing the separate fine reject storage areas, to facilitate early and progressive rehabilitation.

Internal storages 1-9 inclusive can be developed over the life of the mine and separately rehabilitated on completion of filling to each area. The following graph (Figure 1) indicates the relationship between time, cumulative volume of fine reject to be stored and the progressive filling of the internal storages. Therefore, in terms of rehabilitation planning, storage 1 will be filled with fine reject and available for

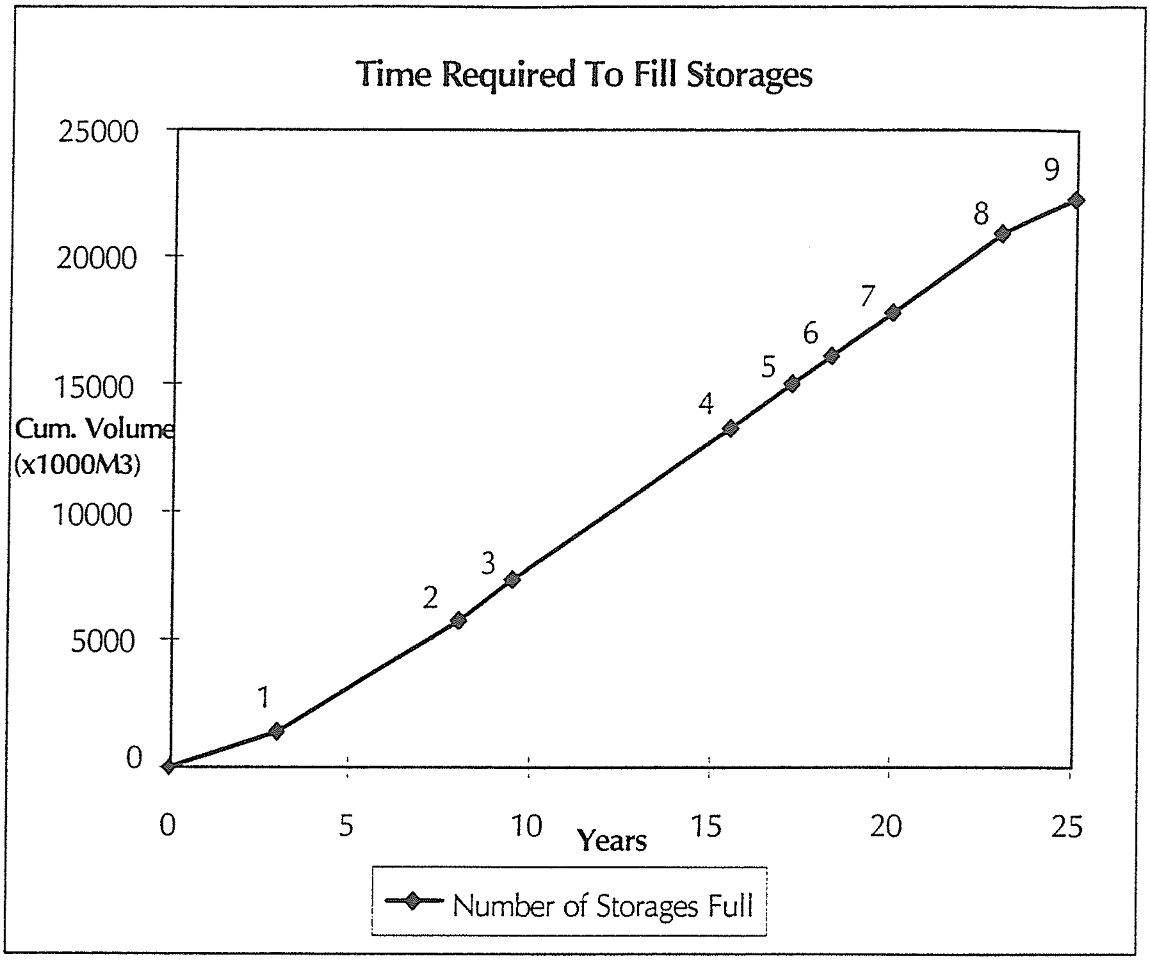


Figure 1

rehabilitation by the end of year 3, similarly storage 2 will be available for rehabilitation by the end of year 7 etc. Rehabilitation work prior to completion of filling to an individual storage area is possible due to the proposed placement technique ie placement commences at the furthest point from the storage wall from where a beach is formed. The point of entry of the fine reject may be raised several times until a final level is reached in advancing areas. It may therefore be possible to rehabilitate behind the pipeline extensions. Details of the rehabilitation plan will be established based upon proposed mining operations and beaching properties of the fine reject.

Stripping and stockpiling of topsoil prior to storage wall construction, environmental dam construction, and fine reject emplacement will be undertaken. This preliminary operation will provide a future topsoil source for rehabilitation work to the capped fine reject areas, the `downstream' slope face and crest of the internal walls, and the environmental dams.

The risk of spontaneous combustion of the reject material is low as the materials in the storages are saturated with water and only the surface is exposed to air. Heat generated by reaction with air will therefore be dissipated. The coarse reject material in the wall will have undergone sufficient compaction to exclude air and will be capped when the dam is filled. Stockpiles of coarse reject material dumped one truck load high, as previously noted, should not be susceptible to self heating as the heat will not be contained in the material due to the low height storage profile.

The downstream face of the dam is benched to minimise the possibility of erosion gullies forming. After capping the benched formation will stop erosion of the capping material and reduce the amount of air reaching the coarse reject. Plant operators should be made aware of the potential for self heating and check the area when during their regular examination of the discharge beach.

4. FINE REJECTS HANDLING

4.1 MATERIAL CHARACTERISTICS

The fine reject material to be disposed of will consist of mainly fine clay, fine coaly shales and fine pyrites, with some sand. It will have a size range of 0.5 mm (wedgewire) x 0. The material is made up of spiral reject that has been dewatered by cycloning, and thickened slimes from the coal preparation plant thickener. The slimes are from the desliming of the fine coal stream and will have been treated with a flocculant at the plant to increase their settling rate in the thickener. They are pumped from the thickener at a controlled density and mixed with the spiral reject.

The mixture is then pumped from the plant at around 40% solids to ensure good pumping rates without becoming too viscous. Urethane lined steel pipe provides a lightweight, wear resistant pipeline. The pipeline will discharge into the reject storages under use.

4.2 THICKENING PROCESS

A thickener dump pond is not required with the conventional thickener as there is no requirement to dump. They are designed to store some material and the rakes are able to move vertically. The rakes are controlled to maintain a load and will raise or lower depending on the needs of the operation. The settling rate is a lot lower than in high rate thickeners and is therefore easier to control. A standby underflow pump ensures continuity of pumping.

Inclusion of a surface run off catchment dam is sufficient to contain any overflow from the top of the thickener. A small sump is used to contain any spills from the underflow pump area and this will be pumped back to the thickener. When the thickener is to be drained for annual maintenance shutdown, a dump valve in the wall of the thickener is used to decant off water to the on site environmental dam with mud still pumped to the fine reject storage area. The floor area is to be hosed clean and resultant mud pumped to the fine reject storage area.

4.3 RATE OF MATERIAL TRANSFER TO THE DAMS

Production is currently staged to meet full production in approximately 6 years. Volumes to be disposed of in the storages have been calculated from data supplied by Coal & Allied Operations Pty Ltd (C&A). Around 1,000,000 m^3 of material will be deposited in the storages each year at full production (10.5 Mtpa). (Refer to Table 1 for quantities of material produced per year of production) The bulk density of settled material is expected to be around 1.2 t/m^3.

4.4 PLACEMENT IN STORAGES

The initial point of entry of the fine reject will be near the rear of the storage so that the solids flow down the valley and towards the storage wall. If the slope of the valley is too steep to allow deposition close to the discharge point then a small wall may be required to slow the flow sufficiently. Once the beach is formed the discharge point will be raised by increasing the height of the fine reject pipeline. This may be done by building a road alongside the existing pipeline, then raising the pipeline onto the new road and adding the necessary extensions to the pipeline.

The aim is to keep the beach above the surrounding area so that dewatering can occur across the beach. The beach area will be inspected regularly to ensure that the discharge area is above the surrounding slurry.

Deposition will occur downslope towards the main wall allowing clear water to pond near the wall. Ideally a minimum distance of 200 m is maintained between the discharge point and the wall.

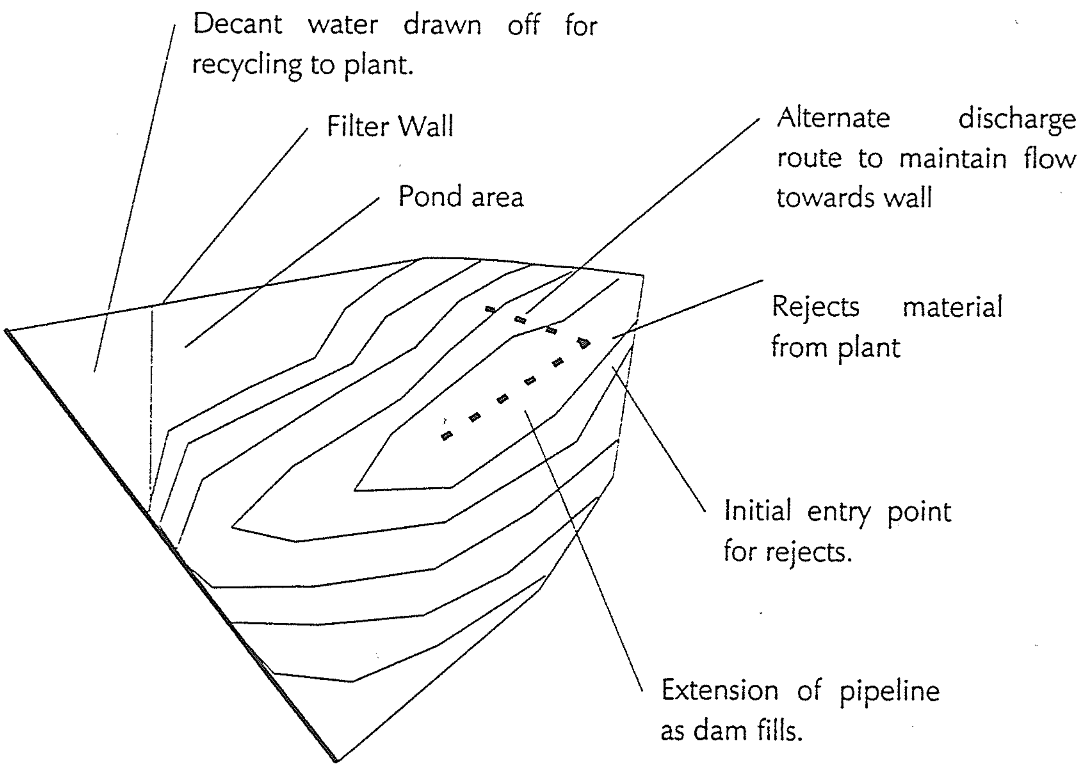


Figure 2

Table 1
Quantities of Material

Year		1	2	3	4	5	6	7	8	9	10	11	12	13
Coal														
ROM COAL a.d.b.	(kt)	513	3,080	4,976	6,131	6,051	8,036	8,043	9.946	9,950	9.950	9,950	9,950	9,951
Prod Coal a.d.b.	(kt)	422	2,193	3,413	4,083	4,296	5,706	5,807	7,181	7,224	7,263	7,323	7,084	7,045
Practical Recovery	(%)	82.2	71.2	68.6	66.6	71.0	71.0	72.2	72.2	72.6	73.0	73.60	71.2	70.8
Total Rej Coal adb	(kt)	91	887	1,562	2,048	1,755	2,330	2,236	2,765	2,726	2,686	2,627	2,866	2,906
Fine Rej Coal adb	(kt)	48.5	350.4	589.5	768.6	776.4	1006.8	988.3	1205.3	1209.8	1193.1	1180.7	1218.2	1211.3
Bath Rej Coal adb	(kt)	21.4	268.4	486.4	639.6	489.2	661.8	623.8	779.9	758.2	746.6	723.0	823.7	847.1
DMC Rej Coal adb	(kt)	21.4	268.4	486.4	639.6	489.2	661.8	623.8	779.9	758.2	746.6	723.0	823.7	847.1

Wet Bulk Volumes		(These volumes include water)												
Fines @ 1.2 RD	(km^3)	40.42	292.00	491.25	640.50	647.00	839.00	823.58	1004.4	1008.2	994.25	983.92	1015.1	1009.4
Cum Fine Reject	(km^3)	40	332	824	1,464	2,111	2,950	3,774	4,778	5,786	6,781	7,765	8,780	9,789
Bath Rej @ 1.7 RD	(km^3)	12.6	157.9	286.1	376.2	287.8	389.3	366.9	458.7	446.0	439.2	425.3	484.5	498.3
DMC Rej @ 1.8 RD	(km^3)	11.9	149.1	270.2	355.3	271.8	367.7	346.6	433.3	421.2	414.8	401.7	457.6	470.6
Coarse Rej T (as)	(kt)	47	593	1,075	1,414	1,081	1,463	1,379	1,724	1,676	1,650	1,598	1,820	1,872

(To be trucked, includes free moistures of 9% for bath and 12% for cyclones)

Year		14	15	16	17	18	19	20	21	22	23	24	25	26	Total
Coal															
ROM COAL a.d.b.	(kt)	9,950	9,550	9,950	9,950	9,950	9,951	9,951	9,952	9,952	9,952	9,953	9,953	9,954	225,895
Prod Coal a.d.b.	(kt)	7,035	6,743	7,094	7,104	7,025	7,105	6,966	7,036	6,867	6,260	5,673	5,703	5,206	156,997
Practical Recovery	(%)	70.7	70.6	71.3	71.4	70.6	71.4	70.0	70.7	69.0	62.9	57.0	57.3	52.3	69.50
Total Rej Coal adb	(kt)	2.915	2,808	2,856	2,846	2,925	2,846	2,985	2,916	3,085	3,692	4,280	4,250	4,748	68,898
Fine Rej Coal adb	(kt)	1248.3	1188.7	1240.1	1193.9	1159.4	1105.5	1204.6	1214.7	1252.4	1164.3	1188.4	1166.6	1111.5	27,185
Bath Rej Coal adb	(kt)	833.6	809.5	807.8	825.9	883.0	870.2	890.4	850.6	916.3	1,264.0	1,545.7	1,541.7	1,818.2	20,856
DMC Rej Coal adb	(kt)	833.6	809.5	807.8	825.9	883.0	870.2	890.4	850.6	916.3	1,264.0	1,545.7	1,541.7	1,818.2	20,856

Wet Bulk Volumes

Fines @ 1.2 RD	(km^3)	1040.2	990.58	1033.4	994.92	966.17	921.25	1003.8	1012.3	1043.6	970.25	990.33	972.17	926.25	22,654
Cum Fine Reject	(km^3)	10,829	11,820	12,853	13,848	14,814	15,736	16,740	17,752	18,795	19,766	20,756	21,728	22,654	22,654
Bath Rej @ 1.7 RD	(km^3)	490.3	476.2	475.2	485.8	519.4	511.9	523.7	500.3	539.0	743.5	909.2	906.9	1,069	12,268
DMC Rej @ 1.8 RD	(km^3)	436.1	449.7	448.8	458.8	490.6	483.5	494.6	472.5	509.1	702.2	858.7	856.5	1,010	11,587
Coarse Rej T (as)	(kt)	1,842	1,789	1,785	1,825	1,951	1,923	1,968	1,880	2,025	2,793	3,416	3,407	4,018	46,092

(To be trucked, includes free moistures of 9% for bath and 12% for cyclones)

Decant water is drawn from the surface of the pond area by allowing it to trickle through a gravel bed placed in the filter wall. The filter wall is constructed in the furthermost corner of the dam from the original discharge point. The filter wall is raised as needed to control the ponded area.

Water is pumped from the decant area to maintain a head difference between the two areas for efficient decanting. This water is recycled back to the mine water management system. This will amount to around 60% of the water entering the storage and will vary depending on evaporation from the surface of the storage. Deposition is controlled by changing the outlet position to fill in selected areas and keep the decant water moving towards the storage wall. This is usually done by filling in the low areas uphill of the main discharge area.

The frequency of the changes is dictated by the shape of the valley and the solids concentration being pumped to the storage. The velocity of fine rejects at the discharge point is kept below 1m/sec where possible to avoid turbulence disrupting the beach formation.

If the material being pumped contains excessive quantities of water and the beach cannot handle such volumes, the profile may become flatter. When this occurs the water reaching the filter wall may not have time to settle and will contain suspended solids.

To overcome this, the point of discharge should be relocated further to the rear of the storage. The solids concentration is normally controlled by the thickener underflow density as the solids concentration in the underflow of the spiral reject dewatering cyclones will be relatively stable. Thickener control is achieved by measuring the density of the underflow and adjusting the pump delivery to maintain a setpoint.

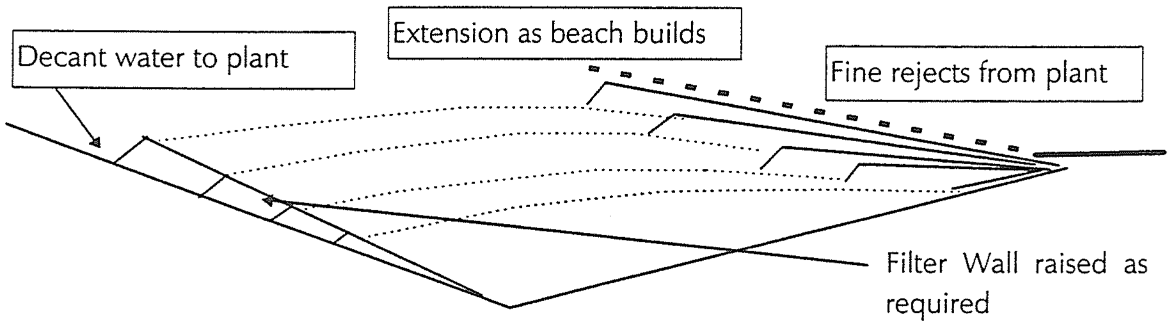


Figure 3

The cause of the excessive water content should be rectified as soon as possible. If a long term problem with solids concentration has developed the storage may contain areas of fine slurry which will need to be covered with a greater depth of reject capping material.

In summary, the placement strategy will be designed to enhance progressive rehabilitation. Many details of the proposed scheme will be subject to review and possible modification as more specific material information becomes available from testing during detailed design.

Performance of the system will also be monitored with a view to achieving rehabilitation requirements efficiently, once operating experience builds up.

5. DAM/STORAGE STRUCTURES

5.1 SITE SELECTION

The two sites selected for fine reject storage are immediately adjacent to the western lease boundary of the mine site, within an area of relatively undisturbed grazing land. Each area is a separate self contained gully draining away from the mine site to an external watercourse.

The profiles of both gullies facilitate construction of relatively short environmental dam structures, thereby providing a storage/cost benefit.

5.2 FINE REJECT STORAGE WALLS - SIZING

The storage walls are sized to contain the required volume of fine reject within the chosen gully. Generally wall heights are reduced at the base of the valley with the final storage wall (adjacent to the environmental dam) at 15 m maximum height. An overall maximum wall height of 35 m is proposed higher in the valley, which will be reduced to a maximum of 20 m once the next lower storage is completed ie material has been placed against the downstream face of the wall.

5.3 FINE REJECT STORAGE DAMS - DESIGN AND CONSTRUCTION CONSIDERATIONS

Storage walls 1 - 9 are to be constructed from coarse reject materials. Preliminary wall profiles are shown on Drawing No MQ0112-C01 and MQ0112-C02 and are designed both to provide both structural stability and facilitate rehabilitation.

The proposed typical coarse reject storage wall profile are shown on the drawings The proposed 'upstream' embankment slope is at the approximate mean angle of repose of 35° (refer Appendix B - Report on Geotechnical Aspects of Proposed Fine Reject Disposal System - June 1997). The lesser graded `downstream' profile is intended to increase the stability of the wall (subject to detailed design) and to provide a finished profile amenable to rehabilitation. Slope lengths on the downstream batter are effectively reduced to approximately 11 m and the benches may be constructed to act as contour drains to minimise the accumulation of rainfall runoff to the slopes. It is stressed that some modification to these profiles may be necessary after detailed analysis of the coarse reject material and consideration of geotechnical stability criteria.

A low section on each storage wall will be incorporated to act as a bywash, to minimise the accumulation of stormwater runoff behind the reject wall and prevent overflow from overtopping the crest of the wall in an uncontrolled manner. The `downstream' slope is therefore subject to direct rainfall runoff only which will minimise erosion loss during rainfall events.

The storage walls are not intended to be water retaining structures and detailed design may establish the need for a series of drainage layers (typically coarse gravels) to eliminate the build up of water pressure and allow moisture to be lost through the wall from the fine reject material. It is not however intended to allow the structure to act as a `drain' as such. Discussion on this matter is presented in Appendix B - Section 4.2. Walls will be designed to stability criteria for normal operations but in the event of local slumping under extreme conditions, any wet fine reject material and any stored water will move to the next downstream storage. This event would not result in a large volume of water movement as the storage walls are to be built in small lifts and bywashes installed adjacent to structures to minimise stormwater storage. In addition pumping from behind the wall will be a continuous process thereby constantly drawing stored water levels down. Once the storages are full, the fine reject dewatered, capped and rehabilitated, any slumping of the wall and fine reject material movement would only amount to a local flattening of the slope grade between the higher and lower storage. However, a thorough investigation of the material properties involved will be undertaken during detailed design to confirm this provisional prediction. Appendix B - Report on Geotechnical Aspects of Proposed Fine Reject Disposal System (June 1997) provides a detailed consideration of the above material characteristics and likely failure mechanisms.

Failure of storage walls 2, 3, 7 and 9 has the potential to reduce the capacity of adjacent Environmental Dams. This presents a problem if the failure coincides with a significant storm event which results in a discharge to the external environment. Two preliminary possibilities to mitigate the potential for such a discharge are firstly, to raise Environmental Dam walls to allow for additional storage capacity, and secondly to direct `clean' stormwater runoff from rehabilitated areas to adjacent catchments, thereby reducing the overall yield from the catchments. The first option precludes a maintenance requirement.

Saturation of the toe of a fine reject storage wall from filling of a lower storage would be considered and accounted for in the material analysis and design of the structures.

Formal control during construction of the storage walls is recommended, firstly to ensure construction of the design profiles of the wall and secondly to control the volume of coarse reject placed to the wall. An excess of reject material would reduce the volume available for fine reject storage.

5.4 ENVIRONMENTAL DAM - SIZING

The function of the environmental dam is to intercept stormwater runoff from the storage areas, thereby minimising the risk of any potential contamination of the external environment. The extent to which such protection is provided can be considered in terms of the Hazard Rating of the storage ie the resultant effects of dam failure. This issue has been dealt with in more detail by Earthtech Laboratories Report - Proposed Coal Reject Storage Dam (1997) included as Appendix A. Based upon the assessed probable hazard and preliminary advice from the NSW Dams

Safety Committee, the environmental dams have been provisionally designed to store without discharge 50% of Probable Maximum Precipitation (½ PMP) assuming 100% yield from their respective catchments.

It should be noted that although provisional advice from the NSW Dams Safety Committee indicates an environmental dam storage volume requirement of ½ PMP it is likely that this volume would be a `freeboard' rather than a `volume' requirement, ie the ½ PMP volume only takes no account of rainfall yield from the catchment before or after the PMP `event'. There is undoubtedly other rain which will run off to the storage which should be considered in conjunction with the main rainfall event. This rainfall does not effect the spillway sizing as spillways cater for `peak' flows. Simulation of rainfall patterns would be necessary using historic rainfall data should there be a requirement to consider the volume generated by `other' rainfall. More detailed and specific advice will be obtained from the NSW Dams Safety Committee during detailed design to finalise acceptance criteria. NSW Dams Safety Committee are able to provide no clearer advice until further details are officially submitted. Addition of `other' rainfall runoff volumes to the currently sized storage volumes is not expected to significantly raise environmental dam heights.

A spillway/bywash is to be installed in each dam, sized to outlet the calculated peak discharge in the design storm event. The installation of a spillway to control outflows is designed to protect the integrity of the dam structure in an extreme storm event. The presence of a spillway does not therefore indicate a proposed discharge arrangement.

Consideration was given to diverting runoff from `clean' areas to minimise the total inflow to environmental dams. This will be achieved by the construction of suitably sized and graded open drains to capture runoff above the storage areas. It would still however be prudent to size the environmental dams assuming contribution of the whole catchment on the basis that the drains may erode or become blocked over time. It should be noted that the volume of runoff able to be diverted is relatively small and would result in a considerable length of open drain to be constructed and maintained.

5.5 ENVIRONMENTAL DAM - CONSTRUCTION

The environmental dams are proposed to be homogeneous earthfill dams.

Slope profiles will be determined once details of insitu soil properties have been advised and the source materials for construction confirmed.

It is recommended that the environmental dams be constructed by a Registered Quality Assured Contractor to both ensure quality of workmanship and to satisfy probable licensing requirements.

5.6 ENVIRONMENTAL DAM - DECOMMISSIONING

On completion of reject material capping and rehabilitation within the storages two preliminary options exist with regard to decommissioning of the environmental dams.

Firstly the dams may remain as permanent water containment structures providing for stock watering, fauna water source etc. Consideration of final water quality will be necessary, however it is likely to be of suitable quality for the above use even though there will be contaminants present within the soils of the ponded areas. Runoff from the catchment will be uncontaminated post rehabilitation establishment and will significantly dilute any contamination present and released from the soils.

Secondly, should there be a requirement to remove the environmental dams it may be necessary to dismantle the wall from the storage side, thereby covering the contaminated soils with uncontaminated volumes from the existing dam structure.

