28 JULY 1995

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY AND SEWERAGE
MECHANICAL AND ELECTRICAL BRANCH
ELECTROLYSIS SECTION
EAGLE FARM PUMPING STATION

OPERATING MANUAL FOR:

RICHLANDS RESERVIOR

CATHODIC PROTECTION SYSTEM..

CLIENT:

DEPARTMENT OF WATER SUPPLY AND SEWERAGE
WATER MAINTENANCE SECTION

MANUAL CONTENTS

DRAWINGS

(1.0) INTRODUCTION

Steel when immersed or covered in water has a tendency to corrode (or rust) as the oxidized form is more stable than the metal.

Because of this, precaution must be taken to stop or minimize the corrosion reaction to an acceptable level consistent with the design life of the structure. This is normally achieved by the use of protective coatings which control the corrosion reaction by isolating the steel from its surrounding environment.

However, it is not practical to achieve a perfect coating and coating damage will always occur with time. Because of this, corrosion may occur at imperfections in the paint coating, causing further deterioration in the coating as well as loss of metal.

As a result of this, the coating defects must be rectified by periodic maintenance or an additional method of protection used to prevent this deterioration and corrosion occurring. This additional protection is achieved by the cathodic protection system.

(2.0) CORROSION AND CATHODIC PROTECTION

Corrosion is an electrochemical process in that it is accompanied by a flow of electrical current.

Corrosion occurs on the surface of metals at active areas known as anodes, which are electrically continuous with less active or passive areas known as cathodes. The electric current flows from the anode through the electrolyte to the cathode, with the circuit being completed by the electrical continuity between the cathode and anode. In practice anodes and cathodes are generally part of the same metallic surface and individual anodic areas may be small.

In applying cathodic protection and external current is applied to the surface so that the entire surface to be protected acts as a cathode. This involves the use of an auxiliary anode and when the current flow from this anode is sufficient, no part of the structure acts as an anode.

An external source of direct current such as a transformer rectifier is used in conjunction with an anode consisting of material with a very slow corrosion rate.

While it is the flow of current which achieves the cathodic protection of the surface it is impractical to measure these currents over individual anodic areas to determine when cathodic protection has been achieved. However, with the flow of cathodic protection current, the structure becomes more negative with respect to the surrounding electrolyte. Because of this, it is possible to state values of metal/electrolyte potential at which corrosion does not occur. This metal/electrolyte potential is generally measured against a standard reference electrode which allows a reproducible potential at which corrosion does not occur to be quoted.

(3.0) RESERVIOR DETAILS

Size:	7 Megalitre Steel Reservior with Concrete Base
Coating:	Enamel.
Length:	N.A
Location:	Cnr Rudyard Street and Government Road,Richlands UBD 51 , G5.
Drawings:	Construction:-

6/29.21	Richlands Reservior No2 Capacity 7 Megalitre Details Excavations and Pipework.
6/29.22	Richlands Reservior No2 Capacity 7 Megalitre Floor Plan and Details.
2/14.185	Cathodic Protection Inala/Richlands Reservior.

(4.0) CATHODIC PROTECTION DETAILS

(4.1) Type of Cathodic Protection: Impressed Current.

(4.2) Rectifier: Standard 32V Volt, 15 amp direct current output enclosed in a stainless steel switchboard. Rectifier has a 240V supply from the distribution switchboard located in the chlorine room,adjacent to the reservior.

(4.3) Cathode: The cathode point is located on the Reservior behind the rectifier switchboard.The cathode point is where the cabling from the rectifier is attached to the structure under cathodic protection.

(4.4) Anodes: Four Anode Strings each containing 3 silicon sausage anodes (240 x 40) were suspended from the ceiling.The sausage anodes were first potted of with a eppoxy resin and covered with a mastic cleve to extend the anode's life.

(4.5) Test Points: Test points are installed on cathodically protected structures to enable testing to ensure full protection of the reservior. On these reservior eleven test points have been installed

(4.6) Associated Drawings:

Cathodic Protection Details	- 2/14.213
Cathodic Protection Test Point Details	- 2/14.199
Standard Rectifier Wiring Diagram With Data Logging Facilities	- 486/7/7-PE1C0052E

(4.7) Associated Standards:

AS 3000 1986 Australia Wiring Rules

AS 2832.1 1985 Pipes, Cables, Ducts, Guide to Cathodic Protection, Part One.

(4.8) Government Regulations:

Queensland Electricity Acts and Regulations.

(5.0) PERFORMED TESTING

(1) Natural Potential Survey.

(2) Testing of Insulated Flanges, Joints.

(3) Current Drain Survey.

(4) Pipe Coating Anomaly Survey.

(5) Rectifier Loop Resistance.

(6) Foreign Structure Interference Survey and Mitigation.

(7) Final Potential Survey and Commissioning.

NOTE: Details of above testing have not been included in this manual but are available upon request.

(6.0) CONCLUSION

Full Cathodic protection has been achieved on this section of trunk mains. The cathodic protection system is registered with the Queensland Electricity Commission and has approval to operate.

(7.0) MAINTENANCE

The cathodic protection system is maintained on a monthly basis after commissioning. These checks involve testing rectifier operation and recording of pipe to soil potentials.

12th October 1992
Electrical Workshop
Cathodic Protection

CPS Monthly Maintenance Details.

Required:

1/ Notify plant operator and/or sign entry logs where necessary.
2/ Have appropriate keying.

Labour:

One tradesperson, one vehicle. 20 minutes per site.

Procedure:

1/ Identify installation.
2/ Check system for operation.
3/ Record voltmeter.
4/ Record ammeter.
5/ Comments.
6/ Log entry.

13th October 1992
Electrical Workshop
Cathodic Protection

CPS 6 Monthly Maintenance Details.

Required:

1/ Notify plant operator and/or sign entry logs where necessary.
2/ Have appropriate keying.
3/ Set of tools. (Electricians)
4/ Multimeter.
5/ DC clampmeter.
6/ Copper sulphate reference cell and leads.
7/ Cleaning equipment.
8/ Gatic cover lifters.

Labour:

One tradesperson electrical, one laborer, one vehicle.
Two hours per site.

Procedure:

1/ Identify system.
2/ Check system for operation.
3/ Record voltmeter.
4/ Record ammeter.
5/ Record "on" potentials for all test points.
6/ Record "instant off" potentials for all test points.
7/ Record "off" potentials for all test points.
8/ Perform loop resistance and record.
9/ Check and record anode string currents.
10/ Comments.
11/ Log entry.

13th October 1992
Electrical Workshop
Cathodic Protection

CPS 60 Monthly Maintenance Details.

Required:

1/ Notify plant operator and/or sign entry logs where necessary.
2/ Have appropriate keying.
3/ Set of tools. (Electricians)
4/ Multimeter.
5/ DC clampmeter.
6/ Copper sulphate reference cell and leads.
7/ Cleaning equipment.
8/ Gatic cover lifters.
9/ Rectifier load bank.
10/ PCS2000 Detection Equipment.

Labour:

One tradesperson electrical, one laborer, one vehicle.
Eight hours per site.

