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BRISBANE CITY COUNCIL
BRISBANE WATER

SP306 – Coronation Drive Pump Station

Operation & Maintenance Manual
Contract No. BW30079-02/03

Volume No. 1

BRISBANE CITY COUNCIL
Brisbane Water
SP306 Coronation Drive Pump Station

BCC Contract No. BW30079-02/03

Coronation Drive Pump Station - SP306 Operation & Maintenance Manual
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BRISBANE CITY COUNCIL
Brisbane Water
SP306 Coronation Drive Pump Station

BCC Contract No. BW30079-02/03

Coronation Drive Pump Station - SP306 Operation & Maintenance Manual
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Brisbane Water
SP306 Coronation Drive Pump Station

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ENERGEX SUPPLY FROM
3 PHASE, 415V SUPPLY
500kVA TX SC485234
(NOTE 4)

N R W B

LOCAL ISOLATOR 400A

ENERGEX METERING TARIFF : 2

MEN LINK

6A 650
651
652

ENERGEX POWER FAILURE RELAY (N1)

REMOTE GEN-SET CONNECTION SOCKET

MANUAL CHANGE OVER SWITCH

400A (NOTE 9) 400A

SR1,2,3 63A

80kA

POWER METER

250A (NOTE 13.2) SUBMERSIBLE PUMP No.1 68kW (Refer to Sheet 02 for pump schematic details)

250A (NOTE 13.2) SUBMERSIBLE PUMP No.2 68kW (Refer to Sheet 03 for pump schematic details)

63A SUB-DISTRIBUTION BD, RD CB

10A MOTORISED VALVE POWER SUPPLY (Refer to Sheet 04 for valve schematic details)

670 671 672 POWER FAILURE RELAY (N4) (Refer to sheet 04 for valve schematic details)

#Lights x8

20A 673 674 675 3 PHASE 32 AMP OUTLET

10A (N5) 676 GPO

10A (N6) 677 RTU LAPTOP G.P.O. (10A)

6A 678 (N14) SWITCHBOARD INTERNAL LIGHTING (DOOR SWITCH OPERATED)

678 — 678A — 678H — N14.
Door Switches
DLSR
689
DLSR-1

6A 681 P1A SM3 PLC POWER SUPPLY (Refer to sheet 5 line 22)

6A 681 P1A SM2 TO FLOW SWITCH (Refer to sheet 14 line 23)

10A 687 (N11) CRITEC SURGE FILTER 681 SM1 RTU POWER SUPPLY (Refer to Sheet 05 Line 6)

681 SM5 SURGE DIVERTER RELAY (Refer to Sheet 06)

6A SPARE

6A SPARE

6A SPARE

6A SPARE

E N L1 L2 L3
(To Sheet 2)

NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-42 DIGITAL INPUT
- DO1-45 DIGITAL OUTPUT
- AI1-42 ANALOGUE INPUT
- AO1-10 ANALOGUE OUTPUT

AS BUILT

FOR CONSTRUCTION

HVAC RECEIVED
Job No.:
Registered by:
08 OCT 2004
Circ. Initial Date
PM
DO

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	ADD PLC FEED AND MINOR MODS	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Consultant: Connell Wagner

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

	Drawn	Designed	Verified	Approved	Signed	Date
	JCP	SPW	JJA	JJA	JJA	02.09.04

Drawing Title: PATRICK LANE PUMP STATION POWER DISTRIBUTION SCHEMATIC DIAGRAM

Brisbane Water

Drawing No.: 486/57-KJ006

Sheet 01 of 10

CW Project No.: 020381WU

Scale: NTS

Drawing No.: 0203-E201 Rev.: B

Laser File # 0203E201DWG

A1

REFER SHEET 1
415VAC SUPPLY
E N R W B

PUMP 1
1E3
250A
1K2
CONTROL SUPPLY
1F4
6A

VFD1
99 (PE)
91 92 93
96 97 98
PP1-R
PP1-W
PP1-B
M
V.F.DRIVE DANFOSS VLT6000
SUBMERSIBLE PUMP MOTOR 45kW

SPEED ADJ. (MCC) 1000 ohms 1W 17turn
183 184
WH BK SCRN
50 53 55
103
105 CP1-81-81
104 CP1-81-82
MOTOR THERMISTOR

VFD SPEED REF. 4-20mA RTU OUTPUT REF. LINE 67
A01-81P
N9
60
MOD BUS
TO VFD2 RS485 PORT SHEET 03
TO PLC RS485 PORT SHEET 05

L1
1N1
110
MCC E STOP
111
1K1
1K2
POWER ON RELAY 38,
E STOP CONTACTOR 5, 6, 7, 42,

1K3-1 113 → 18 RUN COMMAND
1K4-1 114 → 16 FAULT RESET
1K5-1 115 → 29 RUN AT MAX SPEED
112 → 32 COMMON
S1 L R CONTROL MODE COMMON CONTROLS
116 → 32 SELECT SETUP 2
27

READY 1 2 → VFD READY (REF LINE 44)
RUNNING 4 5 → VFD RUNNING (REF LINE 44)
42 39 → 4-20mA PLC INPUT REF. LINE 63
VFD RUNNING SPEED
A12.05

39 120 1K7 121 45
DRIVE IN AUTO
VFD DRIVE IN AUTO 43,

MOISTURE RELAY 1
PA-01 CP1-81-83 122
STATOR PROBE CP1-81-84 123
+ 24VDC −
PN6-01
1K8 1K9 GROUNDFOS MAR2 RELAY
5 6
MOISTURE IN STATOR (REF. LINE 47)

110 1K3-2 117
118
13
14
N
MD001 RUN METER
CUBICLE FAN

Thermostat.

32510

24V DC
Z3
25
P4-01
P4-03

DIGITAL INPUTS

+ 24VDC POWER SUPPLY - REFER SHEET 11

0VDC
44

1K1-1	DI2-01	28	DI2-01	POWER ON %I0017
	DI2-02	29	DI2-02	REFLUX VALVE MICROSWITCH %I0018
1S3 E-Stop	DI2-03	30	DI2-03	LOCAL START PUSHBUTTON %I0019
1S2 E-Stop	DI2-04	31	DI2-04	LOCAL STOP PUSHBUTTON %I0020
1K2-1	DI2-05	32	DI2-05	EMERGENCY STOP PUSHBUTTON %I0021
1K7-1	DI2-06	33	DI2-06	VFD AUTO SELECTED (NO KEYPAD CONTROL) %I0022
READY 1 2	DI2-07	34	DI2-07	VFD READY %I0023
RESET E-Stop	DI2-08	35	DI2-08	LOCAL RESET PUSHBUTTON %I0024
RUNNING 5 6	DI2-09	36	DI2-09	VFD RUNNING %I0025
1K6-LO 13	DI2-10	37	DI2-10	MOISTURE IN OIL %I0026
		38	DI2-11	SPARE %I0027
		39	DI2-12	SPARE %I0028

DIGITAL OUTPUTS

+ 24VDC POWER SUPPLY - REFER SHEET 13

P6-01 48
PN6-01 88

DO1-01	72	DO1-01	1K2	STATUS INDICATOR LAMP %Q0001
DO1-02	73	DO1-02	1K3	RUN COMMAND %Q0002 15
DO1-03	74	DO1-03	1K4	FAULT RESET %Q0003 16
DO1-04	75	DO1-04	1K5	RUN AT MAXIMUM SPEED %Q0004 17

AS BUILT

ANALOG INPUTS

%AI005 AI2-05 AI2-05P 125 AI2-05 120 → VFD RUNNING SPEED (REFER LINE 199)

ANALOG OUTPUTS

%AQ001 AO1-81 AO1-81P 149 N9 150 → SPEED COMMAND (REFER LINE 101)

HVAC RECEIVED
Job No.:
Registered by: W.W.
08 OCT 2004

Cir.	Initial	Date
PM		
DG		

LEGEND:
- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-02 RTU DIGITAL INPUT
- DO1-05 RTU DIGITAL OUTPUT
- AI1-02 RTU ANALOGUE INPUT
- AO1-06 RTU ANALOGUE OUTPUT

NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 15kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

FOR CONSTRUCTION

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	CHANGE TO AND TERMINATIONS	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Connell Wagner

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn JCP	Signed JCP	Date 02.09.04	
Designed SPW	Signed SPW	Date 02.09.04	
Verified JJA	Signed JJA	Date 02.09.04	
Approved JJA	Signed JJA	Date 02.09.04	

Drawing Title: PATRICK LANE PUMP STATION PUMP 01 SCHEMATIC DIAGRAM

Brisbane Water

DRAWING N° 486/5/7-KJ007
SHEET 02 OF 18
CADD FILE N° 0203E202.DWG

CW Project No. 020381WU
Scale NTS
Drawing No. 0203-E202 Rev. B

A1

REFER SHEET 1
415VAC SUPPLY
E N R W B

10A
300A
6A
3F4
300A
300B
300C
MOTORISED VALVE No 1
L4
300N

S1
LOCAL REMOTE

301A CLOSE 302 3K2 VALVE 1- CLOSE 30
OPEN 303 3K3 VALVE 1- OPEN 31
304 3K6-1
3K7-1

MOTORISED VALVE
305
SHUT 306 3K4 VALVE CLOSED 10
OPEN 307 3K5 VALVE OPENED 11
MONITOR 311 3K1 VALVE MONITOR 9 (SEE NOTE 6)
301
308 3K2-1 309 20 10 CLOSE
3K3-1 310 21 35 OPEN

PLC INPUTS
24V DC (REFER SHEET 13)
P4-12 24 44 0VDC
3K1-1 DI2-14 41 VALVE READY IN REMOTE %I0030
3K4-1 DI2-15 42 VALVE CLOSED %I0031
3K5-1 DI2-16 43 VALVE OPENED %I0032

PLC OUTPUTS
24V DC (REFER SHEET 13)
P4-03 70 90 PM4-03
DO1-09 80 3K6 VALVE CLOSE %Q0009 14
DO1-10 81 3K7 VALVE OPEN %Q0010 18
DO1-11 82 (A) 3H1 VALVE CLOSED %Q0011
DO1-12 83 (A) 3H2 VALVE OPENED %Q0012

NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST S12000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.
6. MONITOR RELAY PROGRAMMED FOR:
- 24VDC POWER AVAILABLE
- PHASE LOSS
- THERMISTOR TRIP
- LOCAL STOP
- VALVE IN REMOTE

LEGEND:
- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-12 DIGITAL INPUT
- DO1-15 DIGITAL OUTPUT
- AI-02 ANALOGUE INPUT
- AO-04 ANALOGUE OUTPUT

AS BUILT

HVAC RECEIVED
Job No.:
Registered by:
08 OCT 2004

Circ.	Initial	Date
PM		8/10/04
DO		

32510

FOR CONSTRUCTION

Rev.	Date	Revision Details	By	Ver.	App.
B	29.09.04	CHANGED IO AND TERMINATIONS	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Connell Wagner

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn	JCP	02.09.04	
Designed	SPW	02.09.04	
Verified	JJA	02.09.04	
Approved	JJA	02.09.04	

Drawing Title: PATRICK LANE PUMP STATION MOTORISED VALVE SCHEMATIC DIAGRAM

Brisbane Water

DRAWING N°: 486/5/7-KJ009
SHEET 04 OF 18
CADD FILE N°: 0203E204.DWG

CW Project No.: 020381WU
Scale: NTS
Drawing No.: 0203-E204 Rev.: B

A1

CHA-66

RTU POWER SUPPLY
10A 24V DC

240VAC FROM
SUB-DISTRIBUTION BOARD
(Sheet 01 Line 43)

24VAC
24V DC

RTU POWER FAIL RELAY
BATT OK
POWER ON

BATTERIES

WET WELL LEVEL REFER SHEET 9
SURCHARGE MANOUNT REFER SHEET 9
WET WELL WASHING SOLENOID VALVE REFER SHEET 9
GRAVITY SEWER HIGH LEVEL REFER SHEET 9
GRAVITY SEWER LEVEL REFER SHEET 9
PLC CARD SUPPLY REFER SHEET 9
RTU CARD SUPPLY REFER SHEET 9

Rx TBA
Tx TBA
SD
24V DC
15.6V DC
RADIO

REFER TO SHEET 11

POWER SUPPLY CONNECTOR
RS 485 PORTS
RS 232 PORTS
ANALOGUE INPUTS

MOTHER BOARD

EXTERNAL I/O BOARD CONNECTOR

DIGITAL INPUTS MODULE No. 1
DIGITAL OUTPUTS MODULE No. 1
REFER TO SHEET 06
REFER TO SHEET 08
REFER TO SHEET 07
NOT USED
DIGITAL INPUTS MODULE No. 3
ANALOGUE OUTPUTS

EXTENSION BOARD

DIGITAL INPUTS MODULE No. 2
DIGITAL OUTPUTS MODULE No. 2
REFER TO SHEET 06
REFER TO SHEET 08

NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

HVAC RECEIVED

Job No.:

Registered by: W.V.

08 OCT 2004

Circ.	Initial	Date
PM		8/10/04
DO		

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-I12 DIGITAL INPUT
- DO1-O5 DIGITAL OUTPUT
- AI-I2 ANALOGUE INPUT
- AO-O0 ANALOGUE OUTPUT

240V AC FROM
SUB-DISTRIBUTION BOARD
(Sheet 01 Line 42)

SN3
P1A

GE-FANUC 90-30 PACK 0

	SLOT 1	SLOT 2	SLOT 3	SLOT 4	SLOT 5	SLOT 6	SLOT 7	SLOT 8	SLOT 9	SLOT 10
IC693 PWR 321	IC693 CPU350	IC693 CMM311	IC693 MDL645	IC693 MDL645	IC693 MDL645	IC693 MDL940	IC693 ALG221	IC693 ALG221	IC693 ALG392	
POWER SUPPLY 125/240 VAC	CPU 350	MODBUS COMMS	16 POINT DIGITAL INPUT 24 VDC	16 POINT DIGITAL INPUT 24 VDC	16 POINT DIGITAL INPUT 24 VDC	16 POINT DIGITAL RELAY OUTPUT 2A	4 CHANNEL ANALOGUE INPUT CURRENT (ISOLATED)	4 CHANNEL ANALOGUE INPUT CURRENT (ISOLATED)	8 CHANNEL ANALOGUE OUTPUT CURRENT	SPARE
PRIMARY BACKPLANE		MODBUS 1	30001-30016	30017-30032	30033-30048	30001-30016	XA001-XA004	XA005-XA008	XA001-XA008	

IC693CHS391

VFD1
MODBUS
ADDR 2
REFER TO SHEET 2

VFD2
MODBUS
ADDR 3
REFER TO SHEET 3

32510Q AS BUILT

FOR CONSTRUCTION

Brisbane Water

DRAWING N° 486/5/7-KJ010

SHEET 05 OF 18 CADD FILE N° 0203E205.DWG

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	ADDED PLC FEED, MINOR WIRING CHANGES	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP	NRB	NRB

Connell Wagner

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

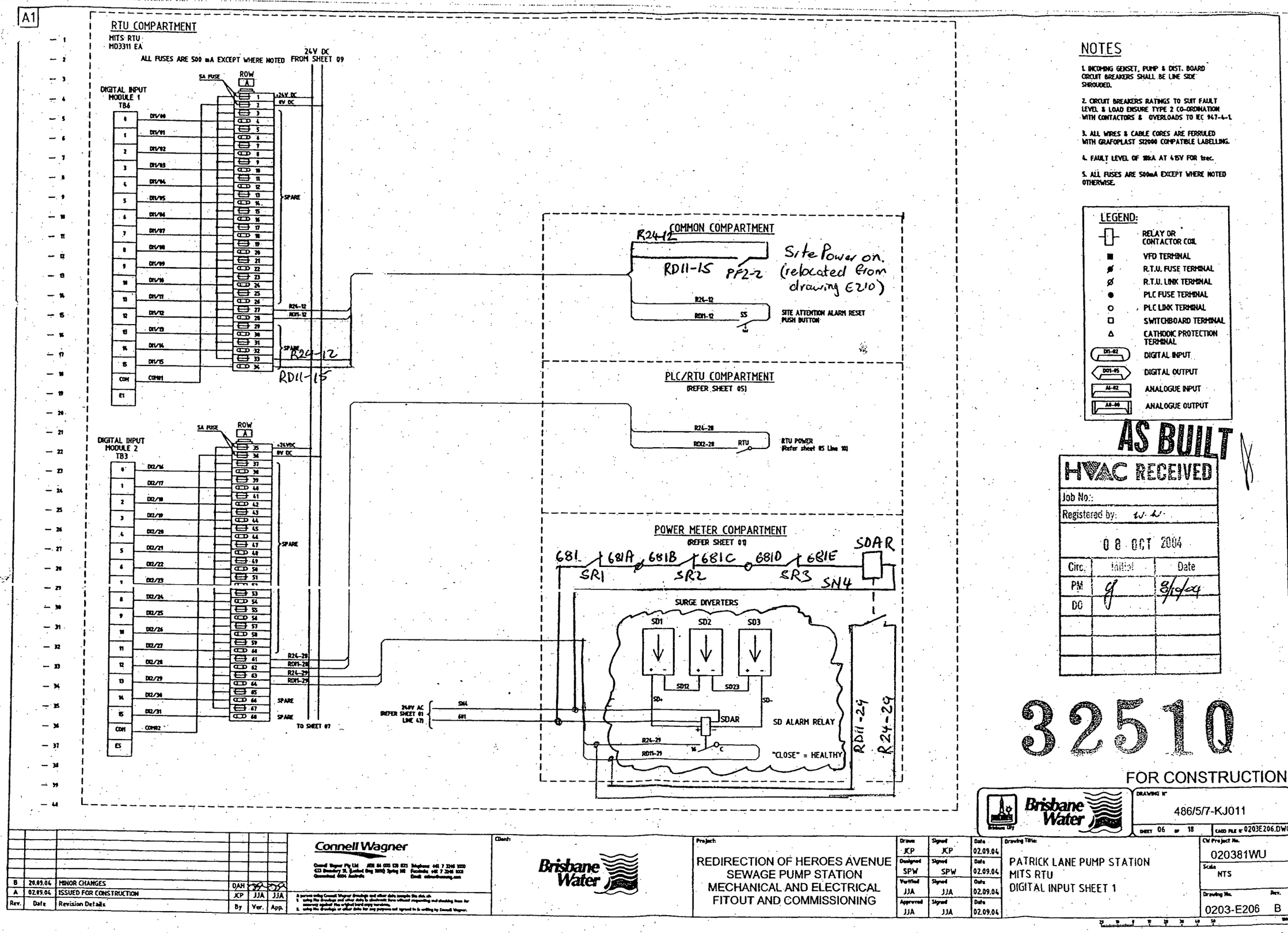
Drawn	JCP	Signed	JCP
Date	02.09.04		
Designed	SPW	Signed	SPW
Date	02.09.04		
Verified	JJA	Signed	JJA
Date	02.09.04		
Approved	NRB	Signed	NRB
Date	02.09.04		

Drawing Title: PATRICK LANE PUMP STATION DC POWER SUPPLY SCHEMATIC DIAGRAM

CW Project No. 020381WU

Scale NTS

Drawing No. 0203-E205 Rev. B



NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-02 DIGITAL INPUT
- DO1-05 DIGITAL OUTPUT
- AI-02 ANALOGUE INPUT
- AO-00 ANALOGUE OUTPUT

AS BUILT

HVAC RECEIVED
Job No.:
Registered by: W. W.
08 OCT 2004

Circ.	Initial	Date
PM	g	8/10/04
DO		

32510

FOR CONSTRUCTION

Brisbane Water

DRAWING No. 486/5/7-KJ011
SHEET 06 OF 18
CADD FILE No. 0203E206.DWG

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	MINOR CHANGES	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Connell Wagner

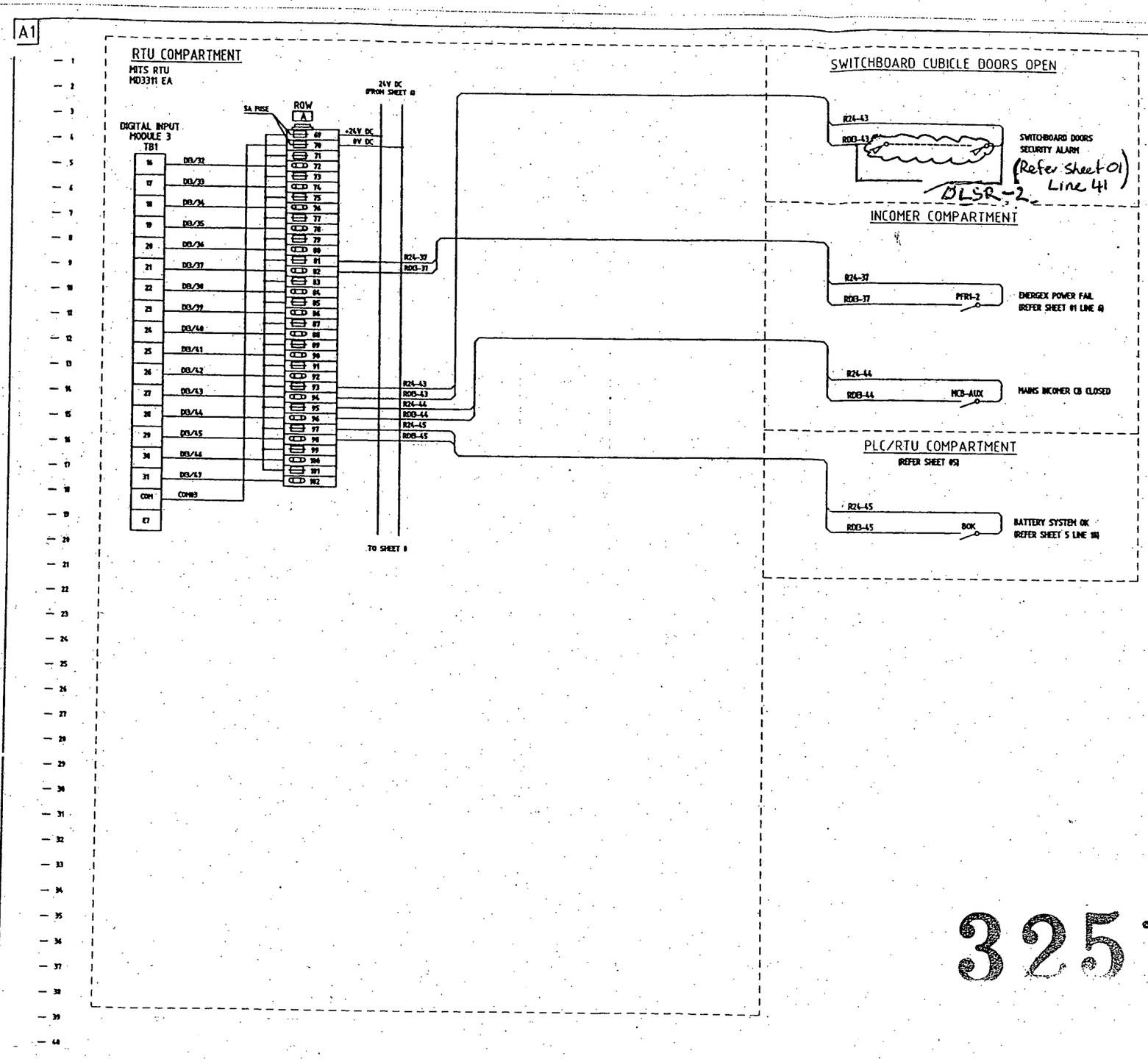
Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn	Signed	Date
JCP	JCP	02.09.04
Designed SPW	Signed SPW	02.09.04
Verified JJA	Signed JJA	02.09.04
Approved JJA	Signed JJA	02.09.04

Drawing Title: PATRICK LANE PUMP STATION MITS RTU DIGITAL INPUT SHEET 1

CW Project No. 020381WU
Scale NTS
Drawing No. 0203-E206 Rev. B



NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-02 DIGITAL INPUT
- DO1-05 DIGITAL OUTPUT
- AI-02 ANALOGUE INPUT
- AO-00 ANALOGUE OUTPUT

AS BUILT

HVAC RECEIVED
Job No.:
Registered by: W.W.
08 OCT 2004

Circ.	Initial	Date
PM	y	8/10/04
DO		

32510

FOR CONSTRUCTION

Brisbane Water

DRAWING N° 486/5/7-KJ012
SHEET 07 OF 18
CADD FILE N° 0203E207.DWG

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	MINOR CHANGES	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Connell Wagner

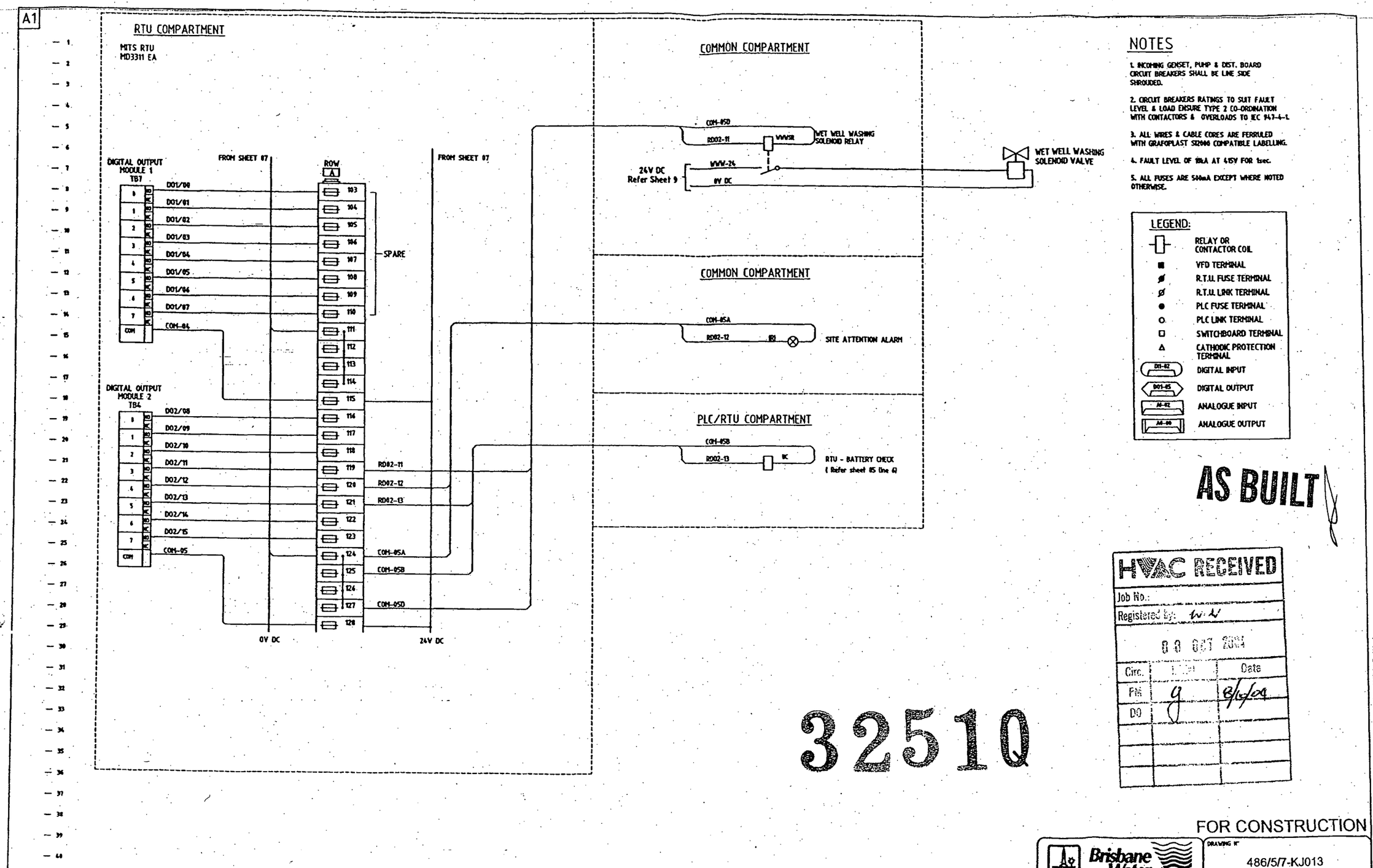
Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn	Signed	Date
JCP	JCP	02.09.04
Designed SPW	Signed SPW	02.09.04
Verified JJA	Signed JJA	02.09.04
Approved JJA	Signed JJA	02.09.04

Drawing Title: PATRICK LANE PUMP STATION MITS RTU DIGITAL INPUT SHEET 2

CW Project No. 020381WU
Scale NTS
Drawing No. 0203-E207 Rev. B


A1
RTU COMPARTMENT
MITS RTU
MD3311 EA
DIGITAL OUTPUT MODULE 1
TB7
DIGITAL OUTPUT MODULE 2
TB4
FROM SHEET 07
ROW
SPARE
COMMON COMPARTMENT
WET WELL WASHING SOLENOID RELAY
24V DC
Refer Sheet 9
WET WELL WASHING SOLENOID VALVE
SITE ATTENTION ALARM
PLC/RTU COMPARTMENT
RTU - BATTERY CHECK
(Refer sheet 05 line 6)
0V DC
24V DC
NOTES
1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.
LEGEND:
RELAY OR CONTACTOR COIL
VFD TERMINAL
R.T.U. FUSE TERMINAL
R.T.U. LINK TERMINAL
PLC FUSE TERMINAL
PLC LINK TERMINAL
SWITCHBOARD TERMINAL
CATHODIC PROTECTION TERMINAL
DIGITAL INPUT
DIGITAL OUTPUT
ANALOGUE INPUT
ANALOGUE OUTPUT
AS BUILT
HVAC RECEIVED
Job No.:
Registered by:
08 OCT 2004
Circ.
Date
FM
DO
32510
FOR CONSTRUCTION
Brisbane Water
DRAWING No
486/5/7-KJ013
SHEET 08 OF 18
CADD FILE No 0203E208.DWG
B 20.09.04 ADDED WET WELL WASHING SOLENOID VALVE DAH
A 02.09.04 ISSUED FOR CONSTRUCTION JCP JJA JJA
Rev. Date Revision Details By Ver. App.
Connell Wagner
Client:
Brisbane Water
Project:
REDIRECTION OF HEROES AVENUE
SEWAGE PUMP STATION
MECHANICAL AND ELECTRICAL
FITOUT AND COMMISSIONING
Drawn JCP Signed JCP Date 02.09.04
Designed SPW Signed SPW Date 02.09.04
Verified JJA Signed JJA Date 02.09.04
Approved JJA Signed JJA Date 02.09.04
Drawing Title:
PATRICK LANE PUMP STATION
MITS RTU
DIGITAL OUTPUT
CW Project No.
020381WU
Scale
NTS
Drawing No.
0203-E208
Rev.
B

A1

RTU COMPARTMENT

MITS RTU
MD3311 EA

ANALOGUE INPUT MODULE TB4

ROW A

0	AI00+	129	
	AI00-	130	
1	AI01+	131	AI01+
	AI01-	132	0V DC
2	AI02+	133	AI02+
	AI02-	134	0V DC
3	AI03+	135	
	AI03-	136	
4	AI04+	137	
	AI04-	138	
5	AI05+	139	
	AI05-	140	
6	AI06+	141	
	AI06-	142	
7	AI07+	143	
	AI07-	144	
E/A			

WET WELL LEVEL CCT
REFER SHEET 14

DC POWER SUPPLIES
REFER SHEET 07

ROW E

24V DC	0+	
	1+	24V DC
	2+	SI-24
	3+	WWW-24
	4+	GSHL-24
	5+	24V DC
	6+	
	7+	
	8+	
	9+	
	10+	
	11+	24V DC
	12+	24V DC
	13+	24V DC
	14+	24V DC
J1	15+	J1
J3	16+	J5

ROW F

0V DC	0-	
	1-	0V DC
	2-	0V DC
	3-	0V DC
	4-	0V DC
	5-	0V DC
	6-	
	7-	
	8-	
	9-	
	10-	
	11-	0V DC
	12-	0V DC
	13-	0V DC
	14-	0V DC
J2	15-	J2
J4	16-	J4

- SURCHARGE IMMINENT RELAY (Refer Sheet 10)
- WET WELL WASHING SOLENOID (Refer Sheet 8)
- GRAVITY SEWER HIGH LEVEL RELAY (Refer Sheet 10)
- RADIO POWER SUPPLY (REFER SHEET 5)
- PLC CARD SUPPLY (REFER SHEET 10)
- RTU CARD SUPPLY (REFER SHEET 4)
- RTU POWER SUPPLY (REFER SHEET 5)
- 24V BATTERIES (REFER SHEET 5)
- RADIO SUPPLY (REFER SHEET 5)

COMMON COMPARTMENT

REFER SHEET 10

LEVEL INDICATOR

AI02-L1

GRAVITY SEWER LEVEL TRANSMITTER

24VDC

NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SIZE000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 10kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-I2 — DIGITAL INPUT
- DO1-O5 — DIGITAL OUTPUT
- AI-I2 — ANALOGUE INPUT
- AO-O0 — ANALOGUE OUTPUT

AS BUILT

HVAC RECEIVED
Job No.:
Registered by: W.L.
00 OCT 2001

Circ	Initial	Date
PS	g	4/10/01
DO	g	4/10/01

32510

FOR CONSTRUCTION

Brisbane Water

DRAWING N° 486/5/7-KJ014
SHEET 09 OF 18
CADD FILE N° 0203E209.DWG

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	ADDED WET WELL WASHING SUPPLY	DAH	JJA	JJA
A	02.01.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Connell Wagner

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn	JCP	Signed	Date 02.09.04
Designed	SPW	Signed	Date 02.09.04
Verified	JJA	Signed	Date 02.09.04
Approved	JJA	Signed	Date 02.09.04

Drawing Title: PATRICK LANE PUMP STATION MITS RTU ANALOGUE INPUT

Civil Project No. 020381WU
Scale NTS
Drawing No. 0203-E209 Rev. B

A1

PLC COMPARTMENT

SLOT 3 16 POINT 24Vdc SINK DIGITAL INPUT MODULE IC693MDL645

24V DC FROM SHEET 09

TO SLOT 4

MARSHALLING TERMINALS ROW 'B'

%I001 DI1-01 (V)
%I002 DI1-02 (BL)
%I003 DI1-03 (BL)
%I004 DI1-04 (BL)
%I005 DI1-05 (BL)
%I006 DI1-06 (BL)
%I007 DI1-07 (BL)
%I008 DI1-08 (BL)
%I009 DI1-09 (BL)
%I010 DI1-10 (BL)
%I011 DI1-11 (BL)
%I012 DI1-12 (BL)
%I013 DI1-13 (BL)
%I014 DI1-14 (BL)
%I015 DI1-15 (BL)
%I016 DI1-16 (BL)

NOT USED

0V DC FROM SHEET 09

TO SLOT 4

COMMON CONTROLS COMPARTMENT

PUMP STATION REMOTE SELECTED
WET WELL SURCHARGE IMMINENT
SITE POWER ON
GRAVITY SEWER HIGH LEVEL

24V DC REFER SHEET 09
0V DC

WELL SURCHARGE IMMINENT RELAY

GRAVITY SEWER HIGH LEVEL RELAY

LEVEL ELEMENT

LEVEL ELEMENT

Removed. See drawing E206 line 17

NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-02 DIGITAL INPUT
- DO1-05 DIGITAL OUTPUT
- AI-02 ANALOGUE INPUT
- AI-04 ANALOGUE OUTPUT

AS BUILT

HVAC RECEIVED
Job No.:
Registered by: W.W.
00 OCT 2004

Circ.		Date
PN	9	8/10/04
DO		

32510

FOR CONSTRUCTION

Brisbane Water

DRAWING N° 486/5/7-KJ015
SHEET 10 OF 18
CAD FILE N° 0203E210.DWG

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	CHANGED IO AND TERMINATIONS	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP		

Connell Wagner

Client: Brisbane Water

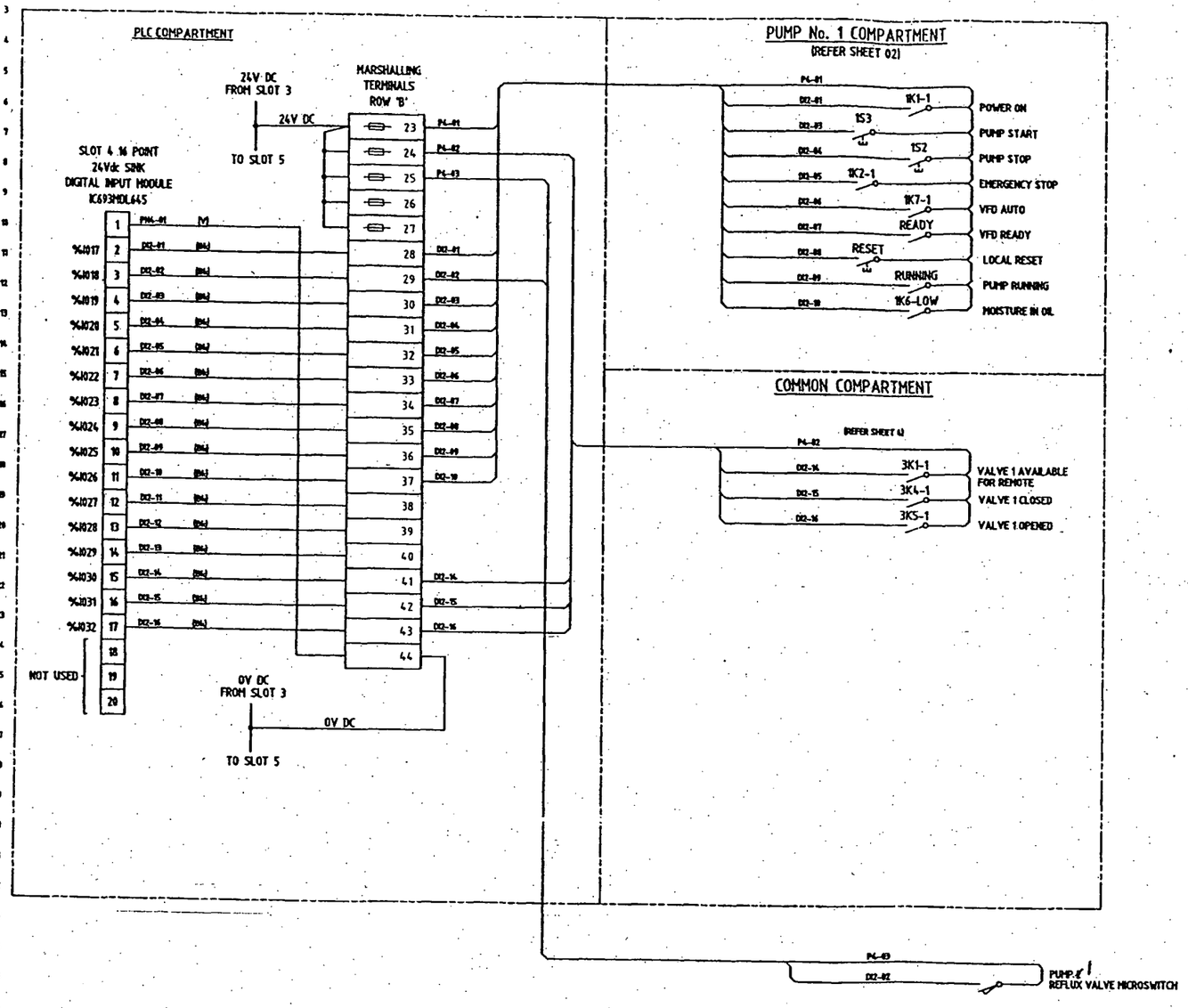
Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn	JCP	Signed JCP	Date 02.09.04
Designed	SPW	Signed SPW	Date 02.09.04
Verified	JJA	Signed JJA	Date 02.09.04
Approved	JJA	Signed JJA	Date 02.09.04

Drawing Title: PATRICK LANE PUMP STATION PLC DIGITAL INPUTS SLOT 3

CW Project No. 020381WU
Scale NTS
Drawing No. 0203-E210 Rev. B

A1



NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SIZ000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-02 DIGITAL INPUT
- DO1-05 DIGITAL OUTPUT
- AI-02 ANALOGUE INPUT
- AO-04 ANALOGUE OUTPUT

AS BUILT

HVAC RECEIVED

Job No.:	
Registered by:	W.W.
08 OCT 2004	

Circ	Initial	Date
PM	g	8/10/04
DO		

32510

FOR CONSTRUCTION

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	CHANGE IO'S AND TERMINATIONS	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Connell Wagner

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn	JCP	Signed JCP	Date 02.09.04
Designed	SPW	Signed SPW	Date 02.09.04
Verified	JJA	Signed JJA	Date 02.09.04
Approved	JJA	Signed JJA	Date 02.09.04

Drawing Title: PATRICK LANE PUMP STATION PLC DIGITAL INPUTS SLOT 4

Brisbane Water

DRAWING N°: 486/5/7-KJ016

SHEET 11 OF 18 CADD FILE N° 0203E211.DWG

CW Project No.: 020381WU

Scale: NTS

Drawing No.: 0203-E211 Rev.: B

A1

PLC COMPARTMENT

24V DC FROM SLOT 4

24V DC

TO SLOT 6

MARSHALLING TERMINALS ROW 'B'

SLOT 5 16 POINT 24Vdc SINK DIGITAL INPUT MODULE IC693MDL645

	1	PS-01	(V)	45	PS-01
%I1033	2	DI-01	(24)	46	
%I1034	3	DI-02	(24)	47	PS-03
%I1035	4	DI-03	(24)	48	
%I1036	5	DI-04	(24)	49	
%I1037	6	DI-05	(24)	50	DI-01
%I1038	7	DI-06	(24)	51	DI-02
%I1039	8	DI-07	(24)	52	DI-03
%I1040	9	DI-08	(24)	53	DI-04
%I1041	10	DI-09	(24)	54	DI-05
%I1042	11	DI-10	(24)	55	DI-06
%I1043	12	DI-11	(24)	56	DI-07
%I1044	13	DI-12	(24)	57	DI-08
%I1045	14	DI-13	(24)	58	DI-09
%I1046	15	DI-14	(24)	59	DI-10
%I1047	16	DI-15	(24)	60	
%I1048	17	DI-16	(24)	61	
	18			62	
NOT USED	19			63	
	20			64	
				65	
				66	

0V DC FROM SLOT 4

0V DC

TO SLOT 6

PUMP No. 2 COMPARTMENT

(REFER SHEET 03)

PS-01		
DO-01	2K1-1	POWER ON
DO-03	2S3	PUMP START
DO-04	2S2	PUMP STOP
DO-05	2K2-1	EMERGENCY STOP
DO-06	2K7-1	VFD AUTO
DO-07	READY	VFD READY
DO-08	RESET	LOCAL RESET
DO-09	RUNNING	PUMP RUNNING
DO-10	2K6-LOW	MOISTURE IN OIL

PS-03

DO-02

PUMP 2 REFLUX VALVE MICROSWITCH

NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.