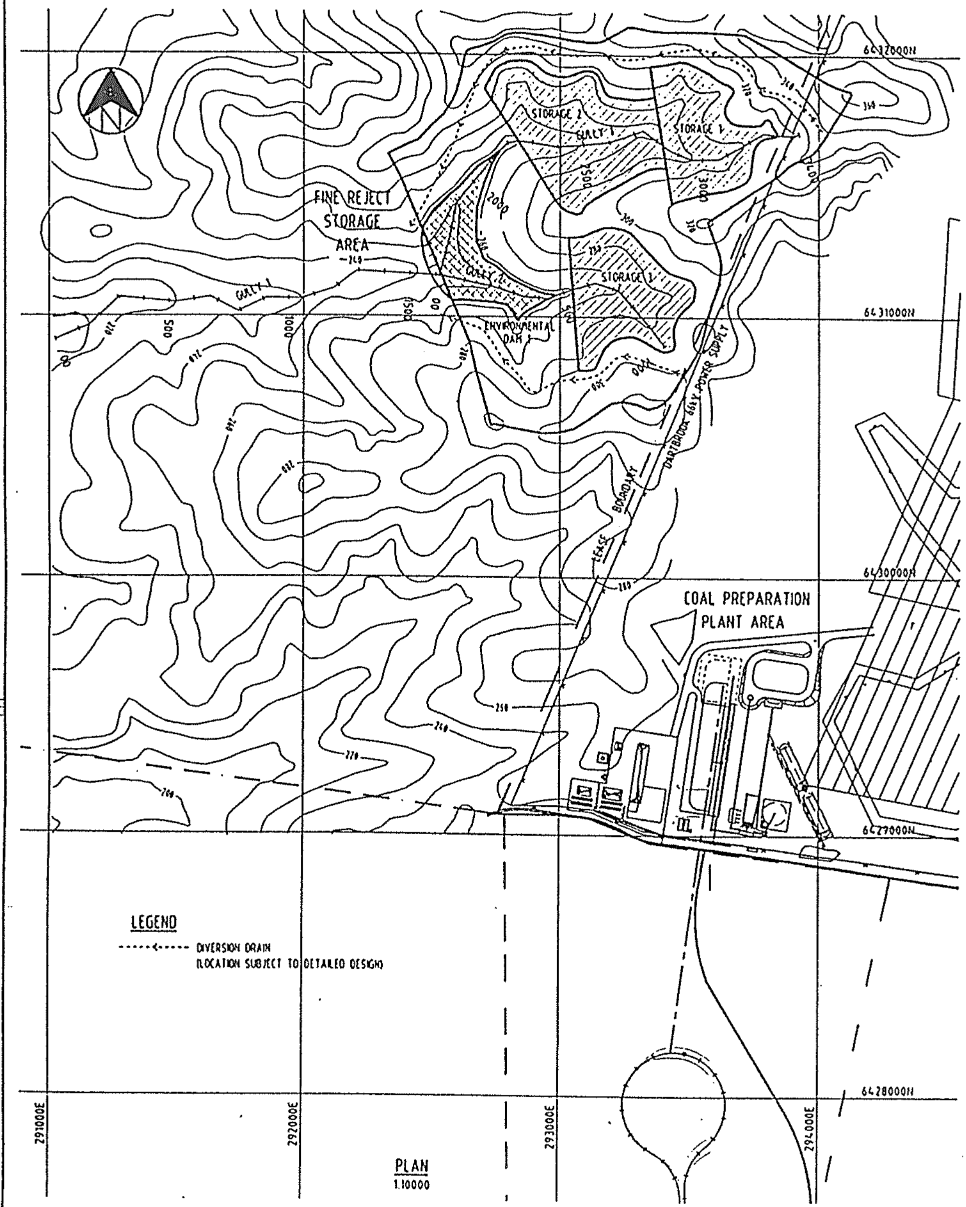
Further consideration in regard to decommissioning requirements and appropriate methodology will be undertaken during detailed planning for mine closure.

6. SITE GEOLOGY AND GROUNDWATER INVESTIGATIONS

A site inspection was undertaken by Earthtech Laboratories on 12 and 13 December 1996. Both proposed sites for permanent fine reject storage were investigated and samples of representative materials removed for analysis. The sampling methodology and results are reported in Appendix A. The report concludes that both sites are suitable for their intended use.

With regard to the potential effects on water quality in groundwater aquifers the above report reviews previous topical reporting and concludes that the potential impacts are low.

7. DRAWINGS



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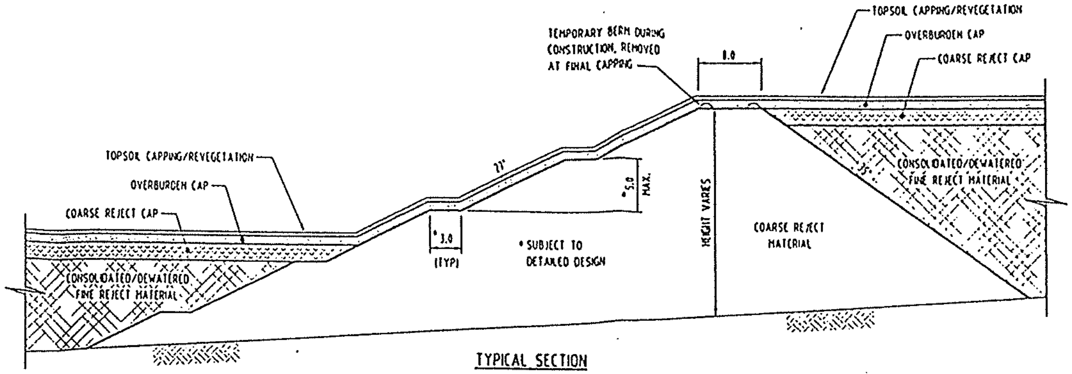
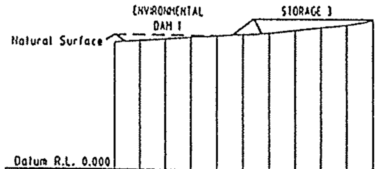


TYPICAL SECTION
STORAGE WALL - FINISHED PROFILE
N.T.S.



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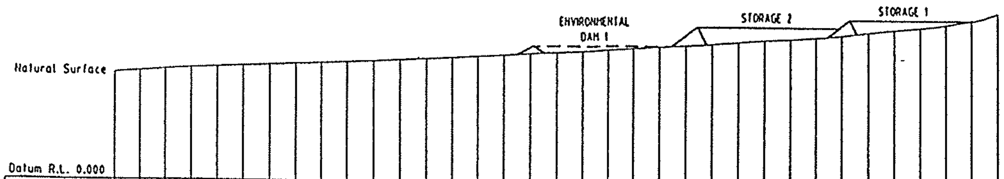

Natural Surface	205.000	208.455	211.740	214.887	217.147	219.373	221.571	223.557	225.205	227.217	229.053	231.102
Chainage	0.000	100.000	200.000	300.000	400.000	500.000	600.000	700.000	800.000	900.000	1000.000	1100.000

Natural Surface	233.328	235.177	237.296	239.416	242.533	244.979	247.467	250.135	253.111	256.086	259.034	262.228
Chainage	1200.000	1300.000	1400.000	1500.000	1600.000	1700.000	1800.000	1900.000	2000.000	2100.000	2200.000	2300.000

Natural Surface	266.192	270.361	273.055	276.338	280.408	286.819	292.103	296.659	302.096	309.210	323.546
Chainage	2400.000	2500.000	2600.000	2700.000	2800.000	2900.000	3000.000	3100.000	3200.000	3300.000	3400.000

GULLY 1
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VER. 1:5000

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B	ISSUED FOR REPORT PURPOSES	A.F.			J.C.T.	5/97
A	ORIGINAL ISSUE	A.F.			J.C.T.	5/97

DRAWING No. | REFERENCE DRAWINGS

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DRG. CHECKED		
DESIGNED		
ENG. CHECKED		
APPROVED		
CLIENT		
JOB No.	HQ0112.600	

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CMPS&F Pty Limited
56 Boyle St BRISBANE QLD 4000

DRAWING No. HQ0112-C02 REV C
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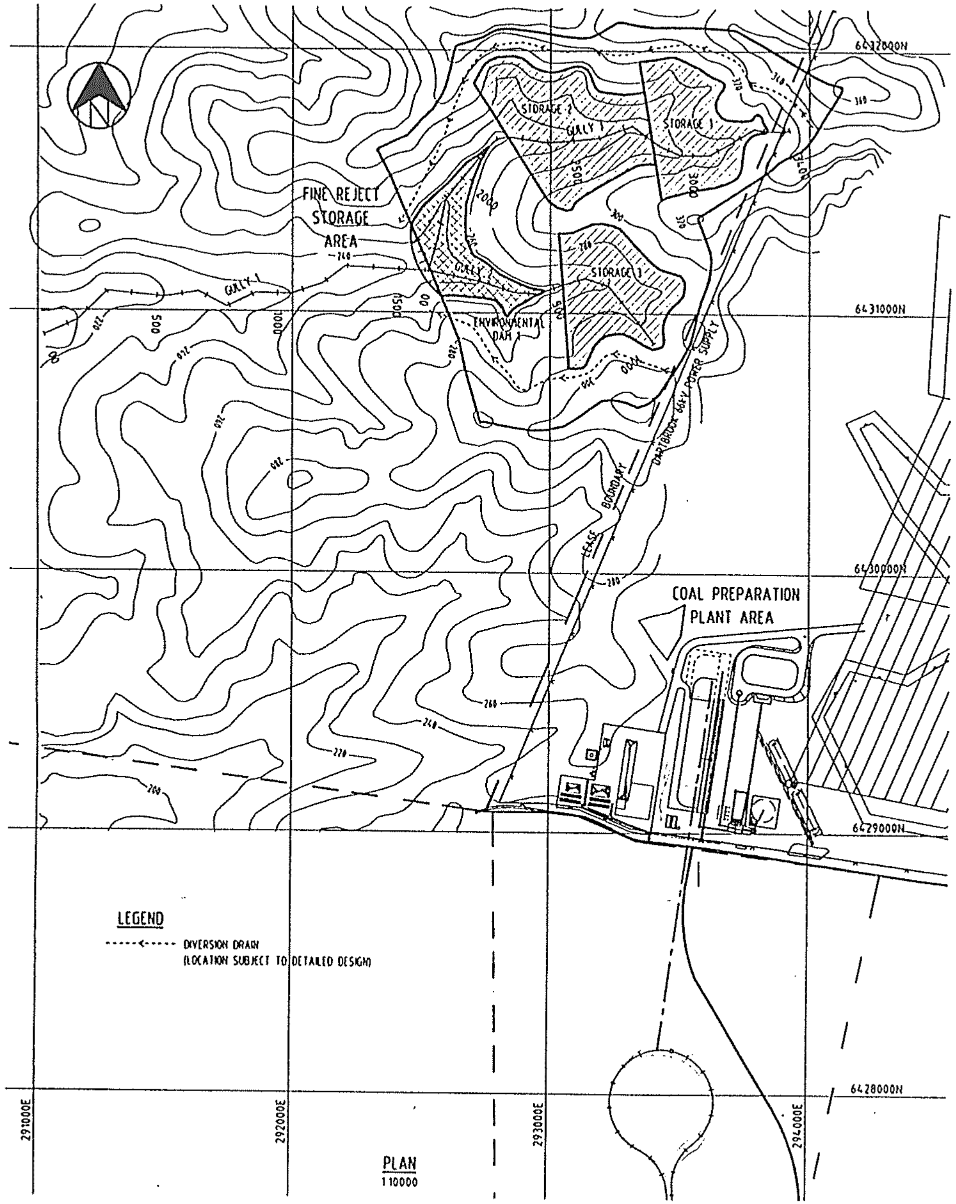

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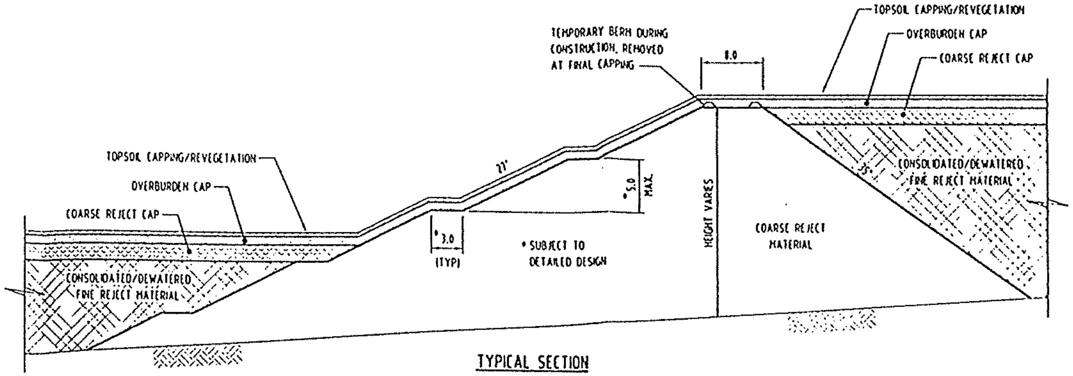

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STORAGE WALL - FINISHED PROFILE
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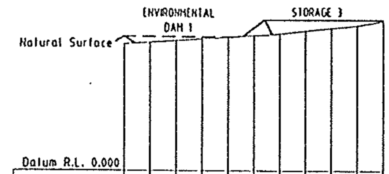

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500.000	260.000
600.000	263.561
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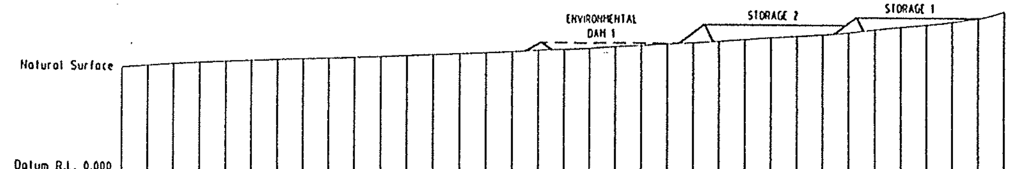

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500.000	219.373
600.000	221.571
700.000	223.557
800.000	225.205
900.000	227.217
1000.000	229.053
1100.000	231.102
1200.000	233.328
1300.000	235.177
1400.000	237.296
1500.000	239.414
1600.000	242.533
1700.000	244.979
1800.000	247.467
1900.000	250.135
2000.000	253.111
2100.000	256.086
2200.000	259.034
2300.000	262.228
2400.000	266.192
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2600.000	273.055
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PRELIMINARY ONLY

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A	ORIGINAL ISSUE	A.F.			J.E.T.	5/97

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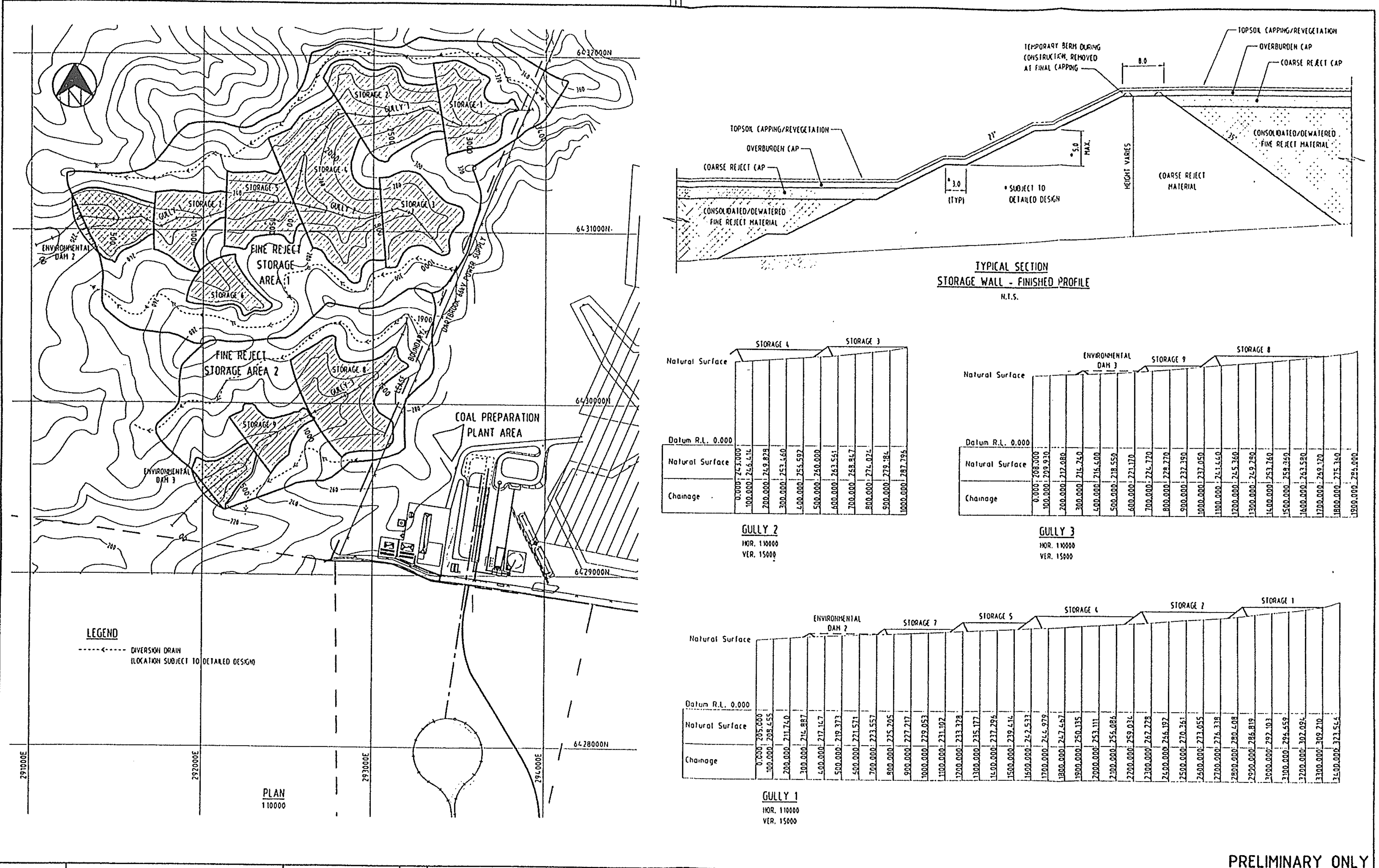

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E	TITLE BLOCK REVISED	A.F.			J.E.T.	5/97
D	ISSUED FOR REPORT PURPOSES	A.F.	S.I.		J.E.T.	2/97
C	GENERAL REVISIONS	A.F.				
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G	ENVIRONMENTAL DAMS RENUMBERED	A.F.				

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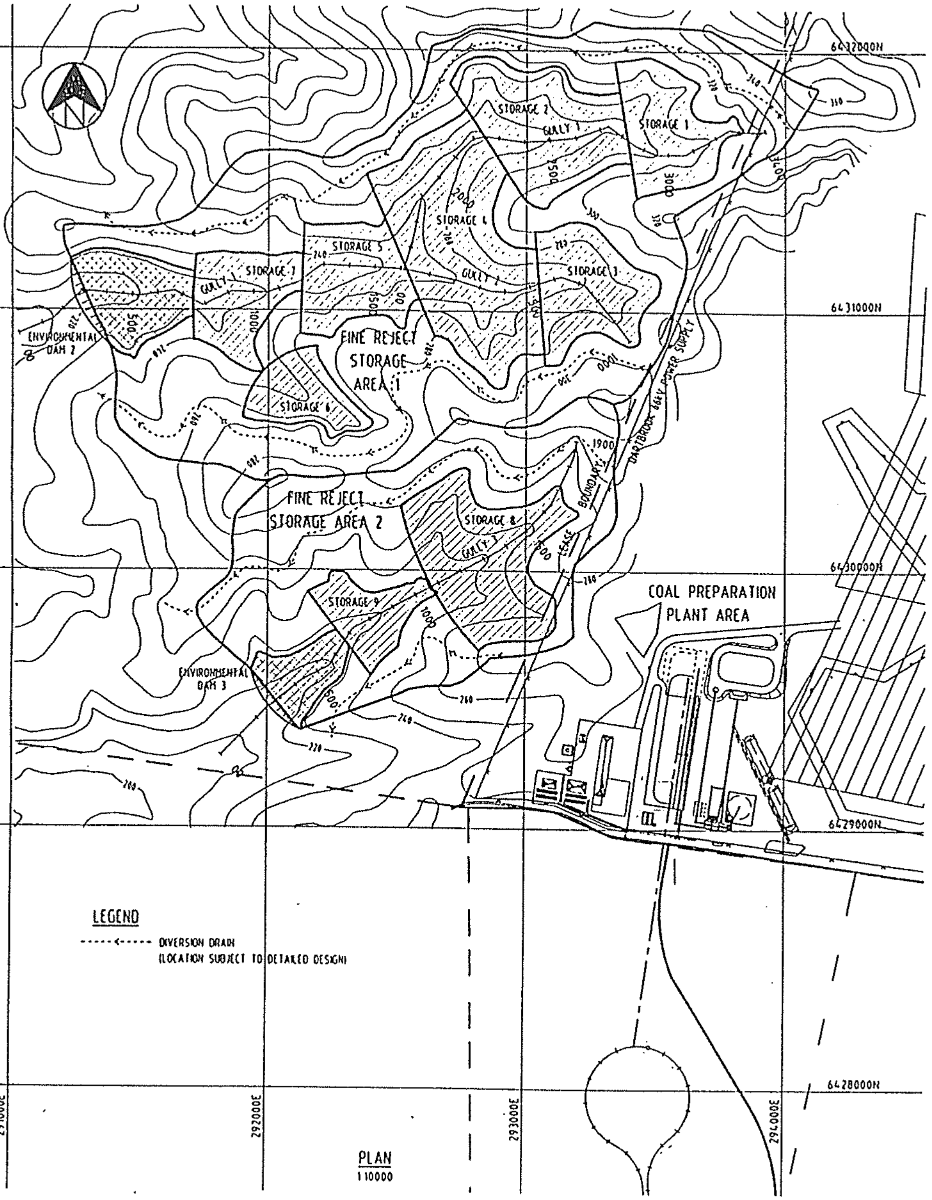

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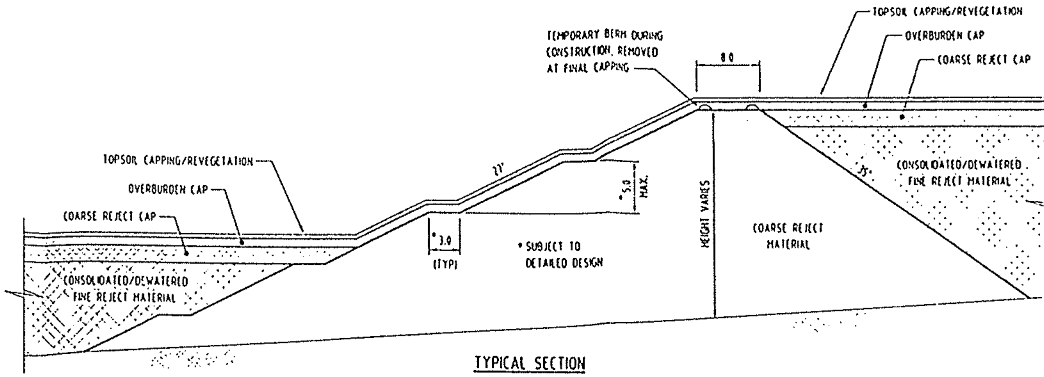

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STORAGE WALL - FINISHED PROFILE
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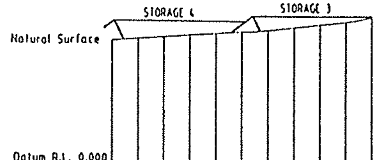

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Natural Surface	243.000	246.414	249.828	253.460	256.597	260.000	263.561	268.847	274.074	279.184	287.796
Chainage	0.000	100.000	200.000	300.000	400.000	500.000	600.000	700.000	800.000	900.000	1000.000

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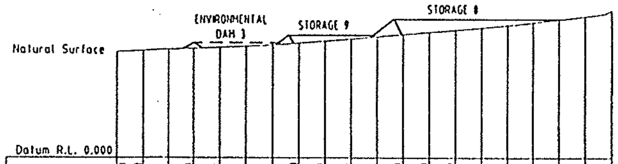

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Chainage	0.000	100.000	200.000	300.000	400.000	500.000	600.000	700.000	800.000	900.000	1000.000	1100.000	1200.000	1300.000	1400.000	1500.000	1600.000	1700.000	1800.000	1900.000

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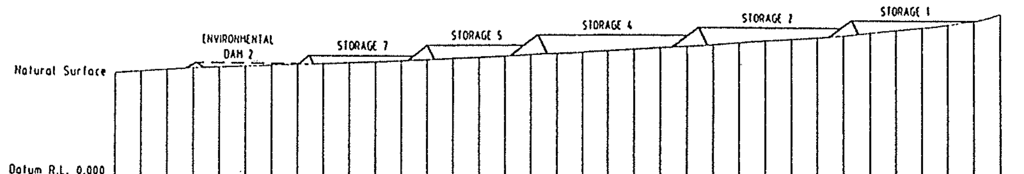

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Chainage	0.000	100.000	200.000	300.000	400.000	500.000	600.000	700.000	800.000	900.000	1000.000	1100.000	1200.000	1300.000	1400.000	1500.000	1600.000	1700.000

Datum R.L. 0.000																	
Natural Surface	247.467	250.135	253.111	256.086	259.034	262.228	266.192	270.361	273.055	276.338	280.408	286.819	292.103	296.459	302.094	309.210	323.546
Chainage	1800.000	1900.000	2000.000	2100.000	2200.000	2300.000	2400.000	2500.000	2600.000	2700.000	2800.000	2900.000	3000.000	3100.000	3200.000	3300.000	3400.000

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D	ISSUED FOR REPORT PURPOSES	A.F.	S.L.		J.E.T.	2/97
C	GENERAL REVISIONS	A.F.				
B	GENERAL REVISIONS	A.F.				
G	ENVIRONMENTAL DAMS RENUMBERED	A.F.			[illegible]	[illegible]

DRAWING No. | REFERENCE DRAWINGS

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ENG. CHECKED		
APPROVED		
CLIENT		
JOB No.	MQ0112.000	

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FINE REJECT STORAGE - TO YEAR 25
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DRAWING No. MQ0112-C01 REV G
CAD FILE No. MQ0112.[illegible]

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COAL & ALLIED

COAL FINE REJECT STORAGE FACILITY

APPENDIX A

EARTHTECH LABORATORIES REPORT - MT PLEASANT COAL MINE DEVELOPMENT - PROPOSED COAL REJECT STORAGE DAM (1997)

Vimbury Pty Ltd A.C.N. 010 826 561
EARTHTECH LABORATORIES
Geotechnical and Environmental Engineering
Soils and Engineering Materials Testing

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P.O. Box 2034 Mansfield DC Qld 4122
Phone: (07) 3343 3166 Fax: (07) 3849 4705
Email: earthtec@powerup.com.au
Website: http://www.powerup.com.au/~earthtec

C.M.P.S. & F.

MT PLEASANT COAL MINE DEVELOPMENT

PROPOSED COAL REJECT STORAGE DAM

June, 1997

Job N° MF-0480

Table of Contents

1.0 INTRODUCTION

Coal and Allied Operations Pty Ltd have commissioned a number of studies as part of a assessment of the feasibility of mining coal resources within Authorisation N° A459 located some 3km to the west of Muswellbrook in the Upper Hunter Valley.

E.R.M. Mitchell McCotter are currently undertaking an Environmental Impact Assessment for the project; Rust P.P.K. have undertaken a Water Management Study for the project; Veness & Associates Pty Ltd have undertaken a Soil/Land Capability Survey; C.M.P.S. & F. are undertaking an assessment of mine infrastructure requirements.

As part of mine infrastructure one option identified for the handling of coal rejects (principally from the Coal Preparation Plant - C.P.P.) is disposal in a reject storage dam(s).

Earthtech Laboratories was retained by C.M.P.S. & F. to assist (by providing geotechnical input) in a review of this coal reject disposal option with the initial aim of ensuring that this option was included in the Environmental Impact Assessment documentation.

In undertaking this study access has been obtained to the following documentation:

- Mt Pleasant Water Management Studies
  Second Draft Report (May 1997 Rev. C) by Rust P.P.K.
- Land Capability & Soil Survey Report
  Mount Pleasant Project (Report No. VA 132A/02) by Veness & Associates.
- Relevant Publications of the New South Wales Dam Safety Committee.
  A list of references is included at the end of this report.

In addition to review of the relevant documentation, a site visit was made and preliminary site characterisation undertaken including:

- backhoe pit excavation and logging and sampling;
- some laboratory testing of samples to determine soil classification and allow engineering properties of foundation and potential construction materials to be inferred.

