Water Utilities Australia
Kooragang Water

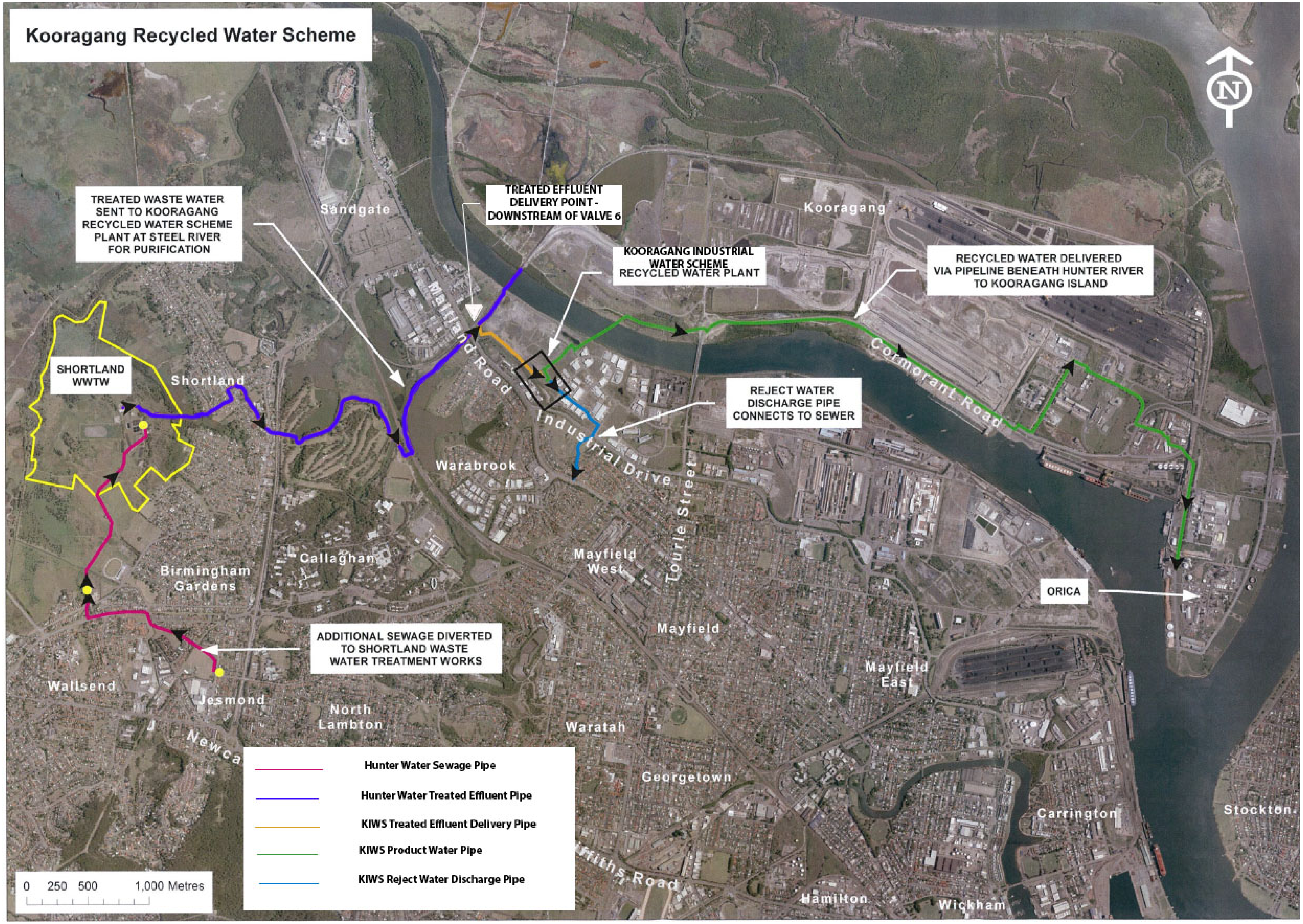
Kooragang Water Pty Ltd

WIC Act licence application

13 April 2022

Attachment 36:

KIWS Network Map


Kooragang Recycled Water Scheme
TREATED WASTE WATER SENT TO KOORAGANG RECYCLED WATER SCHEME PLANT AT STEEL RIVER FOR PURIFICATION
TREATED EFFLUENT DELIVERY POINT - DOWNSTREAM OF VALVE 6
KOORAGANG INDUSTRIAL WATER SCHEME RECYCLED WATER PLANT
RECYCLED WATER DELIVERED VIA PIPELINE BENEATH HUNTER RIVER TO KOORAGANG ISLAND
SHORTLAND WWTW
REJECT WATER DISCHARGE PIPE CONNECTS TO SEWER
ORICA
ADDITIONAL SEWAGE DIVERTED TO SHORTLAND WASTE WATER TREATMENT WORKS
Sandgate
Kooragang
Shortland
Maitland Road
Industrial Drive
Cormorant Road
Warabrook
Tourle Street
Callaghan
Birmingham Gardens
Mayfield West
Mayfield
Mayfield East
Wallsend
Jesmond
North Lambton
Waratah
Georgetown
Carrington
Stockton
Hamilton
Wickham
Griffiths Road
Newca
Hunter Water Sewage Pipe
Hunter Water Treated Effluent Pipe
KIWS Treated Effluent Delivery Pipe
KIWS Product Water Pipe
KIWS Reject Water Discharge Pipe
0 250 500 1,000 Metres
N

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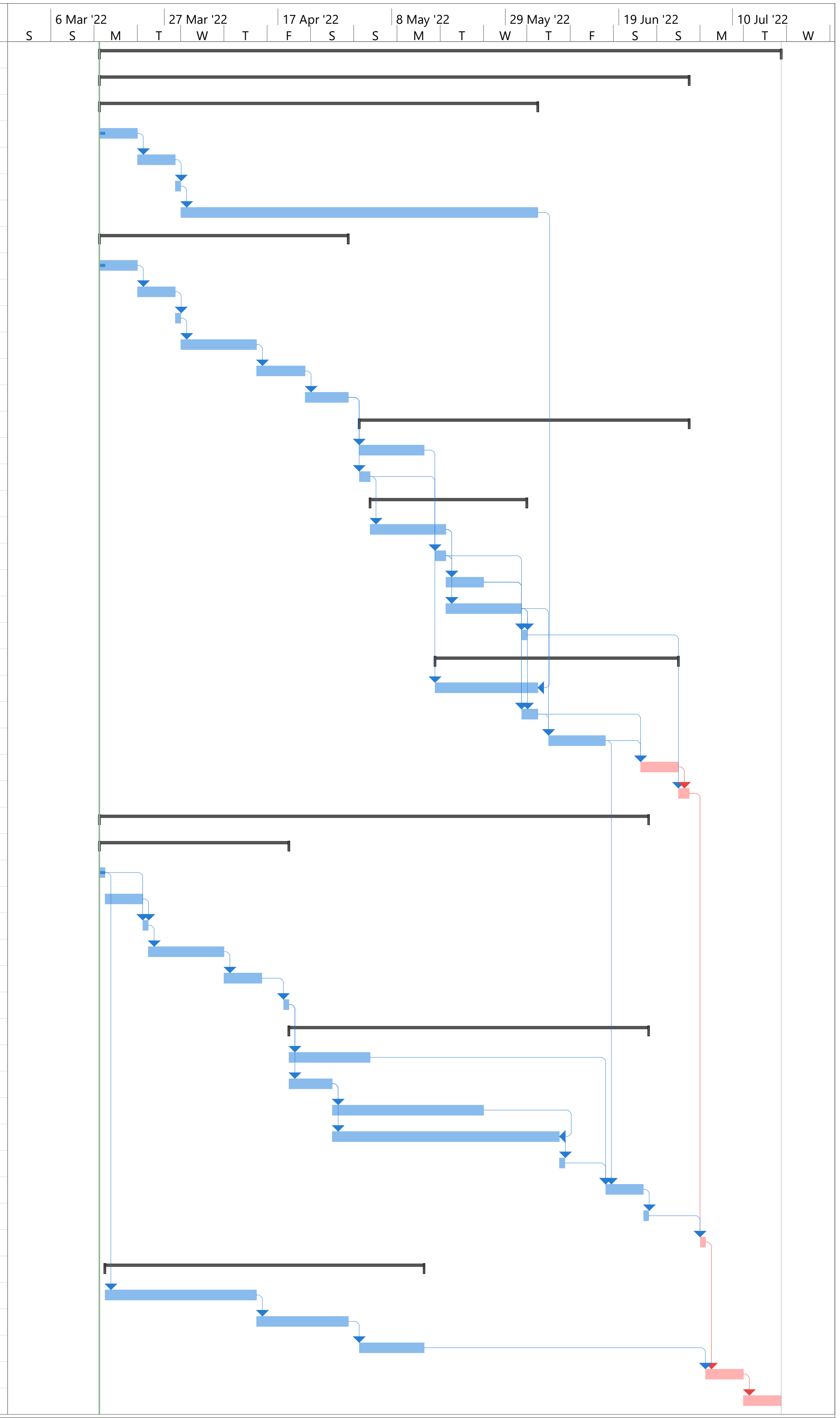
Attachment 37:

NCIG Connection Project Schedule

ID	Task Mode	Name	Duration	Start	Finish	Predecessors	Successors
1		**NCIG Connection and Supply Delivery**	**86 days**	**Tue 15/03/22**	**Mon 18/07/22**		
2		**Civil-Mechanical**	**75 days**	**Tue 15/03/22**	**Fri 1/07/22**		
3		**Procure Principal Supplied (Free Issue) Items**	**56 days**	**Tue 15/03/22**	**Fri 3/06/22**		
4		Vendor Consultation (Flowmeter, Act Valve,Check Valve)	5 days	Tue 15/03/22	Mon 21/03/22		5
5		Issue Datsheet/Receive Quotes	5 days	Tue 22/03/22	Mon 28/03/22	4	6
6		WUA Place Order	1 day	Tue 29/03/22	Tue 29/03/22	5	7
7		Lead time - Delivery	9 wks	Wed 30/03/22	Fri 3/06/22	6	25FF
8		**Procurement**	**31 days**	**Tue 15/03/22**	**Fri 29/04/22**		
9		Prepare tender docs (incl NCIG WHS Discuss)	1 wk	Tue 15/03/22	Mon 21/03/22		10
10		NCIG review/WUA Approve	5 days	Tue 22/03/22	Mon 28/03/22	9	11
11		Issue RFT	1 day	Tue 29/03/22	Tue 29/03/22	10	12
12		Tender Period	2 wks	Wed 30/03/22	Tue 12/04/22	11	13
13		Review Tenders	1 wk	Wed 13/04/22	Thu 21/04/22	12	14
14		Award Contract	1 wk	Fri 22/04/22	Fri 29/04/22	13	16,17
15		**Construction**	**44 days**	**Mon 2/05/22**	**Fri 1/07/22**		
16		Preliminaries & Submissions	10 days	Mon 2/05/22	Fri 13/05/22	14	20
17		Order Materials	2 days	Mon 2/05/22	Tue 3/05/22	14	19,25
18		**Pipeline Construction**	**21 days**	**Wed 4/05/22**	**Wed 1/06/22**		
19		Materials Supply	2 wks	Wed 4/05/22	Tue 17/05/22	17	22,21
20		Site Mobilise	2 days	Mon 16/05/22	Tue 17/05/22	16	22,21,26
21		Set-out , excavate, lay, test, backfill	5 days	Wed 18/05/22	Tue 24/05/22	19,20	23,26
22		Trenchless Construction	10 days	Wed 18/05/22	Tue 31/05/22	19,20	27,23,26
23		Connection Dn400/200 Cut-in (Hot-Tap) & Testing	1 day	Wed 1/06/22	Wed 1/06/22	21,22	29
24		**NCIG Connection**	**32 days**	**Mon 16/05/22**	**Wed 29/06/22**		
25		Materials and Fittings Supply (Free Issue FF)	3 wks	Mon 16/05/22	Fri 3/06/22	17,7FF	
26		Site Measure / Fabrication Drawings	3 days	Wed 1/06/22	Fri 3/06/22	21,22,20	28,27
27		Civil works (concrete slabs and elec conduits) - 3 days cure	1.5 wks	Mon 6/06/22	Thu 16/06/22	22,26	28,44
28		Meter Frame Fabrication & Installation & Test	1 wk	Thu 23/06/22	Wed 29/06/22	26,27	29
29		Civil-Mech Commissioning	2 days	Thu 30/06/22	Fri 1/07/22	23,28	46
30		**EIC**	**69.5 days**	**Tue 15/03/22**	**Fri 24/06/22**		
31		**Procurement**	**23 days**	**Tue 15/03/22**	**Mon 18/04/22**		
32		Finalise Drawings	1 day	Tue 15/03/22	Tue 15/03/22		34,48
33		Prepare tender docs	1 wk	Wed 16/03/22	Tue 22/03/22		34
34		Issue RFT	1 day	Wed 23/03/22	Wed 23/03/22	32,33	35
35		Tender Period	2 wks	Thu 24/03/22	Wed 6/04/22	34	36
36		Review Tenders	1 wk	Thu 7/04/22	Wed 13/04/22	35	37
37		Award Contract	1 day	Mon 18/04/22	Mon 18/04/22	36	39,40
38		**Construction**	**46.5 days**	**Tue 19/04/22**	**Fri 24/06/22**		
39		Preliminaries & Submissions	10 days	Tue 19/04/22	Tue 3/05/22	37	44
40		Order Materials	5 days	Tue 19/04/22	Tue 26/04/22	37	41,42
41		Leadtime Materials	4 wks	Wed 27/04/22	Tue 24/05/22	40	42FF
42		Cabinet Design & Fabrication	6 wks	Wed 27/04/22	Tue 7/06/22	40,41FF	43
43		FAT	1 day	Wed 8/06/22	Wed 8/06/22	42	44
44		Site Installation (cabinet, cabling, connections)	1 wk	Thu 16/06/22	Thu 23/06/22	43,39,27	45
45		SAT (Elec Commissioning)	1 day	Thu 23/06/22	Fri 24/06/22	44	46
46		Connection Site Commission (Civil-Mech-EIC)	1 day	Mon 4/07/22	Mon 4/07/22	45,29	51
47		**Plant PLC and SCADA**	**40 days**	**Wed 16/03/22**	**Fri 13/05/22**		
48		FD2/Update ACMM	4 wks	Wed 16/03/22	Tue 12/04/22	32	49
49		Coding and FAT	2 wks	Wed 13/04/22	Fri 29/04/22	48	50
50		Upload to Plant PLC (incl Suez integration planning)	2 wks	Mon 2/05/22	Fri 13/05/22	49	51
51		System Commissioning	1 wk	Tue 5/07/22	Mon 11/07/22	50,46	52
52		First Water to NCIG	1 wk	Tue 12/07/22	Mon 18/07/22	51	



Critical		Milestone		Rolled Up Critical		Inactive Summary		Manual Summary		External Milestone
Critical Split		Slippage		Rolled Up Critical Split		Manual Task		Start-only		Deadline
Task		Summary		Inactive Task		Duration-only		Finish-only		Progress
Split		Project Summary		Inactive Milestone		Manual Summary Rollup		External Tasks		

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Attachment 38:

KIWS Process Flow Diagram

OPERATING CONDITIONS:

Number of the primary RO running	Number of BRU required	BRU Feed Setpoint (m3/hr)
1	0	0
2	0	0
3	1	93.6
3	1	124.9

Normal Operating Range

		6 Net MF Filtrate	7 PRO Feed	9 PRO Perm	10 PRO Brine	10 -1 BRU Feed	10 -2 BRU Perm	10 -3 BRU Brine	10 -4 Plant Brine
Maximum Flow	m3/hr	500.0	562.4	437.6	124.9	124.9	62.4	62.4	124.9
Minimum Flow	m3/hr	375.0	421.8	328.2	93.6	93.6	46.8	46.8	46.8
Maximum Pressure	kPa	60	250	80	205	350	60	205	205
Minimum Pressure	kPa	50	230	80	180	230	50	180	180

NOTE:
1) 10 & 10-3 & 10-4 - Pressure: Min P is when only 1 RO is running / Max P is when 4 ROs are running
2) 10-2 - Pressure: To be confirmed/updated when the tapping/connecting point is finalised and a check valve is selected .

THIS P&ID HAS BEEN MODIFIED FROM THE ORIGINAL HUNTER WATER DRAWING. CLOUDED AREAS SHOW THE PROPOSED KIWS EXPANSION WORKS FOR PROJECT NO.184.

REV	REVISION	DRAWN	DRAFT CHECK	DESIGN	DESIGN CHECK	APP'D	DATE
A01	ISSUED FOR EW SUBMISSION	CBD	PK	PK	PK	CD	22.01.21

suez

No.	REVISION DETAILS	DWN	DATE

CONSULTANT DETAILS:

FOR INFORMATION

CONSLT. REFERENCE No.