2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.

3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SIZ1000 COMPATIBLE LABELLING.

4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.

5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-02 DIGITAL INPUT
- DO1-05 DIGITAL OUTPUT
- AI1-02 ANALOGUE INPUT
- AO1-00 ANALOGUE OUTPUT

AS BUILT

HVAC RECEIVED

Job No.:

Registered by: W-W

08 OCT 2004

Circ.	Initial	Date
PM	g	8/10/04
DO		

32510

FOR CONSTRUCTION

Rev.	Date	Revision Details	By	Ver.	App.
B	20.09.04	ADD PUMP 2 ID	DAH		
A	02.09.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Connell Wagner

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn	JCP	Signed JCP	Date 02.09.04
Designed	SPW	Signed SPW	Date 02.09.04
Verified	JJA	Signed JJA	Date 02.09.04
Approved	JJA	Signed JJA	Date 02.09.04

Drawing Title: PATRICK LANE PUMP STATION PLC DIGITAL INPUTS SLOT 5

CW Project No. 020381WU

Scale NTS

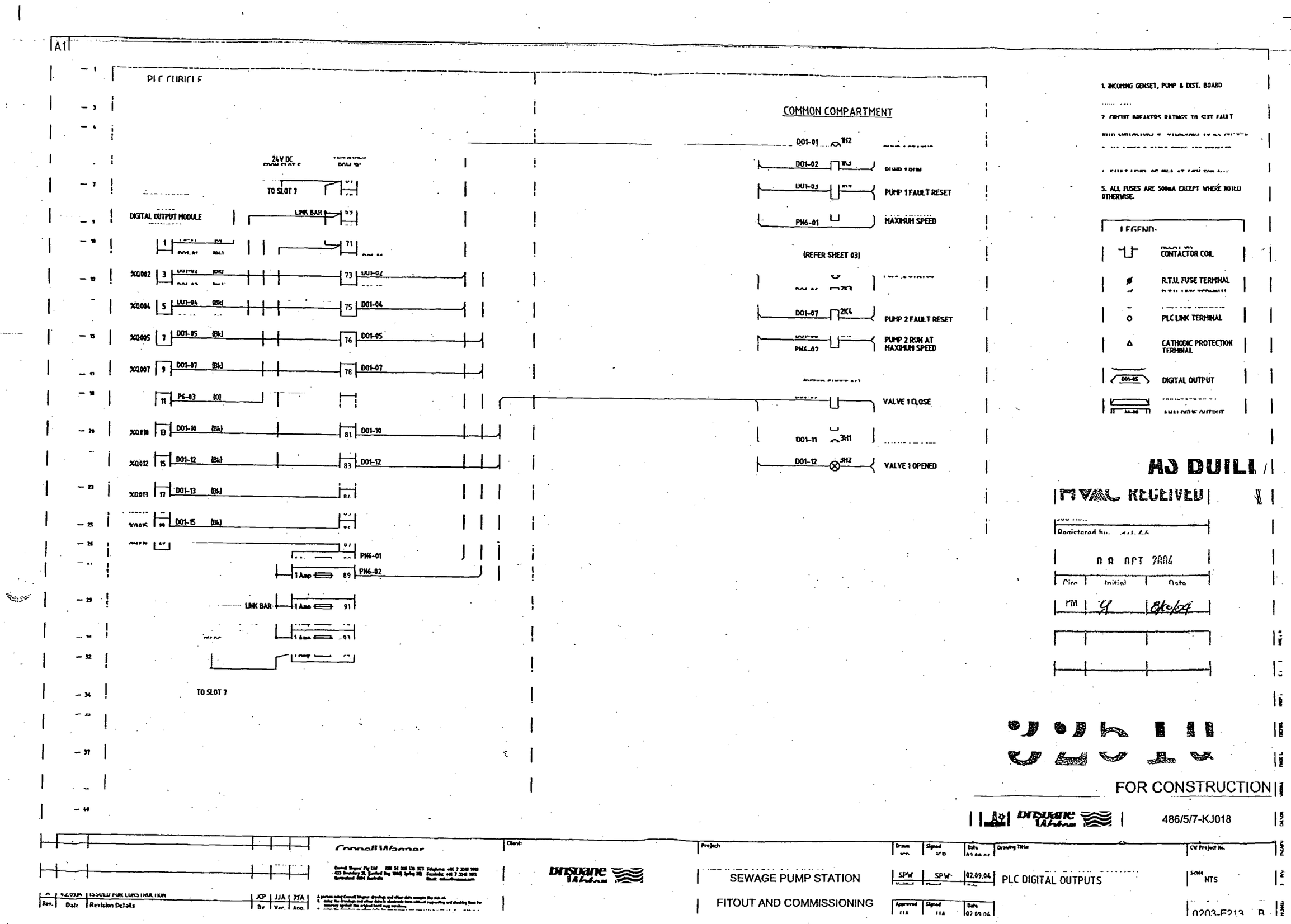
Drawing No. 0203-E212 Rev. B

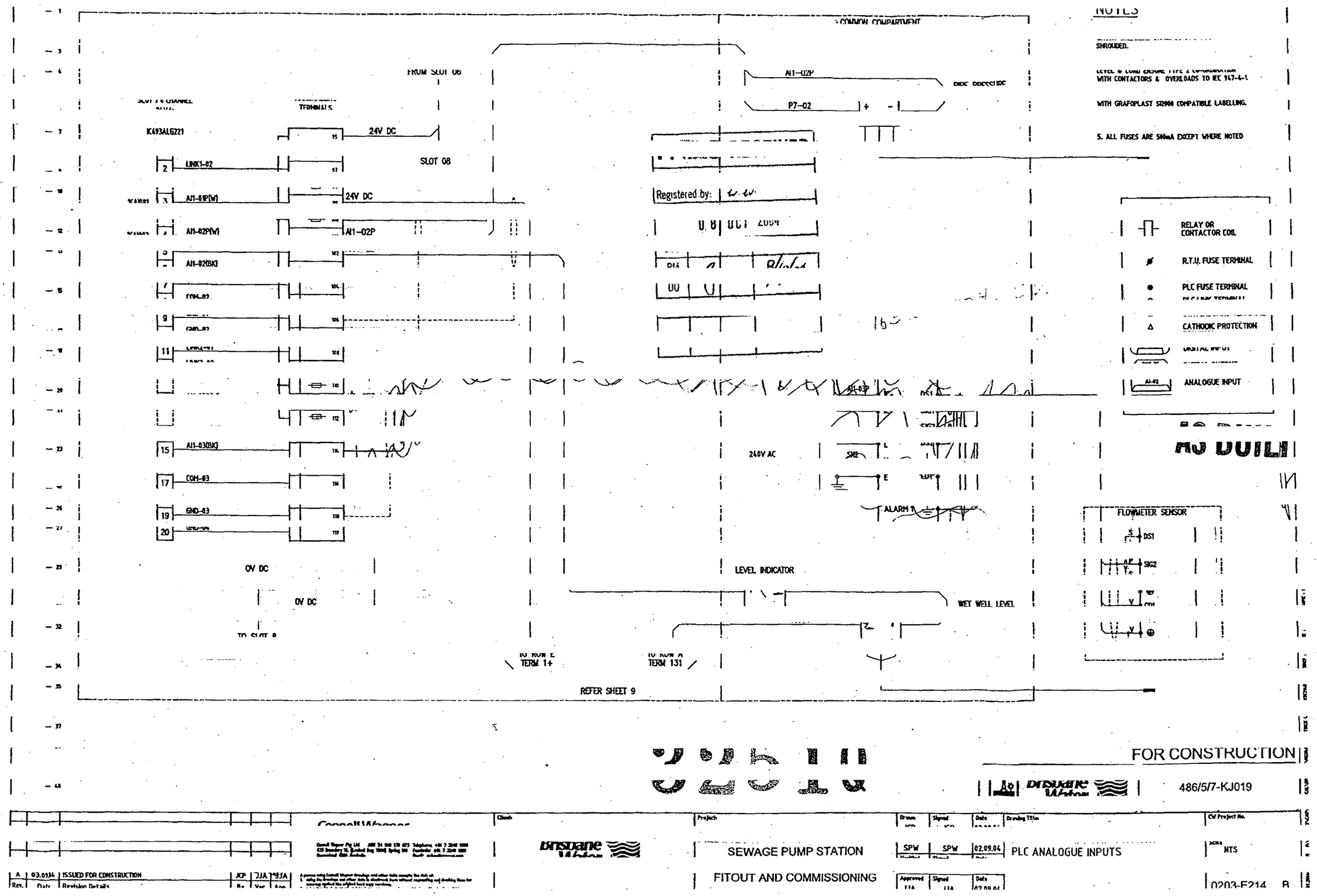
Brisbane Water

DRAWING No. 486/5/7-KJ017

SHEET 12 OF 18

CADD FILE No. 0203E212.DWG


A1
PLC CUBICLE
24V DC
TO SLOT 7
DIGITAL OUTPUT MODULE
LINK BAR
COMMON COMPARTMENT
PUMP 1 FAULT RESET
MAXIMUM SPEED
(REFER SHEET 03)
PUMP 2 FAULT RESET
PUMP 2 RUN AT MAXIMUM SPEED
VALVE 1 CLOSE
VALVE 1 OPENED
1. INCOMING GENSET, PUMP & DIST. BOARD
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.
LEGEND:
CONTACTOR COIL
R.T.U. FUSE TERMINAL
PLC LINK TERMINAL
CATHODIC PROTECTION TERMINAL
DIGITAL OUTPUT
AS BUILT
HVAC RECEIVED
08 OCT 2004
FOR CONSTRUCTION
486/5/7-KJ018
Connell Wagner
SEWAGE PUMP STATION
FITOUT AND COMMISSIONING
PLC DIGITAL OUTPUTS
NTS
0203-E213 B


A1
COMMON COMPARTMENT
NOTES
SHROUDED.
WITH CONTACTORS & OVERLOADS TO IEC 947-4-1
WITH GRAFOPLAST SIZE9O COMPATIBLE LABELLING.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED
FROM SLOT 08
IC693ALG221
24V DC
LINK1-02
SLOT 08
A11-01P(W)
24V DC
A11-02P(W)
A11-02P
A11-02(BK)
A11-03(BK)
COM-03
GND-03
A11-02P
P7-02
+ -
Registered by:
RELAY OR CONTACTOR COIL
R.T.U. FUSE TERMINAL
PLC FUSE TERMINAL
CATHODIC PROTECTION
ANALOGUE INPUT
240V AC
ALARM 1
FLOWMETER SENSOR
DS1
SIG2
0V DC
0V DC
LEVEL INDICATOR
WET WELL LEVEL
TO SLOT B
TO ROW E TERM 14
TO ROW A TERM 131
REFER SHEET 9
AS BUILT
FOR CONSTRUCTION
486/5/7-KJ019
Client
Project
SEWAGE PUMP STATION
FITOUT AND COMMISSIONING
Drawn SPW
Signed SPW
Date 02.09.04
Drawing Title
PLC ANALOGUE INPUTS
CW Project No.
Scale NTS
0203-E214 B
A 03.0934 ISSUED FOR CONSTRUCTION JCP JJA TJA
Rev. Date Revision Details

A1

RTU COMPARTMENT

MITS RTU
MD331H EA

ANALOGUE INPUT MODULE TB4

ROW A

0	+	AI00+	129
	-	AI00-	130
1	+	AI01+	131
	-	AI01-	132
2	+	AI02+	133
	-	AI02-	134
3	+	AI03+	135
	-	AI03-	136
4	+	AI04+	137
	-	AI04-	138
5	+	AI05+	139
	-	AI05-	140
6	+	AI06+	141
	-	AI06-	142
7	+	AI07+	143
	-	AI07-	144
E/S			

AI01+ — 0V DC
AI02+ — 0V DC

WET WELL LEVEL CCT
REFER SHEET 14

COMMON COMPARTMENT
REFER SHEET 10

LEVEL INDICATOR — AI02-L1

GRAVITY SEWER LEVEL TRANSMITTER — 24VDC

DC POWER SUPPLIES
REFER SHEET 07

24V DC

ROW A

0+		
1+	24V DC	
2+	SI-24	SURCHARGE IMMINENT RELAY (Refer Sheet 10)
3+	WWW-24	WET WELL WASHING SOLENOID (Refer Sheet 8)
4+	GSHL-24	GRAVITY SEWER HIGH LEVEL RELAY (Refer Sheet 10)
5+	24V DC	
6+		
7+		
8+		
9+		
10+		
11+	24V DC	RADIO POWER SUPPLY (REFER SHEET 5)
12+	24V DC	PLC CARD SUPPLY (REFER SHEET 10)
13+	24V DC	RTU CARD SUPPLY (REFER SHEET 6)
14+	24V DC	RTU POWER SUPPLY (REFER SHEET 5)
15+	J1	24V BATTERIES (REFER SHEET 5)
16+	J5	RADIO SUPPLY (REFER SHEET 5)

ROW A

0V DC

0-		
1-	0V DC	
2-	0V DC	
3-	0V DC	
4-	0V DC	
5-	0V DC	
6-		
7-		
8-		
9-		
10-		
11-	0V DC	
12-	0V DC	
13-	0V DC	
14-	0V DC	
15-	J2	
16-	J4	

J1 — J3

NOTES

1. INCOMING GENSET, PUMP & DIST. BOARD CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
4. FAULT LEVEL OF 18kA AT 415V FOR 1sec.
5. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- RELAY OR CONTACTOR COIL
- VFD TERMINAL
- R.T.U. FUSE TERMINAL
- R.T.U. LINK TERMINAL
- PLC FUSE TERMINAL
- PLC LINK TERMINAL
- SWITCHBOARD TERMINAL
- CATHODIC PROTECTION TERMINAL
- DI1-I2 — DIGITAL INPUT
- DO1-I05 — DIGITAL OUTPUT
- AI-I2 — ANALOGUE INPUT
- AO-I0 — ANALOGUE OUTPUT

AS BUILT

32510

HVAC RECEIVED
Job No.:
Registered by:
08 OCT 2004

Circ.	Issued	Date
Pl.	g	8/10/04
DG		

FOR CONSTRUCTION

Brisbane Water

DRAWING N° 486/5/7-KJ014
SHEET 09 OF 18. CADD FILE N° 0203E209.DWG

Rev.	Date	Revision Details	By	Ver.	App.
B	20.01.04	ADDED WET WELL WASHING SUPPLY	DAH	JJA	JJA
A	02.01.04	ISSUED FOR CONSTRUCTION	JCP	JJA	JJA

Connell Wagner

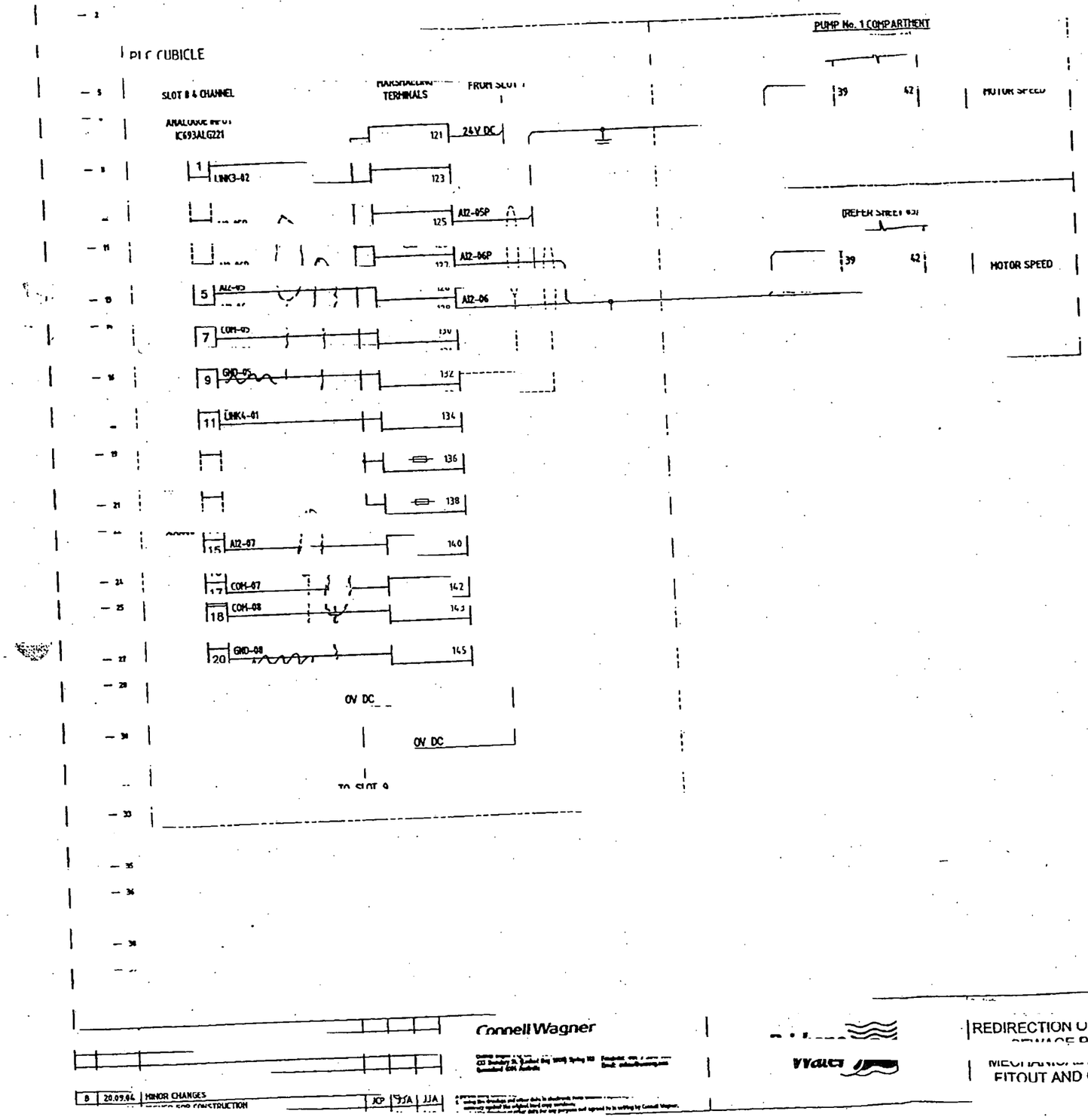
Client: Brisbane Water

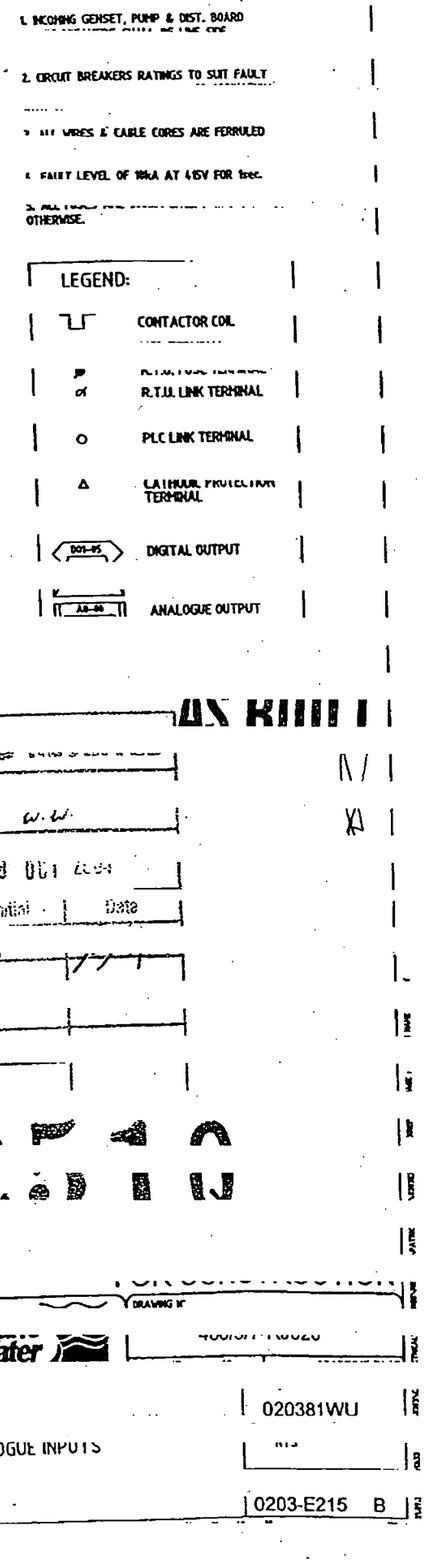
Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

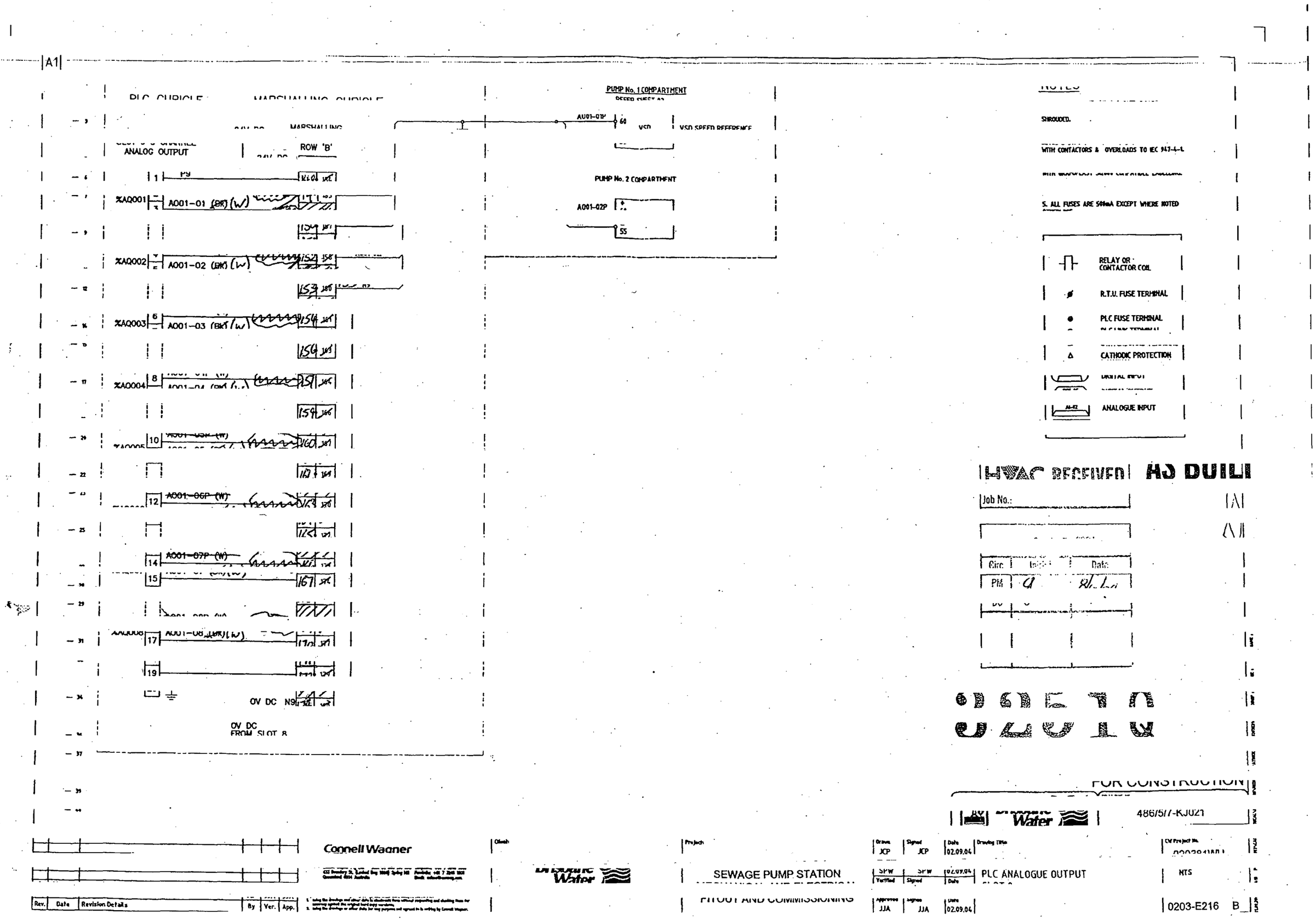
Drawn	JCP	Signed	Date 02.09.04
Designed	SPW	Signed	Date 02.09.04
Verified	JJA	Signed	Date 02.09.04
Approved	JJA	Signed	Date 02.09.04

Drawing Title: PATRICK LANE PUMP STATION MITS RTU ANALOGUE INPUT

Civil Project No. 020381WU
Scale NTS
Drawing No. 0203-E209 Rev. B


PLC CUBICLE
PUMP No. 1 COMPARTMENT
SLOT 8 4 CHANNEL
ANALOGUE INPUT
IC693ALG221
MARSHALLING TERMINALS
FROM SLOT 7
121
24V DC
123
LINK3-02
125
AI2-05P
127
AI2-06P
AI2-05
AI2-06
COM-05
GND-05
LINK4-01
134
136
138
AI2-07
140
COM-07
142
COM-08
143
GND-08
145
0V DC
0V DC
TO SLOT 9
39
42
MOTOR SPEED
39
42
MOTOR SPEED
B 20.09.04 MINOR CHANGES
JCP
JJA
JJA
Connell Wagner
Water


1. INCOMING GENSET, PUMP & DIST. BOARD
2. CIRCUIT BREAKERS RATINGS TO SUIT FAULT
3. ALL WIRES & CABLE CORES ARE FERRULED
4. FAULT LEVEL OF 10kA AT 415V FOR 1sec.
OTHERWISE.
LEGEND:
CONTACTOR COIL
R.T.U. LINK TERMINAL
PLC LINK TERMINAL
CATHODIC PROTECTION TERMINAL
DIGITAL OUTPUT
ANALOGUE OUTPUT
Registered by:
Circ
Initial
Date
DRAWING N°
Water
Drawn
Signed
Date
Drawing Title
020381WU
REDIRECTION OF HEROES AVENUE PUMP STATION
SPW
SPW
02.09.04
PLC ANALOGUE INPUTS
MECHANICAL & ELECTRICAL FITOUT AND COMMISSIONING
Approved
Signed
Date
02.09.04
0203-E215 B


A1
PLC CUBICLE
MARSHALLING CUBICLE
ANALOG OUTPUT
ROW 'B'
PUMP No. 1 COMPARTMENT
VSD SPEED REFERENCE
PUMP No. 2 COMPARTMENT
A001-02P
%AQ001
A001-01 (BK) (W)
%AQ002
A001-02 (BK) (W)
%AQ003
A001-03 (BK) (W)
%AQ004
A001-04 (BK) (W)
A001-06P (W)
A001-07P (W)
A001-08 (BK) (W)
OV DC N9
OV DC
FROM SLOT 8
NOTES
SHROUDED.
WITH CONTACTORS & OVERLOADS TO IEC 947-4-1
S. ALL FUSES ARE 500mA EXCEPT WHERE NOTED
RELAY OR CONTACTOR COIL
R.T.U. FUSE TERMINAL
PLC FUSE TERMINAL
CATHODIC PROTECTION
ANALOGUE INPUT
HVAC RECEIVED
AS BUILT
Job No.:
Circ
Date
PM
FOR CONSTRUCTION
486/5/7-KJ021
Connell Wagner
Drawn JCP
Signed JCP
Date 02.09.04
Drawing Title
SEWAGE PUMP STATION
PLC ANALOGUE OUTPUT
NTS
Approved JJA
Signed JJA
Date 02.09.04
0203-E216 B
Rev.
Date
Revision Details
By
Ver.
App.

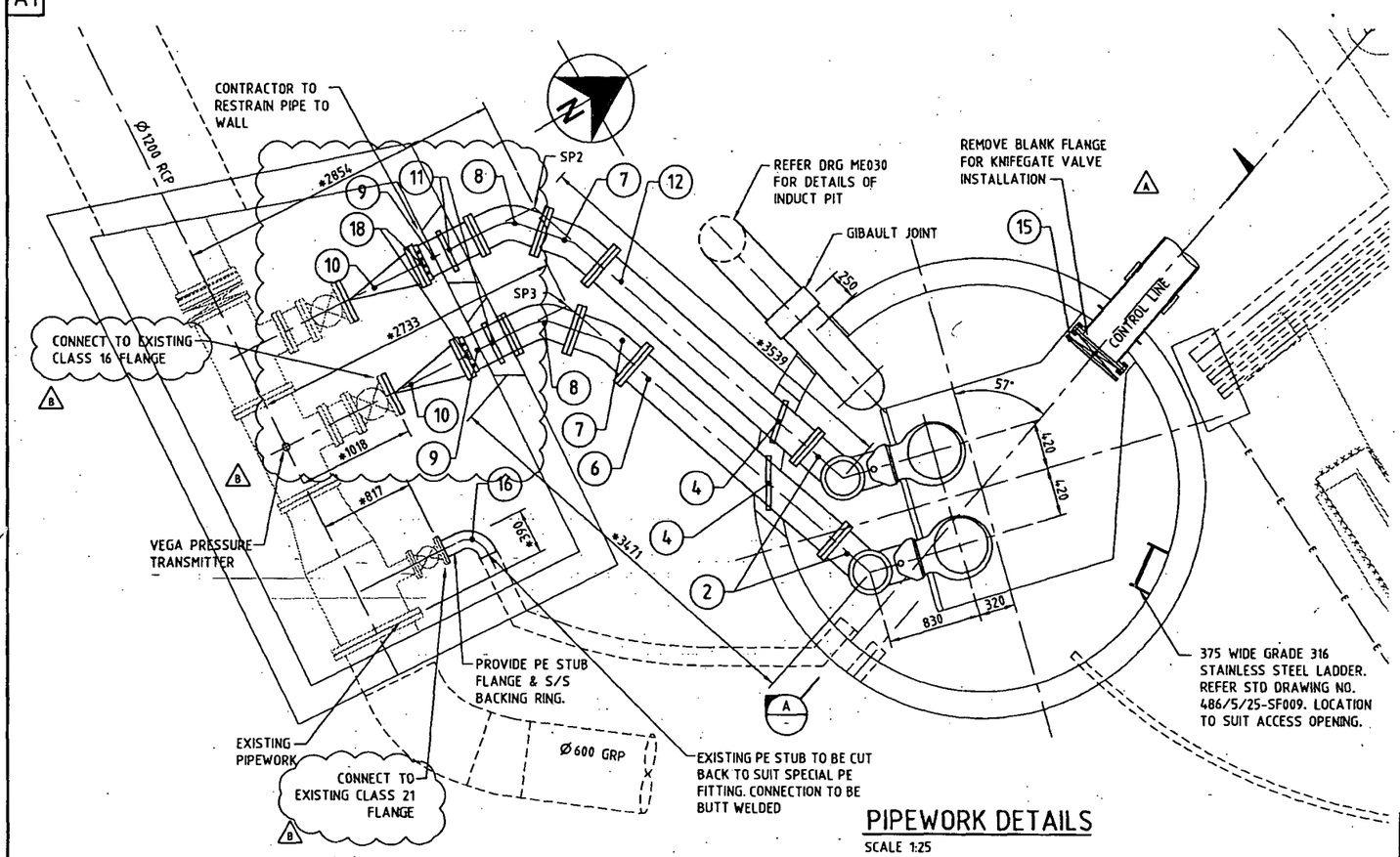
BRISBANE WATER - PATRICK LANE PUMP STATION CABLE SCHEDULE - Drawing #486/5/7-KJ023 Marked Up

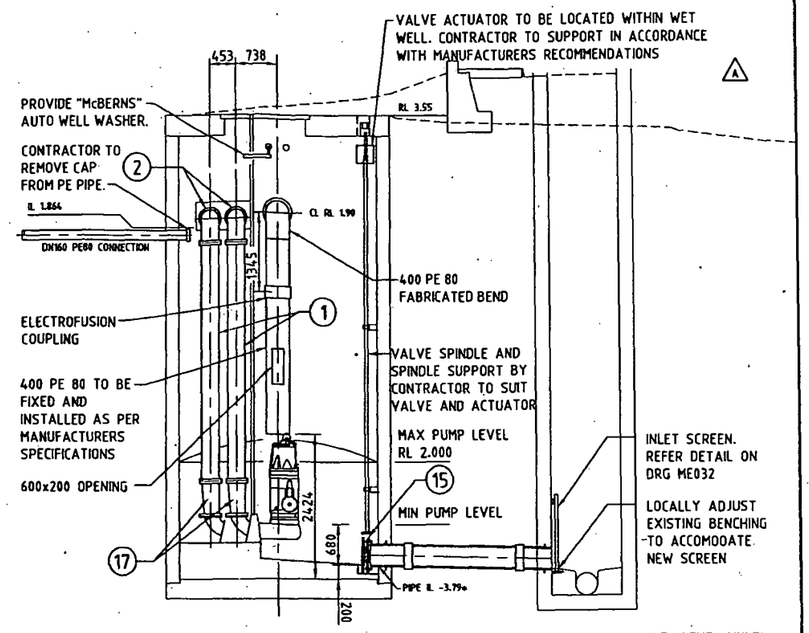
CABLE	SIZE			LENGTH			
E01	120	1C	CU/PVC		Switchboard to Earth Stake	Main Earth	Install to new earth stake
P02	70	4 x 2C	CU/PVC/SCREEN	15	Switchboard to Pump No 1	Pump 1 Power Feed	Install pump 1
~~P04~~	~~2.5~~	~~3C+E~~	~~CU/PVC/PVC~~		~~Switchboard to Motorised Valve~~	~~Valve Motor Feed~~	~~Install to new motorised valve~~
C02A		1PR	VENDOR	20	Switchboard to Pump No 1	Pump 1 Thermistor	Install pump 1 thermistor
C03A		1PR	VENDOR	20	Switchboard to Pump No 2	Pump 2 Thermistor	Install pump 2 thermistor
I01		1C	MULTITRODE		Switchboard to Surcharge Intermittent Probe	Surcharge Intermittent Probe	Install new multitrode level probe in wet well
I02		1C	MULTITRODE		Switchboard to Gravity Sewer High Level Probe	Gravity Sewer High Probe	Install new multitrode level probe in gravity sewer
I03		3C+E	VEGA	25	Switchboard to Pressure Sensor	Outlet Pipe Pressure Signal	Install new pressure sensor
I05		3C+E	VEGA	27	Switchboard to Gravity Sewer Level Sensor	Gravity Sewer Level Signal	Install new wet well sensor
I07	1.5	1PR	DEKORON		Switchboard to P2 Reflux Valve Microswitch	P2 Reflux Valve Position	Install to pump 2 reflux valve microswitch

BRISBANE WATER - PATRICK LANE PUMP STATION CABLE SCHEDULE - Drawing #486/5/7-KJ023 Marked Up

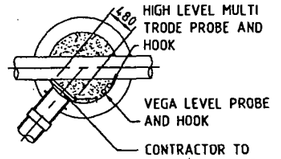
CABLE NO.	SIZE (Sq mm)	CORES	TYPE	LENGTH (m)	FROM - TO - VIA ROUTE	CABLE FUNCTION	NOTES
E01	120	1C	CU/PVC		Switchboard to Earth Stake	Main Earth	Install to new earth stake
P01	150	4C	CU/XLPE/SDI		Energex Supply to Switchboard	Incoming Mains Supply	Install to new pillar box supply
P02	70	4 x 2C	CU/PVC/SCREEN	15	Switchboard to Pump No 1	Pump 1 Power Feed	Install pump 1
P03	70	4 x 2C	CU/PVC/SCREEN	15	Switchboard to Pump No 2	Pump 2 Power Feed	Install pump 2
~~P04~~	~~2.5~~	~~3C+E~~	~~CU/PVC/PVC~~		~~Switchboard to Motorised Valve~~	~~Valve Motor Feed~~	~~Install to new motorised valve~~
~~C01~~	~~1.5~~	~~4PR~~	~~CU/PVC/PVC~~		~~Switchboard to Motorised Valve~~	~~Valve Controls~~	~~Install to new motorised valve~~
C02A		1PR	VENDOR	20	Switchboard to Pump No 1	Pump 1 Thermistor	Install pump 1 thermistor
C02B		1PR	VENDOR	20	Switchboard to Pump No 1	Pump 1 Oil Condition Transmitter	Install pump 1 oil condition transmitter
C03A		1PR	VENDOR	20	Switchboard to Pump No 2	Pump 2 Thermistor	Install pump 2 thermistor
C03B		1PR	VENDOR	20	Switchboard to Pump No 2	Pump 2 Oil Condition Transmitter	Install pump 2 oil condition transmitter
I01		1C	MULTITRODE		Switchboard to Surcharge Imminent Probe	Surcharge Imminent Probe	Install new multitrode level probe in wet well
I02		1C	MULTITRODE		Switchboard to Gravity Sewer High Level Probe	Gravity Sewer High Probe	Install new multitrode level probe in gravity sewer
I03		3C+E	VEGA	25	Switchboard to Pressure Sensor	Outlet Pipe Pressure Signal	Install new pressure sensor
I04		3C+E	VEGA	27	Switchboard to Wet Well Level Sensor	Wet Well Level Signal	Install new wet well sensor
I05		3C+E	VEGA	27	Switchboard to Gravity Sewer Level Sensor	Gravity Sewer Level Signal	Install new wet well sensor
I06	1.5	1PR	DEKORON		Switchboard to P1 Reflux Valve Microswitch	P1 Reflux Valve Position	Install to pump 1 reflux valve microswitch
I07	1.5	1PR	DEKORON		Switchboard to P2 Reflux Valve Microswitch	P2 Reflux Valve Position	Install to pump 2 reflux valve microswitch
I08	1.5	1PR	DEKORON		Switchboard to Wet Well Wash Solenoid	Wet Well Wash	Install to solenoid valve in RPZ housing

A1





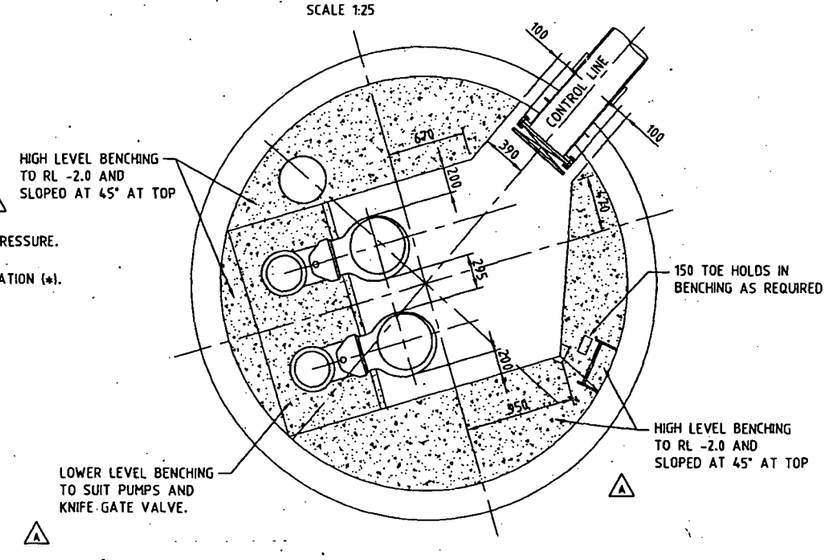
SECTION A
SCALE 1:50



PLAN ON SCREEN

PIPEWORK DETAILS

SCALE 1:25



PLAN ON BENCHING

SCALE 1:25

NOTES:

1. REFER TO DRAWING ME004 FOR GENERAL NOTES.
2. ALL PIPEWORK AND FITTINGS TO BE RATED TO 1.2MPa WORKING PRESSURE.
3. ALL FLANGES TO COMPLY WITH AS4087.
4. ALL DIMENSIONS TO BE CONFIRMED ON SITE PRIOR TO PIPE FABRICATION (*).