The aim of this preliminary site work was to confirm conclusions drawn in the desk top study in regard to:

- appropriateness of the selected reject storage dam site;
- identification of any potential constraints in terms of its design and construction;
- provision of input to the Environmental Impact Assessment with particular regard to potential impacts on ground and surface waters; requirements for progressive rehabilitation etc.

The reject disposal concept and proposed layout were discussed with Mr P Reid of the N.S.W. Dams Safety Committee, and informal response to the proposal by Mr Reid was incorporated in minor revisions to the proposal.

2.0 LEGISLATIVE FRAMEWORK

The Department of Mineral Resources (D.M.R.) takes a lead agency role at the development stage and through the Mining Rehabilitation and Environmental Management Process, maintains this position once a mine is in operation.

In addition to D.M.R. other agencies of the N.S.W. Government have significant input at all stages of mining including development approval mine operations and rehabilitation. D.M.R. plays a key role in coordinating the approval process for new mining projects through Planning Focus which introduces the proposed project to the relevant government agencies involved in the approval process and alerts the developer to specific government concerns and requirements.

Other key N.S.W. Government agencies include:

- N.S.W. Department of Urban Affairs and Planning (D.U.A.P.) which is responsible for administering the states environmental planning system. The Department also administers the environmental impact assessment process for major developments.

- N.S.W. Department of Land and Water Conservation (D.L.W.C.) has a statutory role in the approvals process for mining operations including granting of concurrence for approvals and establishing environmental conditions of approval. Such conditions normally relate to environmental protection, primarily in relation to land, soil and water issues. Conditions would generally include a requirement for an erosion and sediment control plan, a water management plan and a site rehabilitation plan all of which could be incorporated into the Mining Rehabilitation and Environment Management Process (M.R.E.M.P.).

– N.S.W. Environmental Protection Authority (E.P.A.). The legislation that the E.P.A. administers which has implications for the mining industry includes the Clean Air Act, Clean Waters Act, Noise Control Act, Pollution Control Act and Environmental Offences and Penalties Act.

The E.P.A.'s role in relation to new or changed mining operations involves assessing the environmental implications of the work and attaching requirements to control potential pollution. Before mining can start the company must obtain a Pollution Control Licence and usually an approval for construction of pollution control works. The E.P.A. applies a range of licence conditions which include quality of waste water which may be discharged.

The conditions of these licences specify two limits:

(I) a limit a maximum allowable level of conductivity in the river after discharge.

(II) a limit on the maximum allowable increase in conductivity caused by the discharge.

The NSW EPA has recently introduced the Hunter River Salinity Trading Scheme which seeks to reduce salinity levels in the Hunter River and thereby improve the quality of irrigation water, particularly during periods of low flow.

The scheme introduces two major changes to the licensing of sources:

- sources will generally be allowed to discharge at times when flows in the river are relatively high and demands by, and impacts on, the other users are relatively low.

- sources will be able to transfer discharge entitlements among themselves subject to certain conditions to ensure environmental quality is not impaired.

Central to the new scheme is a system of calculation of salinity levels that are acceptable under different flow conditions. The total salt load allowed to go into the river is set to keep the river salt loads under 900 EC.

Equally important is the development of a scheme for allocating and trading credits which it is proposed should be undertaken in consultation with the stockholders.

A performance rating which is derived from a combination of each source's environmental performance score and its contribution to the economy, will be used as the basis of allocation of a number of credits. Sources that have implemented measures to store, control and monitor the discharge of saline water will receive the highest proportion of credits. Where a mine has invested in measures designed to achieve a 'nil discharge' operation, such expenditure will be rewarded in the allocation of credits.

Clearly this scheme has the potential to impact on the strategy for management of the coal washery reject material at Mt Pleasant.

Licensing will be dealt with from 1996 onwards under a new load based licensing (L.B.L.) system which directly links the cost of pollution control licence fees with the amount of pollution discharged. Each licence will include an absolute maximum limit allowable for each type of pollutant discharged. Beneath the limit the licensee chooses a level of emission. The licence fee will be based on the actual emission. Licence fees will be based on the relative harmfulness of the pollutants, the state of the environment affected by the discharge and in some cases the manner of the discharge. Coal Mine water pollutants include suspended solids and salts.

E.P.A. has introduced Pollution Reduction Programs (P.R.P's) which may be attached as a condition of the operating licence of any industry. A P.R.P. may define capital works, new pollution control equipment, process changes, site rehabilitation or other measures to address environmental problems. (The E.P.A. recently attached a P.R.P. to the licence of the Ulan Coal Mine in the Upper Hunter Valley).

- N.S.W. Dams Safety Committee has statutory functions under the Dams Safety Act 1978 and the Mining Act 1992. It's main objective is to ensure that all prescribed dams are in such a condition as not to pose an unacceptable danger to downstream residents and property, or adversely to affect public welfare or the environment. (A dam is prescribed under the Act by recommended action of the Committee, based on the size and hazard rating of the dam).

Table 1

PRESCRIBED DAMS & SURVEILLANCE REQUIREMENTS			
	Hazard Rating		
Size	High	Significant	Low
>15m High	Prescribed Type 1 Report	Prescribe Type 2 Report	Prescribe Type 3 Report
<15m high	Prescribe Type 2 Report	Prescribe Type 3 Report	Do not prescribe

3.0 PROPOSED LOCATION AND SIZE OF DAM

3.1 Proposed Disposal Method

Based on advice from C.M.P.S. & F., the estimated retention volume required to be available for proposed mine production rate (1,200,000 tonnes per year) for the life of the mine (25 years) was approximately 22,650,000m³.

The proposed location of the fine reject storage area is in two valleys dissecting undulating low hills on land acquired by Coal and Allied adjacent to the western edge of Authorisation A459 (See Drawings MQ0112-C01 and CO2).

Rust PPK (Reference 2) point out that development of the fine rejects area to the west of Mt Pleasant will result in loss of catchment runoff over the mine life. To minimise potential adverse effects on downstream water users, staged development of the reject storages is proposed, with progressive rehabilitation of completed storages.

The proposed method of disposal envisages the construction of a series of retention structures for fine reject material commencing near the heads of two valleys and stepping down the valleys progressively, with a water retaining structure (environmental dam) at the lower end of the series.

Emplacement in the more northerly of these two catchment will be undertaken in two stages. The first stage will include construction of retention structures 1, 2 and 3 with an environmental dam (Environmental Dam N° 1) located at the site of retention structure 4. This arrangement aims to minimize the loss of runoff from the northern catchment (and thus the potential impacts on downstream water users) during the early stages of mine operations. It is anticipated that Stage 1 development in the northern catchment would provide adequate storage for fine rejects for the first 9 years of operations.

For years 10 to 21 of operations the remainder of the northern catchment fine reject storage will be developed with the construction of Environmental Dam N° 2 and successive development of retention structures 4, 5, 6 and 7.

A similar approach to fine reject storage in the southern catchment will be adopted if required beyond year 21 with construction of Environmental Dam N° 3 and successive construction of retention structures 8 and 9.

Successive rehabilitation of completed reject storages will be undertaken to minimise environmental impact and impact on downstream runoff flows.

Environmental Dam N° 1 is planned to be approximately 13.5m in height with a storage of 520ML approximately.

Environmental Dam N° 2 is planned to be approximately 18.5m in height with a storage of approximately 960ML. Environmental Dam N° 3 is planned to be approximately 13.5m in height with a storage of approximately 370ML. All structures will be designed as zero release structures based on the half Probable Maximum Precipitation (PMP) storm event. Water from the storages is proposed to be recycled through the Coal Preparation Plant to reduce mine raw water requirements and therefore it is not considered likely that water storage volumes will be maintained at or close to the mandatory reporting level for significant lengths of time.

Operation of the disposal system envisages fine rejects being pumped as a thickened slurry (at approximately 40% solids) to a discharge point within the storage area of the retaining structures. The fine rejects will contain a proportion of sand sized particles to assist in promoting dewatering. Discharge velocity will be kept low (<1m/sec) to promote development of beaching and minimise segregation. Seepage will be promoted through retaining structures. Recovery of decant water for recycling to the Coal Preparation Plant will occur in each of the retaining structures and from the environmental dam at the downstream end of the system.

Results of geochemical testing typical for tailings and reject from other areas in the Hunter Valley are referred to in Reference 14. The results indicate:

- the bulk of washery reject and tailing are likely to meet typical environmental investigation criteria for total element composition
- the contained metals are unlikely to be a concern
- reject from the Wynn seam will most likely contain concentrations towards the upper end of the expected range
- care should be exercised in placement of Wynn seam reject to ensure it is not placed near the final surface of storage dams.

The fine reject retention structures will be constructed progressively from coarse reject material, compacted to provide adequate strength and stability. Design of the fine reject retaining structures will be such as to promote maximum seepage of super natant liquid while maintaining adequate factors of safety with respect to stability of the structures. The preferred method for seepage control is to limit compaction of coarse rejects which will be used in construction of the retaining structures. Actual levels of compaction required to optimise the stability and seepage requirements will be assessed at the time of final design. Coarse rejects material is a relatively strong material and experience elsewhere would indicate that it is likely to behave essentially as rockfill. If at design stage, it becomes evident that simultaneous satisfaction of stability and seepage promotion criteria is not achievable, the option of introduction of a filter zone or zones of single size stone gravel size material through the embankment will be evaluated.

Drawing MQ0112-C01 and CO2 show the proposed layout in plan and longitudinal section. Protection against any adverse event which results in flow of reject material downstream of any of the proposed fine rejects retention structures will be afforded by the environmental dam.

The combined storage for fine reject material available based on final development shown on Drawing MQ0112-C01 has been determined to be capable of retaining approximately 22 million cubic metres of fine rejects. This is very close to the total quantity of fine rejects generated in the 25 year life of the mine.

One of the advantages of the proposed disposal method, is that it allows for progressive rehabilitation to be undertaken, thus limiting the amount of exposure of fine rejects at any given time.

3.2 Site Description

According to the Soil Conservation Service of N.S.W. publication "Soil Land-scapes of the Singleton" 1 : 250 000 Sheet, the proposed sites for reject disposal are located in the Roxburgh Soil Landscape.

The following excerpts from this publication describe the physical characteristics of the site.

3.2.1 Topography

The topography is characterised as "undulating low hills and undulating hills with elevations of 80 to 370m. Slopes are 0 to 10%, with slope lengths of 800 to 1200m. Local relief is 60 to 120m. Drainage lines occur at intervals of 300 to 1500m".

3.2.2 Geology

The geology unit in which the sites are located is Singleton Coal Measures. The Parent Rock at the sites consists of Sandstone, shale, mudstone conglomerate and coal. Parent material consists of Insitu weathered parent rock and derived colluvium.

3.2.3 Native Vegetation

Vegetation occurring naturally at the sites consists essentially of an open woodland of narrow-leaved red ironbark, white box and yellow box with some blakely's red gum, broad leaved ironbark grey gum and grey box. Extensive clearing for grazing has occurred.

3.2.4 Soil Erosion

Minor to moderate erosion is common. Some gullies up to 3m deep are associated with dispersible soils.

3.2.5 Soils

Soils overlying bedrock generally consist of "Yellow Podzolic soils on the more rounded hills. Brown Podzolic Soils occur on slopes on conglomerate. Yellow Soloths have been recorded in some gullies".

Permeability of the insitu soils ranges from low to moderate and erodibility is classed as moderate.

3.2.6 Land Capability

According to Kovac & Lawrie (Reference 1) the land capability classification is V ie. "Land that is suitable for grazing and occasional cultivation Intensive soil conservation measures (for grassland) are required".

3.2.7 Hydrogeology

Rust PPK in Reference 2, describes the hydrogeology of the proposed mine area authorisation A459.

"The regional hydrogeology can be broadly classified in terms of two distinct regimes; the consolidated hard rocks of mostly Permian Age (230 to 280 million years) and the unconsolidated alluvium of Quaternary to Recent Age (less than 1.8 million years). The hardrock regimes may in turn be sub-classified as either the very shallow weathered hard rock aquifer (exposed to rainfall recharge) or the deeper coal measures.

The coal seams are recognised as the main aquifer zones within the coal measures providing storage and transmission within cleats and joints. Groundwater is also stored and transmitted within the interburden zones comprising sandstones and siltstones. However low permeabilities and porosities generally ensure extremely low rates of transmission. Indeed, the interburden zones more often act as aquicludes, effectively impeding or isolating vertical exchange of groundwaters".

It should be noted that the proposed sites for reject disposal, located as they are at elevations in the range RL 220 to RL 260 are well above the Quaternary to Recent alluvium comprising most of the flood plain area.

4.0 SITE INSPECTION

The site was inspected by Mr M Marley, Principal Geotechnical Engineer with Earthtech Laboratories on 12 & 13th December 1996. Two dam sites, designated Site 1 and Site 2 at the time, were inspected and a preliminary investigation programme undertaken involving excavation of a number of exploration backhoe pits at the two sites. The locations of backhoe pits are shown on Drawings N° MF0480-1 and MF0480-2.
It should be noted that Site 1 corresponds to Environmental Dam N° 2 and Site 2 corresponds to Environmental Dam N° 3. No investigation was undertaken at Environmental Dam N° 1.

Logs of backhoe pits are appended at Appendix 1. Representative samples of the main strata encountered in the excavations were subjected to laboratory testing to establish soil classification according to the Unified Soil Classification System and dispersion characteristics.

Results of laboratory tests are summarised in Table 2.

Detailed results are provided in Appendix 2

A number of disturbed samples of near-surface soils recovered during exploration drilling undertaken by Coal and Allied in the Area of Authorisation A459 were selected for laboratory visual classification. Samples representative of the upper 6m to 7m at Boreholes 3000/B250, 3000/B750 and 3000/C250 were selected. Drawing N° MF0480-4 shows locations of the exploration boreholes samples. Drawing N° MF0480-3 is a general locality plan for Drawing N° MF0480-4.

4.1 Site Characterisation

4.1.1 Environmental Dam Site 2

The site is located in a wide relatively flat sloping valley. A relatively narrow stream is incised 2 to 3m into a lower terrace of silty and sandy clay soils of medium plasticity. There was no flow at the time of inspection but evidence of seepage from the interface between soil and sandstone, and a series of waterholes was present downstream of the site. Backhoe refusal was encountered in the lower terrace area at 2m in distinctly weathered sandstone. Inspection of the steep stream banks indicated a layer of large (up to 1.5m) flat sandstone boulders immediately overlying insitu distinctly weathered sandstone.

On the left abutment sandy clay soil of low plasticity extended to depths of 0.5 to 0.6m where backhoe refusal occurred in moderately weathered sandstone.

On the right abutment, (which at the site was significantly steeper than the left), up to about 1.5m of brown high plasticity clay soil overlies distinctly weathered sandstone material. Backhoe refusal was at 1.8m in distinctly to moderately weathered sandstone.

4.1.2 Environmental Dam Site 3

The site is located in a rather narrower flat vee-shaped valley than that for Environmental Dam 2 but similar in most respects to this site. A relatively narrow shallow stream course was evident at the base of the valley with some erosion creating an incised stream channel just downstream of the site.

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EARTHTECH LABORATORIES

Soils and Engineering Materials Testing

Client : CMPS & F
Project : Mt. Pleasant Reject Dam

Table 2

Job No. : MF-0480

SUMMARY OF TEST RESULTS

Reg'n Number	Location *	Description	Percent Passing (mm)									Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Linear Shrinkage (%)	Insitu Moisture Content (%)	Emerson Class Number
			9.5	4.75	2.36	1.18	0.600	0.425	0.300	0.150	0.075						
M1865/96	Site 1 BHP 4 (0.4 - 0.9m)	Sandy CLAY (CI) dark brown & grey fine to coarse sand		100	99	98	96	94	89	71	56	37	14	23	11	16.3	2
M1866/96	Site 1 BHP 4 (0.9 - 2.0m)	Sandy CLAY (CI) light brown fine to coarse sand some fine gravel	100	97	94	92	90	88	85	72	64	41	15	26	12.5		
M1867/96	Site 1 BHP 5 (0.2 - 0.6m)	Clayey SAND (SC) fine to coarse sand medium plasticity reddish brown			100	99	97	95	91	59	47	36	15	21	10.5		
M1868/96	Site 1 BHP 7 (0.5 - 1.4m)	Sandy CLAY (CH) fine to coarse sand brown		100	99	98	97	97	96	92	86	71	22	49	21		4
M1869/96	Site 2 BHP 1 (0.15 - 2.4m)	Sandy CLAY (CI) fine to coarse sand dark brown & grey	100	99	97	95	93	92	90	78	66	44	16	28	14	11.6	4
M1870/96	Site 2 BHP 2 (0.1 - 0.8m)	CLAY (CH) reddish brown				100	99	99	98	95	91	63	20	43	18.5		
M1871/96	Site 2 BHP 2 (0.8 - 1.4m)	Sandy CLAY (CH) light brown fine to coarse sand	100	99	92	91	89	88	88	87	85	58	21	37	16		4
M1872/96	Site 2 BHP 2 (1.4 - 2.5m)	CLAY (CH) light brown	100	97	92	91	91	91	91	91	90	68	23	45	18	16.4	
M1873/96	Site 2 BHP 3 (0.2 - 0.7m)	CLAY (CH) reddish brown			100	99	99	98	97	89	81	55	20	35	17.5	16.8	
M1874/96	Site 2 BHP 3 (0.7 - 1.4m)	CLAY (CI) brown		100	99	98	95	95	94	88	78	49	16	33	15	10.0	

* Note : Site 1 corresponds to Environmental Dam No. 2
Site 2 corresponds to Environmental Dam No. 3

Prepared by NF

Checked by HP

Materials overlying bedrock in the low level terrace consisted of sandy clay soils of medium plasticity. Backhoe refusal occurred at 2.4m in the excavation sited on the low level terrace adjacent to the shallow stream channel. In both the backhoe pit and the erosion channel downstream rounded slightly weathered sandstone cobbles and small boulders (to 300mm) were encountered immediately overlying the insitu distinctly to moderately weathered sandstone bedrock.

On the left abutment red-brown and yellow clay soils of high plasticity occurred to 1.4m with distinctly weathered sandstone below 1.4m. Backhoe refusal occurred in distinctly to moderately weathered sandstone at 2.2m.

On the right abutment dark-brown, yellow-brown, and grey and yellow-brown mottled clay soils occurred to a depth of 2.5m. Backhoe refusal occurred at 2.5m in distinctly weathered sandstone.

4.2 Preliminary Assessment of Dam Sites

4.2.1 Environmental Site 2

Site 1 (Environmental Dam N° 2) is considered to be a suitable location for construction of a water retaining embankment dam. Excavation to a satisfactory founding material (moderately to slightly weathered sandstone) is likely to range from about 0.5m to 2.5m in depth. It is expected that the upper levels of weathered sandstone should be readily machine excavated and cleaned to a satisfactory surface to allow compacted clay materials to seal adequately against foundation rock. No indication was obtained as to the frequency extent or orientation of jointing within the sandstone bedrock. More comprehensive investigation at the design stage would be required to establish these bedrock characteristics.

However, the sedimentary sequences of the Singleton Coal measures are understood to be relatively flat lying with a low angle dip generally to the west. This and the general description by Rust PPK of the characteristics of the interburden and overburden sedimentary rocks, would tend to indicate relatively low vertical permeability for the foundation bedrock. Joints, if oriented up and downstream, may provide preferred seepage paths through bedrock below the dam cutoff. However, it is not expected that this would be of significance in terms of the integrity of the dam. It is possible that minor impacts on downstream areas may occur in terms of elevation of salt levels in the stream channel in the event that jointing in bedrock at the site provides preferential seepage paths.

Similarly, it is not envisaged that there will be any significant impact on local ground water aquifers, based on the information available to date.

It is emphasised that in the event that design stage investigation reveals that seepage either vertically or horizontally through underlying sedimentary rocks could provide potentially unacceptable movement of saline waters, design of adequate preventive measures (which might include compacted clay blankets over part of the proposed storage/ponded areas) can be undertaken at that stage of development.

The proposed method of disposal lends itself to progressive rehabilitation of the reject storage areas. Depending on the rate of drainage of the hydraulically placed tailings material and the particle size distribution of tailings, experience elsewhere in the Hunter Valley would suggest that it should be possible to commence placement of cover material within 2 to 3 months of placement of tailings. As discussed elsewhere it is proposed that tailings structures be constructed of coarse reject and designed to allow seepage downstream of super natant liquid with retention of the saline liquid by an environmental dam at the lower end of the Valley.

4.2.2 Environmental Dam Site 3

Site 2 (Environmental Dam N° 3) is similar in most respects to Site 1 and the comments contained in Section 4.2.1 can be applied also to this site.

5.0 DEVELOPMENT OF HAZARD RATING

5.1 Background

The N.S.W. Dams Safety Committee document DSC 13 "Hazard Ratings for Dams" states:

> "The term "Hazard" in relation to dams refers to the potential for adverse consequences in the event of dam failure. In this context failure is taken to mean any occurrence which results in an uncontrolled loss of storage from the dam. A dam is given a "hazard rating" according to the seriousness and magnitude of the adverse consequences that could be expected to result from, and be directly attributed to, dam failure. In assigning a hazard rating no account is taken of the likelihood of dam failure (i.e. risk)".

Two types of dam failure are recognised for the purposes of hazard rating:

- failures that occur without attendant flooding
- failures that occur in association with a natural flood.

A two-step process is used to assign a hazard rating.

A primary assessment is made on the basis of loss of life consequences only. This sets the minimum level of hazard rating. A secondary assessment is then made on the basis of consequences other than loss of life in order to establish whether the minimum level of hazard rating determined from the primary assessment should be upgraded.

A preliminary assignment of hazard rating for the proposed environmental dam is presented below based on data available or inferred at the time of preparation of this report. The process by which a hazard rating is assigned inevitably involves the exercise of judgement and the Dams Safety Committee publication DSC 13 acknowledges "it is not practicable to set hard and fast rules".

Tables from DSC 13 that summarise the consequences that would justify the various hazard rating are provided below:

HAZARD RATING SUMMARY TABLE
PRIMARY ASSESSMENT

Primary Assessment of either Sunny Day Hazard Rating or Incremental Flood Hazard Category (based on loss of life consequences only - sets the minimum rating).

HIGH	SIGNIFICANT	LOW
Loss of identifiable life, or the loss of more than a few, say 10 non-identifiable lives, would be expected	Loss of identifiable life is not expected, but the possibility is recognised, or the loss of less than, say 10 non-identifiable lives could be expected.	No possibility for loss of identifiable life is foreseen. Any possibility for loss of non-identifiable life would be limited to less than say, 10 persons. At the higher end of the scale (say 7 to 9 lives) a very low probability of such persons being within the dam break inundation area would be a condition for this rating level.

HAZARD RATING SUMMARY TABLE
SECONDARY ASSESSMENT

Secondary Assessment of either Sunny Day Hazard or Incremental Flood Hazard Category (based on factors other than loss of life - can only raise the primary rating - many combinations possible - effects tabulated are examples only to guide decisions on hazard rating).

HIGH (on its own)	SIGNIFICANT (on its own)	LOW
Widespread devastation of an urban area involving severe economic losses or damage to or destruction of many homes, factories and commercial premises.	Appreciable economic loss such as damage to highways, railways and relatively important utilities.	Minimal economic losses.
Financial impacts result in hardship to the community to the point that a significant proportion are unable to pay.	Loss of reserve storage without immediate loss of water or power supply where storage can be restored within a relatively short time, relative to critical drought duration.	Minimal effects on water supply or power supply.
Immediate severe reduction in water supply or power supply to a large community without alternative means of making good the shortfall within a short time frame.	Any escape of toxic / contaminated materials beyond the immediate site that poses only a minor health risk.	Minimal impacts on the environment.
Serious health risk due to a loss of water supply, or release of toxic/contaminated waters.	Limited and temporary environmental damage.	
Widespread major environmental damage that is permanent or would persist for a long time.		

5.2 Assessment of Hazard Rating

Preliminary review of the 1 : 250,000 topographic mapping Sheets covering the area indicates that there are no residential homesteads located in positions relative to the creek which would place them in the path of a flood wave resulting from a possible dam break. The nearest public road which would possibly be affected by such a flood wave is the Roxburgh Road which crosses Sandy Creek some 4 to 5 km downstream of the proposed site. There is one private access road to a shearing shed shown crossing the creek approximately half way between the site and the Roxburgh Road crossing of Sandy Creek.

Based on the above and reference to tables and to other information contained in the document DSC13, the primary assessment of hazard rating for the proposed structure is considered to be "LOW" in that no possibility for loss of identifiable life is foreseen, and any possibility for loss of non-identifiable life would be limited to considerable fewer than 10 persons.

The secondary assessment of hazard rating for the proposed structure is low in that : there would be minimal economic losses and minimal effects on water supply or power supply and minimal, or limited and temporary environmental damage resulting from failure of the dam.

Discussion with Mr P Reid of the N.S.W. Dams Safety Committee raised the following issues in respect of hazard rating:

- Environmental Dam N° 2 and several of the fine rejects storage structures are proposed to be constructed to final heights above stream bed in excess of 15m. They will therefore be prescribed structures under the Dams Safety Act 1978.
- the complete disposal systems at Environmental Dams 1, 2 and 3 (ie. environmental dams and fine rejects storage structures) should be treated as units for the purpose of assigning hazard rating.
- the E.P.A, which will be consulted in the process of assignment of hazard rating, is likely to favour raising the hazard rating to "significant" on environmental grounds associated with potential salinity and sediment load impacts downstream if breaching were to occur.

It is considered prudent to anticipate that the hazard rating finally assigned will be "Significant" and plan accordingly.

The impact of application of a significant hazard rating to the system will include:

- design of environmental dam for an Acceptable Flood Capacity (AFC) not less than half the Probable Maximum Flood (PMF). Discussion with Dams Safety Committee personnel have subsequently confirmed that PMF is that flood resulting from PMP.
- surveillance reports to Type 2 requirements according to DSC15 "Requirements for Surveillance Reports" to be prepared at intervals not greater than five years. Type 2 Reports must be prepared by a qualified experienced dams engineer as a minimum.
- preparation of an effective Operation and Maintenance (O & M) Manual, with regular upgrading (at least every five years). Appropriately trained and experienced personnel must be available to operate and maintain the facilities in accordance with the O & M Manual.
- preparation of a modified Dam Safety Emergency Plan (DSEP) as part of prudent dam operation practice to maximise the safety of the dam. DSEP's must be reviewed annually and upgraded at least every five years.
- design to withstand the most severe earthquake shaking that has an Annual Exceedence Probability (AEP) of 1 in 1000. Design analysis using a pseudo static stability analysis to check for seismic loading is acceptable.

5.3 Occupational Health & Safety

Requirements to ensure that construction operations are undertaken with adequate regard for occupational health and safety requirements will be implemented . These will include:

- maintenance of adequate width for active construction surfaces. A minimum crest width for all embankments of 8m will be adopted with provision of a low safety berm along both the upstream and downstream edges where necessary to prevent construction traffic from leaving the crest. (The safety berms will primarily be a requirement as the embankment approaches full height and minimum crest width).

- developing acceptable construction procedures during capping operations to ensure an adequate thickness of suitable strength fill is maintained over weak or soft areas of reject storage, to ensure that plant traffic does not "punch through" capping material.