Water Utilities Australia

DESIGNED: PK	DATE: 20.01.21	COMPANY: SUEZ
DRAWN: CBD	DATE: 20.01.21	COMPANY: SUEZ
CHECKED: PK	DATE: 22.01.21	COMPANY: SUEZ
APPROVED: CD	DATE: 22.01.21	COMPANY: SUEZ

TITLE:
MAYFIELD WEST AWTP (KIWS)
RT-MAW
PROCESS FLOW DIAGRAM
PFD AND FLOW BALANCE - BRU

SIZE: A1 | SCALE: NTS | INDEX No.: | DRAWING No.: 15270 | SHEET 1000 | REV No. A

Kooragang Water Pty Ltd

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Attachment 39:

KIWS Original Design Report

Mayfield West AWTP
Design Report

Document No: KI-RT-PT-014

Document Number: KI-RT-PT-014
Title: Mayfield West AWTP – Design Report
Authors: Z Matheson , I Tye, C Hitchcock, B Shuen, C Menzies, QOH
Revision: 0
Date of Issue: 22/04/13

DOCUMENT REVISION HISTORY

Rev.	Description	Reviewed By	Date of Review	Approved By	Date of Approval
A	Draft for review	Project Team & PLT	20/11/12		
B	Updated to include Civil	Project Team & PLT	22/11/12		
C	Updated to include Mechanical, Structural, Electrical & Architectural scope	Project Team & PLT	24/01/13		
0	Updated with process information	Project Team & PLT	23/04/13		

TABLE OF CONTENTS

List of Tables

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

This report describes the design criteria for the Mayfield West Advanced Water Treatment Plant (MWAWTP) carried out by the Hunter Treatment Alliance (HTA).

1.2 STRUCTURE OF REPORT

This report is structured into the following sections:

- Section 1 - Introduction;
- Section 2 - Scope of Works;
- Section 3 - Process Design;
- Section 4 - Hydraulic Design;
- Section 5 – Raw Water Inlet Area;
- Section 6 - Auto Strainers;
- Section 7 – Microfiltration;
- Section 8 – RO Feed Tank Area;
- Section 9 – Acid Dosing Pre RO
- Section 10 - Antiscalant Dosing Pre RO
- Section 11 – Reverse Osmosis;
- Section 12 – Degas Tower and Sump Area;
- Section 13 - CCT Area;
- Section 14 – Dechlorination;
- Section 15 - Product Water Tank Area;
- Section 16 – Chemical Neutralisation System;
- Section 17 – Backwash Handling System;
- Section 18 – Ancillary Equipment;
- Section 19 – Chemical Dosing;
- Section 20 – Main Process Building;
- Section 21 – Educational Annex;
- Section 22 – Amenities Building;
- Section 23 – Switchroom;
- Section 24 – Civil Works;
- Section 25 – Major Pipelines;
- Section 26 – Electrical Design;
- Section 27 – KIWS Education Annex

- Section 28 – Acoustic Design Review
- Section 29 – Main Plant Building - Building Code Analysis Compliance

1.3 REFERENCE DOCUMENTS

Other reports that should be consulted in addition to this design report include:

1. Kooragang Industrial Water Scheme Basis of TOC Design Report, (Dec 11);
2. Kooragang Industrial Water Scheme, Basis of Mechanical Design Report , (Dec 11)
3. Kooragang Industrial Water Scheme, Supplementary Concept Design Report, (Dec 11)

1.4 BACKGROUND

1.4.1 SITE DESCRIPTION

The MWAWTP is located on the Steel River Industrial Estate and occupies 3 Lots.

There are 4 buildings on site. These consist of:

1. Education Annex which is visible from the street frontage;
2. Amenities building which houses the operational staff and the control room;
3. Main process building which houses the MF and RO treatment processes; and
4. Switch Room which houses the Main Control Centre for the plant.

In addition to the buildings there are 5 above ground steel panel tanks which store water on site. These consist of:

1. Raw Water Tank;
2. RO Feed tank;
3. Degas Tower and Sump;
4. Chlorine Contact Tank (CCT); and
5. Product Water Tank.

There are two duty pad mounted transformers located at street frontage which supply power to the MWAWTP.

2.0 SCOPE OF WORKS

The Scope of Works (SOW) for the Mayfield West AWTP formally the Kooragang Industrial Water Treatment Plant (IWTP) is outlined in the “Basis of TOC Design Report” as stated in the “Work Package Definition Statement (WPDS)” issued by HWC in late 2011.

Section 1.2 of the Basis of TOC design outlines the proposed scope of the MWAWTP, which includes the following major components:

- Construction of an Industrial Water Treatment Plant (IWTP) with as nominal capacity of 9ML/d output (Stage 1);

- Construction of interconnecting feed pipeline from the existing discharge pipeline from the Shortland WWTW to the MWAWTP;
- Construction of a brine discharge & MF reject pipelines from the MWAWTP site to the Burwood and Shortland sewerage catchments respectively;
- Construction of a discharge pipeline from the treatment plant site to the Hunter River for off spec water, testing and brine discharge during wet weather events;
- Provide the necessary plant SCADA control system and Implement any integration required with existing Hunter Water assets to allow the MWAWTP to function;
- Obtain the relevant approvals for construction and operation of the treatment plant.

3.0 PROCESS DESIGN

The MWAWTP will supply recycled water to Orica as the sole end user (at the time of writing) with the primary use for boiler feed water. The predicted water demand from Orica suggests that the MWAWTP will be constructed under Stage 1 to provide 9MLD and be upgradable to 12 MLD under Stage 2 demand. Stage 1 demand will occur following project completion 2014. The timing of Stage 2 demand is unknown at this time.

3.1 DESIGN BASIS

3.1.1 DESIGN FLOWS

The MWAWTP receives flow from the Shortland WWTW. As there are losses through the plant as a result of onsite reuse of the final product water, backwashing of the auto strainers, microfiltration and the reverse osmosis membranes as described in the sections below Shortland WWTW provides water to the MWAWTP as contained table 1 below.

Table 1: MWAWTP Influent, Production and Losses Design Flows

	Influent flows to MWAWTP (from Shortland WWTW) **(ML/D)**	**MWAWTP Production Capacity (ML/D)**	**Losses through the MWAWTP (ML/D)**
Stage 1	12.8	9	3.8
Stage 2	16.8	12	4.8

3.1.2 DESIGN INFLUENT QUALITY

Table 2 below contains the influent water quality envelope that the MWAWTP has been designed to treat. If the water quality exceeds the upper limits for extended durations the effluent quality parameters may not be achieved.

Table 2: Raw Water Influent Quality

Parameter	Unit	MF Influent (90%tile)	RO Influent (90%tile)
Total Aluminium	mg/L	0.1	0.1
Alkalinity	mg/L	130.8	90.2
Arsenic	mg/L	0.003	0.003
Boron	µg/L	113	113
Barium	mg/L	0.01	0.01
Calcium	mg/L	34.49	34.49
Chloride	mg/L	164	206
Chromium (VI)	mg/L	0.002	0.002
Copper	mg/L	0.02	0.02
Total Iron	mg/L	0.39	0.39
Turbidity	NTU	-	0.5
NH_3 - High	mg/L	2	2
pH	unitless	7.7	6.2-6.5
Reactive SiO_2	mg/L	12.62	12.62
Sulphate	mg/L	104.8	204
Strontium	mg/L	0.34	0.34
TDS	mg/L	530.7	824
TKN-High	mg/L	4	4
TN-High	mg/L	12	12
TON	mg/L NO_3	33.6	33.6
TOC	mg/L	12.51	12.51
Total Hardness	mg/L	140.4	140.4
TP-High	mg/L	8	6
TSS	mg/L	12	0.1
Zn	mg/L	0.0001	0.0001
Design temperature	°C	25	25
BOD	mg/L	4	4
Conductivity	µS/cm	914.8	1250
Manganese (soluble)	µg/L	100	75

3.1.3 DESIGN EFFLUENT QUALITY

Table 3 below contains the effluent water quality envelope as detailed in the WPDS.