Procedure:

1/ Identify system.
2/ Check system for operation.
3/ Record voltmeter.
4/ Record ammeter.
5/ Record "on" potentials for all test points.
6/ Record "instant off" potentials for all test points.
7/ Record "off" potentials for all test points.
8/ Perform loop resistance and record.
9/ Check and record anode string currents.
10/ Load test rectifier for 10 minutes.
11/ Check all switchboard and testpoint terminals for tightness.
12/ Check all switchboard and testpoints are labelled and I.D. tags attached.
13/ Check plans are correctly drawn and modify if necessary.
14/ Remove and inspect anodes.
15/ Recheck all interference (CPS) bleeds.
16/ Pipecamp structure if applicable.
17/ Apply for "continue to operate" permit if applicable.

Brisbane City Council
Dept. W.S.& S.
Metropolitan Division
Eagle Farm Pump Station

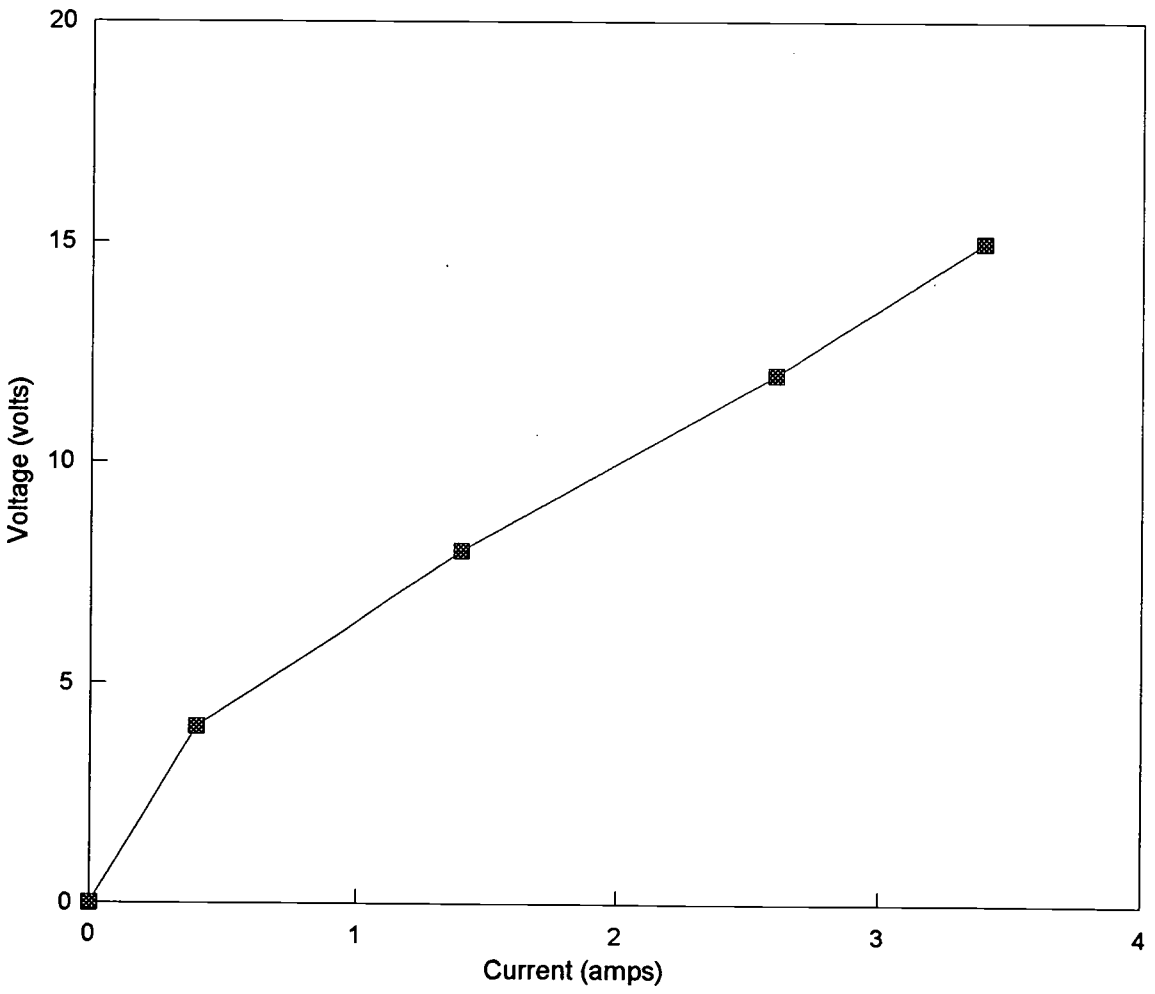
Cathodic Protection System Loop Resistance

Date: 29th June 1994
Cathodic Protection System: Richlands 7 Megalitre Reservior
System Operating Volts: 4.5 System Operating amps: 0.3

Test Voltage: (volts)	Test Current: (amps)
0	0
4	0.4
8	1.4
12	2.6
15	3.4

Loop Resistance (ohms)
3.5

Graph of System voltage vs current.



BRISBANE CITY COUNCIL
MEMORANDUM

To	File No.
From	Date 29/3/95

Subject Richlands
Tank... Operating 4·5 V & 300 ma.

CuSO4 Natural Potential −450mV
Natural Potential Base −540mV

ZN Ref 1 Top	on	off	anode Current.
	+57mv	−60mv	1
	+61mv	−60mv	2
	+74mv	−46mv	3
Bottom	+71mv	−48mv	4

ZN Ref 2 Top.

	+170mv	−07 mv	
	+167mv	−07 mv	
	+166mv	−13 mv	
Bottom	+145mv	−02 mv	

ZN Ref 3 Top.