The Interim Requirements for Seismic Assessment of Dams (DSC 16 April 1993) produced by the Dams Safety Committee of N.S.W. have been reviewed and Dr Jack Rynn, seismologist with the Centre for Earthquake Research in Australia (C.E.R.A.), was consulted to provide general comment about earthquake hazard in the Muswellbrook Area. A short report by Dr Rynn is provided in Appendix 4. While conclusions have been drawn based on currently available data, both CERA and DSC refer to the fact that seismic design methodology for dams is not yet well developed in Australia. This will be addressed in more detail at final design stage.

6.1 Dams Safety Committee Requirements

DSC 16 notes (and Dr Rynn confirms), that Australia is a landmass of comparatively low seismic activity. Being removed from the tectonic plate margins, which are the most seismically active parts of the earth's crust, it is an "intra plate" regime. Overseas experience indicates that large earthquakes are possible in intra plate environments, and Dr Rynn notes that "Australia has been considered as one of the most active intra plate areas".

The 1989 Newcastle event (magnitude 5.6 on the Richter Scale) was significant mainly because of its location close to a major urban centre. It was not an exceptional event - two other earthquakes exceeding magnitude of 5.0 on the Richter Scale have occurred in the past 130 years and two other events in the early 1840's are recorded as causing strong shaking in the Hunter Valley.

DSC 16 notes that generally dams withstand earthquake shaking remarkably well, there being very few recorded instances of dam failure resulting from earthquake. A number of dams overseas have suffered deformation and damage.

Embankment dams can suffer two main types of damage depending on the nature of foundation or fill materials and the design and construction standards.

These are:-

- major deformations, slumping and cracking
- liquefaction of either foundation material or the dam fill.

Generally liquefaction can occur in saturated loose, fine-grained cohesionless materials. Free draining rockfill dams with a thin impervious element are regarded as inherently stable under earthquake loading.

Pertinent DSC requirements in respect of design for earthquake loading are reproduced below:

- 1.1 Check all significant and high hazard dams for safety under seismic loadings. The Committee has no requirements regarding the design of low hazard dams for earthquake loading.

- 2.2 Significant hazard dams are to withstand the most severe earthquake shaking that has an annual exceedence probability (AEP) of 1 in 1000. The Committee will consider departures from this standard that are based on risk analysis that shows that the expected consequences of dam failure justify a lesser design level.

- 6.1 For all high and significant hazard embankment dams determine whether the dam or foundation is potentially subject to liquefaction and report the determination to the Committee.

- 7.1 For high and significant hazard dams carry out as a minimum a pseudo static stability analysis to check for seismic loading using a recognised procedure such as that suggested by the US Corps of Engineers (1984).

- 8.1 Rockfill dams of free-draining rockfill are often designed empirically on the basis of precedent performance. The Committee will accept such a design basis, but it should be noted that some flattening of the slopes is normal where strong shaking is to be expected. Analyse dams of rockfill that is not free draining in a similar manner for earthfill dams.

- 10.1 Identify any faults at the dam site that could displace in a seismic event and report the measures taken to provide for such occurrence.

6.2 Comment on Seismic Assessment

The proposed reject disposal method involves construction of a series of essentially permeable storage dams for fine rejects solids in a cascade down the valley with an environmental dam for retention of seepage flows at the lower end of the valley.

The storage dams for tailings are proposed to be constructed of coarse reject material and can be regarded as rockfill dams. Final slopes required to be adopted for stability will require to be designed when more is known of the actual material properties. The environmental dams at the lower end of each of the valleys will be designed as water retaining earthfill structures. A hazard rating in respect of the entire disposal system will be assigned by the Dams Safety Committee. However it is expected that individual structures within the system, on the basis of height and/or size of storage, may be designated as prescribed structures with consequent specific design requirements to be met. In this context it is noted that Environmental Dam 2 as currently planned, meets the specification of a prescribed structure whereas Environmental Dam N° 1 and 3 do not.

Review of foundation conditions and proposed construction material for the dam indicate that liquefaction is not likely to be a potential problem (foundation consists of medium to high plasticity clay soils and construction is likely to utilise similar materials).

The proposed method of operation of the dam will involve pumping from the storage to recirculate water to the coal preparation plant and thus the volume of water stored at most times will be relatively low.

Advice from Dam Safety Committee indicates that DSC requirements for a significant hazard rating dam would be that Environmental Dams would require to be designed to withstand loads from an earthquake of annual exceedence probability 1 in 1000.

7.0 CONCLUSIONS

Following preliminary assessment of the proposed coal rejects disposal method for Mt Pleasant Coal Mine the following conclusions have been drawn based on the level of information available at the time of preparation of this report.

- The proposed fine reject storage areas have been determined to be capable of storing the approximately 22,650,000m^3 of fine reject material.
- Conditions at proposed sites for Environmental Dames 2 and 3 are essentially similar with up to 3m of medium to high plasticity clay and/or clayey sand overlying sandstone shale and mudstones of the Singleton Coal Measures.
- The sites are considered suitable for the construction of fine reject storage facilities as shown on Drawing N°'s MQ0112-C01 and C02.

- The proposed disposal method involves staged construction (commencing near the heads of the two valleys) of a series of storage structures in which fine reject will be deposited hydraulically as a thickened slurry at approximately 40% solids. Construction of these storage retaining structures will be from coarse reject material. Seepage through these structures will be promoted to assist in dewatering the fine rejects. Environmental dams (designed as water retaining structures) will be constructed below the fine reject storages to catch saline seepage waters and at the same time minimise the loss of runoff from the catchment during operations. Decant waters will be recovered from both the fine reject storages and the environmental dam for recycling to the Coal Preparation Plant.

- The potential impact on water quality of both surface waters downstream, and of local ground water aquifers, is considered to be low. If conditions are found to vary from those inferred, at the design stage measures to reduce seepage flows to acceptably low levels are considered able to be implemented.

- Seepage from beneath the rejects impoundments will occur at a low rate because of the low permeability of the fine rejects. Reference 2 indicates that seepage will migrate westward within coal measures for the first few years of mine development. Seepage pathways will be altered to an easterly direction as the mine pit is developed.

- Preliminary review of results of geochemical tests typical of washery rejects and tailings for other areas in the Hunter Valley indicate that the bulk of washery reject and tailings are likely to meet typical environmental investigation criteria for total element composition for metals. Wynnn seam reject is expected to exhibit concentrations towards the upper end of the expected range and these should not be placed near the final surface of storage dams.

- The hazard rating for proposed water retaining structures at the sites is assessed as "significant", based on advice from N.S.W. Dams Safety Committee.

  The significant hazard rating will require:

  - Hydraulic design of the environmental dams to cope with a half probable maximum precipitation storm.
  - Type 2 Surveillance Reporting by a suitably qualified and experience dam engineer at least once every five years.

- Preparation of an Operation & Maintenance Manual which is regularly upgraded (not less than once every five years).
- Preparation of a modified Dam Safety Emergency Plan which is reviewed annually and upgraded at intervals not exceeding 5 years.

- The Dams Safety Committee of N.S.W. requirements for significant hazard rating dams in respect of its Interim Guidelines for Seismic Assessment of Dams, is that the design should withstand earthquake loads from a 1 in 1000 annual exceedence probability earthquake.

- The proposed disposal method, involving staged development of a series of rejects storage structures progressively constructed down slope from the heads of the valleys lends itself to progressive rehabilitation thus limiting the amount of exposure of rejects at any given time. It also lends itself to a program to monitor performance of early structures and inclusion in later structures of design and construction modifications to improve the performance of these later structures in the sequence.

It should be noted that nothing has been identified about the site, the materials, disposal method or the local environment which would pose unexpected or insurmountable difficulties. Further detailed investigation at time of final design is recommended to develop site specific design parameters and to refine the conceptual design. Thorough monitoring of the performance of the early structures is recommended to assess performance against design assumptions and assist in modifying procedures to improve performance of structures constructed later.

LIST OF REFERENCES

1. Soil Landscapes of the Singleton 1:250000 Sheet, Kovac & Lawrie, Soil Conservation Service of N.S.W.

2. Mt Pleasant Water Management Studies, Second Draft Report (May 1997 Rev C), Rust PPK

3. Land Capability & Soil Survey Report, Mt Pleasant Project (Report No VA132A/02), Veness & Associates.

4. Minfo, New South Wales Mining & Exploration Quarterly No 53 October 1996, Department of Mineral Resources.

5. Load-Based Licensing Scheme - Draft Operational Plan, Environmental Economics Series, EPA of N.S.W.

6. Hunter River Salinity Trading Scheme - Draft Operational Plan, Environmental Economics Series, EPA of N.S.W.

7. Pollution Control and Waste Regulation: Approvals Licences & Registrations (Policy and Legislation), Environment Protection Manual, EPA of N.S.W.

8. DSC 1 July 1996, Dams Safety Committee of N.S.W.

9. DSC 2 Role Policies & Procedures, June 1996, Dams Safety Committee of N.S.W.

10. DSC 5 Advice on Legal Matters for Dam Owners, August 1996, Dams Safety Committee of N.S.W.

11. DSC 12 Operation, Maintenance & Emergency Management Requirements for Dams, October 1995, Dams Safety Committee of N.S.W.

12. DSC 13 Hazard Ratings of Dams October 1992, Dams Safety Committee of N.S.W.

13. DSC 16 Interim Requirements for Seismic Assessment of Dams - April 1993, Dams Safety Committee of N.S.W.

14. Mt Pleasant Project - Preliminary Assessment of Element Toxicity & Leaching Potential of Coal Washery Rejects, Memorandum from Environmental Geochemistry International Pty Ltd to Coal & Allied Operations Pty Ltd 21 May 1997.

APPENDIX 1

Logs of Backhoe Pits

Note: Site 1 corresponds to Environmental Dam N° 2
Site 2 corresponds to Environmental Dam N° 3

Vimbury Pty Ltd A.C.N. 010 826 561

EARTHTECH LABORATORIES
Geotechnical and Environmental Engineering
Soils and Engineering Materials Testing

TEST PIT RECORD

BHP 1
Sheet 1 of 1

Client: CMPS &F Pty Ltd Job No : MF0480
Project: Mt Pleasant
Location: Reject Dam Site 2 (Low level alluvial Terrace - Right Bank)

Date: 13/12/96 Equipment Type: Backhoe Bucket Size RL Surface: -
Logged By: MM Operator: Ch/Coords: -

Depth (m)		Strata Change (m)	Soil/Rock Description & Classification (Australian Standard 1726-1993)	Strength/ Consistency	Sample Type	Sample/Test Depth (m)	Test Results/Field Records
		0.0 0.15	**Silty Clayey TOPSOIL(ML)**, light brown				
0.5			**Sandy CLAY (CI)**, dark brown, medium plasticity. Some fine to coarse sand, medium dry strength. Just Moist. Subrounded sand & gravel size particles increasing with depth. Gradual colour change from dark brown to brown to tan with depth.			D 0.15 to 2.4m	
1.0							
1.5							
2.0							
2.5		2.4	Distinctly weathered Sandstone at 2.4m (probably cobblers & boulders).				
		2.6	Refusal at 2.6m (Rounded slightly weathered gravel cobbles & boulders).				
			TEST PIT TERMINATED AT 2.6m				
3.0							
3.5							
4.0							
4.5							
5.0							

Legend:
U50 - Undisturbed 50mm diam. tube sample
D - Disturbed sample
B - Bulk sample
PP - Pocket Penetrometer test result, kPa
SPT - Standard Penetration Test
* - Inferred SPT 'N' value
VS - Vane Shear test result, kPa
DC - Dynamic Cone Penetrometer test results (blows/100mm penetration)
V - Steel 'V' bit augering
TC - Tungsten carbide bit augering
B - Blade bit washboring
R - Rock roller bit washboring
C - NMLC coring
REC - Core Recovery (%)
RQD - Rock Quality Designation

Groundwater Observations:
First Noted :
Steady Level :

Prepared by: MM/KR **Checked By:**

S02.4

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Soils and Engineering Materials Testing

TEST PIT RECORD

BHP 2
Sheet 1 of 1

Client: CMPS &F Pty Ltd Job No : MF0480
Project: Mt Pleasant Reject Dam
Location: Reject Dam Site 2 (Right Abutment)

Date: 13/12/96 Equipment Type: Backhoe Bucket Size RL Surface: -
Logged By: MM Operator: Ch/Coords: -

Depth (m)		Strata Change (m)	Soil/Rock Description & Classification (Australian Standard 1726-1993)	Strength/ Consistency	Sample Type	Sample/Test Depth (m)	Test Results/Field Records
		0.0 0.1	**Organic TOPSOIL (ML),** dark brown.				
0.5		0.8	**CLAY (CH),** dark reddish brown, high plasticity, high dry strength. Some fine roots. Dry, cracking extends to 0.8m			D 0.1 to 0.8m	
1.0		1.4	**Sandy CLAY (CH),** yellow brown, high plasticity. Dry to just Moist. Contains some subrounded fine to coarse sand and gravel particles to 10mm.			D 0.8 to 1.4m	
1.5 2.0 2.5		2.5	**CLAY (CH),** grey and yellow brown mottled, high plasticity. Moist. Refusal at 2.5m on distinctly weathered Sandstone			D 1.4 to 2.5m	
3.0 3.5 4.0 4.5 5.0			**TEST PIT TERMINATED AT 2.5m**				

Legend:
U50 - Undisturbed 50mm diam. tube sample
D - Disturbed sample
B - Bulk sample
PP - Pocket Penetrometer test result, kPa
SPT - Standard Penetration Test
* - Inferred SPT 'N' value
VS - Vane Shear test result, kPa
DC - Dynamic Cone Penetrometer test results (blows/100mm penetration)
V - Steel 'V' bit augering
TC - Tungsten carbide bit augering
B - Blade bit washboring
R - Rock roller bit washboring
C - NMLC coring
REC - Core Recovery (%)
RQD - Rock Quality Designation

Groundwater Observations:
First Noted :
Steady Level :

Prepared by: MM/KR **Checked By:**

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Geotechnical and Environmental Engineering
Soils and Engineering Materials Testing

TEST PIT RECORD

BHP 3

Sheet 1 of 1

Client: CMPS &F Pty Ltd
Project: Mt Pleasant Reject Dam
Location: Reject Dam Site 2 (Left Abutment)

Job No : MF0480

Date: 13/12/96 | Equipment Type: Backhoe | Bucket Size | RL Surface: -
Logged By: MM | Operator: | Ch/Coords: -

Depth (m)		Strata Change (m)	Soil/Rock Description & Classification (Australian Standard 1726-1993)	Strength/ Consistency	Sample Type	Sample/Test Depth (m)	Test Results/Field Records
		0.0 – 0.2	**Silty Organic TOPSOIL (ML)**, brown, numerous roots.				
0.5		0.7	**CLAY (CH)**, red brown, high plasticity, Very Stiff to Hard. Dry, cracking extends to 0.7m.			D 0.2 to 0.7m	
1.0		1.4	**CLAY (CI)**, yellow brown, medium plasticity. Dry to Just Moist. Contains some fine to coarse sand size particles.			D 0.7 to 1.4m	
1.5			**Distinctly Weathered MUDSTONE & SANDSTONE**				
2.0		2.2	Refusal at 2.2m				
			TEST PIT TERMINATED AT 2.2m				
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

Legend:
U50 - Undisturbed 50mm diam. tube sample
D - Disturbed sample
B - Bulk sample
PP - Pocket Penetrometer test result, kPa
SPT - Standard Penetration Test
* - Inferred SPT 'N' value
VS - Vane Shear test result, kPa
DC - Dynamic Cone Penetrometer test results (blows/100mm penetration)
V - Steel 'V' bit augering
TC - Tungsten carbide bit augering
B - Blade bit washboring
R - Rock roller bit washboring
C - NMLC coring
REC - Core Recovery (%)
RQD - Rock Quality Designation

Groundwater Observations:
First Noted :
Steady Level :

Prepared by: MM/KR | **Checked By:**

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Geotechnical and Environmental Engineering
Soils and Engineering Materials Testing

TEST PIT RECORD

BHP 4
Sheet 1 of 1

Client: CMPS &F Pty Ltd | Job No : MF0480
Project: Mt Pleasant
Location: Reject Dam Site 1 (Low level Alluvial Terrace - Left Bank)

Date: 13/12/96 | Equipment Type: Backhoe | Bucket Size | RL Surface: -
Logged By: MM | Operator: | Ch/Coords: -

Depth (m)		Strata Change (m)	Soil/Rock Description & Classification (Australian Standard 1726-1993)	Strength/ Consistency	Sample Type	Sample/Test Depth (m)	Test Results/Field Records
		0.0	**Silty Organic TOPSOIL (ML),** brown. Dry				
		0.4					
0.5			**Sandy CLAY (CI),** brown, medium plasticity. Sand is fine to coarse. Moist to Damp			D 0.4 to 0.9m	
		0.9					
1.0			**Sandy CLAY (CI),** yellow-brown mottled, medium plasticity, contains some fine to coarse sand and fine gravel. Moist to Damp. Moisture content increasing with depth.			D 0.9 to 2.0m	
1.5							
2.0		2.0	Refusal on Sandstone Cobbles and Boulders				
			TEST PIT TERMINATED at 2.0m				
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

Legend:
U50 - Undisturbed 50mm diam. tube sample
D - Disturbed sample
B - Bulk sample
PP - Pocket Penetrometer test result, kPa
SPT - Standard Penetration Test
* - Inferred SPT 'N' value
VS - Vane Shear test result, kPa
DC - Dynamic Cone Penetrometer test results (blows/100mm penetration)

V - Steel 'V' bit augering
TC - Tungsten carbide bit augering
B - Blade bit washboring
R - Rock roller bit washboring
C - NMLC coring
REC - Core Recovery (%)
RQD - Rock Quality Designation

Groundwater Observations:
First Noted :
Steady Level :

Prepared by: MM/KR | **Checked By:**

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Soils and Engineering Materials Testing

TEST PIT RECORD

BHP 5
Sheet 1 of 1

Client: CMPS &F Pty Ltd	Job No : MF0480
Project: Mt Pleasant	
Location: Reject Dam Site 1 (Left Abutment)	
Date: 13/12/96 Equipment Type: Backhoe Bucket Size	RL Surface: -
Logged By: MM Operator:	Ch/Coords: -

Depth (m)		Strata Change (m)	Soil/Rock Description & Classification (Australian Standard 1726-1993)	Strength/ Consistency	Sample Type	Sample/Test Depth (m)	Test Results/Field Records
		0.0	**Silty Organic TOPSOIL (ML)**, light brown				
		0.2					
			Clayey SAND (SC), red brown, low to medium plasticity. Sand is fine to coarse. Just Moist.			D 0.2 to 0.6m	
0.5							
		0.6	Refusal on distinctly weathered Sandstone				
			TEST PIT TERMINATED at 0.6m				
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

Legend:

U50 - Undisturbed 50mm diam. tube sample	V - Steel 'V' bit augering
D - Disturbed sample	TC - Tungsten carbide bit augering
B - Bulk sample	B - Blade bit washboring
PP - Pocket Penetrometer test result, kPa	R - Rock roller bit washboring
SPT - Standard Penetration Test	C - NMLC coring
* - Inferred SPT 'N' value	REC - Core Recovery (%)
VS - Vane Shear test result, kPa	RQD - Rock Quality Designation
DC - Dynamic Cone Penetrometer test results (blows/100mm penetration)	

Groundwater Observations:
First Noted :
Steady Level :

Prepared by: MM/KR **Checked By:**

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Soils and Engineering Materials Testing

TEST PIT RECORD

BHP 6
Sheet 1 of 1

Client: CMPS &F Pty Ltd
Job No : MF0480
Project: Mt Pleasant
Location: Site 1 Left Abutment

Date: 13/12/96 | Equipment Type: Backhoe | Bucket Size | RL Surface: -
Logged By: MM | Operator: | Ch/Coords: -

Depth (m)		Strata Change (m)	Soil/Rock Description & Classification (Australian Standard 1726-1993)	Strength/ Consistency	Sample Type	Sample/Test Depth (m)	Test Results/Field Records
		0.0 0.2	**Silty Organic TOPSOIL (ML),** light brown				
0.5		0.5	**Clayey SAND (SC),** red brown, low to medium plasticity. Sand is fine to coarse. Just Moist. Refusal on distinctly weathered Sandstone				
			TEST PIT TERMINATED at 0.5m				
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

Legend:
U50 - Undisturbed 50mm diam. tube sample
D - Disturbed sample
B - Bulk sample
PP - Pocket Penetrometer test result, kPa
SPT - Standard Penetration Test
* - Inferred SPT 'N' value
VS - Vane Shear test result, kPa
DC - Dynamic Cone Penetrometer test results (blows/100mm penetration)
V - Steel 'V' bit augering
TC - Tungsten carbide bit augering
B - Blade bit washboring
R - Rock roller bit washboring
C - NMLC coring
REC - Core Recovery (%)
RQD - Rock Quality Designation

Groundwater Observations:
First Noted :
Steady Level :

Prepared by: MM/KR | **Checked By:**

S02.4

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Geotechnical and Environmental Engineering
Soils and Engineering Materials Testing

TEST PIT RECORD

BHP 7
Sheet 1 of 1

Client: CMPS &F Pty Ltd — Job No : MF0480
Project: Mt Pleasant
Location: Reject Dam Site 1 (Right Abutment near Fenceline)

Date: 13/12/96 — Equipment Type: Backhoe — Bucket Size — RL Surface: -
Logged By: MM — Operator: — Ch/Coords: -

Depth (m)		Strata Change (m)	Soil/Rock Description & Classification (Australian Standard 1726-1993)	Strength/ Consistency	Sample Type	Sample/Test Depth (m)	Test Results/Field Records
		0.0	**Organic Clayey TOPSOIL(CH),** dark brown. Numerous large roots. High dry strength.				
0.5		0.5					
			Sandy CLAY (CH), brown, high plasticity. Stiff to Very Stiff. Numerous slickensides. Some fine to coarse Sand.			D 0.5 to 1.4m	
1.0							
		1.4					
1.5			**SANDSTONE,** distinctly weathered.				
		1.8					
			TEST PIT TERMINATED at 1.8m				
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

Legend:
U50 - Undisturbed 50mm diam. tube sample
D - Disturbed sample
B - Bulk sample
PP - Pocket Penetrometer test result, kPa
SPT - Standard Penetration Test
* - Inferred SPT 'N' value
VS - Vane Shear test result, kPa
DC - Dynamic Cone Penetrometer test results (blows/100mm penetration)
V - Steel 'V' bit augering
TC - Tungsten carbide bit augering
B - Blade bit washboring
R - Rock roller bit washboring
C - NMLC coring
REC - Core Recovery (%)
RQD - Rock Quality Designation

Groundwater Observations:
First Noted :
Steady Level :

Prepared by: MM/KR — **Checked By:**

S02.4

APPENDIX 2

Laboratory Test Results

Note: Site 1 corresponds to Environmental Dam Nº 2
Site 2 corresponds to Environmental Dam Nº 3

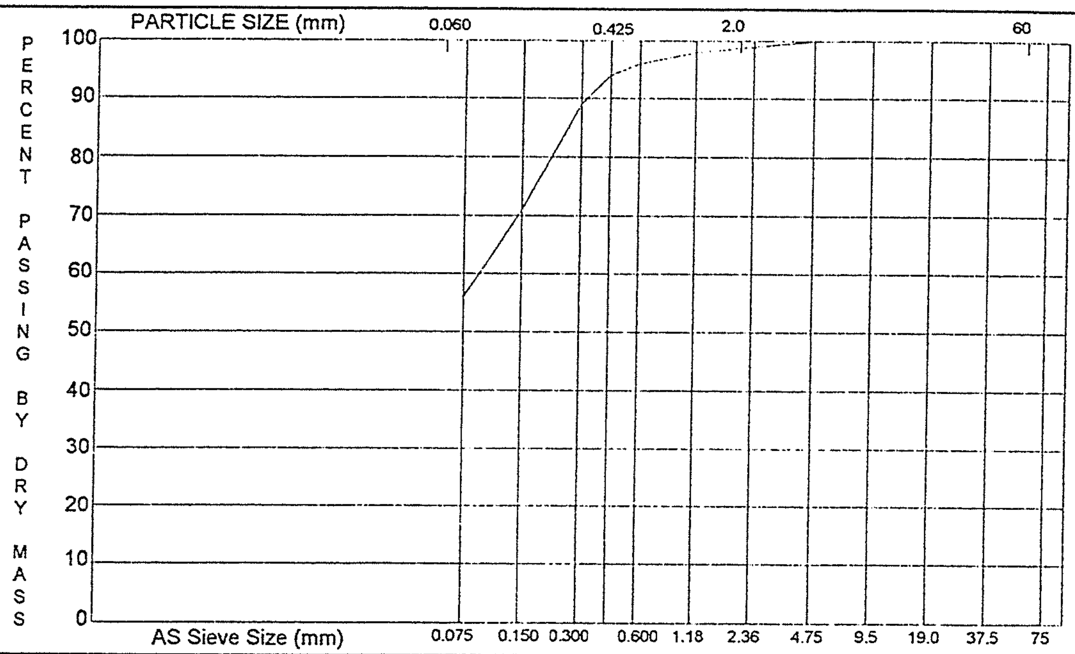
Vimbury Pty Ltd T/A A.C.N. 010 826 561
EARTHTECH LABORATORIES
Soils and Engineering Materials Testing

Mansfield Laboratory
1/51 Secam Street
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client :	CMPS & F	**Report No :**	M2435
Project :	Mt. Pleasant Reject Dam	**Job No :**	MF-0480
Feature :		**Reg'n No :**	M1865/96
Location :	Site 1 BHP 4 (0.4 - 0.9m)	**Senders No :**	
		Date Received:	17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	100
2.36	99
1.18	98
0.600	96
0.425	94
0.300	89
0.150	71
0.075	56



INDEX PROPERTIES

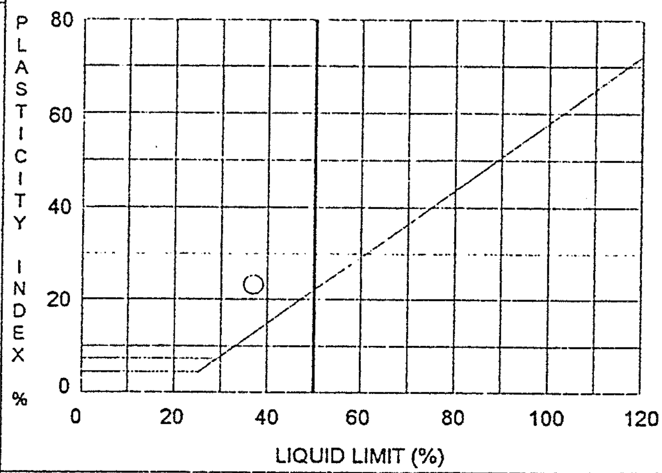
Liquid Limit	37 %
Plastic Limit	14 %
Plasticity Index	23 %
Linear Shrinkage (LS)	11.0 %
Length of LS Mould	125 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³

EMERSON CLASS NUMBER

Emerson Class No.	2
Water Type Used	Distilled
Water Temperature	23 °C



Insitu Moisture Content 16.3 %

Remarks :

Material Description : Sandy CLAY (CI) dark brown & grey fine to coarse sand

Test Procedure/s : AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, C8.1

Prepared by : NH | Checked by : HJ

NATA No. 1446

Authorised Signatory 23/12/96

R07.1

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EARTHTECH LABORATORIES
Soils and Engineering Materials Testing