Table 3: Effluent Water Quality

			Laboratory		Proposed Commitment range		
	Parameter	**Unit**	**Test Method**	**Limit of Detection**	**50%ile**	**90%ile**	**Maximum**
1	TDS	mg/L	APHA (2005) 2540 C	1		<50	
2	Chloride	mg/L	APHA (2005) 4500-Cl- B	1		<15	
3	Calcium	mg/L	APHA (2005) 3111 D, 3120 B	0.1		<5	
4	pH	mg/L	APHA (2005) 4500 H+ B	0.1		5.5 - 7.5	
5	Total Hardness	mg/L CaCO3		0.3		<10	30
6	M Alkalinity	mg/L CaCO3	APHA (2005) 2320 B	1		<20	
7	Total Silica (SiO2)	mg/L	APHA (2005) 4500 SiO2F	0.01		<2	
8	Iron	mg/L	APHA (2005) 3111 B, 3113 B, 3120 B	0.01		<0.015	
9	Copper	mg/L	APHA (2005) 3111 B, 3113 B, 3120 B	0.002		<0.05	0.1
10	Total N	mg/L	APHA (2005) 4500 NO3 I	0.005	<1.8 [note 1]	<2.5 [note 1]	
11	Ammonia (free)	mg/L N		0.005		<0.5	
12	Faecal Coliforms	col/100mL	HWC002 (AS/NZS 4276.7:2007	0		Not Detectable	

	Parameter	Unit	Laboratory Test Method	Limit of Detection	Proposed Commitment range 50%ile	90%ile	Maximum
13	Somatic Coliphage	-	Outsourced			Not Detectable	
14	Cryptosporidium	No./50L	HWA001-005	Not detected/50L		Not Detectable	
15	TOC	mg/L	APHA (2005) 5310 C	0.2		<1	
16	Total Phosphate	mg/L	APHA (2005) 4500 P	0.003		<0.05	
17	TSS	mg/L	APHA (2005) 2540 D	1		<2	
18	Chloramine	mg/L				<0.5	1
19	Aluminium	mg/L	APHA (2005) 3113 B	0.01		<0.1	
20	Temperature	degrees				<27	27
21	Potassium	mg/L	APHA (2005) 3111 B	0.1		<3	
22	Zinc	mg/L	APHA (2005) 3111 B	0.002		<0.2 note 2	
12	Fluoride	mg/L	APHA (2005) 4500 F- C	0.1		<0.1	
24	Sulphate	mg/L	APHA (2005) 4500 SO42-E	1		<5	
25	Carbon dioxide	mg/L				<5	
26	Sodium	mg/L	APHA (2005) 3111 B, 3120 B	0.1		<15	
27	Hexavalent Chromium	mg/L				<0.002 note 2	
28	Arsenic	mg/L				<0.002 note 2	

NOTES:

1. Adopted Total Nitrogen Quality Parameter provides a 50th percentile target of <1.8mg/L in addition to a 90th percentile target of <2.5mg/L

2. Changes as per ORICA request dated 28 April 2011

3. Hunter Water have agreed to run a pilot programme in cooperation with Orica to examine the production of colloidal silica through the AWTP and distribution pipe work. No binding target has been set on colloidal silica.

3.2 PROCESS OVERVIEW

3.2.1 PROCESS FLOW DIAGRAM & MASS BALANCES

The process flow diagram and mass balances developed for the Mayfield West AWTP are shown in Appendix B.

Three mass balances were developed:

- Worst Water Quality (KI-CL-PR-001)
- Average Water Quality (KI-CL-PR-002)
- Worst Brine Quality (KI-CL-PR-003)

3.2.2 PROCESS DESIGN CRITERIA

A summary of the consolidated process design criteria is attached in Appendix C. Descriptions of upgrade works required are detailed in the following sections.

- Process Equipment Calculations (KI-CL-PR-005)
- Equipment List (KI-LT-ME-002)
- Chemical Dosing calculations (KI-CL-PR-004)
- Backwash Handling (KI-CL-PR-008)
- Instrumentation List (KI-LT-IC-001)

4.0 HYDRAULIC DESIGN

The product water design flows for this project have been supplied by HWC and are contained in Table 1 above.

The required influent flow rates and the remaining flow balance for the project were developed as part of the TOC and the detailed design phases of the project.

The hydraulic design is based on the Stage 2 flow rates through the MWAWTP. All pipe work is sized to handle Stage 2 flow rates.

4.1 PUMPED FLOWS FROM SHORTLAND WWTW

Chlorinated secondary treated effluent from the Shortland WWTW is pumped using the reclaimed water pumps via the Shortland dechlorination building to the Hunter River. The reclaimed water pumps operate as show in Table 4 below:

Table 4: Reclaimed Water Pumps Operating Information

	Reclaimed Water Pump No. 1	Reclaimed Water Pump No. 2 &3
Operating Configuration	Duty Only	Duty/Assist
Motor Control	VSD	DOL
Min Flow Rate (L/s)	80	250
Operator Set Point Flow Rate (L/s)	135	250
Max Flow Rate (L/s)	135	350 (both pumps running)

Effluent is diverted prior to the Shortland Dechlorination facility to the MWAWTP. This diversion is controlled using two automated valves and water is directed into the Raw Water Tank located at MWAWTP.

4.2 PIPE DETAILS

Details of the major pipelines and flow rates to and from the plant are shown in Table 5: Pipe Details for Stage 2

Of note is that sizing has been primarily based on desirable flow velocities and allowable head loss between structures for Stage 2, with nominal pipe sizes used in the analysis as a conservative approach.

Table 5: Pipe Details for Stage 2

Drawing (15270 series)	Pipeline	Peak Flow in Pipe (L/s)	Nominal Size	Approx Length (m)
	Existing pipe line at Shortland WWTW Dechlorination building to MWAWTP	253	600	740
	Overflow from MWAWTP to Shortland WWTW Dechlorination existing pipeline	253	450	750
	Product Water line to Orica from MWAWTP	180	400	8000
	Brine pipeline to Burwood WWTW	50	250	1160
	Backwash Handling System return to existing manhole (J1739) Mayfield West Pump Station No.3	11	100	30

5.0 RAW WATER INLET AREA

The raw water inlet area consists of the following:

- Incoming rising main;
- Raw Water tank;
- Overflow gravity main to the Hunter River via the existing dechlorination main;
- Return flows from other treatment areas within the MWAWTP (as detailed in Table 6 below).
- MF Feed Pumps

- Chemical Dosing

5.1 INCOMING RISING MAINS

The rising mains shown in Table 6 discharge into the raw water tank:

Table 6: Incoming Rising Mains

Description	Name	Diameter
Major pipelines discharging into Raw Water Tank	Inlet from Shortland WWTW dechlorination building	400
	Combined RO Off Spec and Auto Strainers (commissioning line)	350
	Combined MF Off Spec and MF CIP Flush	400

5.2 OUTGOING MAINS

The rising and gravity mains shown in Table 7 discharge from various locations around the site and combine into one pipe which ultimately discharges to the Hunter River via the existing Hunter River discharge point. The overflows discharged to the Hunter River are dechlorinated using sodium bisulphite (SBS), the discharge flow is recorded via a DN400 magnetic flow meter and the oxygen reduction potential (ORP) of the flows is recorded online. The ORP is used to ensure the dechlorination process occurs successfully. An auto sampler located on the drain line of the flow through ORP wet rack samples flows during a discharge event to the Hunter River. This sample is used to confirm compliance with the EPA discharge licence No. 1683.

Table 7: Outgoing Overflow Mains

Description	Name	Diameter
Major Pipes from the Raw Water Tank to Hunter River	Raw water tank overflow [*1]	450
	Overflows from RO feed tank, CCT and Product water tank[*1] and off-spec discharge from CCT	450
	RO Brine [*1]	250
	Product Water (commissioning line)[*1]	400

*1 Note all of the below pipelines combine into one pipe and do not operate simultaneously.

5.3 RAW WATER TANK

5.3.1 DESIGN

To confirm the raw water tank buffer capability a simple flow balance was carried out based on the dry weather diurnal influent profile at Shortland WWTW. A simplifying assumption was made: that the influent flow would be equivalent to the effluent flow. The actual effluent profile from Shortland will in fact be much smoother for two reasons:

- The operation of the IDAL and the effluent transfer pumps will act to smooth the flow profile
- A portion of the effluent holding basin at Shortland is planned to be used to buffer peak flows.

Recognising these simplifying assumptions make the analysis conservative, the diurnal effluent profile was used to calculate the variation in the Raw Water Tank level. This is show in Figure 1 below.