	+266mv	−10 mv

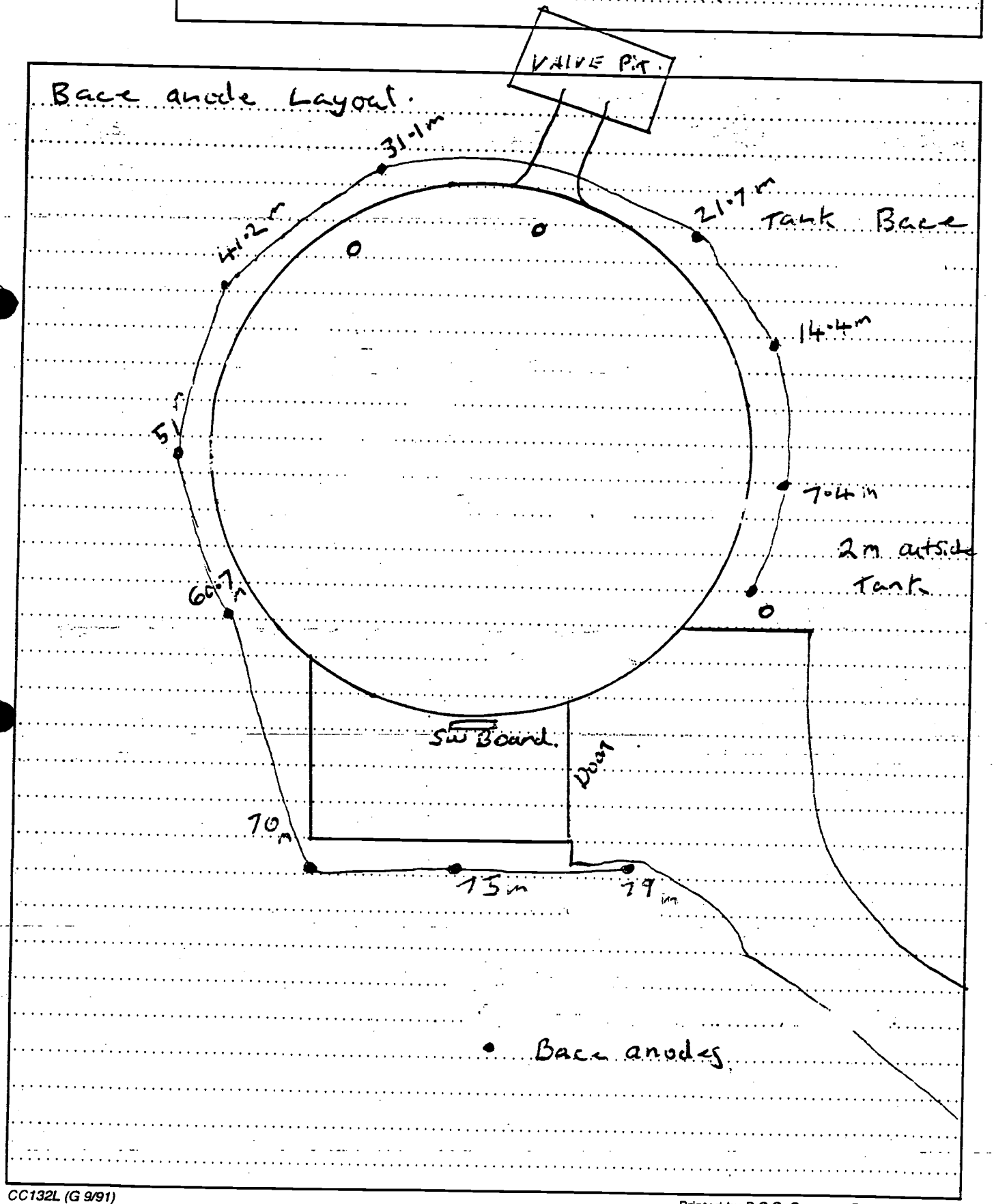
CuSO4 top		CuSO4 top.	
	−850	−772	−820mv 777mv
Bottom	−1227	−930	Bottom −1120mv 850mv

CuSO4 Tank Base −1098 off

Brisbane City

To	File No.
From	Date 26/4/95

Subject Richlands Res
Revised Anode Layout



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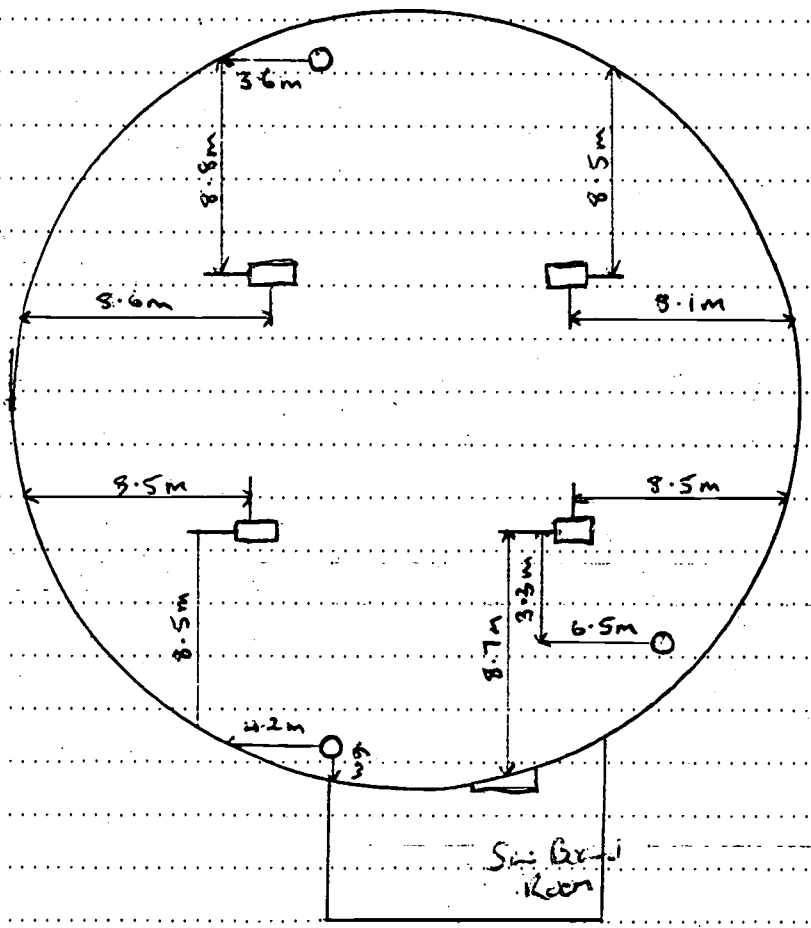
MEMORANDUM