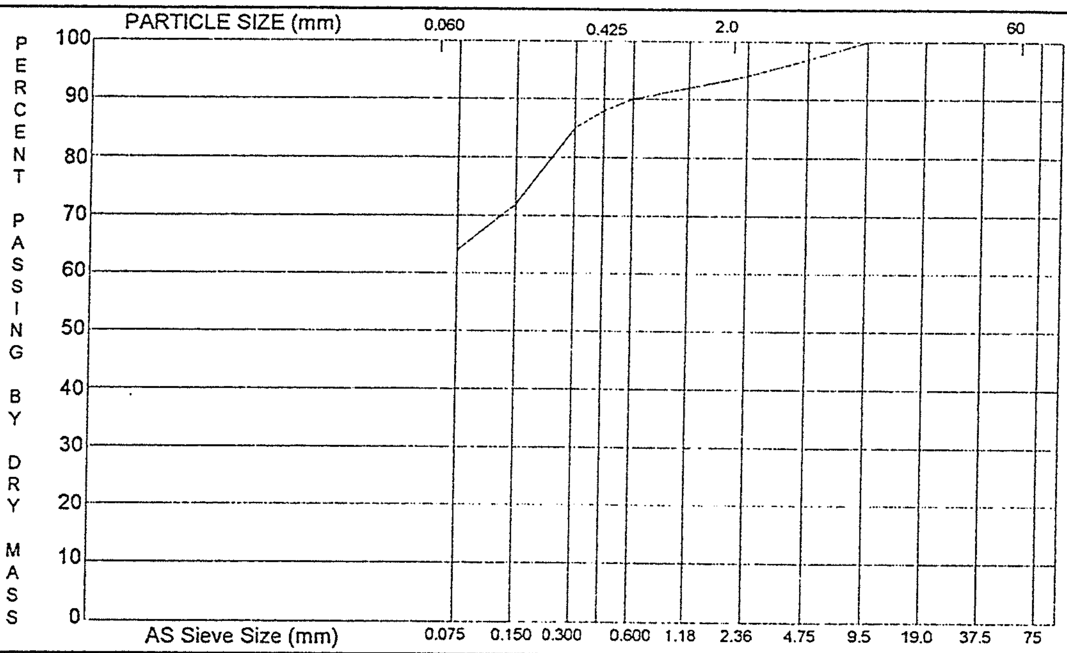
Mansfield Laboratory
1/51 Secam Street
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client : CMPS & F
Project : Mt. Pleasant Reject Dam
Feature :
Location : Site 1 BHP 4 (0.9 - 2.0m)

Report No : M2435
Job No : MF-0480
Reg'n No : M1866/96
Senders No :
Date Received: 17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	100
4.75	97
2.36	94
1.18	92
0.600	90
0.425	88
0.300	85
0.150	72
0.075	64

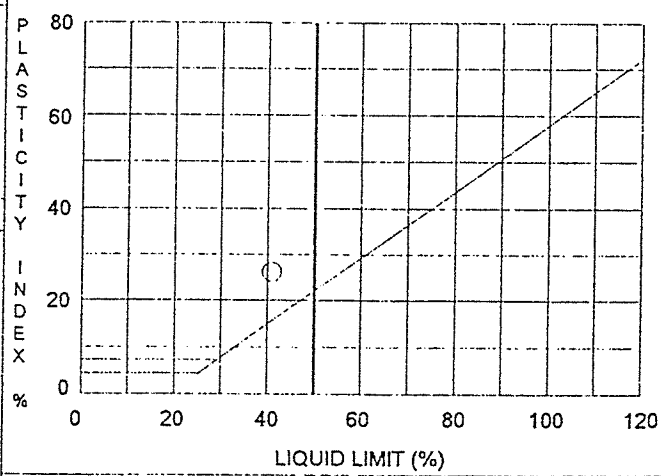


INDEX PROPERTIES

Liquid Limit	41 %
Plastic Limit	15 %
Plasticity Index	26 %
Linear Shrinkage (LS)	12.5 %
Length of LS Mould	126 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³



Insitu Moisture Content %

Remarks :
Material Description : Sandy CLAY (CI) light brown fine to coarse sand some fine gravel

Test Procedure/s : AS 1289 ~~2.1.1~~, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, ~~C8.1~~

Prepared by : M

Checked by : HP

NATA No. 1446

Authorised Signatory 23/12/96

R07.1

Mansfield Laboratory
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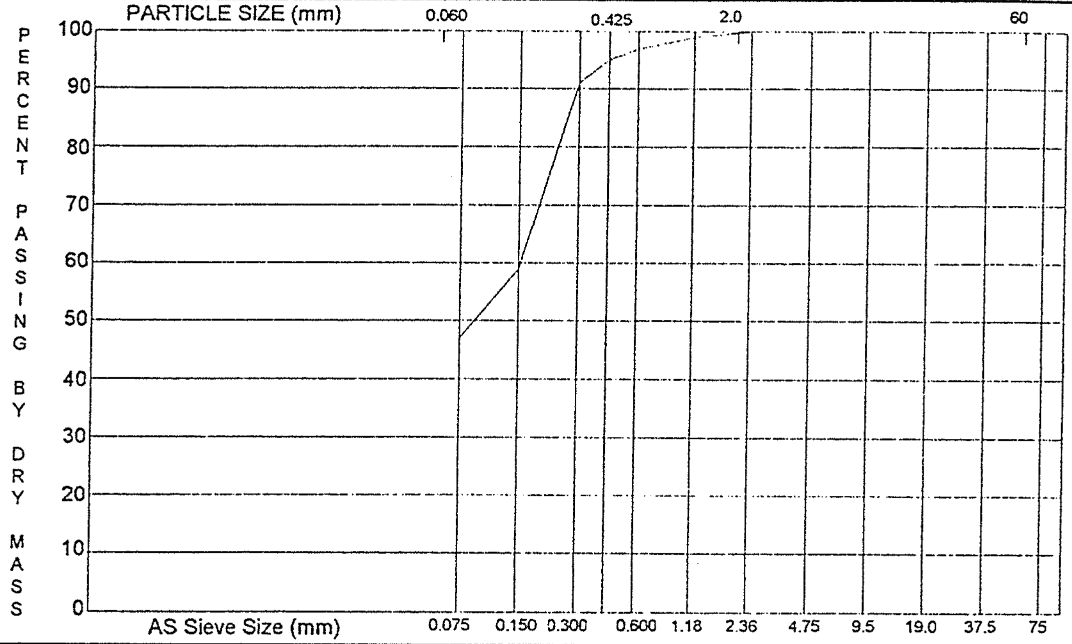
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client : CMPS & F
Project : Mt. Pleasant Reject Dam
Feature :
Location : Site 1 BHP 5 (0.2 - 0.6m)

Report No : M2435
Job No : MF-0480
Reg'n No : M1867/96
Senders No :
Date Received: 17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	97
0.425	95
0.300	91
0.150	59
0.075	47

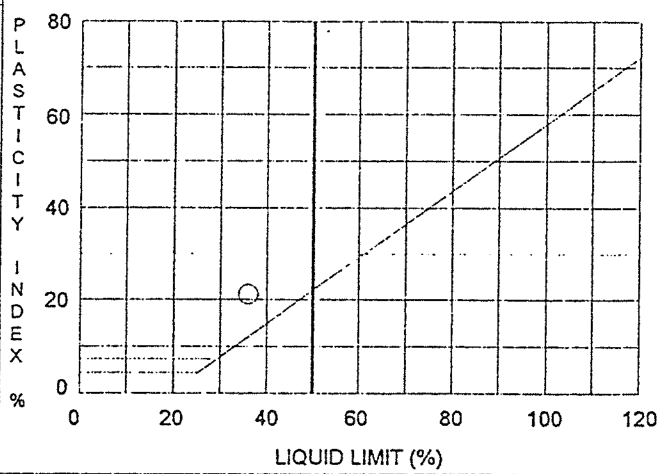


INDEX PROPERTIES

Liquid Limit	36 %
Plastic Limit	15 %
Plasticity Index	21 %
Linear Shrinkage (LS)	10.5 %
Length of LS Mould	123 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³



Insitu Moisture Content %

Remarks :
Material Description : Clayey SAND (SC) fine to coarse sand medium plasticity, reddish brown

Test Procedure/s : AS 1289 ~~2.1.1~~, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, ~~C8.1~~

Prepared by : NF	Checked by : HP

NATA No. 1446 Authorised Signatory 23/12/96

R07.1

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EARTHTECH LABORATORIES

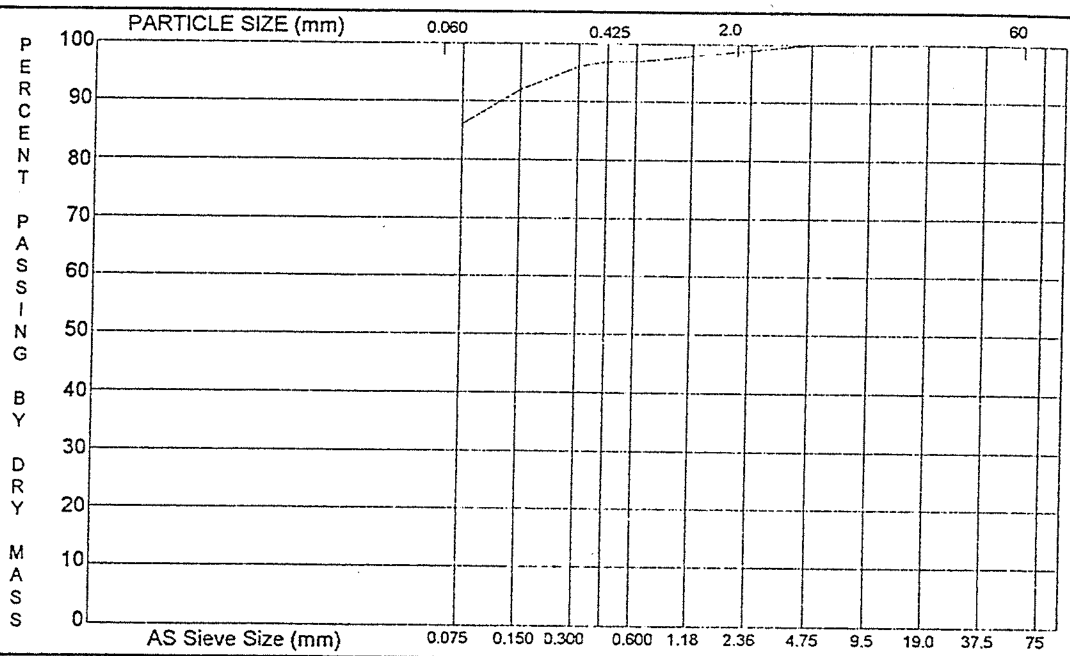
Soils and Engineering Materials Testing

Mansfield Laboratory
1/51 Secam Street
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client :	CMPS & F	Report No :	M2435
Project :	Mt. Pleasant Reject Dam	Job No :	MF-0480
Feature :		Reg'n No :	M1868/96
Location :	Site 1 BHP 7 (0.5 - 1.4m)	Senders No :	
		Date Received:	17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	100
2.36	99
1.18	98
0.600	97
0.425	97
0.300	96
0.150	92
0.075	86



INDEX PROPERTIES

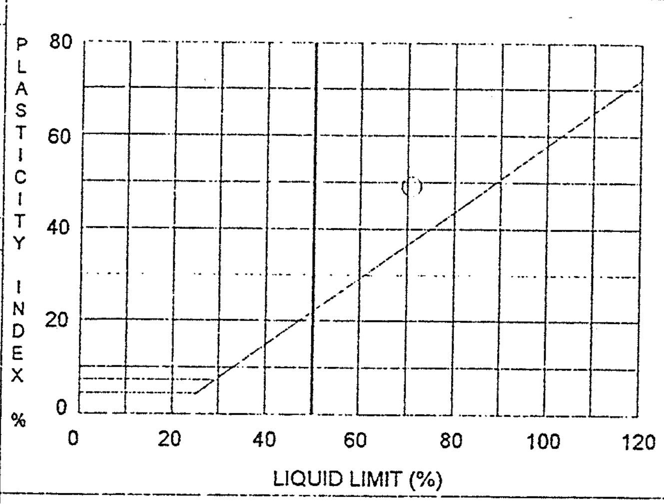
Liquid Limit	71 %
Plastic Limit	22 %
Plasticity Index	49 %
Linear Shrinkage (LS)	21.0 %
Length of LS Mould	125 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³

EMERSON CLASS NUMBER

Emerson Class No.	4
Water Type Used	Distilled
Water Temperature	23 °C



Insitu Moisture Content %

Remarks :

Material Description : Sandy CLAY (CH) fine to coarse sand brown

Test Procedure/s : AS 1289 ~~2.1.1~~, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, C8.1

Prepared by : NF	Checked by : HJ

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NATA No. 1446

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Vimbury Pty Ltd T/A A.C.N. 010 826 561

EARTHTECH LABORATORIES

Soils and Engineering Materials Testing

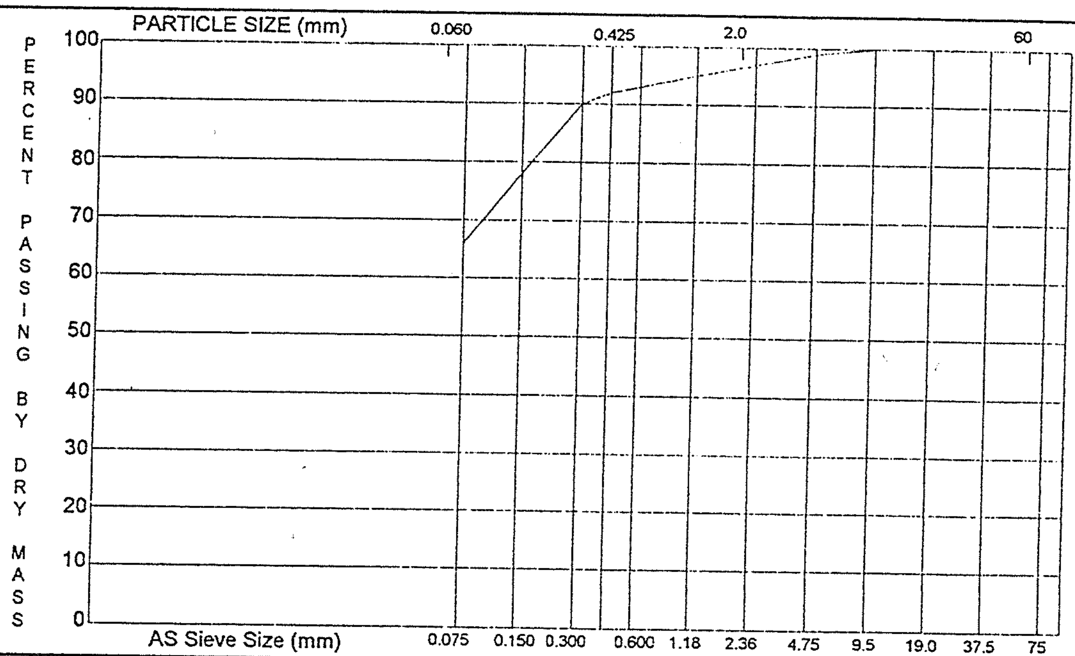
Mansfield Laboratory
1/51 Secam Street
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client : CMPS & F
Project : Mt. Pleasant Reject Dam
Feature :
Location : Site 2 BHP 1 (0.15 - 2.4m)

Report No : M2435
Job No : MF-0480
Reg'n No : M1869/96
Senders No :
Date Received: 17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	100
4.75	99
2.36	97
1.18	95
0.600	93
0.425	92
0.300	90
0.150	78
0.075	66



INDEX PROPERTIES

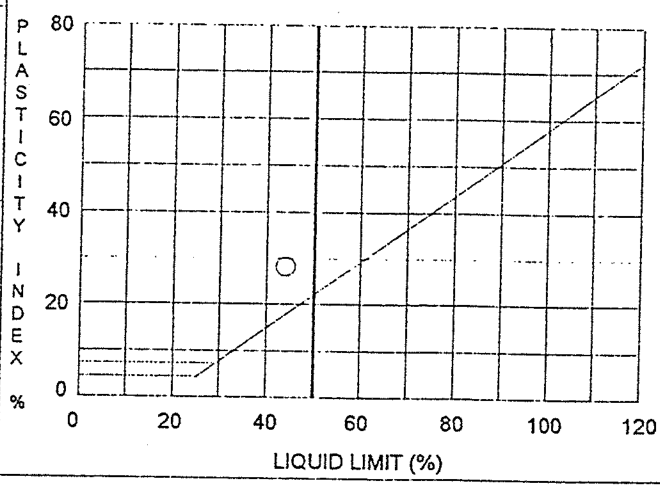
Liquid Limit	44 %
Plastic Limit	16 %
Plasticity Index	28 %
Linear Shrinkage (LS)	14.0 %
Length of LS Mould	125 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³

EMERSON CLASS NUMBER

Emerson Class No.	4
Water Type Used	Distilled
Water Temperature	23 °C



Insitu Moisture Content 11.6 %

Remarks :
Material Description : Sandy CLAY (CI) fine to coarse sand dark brown & grey

Test Procedure/s : AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, C8.1

Prepared by : NF
Checked by : HP

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Soils and Engineering Materials Testing

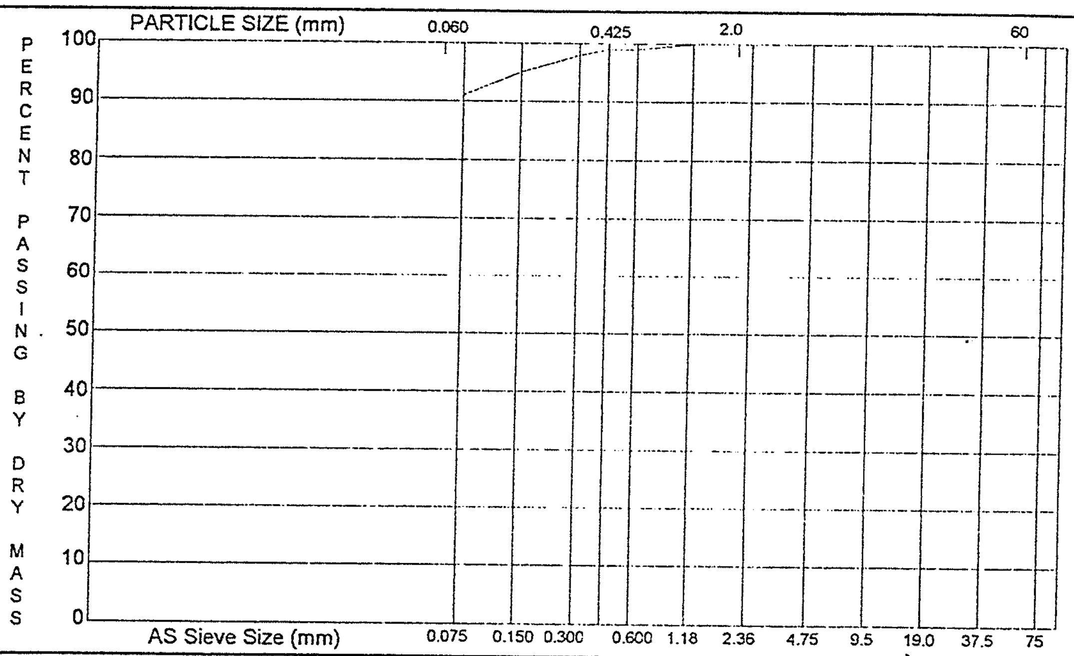
Mansfield Laboratory
1/51 Secam Street
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client : CMPS & F
Project : Mt. Pleasant Reject Dam
Feature :
Location : Site 2 BHP 2 (0.1 - 0.8m)

Report No : M2435
Job No : MF-0480
Reg'n No : M1870/96
Senders No :
Date Received: 17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	
2.36	
1.18	100
0.600	99
0.425	99
0.300	98
0.150	95
0.075	91

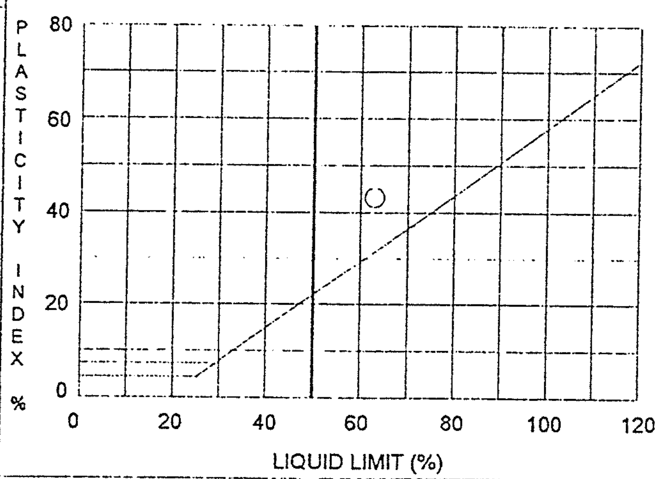


INDEX PROPERTIES

Liquid Limit	63 %
Plastic Limit	20 %
Plasticity Index	43 %
Linear Shrinkage (LS)	18.5 %
Length of LS Mould	125 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³



Insitu Moisture Content %

Remarks :
Material Description : CLAY (CH) reddish brown

Test Procedure/s : AS 1289 ~~2.1.1~~, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, ~~C8.1~~

Prepared by : NF

Checked by : HP

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Soils and Engineering Materials Testing

Mansfield Laboratory
1/51 Secam Street
MANSFIELD Q 4122
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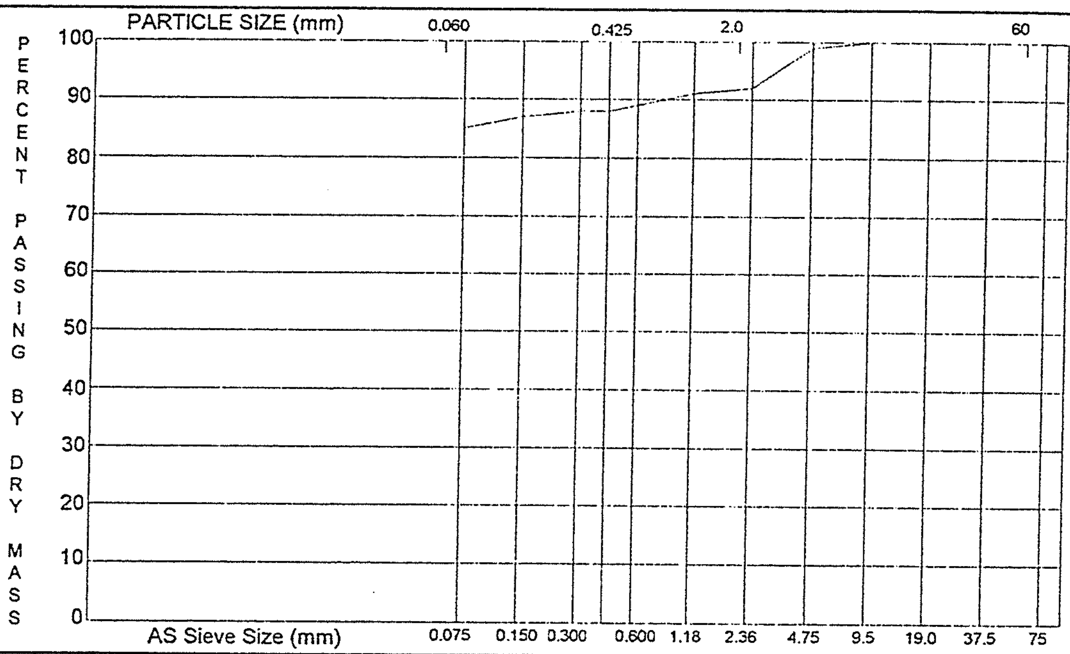
Fax: 07 3849 4705

SOIL TEST RESULTS

Client : CMPS & F
Project : Mt. Pleasant Reject Dam
Feature :
Location : Site 2 BHP 2 (0.8 - 1.4m)

Report No : M2435
Job No : MF-0480
Reg'n No : M1871/96
Senders No :
Date Received: 17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	100
4.75	99
2.36	92
1.18	91
0.600	89
0.425	88
0.300	88
0.150	87
0.075	85



INDEX PROPERTIES

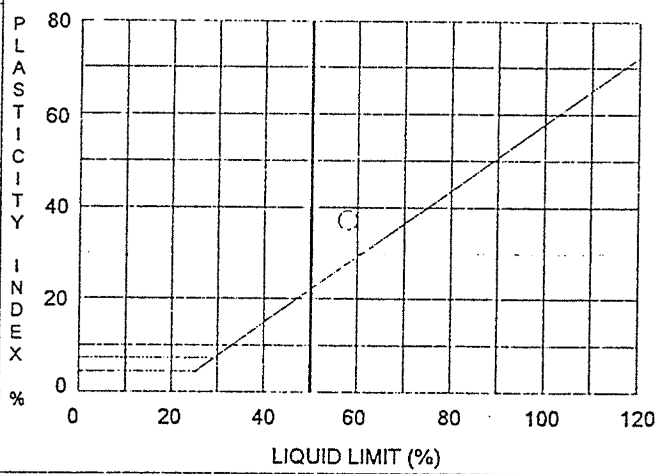
Liquid Limit	58 %
Plastic Limit	21 %
Plasticity Index	37 %
Linear Shrinkage (LS)	16.0 %
Length of LS Mould	125 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³

EMERSON CLASS NUMBER

Emerson Class No.	4
Water Type Used	Distilled
Water Temperature	23 °C



Insitu Moisture Content %

Remarks :
Material Description : Sandy CLAY (CH) light brown fone to coarse sand

Test Procedure/s : AS 1289 ~~2.1.1~~, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, C8.1

Prepared by : MK

Checked by : HP

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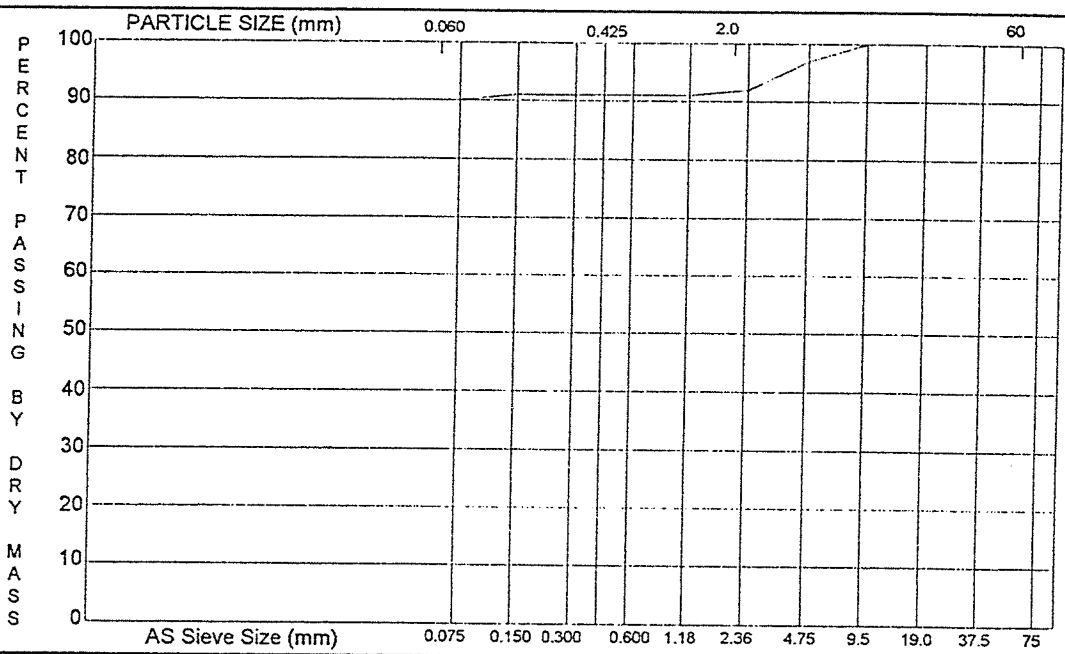
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client : CMPS & F
Project : Mt. Pleasant Reject Dam
Feature :
Location : Site 2 BHP 2 (1.4 - 2.5m)