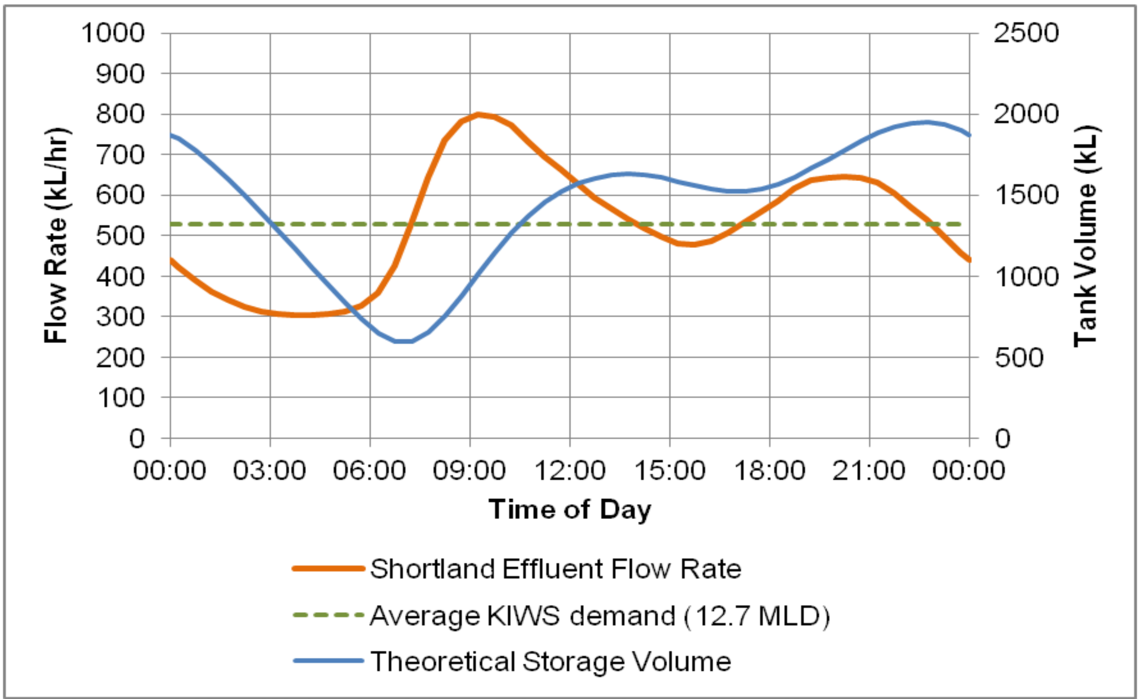


Figure 1 Raw Water Tank Level during dry weather flow operation.

This analysis shows that under dry weather conditions, the Raw Water Tank volume will drop to 595 kL or about 25% of its total capacity during Stage 1.

Based on this analysis of the raw water tank a volume of 2000 kL not negatively impact performance of MWAWTP. The raw water tank provides approximately 4 hours hydraulic retention time at Stage 1 and 3 hours at Stage 2 under average flow conditions of 135L/s.

A DN400 magnetic flow meter was located on the inlet to the raw water tank to accurately record incoming flows into the MWAWTP.

5.3.2 TANK SYNOPSIS

The Raw Water Tank is a 27.75m diameter x 4.77m tall (wall height) HDG Steel panel tank with internal reinforced PVC Elvaloy liner. All process connections are 316 stainless steel and flanged to AS2129 Table D. The tank roof is fully self-supporting and includes an apex-mounted stationary vent for natural ventilation. Two wall mounted vents have been provided for fill and draw air displacement.

For man access purposes two 600dia manways have been included. The first manway is for man access and egress while the second is intended for insertion of forced air ventilation apparatus.

As there are no maintainable items on the roof no permanent means of access to roof has been provided. The stationary vent is designed to operate without inspection and the wall mounted vents can be accessed using a “Cherry-picker” or similar. All level instrumentation has been located at low level for access and maintenance purposes.

The process connections have been located at levels that suit the incoming/outgoing pipework configuration and the location of the horizontal and vertical seams on the tank.

Due to the risk of solids transfer to the tank from Shortland WWTP a drainage sump has been incorporated into the tank design. The sump includes an outlet pipe which has been sized to suit typical tanker camlock connections and enables the tank to be fully drained and "desludged" if required.

5.4 MF FEED PUMPS

The MF feed pumps transfer water from the raw water tank through the auto strainers (Section 5.5) and into the Microfiltration (MF) membrane system.

The MF feed pumps are solids-handling dry mounted centrifugal end suction pumps located outside adjacent to the Raw Water Tank within a sound-proofing enclosure. The pumps operate on a duty/assist/assist/stand-by basis. The MF feed pumps are fitted with variable speed drives to enable the MF system to ramp up and down depending on the number of MF skids online, the flux across them, and the level within the RO feed tank and the raw water tank.

The design basis for the MF Feed pumps is shown in Table 8:

Table 8: MF Feed Pumps Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	Sewatec 150-500G
Number of pumps	No.	4
Number of duty pumps	No.	3
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	68
Head at duty point	m	40
Motor Power	kW	90
Type	-	Dry Mounted end-suction Centrifugal

5.5 RAW WATER SAMPLING

Following discharge from the MF feed pumps online analysis of the raw water for the following parameters occurs:

- pH/Temperature
- Turbidity
- Total Chlorine
- Free Ammonia

All of the online analyzers are located on Wet Rack 2.

5.6 CHLORAMINE DOSING

In order to maintain disinfection residual and prevent microbiological growth through the MWAWTP chloramine dosing occurs upfront of the auto strainers. The auto strainers are used to provide mixing of the chloramines with the raw water prior to the MF system.

Carrier water is added to each separate chemical i.e. sodium hypochlorite and aqueous ammonia, these two diluted streams are then combined in a static mixer, located within the Aqueous Ammonia chemical bund,to form chloramines. The chloramines are dosed at a target dose rate of 2 mg/L.

Chloramine dosing rate is confirmed online post MF feed pumps. The analyser monitors both chloramines and the free ammonia residual of the raw water. The intention is to always maintain a free ammonia residual through the plant to ensure that there is no free chlorine in the raw water which would oxidize the RO membranes.

6.0 AUTO STRAINERS

The auto strainers receive flow from the MF feed pumps and provide physical protection for the MF system by removing all solids greater than 300µm from the flow.

The auto strainers are located outside adjacent to the main process building. The auto strainers have on-line redundancy with a duty/duty/stand-by arrangement, however the units can be operated duty/duty/duty if preferred. The auto strainers are Amiad EBS model type with 300 µm weave wire screens. The auto strainers backwash periodically based on a differential headloss across the screens or on time. Once initiated the auto strainer continuous to screen incoming flows. The backwash process occurs via a rotating suction scanner which removed solids deposited on the screen and diverts them to the backwash drain which ultimately ends up in the backwash handling system pit. The backwash process occurs twice per day and produces approximately 420 L per backwash but is ultimately dependant on operating pressures and solids content of the incoming effluent.

The design basis for the Auto strainers is shown in Table 9:

Table 9: Auto Strainer Design Basis

Parameter	Units	Value
Auto strainer		
Manufacturer	-	Amiad
Model	-	EBS1000
Number of auto strainers	No.	3
Number of duty auto strainers	No.	2
Number of standby auto strainers	No.	1
Screen perforation size	µm	300
Nominal capacity per auto strainer	L/s	137
pH range		6-8
Temperature range	°C	0-40
TSS range	mg/L	12-36
Maximum Chloramine concentration	mg/L	3
Motor Power - backwash drive motor	kW	0.37

7.0 MICROFILTRATION

The microfiltration system is supplied by Pall Australia and consists of 3 skids each skid is configured as outlined in the table 10 below:

Table 10: Microfiltration Design Basis

	STAGE 1	STAGE 2
Membrane Manufacturer	Pall – Asahi (Japan)	
Membrane Type	UNA620A	
Membrane filtration area (m^2)	50	
Flow configuration	Outside - In	
Membrane material	PvDF	
Nominal pore size (micron)	0.1	
Number of membrane modules	85	115
Production Capacity per Skid (kL/d)	4.3	5.6
Net Flux rate (lmh)	45	
Design Instantaneous Flux rate (lmh)	68	
Maximum Instantaneous Flux rate (lmh)	75	

The MF system acts as a pre-treatment stage which removes the suspended solids from the raw water such that the filtrate is suitable for RO treatment.

The MF system is a prevalidated treatment process which can achieve the following log removal values (LRV):

- 0.5 LRV viruses;
- 4 LRV Cryptosporidium;
- 4 LRV Bacteria.

7.1 MEMBRANE INTEGRITY TEST – (MIT)

Integrity testing of hollow fibre module is conducted in accordance with standardized procedures developed at Pall Corporation. These methods have been optimized for modular installations and have proven successful in detecting an integrity breach in systems consisting of over hundreds of thousands of hollow fibres.

In operation, the filtrate quality is constantly monitored to immediately detect a performance change at the system level while an off line pressure hold test provides the ability to isolate and identify a questionable module. These easily implemented procedures ensure system reliability without adding an extensive cost (capital or operating) and maintenance burden on users. Several methods are employed to monitor membrane integrity and treatment reliability.