NOTE: ALL PIPEWORK TO BE MILD STEEL FBPE LINING AND COATING 5mm THICK UNO

MATERIAL LIST

ITEM	DESCRIPTION	NO OFF	REMARKS
1	324 OD STRAIGHT fl,fl	2	LENGTH TO SUIT
2 A	324 OD 90 ° BEND fl,fl	2	
4	PUDDLE FLANGE	2	
6	324 OD STRAIGHT fl,fl	1 A	LENGTH TO SUIT
7	324 OD 22° BEND fl,fl	2	TO SUIT SITE DIMENSIONS
8	~~324 OD 45° BEND fl,fl~~	2	A
9	324 OD STRAIGHT fl,sp B	2	LENGTH TO SUIT
10	~~300 NB NON RETURN VALVE~~ fl,fl	2 A	FLANGE TO SUIT CLASS 16 FLANGE B
11	PUDDLE FLANGE	2	
12	324 OD STRAIGHT fl,fl	1	LENGTH TO SUIT
15	300 NB KNIFE GATE VALVE fl,fl	1	
16	150 NB 90° BEND fl,fl PE SPECIAL	1	STUB FLANGE WITH S.S. ~~BACKING RING~~ TO VALVE TO SUIT CLASS 21 FLANGE B
17	324 OD/219 OD ECCENTRIC REDUCER	2	
18	NB 300 UNI-FLANGE A	2	CLASS 16 AS4087 A

A B

500 0 500 1000 1500 2000 2500mm
SCALE 1:25
1000 0 1000 2000 3000 4000 5000mm
SCALE 1:50

FOR CONSTRUCTION

Brisbane City

Brisbane Water

DRAWING Nº 486/5/7-KJ003

SHEET 3 OF 4 CADD FILE Nº ME031

Rev.	Date	Revision Details	By	Ver.	App.
B	04/03/05	AMEND EXISTING DETAILS	NJS	SYM	CAR
A	25/06/04	FOR CONSTRUCTION	AO	DIF	CAR
02	15/11/02	FOR TENDER	MMB		
01	28/08/02	FOR CLIENT REVIEW	MMB		

Connell Wagner

Connell Wagner Pty Ltd ABN 54 005 139 873 Telephone: +61 7 3246 1000
433 Boundary St (Locked Bag 1000) Spring Hill Facsimile: +61 7 3246 1001
Queensland 4004 Australia Email: cwbne@conwag.com

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2. using the drawings or other data for any purpose not agreed to in writing by Connell Wagner.

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn AO	Signed A OLSON	Date 25/06/04	
Designed SG	Signed S GRAY	Date 25/06/04	
Verified DIF	Signed D FURNER	Date 28/06/04	
Approved CAR	Signed C RUSSELL	Date 29/06/04	

Drawing Title: PUMP STATION PS 1/1 AND PS 2/1 DETAILS

CW Project No. 020300CW

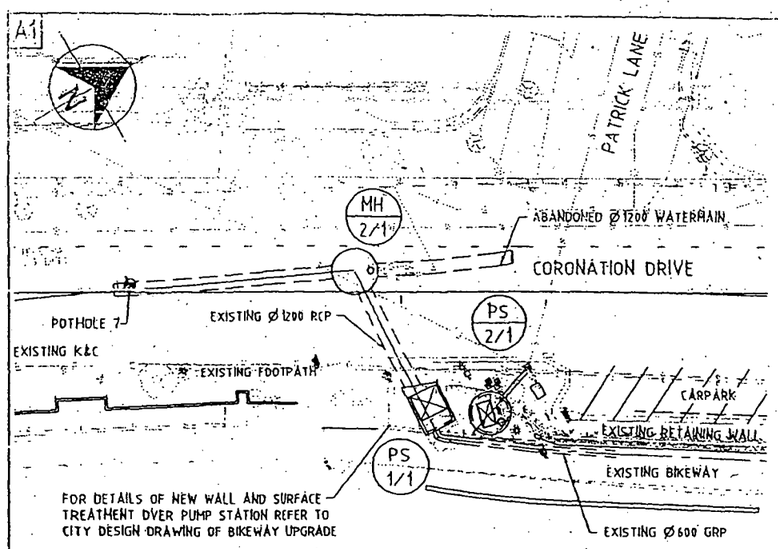
Scale AS SHOWN AT A1

Drawing No. ME031 Rev. B

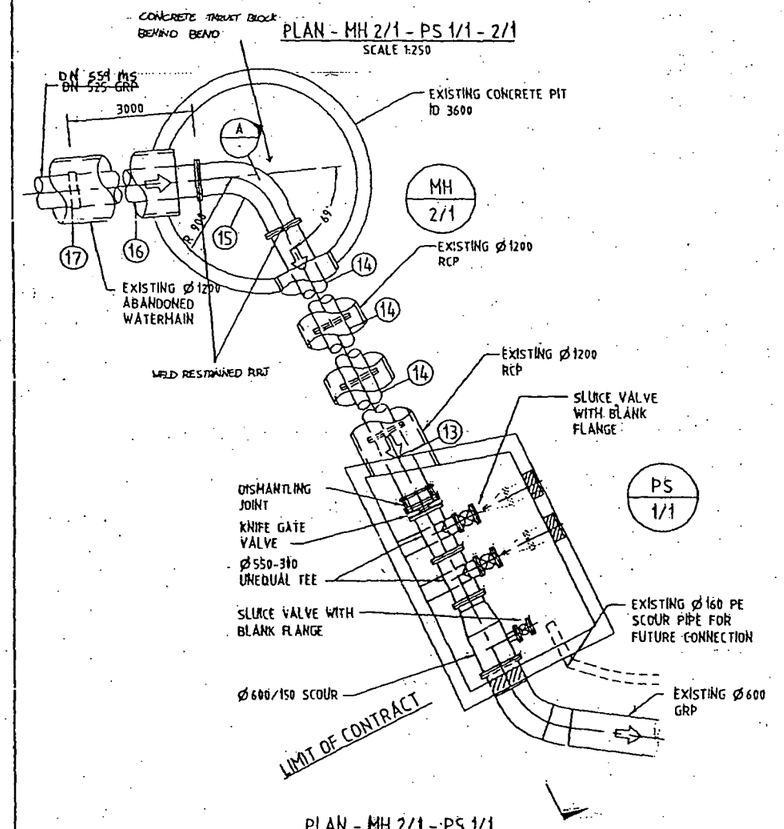
20 10 0 10 20 30 40 50 100mm

P:\CW02003\CAD\Drgs Contract Heroes\ME 031.dwg
xrefs: CW-A1155, ME 030, saved, GANTRY AND WALLS, REMEWAY2
23.06.2004 09:11:17

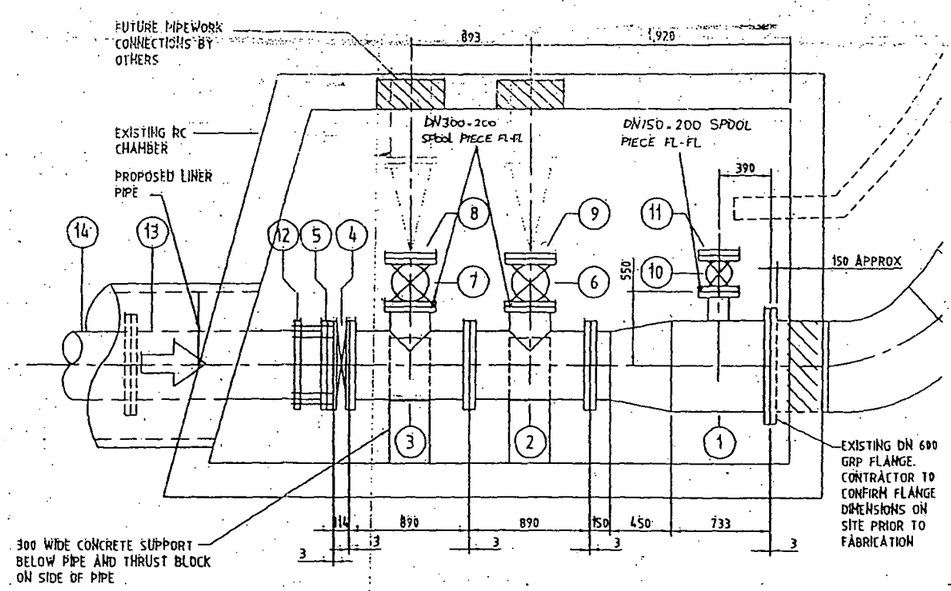
A1



PLAN - MH 2/1 - PS 1/1 - 2/1
SCALE 1:250



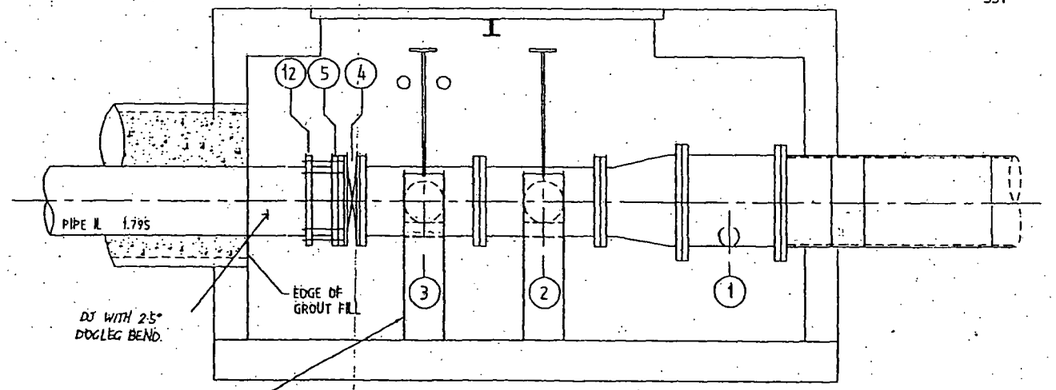
PLAN - MH 2/1 - PS 1/1
SCALE 1:50



PLAN - PS 1/1 - PIPEWORK
SCALE 1:20

PIPE FITTING SCHEDULE			
No.	DESCRIPTION	MATERIAL	LINING
1	~~DN600x550x150 TEE WITH CONCENTRIC TAPER FL.FL.FL~~	~~S.S. 316L~~ FBPE HS	FBPE
2	~~DN550xDN300 UNEQUAL TEE FL. FL. FL~~	~~S.S. 316L~~ FBPE HS	FBPE
3	~~DN550xDN300 UNEQUAL TEE FL. FL. FL~~	~~S.S. 316L~~ FBPE HS	FBPE
4	DN600 KNIFE GATE VALVE FL.FL CLASS 'A'	S.S. 316L	-
5	DN600 DISMANTLING JOINT WITH STUDS FOR ANCHORING TO ANCHOR FLANGE	~~S.S. 316L~~ FBPE HS	FBPE
6	DN300 SLUICE VALVE FL. FL	D.I.	TBE
7	DN300 SLUICE VALVE FL. FL	D.I.	TBE
8	DN300 BLANK FLANGE	MILD STEEL	TBE
9	DN300 BLANK FLANGE	MILD STEEL	TBE
10	DN150 SLUICE GATE VALVE FL. FL	D.I.	TBE
11	DN150 BLANK FLANGE	MILD STEEL	TBE
12	DN600 ANCHOR FLANGE WELDED TO PIPE TO RESTRAIN DISMANTLING JOINT	~~S.S. 316L~~ FBPE HS	FBPE
13	DN550 SPOOL PIECE FL.PL APPROX 2300 LONG (LENGTH TO SUIT)	~~S.S. 316L~~ FBPE HS	FBPE
14	DN550 SPOOL PIECE ~~FL.FL~~ 3000 LONG Sp-Sp ESN	~~S.S. 316L~~ FBPE HS	FBPE
15	~~DN550~~ 67° BEND ~~FL.FL~~ ~~S.O-S.O WELD~~ Sp-Sp RESTRAIN.	~~S.S. 316L~~ FBPE HS	FBPE
16	DN550 SPOOL PIECE ~~FL.PL~~ 3000 LONG ~~PLAIN END TO SUIT GRP COUPLING~~	~~S.S. 316L~~ FBPE HS	FBPE
17	~~DN525 GRP COUPLING~~	S.S. 316L	-

NOTES:
1. ~~ALL S.S. PIPEWORK TO HAVE 6mm WALL THICKNESS.~~
2. ALL FLANGES TO AS4087 CLASS 21.
3. CONTRACTOR TO CONFIRM FINAL ALIGNMENT OF KNIFE GATE VALVE PRIOR TO INSTALLATION.
4. DN ~~550~~ PIPES TO BE MADE UP WITH DN 600 FLANGES. S.S.



SECTION A
SCALE 1:20

AS CONSTRUCTED DRAWING
Brisbane City Council
Contract No. BW20132-01/02
Contractor : Tyco Water Pty Ltd
Completed : 9 March 2004
Sighted : K. Rice
Date : 6.09.2004

FOR CONSTRUCTION

Rev.	Date	Revision Details	By	Ver.	App.
A	02/06/03	ISSUED FOR CONSTRUCTION			
05	01/04/03	TENDER MODIFICATIONS	MP		
04	13/02/03	TENDER MODIFICATIONS	MP		
03	4/10/02	ITEMS 6,7 AND 10 AMENDED	MHB		
02	10/09/02	ISSUED FOR TENDER	MP		
01	11/03/02	FOR CLIENT REVIEW	MHB		

Connell Wagner

Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION SUPPLY AND INSTALLATION OF RISING MAIN CONTRACT No. BW.20132-01/02

Drawn MHB	Signed MB	Date 2/6
Designed TN	Signed	Date 2/6
Verified DIF	Signed	Date 2/6
Approved KJG	Signed RPEQ No. 3297	Date 2/6/03

Drawing Title: PLAN AND DETAILS MH 2/1 AND PS 1/1

CW Project No. 020300CW
Scale AS SHOWN
Drawing No. PL012 Rev. A

Brisbane Water
DRAWING No. 486/5/8-SM 12/061
SHEET 12 OF 35 CAD FILE No. PL012

A1

N

Ø1200 RCP

RPZ HOUSING REFER DETAIL ON DRG ME029

POWER TO SOLENOID

POWER TO FLOW SWITCH

INDUCT PIT. PLACED AGAINST EXISTING STONE PITCHED WALL. FINAL LOCATION TO BE DETERMINED TO SUIT VENT LINE. REFER DETAIL DRG ME032

TAP

POWER SUPPLY TO LIMIT SWITCHES

PS 1/1

NEW Ø100 CONDUIT FOR POWER AND CONTROL

PROVIDE "McBERNS" AUTO WELL WASHER. PROTECTED BY RPZ AND ON TIME CLOCK OPERATION WITH SOLENOID VALVE

DN40 SS SCHEDULE 10 WATER SUPPLY LINE TO WELL WASHER

POWER TO VEGA PRESSURE TRANSMITTER

NEW Ø50 PN16 PE80 OFFTAKE

EXISTING PE METER BOX WITH STOP COCK

SP1

EXISTING CAPPED UPVC VENT LINE LOCATED AT GROUND LEVEL

BIKEWAY EDGE

NEW VENT POLE. REFER TO STD BRISBANE WATER DRG 486/5/25-SC006/3

Ø600 GRP

PS 2/1

HIGH LEVEL MULTITRODE HOOK AND PROBE. REFER DRG ME007 FOR DETAILS

EXISTING SEWER MANHOLE LID

LEVEL PROBE Ø50 UPVC CONDUIT

Ø100 EXISTING ELECTRICAL CONDUIT

ACTUATOR CONTROL

4xØ100 EXISTING ELECTRICAL CONDUITS

ACTUATOR CONTROL TO BE LOCATED BELOW TOP SLABS REFER DRG ME031

1xØ100,2xØ60 ELECTRICAL CONDUITS

LEVEL PROBES

VEGA LEVEL PROBE. REFER DRG ME007 FOR DETAILS

PROVIDE HOOKS AND MULTITRODES AT HIGH LEVEL. REFER DRG ME007 FOR DETAILS

POWER TO PUMPS

CONTRACTOR TO INSTALL ACCESS OPENING SAFETY SCREENS. REFER DRG ME032

PROVIDE HOOKS FOR PUMPS POWER SUPPLY. REFER DRG ME007

EXISTING LIGHT POLE

VEGA LEVEL PROBE. REFER DRG ME007 FOR DETAILS

MATCH EVENLY WITH EXISTING KERB AND PAVEMENT

REMOVE EXISTING PAVEMENT AND KERB

E 9662.778
N 60101.996

R1456

452

2200 APPROX

775

4100

SWITCHBOARD

2119

800

900

ENERGEX PILLER LOCATION

CONTRACTOR TO PROVIDE 100Ø ELECTRICAL CONDUIT TO SWITCHBOARD

NEW 150 THICK SLAB TO SUIT SWITCHBOARD WITH SL 72 MESH, 40 TOP COVER CONCRETE HARDSTAND, 150mm ABOVE TOP OF KERB

200

NEW NON MOUNTABLE BCC KERB TYPE TO MATCH EXISTING

MATCH NEW KERB TO EXISTING PAVEMENT SMOOTHLY

EXISTING LEVEL PROBE STATION TO BE REMOVED BY BRISBANE WATER.

MATCH KERB AROUND EXISTING SUMP

EXISTING SUMP TO REMAIN

FALL NEW KERB AND PAVEMENT TO EXISTING SUMP

PROVIDE MASS CONCRETE STAIRS TO UPPER LEVEL. 4 STAIRS 190 RISER AND 250 TREAD. EXACT LOCATION TO BE DETERMINED ON SITE AND IS TO AVOID EXISTING LIGHT POLE, WALL DRAIN AND PROVIDE ADEQUATE CLEARANCE TO PROPOSED BIKEWAY BARRIER. STAIRS TO COMPLY WITH AS1657.

PLAN ON PUMP STATION PS 1/1 AND PS 2/1

SCALE 1:25

NOTE:

1. CONTRACTOR TO PROVIDE ADEQUATE THRUST RESTRAINT AND PIPEWORK SUPPORT AS REQUIRED
2. EXISTING PUMP STATION DIMENSIONS TO BE CONFIRMED ON SITE PRIOR TO DETAILING AND FABRICATION OF PIPEWORK
3. THIS DRAWING TO BE READ IN CONJUNCTION WITH ME031

EXISTING FEATURES SHOWN ARE A COMPILATION OF FIELD SURVEY AND DESIGN FEATURES OF THE CORONATION DRIVE WIDENING WORKS WHICH MAY NOT YET BE CONSTRUCTED.
INFORMATION SUPPLIED BY CITY DESIGN - SURVEY SERVICES, BRISBANE CITY COUNCIL UNDER COPYRIGHT.

SETOUT TABLE

SETOUT POINT	EASTING	NORTHING	DESCRIPTION
SP1	E9656.939	N60085.624	VENT POLE
SP2	E9657.536	N60091.255	PIPEWORK ALIGNMENT
SP3	E9658.416	N60091.073	PIPEWORK ALIGNMENT

FOR CONSTRUCTION

500 0 500 1000 1500 2000 2500mm
SCALE 1:25

Rev.	Date	Revision Details	By	Ver.	App.
B	28/01/05	REVISED SWITCHBOARD LOCATION	KH	DIF	CAR
A	25/06/04	FOR CONSTRUCTION	AO	DIF	CAR
02	15/11/02	FOR TENDER	MMB		
01	28/08/02	FOR CLIENT REVIEW	MMB		

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Client: Brisbane Water

Project: REDIRECTION OF HEROES AVENUE SEWAGE PUMP STATION MECHANICAL AND ELECTRICAL FITOUT AND COMMISSIONING

Drawn AO	Signed A OLSON	Date 25/06/04	
Designed SG	Signed S GRAY	Date 25/06/04	
Verified DIF	Signed D FURNER	Date 28/06/04	
Approved CAR	Signed C RUSSELL	Date 29/06/04	

Drawing Title: PUMP STATION PS 1/1 AND PS 2/1 GENERAL ARRANGEMENT

DRAWING N° 486/5/7-KJ002
SHEET 2 OF 4 CADD FILE N° ME030

CW Project No. 020300CW
Scale AS SHOWN AT A1
Drawing No. ME030 Rev. B

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units: CM-M,LYR5, levels, CANTRY AND WALLS, XBKGNWY2

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BRISBANE CITY COUNCIL
Brisbane Water
SP306 Coronation Drive Pump Station

BCC Contract No. BW30079-02/03

Coronation Drive Pump Station - SP306 Operation & Maintenance Manual
Table of Contents

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		A complete electronic copy of the Operation & Maintenance Manual is available on CD Note: Click on the blue underlined Hyperlinks below to open the required document.	
1		Revision Control Coronation Drive O & M Manual	1
1		O&M Manual Changes Log	1
1	1	**System Overview - Summary**	
		HVAC Introduction and System Overview Including the following:- Introduction Description of Equipment and Process Design Details Design Criteria Process Design Operation Modes Modifications to Existing Plant	5
1	2	**Pump Station Location**	
		SP306 Location Map	1
1	3	**Pump Station Equipment Operation**	
		BW - Functional Specification (rev 1.01) for Coronation Drive Pump Station SP-306 (Note:- This is in addition to the standard functionality as described in Standard Functional Specification SPSV3) Including the following:- Introduction General Purpose Description Equipment Installed Control Philosophy Site Specific Values Non Standard Control HVAC-HPS Functional Specification	14 57 25

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		Grundfos S2 Pump Operating Instructions	14
		Schedule C4 from Contract - Contractor Pump Guarantee	2
		Factory Acceptance Tests (FAT) - Pumps Including the following:- • Workshop Tests Results • Pumps - Q&H Test Results - Workshop • Pumps - Operating Envelope • Pumps - Volute Casing Hydrostatic Test Reports • Electric Motors - Test Reports	11
		OCT1 Oil Condition Transmitter Installation Instructions	4
		SARI 2 (Tritronics R.T.W.) Pump Insulation Resistance & Seal Oil Monitoring Device and Control Relay	2
		Pump Nameplate Details PDF Document or Word Document	1
2	2	**GE Fanuc PLC Series 90™- 30**	
		GE Fanuc - PLC Series 90™-30 Brochure	2
		GE Fanuc - PLC Series 90™-30 Installation and Hardware Manual (Document Contained on CD-ROM Only)	445
		GE Fanuc - Series 90™-30 Programmable Controller Troubleshooting Guide	18
		BW PLC Physical I/O List - Summary	3
		BW PLC Physical I/O List – Complete Excel Spreadsheet	18
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2	3	**Cathodic Protection**	
		Note: Cathodic Protection has not been installed at Coronation Drive Pump Station SP306	
2	4	**Main Switchboard & Associated Equipment**	
		Technical Manuals and Data Sheets	
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		C191HM Powermeter and Harmonic Manager Modbus Communications Ref Guide	34
		Multitrode MTR Data Sheet	2
		Multitrode MTRA Data Sheet	2
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		Terasaki MCCB's and Contactors Technical Data Sheets	76
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		Miniature Circuit Breakers - Earth Leakage Module Data Sheets	6
		Erico Surge Filter Installation Instructions	31
		Terasaki TemBreak Circuit Breaker BTS Schematic XMC Motor Operator	1
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		Vega Vegadis 12 Adjustment Module for the Pressure Transmitter Operating Instructions	8
		Vega PLICSOM Indicating and Adjustment Module - Operating Instructions	19
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4		**Training / System Testing / Pre-Commissioning / Installation Method Statement / QA Records**	
4	1	**BW: Site Based Training**	
		To be completed and added to manual	-
4	2	**BW: System Integration Testing**	
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BRISBANE CITY COUNCIL
Brisbane Water
Coronation Drive Pump Station SP306

BCC Contract No. BW30079-02/03

Coronation Drive Pump Station SP306

Approval

Name and position	Action	Signature	Date
Stuart Cowhig Technical Author Projects: Project Management	Recommend		
Reg McGirr Commissioning Manager Projects: Engineering Services	Concur		
Mike Heritage Construction Manager Projects: Engineering Services	Concur		
Andrew Bannink Project Manager Projects: Project Management	Approve		

Revision Control

Revision Number	Date	Revision Details	Responsible Officer
1.0	10/05/2007	O & M Manual Issued for Review	Stuart Cowhig

Document Consultation

Please review this O&M Manual and add your comments where necessary. To ensure that this project is completed on time, please forward you comments by the requested date to:

Stuart Cowhig, Document Administrator (Officer Code CM9BW), Level 2 TC Beirne

Version	Forwarded To	Date sent	Requested return date	Date Returned	Comments	
					Rec'd (y/n)	Incorp (y/n)
1.0	Reg McGirr	10/05/2007			Y	Y

BRISBANE CITY COUNCIL
Brisbane Water

Coronation Drive Pump Station Document Revision/Alterations Register

BCC Contract No. BW30079-02/03

Item No	Volume No	Section	Description	Revision No	Revision Date	Name	Signature

Document Revision Log

VOL 1-SECT 1

PASTEL
MANILLA
DIVIDERS
5 TAB A4

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1. Introduction

The Patrick Lane sewage pump station is required to relieve the surcharging in the Coronation Drive gravity sewer. Under wet weather flow conditions, the gravity sewer is susceptible to surcharge and overflows to the environment. The Patrick Lane pump station will be connected to the gravity sewer via a short inlet pipe and manual operated knife gate valve. The knife gate valve will remain open after commissioning under normal pump station operation.

During wet weather events, the gravity sewer and wet well will fill up to a point whereby the control system will start a pump to discharge the sewage into the rising main. This will continue until the level in the well has receded, at which point the pumps shall stop under level control.

The wet well shall house the two submersible pumps, and level monitoring devices.

The works included:

- Fitout existing wet well structure (constructed as part of Early Works Contract) with all appurtenances and benching;
- Two new submersible sewage pumps;
- Power supply, controls and electrical works;
- New pipework, fittings, valves; and
- Surface works including stairs, general services, vent stack and fan pit

Please note the original design specified an actuator to automate the operation of the knife gate valve but Brisbane Water has since requested a deletion of the actuator from the works. (ie. NO valve actuator and associated accessories were installed, however the switchboard has still been supplied to allow for future installation of a valve actuator)

2. Description of Equipment and Process

Equipment	Location	Description
Vegawell 72	Gravity sewer	Monitor gravity sewer level
Multitrode probe	Gravity sewer	Detect gravity sewer high level
Inlet Knife Gate Valve	SP306 Wet well inlet	Valve can be manually operated to allow or disallow sewage into the pump station wet well
Vegawell 72	SP306 Wet well	Monitor pump station wet well level
Multitrode probe	SP306 Wet well	Detect pump station surcharge imminent
65kW Grundfos submersible pump	SP306 Wet well bottom	Pump station pump 1
65kW Grundfos submersible pump	SP306 Wet well bottom	Pump station pump 2
300NB Non return valve + limit switch	SP306 Valve Pit	Pump station pump 1 reflux valve (before header connection to rising main)
300NB Non return valve + limit switch	SP306 Valve Pit	Pump station pump 2 reflux valve (before header connection to rising main)
McBerns well washer	SP306 Wet well	Connected to the water line through RPZ and solenoid valve Washes down the wet well after each pumping

Equipment	Location	Description
		sequence when the solenoid valve is actuated
Switchboard	Slab next to car park kerbing	Supplies power, control and communication to/from Brisbane Water Control Room to operate pump station Houses two Danfoss variable speed drives which provide starting mechanism to the pumps

The Patrick Lane pump station (wet well) is connected to the gravity sewer via a short inlet pipe. During wet weather condition, the sewage level at both sewer and wet well will climb to a point that triggers the control system to start the duty pump.

The sewage will be pumped out of the well and into the rising main through a series of pipework and valve connections located in the adjacent valve pit, as shown on drawing 486/5/7-KJ002/B. Duty pump will be stopped when the wet well returns to normal level. The well washer is actuated after each pumping sequence to minimise odour and the build up of scum.

3. Design Details

The sewage Pumping Station is of underground configuration operating in wet weather conditions only, with a wet well operating volume (under surcharge) of approximately 10 kl. The pump station will operate as a surcharge pump station, only allowing flows into the wet well during periods of surcharge in the adjacent gravity sewer. The wet well will be free to drain back into the gravity sewer at the end of the surcharge event. The pump station will have two submersible type sewage pumps installed in the Pump Well operating as duty/standby units. The pumps are interlocked so that only one pump can operate at a time. The station output with one pump operating at minimum speed will be approximately 20 l/sec, and at maximum speed will be approximately 150 l/sec.

3.1. Design Criteria

The pump station normally operates with the Pump Station Selector Switch in Remote Auto mode. This enables the PLC to start and stop the pumps and vary the operating speed, in response to the wet well level. When the Pump Station Selector Switch is in Local, the pumps can be started or stopped by using the local Start/Stop push buttons mounted on the switchboard. If the Pump Station is selected to Remote Manual from the Network Control Room Graphic Display at Cullen Avenue, the pumps can be started and stopped by the operator at Cullen Avenue. In all modes of operation the pumps will only be controlled by the PLC.

Only one pump will operate at any time.

When the wet well level reaches a predetermined level, the Duty Pump is started, provided it satisfies all the enabling conditions.

3.2. Process Design

There were no process modifications as part of SP306.

3.3. Operational Mode

The pump station can operate in three modes as follows:

- Remote Auto Mode
- Remote Manual Mode
- Local Manual Mode

These modes are selectable via a Local/Remote selector switch mounted on the switchboard, and a Remote Auto/Remote Manual software selection at Cullen Avenue.

When Remote Auto is selected, the control of the pump station will be based on the current state of the sewage wet well level with the station operating on a duty/standby configuration.

When Remote Manual is selected, the operators at Cullen Avenue can start and stop pumps and open and close the Inlet Knife Gate Valve from the Graphic Display.

When the pump station is in Local Manual mode, the pumps can be started via the local start/stop pushbuttons mounted on the switchboard. (Note: the local controls are wired to the PLC and all modes of operations are via PLC only).

3.3.1. NORMAL OPERATION (REMOTE MODE)

Remote mode is the normal operating mode of the station. In this mode the PLC program controls the pumps in a duty/standby configuration, starting and stopping the pumps according to the wet well start and stop set points.

The control room operator can issue remote manual commands to the PLC, via the RTU, to control the station outside the normal set point parameters. The following are the controls available to the control room operator.

- **Stop:** Stops a specific pump provided that the station is in its 'normal' wet well range (below the Start Duty A level. If the wet well level is abnormal (higher than Start Duty A level but below surcharge imminent level), then the "inhibit" can be used to stop a pump.
- **Start:** Start a specific pump provided the wet well level is above the 'bottom water level' (duty A pump stop level). The 'start command' over rides the pump lockout that restricts the number of starts per hour under autonomous control.
- **Reset:** Allows the operator to remotely reset any latched pump alarms provided the original fault condition has cleared.
- **Inhibit:** Allows the operator to inhibit a specific pump from operating under the normal operating mode, effectively removing it from the duty rotation. If all pumps are inhibited the operator has 'inhibited' the station causing the station to run under 'all pumps inhibited' mode.

The control room operator can also send the following site commands:

- **Attention Activate:** By sending this control the operator activates a site attention indicator requesting the on site technician to contact the control room.
- **Abnormal Operation Reset:** This command reset the abnormal operation alarm that is activated whenever the RTU or PLC has an 'abnormal operation' (ie the RTU or PLC resets by itself).

- **Alarm limit set points:** The operator has the ability to modify the set points for the high and low alarms configured for various signals (eg. pressure, motor current and motor power and wet well).

The Control Room Operator can **NOT**:

- Switch the station from local to remote mode. (Physical switch on site only)
- Start or Stop the pumps if the station is in local mode.
- Modify operational set points, eg. Start/Stop dutyA/B level set points.
- Change alarm priority class or alarm triggering configuration on the communications channel.
- Control the speed of the pumps. The PLC automatically determines the speed of the pumps using the PID control algorithms

3.3.2. LOCAL MODE

The on site technician can completely control the site by switching the site into local mode and manually operating the pumps via the push buttons. The speed of each pump can be controlled via individual potentiometers.

WARNING: In local mode there are no automatic controls. Once the pumps have been started they will 'run to destruction', that is, they will not switch off automatically due to wet well level reaching the 'stop duty A level' set point. If the on site technician does not stop the pump before the wet well level falls below the pump intake, then the pump will 'suck' air and will 'air lock' making the pump inoperable until it is either 'bled' or 're-primed'. It is up to the on site technician to ensure the pump only runs while the level is above the stop level.

The on site technician has the following local station controls:

- **Station Local / Remote:** Selector switch to determine operating mode of the station
- **Site attention reset**: Reset the attention indication sent by the control room operator

The on site technician has the following local controls for each pump:

- **Start**: Push button to start pump
- **Stop**: Push button to stop pump (soft stop via VFD)
- **Emergency Stop**: Latched push button (hard stop via electrically isolation)
- **Reset**: Push button (reset any latched alarms in RTU related to pump)
- **Speed Control**: Potentiometer that allows the selection of speed between minimum and maximum configured in the VFD

Local indication on the switchboard includes:

- **Site attention** : Indication lamp – on site technician required to contact control room operator
- **Pump status**: Indication lamp

On continuously	Pump running
Slow Flash (2 sec)	Pump faulted
Fast Flash (1 sec)	Pump lockout

- **Wet well level** : Provides the wet well level indication in %
- **Variable Frequency Drive** : Control panel to configure the parameters of the Variable Frequency drive and also to display motor status (i.e. motor current, VFD speed)

3.4. Modifications to existing Plant

Since this is a new pump station, there have been no modifications. However it is noted that any reference on the inlet knife gate valve actuator must be ignored since this was not installed upon request from Brisbane Water.