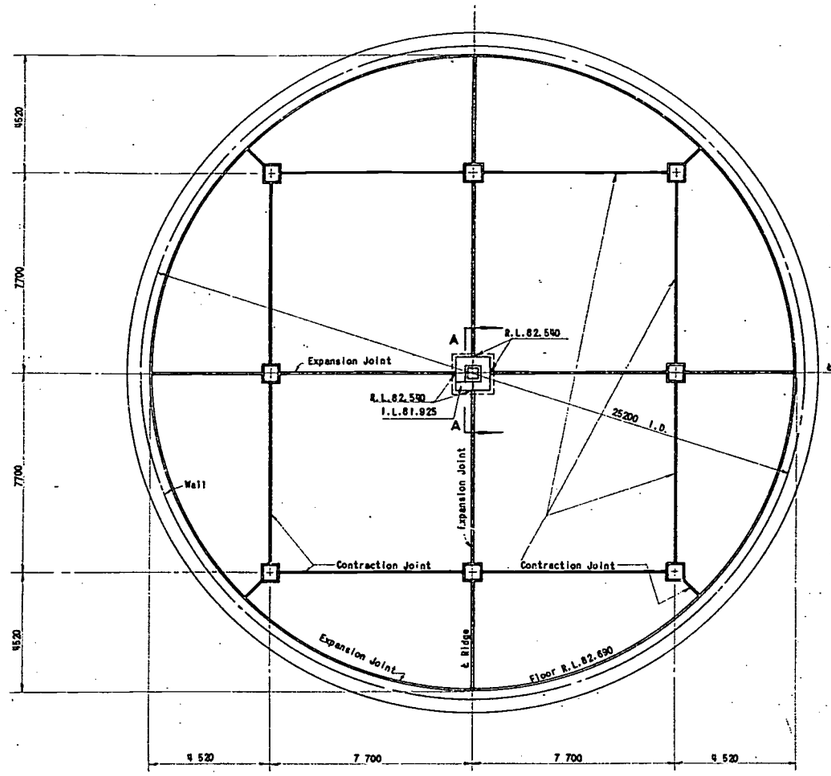
To	File No.
From	Date 26/4/95

Subject Richlands Res
Revised new SW Board

Tank Top Layout

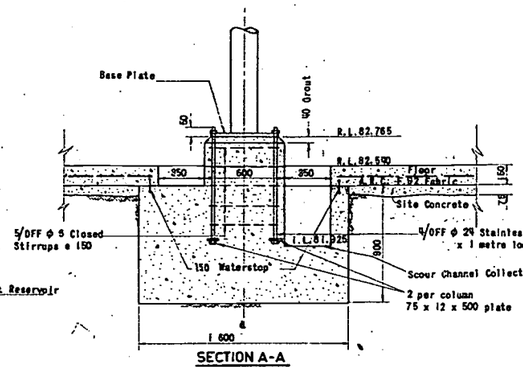


□ anode
○ Reference



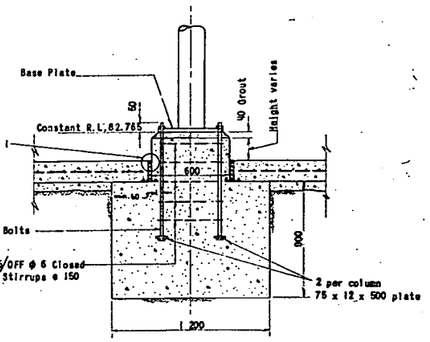
PLAN OF RESERVOIR FLOOR

0 1 2 3 4 5
Scale of Metres

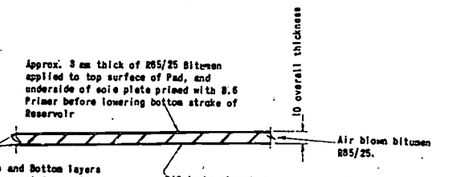


SECTION A-A

DETAIL OF CENTRE COLUMN FOOTING

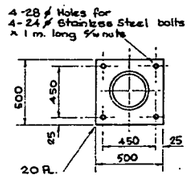


DETAIL OF COLUMN FOOTING



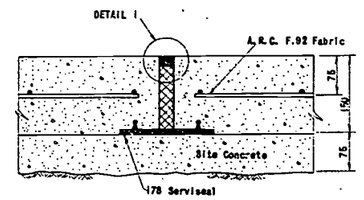
DETAIL 3 — BITUMEN PAD

0 500 1000 1500 2000
Scale of Millimetres
1:20

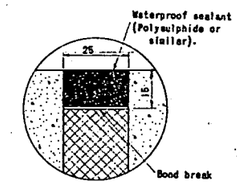


DETAIL OF BASE PLATE

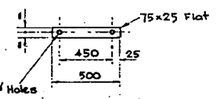
NOTE: H.D. Bolts are to be held in position by means of a rigid cage to suit the holes in column base plate.
H.D. Bolts and cage to be supplied by Contractor



EXPANSION JOINT

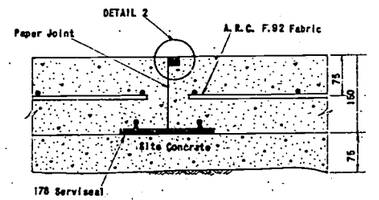


DETAIL 1



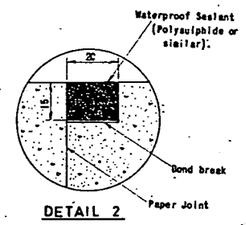
2 REQ'D PER COLUMN

0 100 200 300 400 500 600
Scale of Millimetres
1:20



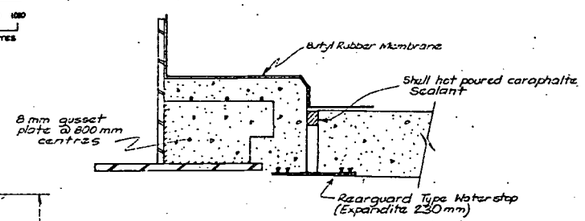
CONTRACTION JOINT

0 100 200 300
Scale of millimetres.



DETAIL 2

NOTES: 1. All dimensions in millimetres unless otherwise shown.



RING BEAM SKETCH (N.T.S.)

N.B. Because Steel Mall expands during the day, this ring beam poured at night using 60 MPa, 10 mm aggregate Pump mix.

RESERVOIR DATA

CAPACITY:	7 megalitres.
INTERNAL DIA:	25 200
DEPTH OF WATER:	10 000
T.W.L.:	96.690 metres
FLOOR LEVEL:	82.690 metres

BAR BENDING SCHEDULE

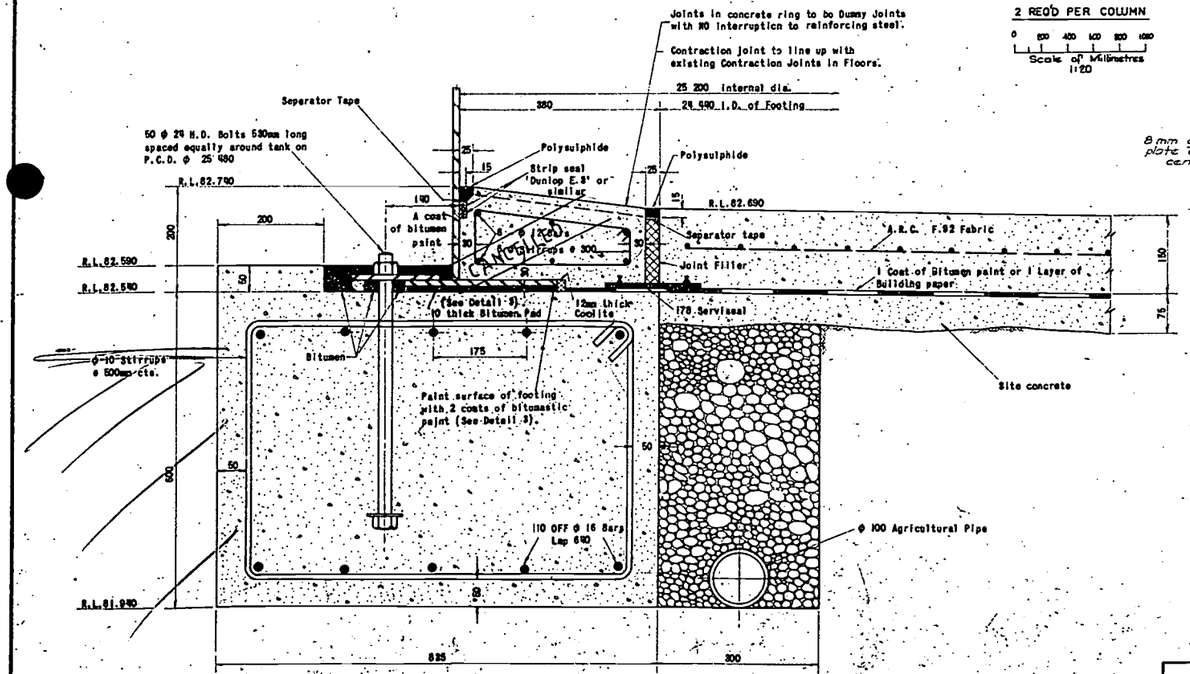
BAR NO.	a	b	ϕ	LENGTH	NO. OFF
16 ϕ A	8000	-	16	8 000	110
10 ϕ S	500	785	10	2585	165
12 ϕ A	8000	-	12	8000	66
6 ϕ S3	c=105	b=55	c=295	f=299	828	265

TYPE A BAR

S TYPE

TYPE SS BAR

TOTAL LENGTH OF ϕ 16 BAR	=	880.000 metres
TOTAL WEIGHT OF ϕ 16 BAR	=	1.890 Tonne
TOTAL LENGTH OF ϕ 12 BAR	=	526.000 metres
TOTAL WEIGHT OF ϕ 12 BAR	=	0.469 Tonne
TOTAL LENGTH OF ϕ 10 BAR	=	426.525 metres
TOTAL WEIGHT OF ϕ 10 BAR	=	0.263 Tonne
TOTAL LENGTH OF ϕ 6 BAR	=	218.095 metres
TOTAL WEIGHT OF ϕ 6 BAR	=	0.048 Tonne
AREA A.R.C. F.92 FABRIC	=	470 sq. metres.