The integrity monitoring methods used on Pall system include:

- Direct Integrity Testing – air pressure decay test
- Indirect integrity testing by turbidity monitoring

At an adjustable interval, as determined by the operator and programmed into the HMI, the system automatically performs an air pressure hold test on each process block (module + valve Rack). First all valves are closed on the rack. The feed side of the modules is vented, while air is introduced on the downstream side. The air displaces the water in the modules until empty, at which time the pressure attains its set point. The air is then shut off and after a stabilisation period - the rate of decay of the pressure is monitored. If broken fibres are present, the decay rate will be faster than acceptable and the system will alarm.

Upon detection of broken fibres, the block of modules will be isolated for a brief period of time while an air leak test is performed on all modules in the block. For the air leak test, the feed side of the module is drained and air is introduced. Visual tests can be performed while air is introduced in the feed. When air on the filtrate side is observed, the damaged module is repaired through fibre repair pins and the module is put back on line. The automated air pressure hold and air leak tests are effective means of ensuring membrane integrity.

These methods are widely accepted and used throughout the industry.

Even though less sensitive, turbidity monitoring is an indirect method of continuously assessing the membrane integrity by using turbidity as a surrogate. On-line turbidimeter will be connected to the membrane filtration effluent line to monitor the performance of the membrane system. Data from the on-line turbidimeters will be recorded by the PLC. The Pressure Decay Test offers the advantage of high sensitivity, not being affected by changes in feed water quality.

7.2 MF BACKWASH TANK AND PUMPS

The MF system operates in forward flush mode which removes the suspended solids. Periodically the MF system carries out backwash or reverse flush cycles which remove the captured suspended solids from the membrane surface and diverts them to the backwash handling system for disposal off site. The MF backwash process utilizes MF filtrate which is stored in the MF backwash tank with a storage capacity of 10kL. Dedicated MF backwash pumps in a duty/standby configuration pump MF filtrate across the membranes in the inside – out flow pattern. Air is added to the backwash water to physically scour the suspended solids from the membrane pores (refer to Section 24.1 for air compressor information). The MF backwash occurs for approximately 2 mins every 30 mins depending on the solids loading of the system.

The design basis for the MF backwash tank and pumps is shown in Table 11:

Table 11: MF Backwash Tank and Pumps Design Basis

Parameter	Units	Value
Tank		
Volume	kL	10
Pump		
Manufacturer	-	KSB
Model	-	Elite 125-32
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1

Parameter	Units	Value
Nominal capacity per pump	L/s	42.5
Head at duty point	m	21
Motor Power	kW	22
Type	-	Dry Mounted end-suction Centrifugal
Tank Heater		
Type	-	Flanged Immersion
Connection Diameter	mm	200
Power	kW	106

7.3 MF CLEAN IN PLACE (CIP) SYSTEM

The MF system is cleaned using a combination of warmed filtrate and chemicals to assist in the removal of the following:

- Organic matter: Caustic / Chlorine Solution
- Dissolves inorganic matter such as hardness and metals (iron): Citric Acid Solution:

The Enhanced Flux Maintenance (EFM) and Clean In Place (CIP) processes both use the same equipment. EFM occurs daily for approximately 60 mins with CIP taking approximately 3.5 hours and occurring on a monthly or as required basis.

The design basis for the MF CIP system is shown in Table 12:

Table 12: MF CIP System Design Basis

Parameter	Units	Value
Tank		
Volume	kL	10
Pump		
Manufacturer	-	KSB
Model	-	ISO 100-65-315
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	23.6
Head at duty point	m	31
Motor Power	kW	15
Type	-	Dry Mounted end-suction Centrifugal

8.0 RO FEED TANK AREA

The RO Feed Tank area consists of the following:

- Incoming rising main from the Process Building;
- Overflow gravity main;
- Outlet main to the LP RO Feed Pumps.
- LP RO Feed Pumps
- Cartridge Filters
- Chemical Dosing

8.1 INCOMING MAINS

The rising mains shown in Table 13a discharge into the RO Feed tank:

Table13a: Incoming Rising Mains

Description	Name	Diameter
Major pipeline discharging into RO Feed Tank	RO Feed Tank feed rising main	400

8.2 OUTGOING MAINS

The mains shown in Table 13b discharge from the RO Feed tank.

Table 13b: Outgoing Mains

Description	Name	Diameter
Major Pipes from the RO Feed Tank	RO Feed Tank outlet main	400
	Overflow from RO Feed Tank	400

8.3 RO FEED TANK

8.3.1 DESIGN

The RO feed tank is required to balance out the irregular flow from the MF unit. The MF flow is irregular due to the regular (and automatic) maintenance operations. Regular automated operations include:

- Backwashes – A reverse flow of water to remove any accumulated solids on the membrane surface. These are expected to occur approximately every 20 minutes lasting about 2 minutes.
- EFM Cleans – Enhanced Flux Maintenance Cleans daily are chemical backwashes, lasting about 60 minutes, which are done to remove any accumulated foulants not removed through regular backwashing.
- CIP Cleans – To remove more stubborn foulants, the train is taken offline for about 3.5 hours while it is soaked in a high strength chemical solution. CIP cleans are proposed to be carried out monthly.

- MIT – A Membrane Integrity Test is an operation where the membrane is taken offline and pressurised with compressed air to identify any membrane damage or defects. This operation will take place as required to ensure membrane integrity. It is expected to last about 15 minutes.

To confirm the proposed 700 kL RO Feed Tank is sufficient to balance out the fluctuations in production cause by these operations, several scenarios were developed. As part of the scenario analysis a complete MF train failure was also considered. This could be a failure of the membrane itself or a mechanical component on the train (valve, pump etc.) which prevents the train from operating normally.

Ten scenarios were developed to cover the range of possible operational conditions and include:

1. Base Case of normal operation (with regular backwashes on each train)
2. One train in EFM, two trains in normal operation
3. One train in CIP, two trains in normal operation
4. One train in MIT, two trains in normal operation
5. One train in CIP, one in MIT and one in normal operation
6. One train offline, two trains in normal operation
7. One train in EFM, one train offline, one train in normal operation
8. One train in CIP, one train offline, one train in normal operation
9. One train in MIT, one train offline, one train in normal operation
10. One train in CIP, one in MIT and one train offline

Several assumptions were made regarding the operation of the MF system. These were based on the available information within the MF and RO tenders and conversations with the MF supplier. Actual operation may be different, but these assumptions are likely conservative:

- Backwashes will occur every 20 minutes, lasting 2 minutes at the maximum backwash flow rate
- EFMs will last for 60 minutes
- CIP will last for 3.5 hours and consume 210 kL of treated water
- MITs will last for 15 minutes

The goal of the analysis was to confirm the adequacy of the proposed tank size. The approach taken was to calculate the change in the RO Feed Tank Volume under the 10 scenarios identified above. This was done for both Stage 1 and Stage 2 with the results are presented in Table 13: RO Feed Tank Analysis Under Stage 1

and Table 14: RO Feed Tank Analysis Under Stage 2

Table 13: RO Feed Tank Analysis Under Stage 1

Scenario	1-Base	2-EFM	3-CIP	4-MIT	5-CIP & MIT	6-MF Failure	7-EFM with MF Failure	8-CIP with MF Failure	9-MIT with MF Failure	10-CIP & MIT with MF Failure
MF trains available	3	3	3	3	3	2	2	2	2	2
Scenario Duration (min)	60	90	240	60	240	60	90	240	60	240
MF Flux (LMH) Required[1]	48	69	66	49	63	69	116	120	73	112
RO Feed Tank Volume Change (kL)[2]	0	0	0	0	0	0	-326	-784	0	-675

Table 14: RO Feed Tank Analysis Under Stage 2

Scenario	1-Base	2-EFM	3-CIP	4-MIT	5-CIP & MIT	6-MF Failure	7-EFM with MF Failure	8-CIP with MF Failure	9-MIT with MF Failure	10-CIP & MIT with MF Failure
MF trains available	3	3	3	3	3	2	2	2	2	2
Scenario Duration (min)	60	90	240	60	240	60	90	240	60	240

[1] *Flux require to meet RO feed flow requirement of 12 MLD by scenario end*

[2] *Assuming MF operates at the maximum flux of 75 LMH*

MF Flux (LMH) Required[3]	46	64	64	48	61	67	109	117	72	110
RO Feed Tank Volume Change (kL)[2]	0	0	0	0	0	0	-366	-989	0	-864

[3] *Flux required to meet RO feed flow requirement of 16 MLD by scenario end*

Looking at Table 13: RO Feed Tank Analysis Under Stage 1

and Table 14: RO Feed Tank Analysis Under Stage 2

it is clear that the MF system is able to meet the RO feed requirements under all scenarios, provided 3 trains are in operation (Scenarios 1 through 5). Note this requires the MF system to increase the flux to meet the RO demand. In reality it is more likely that some of this storage will be used to reduce the required peak flux.