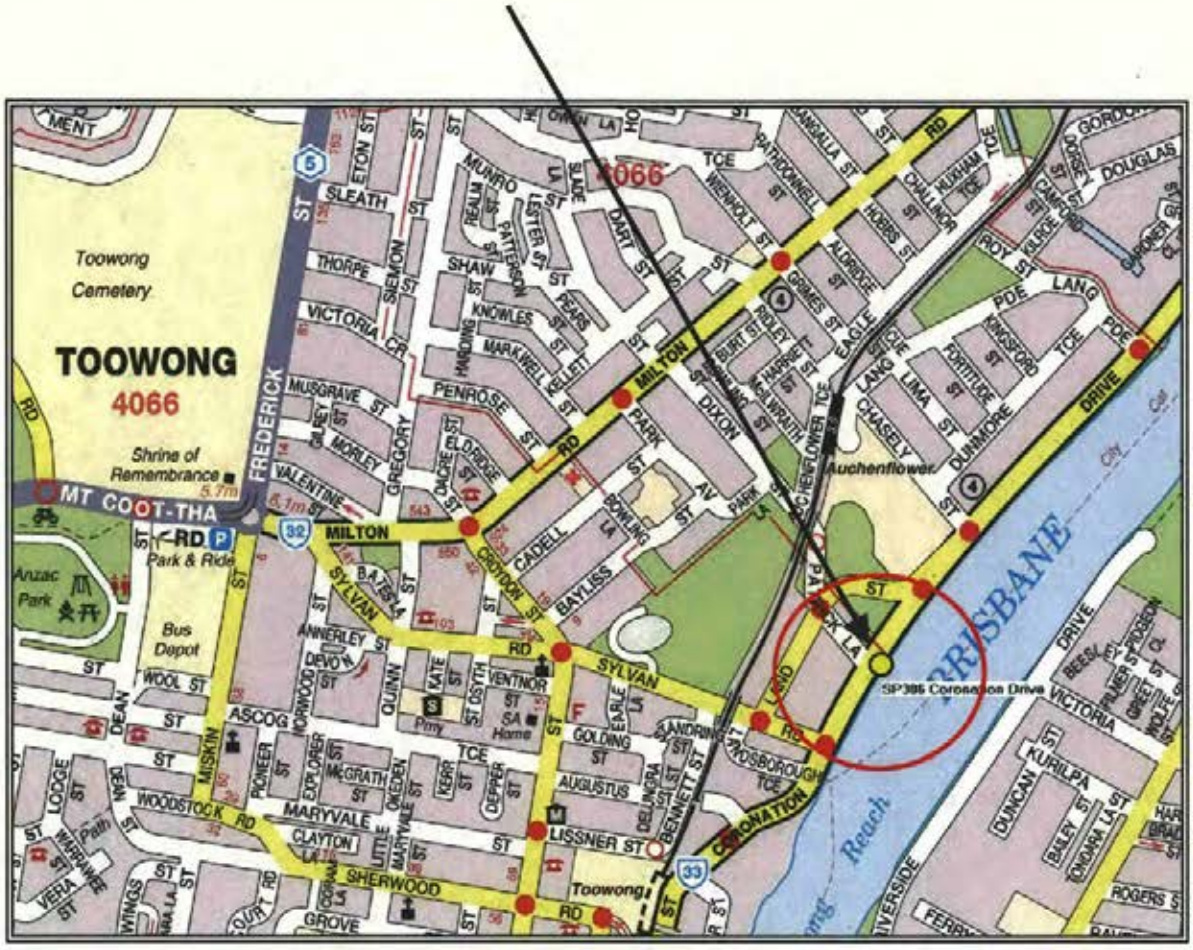
VOL 1 - SECT 2

BRISBANE CITY COUNCIL
Brisbane Water
Coronation Drive P/S SP306

BCC Contract No. BW30079-02/03

Coronation Drive Pump Station SP306 - Location

Coronation Drive Pump Station SP-306 is located on Coronation Drive, Toowong, opposite Patrick Lane.



SP306 Location Map

VOL1 - SECT 3

BRISBANE WATER

Network Control Systems

FUNTIONAL SPECIFICATION

SP306 Coronation Drive

Sewage Pumping Station

Submersible 2 Pumps With VSD

(Wet Weather Station)

Document Signoff

Approval

	Name	Role	Signature	Date
Manager Mechanical and Electrical Services *Engineering Design Services*	Rahim Janfade.	Concur		
Manager *Water And Watewater Operations Manager*	Anu Atukorala	Concur		
Team Leader *Network Control Systems*	Peter Sherriff	Concur		
Manager *System Planning*	Peter Casey	Concur		
Project Manager	Andrew Bannink.	Approve		

Distribution

Name	Role	Section

Revision Control

Revision Number	Date	Amendment Details	Responsible Officer
Version 0.00	16/08/2005	Original Draft – Developed from Connell Wagner SP306 Revised Functional Spec	Alex Witthoft
Version 0.01	25/7/06	Updated approval sheet, removed flowmeter reference.	Gerard Anderson
Version 0.02	2/8/06	Updated approval sheet, Pump kW, picture details.	Gerard Anderson
Version 0.03	21/8/06	Updated confirmed sewer surcharge level and surcharge imminent level for SP306 (Noel Ralph). Station changed to Stop/Start at 50Hz (RM). Added Gravity Sewer alarm level diagram. Set High Level setpoint to 0.4M above TWL. Set pump inhibit limits to 200 and 400mm below Surcharge Imminent	Gerard Anderson
Version 1.00	14/3/2007	Site commissioned. Added level ranges.	Gerard Anderson
Version 1.01	27/4/2007	Added Bump Pumps Functionality ie run pumps every 3 days for 30 seconds to prevent seizing.	Gerard Anderson

Document Consultation

Please review the attached document and add your comments where necessary. To ensure that the process is kept within reasonable timeframes, it would be appreciated if you could return this document by the **Requested Return Date** listed below.

Project Sponsor:	Andy Moore	Officer Code: PM13BW	Location: T.C.B. Level 2
Author:	Alex Witthoft/ Gerard Anderson	Officer Code: CTAMP12/ E2SBW	Location: Cullen Ave
Document Administrator:	Gerard Anderson	Officer Code: E2SBW	Location: Cullen Ave

Version Number (1,2,3 etc)	Forwarded To: (Name / Officer Code)	Location (eg,TCB, Cullen Ave)	Date Sent	**Requested Return Date**	Date Returned	Comments Received (Y / N)	Comments Incorporated (Y / N)

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Definitions

BWTS	Brisbane Water Telemetry System
RTU	Remote Telemetry Unit
SCADA	Supervisory Control And Data Acquisition
MAHD	Metres above Australia Height Datum

1 INTRODUCTION

This document contains the site specific details and describes the non standard functional requirements for control, monitoring and telemetry at sewage pump station SP306 at Coronation Drive, Toowong, opposite Patricks Lane. The functional requirements described in the document are in addition to the standard functionality detailed in "SPSV3 SEWAGE PUMPING STATION SUBMERSIBLE 3 PUMPS WITH VFD" [1].

The standard specification was written for a 3 pump station, of which only 2 pumps are allowed to run at any given time. The functionality for SP306 Coronation Drive is identical, except the third pump is removed. The pumps are interlocked so that only one pump can operate at a time. All site specific values are detailed in this document. The site specific details and the non standard functional requirements in this document were derived from the functional specification written by Connell Wagner "PATRICK LANE FUNCTIONAL SPECIFICATION" [2].

SP306 Coronation Drive sewage pump station is required to relieve the surcharging in the Coronation Drive gravity sewer. Under wet weather flow conditions, the gravity sewer is susceptible to surcharge and overflows to the environment. . SP306 Coronation Drive is therefore wet weather sewage pump station only, incorporating two variable speed driven 65 kW submersible pumps operating in a one duty and one standby arrangement

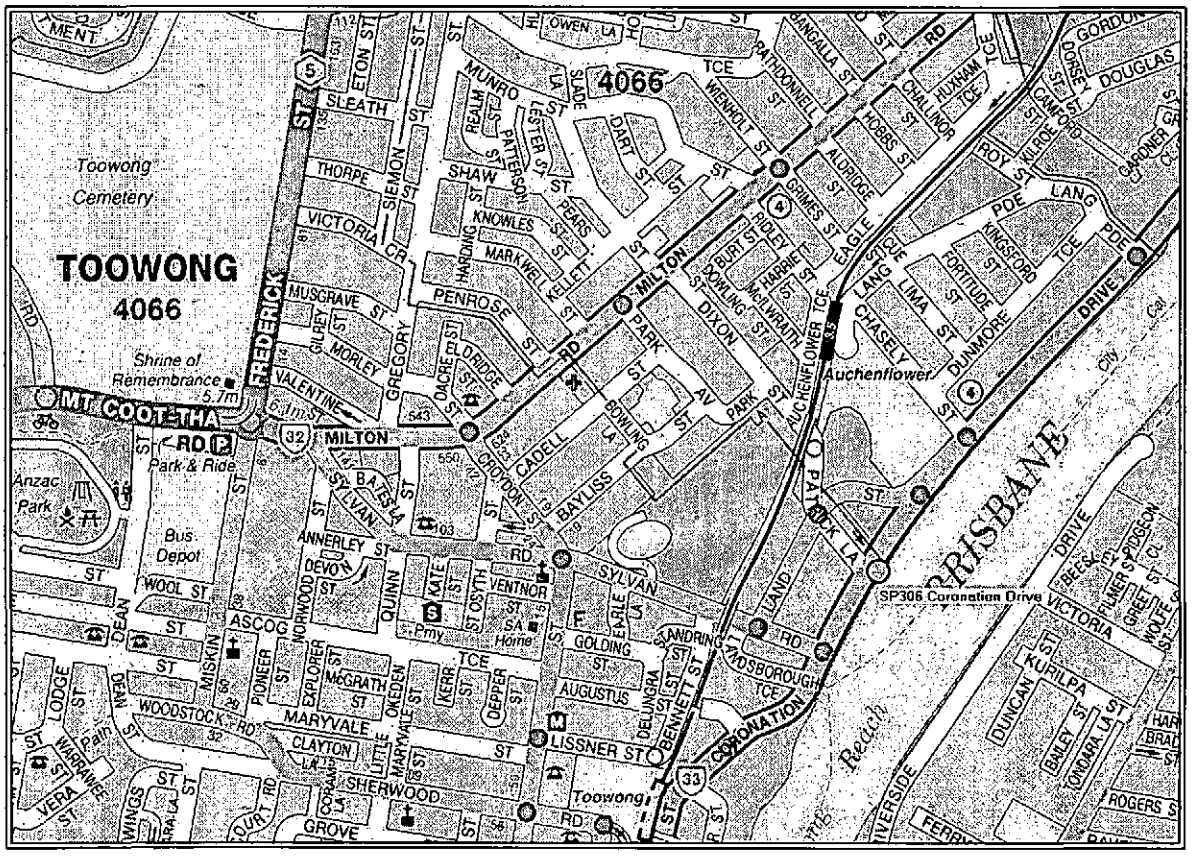


Figure 1: SP306 Location Map

1.1 General Process Description

SP306 Coronation Drive pump station will be connected to the gravity sewer via a short inlet. During wet weather events the sewage will flow into the well. This sewage will then be pumped into the rising main. This will continue until the level in the gravity sewer has receded, at which point the pumps shall stop under level control.

The sewage Pumping Station is of underground configuration operating in wet weather conditions only, with a wet well operating volume (under surcharge) of approximately 10 kl. The pump station will operate as a surcharge pump station, only allowing flows into the wet well during periods of surcharge in the adjacent gravity sewer. The wet well will be free to drain back into the gravity sewer at the end of the surcharge event. The pump station will have two submersible type sewage pumps installed in the Pump Well operating as duty/standby units. The pumps are interlocked so that only one pump can operate at a time. The station output with one pump operating at maximum speed will be approximately 150 l/sec.

This pump station will operate as a stop/start station only, there will be no PID control at this site. Pump speed will be limited to 50Hz, this is designed to pump down the Wet Well as quickly as possible.

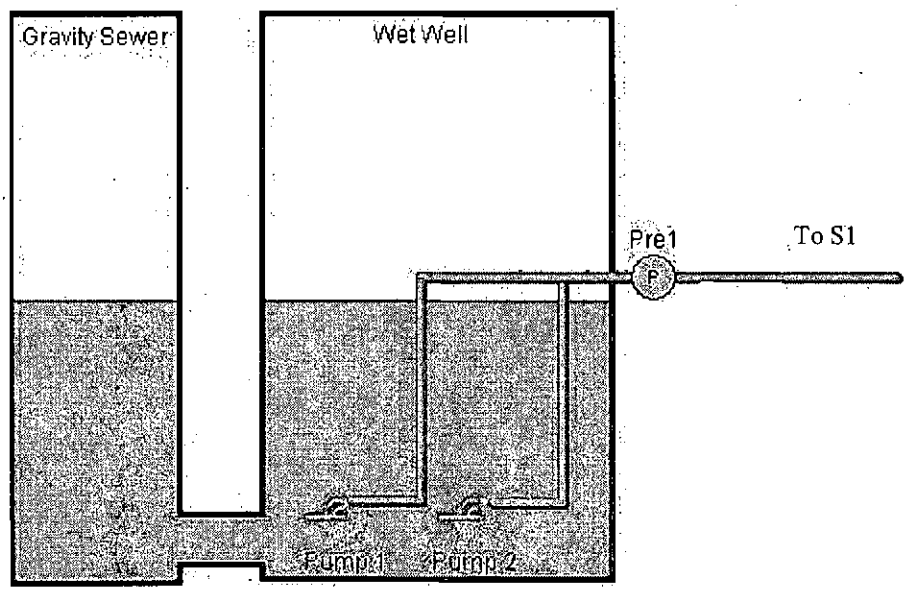


Figure 2: SP306 Process and Instrumentation Overview

2 EQUIPMENT INSTALLED

2.1 Standard Equipment

SP306 Coronation Drive pump station has the following standard equipment installed. The functionality for the control, monitoring and alarming for these items is fully described in the standard functional specification.

Pumps	Two Grundfoss submersible pumps with 65 kW four pole electric motors are installed in the wet well. Each pump is fitted with moisture probes in the oil chamber and thermistors in the stator windings.
Pump Starters	Two Danfoss Variable Frequency Drives (VFDs) are installed in the pump station switchboard. The VFDs will also provide soft starting functionality.
Level Sensors	One Vega hydrostatic level transmitter installed in the wet well. One Multitrode level probe (Surcharge imminent) installed in the wet well.
Pressure Transmitters	One Vega D84 pressure transmitters are installed on the discharge side of the pumps.

2.2 Non Standard Equipment

SP306 Coronation Drive pump station has the following non standard equipment installed. The functionality for the control, monitoring and telemetry for is described in the following sections as these items are NOT described in the standard specification. The pumps are interlocked so that only one pump can operate at a time.

Emergency Generator	The switchboard will have the facility for a generator to be connected. No generator will be installed on site.
Level Sensors	One Vega hydrostatic level transmitter installed in the gravity sewer One Multitrode level probe (Gravity Sewer High) installed in the gravity sewer
Reflux Limit Switches	Each pumps reflux valve has a reflux limit switch fitted. NB There is no flowmeter onsite.
Wet well washer solenoid	Well washer solenoid valve with flow switch installed in the wet well. Note that there is currently no water supply to the Wet well washer. The Wet Well washer will not be commissioned at this stage.

2.2.1 Emergency Generator

The emergency generator is designed to the standard functionality as described by "DIESEL STANDBY GENERATOR LOCAL CONTROL PANEL FUNCTIONAL DESCRIPTION". [3] The generator is supplied with the PLC fully configured and loaded with the standard program. The RTU (Logica MD3311) will programmed with the standard interface program that will provide the monitoring, control and telemetry to the BWTS master station.

2.2.2 Gravity Sewer Monitoring

The gravity sewer will also have monitoring in the form of a vega hydrostatic level transmitter as well as a gravity high multitrode electrode.

3 CONTROL PHILOSOPHY

The station will operate according to the control philosophy detailed in the standard functional specification (SPSV3). The initialisation block will be configured with the site specific set points listed in the tables in the next sections. Surcharge Occurring & Surcharge Imminent mAHD will be the same levels as the gravity main setup (confirmed with Noel Ralph). There is no physical surcharge pipe at SP306. Inlet level of pipe from gravity main to wet well is IL -3.790.

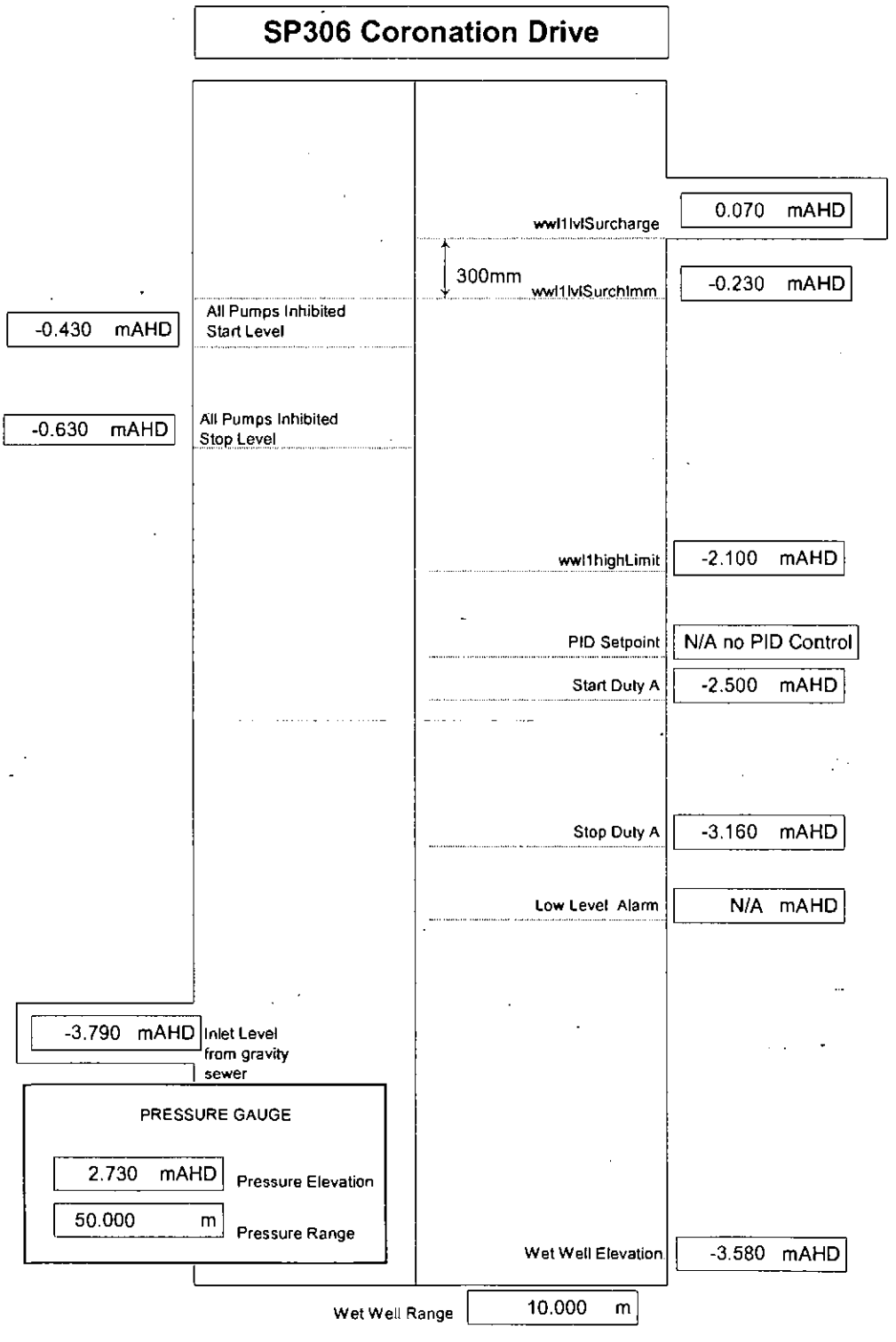


Figure 3: SP306 Station Level Set Points

3.1 Site Specific Values

Table 1: Site Specific Constants defined in the PLC

Tag Name	Description	Type	Value	Units
Sewerage Pumping Station				
Stn01grSurchPumpingTime	Surcharge pumping duration [3]	Integer	60	Sec
Delivery pressure				
Pre01txRange	Delivery pressure - Range	Real	5000	mmAHD/ 10
Pre01txZero	Delivery pressure – Elevation of the transducer	Real	273	mmAHD/ 10
Pump Blockage				
Stn01grPmpBlockFlowKneeSP	Flow blocked limit for flow/level PID control (knee)	Integer	N/A	l/s x 100
Stn01grPmpBlockSpeedKneeSP	VFD speed blocked limit for flow/level PID control (knee)	Integer	N/A	Hz x 100
Stn01grPmpBlockSpeedMinSP	VFD speed blocked limit for minimum flow PID control	Integer	N/A	Hz x 100
Wet well level				
Wwl01txRange	Wet well level range	Integer	10	mmAHD
Wwl01txSurchImmLevelSP	Wet well surcharge imminent level (300mm below Overflow #330 Coronation Drive "Oxleys on the River" Surcharge point of 0.070 MAHD)	Integer	-0.230	mmAHD
Wwl01grInhStartLevelSP	Wet well inhibit mode start level	Integer	-0.430	mmAHD
Wwl01grInhStopLevelSP	Wet well inhibit mode stop level	Integer	-0.630	mmAHD
Wwl01grRunatMaxLvlSP	Wet well run at maximum speed level	Integer	N/A	mmAHD
Wwl01txDtyBStartLevelSP	Wet well duty B pump start level	Integer	N/A	mmAHD
~~Wwl01txPIDLevelSP~~	~~Wet well PID set point~~	~~Integer~~	~~-2200~~	~~mmAHD~~
Wwl01txDtyAStartLevelSP	Wet well duty A pump start level	Integer	-2500	mmAHD
Wwl01txDtyAStopLevelSP	Wet well duty A pump stop level	Integer	-3160	mmAHD
Wwl01txDtyAStopLevelSP	Wet well duty A pump stop level	Integer	-3160	mmAHD
Wwl01txZero	Wet well empty level (4mA of Probe)	Integer	-3580	mmAHD
Variable Frequency Drive				
Stn01grMinSpeed	Variable Frequency Drive – Minimum Speed	Integer	5000	Hz x 100
Stn01grMaxSpeed	Variable Frequency Drive – Maximum Speed	Integer	5000	Hz x 100

Table 2: Site Specific Constants defined in the RTU

Tag Name	Description	Type	Value	Units
pre1almInhibitTm	Delivery pressure - Alarm inhibit timer	Integer	15	sec
wwl1surchLvlVol	Wet well volume at surcharge level	Real		kl
wwl1lvlSurcharge	Wet well surcharge occurring level	Real	0.070	mAHD
Pumps 1 & 2				
Pmp[x]almInhPwrTm	Pump [x] - Motor power alarm inhibit timer.	Integer	15	sec
pmp[x]almInhCrntTm	Pump [x] - Motor current alarm inhibit timer.	Integer	15	sec
pmp[x]currRange	Pump [x] - Motor current range	Real	120.0	Amps

Table 3: Site Specific Variable defined in the RTU

Wet well level				
wwl1highLimit	Wet well level - High alarm set point	Integer	-2100	mmAHD
wwl1lowLimit	Wet well level - Low alarm set point	Integer	N/A	mmAHD
Delivery flow				
flw1highLimit	Delivery flow - High alarm set point	Integer	N/A	ml/s x 10
flw1lowLimit	Delivery flow - Low alarm set point	Integer	N/A	ml/s x 10
Delivery pressure				
pre1highLimit	Delivery pressure DN1370 – High alarm set point	Integer	Max	mmAHD
pre1lowLimit	Delivery pressure DN1370 – Low alarm set point	Integer	Min	mmAHD
Pumps 1 & 2				
pmp[x]currHiLimit	Pump [x] - Motor current high alarm set point [4]	Integer	130	Amps
pmp[x]currLoLimit	Pump [x] - Motor current low alarm set point [5]	Integer	130	Amps
pmp[x]powHiLimit	Pump [x] - Motor power high alarm set point	Integer		Watts
pmp[x]powLoLimit	Pump [x] - Motor power low alarm set point	Integer		Watts

Table 4: Wet Well Level vs Volume Data

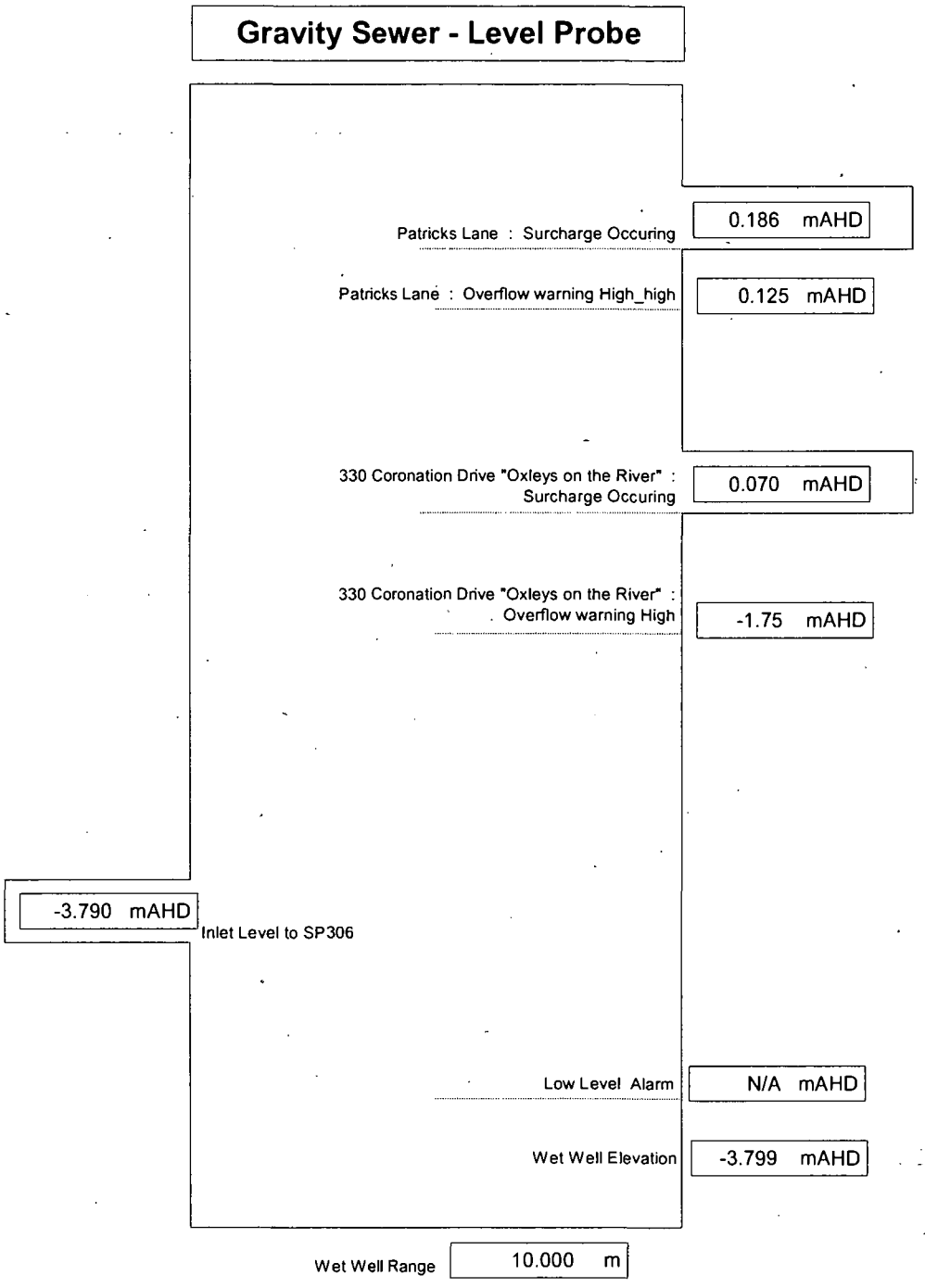
	Height (mAHD)	Volume m³	Remaining Storage m³	% Level	% Volume
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

3.2 Non Standard Monitoring and Alarms

3.2.1 Gravity Sewer Level

As the Vega probe takes a few seconds to initialise, all the wet well alarms except for invalid, are suppressed for 10 seconds upon RTU start up

Gravity Sewer	Invalid	1
Gravity Sewer	Patricks Lane Surcharge Occuring alarm	1
Gravity Sewer	Patricks Lane Overflow Warning High_high alarm	1
Gravity Sewer	330 Coronation Drive Oxleys on the River" Surcharge Occuring alarm	1
Gravity Sewer	330 Coronation Drive Oxleys on the River" Overflow Warning High alarm	1



Invalid

The signal is deemed invalid if it is :

Less than (4mA – dead band) or greater than (20mA + dead band) for 1 second.

Once the invalid alarm has been activated it can only be reset when the signal is both greater than 4mA and less than 20mA for 20 seconds. The time delays ensure that a signal is truly invalid before an alarm is set and that it is stable before it is reset. The dead band is calculated using the site invalid hysteresis value multiplied by the range.

If the gravity sewer level becomes invalid, the gravity sewer low and high alarm alarms are suppressed.

NOTE: As the wet well level is backed up by the battery – the site power does **not** suppress the invalid alarm.

Low Alarm

If the signal is valid and the start up delay has expired then the low alarm is activated if the signal is less than the low limit set point. It is deactivated if any of the above conditions become false or the signal is greater that the low limit set point plus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

High Alarm

If the signal is valid and the start up delay has expired then the high alarm is activated if the signal is greater than the high limit set point. It is deactivated if any of the above conditions become false or the signal is less that the high limit set point minus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

3.2.2 Bump Pumps Routine

Each sewer pump will be requested to run for 30 seconds every 3 days to prevent the pumps from seizing. The pumps will be run regardless of wet well level. The RTU will check if a pump has not run within 48 hours or if either pump is inhibited before initiating the bump pump routine.

3.3 Non Standard BWTS Picture

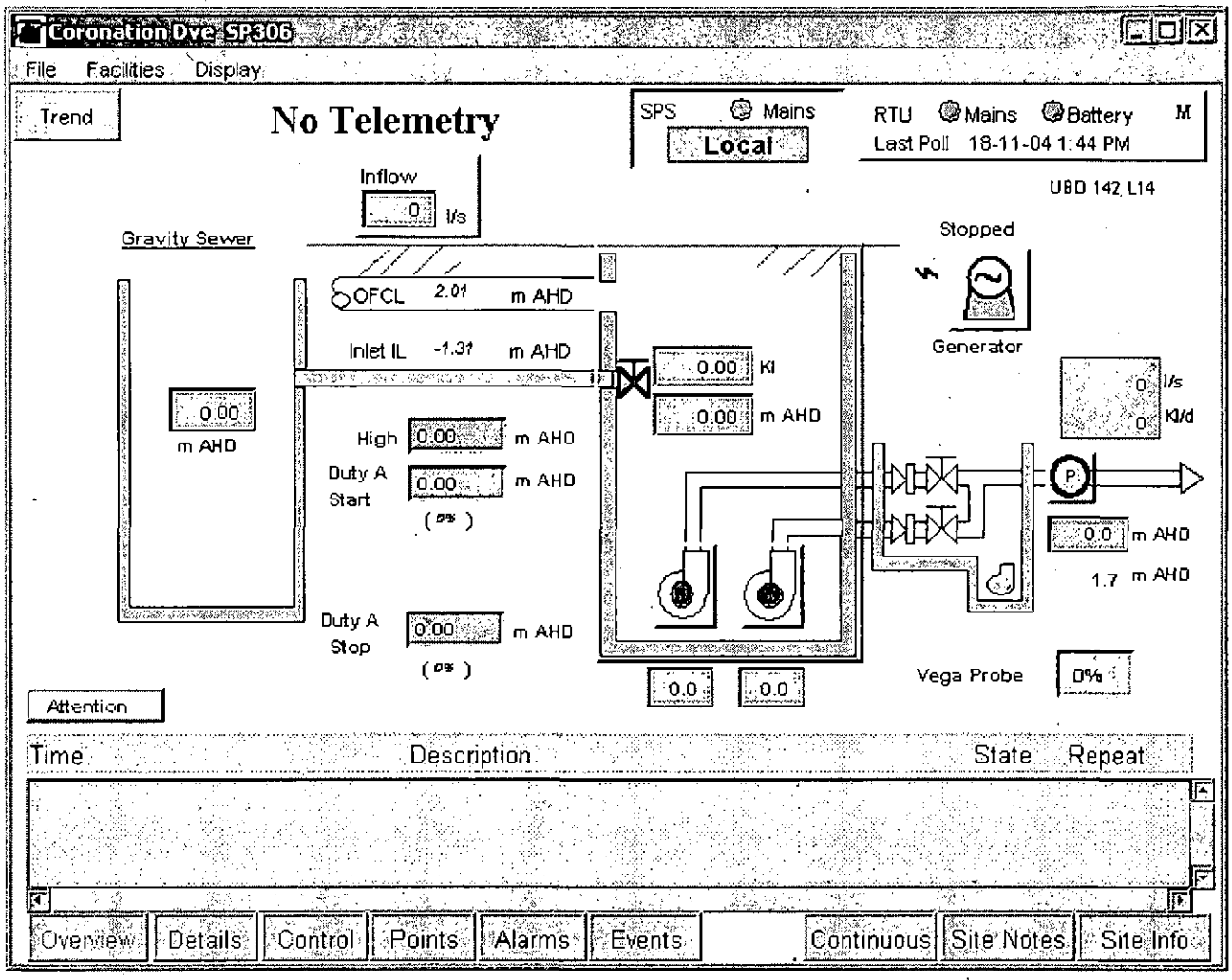


Figure 4 SP306 Details Page

3.4 Sewer Network Overview

The sewer network overview page will be updated to include the gravity sewer at Coronation drive pumping into the new S1 rising main at Coronation drive.

4 REFERENCES

1

TITLE	SPSV3 Sewage Pumping Station Submersible 3 Pumps With VFD – Functional Specification
DOCUMENT ID	003589
VERSION	0.30
AUTHOR	Alex Witthoft , Brisbane Water – Network Control Systems
DOCUMENT OWNER	Peter Sherriff, Brisbane Water – Network Control Systems

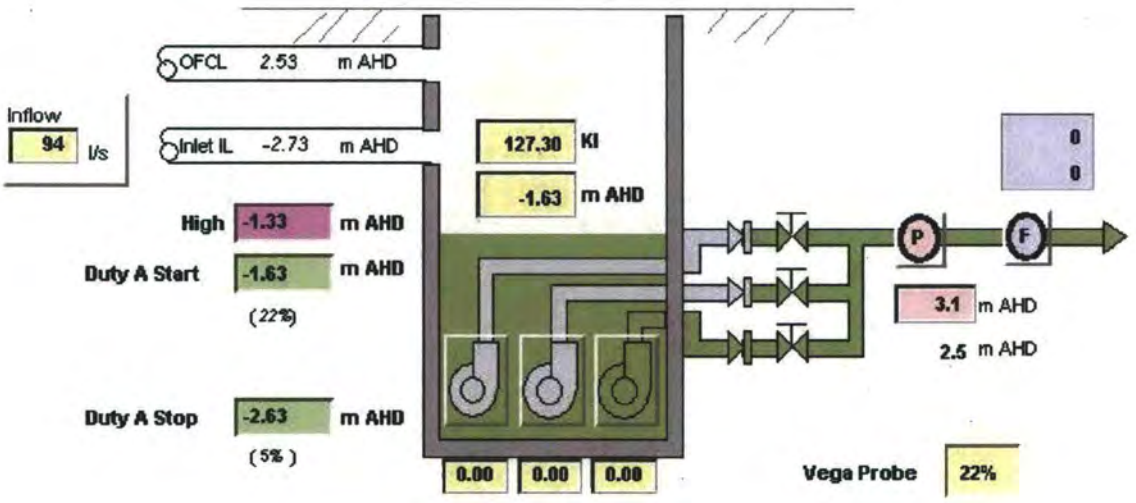
2

TITLE	Heroes Avenue Functional Specification
DOCUMENT ID	N/A
VERSION	N.A
AUTHOR	N.A
DOCUMENT OWNER	Cardino Davies Pty Ltd

3

TITLE	Diesel Standby Generator - Local Control Panel - Functional Description
DOCUMENT ID	N/A
VERSION	02
AUTHOR	SOUTH EAST POWER GENERATION
DOCUMENT OWNER	

SPSV3
SEWAGE PUMPING STATION
SUBMERSIBLE
3 PUMPS WITH VARIABLE FREQUENCY DRIVES



FUNCTIONAL SPECIFICATION

BW NET M&E 04/04
Network Branch

Project Owner:
George Theo.

Project Manager:
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Document Signoff

Approval

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Team Member NCS - IDTS Administrator	John Titmarsh	Concur		
Supervising Elec. Eng *Engineering Design Services*	Alan Mooney	Concur		
Manager *M & E Planning*	Peter Casey	Concur		
Manager Water & Sewerage Operations	George Henry	Concur		
Project Owner	George Theodorakopoulos	Approve		

Distribution

	Name	Role	Section
For Action			
For Information	Shane Harrison	Manager	Maintenance Planning

Revision Control

Revision Number	Date	Amendment Details	Responsible Officer
Version 0.00	09/09/2004	Original Draft - developed from the standard spec for a 2 pump soft starter site with Soft Starters	Alex Witthoft
Version 0.11	14/09/2004	Draft Issued for review	Alex Witthoft
Version 0.13	17/09/2004	Comments included from Malcolm Barrett	Alex Witthoft
Version 0.15	29/09/2004	Comments included from George Henry	Alex Witthoft
Version 0.30	26/10/2004	Final draft issued for comments	Alex Witthoft

Document Consultation

Please review the attached document and add your comments where necessary. To ensure that the process is kept within reasonable timeframes, it would be appreciated if you could return this document by the **Requested Return Date** listed below.