DETAIL OF WALL BASE AND FOOTING

0 100 200 300 400 500
Scale of millimetres.

NOTE: The sub-foundation is to be founded on a material that is in the opinion of the engineer has a minimum bearing capacity of 190kPa.

WORKS AS CONSTRUCTED

ALL DIMENSIONS ARE METRIC

CHIEF ENGINEER & MANAGER	ENGINEER FOR DESIGN	DESIGN			ENGINEER IN CHARGE
	CONSTRUCTION ENGINEER	DRAWN	A.V.H.	APRIL 75	ASST./ENG.
	MECH. & ELECT. ENGINEER	TRACED	A.M.B. / D.S.D.	6.5.75 / 7.5.75	LEVEL BOOK
		CHECKED		MAY '75	FIELD BOOK
		A.H. DATUM			SURVEYED

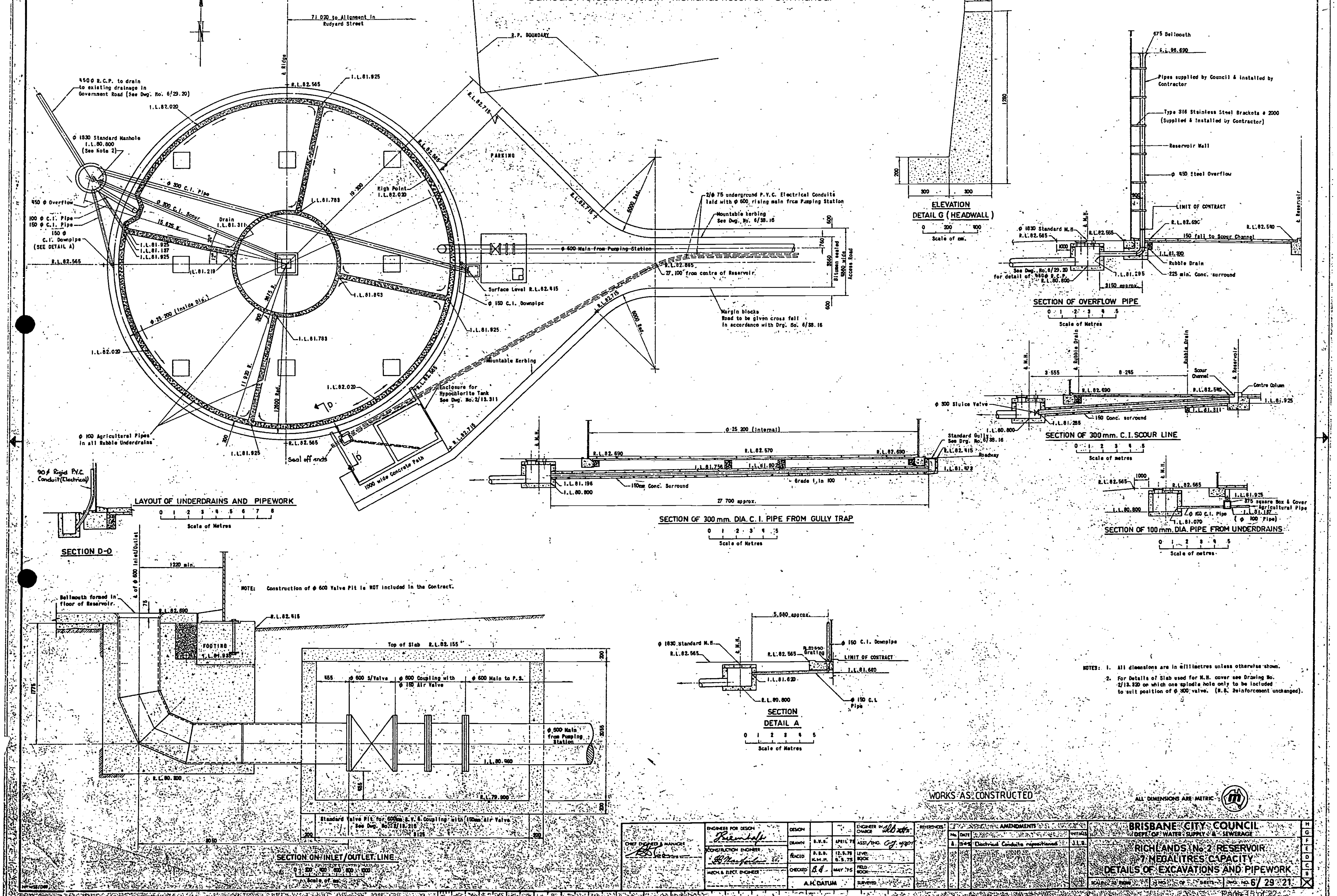
REFERENCES

No.	DATE	AMENDMENTS	INITIALS

BRISBANE CITY COUNCIL
DEPT. OF WATER SUPPLY & SEWERAGE

RICHLANDS RESERVOIR NO.2.
CAPACITY 7 MEGALITRES
FLOOR PLAN & DETAILS

SCALE AS SHOWN | NO. OF SHEETS | DWG. NO. 6/29/22



LAYOUT OF UNDERDRAINS AND PIPEWORK
Scale of Metres
71 020 to Alignment in Rudyard Street
R.P. BOUNDARY
450 ϕ R.C.P. to drain to existing drainage in Government Road (See Dwg. No. 6/29.20)
ϕ 1830 Standard Manhole I.L.80.800 (See Note 2)
450 ϕ Overflow
100 ϕ C.I. Pipe
150 ϕ C.I. Pipe
150 ϕ C.I. Downpipe (SEE DETAIL A)
ϕ 300 C.I. Pipe
ϕ 300 C.I. Scour
Drain I.L.81.311
High Point I.L.82.020
ϕ 25 200 (Inside Dia.)
PARKING
ϕ 600 Main from Pumping Station
2/ϕ 75 underground P.V.C. Electrical Conduits laid with ϕ 600 rising main from Pumping Station
Mountable kerbing See Dwg. No. 6/38.16
Surface Level R.L.82.415
ϕ 150 C.I. Downpipe
R.L.82.865
27.100 from centre of Reservoir
Bitumen sealed 9550 wide Access Road
Margin blocks Road to be given cross fall in accordance with Drg. No. 6/38.16
Mountable Kerbing
Enclosure for Hypochlorite Tank See Dwg. No. 2/13.311
ϕ 100 Agricultural Pipes in all Rubble Underdrains
Seal off ends
1000 wide Concrete Path
90ϕ Rigid P.V.C. Conduit (Electrical)
SECTION D-D
ELEVATION DETAIL G (HEADWALL)
Scale of mm.
675 Bellmouth
Pipes supplied by Council & installed by Contractor
Type 316 Stainless Steel Brackets @ 2000 (Supplied & Installed by Contractor)
Reservoir Wall
ϕ 450 Steel Overflow
LIMIT OF CONTRACT
150 fall to Scour Channel
Rubble Drain
225 min. Conc. surround
See Dwg. No. 6/29.20 for detail of 450ϕ R.C.P.
SECTION OF OVERFLOW PIPE
Scale of Metres
ϕ 300 Sluice Valve
150 Conc. surround
Scour Channel
Centre Column