In the event that an MF train fails (Scenarios 6 through 10) the RO Feed Tank is be sufficiently sized, provided an CIP is not required. Performing a CIP while a train is offline is an unlikely scenario and can usually be avoided.

Under the more likely scenarios (Scenarios 7, 9 and 10) the RO Feed Tank level will decrease about 350 kL – substantially less than the proposed RO Feed Tank storage volume. A level of conservatism was included in the RO feed tank sizing based on operational experience at other plants.

8.3.2 TANK SYNOPSIS

The RO Feed Tank is a 12.0m diameter x 7.666m tall (wall height) HDG Steel panel tank with internal reinforced PVC Elvaloy liner. All process connections are 316 stainless steel and flanged to AS2129 Table D. The tank roof is fully self-supporting and includes an apex-mounted stationary vent for natural ventilation. One wall mounted vent has been provided for fill and draw air displacement.

For man access purposes two 600dia manways have been included. The first manway is for man access and egress while the second is intended for insertion of forced air ventilation apparatus.

As there are no maintainable items on the roof no permanent means of access to roof has been provided. The stationary vent is designed to operate without inspection and the wall mounted vent can be accessed using a “Cherry-picker” or similar. All level instrumentation has been located at low level for access and maintenance purposes.

The process connections have been located at levels that suit the incoming/outgoing pipework configuration and the location of the horizontal and vertical seams on the tank.

9.0 ACID DOSING PRE-REVERSE OSMOSIS

In order to reduce scaling of the RO membranes sulphuric acid dosing occurs upfront of the RO system.

Carrier water is added to the sulphuric acid to dilute to reduce health and safety issues with acid dosing around site. The sulphuric acid is dosed to achieve a target pH of 6.5. The pH is monitored with an online pH meter.

10.0 ANTISCALANT DOSING PRE-REVERSE OSMOSIS

In order to reduce scaling of the RO membranes antiscalant dosing occurs upfront of the RO system.

The antiscalant MDC700 is propriety chemical supplied by GE and is dosed at a target of 2 mg/L with a maximum dose rate of 4.5mg/L.

10.1 LP RO FEED PUMPS

The LP RO pumps transfer water from the RO Feed Tank through the cartridge filters and HP RO Feed pumps into the RO system.

The LP RO Pumps are dry mounted centrifugal end suction pumps located outside adjacent to the RO Feed Tank within a sound-proofing enclosure. The pumps operate on a duty/assist/assist/assist/stand-by basis. The LP RO pumps are designed to provide sufficient head to pump through the cartridge filters and maintain a minimum of 10m(g) suction head at the HP RO Pumps. The pumps operate as fixed speed units with their outputs controlled by the HP RO Pumps that operate variable speed.

Although pumping into a common discharge manifold, each LP RO pump is sized to serve one RO train such that the number of LP RO pumps in operation matches the number of RO trains in operation.

Table 15: RO LP Feed Pumps Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	Elite 100-26
Number of pumps	No.	5
Number of duty pumps	No.	4
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	37 L/s
Head at duty point	m	22.5
Motor Power	kW	15
Type	-	Dry Mounted end-suction Centrifugal

10.2 RO CARTRIDGE FILTERS

To mitigate the risk of solids being pumped into the RO trains causing mechanical failure of the membranes cartridge filters have been included between the LP and HP RO Feed pumps. There are 3 horizontally mounted cartridge filters units each sized for 50% of maximum flow but operating duty/duty/duty (operator adjustable).

Each cartridge filter consists of three 60" long cartridges that provide nominal filtration to 1µm (absolute filtration to 4.5µm).

Table 16: RO Cartridge Design Basis

Parameter	Units	Value
Cartridge Filter		
Manufacturer	-	Pall Corporation
Model	-	3HFHK-6G129J-CH13006
Nominal filter pore size	µm	1
Number of cartridge filters	No.	3
Number of duty cartridge filters	No.	2
Number of standby cartridge filters	No.	1
Maximum capacity per cartridge filter	L/s	95
Maximum pressure drop before cartridge replacement	m	10

11.0 REVERSE OSMOSIS

The RO system allows pure water to pass through the membrane and retains the dissolved mineral salts, bacteria, and other particles no matter how fine. MF filtrate is forced through the RO membrane with a combined pump and cartridge configuration as shown below:

- Low Pressure (LP) RO feed pumps (refer section 13.1)
- Cartridge filters (refer section 13.2)
- High Pressure (HP) RO feed pumps

11.1 HP RO FEED PUMPS

The HP RO pumps provide the necessary increase in pressure to achieve the required osmotic pressure across both stages of the RO membranes.

The HP RO Pumps are dry mounted multistage centrifugal end suction pumps located within the HP RO pump and compressed air system room adjacent to the main process room within the Process Building. The pumps are arranged to provide a dedicated HP pump per RO train. No online stand-by is provided, however there is one cold (uninstalled) stand-by pump located within the HP RO pump room to allow quick pump replacement in the event of a pump failure.

The pumps each operate with variable speed starters and are controlled based on the output flow rate of the relevant RO train to which they are connected. There are a number of parameters that may alter the pump speed including:

1. Inlet (suction) pressure
2. Fouling factor on the RO membranes
3. Temperature of the treated water
4. Required flux across the membranes

The pumps are manufactured with all wetted parts 316 stainless steel. This is to ensure that no iron-based corrosion products generated from rusting of cast iron, both during operation and when off line, can cause fouling or damage to the membranes by acting as a catalyst for membrane oxidation by monochloramine.

Table 17: RO HP Feed Pumps Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	Multitec A 100/2-8.1 30-63
Number of pumps	No.	5
Number of duty pumps	No.	4
Number of standby pumps	No.	1 (cold stand-by)
Nominal capacity per pump	L/s	38 L/s
Minimum head at nominal capacity	m	53
Design head at nominal capacity	m	70
Maximum head at nominal capacity	m	145
Motor Power	kW	90
Type	-	Dry Mounted multistage Centrifugal

11.2 RO SYSTEM

The purified water passes through the membrane to process or second pass RO units while the concentrated mineral salts are rejected to the low quality RO Reject. The MWAWTP RO system comprises of the 4 trains at Stage 1 and a 5 trains at Stage 2 as outlined in the table 15 below:

Table 18: RO Design Basis

	STAGE 1	STAGE 2
Membrane Manufacturer	Hydranautics	
Membrane Type	ESPA2-LD	
Membrane filtration area (m^2)	37.1m^2	
Flow configuration	Stage 1- 14 vessels Stage 2 - 8 vessels	
Membrane material	Composite Polyamide	
Nominal pore size	0.001 µm	
Minimum salt rejection	99.5%	
Number of modules per Train	154	
Number of membrane modules	616	770
Production Capacity per Skid (kL/d)	2.3	2.4
Recovery	75%	
Net Flux rate (lmh)	16.4	
Maximum operating pressure	4.16 MPa	

The RO system can achieve the following log removal values (LRV):

- 1 LRV viruses using online EC measurement as a surrogate.

11.3 RO FLUSH PUMPS

On a shut down it is necessary to remove the brine from the RO membranes immediately. In order to remove the brine the RO undergoes a flush using a volume of approximately 15m^3 per train of RO permeate stored in the degas sump. Each RO train is flushed for approximately 15 mins to remove any salts deposited on the membranes.

The RO Flush Pumps are dry-mounted end-suction centrifugal pumps operating fixed speed in a duty/stand-by arrangement. They are located alongside the CCT Feed pumps and Process Water pumps within a sound-proofing enclosure by the Degas Sump.

There are a number of situations where a flush cycle needs to be initiated. Typically it will occur as a train is taken off-line during low flow periods. However, consideration for a site power failure event was required. To mitigate this issue one of the RO Flush pumps is powered by a diesel engine. Control of the pump is via the site switchboard, as per all other pumps, but it is capable of operating a complete flush cycle for all RO trains in the event of a power failure. Its fuel tank is a double-contained 80L vessel that will provide one month's service between re-fills based on an operating philosophy agreed with HWC.

The design basis for the RO Flush pumps is shown in Table 19:

Table 19: RO Flush Pumps Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	Electric: ISO125x80-400 Diesel: ISO80x50-250
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	20
Head at duty point	m	45
Motor Power	kW	Electric: 22 Diesel: N/A
Type	-	Dry Mounted Centrifugal

11.4 RO CLEAN IN PLACE (CIP) SYSTEM

The RO system is cleaned using a combination of warmed filtrate and chemicals to assist in the removal of the following:

- Organic matter: Caustic / EDTA Solution
- Dissolves inorganic matter such as hardness and metals (iron): Citric Acid/HCl Solution:

The CIP takes approximately 8 hours per train and occurs on a 3 monthly or as required basis.