Project Sponsor: George Theo Officer Code: NSMBW Location: Cullen Ave

Author: Alex Witthoft Officer Code: CTAMP12 Location: Cullen Ave

Document Administrator: Peter Sherriff Officer Code: TL1SBW Location: Cullen Ave

Version Number (1,2,3 etc)	Forwarded To: (Name / Officer Code)	Location (eg,TCB, Cullen Ave)	Date Sent	**Requested Return Date**	Date Returned	Comments Received (Y / N)	Comments Incorporated (Y / N)
0.11	Malcolm Barrett	Cullen Ave	14/09/2004	17/09/2004	17/09/2004	Y	Y
0.13	Ian Dixon	TCB	17/09/2004	24/09/2004	23/09/2004	Y	Y
0.13	George Henry	Cullen Ave	17/09/2004	24/09/2004	24/09/2004	Y	Y
0.15	Paul Daley	Cullen Ave	01/10/2004	22/10/2004	-	N	N
0.15	Alan Mooney	TCB	01/10/2004	22/10/2004	-	N	N
Version 0.15 superseded – Paul Daley and Alan Mooney issued with later version for review.							
0.30	Paul Daley	Cullen Ave	05/11/2004	12/11/2004			
0.30	Alan Mooney	TCB	05/11/2004	12/11/2004			
0.30	John Titmarsh	Cullen Ave	05/11/2004	12/11/2004			
0.30	Peter Sherriff	Cullen Ave	05/11/2004	12/11/2004			
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Definitions

IDTS	Integrated Departmental Telemetry System
RTU	Remote Telemetry Unit
SCADA	Supervisory Control And Data Acquisition
MAHD	Metres above Australia Height Datum
TWL	Top Water Level
BWL	Bottom Water Level
PID	Proportional, Integral and Derivative

1 EXECUTIVE SUMMARY

This document outlines the functional requirements for the control, monitoring, and telemetry of a standard three-pump submersible sewerage pump station with variable frequency drive (VFD), controlled by a GE-Fanuc 90-30 PLC which communicates to the IDTS master station via a Logica CMG MD3311 Remote Telemetry Unit (RTU).

The boundary of this functional specification is to form the basis for the PLC and RTU code development. The Summary of IDTS SCADA configuration and control room operator actions are provided for completeness only.

This type of station is equipped with variable frequency drives to reduce odour emission (caused by the 'bellows effect' of a continually rising and falling wet well). The variable frequency drives also enable the smoothing of the fluctuation in delivery flow to the down stream sewer network. This is particularly important for waste water treatment plants which operate more effectively under constant flow conditions.

The station is designed, and is normally selected, to run autonomously under the control of the GE-Fanuc PLC based on the value of the wet well level. This 'remote' mode starts the duty pump when the wet well level reaches the start duty A level (refer to *Figure 1: Wet Well Level Set Points*) and continues to run the pump while the wet well level is above the stop duty A level. A second pump will operate if the wet well rises to the start duty B level (when the inflow into the station is above the flow capacity of one pump). The station will be interlocked (within the code) so that only two pumps can operate at any one time.

The 'remote' mode control algorithm will gradually vary the speed of the pump (thereby limiting delivery flow fluctuations), to maintaining the wet well to as constant a level as possible. In effect, the change in speed will control the delivery flow to match the inflow to the station. The inflow varies according to the stations diurnal flow pattern, therefore the station delivery flow will also have a diurnal flow pattern (refer to *Figure 2: Typical Diurnal Flow Pattern*).

For a sudden change in the station's inflow, caused by the on/off cycling of an upstream station, the pumps will vary their speed (and thus the delivery flow) in a controlled manner, using the wet well as a temporary storage buffer. Once the delivery flow has converged on the inflow, it will slightly over compensate, so that over time, the wet well level will be brought back to the desired level. Thus the change in wet well level is controlled while still minimising delivery flow fluctuations.

To provide redundancy for the Vega probe (which measures the wet well level) a surcharge imminent electrode is installed. This electrode not only provides redundancy in the alarming of abnormally high wet well levels, it also serves as a backup signal to start the pumps, ensuring that the station does not surcharge due to a fault in the Vega probe. If the pumps are started using this electrode, the station is said to be in 'surcharge pumping' mode. This mode will start two pumps and command them to run at maximum speed.

The station is also designed, and may be selected, to operate under local control. The primary use of local control is for testing the system during maintenance. The speed of the pumps in local mode is also locally controlled via a dial on the switchboard.

In an emergency situation, if the PLC has failed, a qualified technician is able to start any individual pump via VFD by activating the VFD keypad (changing the VFD from auto to manual (keypad) control). In manual mode, however, the VFD can **not** be controlled by the PLC.

The pumping station, as part of a larger sewer network, will be pumping to either downstream pump station, waste water treatment plant or downstream sewer network. In the event of a downstream failure, the control room operator can delay and minimise the volume pumped by selecting 'all pumps inhibited' mode. This mode delays and minimises the volume pumped by fully utilising the storage capacity of the wet well and the inlet sewer system. This can avoid or minimise the volume surcharged downstream of the station.

The RTU will report by exception (eg alarm) to the IDTS master station if an event occurs outside its normal operating parameters. The control room operator, via the IDTS master station, can modify certain PLC/RTU operating parameters to respond to an abnormal situation, but can not override the PLC/RTU logic.

The program written for the PLC has significant 'intelligence' to be able to cope with any abnormal events and continue to operate the station in a safe manner. The functional specification also describes the control strategies for the majority of failure scenarios, for which the intervention by the control room operator is not relied upon.

The station is interrogated hourly via the telemetry network to routinely update the status of the station to the IDTS master station and upload the previous hour's historical data. The station also requests an immediate upload when any critical event occurs at the station. The IDTS master station will then alert the control room operator of any abnormal conditions at the station. Calculations are also performed and telemetered to the IDTS master station to aid system planning and fault finding for the station and surrounding sewer network.

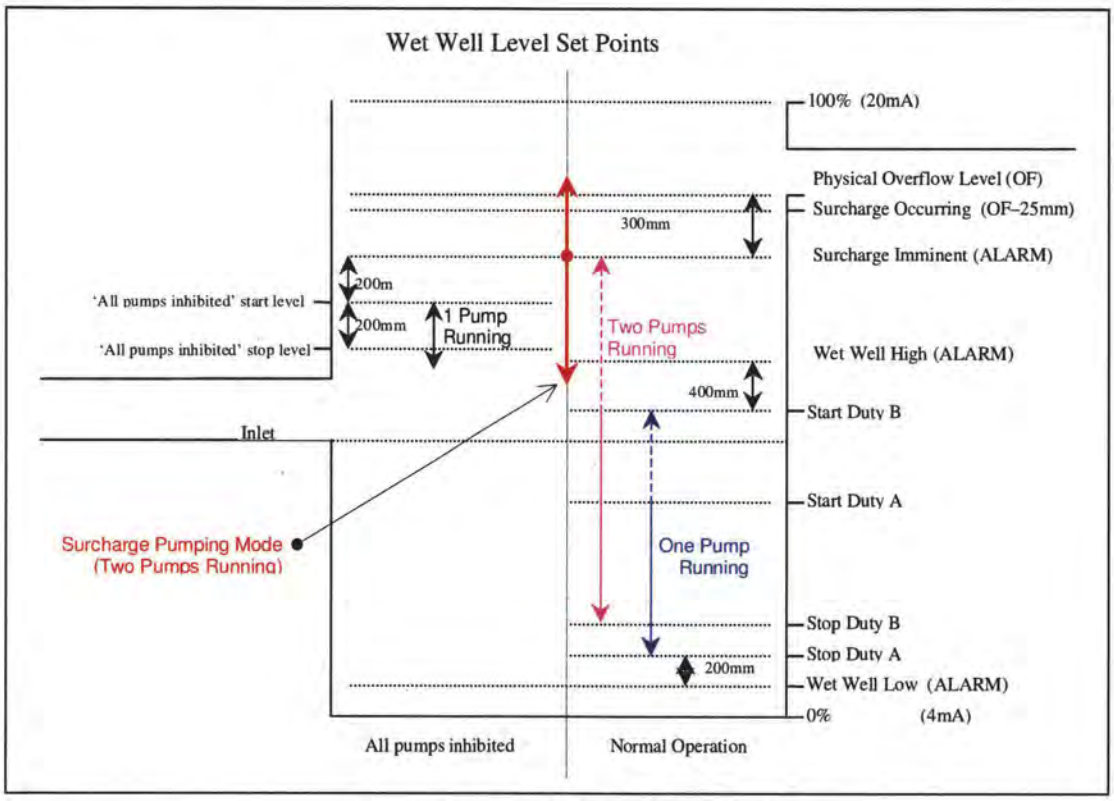

Figure 1: Wet Well Level Set Points

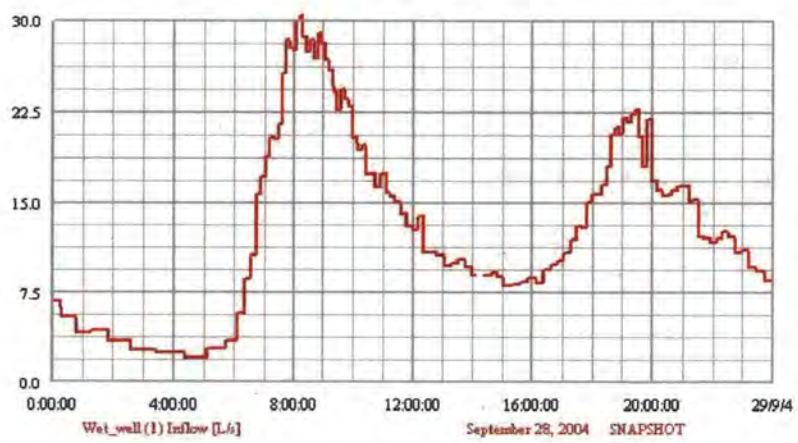

Figure 2: Typical Diurnal Flow Pattern

2 CONTROL PHILOSOPHY

2.1 Overview

The following section outlines the operating philosophy of a standard three-pump submersible sewerage pump station with variable frequency drives. The size of the sewer pumps shall be selected so that one pump will be adequate for normal dry weather flow. Two (only) pumps are allowed to run simultaneously to cope with higher flows during wet weather conditions.

The station can be selected to be in one of the following three modes

- Remote Mode (Normal Operating Mode)
- Local Mode
- Emergency Mode (VFD Keypad control)

All mode selection is done on site by the on site technician via the local/remote selector switch. Both local and remote control are controlled by the GE-Fanuc 90-30 PLC, independently from the MD3311 RTU. The RTU is only required for the monitoring of the station by the IDTS master station.

The station is designed, and is normally selected, to run autonomously under the control of the GE-Fanuc PLC based on the value of the wet well level. The station is also designed, and may be selected to run under local control. Local mode is designed for an on site technician to manually control the pumps. Its primary use is for testing the system during maintenance.

In the event of a complete RTU failure, the PLC will continue to operate in the mode that it is selected. The IDTS master station will alert the control room operator of a communications fault.

In the event of a PLC failure, the RTU will immediately alarm a PLC fault at the IDTS master station and each pump can be individually run via the VFD keypad when a technician arrives on site, completely independent of the PLC. Keypad control is initiated via each pumps individual VFD control keypad.

2.1.1 Normal Operation (Remote Mode)

Under normal operation (in remote mode) the station is controlled using 'dutyA pump stop level' and 'dutyA pump start level'. Once one pump is running, if the level continues to rise above the 'dutyB start level', a second pump will start and run until the level falls to the 'dutyB stop level'. The second pump will run at the same speed as the dutyA pump - as calculated by the control algorithm. The pump station will be interlocked so that only two pumps can operate at any time. The start and stop levels are measured in mAHD and are site specific (refer to *Figure 1: Wet Well Level Set Points* for a graphical representation of the various wet well level set points).

As described in the executive summary, under normal operating conditions, the 'remote' mode control algorithm will gradually vary the speed of the pump to control both the wet well level and the flow. Provided the delivery flow meter signal is valid, the pump speed will be controlled by a 'level-flow-speed' cascaded P.I.D.[1] loop. This loop will be 'tuned' to control the wet well level to a constant set point, to minimise the 'bellows' effect, while limiting excessive fluctuations in the delivery flow.

In the event that the delivery flow meter signal is invalid, a basic 'level-speed' P.I.D. loop will be utilised to maintain the desired wet well level. This P.I.D. loop will be 'tuned' to control the wet well level to a constant set point to minimise the 'bellows' effect.

[1] A proportional-integral-derivative (PID) controller tracks the error between the process variable and the setpoint, the integral of recent errors, and the rate by which the error has been changing. It computes its next corrective action from a weighted sum of those three terms (or modes), then outputs the results to the process and awaits the next measurement.

Cascaded 'Level to Flow to Speed' PID Control

The pump speed will increase, using a cascaded PID loop controlling both wet well level and flow rate, until it reaches its maximum speed. The diagram below shows the PID loop for flow control. (The control algorithm of the PID integration and output values is limited to within minimum and maximum values for flow rates and VFD speed.)

The cascaded PID loop control relies on the wet well level set point. This set point is compared with the actual wet well level. When the wet well level is greater/smaller than the wet well level set point the flow control set point will increase/decrease accordingly. This flow control set point is then compared with the actual flow reading and the speed of the VFD is adjusted to achieve the required flow set point.

The PID loop will be tuned so that as the inflow to the station increases, the outflow increases to match, thereby maintaining the wet well level set point. The secondary PID loop will be tuned so that the rate of change of the flow rate is controlled and undue flow fluctuations are minimised.

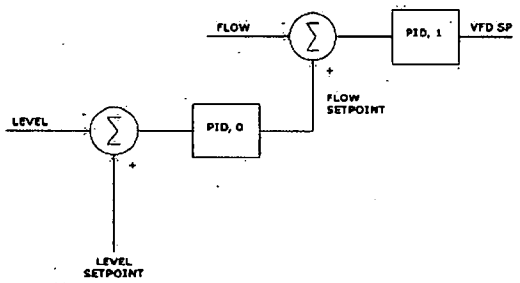

Figure 3 :Cascade Level-Flow Pid Loop Control

'Level to Speed' PID Control

In the event of a failure of the flow meter, a simple level-speed PID control loop will control the speed of the pumps to maintain a constant level. The diagram below shows the PID loop control for the level/flow control.

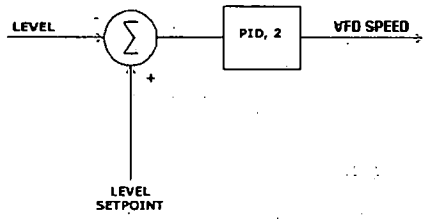

Figure 4: Wet Well Level Pid Loop Control

The value of the VFD speed is adjusted to achieve the required level set point. The PID loop will be tuned so that as the inflow of the station increases, the speed of the variable frequency drive will increase to match the flow, thereby maintaining the level set point. The wet well level will only fall below the set point if the inflow to the station is less than the flow rate produced when the VFD is at minimum speed.

2.1.2 Surcharge Pumping Mode

If the level continues to rise above the Duty B start level then depending on the level reached, 'High', 'Surcharge Imminent' and 'Surcharge Occurring' alarms will be raised and sent back to the control room operator. The control room operator is also alerted to 'Low' and 'Invalid' conditions (Refer to *2.5.1 Wet Well Level Invalid*). The alarm conditions are normally set as follows:

Wet Well Low	200mm (nominal) below 'dutyA pump stop level' set point (BWL)
Wet Well High	400mm (nominal) above 'dutyB pump start level' (TWL)
Surcharge Imminent	300mm below actual surcharge level
Surcharge Occurring	25mm below actual surcharge level

When the level reaches the surcharge imminent level (as per the physical surcharge imminent electrode or according to the wet well Vega probe) the station will initiate the surcharge pumping mode. In surcharge pumping mode two available pumps will be commanded to run at maximum speed. The speed analog output will be clamped at maximum speed and as a backup, the 'run at maximum' digital output will also be activated. For environmental reasons, surcharge pumping mode has priority and all pump inhibits and wet well level duty stop set points are ignored.

There are three main reasons that a station will fill to the surcharge imminent level.

1. The Vega probe measuring the wet well level is invalid (pumps will not start if the level is not valid)
2. The Vega probe measuring the wet well level is 'frozen' at a valid level but below the start level.
3. The inflow to the station is higher than the pumping capacity of the available pumps running.

The surcharge pumping mode is active while the wet well level is at or above the surcharge imminent level and for a site specific minimum of time after the level falls below the surcharge imminent condition. Once surcharge pumping mode is deactivated the station will revert to its previous mode of operation (normal operation or all pumps inhibited mode).

NOTE: The site specific minimum time is calculated as half the time taken to pump from surcharge imminent level to the dutyA stop level under normal dry weather conditions.

2.1.3 All Pumps Inhibited / Blocked Mode and Individual Pump Inhibit / Blocked

The control room operator can inhibit one or more of the station's pumps. If a single pump is inhibited, then that pump is considered inhibited from operating under normal operating conditions. If all pumps are inhibited, then the whole station is considered inhibited and in 'all pumps inhibited mode'

NOTE: If a pump blockage alarm is active for a specific pump then this will have the same effect as if the control room operator has inhibited the pump.

Single Pump Inhibit (Blocked) Mode

A single or pair of pumps can be inhibited if they are not operating efficiently (eg partially or fully blocked). This will remove them from the duty cycle allowing the more efficient pump(s) to permanently operate as the duty pump until the inhibit is removed. This will allow the station to run normally until the inefficient pump(s) can be unblocked or repaired.

If the uninhibited duty pump(s) can not keep up with the inflow and the wet well level rises, as the respective alarm levels are reached, the wet well high alarm will activate as a warning. If the level continues to rise above the surcharge imminent level, then the surcharge imminent alarm will activate and, if less than two pumps are running, one of the inhibited pumps, if available, will automatically be commanded to run to ensure two pumps are running under surcharge pumping mode. They effectively ignore the inhibit placed upon it by the control room operator. After the surcharge pumping cycle is completed, the pump(s) will remain "inhibited" and are only uninhibited by a command from the control room operator.

All Pumps Inhibited Mode

All pumps inhibited mode is utilised to delay the flow of sewerage to downstream sites in an emergency. This will mitigate a surcharge situation at either a failed downstream pump station or a problem in the sewer network downstream from the pump station. To activate 'all pumps inhibited' mode, all the pumps at a site have to be either inhibited individually by the control room operator or have their respective 'pump blockage' alarm active.

When the whole pumping station is in 'all pumps inhibited' mode, it is desirable to minimise the volume pumped. This is achieved by utilising the wet well storage capacity to a safe maximum level. Nominally the duty start level is raised to 200mm below surcharge imminent. At this level a single pump will run for a minimum of 2 minutes and until the wet well level drops to 400 mm below surcharge imminent (both conditions need to be satisfied before the pump stops). Refer to *Figure 1: Wet Well Level Set Points* for a graphical representation of these new start and stop levels.

NOTE: In the case where some of the pumps are inhibited and some have the pump blockage alarm active, the pumps which are inhibited are started in preference to the pumps that are blocked.

If the inflow volume causes the wet well level to rise above the 'all pumps inhibited' start level and reach the surcharge imminent level, the surcharge imminent alarm will activate and command the pumps to follow the surcharge pumping mode instead of the 'all pumps inhibited' mode.

Surcharge pumping mode is designed to control the well level and will run the pumps for a longer minimum duration than 'all pumps inhibited' mode. Although this is contrary to the purpose of 'all pumps inhibited' mode, which is to minimise the flow to the down stream station, surcharge pumping mode takes precedence. The inflow to the station would have to be significantly higher than the dry weather average inflow to cause the level to reach surcharge imminent level set point.

Once the surcharge pumping mode deactivates, the station will revert back to 'all pumps inhibited' mode. The station will remain in this mode until at least one pump is both uninhibited by the control room operator and is not blocked. As a feedback indicator for the control room operator, the sewer pump displayed on the IDTS master station has a yellow inner circle if it is inhibited. The pump blockage alarm is itself a priority 1 alarm and is not part of the pump availability condition.

The wet well high alarm will be suppressed when 'all pumps inhibited' mode is active as the well level, in 'all pumps inhibited' mode, is above the wet well high alarm set point.

NOTE: As the 'all pumps inhibited' mode is operating within 200mm of the surcharge imminent level set point, a calibration 'drift' in the wet well Vega probe can cause the station to trigger a surcharge imminent alarm during dry weather conditions. This will trigger a 'wet well calibration fault' alarm to the control room operator, instructing him to schedule a calibration of the Vega probe.

2.2 Station Instrumentation

The station has the following instrumentation connected to the MD3311 RTU or GE-Fanuc 90-30 PLC. All I/O must be connected as per the standard site physical I/O connections (Refer to *Appendix A: Standard Physical I/O List*). For a full equipment list refer to the standard drawing set. (Refer to *Appendix C: Drawing List*)

Table 1: Station Instumentation

Station Energex power relay	Status of power on the line side of the main incomer
Station mains power relay	Status of power after the main incomer
Pump mains power relay	Status of power after the pump circuit breakers
RTU mains power relay	Status of power after the RTU circuit breaker
Main incomer CB status	Status of the Main Incomer CB (used in conjunction with Energex and station mains power relays to determine whether a generator is currently running on site)
Battery system	Status of the battery system
Surge diverter	Status of surge diverter
Site door switch status	Combined status of all switchboard door (All closed or not)
Wet Well Vega Probe	The probe is positioned in the well to cover the operating level of the well. in mAHD
Pressure Gauge	Delivery pressure of the pump station in mAHD
Flow Meter	Delivery flow of the pump station in l/s
Wet Well Surcharge Imminent Electrode	Electrode to detect if wet well level has reached surcharge imminent level
Station Local Controls and Indication	Site attention reset push button Local/remote selector switch Site attention indication lamp Wet Well level % indicator gauge Battery Check relay
Pump Local Controls and Indication	Start push button Stop push button Emergency stop push button Pump status indication lamp
Pump Variable Frequency Drives (Danfoss)	VFD control and display panel Running Feedback Fault Feedback Run Command Reset Command Local Speed Command (4-20 from Potentiometer) Remote Speed Command (4-20mA from PLC) Speed Feedback (4-20mA to PLC) Modbus link to RTU for pump power and current Moisture in Oil (Optional)

2.2.1 IO Allocation between RTU and PLC

The IO is split into the MD3311 RTU and GE-Fanuc PLC, determined by whether or not the I.O. is required for the control of the pumps.

Signals which are required for monitoring only, or controls not associated with the control of the pumps (ie generator I.O.) are wired directly into the MD3311 RTU. All I.O., which are wired into the MD3311 RTU, are backed up by the battery system and will continue to function even during power outages.

All pump I.O. required for pump control are wired into the GE-Fanuc PLC. All monitoring and controls are communicated via the Modbus link to the MD3311 RTU and then to the IDTS master station. The I.O. wired to the GE-Fanuc PLC are not backed up by the battery system and will fail during power outages. This is not detrimental to the operation of the station as the pumps can not run without 415VAC.

Even though wet well level analog signal is required for the control of the pumps, it is also critical during power outage. Therefore it is wired, in series, to both the RTU and the PLC.

2.2.2 Modbus Communications

The Modbus communications will be configured as over a RS485 link as per the diagram below.

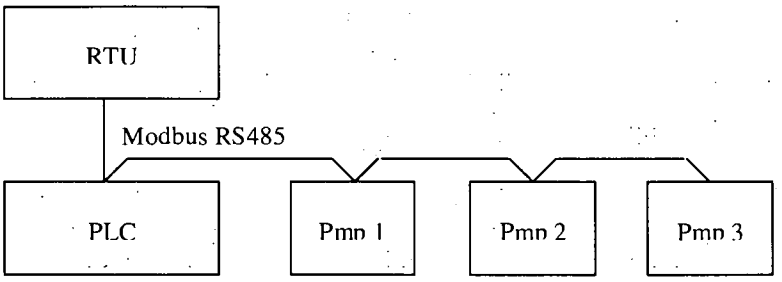

Figure 5: Modbus RS485 Network Diagram

For a full description on how to configure this network, refer to the following range of technical documents found on the Brisbane Water Infonet.

Branch	Section	Document Type	ID	Title
Newtorks	Water &Sewerage Operations	Technical Manual Or Specification	003590	Modbus Md3311 To Ge 90-30
Newtorks	Water &Sewerage Operations	Technical Manual Or Specification	003591	Modbus Ge 90-30 To Danfoss
Newtorks	Water &Sewerage Operations	Technical Manual Or Specification	003592	Modbus Md3311 To Ematron.Doc

The IO that is calculated in the PLC and then transferred from the PLC to the RTU is listed in the tables below.

The Modbus communication fault is determined by a watchdog counter which is passed back and fourth from the RTU and the PLC and incremented on each pass in the PLC. If the RTU does not register an increment in any given 30 second time period, then a communication fault alarm is activated.

Table 2: Modbus Digital Signals to the RTU

GE-Fanuc Tag Name	Description
Pmp[x]dsMainsPower	Pump No.[x] Mains Power IDTS Indication
Pmp[x]dsAvailableIDTS	Pump No.[x] Available IDTS
Pmp[x]dsRunning	Pump No.[x] Running
Pmp[x]dsInhibit	Pump No.[x] Inhibited
Pmp[x]dsEStop	Pump No.[x] Emergency Stop Fault
Pmp[x]dsFault	Pump No.[x] Fault
Pmp[x]dsVFDFlt	Pump No.[x] VFD Fault
Pmp[x]dsVFDAuto	Pump No.[x] VFD Auto
Pmp[x]dsMIO	Pump No.[x] Moisture in Oil
Pmp[x]dsBlockAlm	Pump No.[x] Blockage Alarm
Pmp[x]dsVFDFltExceeded	Pump No.[x] VFD Fault Count Exceeded
Pmp[x]dsVFDFltAutoReset	Pump No.[x] VFD Fault Auto Reset
Pmp[x]dsSpeedInvalid	Pump No.[x] Speed Signal Invalid
Stn01dsSurchImm	Surcharge Imminent
Stn01dsRemote	Station Remote Selected
Wwl01dsInvalid	Wet Well Level Signal Invalid
Pre01dsInvalid	Delivery Pressure Signal Invalid
Flw01dsInvalid	Delivery Flow Signal Invalid
Plc01dsFirstScan	PLC 1 first scan

Table 3: Modbus Digital Controls to the PLC

GE-Fanuc Tag Name	Description
Pmp[x]dcStart	Pump No.[x] Remote Start Command
Pmp[x]dcStop	Pump No.[x] Remote Stop Command
Pmp[x]dcReset	Pump No.[x] Remote Reset
Pmp[x]dcInhibit	Pump No.[x] Remote Inhibit
PLC01dcinitReset	PLC 1 initiate reset

Table 4: Modbus Integer Signals to the RTU

GE-Fanuc Tag Name	Description
Wwl01txSurchImmLevelSP	Surcharge Imminent
Wwl01txDtyBStartLevelSP	Duty B Pump Start Level (mmAHD)
Wwl01txPIDLevelSP	PID Level Setpoint (mmAHD)
Wwl01txDtyAStartLevelSP	Duty A Pump Start Level (mmAHD)
Wwl01txDtyBStopLevelSP	Duty B Pump Stop Level (mmAHD)
Wwl01txDtyAStopLevelSP	Duty A Pump Stop Level (mmAHD)
Wwl01txEGU	Wet Well Level (mmAHD)
Wwl01txRange	Wet Well Level Range (mm)
Wwl01txZero	Wet Well Zero (mmAHD)
Pre01txEGU	Delivery Pressure (mmAHD)x10
Pre01txRange	Delivery Pressure Range (mm)
Pre01txZero	Delivery Pressure Zero (mmAHD)x10
Flw01txEGU	Deliver Flow (l/s) x 10
Flw01txRange	Delivery Flow Range (l/s) x 10
Pmp01txSpeedEGU	Pump 1 Speed (%) x 10
Pmp02txSpeedEGU	Pump 2 Speed (%) x 10
Pmp03txSpeedEGU	Pump 3 Speed (%) x 10

2.3 Remote Mode

Remote mode is the normal operating mode of the station. In this mode the PLC program controls the pumps in a duty standby configuration, starting and stopping the pumps according to the wet well start and stop set points (as described in the overview and illustrated in *Figure 1: Wet Well Level Set Points*)

The control room operator can issue remote manual commands to the PLC, via the RTU, to control the station outside the normal set point parameters. The following are the controls available to the control room operator.

- Stop — Stops a specific pump provided that the station is in its 'normal' wet well range (below the Start Duty A level. If the wet well level is abnormal (higher than Start Duty A level but below surcharge imminent level), then the "inhibit" can be used to stop a pump.
- Start — Start a specific pump provided the wet well level is above the 'bottom water level' (duty A pump stop level). The 'start command' over rides the pump lockout which restricts the number of starts per hour under autonomous control.
- Reset — Allows the operator to remotely reset any latched pump alarms provided the original fault condition has cleared.
- Inhibit — Allows the operator to inhibit a specific pump from operating under the normal operating mode, effectively removing it from the duty rotation. If all pumps are inhibited the operator has 'inhibited' the station causing the station to run under 'all pumps inhibited' mode.

The control room operator can also send the following site commands:

- Attention Activate — By sending this control the operator activates a site attention indicator requesting the on site technician to contact the control room.
- Abnormal Operation Reset — This command reset the abnormal operation alarm which is activated whenever the RTU or PLC has an 'abnormal operation' (ie the RTU or PLC resets by itself).
- Alarm limit set points — The operator has the ability to modify the set points for the high and low alarms configured for various signals (eg. pressure, motor current and motor power and wet well).

The Control Room Operator can NOT:

- Switch the station from local to remote mode. (Physical switch on site only)
- Start or Stop the pumps if the station is in local mode.
- Modify operational set points, eg. Start/Stop dutyA/B level set points.
- Change alarm priority class or alarm triggering configuration on the communications channel.
- Control the speed of the pumps. The PLC automatically determines the speed of the pumps using the PID control algorithms

2.3.1 Pump Duty Selection

The duty rotation is based on a simple rotational basis. When the duty pump stops running, the duty is rotated to the next pump available for normal duty standby operation. If a pump is unavailable, inhibited, blocked or locked out then that pump will not be set as duty A or duty B. If no pumps are running and the control room operator issues the command for a specific pump to run then that pump is assigned to be the duty A pump.

2.3.2 Pump Lockout

In remote mode, under normal operating conditions (the station is not in either surcharge pumping or 'all pumps inhibited' mode) a pump is locked out from starting for 5 minutes since its last start. This is to protect the motor and starting equipment from thermal failure due to too many starts per hour. The lockout is bypassed by the remote start command sent from the IDTS master station.

2.3.3 Pump Start Delay

In remote mode, the stations pumps are prevented from starting simultaneously by a pump start delay of 10 seconds commencing from the last time a pump has started. This will minimise any inrush current to the station and also minimise water hammer effects.

2.4 Local Mode

The on site technician can completely control the site by switching the site into local mode and manually operating the pumps via the push buttons. The speed of each pump can be controlled via individual potentiometers.

WARNING: In local mode there are no automatic controls. Once the pumps have been started they will 'run to destruction', that is, they will **not** switch off automatically due to wet well level reaching the 'stop duty A level' set point. If the on site technician does not stop the pump before the wet well level falls below the pump intake, then the pump will 'suck' air and will 'air lock' making the pump inoperable until it is either 'bled' or 're-primed'. It is up to the on site technician to ensure the pump only runs while the level is above the stop level.

The on site technician has the following local station controls:

- Station Local / Remote — Selector switch to determine operating mode of the station
- Site attention reset — Reset the attention indication sent by the control room operator

The on site technician has the following local controls for each pump:

- Start — Push button to start pump
- Stop — Push button to stop pump (soft stop via VFD)
- Emergency Stop — Latched push button (hard stop via electrically isolation)
- Reset — Push button (reset any latched alarms in RTU related to pump)
- Speed Control — Potentiometer that allows the selection of speed between minimum and maximum configured in the VFD

Local indication on the switchboard includes:

- Site attention — Indication lamp – on site technician required to contact control room operator
- Pump status — Indication lamp: On continuously Pump running; Slow Flash (2 sec) Pump faulted; Fast Flash (1 sec) Pump lockout
- Wet well level — Provides the wet well level indication in %
- Variable Frequency Drive — Control panel to configure the parameters of the Variable Frequency drive and also to display motor status (i.e. motor current, VFD speed)

2.5 Station Fault Conditions

2.5.1 Wet Well Level Invalid

Remote mode relies on the wet well level from the Vega probe to operate normally. If the wet well level becomes invalid (is outside the operating range of 4-20 mA) then the station will rely on the surcharge imminent probe to control the starting and stopping of the pumps. The wet well level is deemed invalid if it is

[Less than (4mA – dead band) OR greater than (20mA + dead band)] for 2 seconds.

Once the invalid alarm has been activated it can only be reset when the signal is both greater than 4mA and less than 20mA for 20 seconds. The time delays ensure that a signal is truly invalid before an alarm is set and that it is stable before it is reset.

2.5.2 Site Power

The site requires 3 phase mains power (Energex) to operate the sewer pumps. The RTU requires DC power and is equipped with a backup battery supply that lasts for approximately 2 hours. These batteries also supply standby power to the communications device (eg Trio radio), the wet well level Vega probe and surcharge imminent electrode. The PLC is **NOT** backed up by the Battery as it requires 240VAC.

The control room operator is alerted of a site power outage. Any consequential alarms resulting from the power outage are suppressed as described in the section 4.4.6 Alarm Suppression Tree. The control room operator is able to monitor the wet well level and is alerted to a wet well high condition and eventually a surcharge imminent condition during the power outage (until the battery goes flat).

The station switchboard has a generator connection cubicle allowing a mobile generator to be connected under extended power outages. The generator is manually operated and can supply power via a generator circuit breaker which is mechanically interlocked with the mains circuit breaker. The pump station will operate normally (with at least one pump) while the site power is supplied from the generator. Depending on the capacity of the generator the station may have to be further interlocked to a limit of one pump.

NOTE: The on site technician is required to remain on site while the generator is connected and running, to ensure the safety of the public as the generator connection are temporary and are not secured.

An optional upgrade to a pump station is to have a semi-permanently connected generator which automatically runs the station on generator supply following an Energex power failure. This upgrade provides an automatic transfer switch (ATS) to disconnect Energex and connect the generator. Extra physical I.O and IDTS alarms are configured in the RTU to provide full feedback on the status of the semi-permanent generator.

2.5.3 Pump Availability

All electrical fault and interlock conditions pertaining to a particular pump must be healthy before that pump can be run. A pump is considered 'available' if all these conditions are met. The PLC will only command a pump to run if it is available. If a pump becomes unavailable at any time while the pump is running, it will stop immediately.

Any one of the following on site fault conditions will make the pump unavailable.

- Site mains power fail - Switchboard does not have 415V mains power supplied
- Pump well flooded trip - The pump dry well has flooded above the trip level
- Pump mains power fail - Pump does not have 240V control power supplied
- Pump fail - Pump has failed to start
- Pump VFD not in Auto - Pump is in Keypad control
- Pump VFD fault - Pump VFD motor protection has activated
- Pump VFD fault Count Exceeded - Three or more faults in the last 8 hours
- Pump emergency stop input faulted - Push button has been pressed
- Pump emergency stop fault latched - Emergency fault has not been reset

The functional descriptions of these conditions are described under section 4.6 Alarm and Event Description

To ensure that there is redundancy in the number of pumps available, each pump station is designed to require only one pump to run under dry weather conditions. If one pump becomes unavailable, the another pump will become the duty pump until such time as the unavailable pump is once again available for duty rotation.

As a feedback indicator for the control room operator, the sewer pump displayed on the IDTS master station has a red inner circle if it is unavailable.

If all pumps become unavailable, then the station will not run any pumps and contingency measures are initiated by the control room operator to ensure that no surcharge occurs.

3 SITE SPECIFIC VALUES

Although each pump station is built according to a standard, there are variables which are site specific and must be programmed directly into the PLC code. This is achieved by an initialisation block in which all the site specific values are loaded with an initial value. The code for each site is identical except for this initialisation block. This initialisation block is divided into two distinct sections:

1. Site specific Constants
2. Site specific Variables

The site specific constants are internal parameters of the code and can be directly written to by a move command. The site specific variables are also adjustable by the control room operator, an operate block is used to 'load' a default value into these pseudo inputs. Most constant values are listed as 'site specific', but where a default value is commonly used its' value is listed in the table below.

3.1 Site Specific Constants defined in PLC

Description	Type	Value	Units
Sewerage Pumping Station			
Minimum time between starts for each pump	Integer	300	Sec
Fail to start/stop timer	Integer	30	Sec
Minimum time 'all pumps inhibited' run is active.	Integer	120	Sec
Surcharge pumping duration [3]	Integer	Site Spec	Sec
Delivery flow			
Delivery flow – Range	Real	Site Spec	l/s x 100
Delivery flow – Minimum flow	Real	Site Spec	l/s x 100
Delivery pressure			
Delivery pressure - Range	Real	Site Spec	mmAHD
Delivery pressure – Elevation of the transducer	Real	Site Spec	mmAHD
Pump Blockage			
Flow blocked limit for flow/level PID control (knee)	Integer	Site Spec	l/s x 100
VFD speed blocked limit for flow/level PID control (knee)	Integer	Site Spec	Hz x 100
VFD speed blocked limit for minimum flow PID control (min)	Integer	Site Spec	Hz x 100
Wet well level			
Wet well level range	Integer	Site Spec	mmAHD
Wet well surcharge occurring level	Integer	Site Spec	mmAHD
Wet well surcharge imminent level	Integer	Site Spec	mmAHD
Wet well inhibit mode start level	Integer	Site Spec	mmAHD
Wet well inhibit mode stop level	Integer	Site Spec	mmAHD
Wet well duty B pump start level	Integer	Site Spec	mmAHD
Wet well duty A pump start level	Integer	Site Spec	mmAHD
Wet well duty A pump stop level	Integer	Site Spec	mmAHD
Wet well duty B pump stop level	Integer	Site Spec	mmAHD
Wet well empty level (4mA of Probe)	Integer	Site Spec	mmAHD
Variable Frequency Drive			
Variable Frequency Drive – Minimum Speed	Integer	Site Spec	Hz x 100
Variable Frequency Drive – Maximum Speed	Integer	Site Spec	Hz x 100

3.2 Site Specific Constants defined in RTU

Tag Name	Description	Type	Value	Units
Sewerage Pumping Station				
atn1duration	Attention alarm duration	Integer	15	min
stn1calFltDelay	Delay wet well calibration fault on start up [1]	Integer	3600	sec
rtu1BattChkDur	Battery check test duration [2]	Integer	600	sec
ste1percent	Percentage value of analog alarm hysteresis	Real	1.0	%
Delivery flow				
flw1almInhibitTm	Delivery flow - Alarm inhibit timer	Integer	15	sec
Delivery pressure				
pre1almInhibitTm	Delivery pressure - Alarm inhibit timer	Integer	15	sec
Wet well level				
wwl1surchLvlVol	Wet well volume at surcharge level	Real	Site Spec	kl
Pumps 1 - 3				
Pmp[x]almInhPwrTm	Pump [x] - Motor power alarm inhibit timer.	Integer	15	sec
pmp[x]almInhCmtTm	Pump [x] - Motor current alarm inhibit timer.	Integer	15	sec
pmp[x]currRange	Pump [x] - Motor current range	Real	Site Spec	Amps

3.3 Site Specific Variables defined in RTU

Tag Name	Description	Type	Value	Units
Wet well level				
wwlhighLimit	Wet well level - High alarm set point	Integer	Site Spec.	mmAHD
wwllowLimit	Wet well level - Low alarm set point	Integer	Site Spec.	mmAHD
Delivery flow				
flwhighLimit	Delivery flow - High alarm set point	Integer	Site Spec.	ml/s
flwllowLimit	Delivery flow - Low alarm set point	Integer	Site Spec.	ml/s
Delivery pressure				
prelhighLimit	Delivery pressure - High alarm set point	Integer	Site Spec.	mmAHD
prellowLimit	Delivery pressure - Low alarm set point	Integer	Site Spec.	mmAHD
Pumps 1 - 3				
pmp[x]currHiLimit	Pump [x] - Motor current high alarm set point [4]	Integer	Site Spec.	mAmps
pmp[x]currLoLimit	Pump [x] - Motor current low alarm set point [5]	Integer	Site Spec.	mAmps
pmp[x]powHiLimit	Pump [x] - Motor power high alarm set point	Integer	Site Spec.	Watts
pmp[x]powLoLimit	Pump [x] - Motor power low alarm set point	Integer	Site Spec.	Watts

Notes

1. Upon start-up a delay of 1 hour ensures that, if PLC/RTU initialises while the level is above the surcharge imminent level, the station has adequate time to pump the level back to within normal operating levels. This prevents invalid 'calibration fault' alarms from being triggered.
2. The battery test checks that the battery is able to provide backup power long enough (ten minutes) after a station mains fail to send the station mains fail alarm back to the IDTS master station.
3. The surcharge pumping duration is calculated as half the time taken to pump from surcharge imminent level to the dutyA stop level under normal dry weather conditions.
4. The current high alarm set point is configured to detect high current reading which is a symptom of a jammed pump.
5. The current low alarm set point is configured to detect a low current reading which is a symptom of an air locked, a worn pump or a blocked pump.