SECTION OF 300mm. C.I. SCOUR LINE
Scale of metres
ϕ 25 200 (Internal)
Standard Gully See Drg. No. 6/38.16
Roadway
150mm Conc. Surround
Grade 1 in 100
27 700 approx.
SECTION OF 300mm. DIA. C.I. PIPE FROM GULLY TRAP
Scale of Metres
375 square Box & Cover
Agricultural Pipe
ϕ 100 C.I. Pipe
SECTION OF 100mm. DIA. PIPE FROM UNDERDRAINS
Scale of metres
NOTE: Construction of ϕ 600 Valve Pit is NOT included in the Contract.
Bellmouth formed in floor of Reservoir.
ϕ of ϕ 600 Inlet/Outlet
1220 min.
FOOTING
Top of Slab R.L.82.155
ϕ 600 S/Valve
ϕ 600 Coupling with ϕ 150 Air Valve
ϕ 600 Main to P.S.
ϕ 600 Main from Pumping Station
Standard Valve Pit for 600mm S.V. & Coupling with 150mm Air Valve See Dwg. No. 2/13.216
SECTION ON INLET/OUTLET LINE
Scale of mm.
ϕ 1830 Standard M.H.
ϕ 150 C.I. Downpipe
Grating
LIMIT OF CONTRACT
ϕ 150 C.I. Pipe
SECTION DETAIL A
Scale of Metres
NOTES: 1. All dimensions are in millimetres unless otherwise shown.
2. For Details of Slab used for M.H. cover see Drawing No. 2/13.320 on which one spindle hole only to be included to suit position of ϕ 300 valve. (N.B. Reinforcement unchanged).
WORKS AS CONSTRUCTED
ALL DIMENSIONS ARE METRIC
CHIEF ENGINEER & MANAGER
ENGINEER FOR DESIGN
CONSTRUCTION ENGINEER
MECH. & ELECT. ENGINEER
DESIGN
DRAWN B.W.S. APRIL 75
TRACED 12.5.75 6.5.75
CHECKED MAY 75
A.H. DATUM
ENGINEER IN CHARGE
ASST./ENG.
LEVEL BOOK
FIELD BOOK
SURVEYED
REFERENCES
AMENDMENTS
No. DATE INITIALS
A Electrical Conduits repositioned J.L.B.
BRISBANE CITY COUNCIL
DEPT. OF WATER SUPPLY & SEWERAGE
RICHLANDS No 2 RESERVOIR
7 MEGALITRES CAPACITY
DETAILS OF EXCAVATIONS AND PIPEWORK
SCALE AS SHOWN
DWG. No. 6/29 21

BRISBANE CITY COUNCIL

MEMORANDUM

To	File No.
From	Date 29/3/95

Subject Richlands.

Tank. opperating 4·5 V & 300 ma.

CuSO4 Natural Potential −450mV

Natural Potential Bare −540mV

ZN Ref	TOP on	off	anode Current.
	+57mv	−60mv	1
	+61mv	−60mv	2
	+74mv	−46mv	3
Bottom	+71mv	−48mv	4

ZN Ref 2 TOP.

+170mv −07 mv

+167mv −07 mv

+166mv −13mv

Bottom +145mv −02 mv

ZN Ref 3 TOP.

+266mv −10mv

CuSO4 top		CuSO4 top.	
−850	−772	−820mv	777mv
Bottom −1227	−930	Bottom −1120mv	850mv

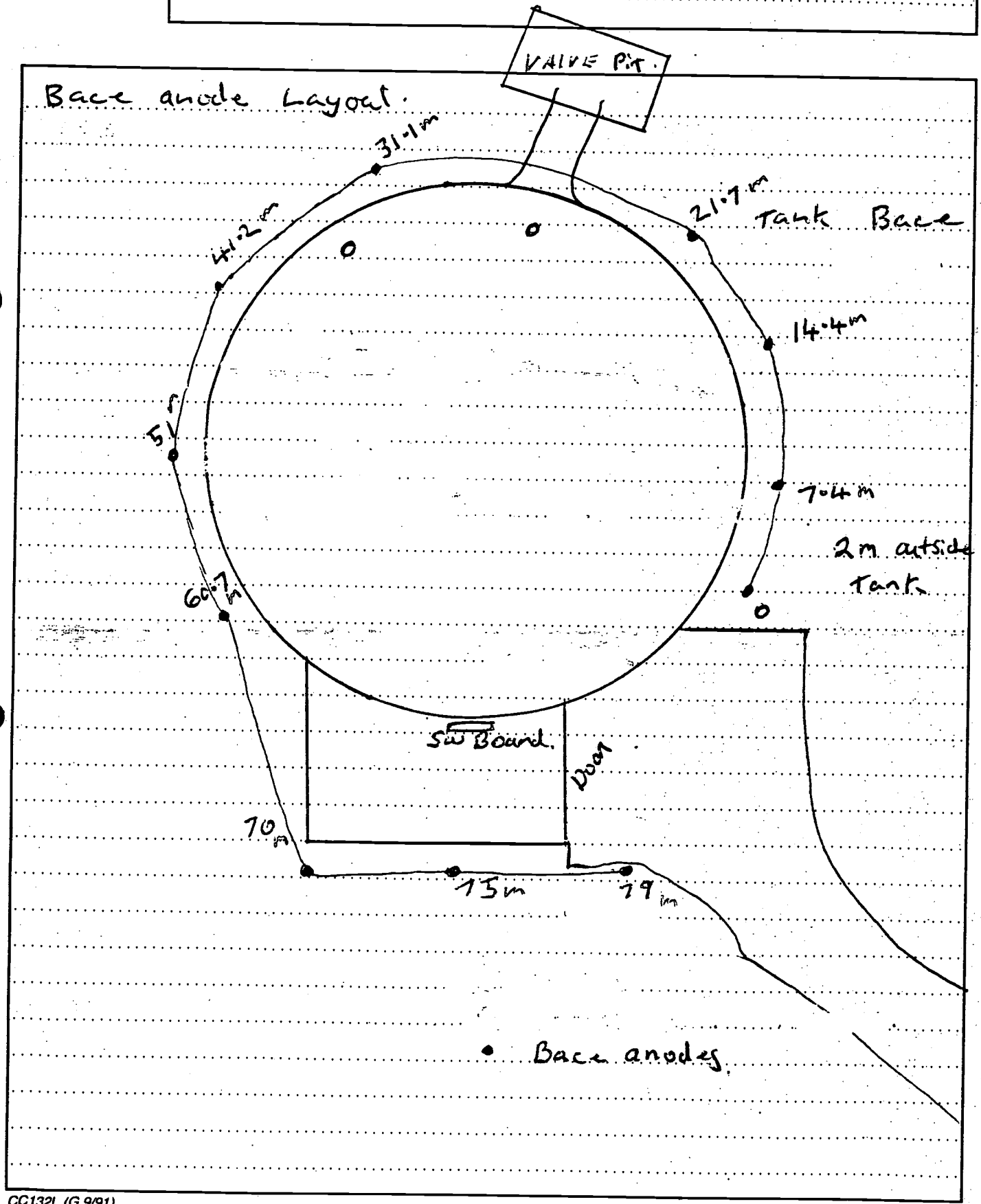
CuSO4 Tank Bare −1098 off

MEMORANDUM

Brisbane City

To	File No.
From	Date 26/4/95.