Report No : M2435
Job No : MF-0480
Reg'n No : M1872/96
Senders No :
Date Received: 17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	100
4.75	97
2.36	92
1.18	91
0.600	91
0.425	91
0.300	91
0.150	91
0.075	90

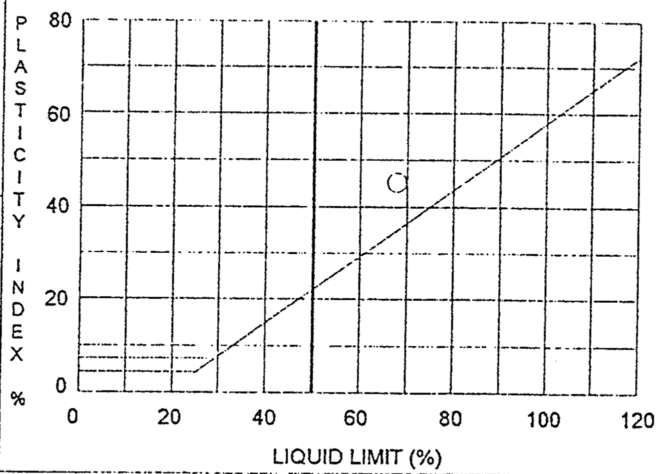


INDEX PROPERTIES

Liquid Limit	68 %
Plastic Limit	23 %
Plasticity Index	45 %
Linear Shrinkage (LS)	18.0 %
Length of LS Mould	126 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³



Insitu Moisture Content 16.4 %

Remarks :
Material Description : CLAY (CH) light brown

Test Procedure/s : AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, ~~C8.1~~

Prepared by : MF
Checked by : HP

NATA No. 1446

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Soils and Engineering Materials Testing

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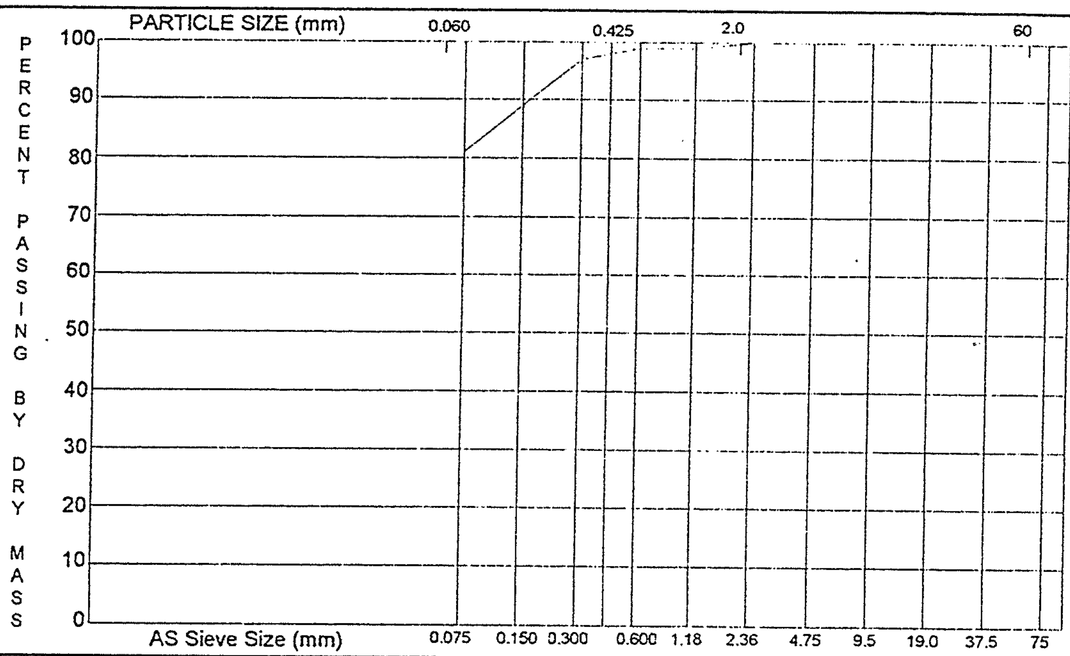
1/51 Secam Street
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client : CMPS & F
Project : Mt. Pleasant Reject Dam
Feature :
Location : Site 2 BHP 3 (0.2 - 0.7m)

Report No : M2435
Job No : MF-0480
Reg'n No : M1873/96
Senders No :
Date Received: 17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	99
0.425	98
0.300	97
0.150	89
0.075	81

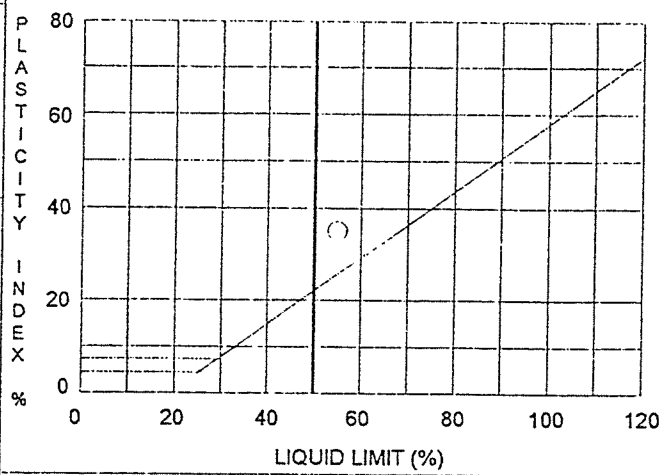


INDEX PROPERTIES

Liquid Limit	55 %
Plastic Limit	20 %
Plasticity Index	35 %
Linear Shrinkage (LS)	17.5 %
Length of LS Mould	125 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³



Insitu Moisture Content 16.8 %

Remarks :
Material Description : CLAY (CH) reddish brown

Test Procedure/s : AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, ~~C8.1~~

Prepared by : NF
Checked by : HP

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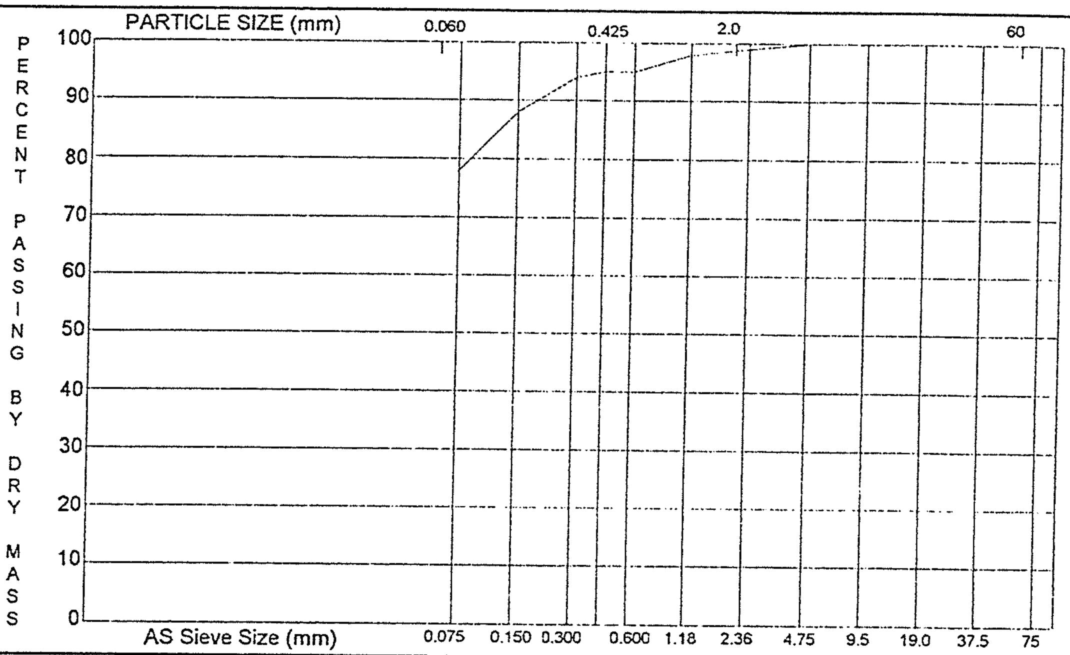
MANSFIELD Q 4122
Tel: 07 3343 3166
Fax: 07 3849 4705

SOIL TEST RESULTS

Client : CMPS & F
Project : Mt. Pleasant Reject Dam
Feature :
Location : Site 2 BHP 3 (0.7 - 1.4m)

Report No : M2435
Job No : MF-0480
Reg'n No : M1874/96
Senders No :
Date Received: 17/12/96

Sieve Size (mm)	Percent Passing
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	100
2.36	99
1.18	98
0.600	95
0.425	95
0.300	94
0.150	88
0.075	78

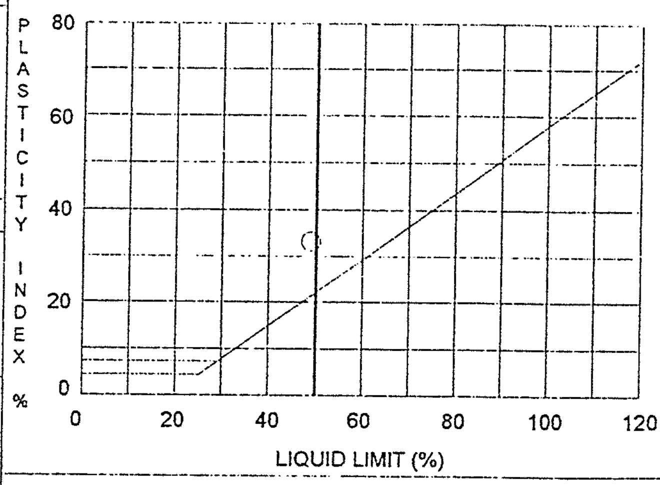


INDEX PROPERTIES

Liquid Limit	49 %
Plastic Limit	16 %
Plasticity Index	33 %
Linear Shrinkage (LS)	15.0 %
Length of LS Mould	125 mm

SOIL PARTICLE DENSITY

Material Passing 2.36mm	t/m³
Material Retained 2.36mm	t/m³
Total	t/m³



Insitu Moisture Content 10.0 %

Remarks :
Material Description : CLAY (CI) brown

Test Procedure/s : AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1, ~~C5.1~~, 3.6.1, ~~C8.1~~

Prepared by : NF
Checked by : HA

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APPENDIX 3

Summary of Visual Classifications
of disturbed near surface samples
recovered during Exploration Drilling
in Area of Authorisation A459 by
Coal & Allied

Vimbury Pty Ltd A.C.N. 010 826 561
EARTHTECH LABORATORIES
Geotechnical and Environmental Engineering
Soils and Engineering Materials Testing

1/51 Secam Street, Mansfield Q 4122
Tel: (07) 3343 3166; Fax: (07) 3849 4705
NATA No. 1446

INSITU SOILS PROFILES

Client: CMPS & F — Report. No : M
Project : Mt. Pleasant Mine — Job No : MF 0480

Location	Depth	Material Description
B250 / 3000	@ 1.0m	Clayey SAND/Sandy CLAY(SC/CI); med-fine grained; med plasticity fines; light reddish brown, some grey.
B250 / 3000	@ 2.0m	Clayey SAND(SC); med-fine grained; med plasticity fines; light reddish brown and brown.(residual sandstone)
B250 / 3000	@ 3.0m	Silty SAND(SM); coarse-fine grained; low plasticity fines; light brown.(residual sandstone)
B250 / 3000	@ 4.0m	Well graded SAND(SW); corse-fine grained; few fines; light brown. (insitu sandstone)
B250 / 3000	@ 5.0m	Clayey SAND(SC); coarse-fine grained; med plasticity fines; light brown.(insitu sandstone)
B250 / 3000	@ 6.0m	Well graded/Silty SAND(SW/SM); coarse-fine grained; low plasticity fines; light brown. Trace 'weak' Gravel. (insitu sandstone)
B750 / 3000	@ 1.0m	Silty CLAY(CH); high plasticity; dark reddish brown. Trace fine Gravel.
B750 / 3000	@ 2.0m	Silty CLAY(CH); high plasticity, light brown, trace of grey. Trace 'weak' fine Gravel. (residual mudstone)
B750 / 3000	@ 3.0m	Silty CLAY(CH); high plasticity; light brown, some grey. Trace 'weak' fine Gravel. (insitu mudstone)
B750 / 3000	@ 4.0m	Silty CLAY(CH); high plasticity; light brown, some grey. Trace 'weak' fine Gravel. (insitu mudstone)
B750 / 3000	@ 5.0m	Silty CLAY(CI); med plasticity; grey, somelight brown. Trace 'weak' fine Gravel. (insitu mudstone)
B750 / 3000	@ 6.0m	Silty CLAY(CI); med plasticity; grey, some reddish brown. Trace 'weak' fine Gravel. (insitu mudstone)
B750 / 3000	@ 7.0m	Silty CLAY(CI); med plasticity; grey. Trace 'weak' fine Gravel.(insitu mudstone)
C250 / 3000	@ 1.0m	Silty CLAY(CI); med plasticity; some fine Sand; dark grey and reddish brown.(some organic matter and odour)
C250 / 3000	@ 2.0m	Silty CLAY(CH); high plasticity; light brown. Trace 'weak' fine Gravel. (residual mudstone)
C250 / 3000	@ 3.0m	Silty CLAY(CH); high plasticity; light brown some grey. Trace 'weak' fine Gravel. (insitu mudstone)
C250 / 3000	@ 4.0m	Silty CLAY(CH); high plasticity; light brown some grey. Trace 'weak' fine Gravel. (insitu mudstone)
C250 / 3000	@ 5.0m	Silty CLAY(CI); med plasticity; reddish brown and grey. Trace 'weak' fine Gravel. (insitu mudstone)
C250 / 3000	@ 6.0m	Silty CLAY(CI); med plasticity; reddish brown some grey. Trace 'weak' fine Gravel. (insitu mudstone)
C250 / 3000	@ 7.0m	Silty CLAY(CI); med plasticity; grey some reddish brown. Trace 'weak' fine Gravel. (insitu mudstone)

Remarks : Samples are from washed bores, thus moisture conditions are unattainable.

Prepared by : HP — Checked by : NF

APPENDIX 4

Brief Report on Seismic Hazard
Muswellbrook Area

CERA

The Centre for Earthquake Research in Australia

BRISBANE and NEWCASTLE

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QUEENSLAND 4068 AUSTRALIA
Telephone : +61 7 3374 2260
Facsimile : +61 7 3878 1252
Directors : Dr Jack Rynn (Research)
Mr Peter Hughes
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Directors : Mr Harold Stuart
Mr Ian Pedersen

CERA PTY LTD - ACN 057 393 441

2 January 1997
Ref : CERA/ETL-MM/JR-005

ADDENDUM TO SEISMIC HAZARD MUSWELLBROOK AREA

3.1: Earthquake Hazard in Australia

The earthquake hazard for Australia has been reported in the study of Gaull et al (1990). FIGURE 1 shows this in terms of peak ground accelerations. This was then the basis for the Australian Standard AS1170.4-1993 where the modified map of acceleration coefficients, FIGURE 2, was prepared.

In terms of global seismicity, Australia is a continental (or intra-plate) regime considered to have low to moderate seismic activity. This means that, in terms of the historic record of earthquakes, Australia does not have the frequency of large damaging earthquakes as those in the very active plate margin regions (such as California, New Zealand, Japan etc). Relative to other continental regions on Earth, Australia has been considered as one of the most active intra-plate areas (Gibson, 1994).

However, the earthquake record does show that Australia has indeed experienced several major damaging earthquakes since European settlement (in the period 1788 through 1996). The Earthquake Hazard Maps are based on parts of this seismological record.

Note : (i) The Gaull et al (1990) study covered the period 1788 - 1985 - and so did not include the 1989 Newcastle earthquake;
(ii) AS1170.4-1993 attenuation coefficients map was modified to include earthquakes up through 1989 (and hence the 1989 Newcastle earthquake).

The relationship of the earthquake hazard with potentially high hazard dams was considered by Fell (1994). Such arguments have been considered in the ANCOLD guidelines on risk assessment (ANCOLD, 1994). However, **CAUTION** must be exercised in such situations (that is, re dam safety) as many questions, both seismological and engineering, are not considered to be satisfactorily answered at this time (pers. comm., R. McConnell, Queensland Department of Natural Resources (Water Resources Commission), December 1996).

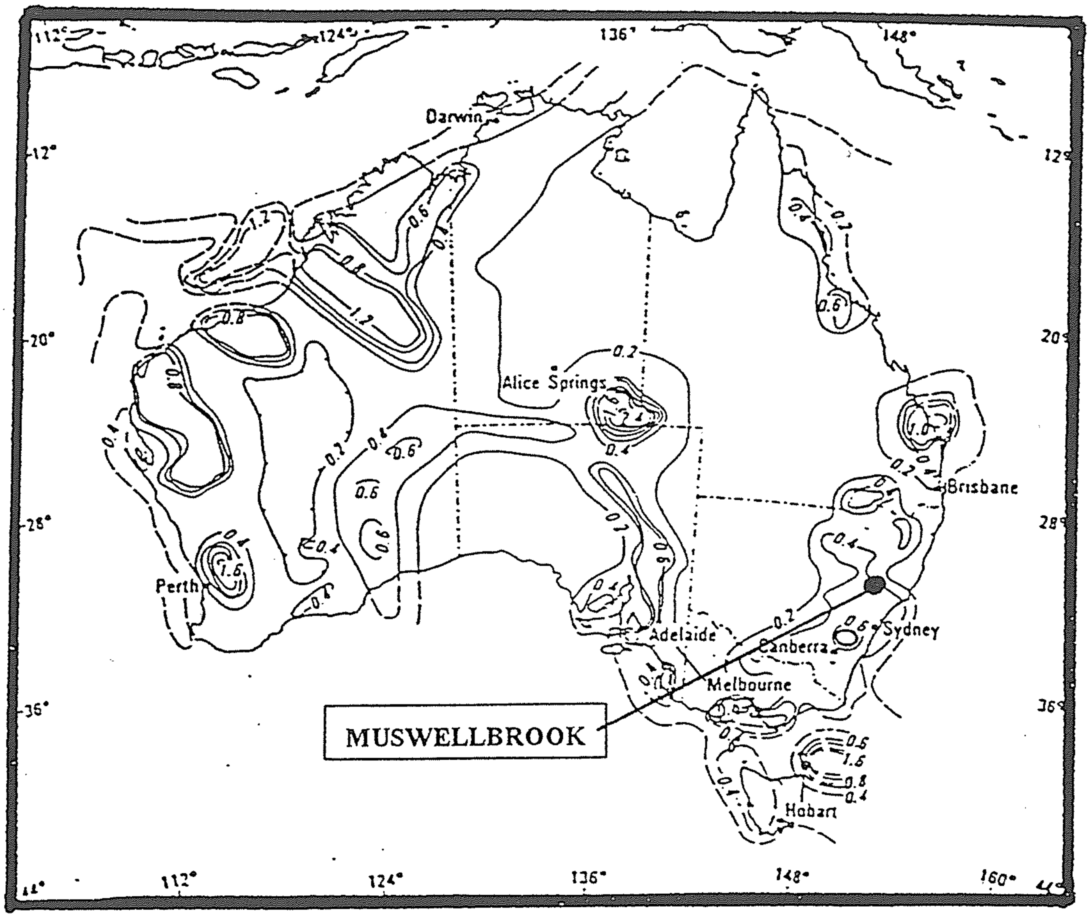

Figure 5: Probabilistic earthquake hazard map for Australia in terms of peak ground acceleration ($msec^{-2}$) with 10% chance of being exceeded in a 50 year period

FIGURE 1 : SEISMIC HAZARD MAP FOR AUSTRALIA
(From Gaull et al, 1990)

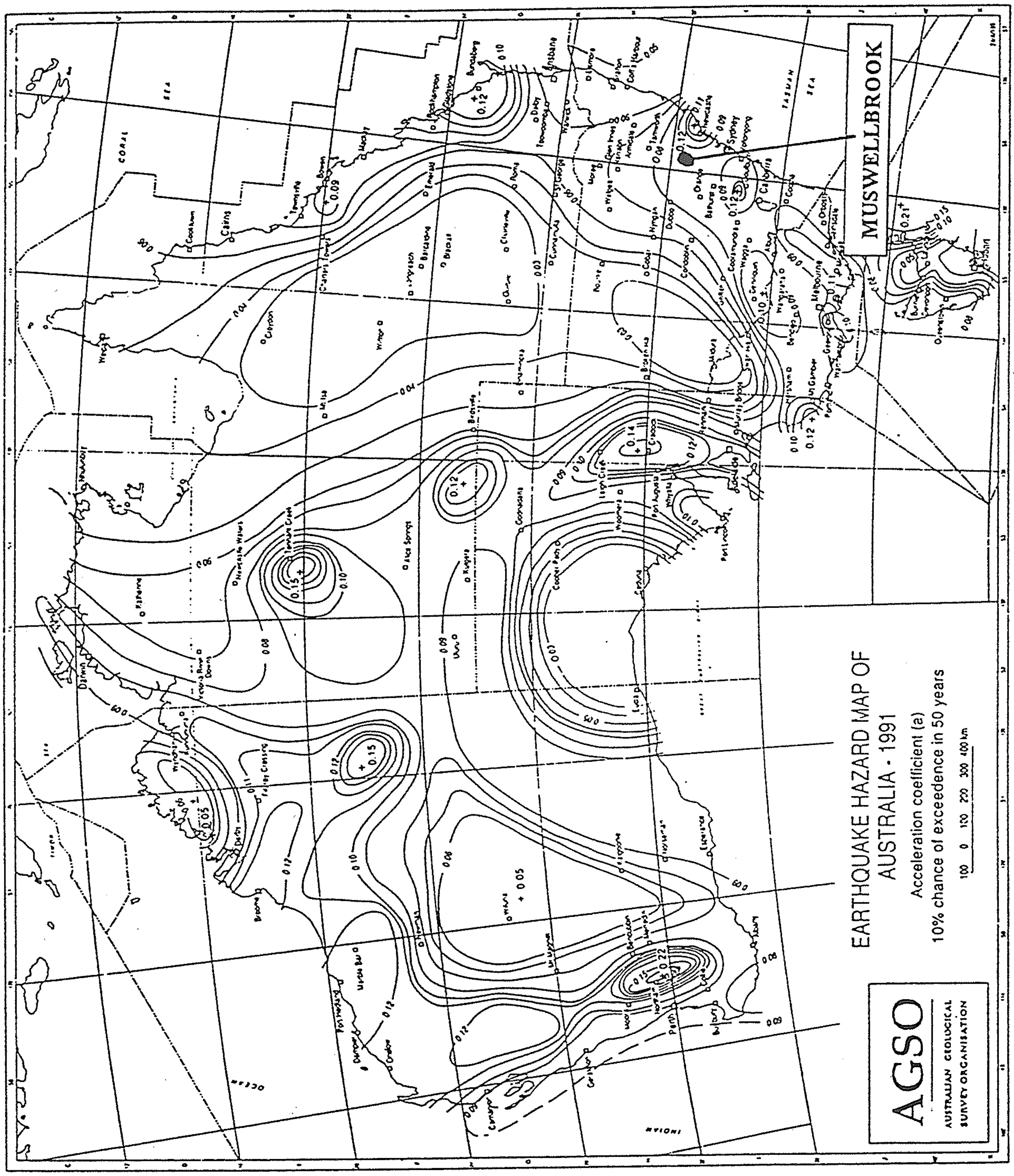

FIGURE 2.3(a) ACCELERATION COEFFICIENT MAP OF AUSTRALIA

FIGURE 2 : SEISMIC HAZARD MAP FOR AUSTRALIA - ACCELERATION COEFFICIENTS PER AS1170.4-1993
(From Standards Australia AS1170.4-1993)

3.2: Earthquake Hazard in Muswellbrook Area

The earthquake hazard of the Muswellbrook area has been considered, in a regional sense, within the CERA studies of earthquake mitigation for the Sydney region (CERA, 1992) and the City of Newcastle (CERA, 1996), in terms of the Lower Hunter Valley.

(Note : This was not intended as a rigorous study of the Lower Hunter region, which includes the Muswellbrook area)

The level of seismic activity in the Muswellbrook area is considered as low. This is shown in FIGURE 3 for instrumental locations of earthquakes of all magnitudes during the period 1958 through 1993.

However, in terms of significant (damaging) earthquakes in a regional sense (Sydney-Newcastle-Lower Hunter region), the two recent CERA studies thereon indicate that the potential for future earthquake damage in the Lower Hunter is a real entity (FIGURES 4,5). It is important to recognize that potential earthquake damage cannot only result from an earthquake occurrence near to a site in question, but also be sustained from a more distant (or regional) earthquake. This was clearly manifested in the 1989 Newcastle earthquake (even though of moderate Richter magnitude ML 5.6) where Modified Mercalli intensities of MM5-6 were assigned to effects in the Lower Hunter (Maitland to Muswellbrook) at distances of 50 to 100 km from the epicentral area near Newcastle (Rynn et all, 1992; FIGURE 6).

Considering the seismic hazard map for Australia, in the light of the more detailed regional studies, it is possible that the seismic hazard in the Muswellbrook area may be underestimated. A more rigorous study of this area in detail, similar to that for the City of Newcastle (CERA, 1996) is thus considered to be warranted.