4 ALARMS AND EVENTS

4.1 Introduction

Acquisition of data from the site is performed by the IDTS master station regularly "polling" the RTU once every hour. When this poll occurs the current status of all digital and analog values are transmitted to the IDTS master station. Additionally, time stamped historical values for selected points may also be uploaded. (This information is used for trending purposes).

The regular polling routine is overridden by an "Alarm call" message generated by the RTU if a "significant' point changes state at the site. An "Alarm call" is a short message sent to the IDTS Master station requesting an immediate communication with the site. The master station then schedules a "poll"

1. Significant : Alarm call the master station on change of state or prescribed deviation
2. History : Time stamp events in the RTU at the prescribed frequency and deviation

The RTU communicates to the IDTS master station via a communication channel, typically the Trio radio network. To conserve the radio channel bandwidth the RTU only priority 1 alarms are set up to be significant points.

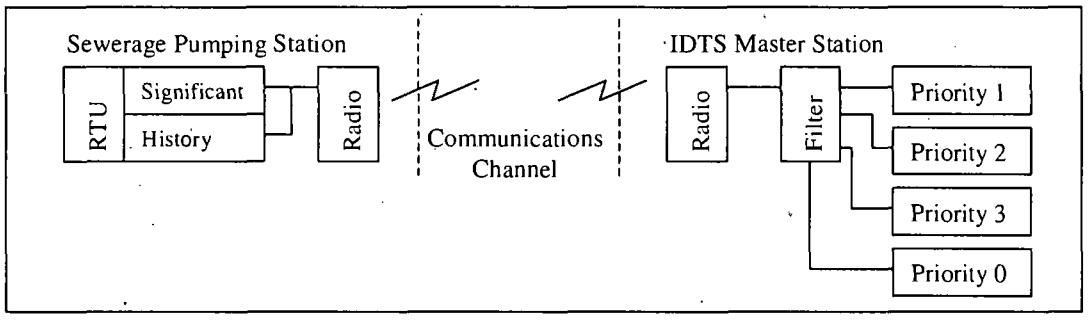

Figure 6 Radio Communication Channel

4.2 Alarm and Event Definitions

All Boolean signals sent back to the IDTS master station are given an alarm priority classification which will determine weather they are alarms or events. These priorities are as follows:

Priority 1	Alarm	Immediate action
Priority 2	Alarm	Action next calendar day
Priority 3	Alarm	Action next working day
Priority 0	Event	No Action required

4.2.1 Alarms

As the definition of a Priority 1 alarm is that immediate action is required. All Priority 1 alarms are classified as significant. Any change of state triggers an alarm call from the RTU to the IDTS master station requesting an immediately poll of the RTU. All other non-significant alarms/events which are configured for history are time stamped and placed in the RTU history to be uploaded when:

- the RTU is polled by the IDTS or
- the buffer becomes full or
- a priority 1 alarm occurs causing all the buffer contents to be sent.

NOTE: The MITS MD3311 RTU's synchronise their time with the master station using a UNIX time routine.

The alarm priority class is shown by colour in the control room operator's alarm page picture on the IDTS. The IDTS SCADA alarms are filtered by priority class, then by the time stamp. A log file records the time and date of the activation and deactivation of alarms at the RTU.

NOTE: Alarms which have an initial state of 'TRUE' (i.e. Available) should be initialised as TRUE in the point configuration of ISaGRAF to avoid erroneous alarm on the first scan of the RTU.

4.2.2 Events

Events are actions recorded by the RTU, which are not in an alarm category, for example pump running (start/ stop action). The events are stored in the RTU history with a time and date stamp and are transmitted to the IDTS master station with the priority 2 and 3 alarms. To avoid multiple alarms for a single pump fault, all pump faults have been classified as events. They all trigger the pump available alarm, which is a priority 1 alarm.

4.3 Alarm Instructions

Each event or alarm that requires an action from the control room operator is provided with an 'Alarm Instruction'. This 'alarm instruction' is in the form of a text file that is associated with all alarms and events. A typical action may be to send an electrician to the site or to order a sewerage tanker. Refer to Section *6.5 IDTS Alarm Instructions* for an example of an alarm instruction file.

4.4 Alarm Suppression

An alarm's primary function is to notify the control room operator that an abnormal situation exists at a sewerage pump station. The Brisbane Water operational instructions for each sewerage site determine the action the control room operator takes in response to an alarm. To avoid consequential alarming (one fault condition triggering multiple alarms at the IDTS SCADA system) alarm suppression is used on secondary alarms. All alarm suppression is performed in the RTU therefore modification to the RTU code is required to alter the suppression of any alarms.

4.4.1 Local Mode

When the station is switched to local mode, the site is under control of the on site technician. An alarm is triggered at the IDTS SCADA system to indicate the station is in local control. All pump alarms are suppressed as the on site technician has assumed responsibility for the station. Surcharge imminent, based on the wet well level, is also suppressed to avoid triggering Surcharge pumping mode during the maintenance of the Vega probe. The wet well level alarms of wet well high, surcharge imminent (triggered by the surcharge imminent electrode), and surcharge occurring are **not** suppressed in local mode.

4.4.2 Station Mains Fail

The main consequential alarm condition is Site Power Fail. If site power fails the following secondary alarms are suppressed:

- RTU Mains Fail
- Sewer pump not available
- Sewer pump motor power
- Current Invalid
- Delivery pressure Invalid
- Flow Invalid

4.4.3 All Pumps Inhibited

When the 'all pumps inhibited' mode is active, the wet well high alarm is suppressed, since the normal wet well level in inhibit mode is above the wet well high point.

4.4.4 Wet Well Invalid

If the wet well level becomes invalid, the wet well low and high alarm, surcharge imminent based on wet well level and surcharge occurring alarms are suppressed.
NOTE: As the wet well level is backed up by the battery – the site power does **not** suppress the invalid alarm.

4.4.5 Signal Invalid Alarm

Any analog signal (delivery pressure) not backed up by the RTU battery has its invalid alarm suppressed by the station mains power input. The signal high and low alarms are suppressed by both the signal invalid alarm and the station mains power input.

4.4.6 Alarm Suppression Tree

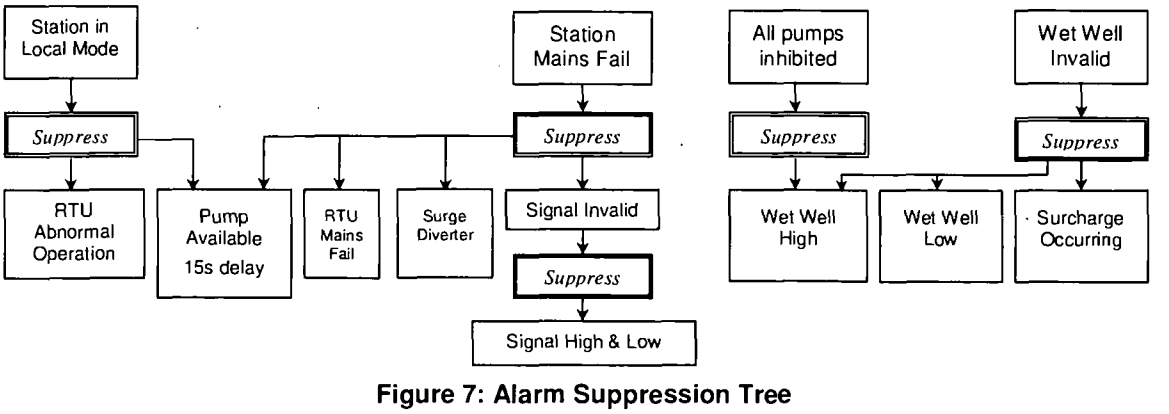

Figure 7: Alarm Suppression Tree

4.5 Alarm and Event Listing

Table 5: Priority 1 Alarms

Plant	Quantity	Desig	Alarm Description
Plc	Abnormal_operation	1	Abnormal operation of PLC
Plc	Comms_fault	1	Modbus communications to PLC has failed
Rtu	Abnormal_operation	1	Abnormal operation of RTU
Rtu	Battery	1	RTU power failure (battery)
Rtu	Heartbeat	1	RTU heartbeat to IDTS has failed
Rtu	Mains_fail	1	RTU power failure (mains)
Power_supply	Surge_diverter_fault	1	Surge Diverter fault
Sewage_pumping_station	Local_remote	1	Station in local mode
Sewage_pumping_station	Mains_fail	1	Site main power fails
Sewer_pump	Available	1-3	Pump unavailable
Sewer_pump	Blocked	1-3	Pump blocked
Wet_well	Level_invalid	1	Wet well measuring instrument faulted
Wet_well	High	1	Wet well level rises above a high alarm level
Wet_well	Surcharge_imminent	1	Wet well level reaches the surcharge imminent level
Wet_well	Surcharge_occuring	1	Wet well level reaches the surcharge occurring level

Table 6: Priority 2 Alarms

Plant	Quantity	Desig	Alarm Description
Sewer_pump	Inhibit_Fbk	1-3	Pump 1 inhibited by control room operator
Security	Door_limit_switch	1	One or more of the switchboard doors is open

Table 7: Priority 3 Alarms

Plant	Quantity	Desig	Alarm Description
Wet_well	Low	1	Wet well level is low
Wet_well	Calibration_fault	1	Wet well level calibration fault
Pressure_gauge	High	1	Delivery pressure high
Pressure_gauge	Low	1	Delivery pressure low
Pressure_gauge	Invalid	1	Delivery pressure invalid
Flow_meter	High	1	Delivery flow high
Flow_meter	Low	1	Delivery flow low
Flow_meter	Invalid	1	Delivery flow invalid
Variable_speed_drive	Automatic_reset	1-3	VFD starter fault has reset automatically
Variable_speed_drive	Speed_invalid	1-3	VFD speed feedback is invalid

Table 8: Events (Priority 0 Alarms)

Plant	Quantity	Desig	Alarm Description	Alarm
Attention	Automatic_reset	1	Site attention indication has automatically reset	N/A
Rtu	Battery_test_failed	1	Battery test has failed	N/A
Rtu	Battery_test_inprogress	1	Battery test is in progress	N/A
Power_supply	Generator_online	1	Generator is Running	N/A
Power_supply	Main_incomer_CB_closed	1	Main Incomer CB is closed	N/A
Sewer_pump	Emergency_stop_fault	1-3	Pump Emergency stop active	Pump Avail
Sewer_pump	Fault	1-3	Pump Failed to start or stop	Pump Avail
Sewer_pump	Mains_power	1-3	Pump Mains power fault	Pump Avail
Sewer_pump	Moisture_in_oil_fault	1-3	Pump Moisture in oil fault	Pump Avail
Sewer_pump	Motor_power_high	1-3	Pump motor power high	N/A
Sewer_pump	Motor_power_low	1-3	Pump motor power low	N/A
Sewer_pump	Motor_current_high	1-3	Pump motor current high	N/A
Sewer_pump	Motor_current_low	1-3	Pump motor current low	N/A
Sewer_pump	Running	1-3	Pump Running	N/A
Variable_speed_drive	Auto	1-3	VFD starter not in keypad mode	Pump Avail
Variable_speed_drive	Count_exceeded	1-3	VFD starter faults exceeds maximum allowed	Pump Avail
Variable_speed_drive	Fault	1-3	VFD starter fault	Pump Avail

4.6 Alarm and Event Description

4.6.1 Attention

The following alarms and events are associated with the Attention Command

Plant	Quantity	Priority
Attention	Automatic_reset	0

Automatic Reset

The site attention control controls a indication lamp or strobe light at the RTU site. The control room operator is able to initiate and cancel the "attention indication" from the work stations. The on site technician will be required to contact the control room operator by radio or telephone when they see the alarm lamp/strobe.

Once activated, the attention alarm shall remain on for a period of 15 minutes. If it is not acknowledged it is then reset automatically. The attention indication can be acknowledged by the on site technician pushing the local 'attention acknowledge' pushbutton. An alarm flag is returned to the IDTS master station if the site attention was reset automatically.

4.6.2 Flow meter

The following alarms and events are associated with the delivery flow meter.

Plant	Quantity	Priority
Flow_meter	High	3
Flow_meter	Low	3
Flow_meter	Invalid	3

The delivery flow meter low alarm is only checked when station power and the invalid alarms are healthy. It will be active at all times but when a pump starts the alarms will be inhibited for a period determined by the flow meter alarm inhibit time (default 15 seconds). This ensures that any instability caused by the pump starting has dissipated.

Invalid

The signal is deemed invalid if it is

Less than (4mA – dead band) or greater than (20mA + dead band) for 2 seconds.

Once the invalid alarm has been activated it can only be reset when the signal is both greater than 4mA and less than 20mA for 30 seconds. The time delays ensure that a signal is truly invalid before an alarm is set and that it is stable before it is reset. The dead band is calculated using the site invalid hysteresis value multiplied by the range.

Low Alarm

If all the alarm conditions are satisfied then the flow low alarm is activated if the signal is less than the low limit set point. It is deactivated if any of the above conditions become false or the signal is greater that the low limit set point plus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

High Alarm

If all the alarm conditions are satisfied then the flow high alarm is activated if the signal is greater than the high limit set point. It is deactivated if any of the above conditions become false or the signal is less that the high limit set point minus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

4.6.3 Pressure Gauge

The following alarms and events are associated with the delivery pressure gauge.

Plant	Quantity	Priority
Pressure_gauge	High	3
Pressure_gauge	Low	3
Pressure_gauge	Invalid	3

The high and low alarms are only checked when station power and the invalid alarms are healthy and a pump has been running for the pressure alarm inhibit time (default 15 seconds). This ensures that any instability caused by the pump starting has dissipated.

Invalid

The signal is deemed invalid if it is

Less than (4mA – dead band) or greater than (20mA + dead band) for 2 seconds.

Once the invalid alarm has been activated it can only be reset when the signal is both greater than 4mA and less than 20mA for 20 seconds. The time delays ensure that a signal is truly invalid before an alarm is set and that it is stable before it is reset. The dead band is calculated using the site invalid hysteresis value multiplied by the range.

Low Alarm

If all the alarm conditions are satisfied then the pressure low alarm is activated if the signal is less than the low limit set point. It is deactivated if any of the above conditions become false or the signal is greater that the low limit set point plus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

High Alarm

If all the alarm conditions are satisfied then the pressure high alarm is activated if the signal is greater than the high limit set point. It is deactivated if any of the above conditions become false or the signal is less that the high limit set point minus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

4.6.4 Security

The following alarms and events are associated with the Security.

Plant	Quantity	Priority
Security	Door_limit_switch	2

Door Limit Switch

This alarm indicates that someone authorised or not, has opened a switchboard door. All the doors of the switchboard have a limit switch to indicate the status of that door. All of these limit switches are wired in series to give a combined signal which indicates whether all the doors are closed or at least one door is open. This signal is fed back directly to give a status indication of all the doors on the switchboard to the control room operator.

4.6.5 Switchboard Power Monitoring

The switchboard at a sewerage pumping station has multiple points of isolation and failure. There are various monitoring relays and circuit breaker status inputs to determine the power status for the entire switchboard.

The following alarms and events are power alarms associated with the switchboard (refer to Figure 8: Example of Switchboard Power Monitoring Diagram, to locate the point of failure for the switchboard).

Drawing ID	Plant	Quantity	Priority
1	Sewage_pumping_station	Energex_power	1
2	Power_supply	Main_incomer_CB_closed	0
1&2	Power_supply	Generator_online	0
3	Sewage_pumping_station	Mains_fail	1
4	Power_supply	Surge_diverter_fault	1
5	Rtu	Battery	1
6	Rtu	Mains_fail	1
7 & 8	Sewer_pump	Mains_fail	0

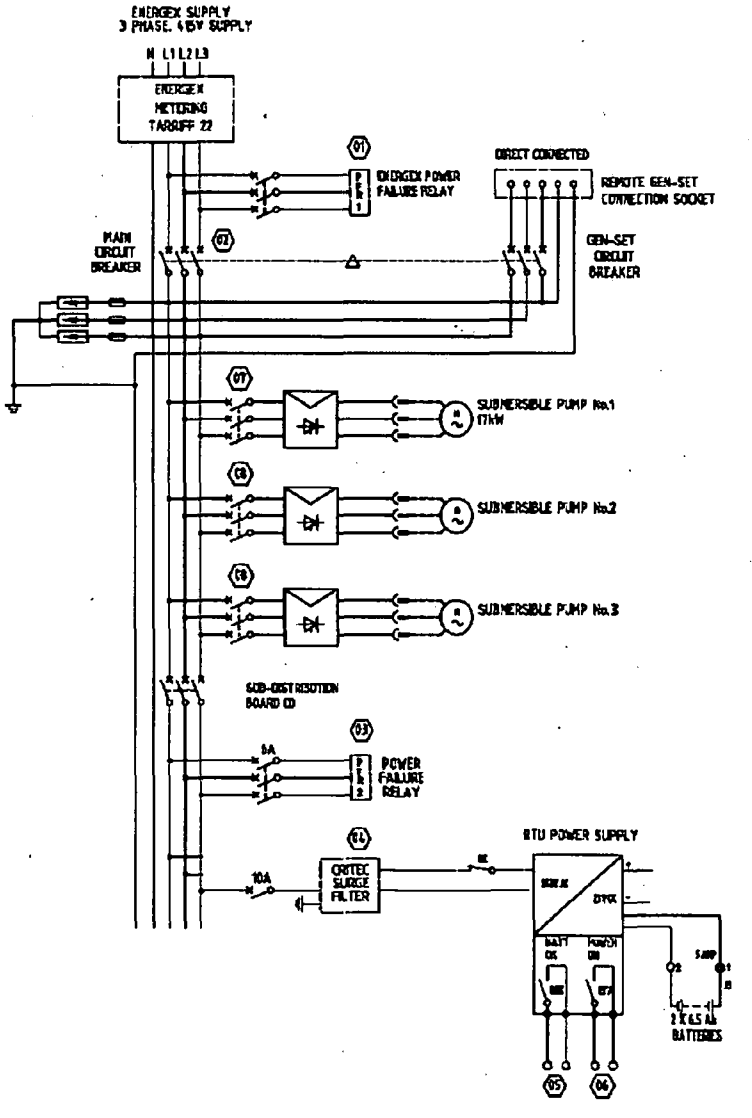

Figure 8: Example of Switchboard Power Monitoring Diagram

Energex Power

If the power monitoring relay on the Energex side of the main incomer is indicating a fault then after a 120 seconds delay, the Energex power signal will be set to the fault state. This signal is used to determine if the Energex power is healthy while the station is running on a generator. The 120 second delay is used to eliminate alarms due to brown outs and momentary losses of power.

Main Incomer Circuit Breaker Closed

This event is a direct feedback of the digital input indication the status of the main incomer circuit breaker.

Generator Online

The main incomer circuit breaker is interlocked with the generator circuit breaker, only one can be closed at any given time. If the main incomer circuit breaker is not closed and the station still has mains power then, the station must be powered by the generator. Therefore after a 5 second delay, the generator online status is activated.

Station Mains Fail

If the power monitoring relay on the station side of the main incomer is indicating a fault then after a 15 seconds delay, the Mains fail signal will activated. This signal is used to determine if station has power, from either the line side of the main incomer or from the generator. The 15 second delay is to eliminate alarms due to brown outs and momentary losses of power.

Surge Diverter Fault

The surge diverter has a healthy status fed back to the RTU. If this signal indicates a fault, and the site power is still active, then after a 2 second delay the surge diverter fault is activated.

RTU Mains Fail

If the circuit breaker feeding the 240VAC to 24VDC power supply is tripped, and the station mains power is healthy, then after a 15 seconds delay, the RTU mains fail alarm is activated.

Pump Mains power

If the pump control power is faulted and the station mains fail is healthy, then after a 2 second delay, the pump mains power is set to the fault condition.

Battery (Fault)

This alarm indicates whether the power supply has a healthy battery system connected and that the batteries are adequately charged. If the battery system signal is in the fault state (and the battery check is not in progress) then the RTU Battery signal becomes faulty after a 20 second delay.

4.6.6 Station Mode

The following alarms and events are associated with the Mode of the switchboard

Plant	Quantity	Priority
Sewage_pumping_station	Local_remote	1

Local Remote

When the station is turned into local mode it ceases to be autonomous and can no longer be controlled by the control room operator. The pumps can only be started and stopped locally by the on site technician.

The status of the local remote switch is sent back directly to the control room operator. This signal is a priority one alarm to immediately inform the control room operator that the station is no longer running under automatic control.

4.6.7 Sewer Pump

The following alarms and events are associated with the sewage pump.

Plant	Quantity	Priority
Sewer_pump	Available	1
Sewer_pump	Blocked	1
Sewer_pump	Emergency_stop_fault	0
Sewer_pump	Fault	0
Sewer_pump	Inhibit_Fbk	2
Sewer_pump	Mains_power	0
Sewer_pump	Moisture_in_oil_fault (optional)	0
Sewer_pump	Motor_power_high	3
Sewer_pump	Motor_power_low	3
Sewer_pump	Motor_current_high	3
Sewer_pump	Motor_current_low	3
Sewer_pump	Running	0
Variable_speed_drive	Auto	0
Variable_speed_drive	Automatic_reset	3
Variable_speed_drive	Count_exceeded	0
Variable_speed_drive	Fault	0
Variable_speed_drive	Speed_invalid	0

Available

The pump considered available only when all of the following conditions are not present:

- Site mains power fail - Switchboard does not have 415V mains power supplied
- Pump mains power fail - Pump does not have 240V control power supplied
- Pump fail - Pump has failed to start
- Pump VFD not in Auto - Pump is in Keypad control
- Pump VFD fault - Pump VFD motor protection has activated
- Pump VFD fault Count Exceeded - Three or more faults in the last 8 hours
- Pump emergency stop input faulted - Push button has been pressed
- Pump emergency stop fault latched - Emergency fault has not been reset

As the emergency stop fault is latched and has a 2 second delay, both the emergency stop input and the emergency stop fault are needed to ensure the pump becomes unavailable and stops immediately when the emergency stop button is pressed. It also ensures that although the emergency stop button may be unlatched, the emergency stop fault must be reset by the on site technician before the pump can start.

The availability alarm is suppressed by the station mains power fault condition and the station being in local mode. The pump must also be unavailable for 15 seconds before the alarm is sent to the IDTS master station. All the conditions which make the pump unavailable are event and can be easily identified by the control room operator by listing the abnormal points for the station.

Running

The pump running status input is directly fed back to the sewer pump running indication signal to the IDTS master station.

Emergency Stop Fault

If the emergency stop input becomes faulty and the station mains power is still healthy then, after a 2 second delay, the emergency stop fault is activated. Once activated, the emergency stop button must be unlatched and then the on site technician must press the local reset button.

Fault

The sewer pump fault flag is activated by the pump failing to start or failing to stop. If the pump is commanded to start or stop and the running indication does not match the running command, then after a site specific time period, the pump fault will become active. The time period is dependant on the ramp up and ramp down period of the VFD. (Default 30 seconds).

Moisture in Oil (Optional)

If the moisture in oil relay is in the fault condition and the station mains fail is healthy, then after a 2 second delay, the pump moisture in oil fault is activated. The moisture in oil relay is only installed on pump motors which are 22kW or greater in size.

Pump Blockage

Pump Blockage is designed to identify a possible blockage in an individual pump.

The pump blockage alarm is set if the pump is running individually in remote and for longer than a certain time period either:

1. The speed is too high for producing the minimum flow **or**
2. The flow is lower than the 'blocked flow rate limit' while the pump speed is greater that the 'blocked speed limit'.

The first condition will ensure that the pump does not speed up continuously to meet the minimum required flow rate. The second condition has site specific set points, which ensure that, while flow rate is above the minimum required, the speed to achieve this is not excessive. Two conditions are required so that the pump blockage can be determined in both low flow and peak flow conditions.

Once the pump blockage alarm is set for a pump is can be reset by the on site technician pressing the local reset button or the control room operator sending a remote reset (if the station is in remote mode).

It is not desirable to run a blocked pump as it may damage the pump. To ensure that a pump which has a potential blockage does not run unnecessarily, the pump blockage alarm effectively 'inhibits' the blocked pump from running. (refer to section 2.1.3 All Pumps Inhibited / Blocked Mode and Individual Pump Inhibit / Blocked). If all the pumps are either blocked or inhibited, then the inhibited pumps will be given preference to run.

Motor Current High and Low Alarms

The pump current high and low alarms are only checked when station power is healthy and the pump has been running for the pump alarm inhibit time (default 15 seconds). This ensures that any instability caused by the pump starting has dissipated.

If all the above conditions are satisfied then the high alarm is activated if the signal is greater than the high limit set point. It is deactivated if any of the above conditions become false or the signal is less that the high limit set point minus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range. A high alarm is indicative of a jammed pump or a pump motor fault.

If all the above conditions are satisfied then the low alarm is activated if the signal is less than the low limit set point. It is deactivated if any of the above conditions become false or the signal is greater that the low limit set point plus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range. A low alarm is indicative of an air locked pump or a blocked pump.

Motor Power High and Low Alarms

The pump power high and low alarms are only checked when station power is healthy and the pump has been running for the pump alarm inhibit time (default 15 seconds). This ensures that any instability caused by the pump starting has dissipated.

If all the above conditions are satisfied then the high alarm is activated if the signal is greater than the high limit set point. It is deactivated if any of the above conditions become false or the signal is less that the high limit set point minus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

If all the above conditions are satisfied then the low alarm is activated if the signal is less than the low limit set point. It is deactivated if any of the above conditions become false or the signal is greater that the low limit set point plus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

Variable Frequency Drive Auto

Direct feedback of the digital input status to indicate whether the VFD is on auto or keypad control.

Variable Frequency Drive Fault

If the variable frequency drive fault input becomes active and the station mains power is healthy and the emergency stop button has not been pressed, then after a 2 second delay, the variable frequency drive fault signal is activated. Once activated, the variable frequency drive fault input must clear before the fault signal can be reset.

The fault signal can be reset by the on site technician pressing the local reset button, the control room operator sending a remote reset (if the station is in remote mode) or by an automatic reset. All these three resets will activate the reset relay for 2 seconds, which sends a physical reset command to the variable frequency drive.

Variable Frequency Drive Fault Automatic Reset

Once the variable frequency drive fault input becomes healthy, to avoid the unnecessary unavailability of the sewer pump, the latched variable frequency drive fault signal will be reset automatically after the variable frequency drive fault reset delay time (default 20 minutes).

Variable Frequency Drive Fault Count Exceeded

The purpose of the fault count exceeded alarm is to prevent a reoccurring variable frequency drive fault being continuously reset automatically.

The fault count exceed signal is activated if 3 automatic resets have occurred in the last 8 hours. This signal can only be reset by the on site technician pressing the local reset button or by the control room operator sending a remote reset (if the station is in remote mode).

Variable Frequency Drive Speed Invalid

The signal is deemed invalid if it is

Less than (4mA – dead band) or greater than (20mA + dead band) for 2 seconds.

Once the invalid alarm has been activated it can only be reset when the signal is both greater than 4mA and less than 20mA for 20 seconds. The time delays ensure that a signal is truly invalid before an alarm is set and that it is stable before it is reset. The dead band is calculated using the site invalid hysteresis value multiplied by the range.

4.6.8 Wet Well

Plant	Quantity	Priority
Wet_well	Level_invalid	1
Wet_well	Low	3
Wet_well	High	1
Wet_well	Surcharge_imminent	1
Wet_well	Surcharge_occuring	1
Wet_well	Calibration_fault	3

As the Vega wet well probe takes a few seconds to initialise, all the wet well alarms except for invalid, are suppressed for 10 seconds upon RTU start up

Invalid

The signal is deemed invalid if it is

Less than (4mA – dead band) or greater than (20mA + dead band) for 1 second.

Once the invalid alarm has been activated it can only be reset when the signal is both greater than 4mA and less than 20mA for 20 seconds. The time delays ensure that a signal is truly invalid before an alarm is set and that it is stable before it is reset. The dead band is calculated using the site invalid hysteresis value multiplied by the range.

Low Alarm

A low alarm indicates that the wet well level may be lower than the intake for the pump. This puts the pump at risk of air locking. An air locked pump must be primed by an on site technician to make it available to run.

If the signal is valid and the start up delay has expired then the low alarm is activated if the signal is less than the low limit set point. It is deactivated if any of the above conditions become false or the signal is greater that the low limit set point plus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

High Alarm

A high alarm indicates that the wet well level is above the normal operating range of the pump station and that the inflow is higher than the current pumping capacity of the station. The control room operator must now initiate contingency plans to minimise the possibility of a surcharge.

If the signal is valid and the start up delay has expired then the high alarm is activated if the signal is greater than the high limit set point. It is deactivated if any of the above conditions become false or the signal is less that the high limit set point minus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

Surcharge Imminent Alarm

The surcharge imminent alarm is a final warning to the control room operator that the site is at immediate risk of surcharging. This serves as a reminder to the control room operator in implementing the contingency plans. It also provides a statistical count of all sites that came close to surcharging.

As this alarm is triggered by the surcharge imminent electrode, it also provides a redundancy to the wet well high alarm that the Vega probe should activate. The surcharge imminent alarm is the first alarm that the control room operator receives if the wet well level Vega probe is not functioning correctly.

The surcharge imminent alarm is primarily activated by the surcharge imminent electrode input. When this signal is active for 10 seconds then the surcharge imminent alarm is activated. To prevent repetitious alarms due to wave action the signal is kept active for 1 minute after the surcharge imminent electrode deactivates.

As a backup, a valid wet well level signal exceeding the surcharge imminent level by 100mm, for 10 seconds, will also trigger the surcharge imminent alarm while the station is in remote mode. This 100mm is ignored during power outages.

The surcharge imminent electrode is 24VDC and is backed up by the battery system. On all previous installations for HWT sites the surcharge imminent electrode has been powered by mains power and was not backed up by the battery.

Surcharge Occurring Alarm

This alarm is the final alarm that the control room operator will receive as the wet well level rises until it overflows. This alarm is used to calculate the duration of the surcharge event (surcharge duration).

When the wet well level is greater than or equal to the surcharge level minus 25 mm the surcharge occurring signal is activated. To prevent repetitious alarms due to wave action the signal is kept active for 1 minute after the wet well level falls below the surcharge occurring level.

Wet Well Calibration Fault

The wet well calibration fault is activated one of two ways. The first is if the surcharge imminent electrode is activated while the wet well level (reading on the Vega probe) is more than 100mm below the surcharge imminent level. The second is if the wet well level (reading on the Vega probe) reaches 100mm above the surcharge imminent level without the surcharge imminent electrode being activated.

Both of these methods are inhibited for 1 hour after the RTU intitialises. This prevents the alarm raised if on power up the wet well level is already above the surcharge imminent level. To reset the calibration fault signal the control room operator sends a calibration fault reset command from the IDTS master station.

4.6.9 RTU and PLC

The following alarms and events are associated with the RTU.

Plant	Quantity	Priority
Rtu / Plc	Abnormal_operation	1
Rtu	Heartbeat_failed	1
Plc	Comms_fault	1
Rtu	Battery_test_failed	3
Rtu	Battery_test_inprogress	0

Abnormal Operation

An abnormal operation alarm identifies when the RTU or PLC operating system program has restarted. This restart is determined by the presence of the 'first scan' flag. A first scan can occur when the RTU has reset itself due to a fault condition. Any abnormal operation should be investigated by a technical officer from the Networks Control Systems (NCS).

As downloading the code by a technical officer also causes a first scan, the technical officer can turn the station to local to suppress and/or reset this alarm. The alarm can also be reset by control room operator using the RTU abnormal operation reset command from the IDTS master station.

Heartbeat failed

A counter increments every 1 minute and is sent to the IDTS master station. The IDTS master stations then checks that this 'heartbeat' figure has incremented every time the site has polled. If it has not, then a heartbeat failed alarm is by the IDTS master station to alert the control room operator that the RTU has stopped operating.

PLC Comms Fault

The Modbus communication fault is determined by a watchdog counter which is passed back and fourth from the RTU and the PLC and incremented on each pass in the PLC. If the RTU does not register an increment in any given 30 second time period, then a communication fault alarm is activated.

Battery Test in Progress

The battery test is used to check the state of the battery system. When a battery test is initiated, the battery test output relay is driven to disconnect the RTU power supply from mains power for 10 minutes. During this test, and while the station and RTU mains power signals are healthy and the battery system signal is healthy, the battery test in progress signal is active.

Battery Test Failed

A battery test failed alarm indicates that the batteries have failed their test and need to be replaced. The battery test failed signal is activated if the battery test in progress is deactivated because the battery system signal is in the fault state. This alarm is latched until a new battery test is activated or a battery test failed reset signal is sent by the control room operator.

5 CALCULATIONS

The RTU performs calculations for both the controls of the station and for analytical analysis of the station's performance. The calculated values are stored in ordinary RTU memory and are lost when the RTU restarts. The calculated values are sent back periodically to the IDTS SCADA system and stored in the history database. Access to this information is via the operators control station or a casual use work station. All the control variables are also sent back to the IDTS SCADA system as feedback points to allow the control room operator to view the current control parameters.

5.1 Calculated Values

Plant	Quantity	Desig	Alarm Description
Flow_meter	Flow_rate	1	Delivery flow rate in l/s
Flow_meter	Volume	1	Daily volume in kL
Flow_meter	Volume_yesterday	1	Daily volume for past 24 hrs in kL
Pressure_gauge	Pressure_mahd	1	Delivery Pressure in mAHD
Pressure_gauge	Pressure_kpa	1	Delivery Pressure in kpa
Rtu	Battery_discharge_time	1	Time taken for Battery to discharge during test
Rtu	Site_id	1	Network Address of RTU
Sewer_pump	Hours_run	1-3	Hours run for pump running by itself since midnight
Sewer_pump	Hours_run_yesterday	1-3	Hours run for pump by itself yesterday
Sewer_pump	Hours_run_12	1	Run hours of pumps 1&2 operating since midnight
Sewer_pump	Hours_run_12_yesterday	1	Run hours of pumps 1&2 operating yesterday
Sewer_pump	Hours_run_13	1	Run hours of pumps 1&3 operating since midnight
Sewer_pump	Hours_run_13_yesterday	1	Run hours of pumps 1&3 operating yesterday
Sewer_pump	Hours_run_23	1	Run hours of pumps 2&3 operating since midnight
Sewer_pump	Hours_run_23_yesterday	1	Run hours of pumps 2&3 operating yesterday
Sewer_pump	Motor_current	1-3	Motor current
Sewer_pump	Motor_power	1-3	Motor power
Sewer_pump	Number_of_starts	1-3	Number of starts for pump since midnight
Sewer_pump	Number_of_starts_yesterday	1-3	Number of starts for pump yesterday
Sewer_pump	Total_kWHrs	1-3	Total kWHrs for pump since midnight
Sewer_pump	Total_kWHrs_yesterday	1-3	Total kWHrs for pump yesterday
Sewer_pump	Total_outflow	1-3	Total outflow for pump since midnight
Sewer_pump	Total_outflow_yesterday	1-3	Total outflow for pump yesterday
Variable_speed_drive	Speed_Fbk	1-3	Variable frequency drive operating speed
Wet_well	Inflow	1	Average inflow to the station
Wet_well	Level	1	Level of the wet well in mAHD
Wet_well	Surcharge_duration	1	Duration of last surcharge event
Wet_well	Surcharge_time_remaining	1	Estimated time until surcharge if pumps do not run
Wet_well	Total_inflow	1	Total inflow to the station since midnight
Wet_well	Total_inflow_yesterday	1	Total inflow to the station yesterday
Wet_well	Volume	1	Current Volume in the wet well

5.2 Feedback Values

Plant	Quantity	Desig	Alarm Description
Flow_meter	High_limit_Fbk	1	Delivery flow High alarm set point
Flow_meter	Low_limit_Fbk	1	Delivery flow Low alarm set point
Pressure_gauge	Elevation_Rtu	1	Static elevation of the pressure gauge in mAHD
Pressure_gauge	High_limit_Fbk	1	High alarm set point
Pressure_gauge	Low_limit_Fbk	1	Low alarm set point
Pressure_gauge	Pressure_range_Fbk	1	Range of the pressure gauge in meters
Sewer_pump	Motor_current_high_limit_Fbk	1-3	High alarm set point
Sewer_pump	Motor_current_low_limit_Fbk	1-3	Low alarm set point
Sewer_pump	Motor_power_high_limit_Fbk	1-3	High alarm set point
Sewer_pump	Motor_power_low_limit_Fbk	1-3	Low alarm set point
Sewerage_pumping_station	Blockage_flw_SP_knee_Fbk	1	Blockage flow setpoint at the 'knee' of the curve
Sewerage_pumping_station	Blockage_spd_SP_knee_Fbk	1	Blockage speed setpoint at the 'knee' of the curve
Sewerage_pumping_station	Blockage_spd_SP_min_Fbk	1	Blockage speed setpoint for the minimum flow
Wet_well	Duty_A_start_setpoint_Fbk	1	Start duty pump set point
Wet_well	Duty_A_stop_setpoint_Fbk	1	Stop duty pump set point
Wet_well	Duty_B_start_setpoint_Fbk	1	Start standby pump set point
Wet_well	Duty_B_stop_setpoint_Fbk	1	Stop standby pump set point
Wet_well	High_limit_Fbk	1	High alarm set point
Wet_well	Level_range_Fbk	1	Range of Vega Instrument measuring wet well level
Wet_well	Low_limit_Fbk	1	Low alarm set point
Wet_well	Zero_MAHD_Fbk	1	Bottom of wet well Vega Probe in mAHD

5.3 Analog Signal Processing

5.3.1 Analog Clamping

Before it is used to calculate the engineering value of the signal the raw analog input signal is clamped to the 4-20mA limits if the value is above or below these values plus and minus the flux value respectively. Flux value is the range of the signal multiplied by the site percent variable which represents the acceptable error percent.