Subject Richlands Res
Revised new SW Board.



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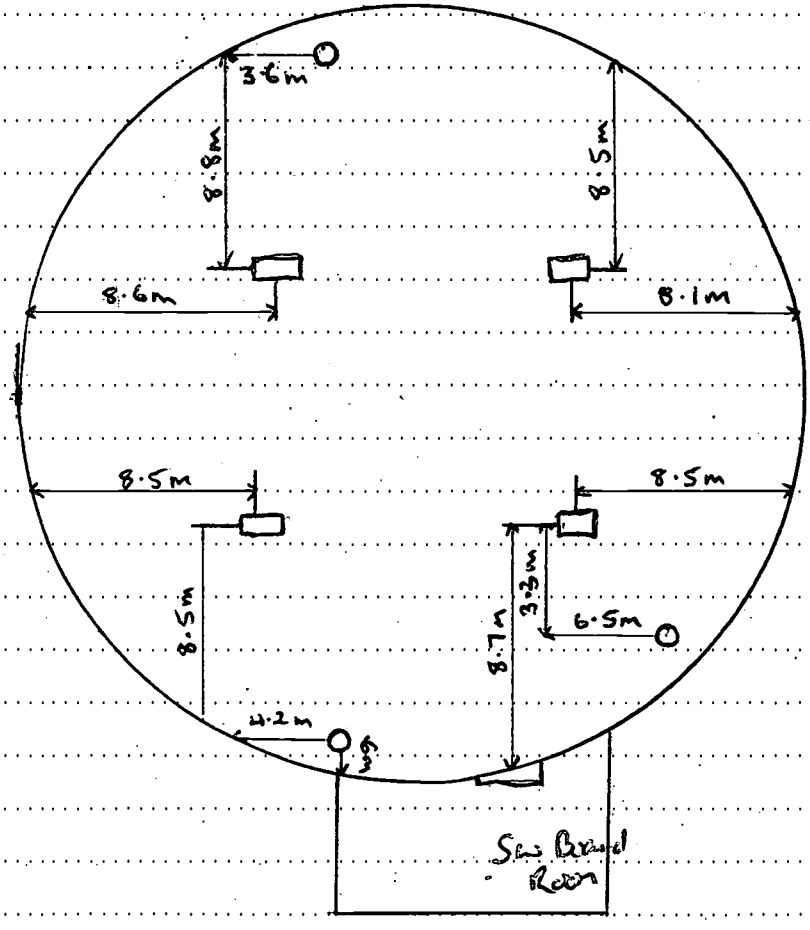
BRISBANE CITY COUNCIL

MEMORANDUM

To	File No.
From	Date 26/4/95

Subject Richands Res
Rewired new Sw Board

Tank TOP. Layout



□ anodes
○ Refrences

Brisbane City

MEMORANDUM

To	File No.
From	Date 26/4/95

Subject Richlands Res.
Rewired new Sw Board.

Tank.

V	A
4	400ma →
8	1400ma
12	2600ma
15	3400ma

Brisbane City

MEMORANDUM

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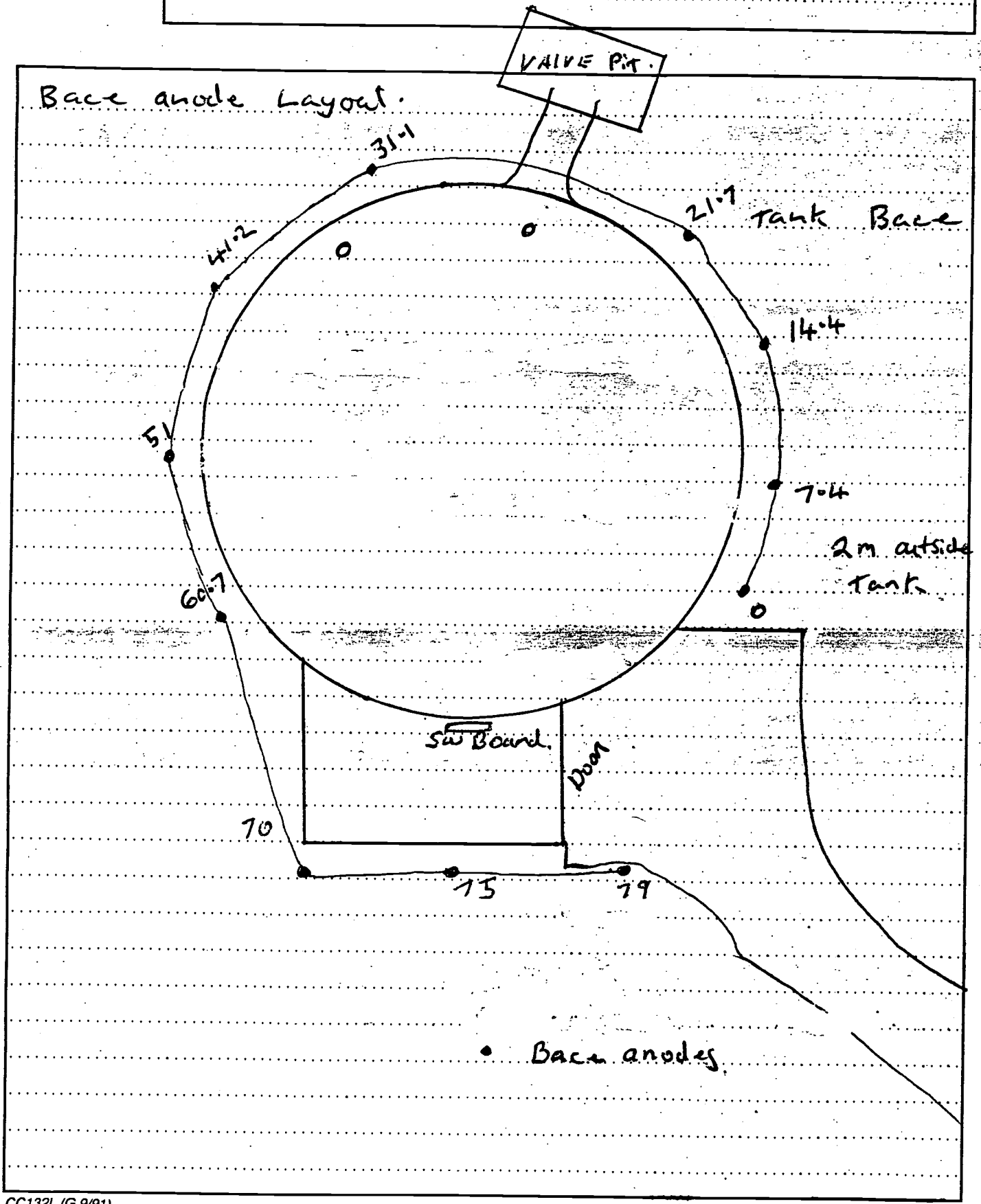
From	Date 26/4/95.

Subject Richlands Res
Rewired new SW Board.