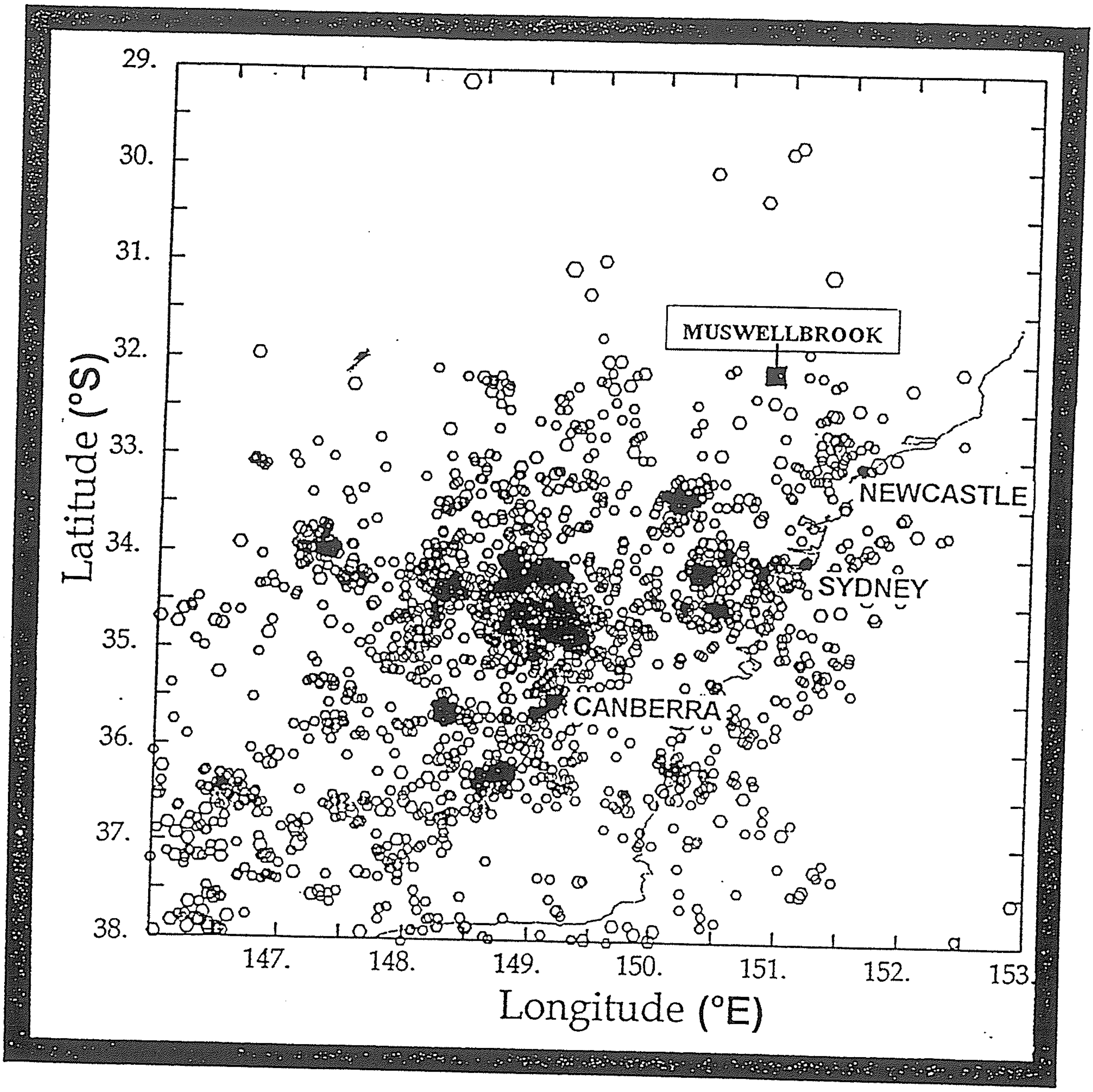

FIGURE 7a : REGIONAL EXTENT OF SEISMICITY (TO SOUTH AND WEST) DEFINED FOR EARTHQUAKE ZONATION OF THE CITY OF NEWCASTLE - AUSTRALIAN NATIONAL UNIVERSITY INSTRUMENTAL DATA 1958-1993 FOR ML> 1.0
(J. Weekes, pers. comm., 1993)

FIGURE 3 : SEISMICITY OF NSW 1958 - 1993 BASED ON AUSTRALIAN NATIONAL UNIVERSITY INSTRUMENTAL DATA
(From CERA, 1996)

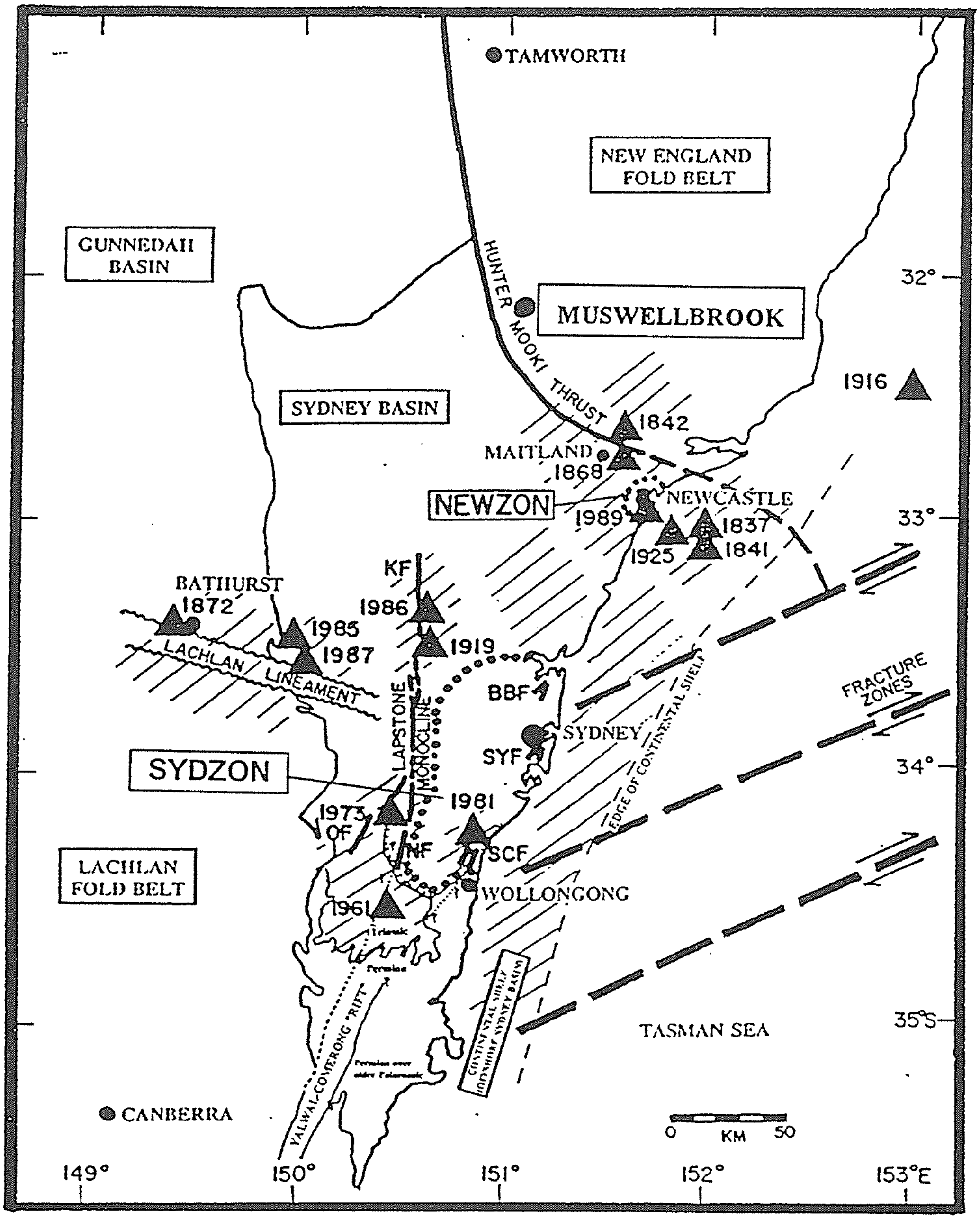

FIGURE 54 : CAUSAL RELATIONSHIPS - EARTHQUAKE ACTIVITY (BROAD HATCHING AND SIGNIFICANT EARTHQUAKES AS TRIANGLES) AND MAJOR GEOLOGICAL FEATURES
(a) BROAD-SCALE REGION VIEW (SYDNEY BASIN)

FIGURE 4 : SIGNIFICANT EARTHQUAKES AND POTENTIAL EARTHQUAKE SOURCES IN THE SYDNEY BASIN AND SURROUNDING REGION (From CERA, 1992)

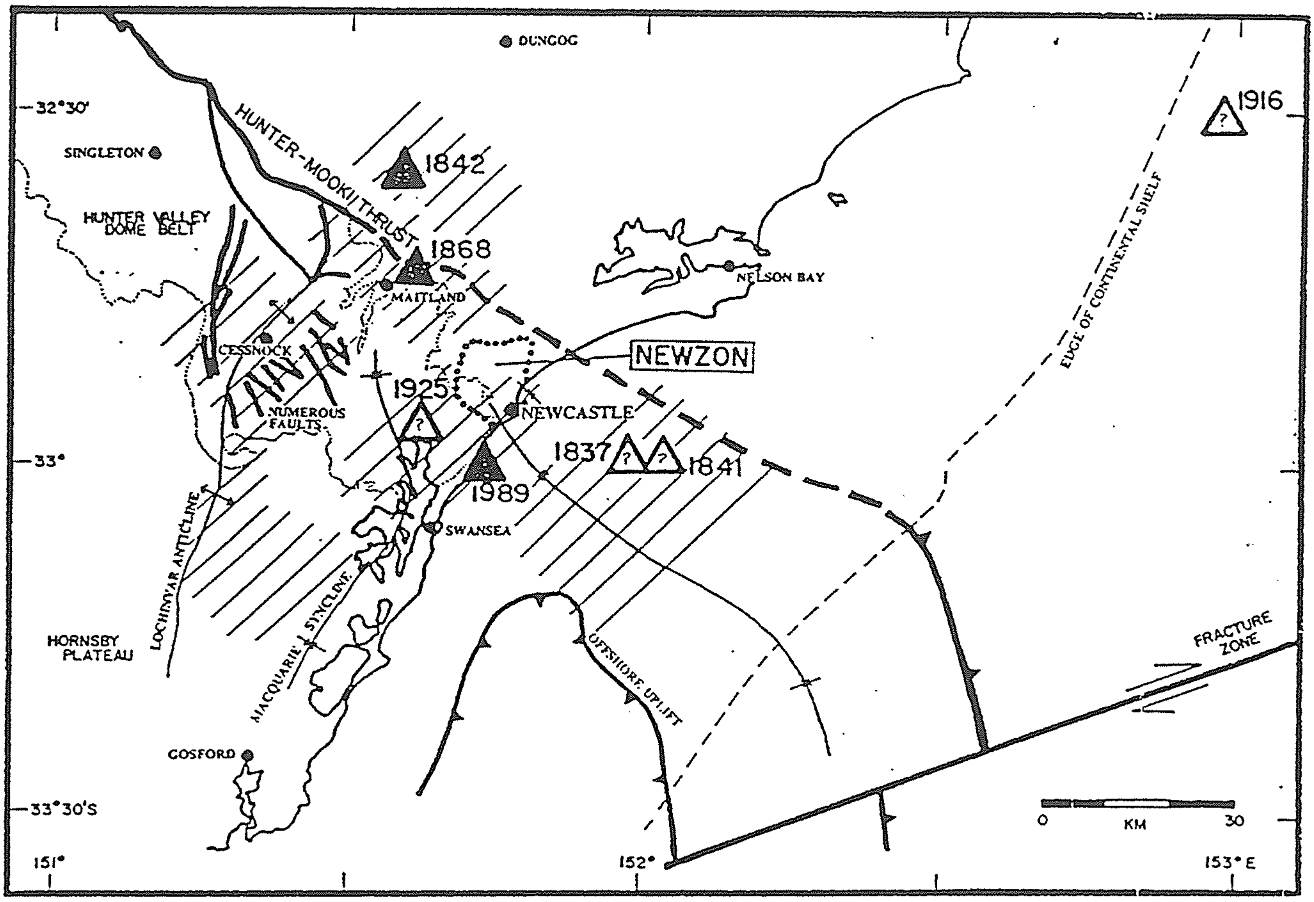

FIGURE 54 : CAUSAL RELATIONSHIPS - EARTHQUAKE ACTIVITY (BROAD HATCHING AND SIGNIFICANT EARTHQUAKES AS TRIANGLES) AND MAJOR GEOLOGICAL FEATURES
(b) NEAR-FIELD FOR NEWZON REGION (LOWER HUNTER)

NEWZON NCC/CERA-IDNDR MAR95 JR 102

FIGURE 5 : SIGNIFICANT EARTHQUAKES AND POTENTIAL EARTHQUAKE SOURCES IN THE NEWCASTLE AND LOWER HUNTER REGIONS (From CERA, 1996)

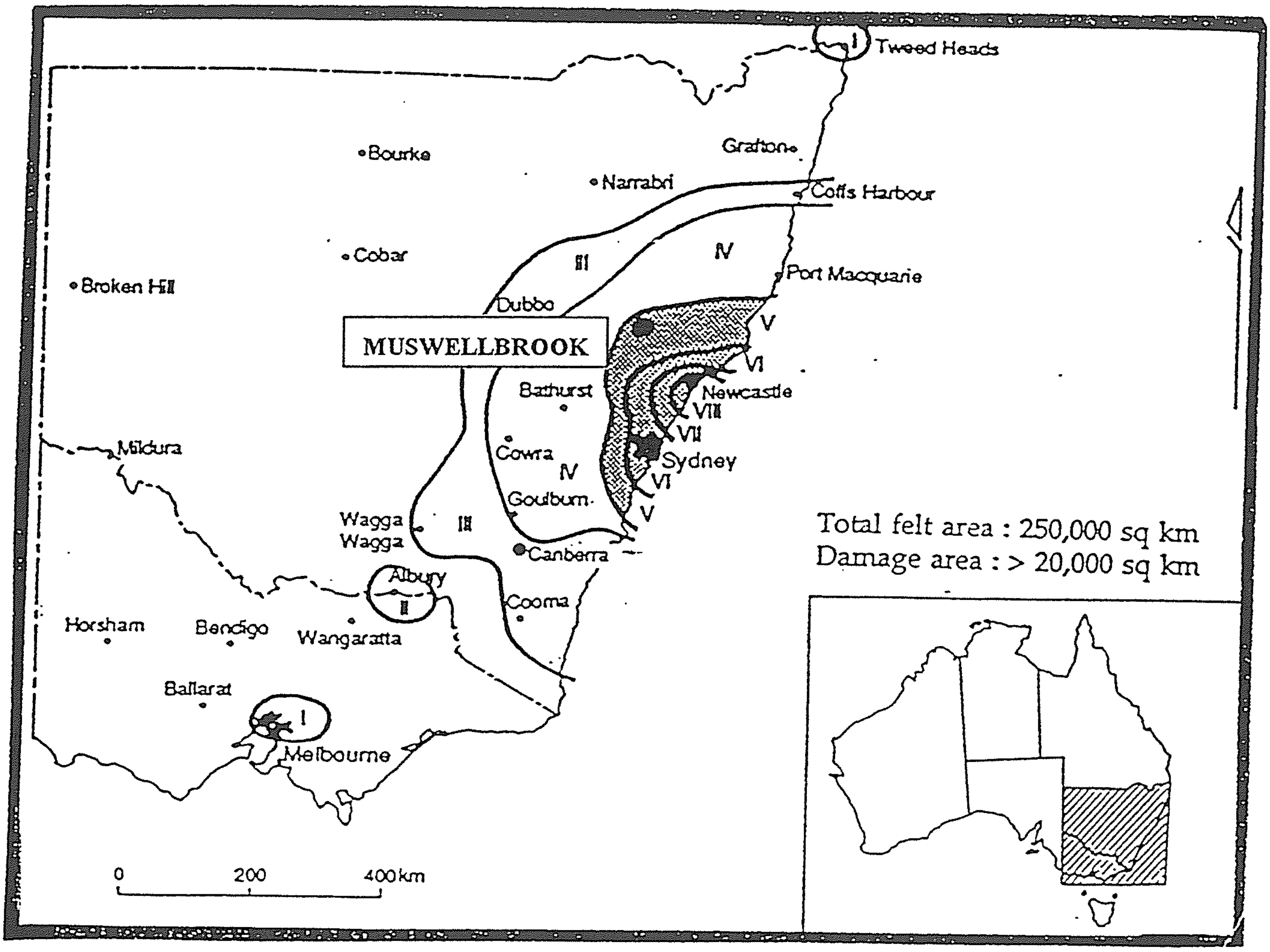

FIGURE 6 : ISOSEISMAL MAP (ASSIGNED MODIFIED MERCALLI INTENSITIES MM TO EARTHQUAKE EFFECTS) FOR THE 1989 ML 5.6 NEWCASTLE EARTHQUAKE (From Rynn et al, 1992)

REFERENCES

ANCOLD, 1994 : "Guidelines on Risk Assessment", Section 4.2.2 : "Application of Risk Assessment - Seismic", p.63.

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Mt Pleasant Project
Fine Reject Storage

Drawing MQ0112-C01	Fine Reject Storage - To Year 25 Plan & Longitudinal Sections
Drawing MQ0112-C02	Fine Reject Storage - To Year 10 Plan & Longitudinal Sections
Drawing MF0480-1	Environmental Dam Site 2 - Backhoe Pit Locations
Drawing MF0480-2	Environmental Dam Site 3 - Backhoe Pit Locations
Drawing MF0480-3	Locality Plan Showing Approximate Location of Drawing MF0480-4
Drawing MF0480-4	Location of Exploration Boreholes Sampled for Potential Construction Materials

COAL & ALLIED

COAL FINE REJECT STORAGE FACILITY

APPENDIX B

MOUNT PLEASANT PROJECT GEOTECHNICAL ASPECTS OF PROPOSED FINE REJECTS DAM

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MOUNT PLEASANT PROJECT GEOTECHNICAL ASPECTS OF PROPOSED FINE REJECTS DISPOSAL SYSTEM

Report Number 97003-2
June 1997

1. INTRODUCTION

This Sherwood Geotechnical and Research Services Report Number 97003-2 replaces an earlier report 97003-1 issued in February 1997. Since the earlier report, SGRS has completed a major study of coarse rejects at a Bowen Basin mine site which has resulted in more definitive comments being possible about the use of coarse rejects for retaining structures. In light of the time since the earlier report it was felt desirable to consolidate final information for the Mount Pleasant project studies.

This report describes likely geotechnical characteristics of the fine rejects disposal scheme proposed for the Mount Pleasant Project. It was commissioned by CMPS & F Pty Ltd on behalf of Coal & Allied Operations Pty Ltd. It provides input for use by CMPS & F and for possible inclusion in an EIS for the project.

Consideration had previously been given to implementing a fine and coarse rejects codisposal scheme for Mount Pleasant. Following revisions to the project layout, the finalised proposal consists of a sequence of retaining embankments constructed from coarse rejects, impounding beached deposits of fine rejects which will be deposited from a slurry pipeline. Downstream of the retaining embankments will be an environmental dam to retain runoff water. Details of the retaining system are described elsewhere.

2. PREVIOUS CODISPOSAL PROPOSALS

Refs. 1, 2, and 3 describe a variety of methodologies relating to codisposal. It must be noted that options described in the CMPS & F project studies of Ref. 1 have been totally set aside by the current proposal. However, some of the observations made in Refs. 2 and 3 may be relevant to the current retaining scheme, particularly in relation to potential beach slope, seepage, and slope stability conditions to be considered for final design.

Codisposal provides the advantages of broader particle size distribution and more rapid drainage, leading to potentially rapid and simple rehabilitation. Disadvantages include requirements for large volumes of water, and high discharge velocities, leading to potentially large-scale segregation of fines, because the coarse and fine rejects are normally transported together.

3. PROPOSED FINE AND COARSE REJECTS DISPOSAL SCHEME

The fine rejects stream will be pumped from the Coal Preparation Plant (CPP) to a discharge point located within the storage of each retaining structure. This discharge point may be moved from time to time in order to optimise deposition within each storage. The coarse rejects stream will be conveyed from the CPP by truck, and may thus be dumped at convenient stockpile locations or deposited directly to construction areas from time to time.

Decant water will be collected from within the storage of each retaining structure. Significant seepage is also expected through each retaining structure, and this will be collected as convenient locations downstream, and/or ultimately from the environmental dam.

By careful management of the storages, and optimisation based on monitoring all aspects of performance of the system, the storage space occupied by high moisture content, non-sedimented fines will be minimised. Using the same principles, the area of beached fine rejects will be maximised. The beach surfaces will be progressively capped with coarse rejects, enabling rehabilitation of these surfaces to proceed as the storage system is developed over the proposed life of the facility.

Within the catchment of the entire facility, there will be a number of activities taking place during the operating life that will require appropriate design and monitoring to meet occupational health and safety criteria.

4. GEOTECHNICAL ISSUES RELEVANT TO THE PROPOSED SCHEME

Sketches 1 and 2 should be reviewed in association with the following descriptions.

4.1 Beaching and Progressive Rehabilitation Elements

The fine rejects stream will consist of a certain proportion of fine sand-sized particles, and will be pumped at a slurry solids density that is as high as practicable, and likely to be about 40%. Provided that the discharge velocity is kept low, preferably well less than 1 m/s, beaching action of the material will be enhanced, segregation of slimes will be minimised, and dewatering will be maximised. Beach angles of greater that 2° are expected near the discharge, and less than 0.5° near free decant water.

Inevitably there will be some segregation of non-sedimented fines, but an important objective of early operations will be to minimise segregation. Apart from maintaining a sand-size component in the slurry, and maintaining as high a slurry solids density as possible, dewatering is likely to be maximised by maintaining decant water levels as low as practicable within the storage. This implies that the decant recovery processes must be maintained at a surface elevation as low as possible below the slurry pipeline discharge point.

The majority of the beached area will form a series of coalesced lobes or deltas which will remain untrafficable while the free water level in the deposit is within 0.5 to 1.0 metres of the surface. After discharge ceases, and provided that decant and drainage from the deposited areas is maximised, the surface of the lobes will form a crust that will dry back and crack over a period of some weeks. This surface will be trafficable after some time, provided that a capping layer of the order of 1 metre thickness of coarse rejects is used as a bridging medium and construction platform for extending the capped area.

It is expected that during the capping operations, there will be softer areas where the crusted deposit surface will deform, with concerns about trafficability for the capping operation. Similar concerns may develop after a period of wet weather. The capping operations will be planned so that a broad front will always be available for work, enabling softer and deformed areas to be left to stabilise for some period. These deformations are due to reduction of bearing capacity caused by temporary generation of excess pore pressures due to the rate of loading. The time taken for such effects to dissipate will be assessed as part of the early monitoring program, by means of trial embankments.

In the event that areas of very soft and wet fine rejects develop and prove to be difficult to decant or drain, it is proposed to introduce layers of dumped coarse rejects, preferably using a loader and a light dozer, to provide drainage and stiffening so that the overall program for progressive rehabilitation can be maintained. In the worst situation that can be envisaged, limited areas of the fine rejects storage will be treated by interlaying coarse rejects over soft segregated fines. It is suggested that, based on coal industry experience with capping and raising of tailings dams using rejects over soft slimes, the worst scenario would be lifts of up to 5 metres of slimes interlaid with 1.5 to 2 metres of coarse rejects. In working such areas particular care would be taken to maintain stability and prevent break-through by construction plant.

It is expected that the majority of the fine rejects will be progressively rehabilitated using a coarse rejects capping layer of the order of 1 metre thickness. In softer areas where some deformation of the fine rejects occurs during capping, the capping may end up being up to three metres thick. It is intended that capping trials will be conducted as part of the early monitoring program.

4.2 Retaining Structure Elements

The retaining structures will be constructed progressively from coarse rejects materials. The design of the structures will be based on promoting as much seepage from the storage area as possible, whilst minimising any destabilising effects due to seepage flow. Seepage will be maximised for loose deposits of coarse rejects, while stability will be enhanced through compaction of the coarse rejects. Since coarse rejects is an inherently strong material, the development of appropriate criteria for seepage and for densification during detailed design is not regarded as difficult.

Typically, loose-dumped rejects will stand at slopes ranging from 33° to 40°, with steeper slopes achievable over limited heights through appropriate compaction and trimming. A mean angle of repose of 35° should therefore be adopted for design of the upstream batters of retaining structures, since this best reflects widespread industry experiences.

When there are no specific underdrainage provisions, typical downstream slopes of coarse rejects embankments subject to seepage outflows are adequately stable at overall slopes of 1(V):2(H). Slopes flatter than this have only been observed locally following small slips caused by excavation-induced oversteepening. Since there will be no oversteepening of the proposed configurations for Mount Pleasant, 1(V):2(H) should be adopted for design of downstream slopes.

Final design of the retaining embankments will take into account stability under a full range of criteria applying during construction, operation, capping, and rehabilitation.

The mechanism of transmission of seepage from the fine rejects storage through the retaining embankments will be analysed and tested as part of detailed design. Segregated fines, together with self-weight compaction during wetting-up, will act to reduce the effective permeability of the coarse rejects. Based on coal industry experience, the wetted face of the retaining structure will become clogged unless specific filtration zones are introduced. Most seepage water will be 'skimmed' from the surface of the decant area.

The preferred option for managing seepage will be limitations on compaction of the coarse rejects placed in the embankment. This may lead to zonation of the embankment, by variation of compaction standards, in order to simultaneously satisfy criteria for stability of the structure under seepage and earthquake loading. Any specific requirements for seepage and surface runoff control, or capping configurations to address rehabilitation criteria, will be identified and incorporated into the final design.

The potential impacts of any breaching of a retaining structure wall by a combination of severe rainfall event and blockage of bywash channels will be minimised to satisfy regulatory agency criteria. Downstream storages will be sized to accept the discharge from such a breach. In the event of such a breach, the principal damage to the retaining structure is likely to be erosion from water flow, and this has the potential to cause subsequent erosion of the fine rejects deposited in the storage area. Erosion gullies in coarse rejects stockpiles and embankments are expected to form side slopes of 35°, with outwash fans at typical slopes of 10°. The erosion bowl within the fine rejects deposit is expected to be equivalent to an arcuate shape (in plan) defined by a characteristic radial distance from the upstream side of the gully. Based on observations of erosion in coal mine tailings dams and storages, the characteristic radial distance is likely to be less than four times the height of the retaining structure at the gully location.

4.3 Decant Water Recovery Elements

It is expected that there will be significant seepage through the wall of each retaining embankment. Depending on studies undertaken for detailed design, such seepage may not be sufficient to control the decant water level and thus the deposition process for the fine rejects in the storage. Provision has therefore been made for a variety of means for decant water control within each storage. The preferred element(s) will be finalised as part of detailed design, and some possible arrangements are described briefly below.

Decant water and segregated slimes will tend to collect at the low point of the storage area, subject to the flow directions dictated by the discharge arrangement. Maximum decant rates will develop in quiet water conditions of limited surface area. These may be artificially created by sequential dumping of loose rejects to form low leaky walls, trapping slimes without affecting beaching of the fine rejects stream, but allowing clarified water to be collected and returned to the CPP by pumping. In an alternative arrangement, low leaky walls may be aided by 'glory-hole' decant collection pipes used to skim clarified water off into a temporary collection area behind a low wall of dumped coarse rejects.

Another option to be evaluated during detail design is to use a filter zone or filter plug of single-sized stone through the retaining embankment. A cake of fines tends to build up on the upstream side of such a filter, with clarified decant water trickling over the top surface. Such zones can be highly successful, but they introduce complexity for design and construction, and require supervision during operation in order to maximise clarified water recovery.

4.4 Occupational Health And Safety Elements

Dusting will be minimised through a combination of low coarse rejects stockpile heights, watering during construction, and progressive rehabilitation.

Stability design of the retaining structures will include allowances for construction traffic loadings. Crest widths will be designed to include adequate safety bunds wherever they are considered necessary or desirable.

Capping operations will involve trafficking over fill placed upon dried surfaces of fine rejects deposits. Under the dried surface, there may be substantial thicknesses of weak and soft material. The fill thicknesses required to achieve safety against bearing capacity failure (bogging) of construction plant will be determined as part of detailed design, and reviewed during monitoring of initial progressive rehabilitation.