5.3.2 Analog Filtering

The engineering values are filtered using a five element FIFO (first in, first out) stack sampled every 1 second to produce a rolling average.

5.3.3 Analog Conversion to Engineering Unit

The analog input card converts the 4-20mA signals received to a raw count of 800 to 4000 for the RTU and 6400 to 32000 in the GE Fanuc PLC. This raw count is converted in the code to engineering units using the following formula. This is to be done in the code using the site specific values (conversion tables are not to be used).

Engineering Unit (RTU) = (Raw signal – 800)/3200 x Engineering Range.
Engineering Unit (PLC) = (Raw signal – 6400)/32000 x Engineering Range.

The following are the signals received by the RTU.

Signal	Engineering Units
Flow Meter	Litres per second
Delivery Pressure	meters
Wet Well Level	meters
Flow Meter	Litres per second
Motor Power	kW
Motor Current	Amps
VFD Speed	Hz

5.4 Delivery Flow Rate kl/day

The flow is measured in litres per second. For every sewerage flow meter a flow rate conversion is performed to get the equivalent flow rate in kilolitres per day (kl/day) and sent back to the IDTS SCADA system.

Flow (kl/day) = Flow (l/s) * K
k = 86.4 (converts l/s to kl/day)

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Flow_meter	Flow_kl	Flow rate in l/s converted to kl/day value

5.5 Delivery Flow - Volume Pumped (kl)

The total volume pumped for the station is calculated using the flow rate (l/s) integrated over time, while the any pump is running. A snapshot of this figure is recorded at midnight to give the previous days volume pumped and this integral is reset.

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Flow_meter	Volume	Total volume pumped since midnight
Flow_meter	Volume_yesterday	Total volume pumped yesterday

5.6 Delivery Pressure mAHD

The pressure probe measures the pressure in kPa. So that the control room operators can compare different sewerage sites successfully, the Pressure in mAHD is calculated and sent back to the IDTS SCADA system.

Pressure (mAHD) = Pressure (kPa) / k + Pres Elev (mAHD)
k = 9.803 (Pressure constant to convert from kPa to metres)
Pres Elev (mAHD) = Site specific pressure elevation of pressure gauge

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Pressure_gauge	Pressure_kpa	Delivery pressure (if gauge operating) of pumps - kpa units
Pressure_gauge	Pressure_mahd	Delivery pressure (if gauge operating) of pumps - MAHD units

5.7 Pump Hrs Run / day

The hours a pump runs individually are accumulated. The hours when both pumps run together are also accumulated. These integrals are reset at midnight

NOTE: To calculate the total hours run for a pump for one day the individual pump run hours are added to the both pumps running together run hours.

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Sewer_pump	Hours_run	Pump only run hours since midnight
Sewer_pump	Hours_run_yesterday	Pump only run hours yesterday
Sewer_pump	Hours_run_12	Run hours of pumps 1&2 operating simultaneously since midnight
Sewer_pump	Hours_run_12_yesterday	Run hours of pumps 1&2 operating simultaneously yesterday
Sewer_pump	Hours_run_13	Run hours of pumps 1&3 operating simultaneously since midnight
Sewer_pump	Hours_run_13_yesterday	Run hours of pumps 1&3 operating simultaneously yesterday
Sewer_pump	Hours_run_23	Run hours of pumps 2&3 operating simultaneously since midnight
Sewer_pump	Hours_run_23_yesterday	Run hours of pumps 2&3 operating simultaneously yesterday

5.8 Pump Starts / day

The number for starts per day counter is incremented every time a pump starts. This counter is reset at midnight.

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Sewer_pump	Number_of_starts	Starts of Pump since midnight
Sewer_pump	Number_of_starts_yesterday	Starts of Pump yesterday

5.9 Pump kl / day

The volume that an individual pump delivers is calculated by integrating the flow rate over time while that pump is running by itself. This integral is reset at midnight

NOTE: outflow, while a pump is running in tandem with the other pump, is ignored.

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Sewer_pump	Total_outflow	Volume pumped by Pump running by itself
Sewer_pump	Total_outflow_yesterday	Volume pumped yesterday by Pump running by itself

5.10 Pump kW hrs / day

The kilowatt-hours that an individual pump consumes are calculated by integrating the power over time while that pump is running by itself. This integral is reset at midnight

NOTE: kilowatts while a pump is running in tandem with the other pump are ignored.

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Sewer_pump	Total_KWHrs	Pump power consumption
Sewer_pump	Total_KWHrs_yesterday	Pump power consumption yesterday

5.11 Wet Well Level mAHD

The on site indication on the switchboard is in level % of full range. This value is also sent back to the control room so that the on site technician and control room operator can compare values in the same units. The Control room operator also requires the wet well level in mAHD to be able to do a meaningful comparison between different sites. The following formulas are used to calculate these values.

WWL (mAHD) = WWL (meters) + WWL Zero Level (mAHD)

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Wet_well	Level	Level of wet well

5.12 Wet Well Volume

The wet well volume is calculated using a 'wet well levels vs volume' look up table stored in the RTU database (.main file). The look up table has a maximum 32 point specification of the non-linear relationship of the wells 'Level vs Volume'. Volume in wet well is an interpolation of the well vs volume lookup table values. The site specific data is obtained from a table in an Excel spreadsheet (Table 9: Level vs Volume Lookup Table) which also provides a graphical representation of all the sample points (Figure 9: Level vs Volume Chart).

Table 9: Level vs Volume Lookup Table (SAMPLE)

	Excel Data		RTU Data
	Wet Well LevelAHD]	Remaining Storage Capacity [m^3]	Current Storage Volume [m^3]
BWL of PS	1.780	9.219	0.000
	1.866	9.020	0.199
	1.941	8.821	0.398
	2.017	8.622	0.597
	2.093	8.423	0.796
	2.168	8.224	0.995
	2.244	8.025	1.194
	2.319	7.826	1.392
TWL of PS	2.390	7.641	1.578
	2.471	7.429	1.790
	2.546	7.207	2.012
	2.622	6.832	2.387
	2.698	6.139	3.080
High Alarm Level	2.790	4.968	4.251
	2.849	4.130	5.089
	2.924	3.005	6.213
	3.000	2.139	7.079
	3.076	1.417	7.802
	3.151	0.709	8.510
Surcharge Level	3.227	0.000	9.219

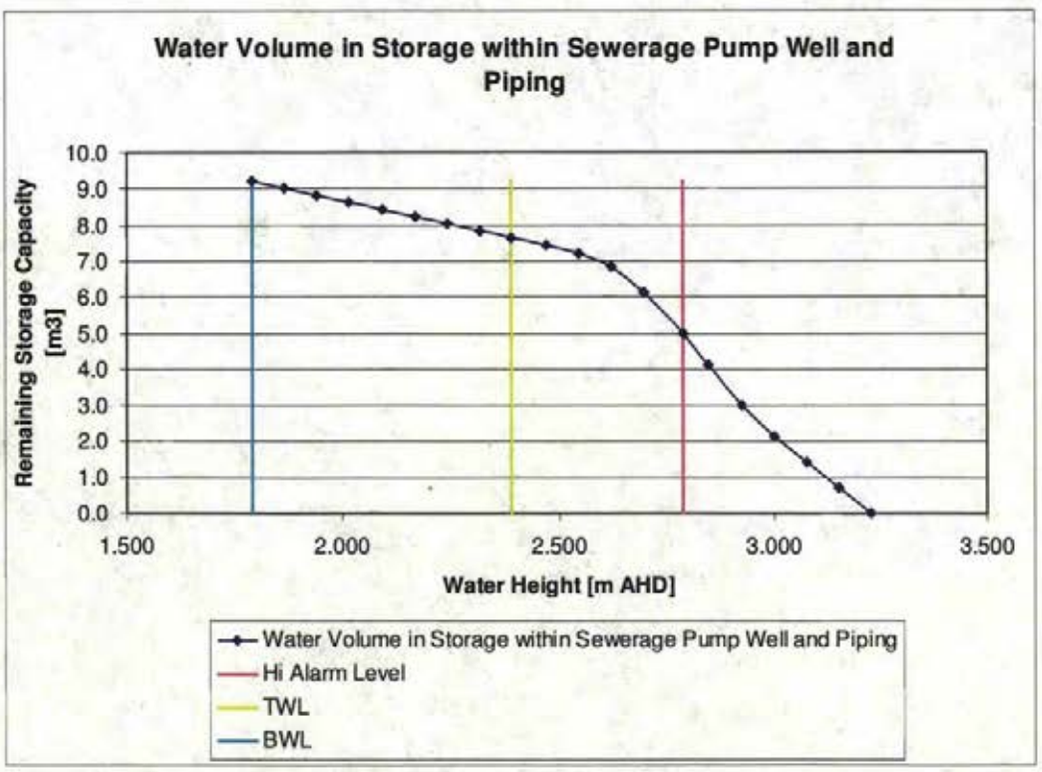

Figure 9: Level vs Volume Chart (SAMPLE)

The non-linearity of the curve level vs volume curve is caused by non cylindrical shape of the wet well, the displacement of volume caused by object inside the well (pumps and pipe work) and the additional capacity provided by the inlet pipes that feed the wet well. Refer to *Figure 10: Wet well diagram*

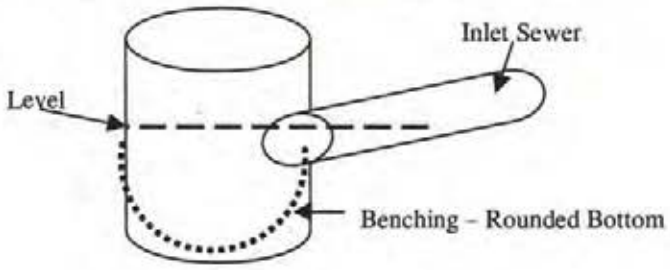

Figure 10: Wet well diagram

The data in the RTU database is stored in an array of 32 'segments'. Each segment has the volume of that segment and the height of that segment. (Not a cumulative height and volume as per the table shown). The site specific RTU database includes the 'SPxxx.main' file is stored on the IDTS server and can download directly to the RTU from the server. (Refer to *Appendix B: Spxxx.main File* for an example of a site *.main file).

The wet well vs volume table is derived from the 'As Constructed' civil drawings of the station and are provided by the System Planning section of Brisbane Water.

In *Figure 9: Level vs Volume Chart*, the 'Top Water Level' (TWL) is the Duty A Start, and the 'Bottom Water Level' (BWL) is Duty A Stop.

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Wet_well	Volume	Volume of sewerage in wet well calculated from using the level in the lookup table

5.13 Station Surcharge Duration

While the surcharge occurring alarm is active, a timer is accumulated to measure the duration of the surcharge event. This figure is stored until a new surcharge occurring alarm is triggered, at which time the timer is reset to zero.

IDTS Database Record Name		
Plant	Quantity	**Description**
Wet_well	Surcharge_duration	Time duration of surcharge

5.14 Station Time to Surcharge (UNDER DEVELOPMENT)

When both pumps are stopped, the Station Inflow is used to calculate the time it would take the fill the remaining storage capacity (wet well capacity - current Wet Well Volume). The time (in minutes) to surcharge is only displayed on the station MITS GUI picture after the wet well high alarm is raised.

IDTS Database Record Name		
Plant	**Quantity**	**Description**
Wet_well	Surcharge_time_remaining	Estimated time in minutes until surcharge when both pumps are NOT running

5.15 Station Inflow (UNDER DEVELOPMENT)

The simplified formula for calculating the inflow over a period of time is

Inflow (l/s)	=	Volume Difference (litres) / Δt (s) + Outflow (l/s)
Volume Difference (l)	=	difference in volume over the sample period
Δt (s)	=	sample period
Outflow (l/s)	=	Integral of the flow meter for the sampling period

5.15.1 Method A – Time between Start and Stop

To ensure a change in volume large enough to make the inherent errors in the volume calculations negligible, method A takes the time to fill the well between the pump stop and start levels as the sampling time and the difference as the change in volume between the duty A stop and duty A start levels. This produced an average inflow over the sample period.

5.15.2 Method B – Array method

To remove the errors inherent in calculating small changes of wet well level, method B applies a 17 element FIFO (first in, first out) stack sampled every 15 second to produce a rolling average filter of the well level. The filter is reset (cleared) when a pump stops.

To calculate the instantaneous inflow, the volume calculated using the filtered wet well level is recorded every 2 minutes (every 8 samples of the wet well level). The volume difference is the change in volume over a sample period of 2 minutes.

To further stabilise the calculated instantaneous inflow calculation, the calculated inflow value itself is passed through a 7 element moving average filter. This filter is not reset between pump running transitions.

5.15.3 Combining Method A and Method B results

Due to the moving average filter and sample intervals used by method B, the first raw inflow value can not be calculated until 6 ¼ minutes after the pumps stopped. If the pumps are stopped long enough for method B to calculate a new inflow value then this new value if loaded into the inflow filter. The average of the last 7 values calculated is the new calculated average inflow figure.

Method A is used to calculate the inflow during high inflows (Off time is less than 6 ¼ minutes). When the flow is high enough that the off time is less than 6 ¼ minutes then the value calculated is 'flooded' into all elements of the inflow filter to make the average inflow value equal to newly calculated inflow value derived by method A.

5.15.4 Total Inflow

The total inflow for each day is the integration of the calculated average inflow value using 15 second sample rate.

Total Inflow (kl) = Total Inflow (kl) + [Inflow (l/s) x 15 (s)/1000]

IDTS Database Record Name		
Plant	Quantity	Description
Wet_well	Inflow	Instantaneous inflow to the wet well when pumps are NOT running
Wet_well	Total_inflow	Total inflow to the wet well since midnight when pumps are NOT running

6 IDTS SCADA CONFIGURATION

Every site on the IDTS SCADA system has to be configured individually. To make each site the following data must be released into the online database.

- Points Database
- Significant/Trigger Points
- History Database
- Site RTU database
- Alarm Instructions
- Site Picture

6.1 IDTS Points Database

The points database consists of all the points configured for communication with site RTU. They fall under one of three categories .

- Digital Alarms and Events (Boolean)
- Control Points (Boolean, Real and Integer)
- Analog Status (Integer and Real)

These points are detailed on the 'IDTS spreadsheet' which is created for each site. This spreadsheet details each point's corresponding address in the RTU, sets up any alarm priority and all other point attributes. The site 'IDTS spreadsheet' is used by the IDTS system administrator to populate the online database with the site points required.

6.2 IDTS Significant Points

All points which are classified as priority 1 alarms are configured as 'significant' points. This is done on the online IDTS database and is then downloaded to the RTU. Any alarm configured to be significant will cause the RTU to immediately transmit to the IDTS master station.

6.3 IDTS History Database

All digital and analog points, for which trend data is to be stored, must be populated in the history database and have their parameter (such as sample granularity) configured. Only points configured in the history database can be trended on the IDTS SCADA system. The history database is configured by the IDTS system administrator.

6.4 IDTS Site RTU database

Each MD3311 or MD1000 RTU commissioned in the field has a RTU database generated from in the IDTS master station. This database stores all I/O (physical and pseudo) and also stores the wet well level vs volume data. This database can be used to re-configure the RTU CPU in case of failure. The RTU database is created using by the IDTS master station using the IO configuration, history configuration, significant points configuration as well as the *.main file in the IDTS server. (Refer to *Appendix B: Spxxx.main File* for an example of a site *.main file).

6.5 IDTS Alarm Instructions

The IDTS administrator installs the alarm instruction list onto the IDTS master station. Each file is linked to its associated alarm and provided the control room operator the actions required if that alarm is triggered. Below is an example of an alarm instruction file for the "Sewerage_pumping_station – Mains_fail alarm".

```
Contact Energex

If Energex are aware of the problem.
Request an estimate of when power will be restored.

If Energex are unaware of any problem.
An urgent inspection is required.

     Obtain estimate from contingency data as to likelihood of times station will
     overflow.

Normal hours:

Notify Field Services to attend.
Notify Field Services Duty Officer.
Inhibit flow from pumping stations upstream of station outage if possible.

Monitor & check regularly with Energex.

After hours:
Notify Field Services Duty Officer.
Inhibit flow from pumping stations upstream of station outage if possible.


If Energex are unaware of any problem.
An urgent inspection is required.
```

The alarm instructions are generic for each alarm plant and quantity. The IDTS administrator can generate a site specific instruction file if the site needs a unique instruction. It is preferable, however, to expand on the generic alarm instruction where possible as this reduces the amount of deviation from the standard. (Easier to maintain the current set of alarm instruction list)

6.6 IDTS Pictures

6.6.1 Main Site Detail Screen

Each 3 pump submersible pump station has as a detail screen as shown below:

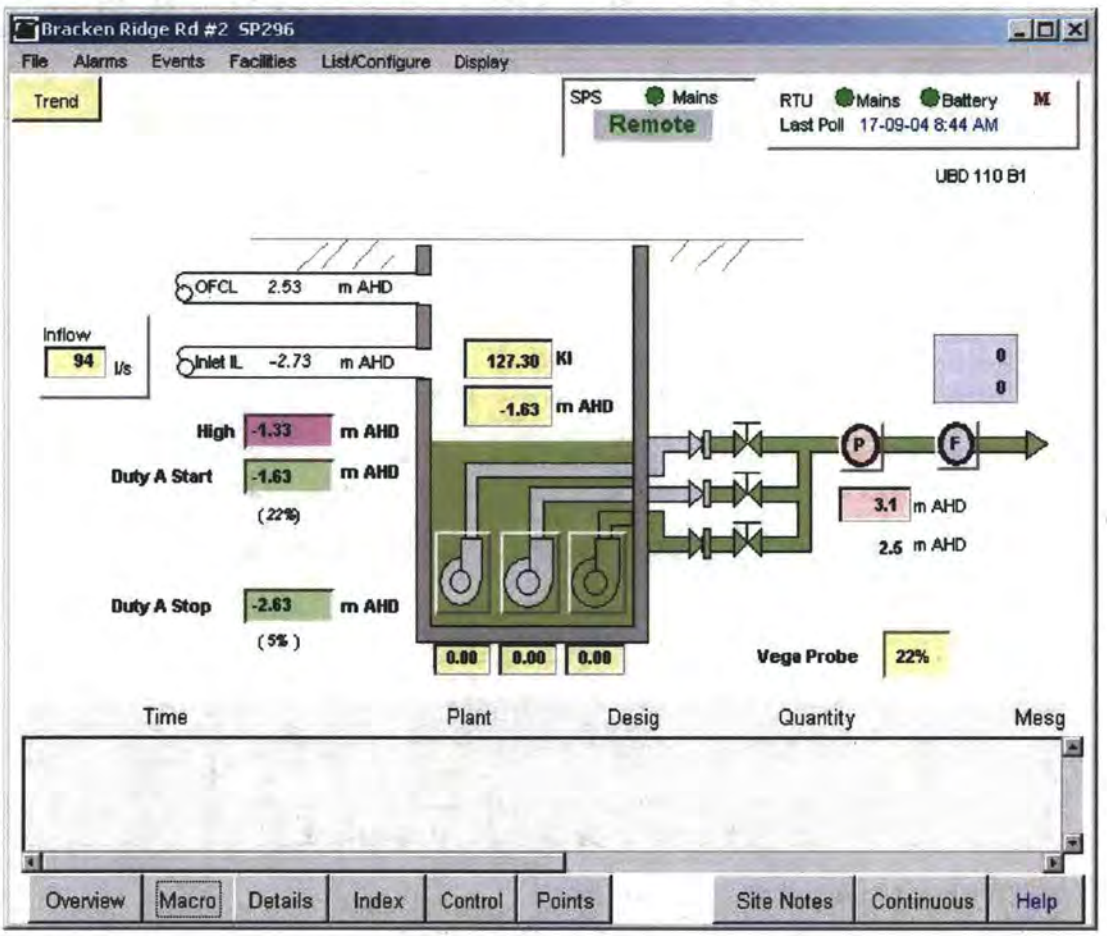

Figure 11: Site Detail Screen

Live points from RTU fed back to picture:

- Wet well level in metres AHD and % full.
- Pump duty A start level (in metres AHD and percentage), pump duty A stop level, and wet well high level
- Status of each pump (available, running, inhibited status shown by colour)
- Speed of each pump
- Delivery pressure in metres AHD
- Delivery flow in l/s (and volume for the day)
- Site power status
- Local/ remote control status
- Station inflow (when pumps are not running)
- Wet well volume
- Time (in minutes) to surcharge (when pumps are unavailable and wet well high alarm is active)

IDTS database points in the picture are stored in the IDTS database and not in the RTU. These values are displayed in the main station picture:

- The Inlet level (metres AHD)
- Overflow Control Level (metres AHD)
- Site Level (metres AHD)

6.6.2 Popup Controls Screens

Pump Control Popup

Each pump can be controlled by the following popup. Clicking on the pump icon on the main operator screen activates the individual pump control screens.

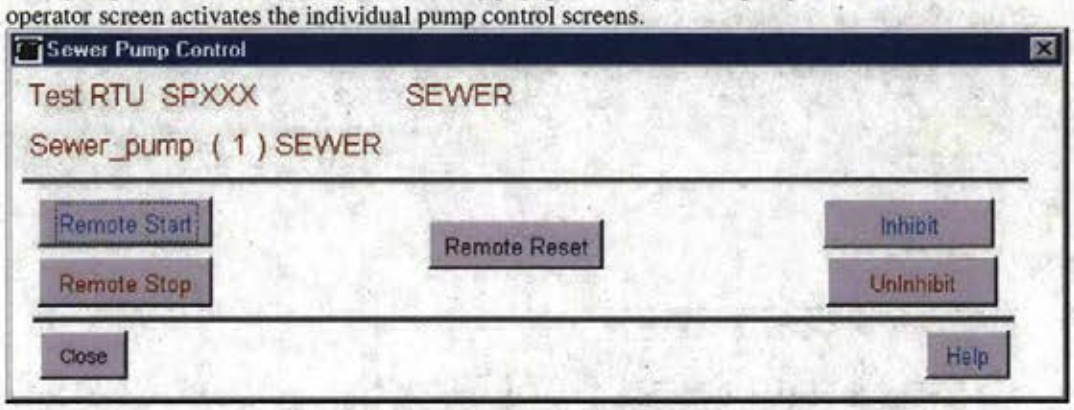

Figure 12: Pump Control Popup

Attention Alarm button

The Site Attention Control Popup is activated by pressing the "Attention" button of the main control page (bottom LHS of screen).

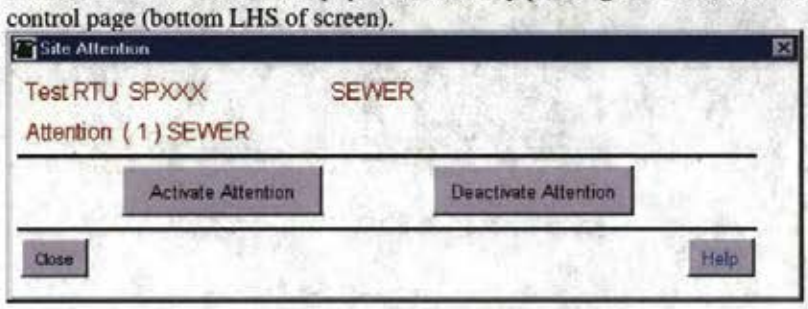

Figure 13: Set Point Control Popup

Set point adjustment - alarm limits

Clicking on a set point will give you the set point control popup.

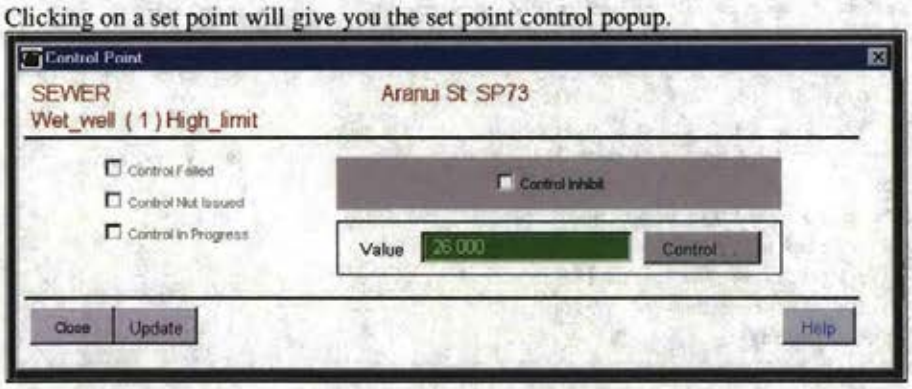

Figure 14: Control Point Page

Appendix A: STANDARD PHYSICAL I/O LIST

The Physical IO Spreadsheet will be created for each site, identifying not only the standard IO, but the Drawing Numbers which are unique to each site. This Physical IO Spreadsheet becomes part of the On-site documentation, providing a quick reference guide of the Physical IO to the on site technician.

SP103 Heroes Ave Sewage Pumping S

MITS MD3311 EA (Extended I-O) DIGITAL INPUTS (0-15)

I/O #	Description	MITS Tag	Off State	On State	Term. #	Wire #	Drawing #
0	Spare	-	-	-		DI00	
1	Spare	-	-	-		DI01	
2	Spare	-	-	-		DI02	
3	Spare	-	-	-		DI03	
4	Spare	-	-	-		DI04	
5	Spare	-	-	-		DI05	
6	Spare	-	-	-		DI06	
7	Spare	-	-	-		DI07	
8	Spare	-	-	-		DI08	
9	Spare	-	-	-		DI09	
10	Spare	-	-	-		DI10	
11	Spare	-	-	-		DI11	
12	Site attention alarm reset pushbutton	atn1acknowledge	Not Pressed	Pressed		DI12	
13	Spare	-	-	-		DI13	
14	Spare	-	-	-		DI14	
15	Site Power	stn1sitePower	Fault	Healthy		DI15	

SP103 Heroes Ave Sewage Pumping S

MITS MD3311 EA (Extended I-O) DIGITAL INPUTS (16-31)

I/O #	Description	MITS Tag	Off State	On State	Term..#	Wire #	Drawing #
16	Spare	-	-	-		DI16	
17	Spare	-	-	-		DI17	
18	Spare	-	-	-		DI18	
19	Spare	-	-	-		DI19	
20	Spare	-	-	-		DI20	
21	Spare	-	-	-		DI21	
22	Spare	-	-	-		DI22	
23	Spare	-	-	-		DI23	
24	Spare	-	-	-		DI24	
25	Spare	-	-	-		DI25	
26	Spare	-	-	-		DI26	
27	Spare	-	-	-		DI27	
28	RTU Power	RTUpower	Off	On		DI28	
29	Surge Diverter Alarm	Stn1SurgeDivAlm	Healthy	Fault		DI29	
30	Spare	-	-	-		DI30	
31	Spare	-	-	-		DI31	

SP103 Heroes Ave Sewage Pumping S

MITS MD3311 EA (Extended I-O) DIGITAL INPUTS (32-47)

I/O #	Description	MITS Tag	Off State	On State	Term. #	Wire #	Drawing #
32	Generator Fault	gen1tripped	Ok	Tripped		DI32	
33	Generator Warning	gen1warning	Ok	Alarm		DI33	
34	Generator Low Fuel	gen1lowFuel	Ok	Low		DI34	
35	Generator Running	gen1running	Stopped	Running		DI35	
36	Generator Connected	gen1connected	Energex	Generator		DI36	
37	Energex Power	energexPower	Available	Not Available		DI37	
38	Generator Security	gen1security	Unsecured	Secured		DI38	
39	Generator CB Status	gen1locCBTripped	Closed	Tripped		DI39	
40	Generator Mode	gen1auto	Auto	Not Auto		DI40	
41	Generator On Site	gen1onSite	False	True		DI41	
42	Spare	-	-	-		DI42	
43	Security Alarm	???	Alarm	Healthy		DI43	
44	Main Incomer CB Closed	???	Open	Closed		DI44	
45	Battery System OK	???	Fault	Healthy		DI45	
46	Cathodic Protection Alarm Reset	???	Not Pressed	Pressed		DI46	
47	Cathodic Protection Power	???	Off	On		DI47	

MITS MD3311 EA (Extended I-O) DIGITAL OUTPUTS (0-15)

I/O #	Description	MITS Tag	Off State	On State	Term. #	Wire #	Drawing #
0	Spare	-	-	-		DO00	
1	Spare	-	-	-		DO01	
2	Spare	-	-	-		DO02	
3	Spare	-	-	-		DO03	
4	Spare	-	-	-		DO04	
5	Spare	-	-	-		DO05	
6	Spare	-	-	-		DO06	
7	Spare	-	-	-		DO07	
8	Generator Remote Start	genlstart	Off	On		DO08	
9	Generator Remote Stop	genlstop	Off	On		DO09	
10	Spare	-	-	-		DO10	
11	Wet Well Washer Solenoid	WwllWasher	Off	On		DO11	
12	Attention alarm Indicator	atnlindicator	Off	Alarm		DO12	
13	Battery Check	BattCycRelay	Off	On		DO13	
14	Cathodic Protection Alarm Indicator	cplAlarm	Off	Alarm		DO14	
15	Cathodic Protection De-energise Rectifier Unit	cplDeEnergise	Energise	De-Energise		DO15	

Brisbane Water

MITS MD3311 EA (Extended I-O) ANALOG INPUTS (0-7)

SP103 Heroes Ave Sewage Pumping S

I/O #	Description	MITS Tag	4mA	20mA	Term. #	Wire #	Drawing #
0	Cathodic Protection Rectifier Current	cp1RectCurrent	Site Specific	Site Specific		AI00 +/-	
1	Wet Well Level	wwllevel	0.000 m	??.000 m		AI01 +/-	
2		-	-	-		AI02 +/-	
3		-	-	-		AI03 +/-	
4		-	-	-		AI04 +/-	
5		-	-	-		AI05 +/-	
6		-	-	-		AI06 +/-	
7		-	-	-		AI07 +/-	

SP103 Heroes Ave Sewage Pumping Station

GE FANUC

RACK: 0
Slot: 3
Card Type: IC693MDL645
Description: 16 Point Digital Input 24VDC

GE-Fanuc 90-30 PACK 0

I/O #	Term. #	Description	GE Tag	Address	Off State	On State	Term. #	Wire #	Drawing #
1	2	Station Local remote switch.	Stn01diRemote	%I0001	Local	Remote		DI1-01	
2	3	Station Surcharge Imminent level	Stn01diSurchImm	%I0002	Healthy	Surcharge Imm		DI1-02	
3	4	Spare	%I0003	%I0003	-	-		DI1-03	
4	5	Spare	%I0004	%I0004	-	-		DI1-04	
5	6	Spare	%I0005	%I0005	-	-		DI1-05	
6	7	Spare	%I0006	%I0006	-	-		DI1-06	
7	8	Spare	%I0007	%I0007	-	-		DI1-07	
8	9	Spare	%I0008	%I0008	-	-		DI1-08	
9	10	Spare	%I0009	%I0009	-	-		DI1-09	
10	11	Spare	%I0010	%I0010	-	-		DI1-10	
11	12	Spare	%I0011	%I0011	-	-		DI1-11	
12	13	Spare	%I0012	%I0012	-	-		DI1-12	
13	14	Spare	%I0013	%I0013	-	-		DI1-13	
14	15	Spare	%I0014	%I0014	-	-		DI1-14	
15	16	Spare	%I0015	%I0015	-	-		DI1-15	
16	17	Spare	%I0016	%I0016	-	-		DI1-16	

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SP103 Heroes Ave Sewage Pumping Station

GE FANUC

RACK: 0
Slot: 4
Card Type: IC693MDL645
Description: 16 Point Digital Input 24VDC

GE-Fanuc 90-30 PACK 0

I/O #	Term. #	Description	GE Tag	Address	Off State	On State	Term. #	Wire #	Drawing #
1	2	Pump 1 Pump power on	Pmp01diPower	%I0017	Off	On		DI2-01	
2	3	Pump 1 Reflux Valve Open	Pmp01diRefluxOpen	%I0018	Not Open	Open		DI2-02	
3	4	Pump 1 Local start pushbutton	Pmp01diLocalStartPB	%I0019	Not Pressed	Pressed		DI2-03	
4	5	Pump 1 Local stop pushbutton	Pmp01diLocalStopPB	%I0020	Not Pressed	Pressed		DI2-04	
5	6	Pump 1 Emergency Stop	Pmp01diEStop	%I0021	Fault	Healthy		DI2-05	
6	7	Pump 1 VFD Auto	Pmp01diVFDAuto	%I0022	Manual	Auto		DI2-06	
7	8	Pump 1 VFD Ready	Pmp01diVFDReady	%I0023	Fault	Ready		DI2-07	
8	9	Pump 1 local reset pushbutton	Pmp01diLocalReset	%I0024	Not Pressed	Pressed		DI2-08	
9	10	Pump 1 Running	Pmp01diRunning	%I0025	Not Running	Running		DI2-09	
10	11	Pump 1 Moisture in Oil	Pmp01diMIO	%I0026	Healthy	Fault		DI2-10	
11	12	Pump 1 Thermistor Fault	Pmp01diTermistor	%I0027	???	???		DI2-11	
12	13	Pump 1 Bearing Temperature	Pmp01diBearingTemp	%I0028	???	???		DI2-12	
13	14	Spare	%I0029	%I0029	-	-		DI2-13	
14	15	Spare	%I0030	%I0030	-	-		DI2-14	
15	16	Spare	%I0031	%I0031	-	-		DI2-15	
16	17	Spare	%I0032	%I0032	-	-		DI2-16	

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SP103 Heroes Ave Sewage Pumping Station

GE FANUC

RACK: 0
Slot: 5
Card Type: IC693MDL645
Description: 16 Point Digital Input 24VDC

GE-Fanuc 90-30 PACK 0

I/O #	Term. #	Description	GE Tag	Address	Off State	On State	Term. #	Wire #	Drawing #
1	2	Pump 2 Pump power on	Pmp02diPower	%I0033	Off	On		DI3-01	
2	3	Pump 2 Reflux Valve Open	Pmp02diRefluxOpen	%I0034	Not Open	Open		DI3-02	
3	4	Pump 2 Local start pushbutton	Pmp02diLocalStartPB	%I0035	Not Pressed	Pressed		DI3-03	
4	5	Pump 2 Local stop pushbutton	Pmp02diLocalStopPB	%I0036	Not Pressed	Pressed		DI3-04	
5	6	Pump 2 Emergency Stop	Pmp02diEStop	%I0037	Fault	Healthy		DI3-05	
6	7	Pump 2 VFD Auto	Pmp02diVFDAuto	%I0038	Manual	Auto		DI3-06	
7	8	Pump 2 VFD Ready	Pmp02diVFDReady	%I0039	Fault	Ready		DI3-07	
8	9	Pump 2 local reset pushbutton	Pmp02diLocalReset	%I0040	Not Pressed	Pressed		DI3-08	
9	10	Pump 2 Running	Pmp02diRunning	%I0041	Not Running	Running		DI3-09	
10	11	Pump 2 Moisture in Oil	Pmp02diMIO	%I0042	Healthy	Fault		DI3-10	
11	12	Pump 2 Thermistor Fault	Pmp02diTermistor	%I0043	???	???		DI3-11	
12	13	Pump 2 Bearing Temperature	Pmp02diBearingTemp	%I0044	???	???		DI3-12	
13	14	Spare	%I0045	%I0045	-	-		DI3-13	
14	15	Spare	%I0046	%I0046	-	-		DI3-14	
15	16	Spare	%I0047	%I0047	-	-		DI3-15	
16	17	Spare	%I0048	%I0048	-	-		DI3-16	

SP103 Heroes Ave Sewage Pumping Station

GE FANUC

RACK: 0
Slot: 6
Card Type: IC693MDL645
Description: 16 Point Digital Input 24VDC

GE-Fanuc 90-30 PACK 0

I/O #	Term. #	Description	GE Tag	Address	Off State	On State	Term. #	Wire #	Drawing #
1	2	Pump 3 Pump power on	Pmp03diPower	%I0049	Off	On		DI4-01	
2	3	Pump 3 Reflux Valve Open	Pmp03diRefluxOpen	%I0050	Not Open	Open		DI4-02	
3	4	Pump 3 Local start pushbutton	Pmp03diLocalStartPB	%I0051	Not Pressed	Pressed		DI4-03	
4	5	Pump 3 Local stop pushbutton	Pmp03diLocalStopPB	%I0052	Not Pressed	Pressed		DI4-04	
5	6	Pump 3 Emergency Stop	Pmp03diEStop	%I0053	Fault	Healthy		DI4-05	
6	7	Pump 3 VFD Auto	Pmp03diVFDAuto	%I0054	Manual	Auto		DI4-06	
7	8	Pump 3 VFD Ready	Pmp03diVFDReady	%I0055	Fault	Ready		DI4-07	
8	9	Pump 3 local reset pushbutton	Pmp03diLocalReset	%I0056	Not Pressed	Pressed		DI4-08	
9	10	Pump 3 Running	Pmp03diRunning	%I0057	Not Running	Running		DI4-09	
10	11	Pump 3 Moisture in Oil	Pmp03diMIO	%I0058	Healthy	Fault		DI4-10	
11	12	Pump 3 Thermistor Fault	Pmp03diTermistor	%I0059	???	???		DI4-11	
12	13	Pump 3 Bearing Temperature	Pmp03diBearingTemp	%I0060	???	???		DI4-12	
13	14	Spare	%I0045	%I0061	-	-		DI4-13	
14	15	Spare	%I0046	%I0062	-	-		DI4-14	
15	16	Spare	%I0047	%I0063	-	-		DI4-15	
16	17	Spare	%I0048	%I0064	-	-		DI4-16	