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MEMORANDUM

Brisbane City

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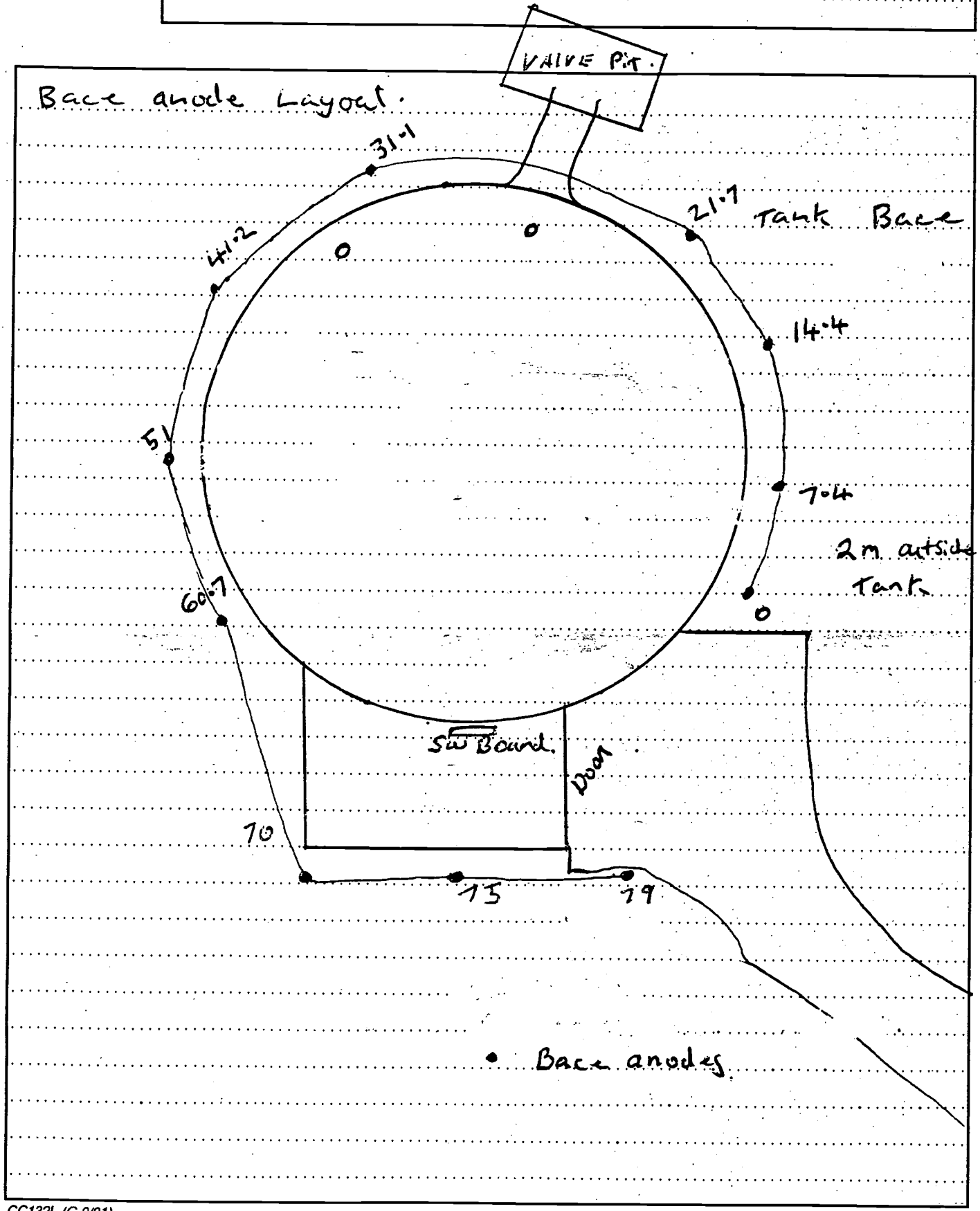
From	Date 26/4/95

Subject Rich Lands Res
Revised New SW Board



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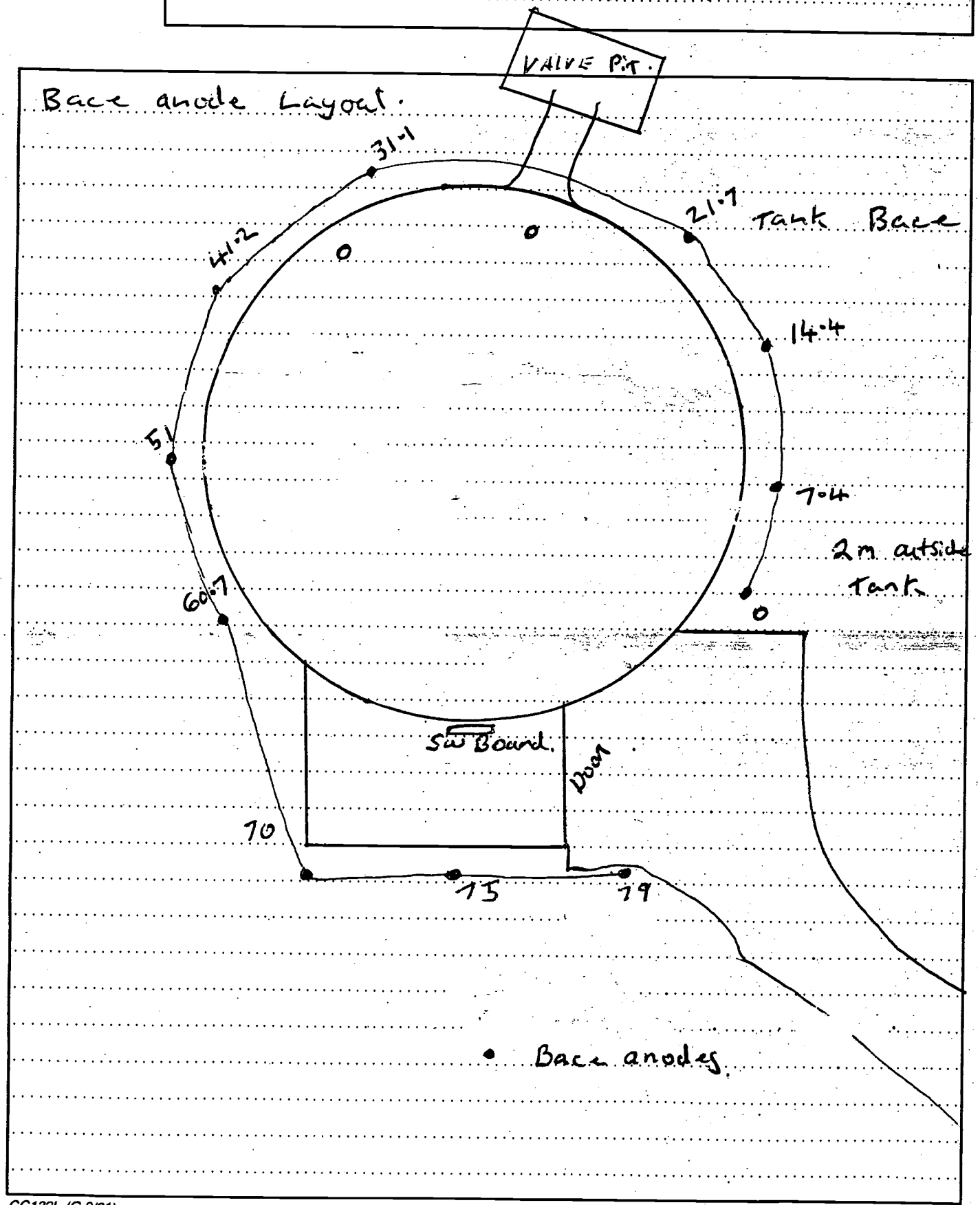

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