In the event that areas of very soft, wet fine rejects remain to be capped, a very cautious work plan will be developed to ensure that capping progresses incrementally over a wide working front.

Capping is best done under such conditions by loader placement of relatively thick fill prior to dozer working. Truck access will be limited to ensure that there is no likelihood of bogging or punching-through.

5. REQUIREMENTS FOR DETAILED DESIGN

The following matters require detailed evaluation, with testing where necessary, as part of detailed design:

- shear strength of coarse rejects at various densities, including identification of the critical density where liquefaction susceptibility is suppressed;
- shear strength of fine rejects at a range of moisture contents and gradings;
- sedimentation and consolidation characteristics of fine rejects;
- permeability of coarse rejects at a range of gradings, moisture contents, and densities;
- permeability of fine rejects as a function of density;
- liquefaction susceptibility evaluation for fine rejects.

Appropriate filtration, discharge, and slope stability factor of safety criteria for operation of the proposed scheme in accordance with regulatory agency requirements also need to be identified.

6. SUMMARY AND CONCLUSIONS

The proposed fine rejects storage scheme is feasible provided that it can be operated so as to maximise beaching performance and minimise segregation of slimes. There are existing and successful coal mine rejects disposal precedents for all of the issues identified as part of the Mount Pleasant proposal.

The key to successful implementation will be a commitment to successful operation of the entire facility to meet the primary goal of progressive rehabilitation. All of the issues identified can be traced back to meeting this goal. All geotechnical aspects of the proposal are feasible based on coal mining industry experience.

7. REFERENCES

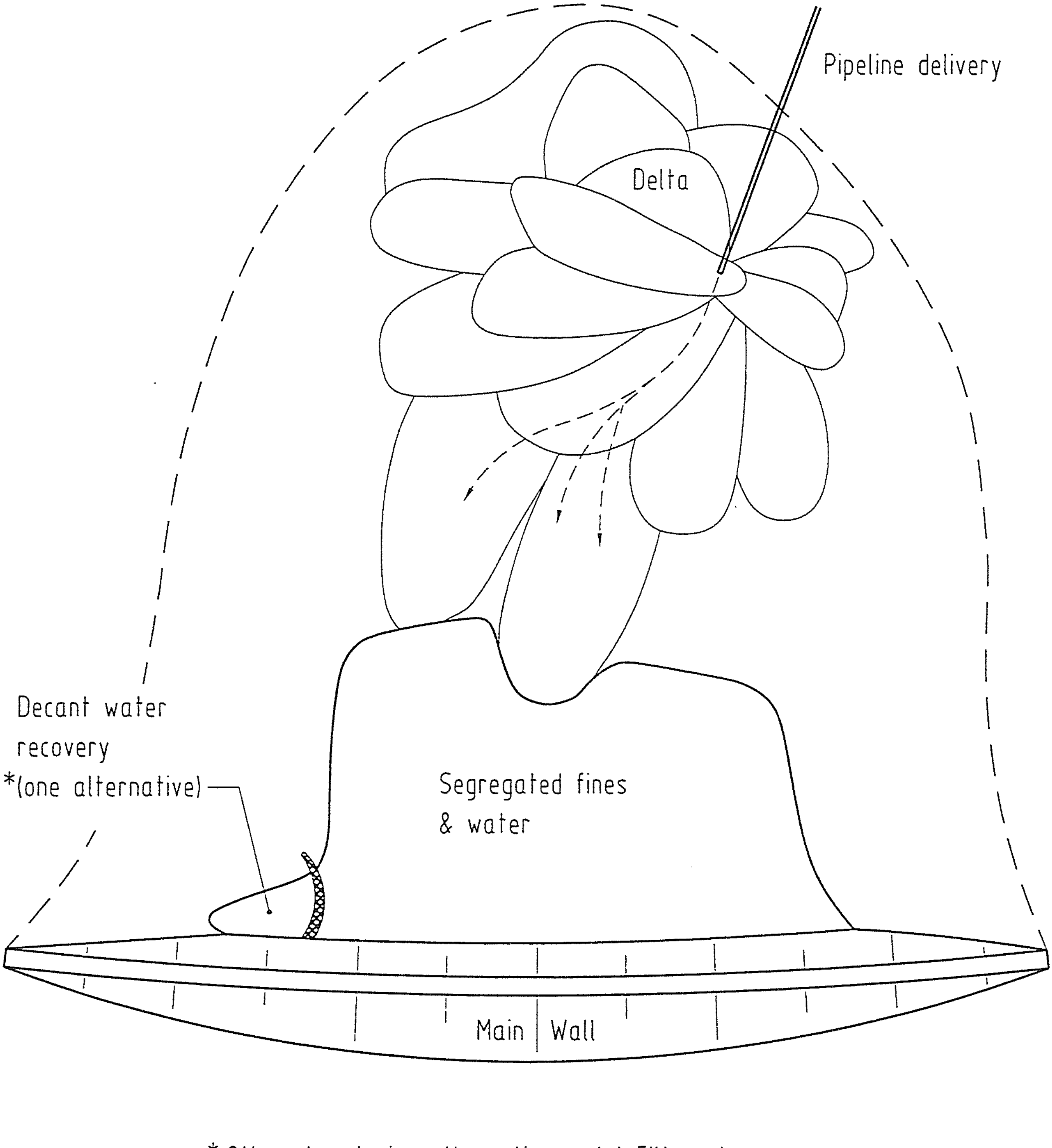
(1) CMPS & F Pty Ltd. Mount Pleasant Project Studies for Review of Permanent Co-Disposal placement and Co-Disposal Re-Handling Options. Report to Coal and Allied Operations Pty Ltd, 29 September 1995.

(2) D J Williams. Suitability of and Conceptual Design for Co-Disposal of Washery Wastes Mt Pleasant Project, 27 October 1994. Report to Coal & Allied Operations Pty Ltd, Ref. 940701, The University of Queensland, Department of Civil Engineering.

(3) D J Williams. Co-Disposal of Washery Wastes Mount Pleasant Project. A: Feasibility of Underdrainage, 27 October 1995. B: Stability of Spoil Pile Containment and Co-Disposal, 18 December 1995. Reports to Coal & Allied Operations Pty Ltd, Ref. 950802, The University of Queensland, Department of Civil Engineering.

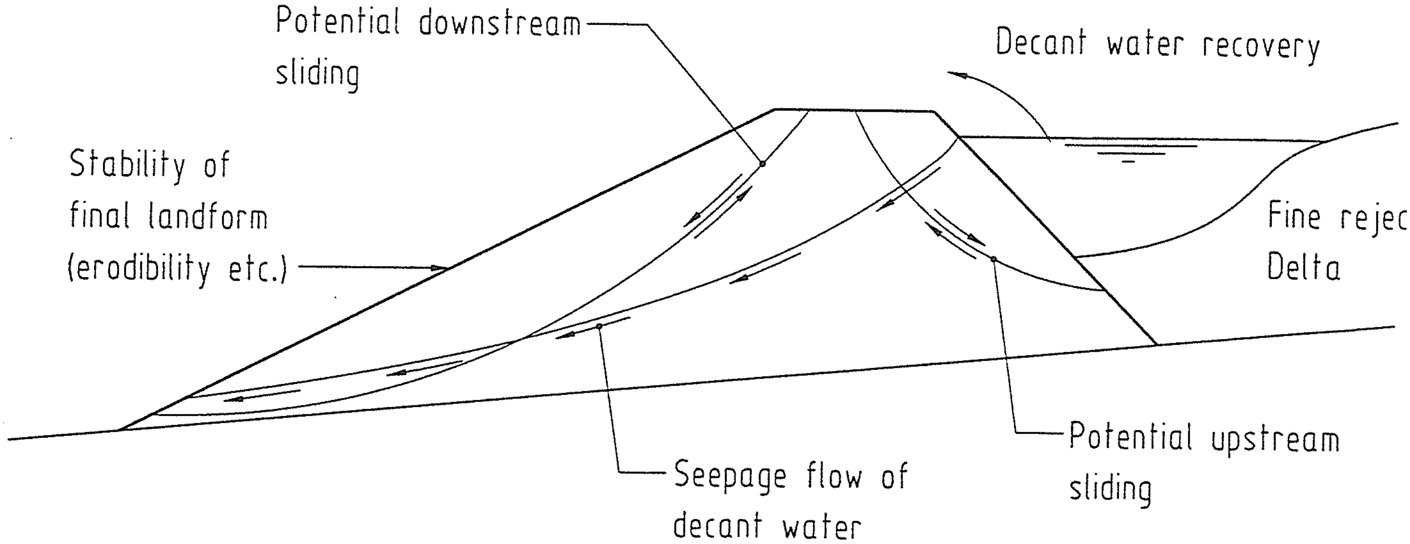
8. SKETCHES

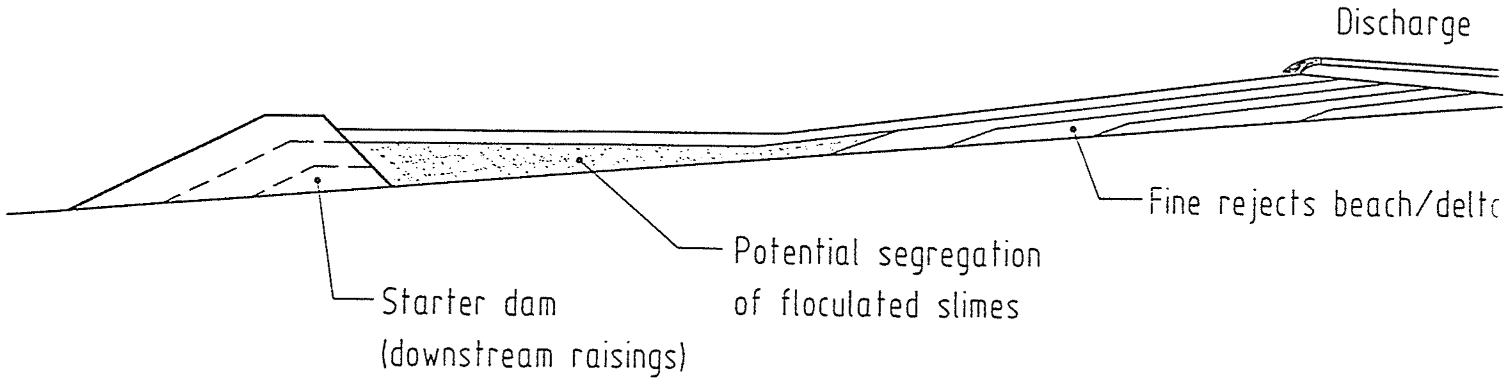
Please refer to two sheets appended, showing a typical plan and sectional view of the proposed facility respectively.



* Other dewatering alternatives : (a) Filter plug
(b) Different bund and water recovery

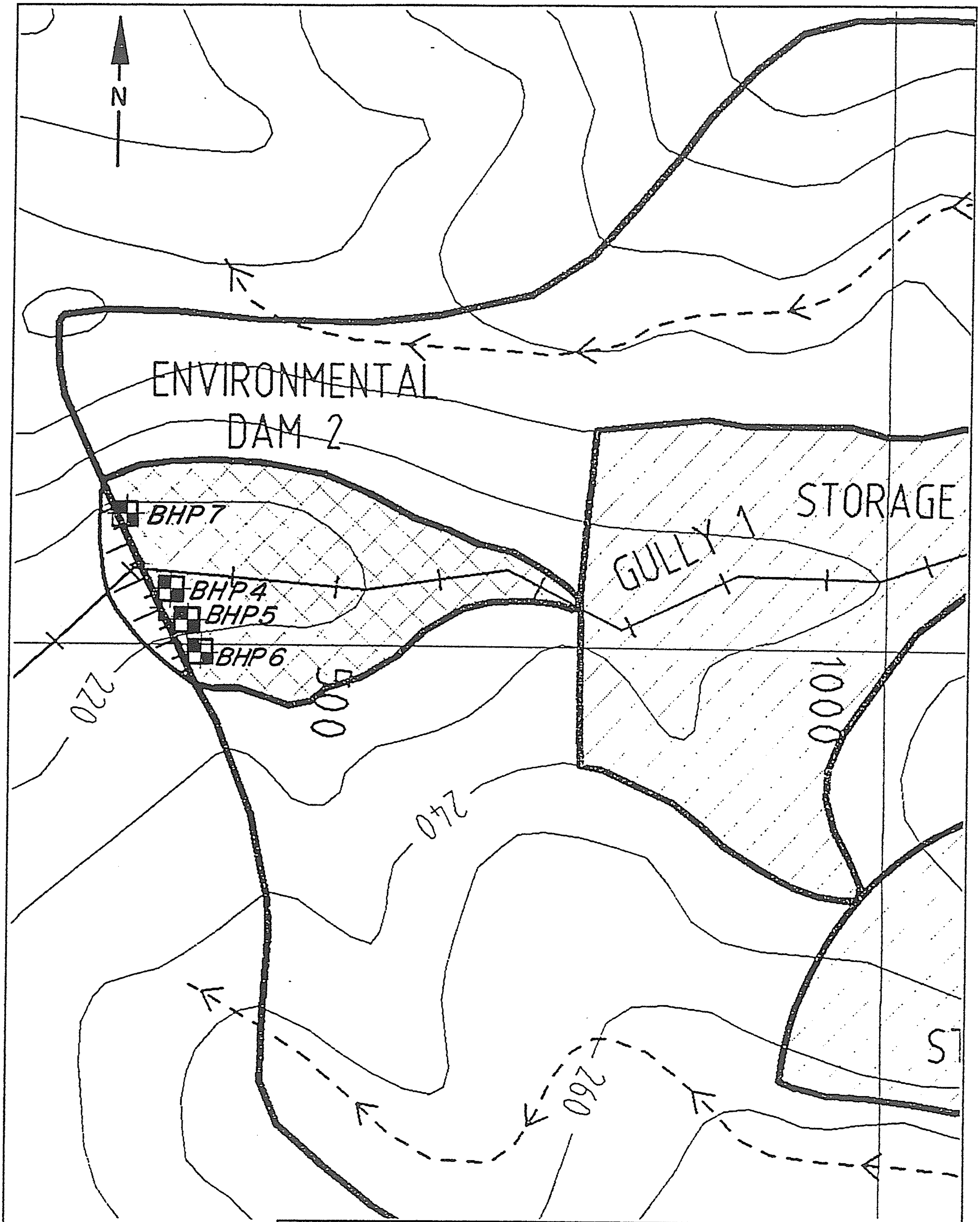
SKETCH 1





Issues for progressive rehabilitation - capping
- consolidation and final landform drainage

SKETCH 2



KEY

Backhoe Pit Location

EARTHTECH LABORATORIES
Geotechnical & Environmental Engineering

DRAWN MM / AB	CMPS & F MT PLEASANT PROJECT - FINE REJECT STORAGE **ENVIRONMENTAL DAM SITE 2 - BACKHOE PIT LOCATIONS**
CHECKED	
DATE January 1997	
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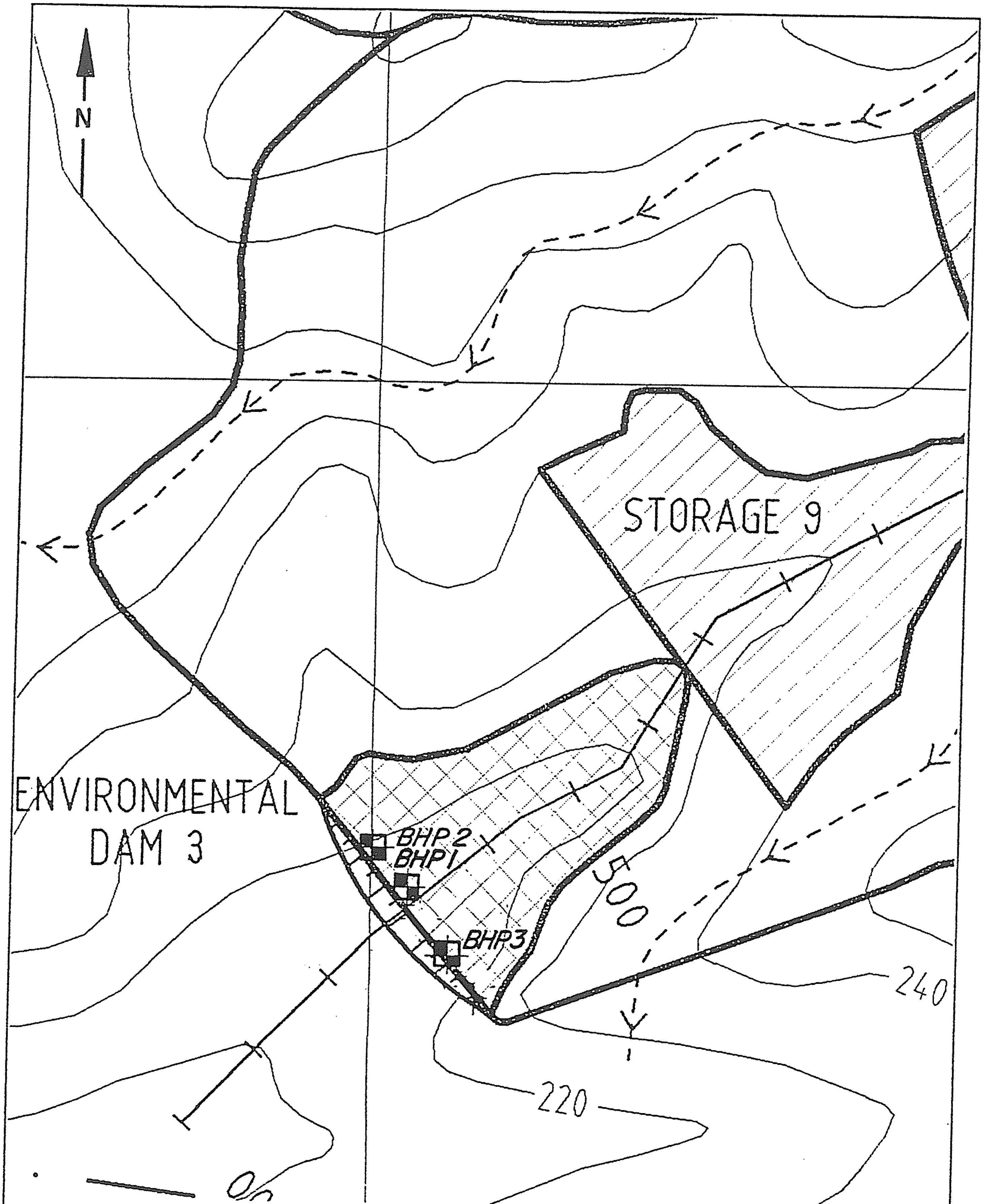

KEY

Backhoe Pit Location

EARTHTECH LABORATORIES
Geotechnical & Environmental Engineering

DRAWN MM / AB	CMPS & F MT PLEASANT PROJECT - FINE REJECT STORAGE ENVIRONMENTAL DAM SITE 3 - BACKHOE PIT LOCATIONS
CHECKED	
DATE January 1997	
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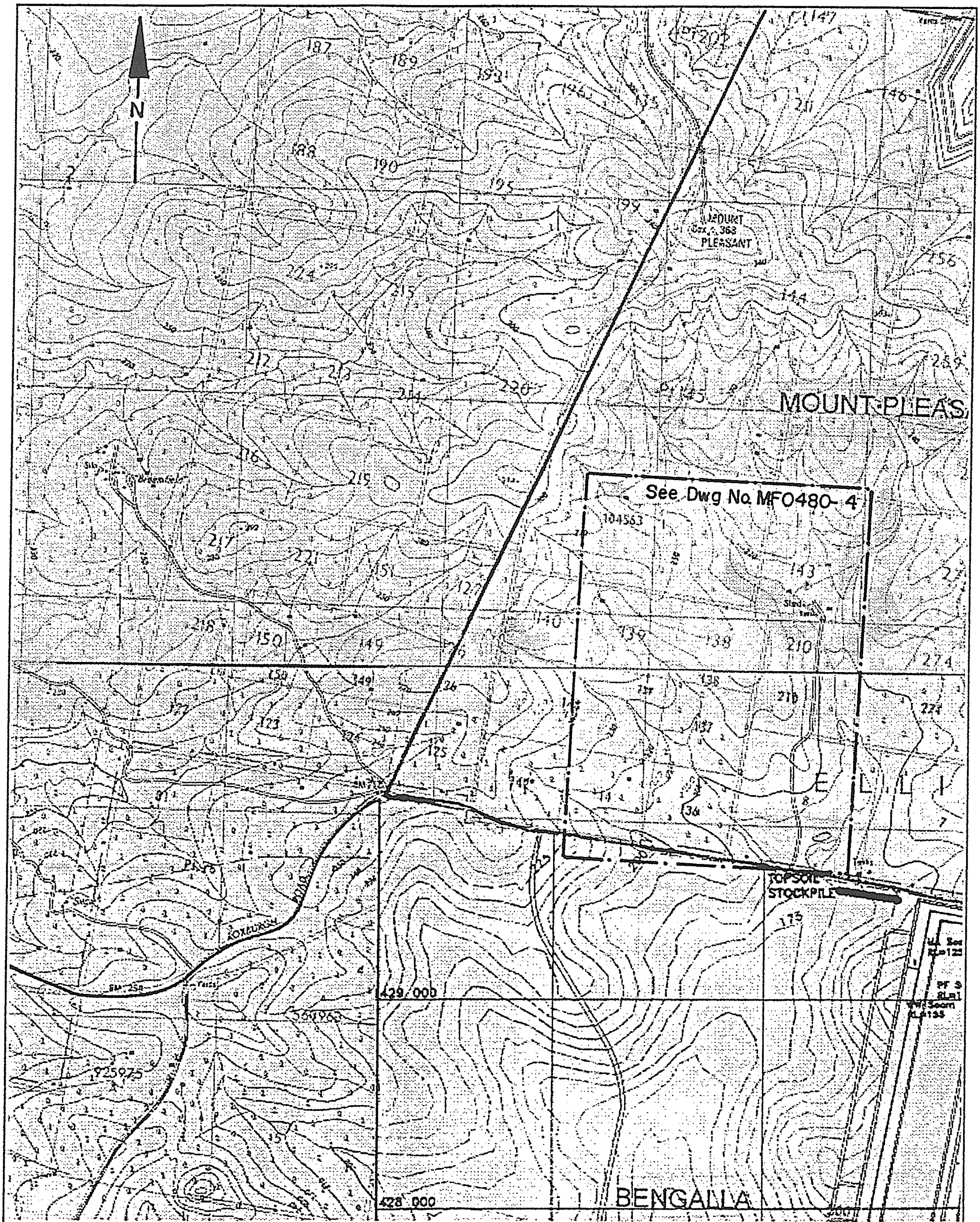
	Dwg No. MFO480-2



EARTHTECH LABORATORIES
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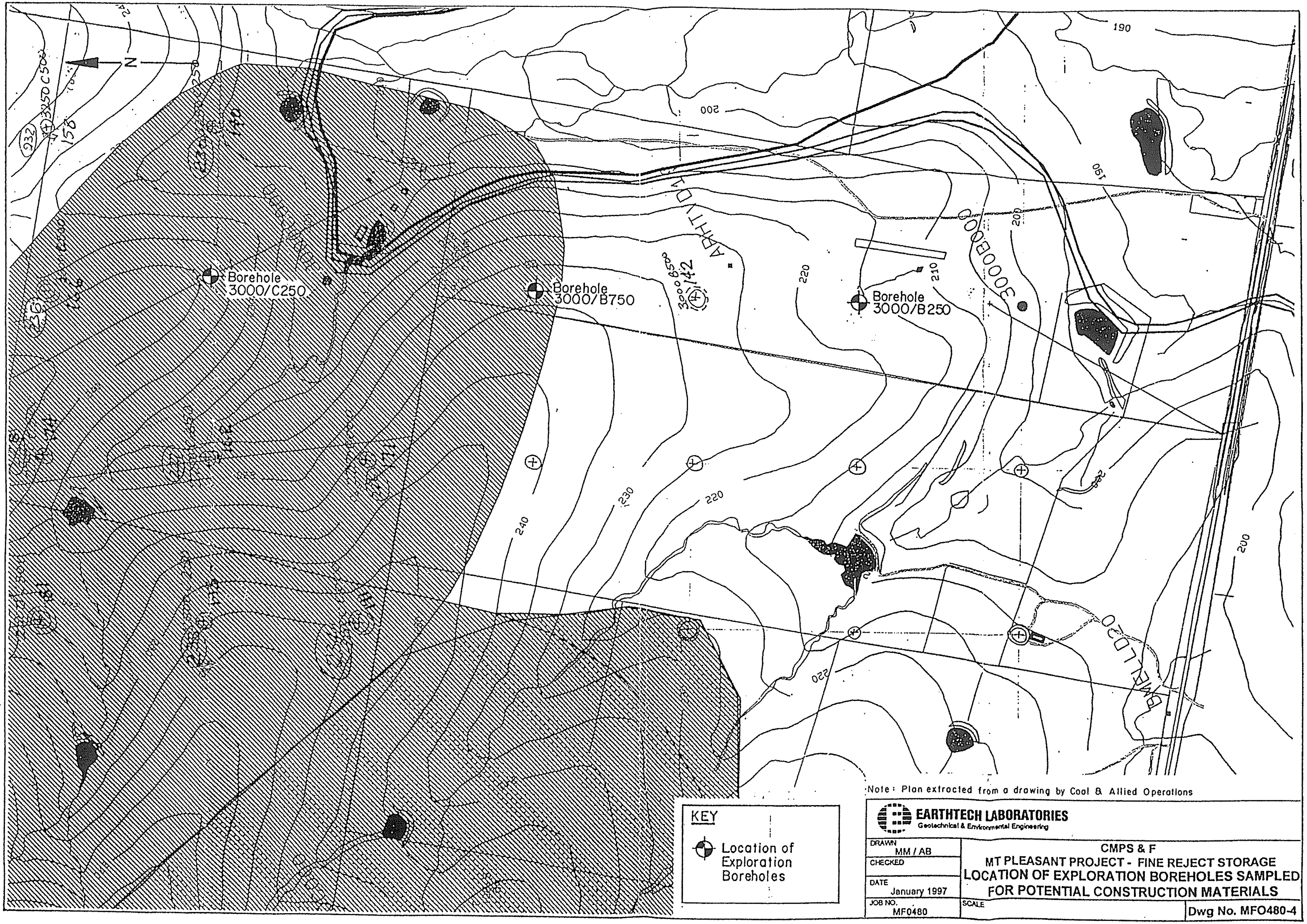
DRAWN MM / AB	CMPS & F
CHECKED	MT PLEASANT PROJECT - FINE REJECT STORAGE
DATE January 1997	LOCALITY PLAN SHOWING APPROXIMATE LOCATION OF DRAWING MF0480 - 4
JOB NO. MF0480	SCALE 1: 25 000 — Dwg No. MFO480-3



Note: Plan extracted from a drawing by Coal & Allied Operations

EARTHTECH LABORATORIES
Geotechnical & Environmental Engineering

DRAWN MM / AB	CMPS & F
CHECKED	MT PLEASANT PROJECT - FINE REJECT STORAGE
DATE January 1997	LOCATION OF EXPLORATION BOREHOLES SAMPLED FOR POTENTIAL CONSTRUCTION MATERIALS
JOB NO. MF0480	SCALE
	Dwg No. MFO480-4