SP103 Heroes Ave Sewage Pumping Station

GE FANUC

RACK: 0
Slot: 7
Card Type: IC693MLD940
Description: 16 Point Ditital relay Output 2A

GE-Fanuc 90-30 PACK 0

I/O #	Term. #	Description	GE Tag	Address	Off State	On State	Term. #	Wire #	Drawing #
1	2	Pump 1 Status Indicator	Pmp01dqLamp	%Q0001	Off	On		DO1-01	
2	3	Pump 1 Run Command	Pmp01dqGo	%Q0002	Off	Run		DO1-02	
3	4	Pump 1 Fault Reset	Pmp01dqReset	%Q0003	Off	Reset		DO1-03	
4	5	Pump 1 Run at Maximum Speed	Pmp01dqRunMax	%Q0004	Off	Maximum Speed		DO1-04	
5	7	Pump 2 Status Indicator	Pmp02dqLamp	%Q0005	Off	On		DO1-05	
6	8	Pump 2 Run Command	Pmp02dqGo	%Q0006	Off	Run		DO1-06	
7	9	Pump 2 Fault Reset	Pmp02dqReset	%Q0007	Off	Reset		DO1-07	
8	10	Pump 2 Run at Maximum Speed	Pmp02dqRunMax	%Q0008	Off	Maximum Speed		DO1-08	
9	12	Pump 3 Status Indicator	Pmp03dqLamp	%Q0009	Off	On		DO1-09	
10	13	Pump 3 Run Command	Pmp03dqGo	%Q0010	Off	Run		DO1-10	
11	14	Pump 3 Fault Reset	Pmp03dqReset	%Q0011	Off	Reset		DO1-11	
12	15	Pump 3 Run at Maximum Speed	Pmp03dqRunMax	%Q0012	Off	Maximum Speed		DO1-12	
13	17	Spare	%Q0013	%Q0013	-	-		DO1-13	
14	18	Spare	%Q0014	%Q0014	-	-		DO1-14	
15	19	Spare	%Q0015	%Q0015	-	-		DO1-15	
16	20	Spare	%Q0016	%Q0016	-	-		DO1-16	

SP103 Heroes Ave Sewage Pumping Station

GE FANUC

RACK: 0
Slot: 8
Card Type: IC693ALG221
Description: 4 Channel Analog Input Current (Isolated)

GE-Fanuc 90-30 PACK 0

I/O #	Term. #	Description	GE Tag	Address	4mA	20mA	Term. #	Wire #	Drawing #
1	3,5	Wet Well Level	Wwl01aiRaw	%AI001	0.000 m	??.000 m		AI1-01P	
2	4,6	Delivery Pressure	Pre01aiRaw	%AI002	0.00 m	???.00 m		AI1-02P	
3	13,15	Delivery Flow	Flw01aiRaw	%AI003	0.0 l/s	???.00 l/s		AI1-03P	
4	14,16	Spare	%AI004	%AI004	-	-		AI1-04P	

SP103 Heroes Ave Sewage Pumping Station

GE FANUC

RACK: 0
Slot: 9
Card Type: IC693ALG221
Description: 4 Channel Analog Input Current (Isolated)

GE-Fanuc 90-30 PACK 0

I/O #	Term. #	Description	GE Tag	Address	4mA	20mA	Term. #	Wire #	Drawing #
1	3,5	Pump 1 VFD Running Speed	Pmp01SpeedFbk	%AI005	0.0%	100%		AI2-01P	
2	4,6	Pump 2 VFD Running Speed	Pmp02SpeedFbk	%AI006	0.0%	100%		AI2-02P	
3	13,15	Pump 3 VFD Running Speed	Pmp03SpeedFbk	%AI007	0.0%	100%		AI2-03P	
4	14,16			%AI008				AI2-04P	

SP103 Heroes Ave Sewage Pumping Station

GE FANUC

RACK: 0
Slot: 10
Card Type: IC693ALG392
Description: 8 Channel Analog Output Current

GE-Fanuc 90-30 PACK 0

I/O #	Term. #	Description	GE Tag	Address	4mA	20mA	Term. #	Wire #	Drawing #
1		Pump No.1 Speed Command	Pmp01aqControlSpeed	%AQ001	0%	100%		AO1-01P	
2		Pump No.2 Speed Command	Pmp02aqControlSpeed	%AQ002	0%	100%		AO1-02P	
3		Pump No.3 Speed Command	Pmp03aqControlSpeed	%AQ003	0%	100%		AO1-03P	
4				%AQ004				AO1-04P	
5				%AQ005				AO1-05P	
6				%AQ006				AO1-06P	
7				%AQ007				AO1-07P	
8				%AQ008				AO1-08P	

Appendix B: SPXXX.MAIN FILE

```
/*
 *      SP285 - Aringa Cres
 */
#include "../include/rtudata.h"
#include "../include/md3scanlist.h"
#include "../include/ctrlschl.h"
#include "../include/grfb0002.h"
#include "../include/grfb0006.h"
#include "../include/db_constants.h"

#ifndef PERMANENT

defineclass remote_rtu REMOTE_RTU_CLASS

/* Master station dial-in radio numbers */

record 1                                        /* Trio Alarmcall               */
        trio_ipad       0xc0a82346              /* Source IP Address (RTU)      */
        ipad            0xc0a82301              /* Destination IP Address (CSU) */


defineclass rtu_rtu RTU_RTU_CLASS
/*
 *  Vaga Probe length = ?m
 *  Diameter = ?.???m
 *  the volume value is derived from the formula PI*(r^2)*h, where
 *  r = d/2, h = level and PI = 3.1415927. the volume value represents
 *  the volume of the segment defined by the level associated with
 *  the volume value and the previous level/volume record. If the
 *  current record is the first of the list then the segment is defined
 *  by the level associated with the volume value and the level of 0.0.
 *
 *  level values are entered as millimetres.
 *  volume values are entered as m^3 (or kL).
 */

defineclass wetwell WETWELL_CLASS

/* wet well level to volume lookup table - based on vega probe 0 level */
record 1
        { level 88      volume 0.000 }
        { level 207     volume 0.653 }
        { level 308     volume 0.552 }
        { level 445     volume 0.753 }
        { level 564     volume 0.653 }
        { level 708     volume 0.784 }
        { level 803     volume 0.521 }
        { level 922     volume 0.653 }
        { level 1041    volume 0.728 }
        { level 1160    volume 1.026 }
        { level 1280    volume 1.108 }
        { level 1399    volume 1.331 }
        { level 1518    volume 1.320 }
        { level 1637    volume 1.233 }
        { level 1756    volume 1.170 }
        { level 1876    volume 1.208 }
        { level 1995    volume 1.392 }
        { level 2114    volume 1.342 }
        { level 2233    volume 1.470 }
        { level 2353    volume 1.436 }
        { }

/* wet well surcharge outflow per second lookup table - based on lip of surcharge */
record 2
        { level 0250    volume 1.000 }
        { level 0500    volume 1.000 }
        { level 0750    volume 1.000 }
        { level 1000    volume 1.000 }
        { level 2000    volume 4.000 }
        { }

/*
 * Automatically Generated Database files
 */
#include "SP285.scanlist"
#endif
#include "SP285.reset_fm"
```

Appendix C: DRAWING LIST

TO BE COMPLETED ONCE THE STANDARD DRAWINGS HAVE BEEN CREATED

Electrical Drawing List			
Sheet #	Drawing #	Rev.	Title

BRISBANE WATER

Network Control Systems

FUNTIONAL SPECIFICATION

SP306 Coronation Drive

Sewage Pumping Station

Submersible 2 Pumps With VSD

(Wet Weather Station)

Document Signoff

Approval

	Name	Role	Signature	Date
Manager Mechanical and Electrical Services *Engineering Design Services*	Rahim Janfade.	Concur		
Manager *Water And Watewater Operations Manager*	Anu Atukorala	Concur		
Team Leader *Network Control Systems*	Peter Sherriff	Concur		
Manager *System Planning*	Peter Casey	Concur		
Project Manager	Andrew Bannink.	**Approve**		

Distribution

Name	Role	Section

Revision Control

Revision Number	Date	Amendment Details	Responsible Officer
Version 0.00	16/08/2005	Original Draft – Developed from Connell Wagner SP306 Revised Functional Spec	Alex Witthoft
Version 0.01	25/7/06	Updated approval sheet, removed flowmeter reference.	Gerard Anderson
Version 0.02	2/8/06	Updated approval sheet, Pump kW, picture details.	Gerard Anderson
Version 0.03	21/8/06	Updated confirmed sewer surcharge level and surcharge imminent level for SP306 (Noel Ralph). Station changed to Stop/Start at 50Hz (RM). Added Gravity Sewer alarm level diagram. Set High Level setpoint to 0.4M above TWL. Set pump inhibit limits to 200 and 400mm below Surcharge Imminent	Gerard Anderson
Version 1.00	14/3/2007	Site commissioned. Added level ranges.	Gerard Anderson
Version 1.01	27/4/2007	Added Bump Pumps Functionality ie run pumps every 3 days for 30 seconds to prevent seizing.	Gerard Anderson

Document Consultation

Please review the attached document and add your comments where necessary. To ensure that the process is kept within reasonable timeframes, it would be appreciated if you could return this document by the **Requested Return Date** listed below.

Project Sponsor:	Andy Moore	Officer Code: PM13BW	Location: T.C.B. Level 2
Author:	Alex Witthoft/ Gerard Anderson	Officer Code: CTAMP12/ E2SBW	Location: Cullen Ave
Document Administrator:	Gerard Anderson	Officer Code: E2SBW	Location: Cullen Ave

Version Number (1,2,3 etc)	Forwarded To: (Name / Officer Code)	Location (eg,TCB, Cullen Ave)	Date Sent	**Requested Return Date**	Date Returned	Comments Received (Y / N)	Comments Incorporated (Y / N)

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Definitions

BWTS	Brisbane Water Telemetry System
RTU	Remote Telemetry Unit
SCADA	Supervisory Control And Data Acquisition
MAHD	Metres above Australia Height Datum

1 INTRODUCTION

This document contains the site specific details and describes the non standard functional requirements for control, monitoring and telemetry at sewage pump station SP306 at Coronation Drive, Toowong, opposite Patricks Lane. The functional requirements described in the document are in addition to the standard functionality detailed in "SPSV3 SEWAGE PUMPING STATION SUBMERSIBLE 3 PUMPS WITH VFD" [1].

The standard specification was written for a 3 pump station, of which only 2 pumps are allowed to run at any given time. The functionality for SP306 Coronation Drive is identical, except the third pump is removed. The pumps are interlocked so that only one pump can operate at a time. All site specific values are detailed in this document. The site specific details and the non standard functional requirements in this document were derived from the functional specification written by Connell Wagner "PATRICK LANE FUNCTIONAL SPECIFICATION" [2].

SP306 Coronation Drive sewage pump station is required to relieve the surcharging in the Coronation Drive gravity sewer. Under wet weather flow conditions, the gravity sewer is susceptible to surcharge and overflows to the environment. . SP306 Coronation Drive is therefore wet weather sewage pump station only, incorporating two variable speed driven 65 kW submersible pumps operating in a one duty and one standby arrangement

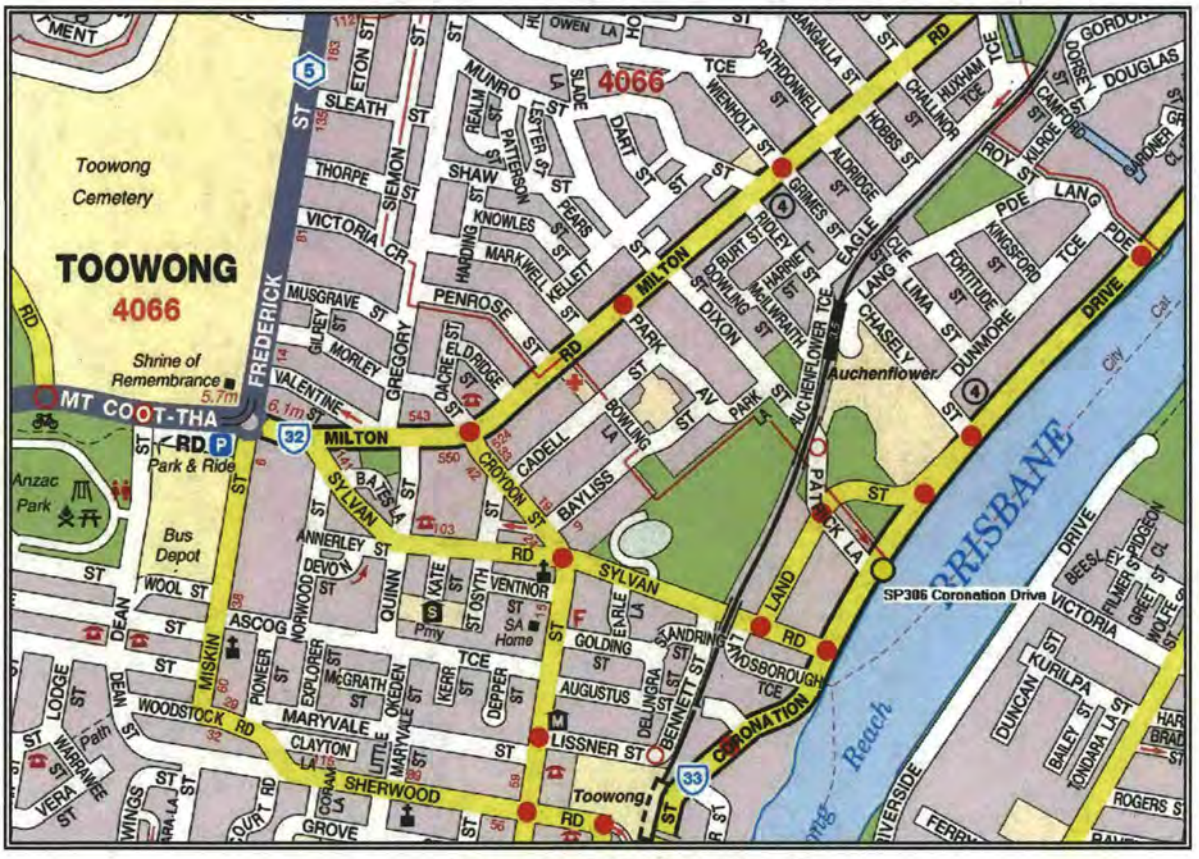


Figure 1: SP306 Location Map

1.1 General Process Description

SP306 Coronation Drive pump station will be connected to the gravity sewer via a short inlet. During wet weather events the sewage will flow into the well. This sewage will then be pumped into the rising main. This will continue until the level in the gravity sewer has receded, at which point the pumps shall stop under level control.

The sewage Pumping Station is of underground configuration operating in wet weather conditions only, with a wet well operating volume (under surcharge) of approximately 10 kl. The pump station will operate as a surcharge pump station, only allowing flows into the wet well during periods of surcharge in the adjacent gravity sewer. The wet well will be free to drain back into the gravity sewer at the end of the surcharge event. The pump station will have two submersible type sewage pumps installed in the Pump Well operating as duty/standby units. The pumps are interlocked so that only one pump can operate at a time. The station output with one pump operating at maximum speed will be approximately 150 l/sec.

This pump station will operate as a stop/start station only, there will be no PID control at this site. Pump speed will be limited to 50Hz, this is designed to pump down the Wet Well as quickly as possible.

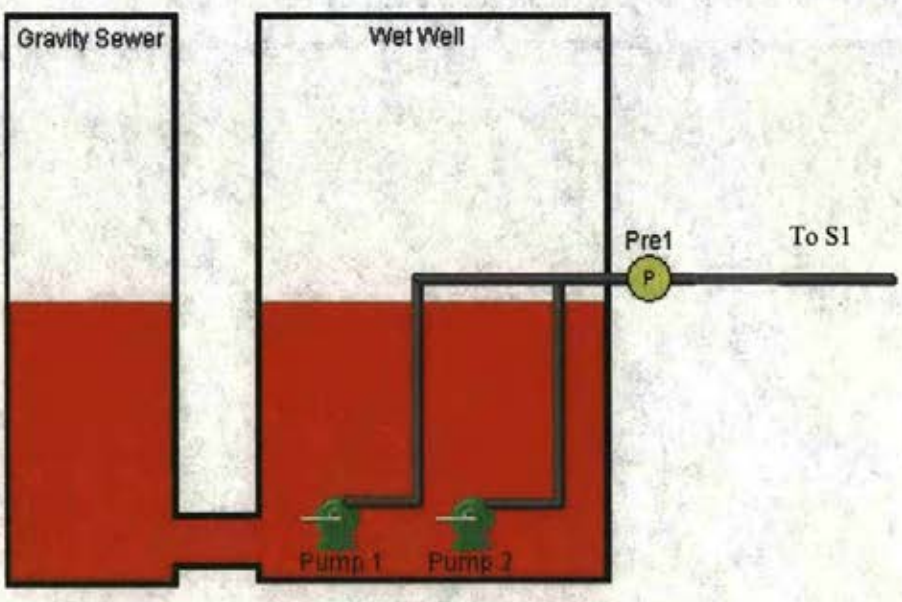


Figure 2: SP306 Process and Instrumentation Overview

2 EQUIPMENT INSTALLED

2.1 Standard Equipment

SP306 Coronation Drive pump station has the following standard equipment installed. The functionality for the control, monitoring and alarming for these items is fully described in the standard functional specification.

Pumps	Two Grundfoss submersible pumps with 65 kW four pole electric motors are installed in the wet well. Each pump is fitted with moisture probes in the oil chamber and thermistors in the stator windings.
Pump Starters	Two Danfoss Variable Frequency Drives (VFDs) are installed in the pump station switchboard. The VFDs will also provide soft starting functionality.
Level Sensors	One Vega hydrostatic level transmitter installed in the wet well. One Multitrode level probe (Surcharge imminent) installed in the wet well.
Pressure Transmitters	One Vega D84 pressure transmitters are installed on the discharge side of the pumps.

2.2 Non Standard Equipment

SP306 Coronation Drive pump station has the following non standard equipment installed. The functionality for the control, monitoring and telemetry for is described in the following sections as these items are NOT described in the standard specification. The pumps are interlocked so that only one pump can operate at a time.

Emergency Generator	The switchboard will have the facility for a generator to be connected. No generator will be installed on site.
Level Sensors	One Vega hydrostatic level transmitter installed in the gravity sewer One Multitrode level probe (Gravity Sewer High) installed in the gravity sewer
Reflux Limit Switches	Each pumps reflux valve has a reflux limit switch fitted. NB There is no flowmeter onsite.
Wet well washer solenoid	Well washer solenoid valve with flow switch installed in the wet well. Note that there is currently no water supply to the Wet well washer. The Wet Well washer will not be commissioned at this stage.

2.2.1 Emergency Generator

The emergency generator is designed to the standard functionality as described by "DIESEL STANDBY GENERATOR LOCAL CONTROL PANEL FUNCTIONAL DESCRIPTION".[3] The generator is supplied with the PLC fully configured and loaded with the standard program. The RTU (Logica MD3311) will programmed with the standard interface program that will provide the monitoring, control and telemetry to the BWTS master station.

2.2.2 Gravity Sewer Monitoring

The gravity sewer will also have monitoring in the form of a vega hydrostatic level transmitter as well as a gravity high multitrode electrode.

3 CONTROL PHILOSOPHY

The station will operate according to the control philosophy detailed in the standard functional specification (SPSV3). The initialisation block will be configured with the site specific set points listed in the tables in the next sections. Surcharge Occurring & Surcharge Imminent mAHD will be the same levels as the gravity main setup (confirmed with Noel Ralph). There is no physical surcharge pipe at SP306. Inlet level of pipe from gravity main to wet well is IL -3.790.

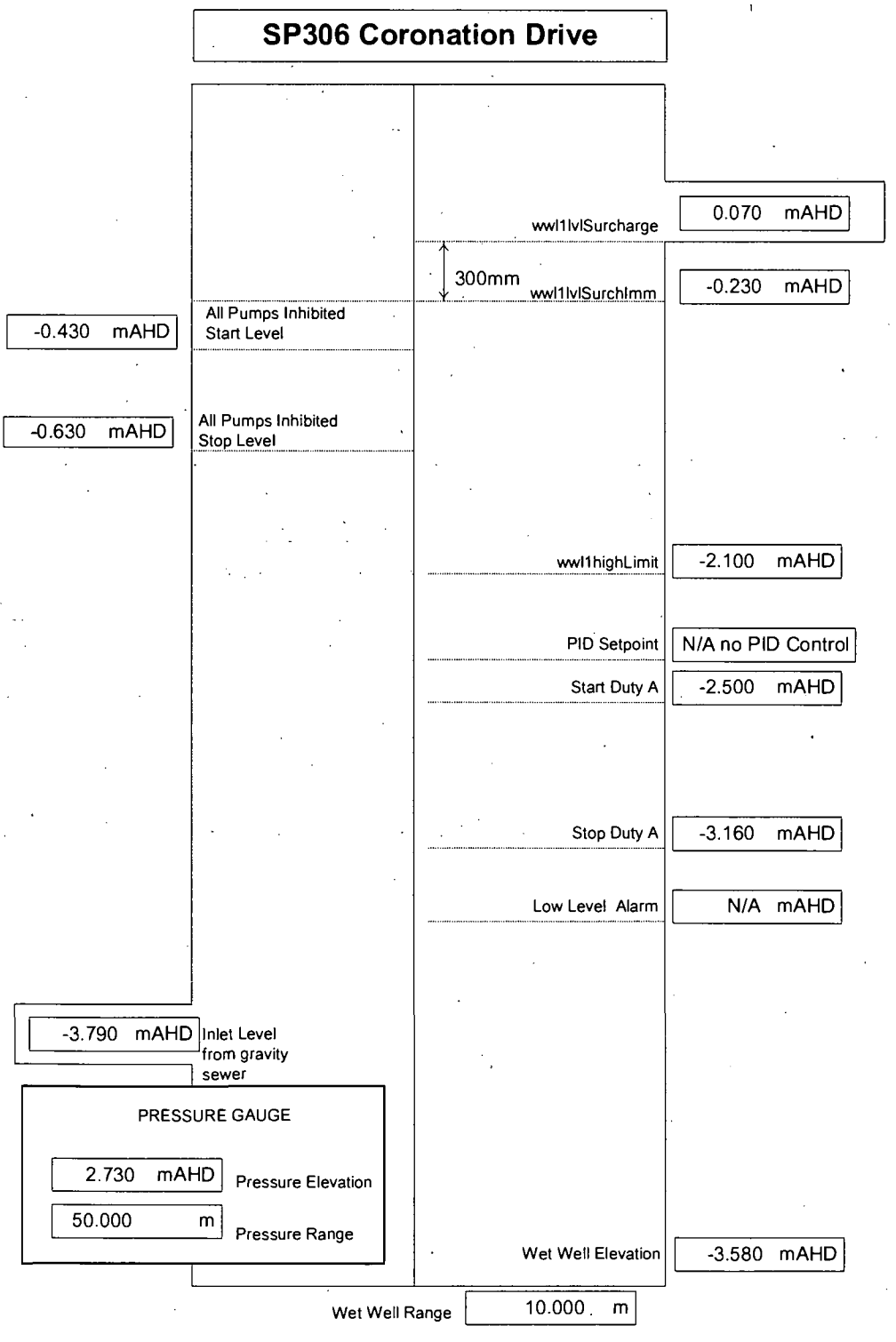


Figure 3: SP306 Station Level Set Points

3.1 Site Specific Values

Table 1: Site Specific Constants defined in the PLC

Tag Name	Description	Type	Value	Units
Sewerage Pumping Station				
Stn01grSurchPumpingTime	Surcharge pumping duration [3]	Integer	60	Sec
Delivery pressure				
Pre01txRange	Delivery pressure - Range	Real	5000	mmAHD/ 10
Pre01txZero	Delivery pressure – Elevation of the transducer	Real	273	mmAHD/ 10
Pump Blockage				
Stn01grPmpBlockFlowKneeSP	Flow blocked limit for flow/level PID control (knee)	Integer	N/A	l/s x 100
Stn01grPmpBlockSpeedKneeSP	VFD speed blocked limit for flow/level PID control (knee)	Integer	N/A	Hz x 100
Stn01grPmpBlockSpeedMinSP	VFD speed blocked limit for minimum flow PID control	Integer	N/A	Hz x 100
Wet well level				
Wwl01txRange	Wet well level range	Integer	10	mmAHD
Wwl01txSurchImmLevelSP	Wet well surcharge imminent level (300mm below Overflow #330 Coronation Drive "Oxleys on the River" Surcharge point of 0.070 MAHD)	Integer	-0.230	mmAHD
Wwl01grInhStartLevelSP	Wet well inhibit mode start level	Integer	-0.430	mmAHD
Wwl01grInhStopLevelSP	Wet well inhibit mode stop level	Integer	-0.630	mmAHD
Wwl01grRunatMaxLvlSP	Wet well run at maximum speed level	Integer	N/A	mmAHD
Wwl01txDtyBStartLevelSP	Wet well duty B pump start level	Integer	N/A	mmAHD
~~Wwl01txPIDLevelSP~~	~~Wet well PID set point~~	~~Integer~~	~~-2200~~	~~mmAHD~~
Wwl01txDtyAStartLevelSP	Wet well duty A pump start level	Integer	-2500	mmAHD
Wwl01txDtyAStopLevelSP	Wet well duty A pump stop level	Integer	-3160	mmAHD
Wwl01txDtyAStopLevelSP	Wet well duty A pump stop level	Integer	-3160	mmAHD
Wwl01txZero	Wet well empty level (4mA of Probe)	Integer	-3580	mmAHD
Variable Frequency Drive				
Stn01grMinSpeed	Variable Frequency Drive – Minimum Speed	Integer	5000	Hz x 100
Stn01grMaxSpeed	Variable Frequency Drive – Maximum Speed	Integer	5000	Hz x 100

Table 2: Site Specific Constants defined in the RTU

Tag Name	Description	Type	Value	Units
pre1almInhibitTm	Delivery pressure - Alarm inhibit timer	Integer	15	sec
wwl1surchLvlVol	Wet well volume at surcharge level	Real		kl
wwl1lvlSurcharge	Wet well surcharge occurring level	Real	0.070	mAHD
Pumps 1 & 2				
Pmp[x]almInhPwrTm	Pump [x] - Motor power alarm inhibit timer.	Integer	15	sec
pmp[x]almInhCrntTm	Pump [x] - Motor current alarm inhibit timer.	Integer	15	sec
pmp[x]currRange	Pump [x] - Motor current range	Real	120.0	Amps

Table 3: Site Specific Variable defined in the RTU

Wet well level				
wwl1highLimit	Wet well level - High alarm set point	Integer	-2.100	mmAHD
wwl1lowLimit	Wet well level - Low alarm set point	Integer	N/A	mmAHD
Delivery flow				
flw1highLimit	Delivery flow - High alarm set point	Integer	N/A	ml/s x 10
flw1lowLimit	Delivery flow - Low alarm set point	Integer	N/A	ml/s x 10
Delivery pressure				
pre1highLimit	Delivery pressure DN1370 – High alarm set point	Integer	Max	mmAHD
pre1lowLimit	Delivery pressure DN1370 – Low alarm set point	Integer	Min	mmAHD
Pumps 1 & 2				
pmp[x]currHiLimit	Pump [x] - Motor current high alarm set point [4]	Integer	130	Amps
pmp[x]currLoLimit	Pump [x] - Motor current low alarm set point [5]	Integer	130	Amps
pmp[x]powHiLimit	Pump [x] - Motor power high alarm set point	Integer		Watts
pmp[x]powLoLimit	Pump [x] - Motor power low alarm set point	Integer		Watts

Table 4: Wet Well Level vs Volume Data

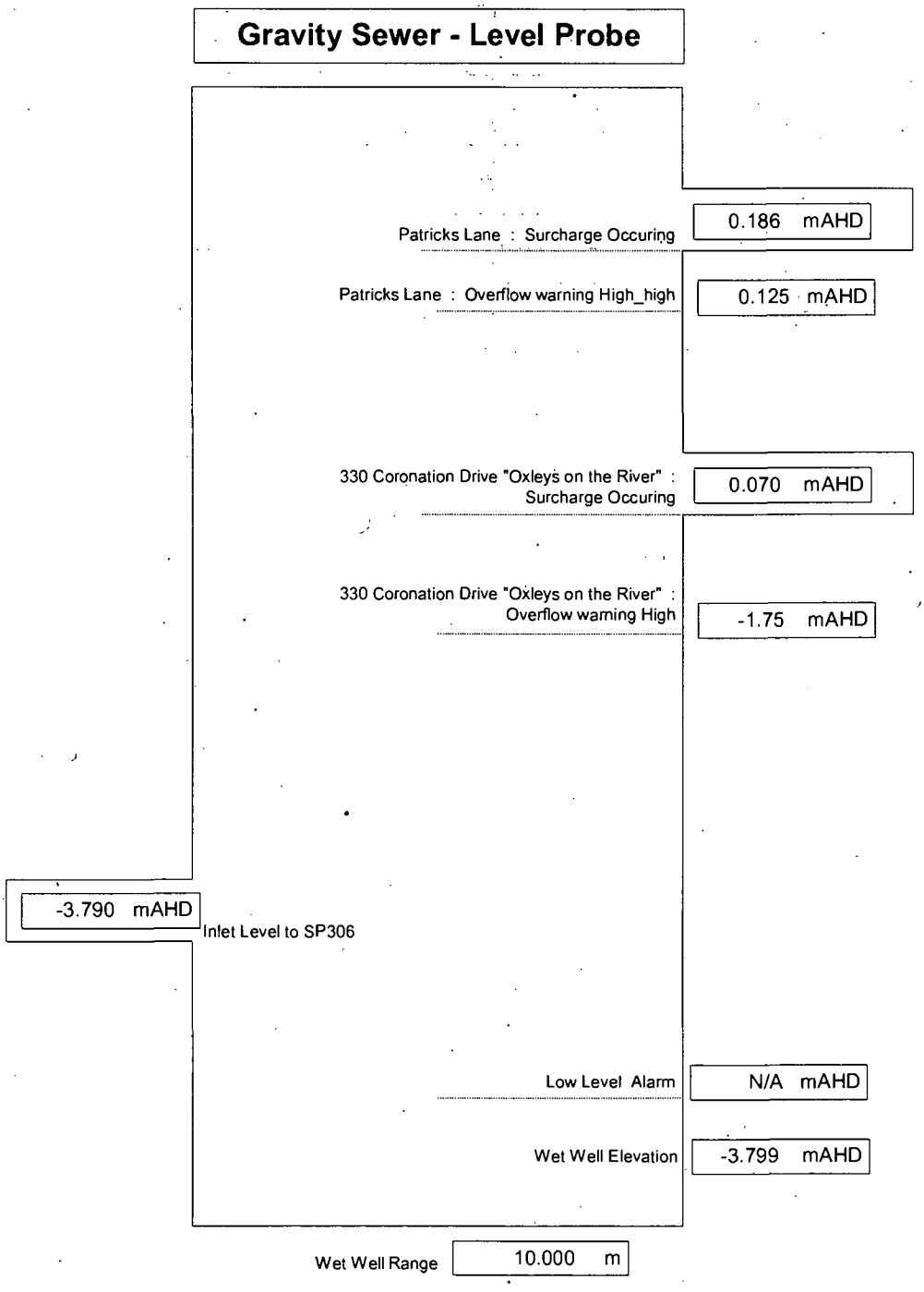
	Height (mAHD)	Volume m³	Remaining Storage m³	% Level	% Volume
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

3.2 Non Standard Monitoring and Alarms

3.2.1 Gravity Sewer Level

As the Vega probe takes a few seconds to initialise, all the wet well alarms except for invalid, are suppressed for 10 seconds upon RTU start up

Gravity Sewer	Invalid	1
Gravity Sewer	Patricks Lane Surcharge Occuring alarm	1
Gravity Sewer	Patricks Lane Overflow Warning High_high alarm	1
Gravity Sewer	330 Coronation Drive Oxleys on the River" Surcharge Occuring alarm	1
Gravity Sewer	330 Coronation Drive Oxleys on the River" Overflow Warning High alarm	1



Invalid

The signal is deemed invalid if it is :

Less than (4mA – dead band) or greater than (20mA + dead band) for 1 second.

Once the invalid alarm has been activated it can only be reset when the signal is both greater than 4mA and less than 20mA for 20 seconds. The time delays ensure that a signal is truly invalid before an alarm is set and that it is stable before it is reset. The dead band is calculated using the site invalid hysteresis value multiplied by the range.

If the gravity sewer level becomes invalid, the gravity sewer low and high alarm alarms are suppressed.

NOTE: As the wet well level is backed up by the battery – the site power does **not** suppress the invalid alarm.

Low Alarm

If the signal is valid and the start up delay has expired then the low alarm is activated if the signal is less than the low limit set point. It is deactivated if any of the above conditions become false or the signal is greater that the low limit set point plus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

High Alarm

If the signal is valid and the start up delay has expired then the high alarm is activated if the signal is greater than the high limit set point. It is deactivated if any of the above conditions become false or the signal is less that the high limit set point minus the dead band. The dead band is calculated using the alarm hysteresis value multiplied by the range.

3.2.2 Bump Pumps Routine

Each sewer pump will be requested to run for 30 seconds every 3 days to prevent the pumps from seizing. The pumps will be run regardless of wet well level. The RTU will check if a pump has not run within 48 hours or if either pump is inhibited before initiating the bump pump routine.

3.3 Non Standard BWTS Picture

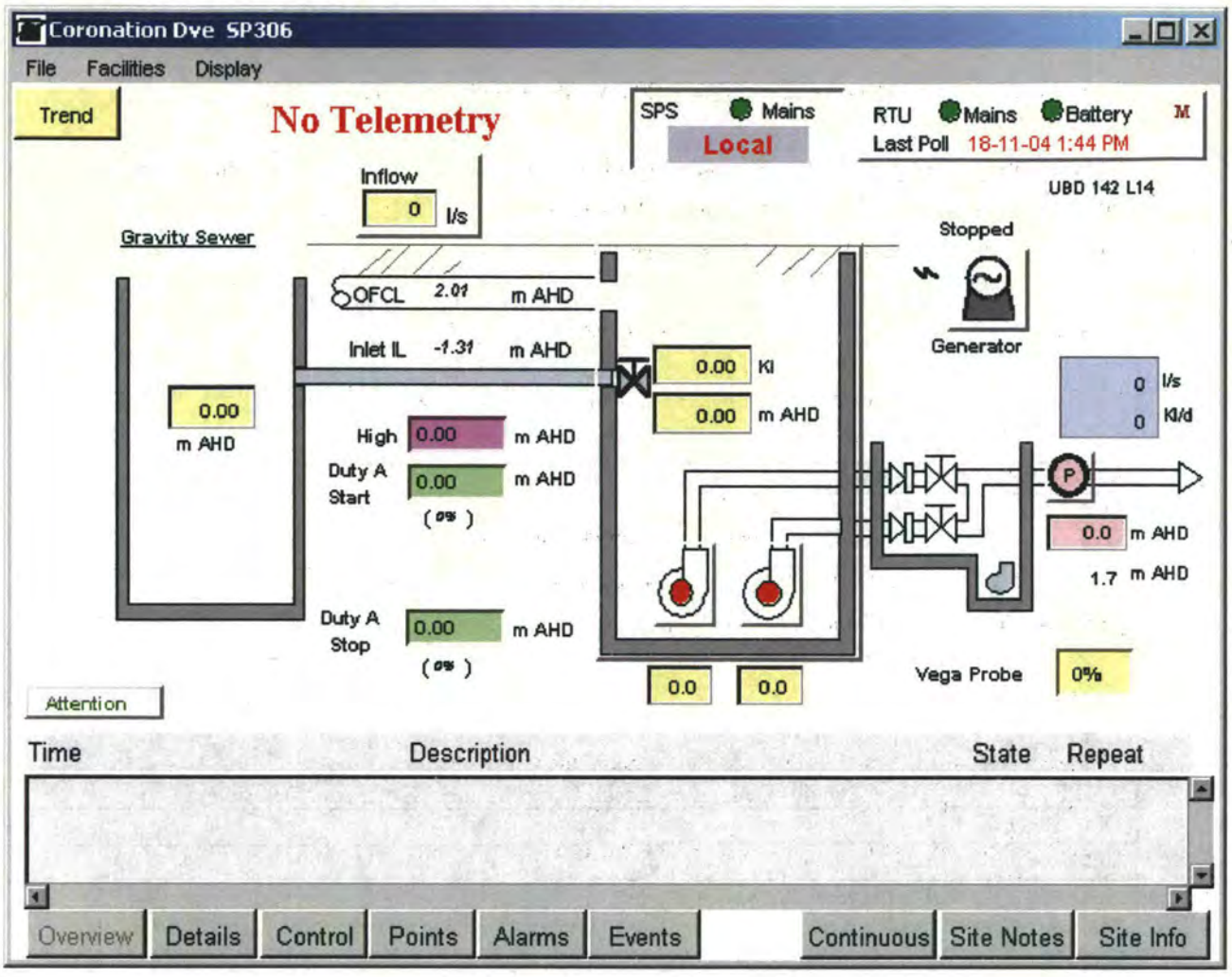


Figure 4 SP306 Details Page

3.4 Sewer Network Overview

The sewer network overview page will be updated to include the gravity sewer at Coronation drive pumping into the new S1 rising main at Coronation drive.

4 REFERENCES

1

TITLE	SPSV3 Sewage Pumping Station Submersible 3 Pumps With VFD – Functional Specification
DOCUMENT ID	003589
VERSION	0.30
AUTHOR	Alex Witthoft , Brisbane Water – Network Control Systems
DOCUMENT OWNER	Peter Sherriff, Brisbane Water – Network Control Systems

2

TITLE	Heroes Avenue Functional Specification
DOCUMENT ID	N/A
VERSION	N.A
AUTHOR	N.A
DOCUMENT OWNER	Cardino Davies Pty Ltd

3

TITLE	Diesel Standby Generator - Local Control Panel - Functional Description
DOCUMENT ID	N/A
VERSION	02
AUTHOR	SOUTH EAST POWER GENERATION
DOCUMENT OWNER	