The RO CIP feed pipework into the RO trains also includes a cartridge filter similar to those used on the RO Feed pipeline. The unit ensures that no solids from the recirculating CIP process are able to return to the membranes potentially causing damage.

The design basis for the RO CIP system is shown in Table 20:

Table 20: RO CIP Pumps Design Basis

Parameter	Units	Value
Tank		
Volume	kL	10
Pump		
Manufacturer	-	KSB
Model	-	ISO125X100-400
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	35
Head at duty point	m	41

Parameter	Units	Value
Motor Power	kW	30
Type	-	Dry Mounted Centrifugal
Tank Heater		
Type	-	Flanged Immersion
Connection Diameter	mm	200
Power	kW	53
Cartridge Filter		
Manufacturer	-	Pall Corporation
Model	-	2HFHK-6G97H13 - CH13008
Nominal filter pore size	µm	1
Number of cartridge filters	No.	1
Number of duty cartridge filters	No.	1
Number of standby cartridge filters	No.	0
Design flow capacity	L/s	37
Maximum pressure drop before cartridge replacement	m	10

11.5 RO PERMEATE SAMPLING

Following discharge from the RO online analysis of the combined RO permeates for the following parameters occurs:

- pH
- Conductivity

All of the online analyzers are located on a wet rack.

12.0 DEGAS TOWER AND SUMP AREA

The degas tower and sump area consists of the following:

- Incoming rising main;
- Degas tower with fans;
- Degas sump;
- Overflow gravity main;
- CCT Pumps
- RO Flush Pumps(refer section 11.3)
- Process Pumps.
- Chemical Dosing

12.1 DEGAS TOWER RISING MAINS

The rising mains shown in Table 21 discharge at the bottom of the product water tank:

Table 21: Incoming Rising Mains

Description	Name	Diameter
Major pipeline discharging into Degas Tower	Degas Tower feed rising main	350 (splits into 2x 250dia distribution pipe connections at the tower inlet)

12.2 OUTGOING MAINS

The rising and gravity mains shown in Table 22 discharge from the Degas Sump tank.

Table 22: Outgoing Mains

Description	Name	Diameter
Major Pipes from the Degas Sump	Degas Sump outlet main to the common suction header to the CCT, RO Flush and Process Water Pumps	400
	Overflow from degas sump to Backwash Handling	350

12.3 DEGAS TOWER

The degas tower is required to remove CO_2 from the RO permeate in order to meet the required effluent water quality. The permeate enters the Degas Tower at a high level and is distributed across the footprint area of the tower by way of a trough distribution system before dropping through the tower under gravity. Air, introduced into the tower at low level, passes up through the RO permeate which is travelling in the opposite direction. Internal packing media within the tower assists in maximising the exposure of the permeate with the air and ensures CO_2 is brought out of solution and released as a gas.

Air is introduced via low pressure fans operating fixed speed in a duty/standby arrangement. Each fan is fitted with a two-stage inlet air filter and silencer on the suction side and a flow damper, non-return damper and flexible coupling on the discharge side.

In order to prevent droplets of permeate from being emitted from the Degas Tower to the surrounding area a mist eliminator has been included.

Table 23a provides details of the Degas Tower and Fan systems.

Table 23a: Degas Tower and Fan System Information

Parameter	Units	Value
Degas Tower		
Manufacturer	-	Cleanteq
Type	-	Tower with internal trough distributor
Packing Media	-	Plastic medium with surface area 132.5 m2/m3
Minimum Permeate Flow Rate	L/s	104
Design Permeate Flow Rate	L/s	138
Maximum Permeate Flow Rate	L/s	156

Parameter	Units	Value
Maximum permissible CO_2 in degassed permeate	Mg/L	5
Degas Fans		
Manufacturer	-	Aerovent
Model	-	BCAI-710/100-100
Design Air Flow	m3/hr	12,000
Design Air Pressure differential across fan	Pa	850
Motor power rating	Kw	7.5
Inlet Filter rating	To ASHRAE 52.2	1st Stage: MERV 5 2nd Stage: MERV 9

12.4 DEGAS SUMP

12.4.1 DESIGN

The degas tower is mounted on a steel supporting structure which allows for “degassed” flow to gravitate directly into the adjacent Degas Sump which has a storage capacity of 80kL. Table 23b below contains the information used to size the degas sump, primarily this is based on the flushing volumes required for the RO system on a shut down.

Table 23b: Degas Sump Sizing Information Stage 2

From	In	Out
RO Permeate 5 trains operating	34.7-36.7L/s per train 173.5-183.5 L/s per train	
CCT Feed pumps		173.5-183.5 L/s
Process Water Pumps		10 L/s
RO Flush volume per train *		15kL per Train Total – 75kL
Total Degas Sump Volume (kL)		80 kL

12.4.2 TANK SYNOPSIS

The Degas Sump is an 8.25m diameter x 2.425m tall (wall height) HDG Steel panel tank with internal reinforced PVC Elvaloy liner. All process connections are 316 stainless steel and flanged to AS2129 Table D. The tank roof is fully self-supporting and includes an apex-mounted stationary vent for natural ventilation. Five wall mounted vents have been provided for fill and draw air displacement.

For man access purposes two 600dia manways have been included. The first manway is for man access and egress while the second is intended for insertion of forced air ventilation apparatus.

As there are no maintainable items on the roof no permanent means of access to roof has been provided. The stationary vent is designed to operate without inspection and the wall mounted vents can be accessed using scaffolding. All level instrumentation has been located at low level for access and maintenance purposes.

The process connections have been located at levels that suit the incoming/outgoing pipework configuration and the location of the horizontal and vertical seams on the tank.

12.5 CCT FEED PUMPS

The CCT Feed pumps transfer water from the degas sump to the CCT and ultimately to the product water tank.

The CCT feed pumps are located outside adjacent to the Degas Sump within a sound-proofing enclosure. The CCT feed pumps have on-line redundancy with a duty/assist/stand-by arrangement. The CCT feed pumps were fitted with variable speed drives to enable a level set point to be maintained within the degas sump.

The design basis for the CCT feed pumps is shown in Table 23c:

Table 23c: CCT Feed Pumps Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	ISO HD150X125-250
Number of pumps	No.	3
Number of duty pumps	No.	2
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	70
Head at duty point	m	12
Motor Power	kW	15
Type	-	Dry Mounted Centrifugal

12.6 pH ADJUSTMENT

The RO permeate leaving the RO is at an approximate pH of 5.9 and following the removal of the CO_2 the pH will increase slightly to 6.5 however the in order to ensure the corrosively of the final product water does not affect the distribution pipeline a target pH of 7 is desirable. As such caustic soda is dosed to achieve a target pH of 7. The pH is monitored with an online pH meter.

12.7 PROCESS WATER PUMPS

A process water system is provided using RO permeate which has passed through the degas tower.

The process water system provides water for the following applications:

- Process water to fill the MF CIP tank
- Process water directly into the MF CIP pipeline for MF cleaning procedures
- Process water to fill the RO CIP tank

Two dry-mounted end-suction centrifugal pumps running fixed speed operating in a duty/standby configuration are located adjacent to the CCT Feed and RO Flush pumps.

A DN100 magnetic flow meter is located on the outlet to the process water pumps to accurately record flows used.

The design basis for the process water pump station is shown in Table 23d:

Table23d: Process Water Pump Station Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	ISO100X65-200
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Nominal capacity per pump	L/s	24
Head at duty point	m	12.3
Motor Power	kW	5.5
Type	-	Dry Mounted Centrifugal

13.0 CCT AREA

The Chlorine Contact Tank (CCT) area consists of the following:

- Incoming rising main from the CCT Pumps
- CCT
- CCT Overflow gravity main
- Outlet main to Product Water tank.

13.1 CCT RISING MAINS

The rising mains shown in Table 24 discharge into the CCT:

Table 24: Incoming Rising Mains

Description	Name	Diameter
Major pipeline discharging into CCT	CCT feed rising main	350

13.2 OUTGOING MAINS

The rising and gravity mains shown in Table 25 discharge from the CCT.

Table 25: Outgoing Mains

Description	Name	Diameter
Major Pipes from the CCT	CCT outlet gravity main to the Product Water Tank	450
	Overflow from CCT	450

13.3 CHLORINE CONTACT TANK (CCT)

13.3.1 DESIGN

The RO permeate is pumped through the CCT and from there discharges via a high level overflow bellmouth into the Product Water Tank. The CCT iprovides 700kL in volume and at average flows provides a hydraulic retention time of 112 mins at Stage 1 flows and 84 mins at Stage 2 flows. The CCT has a distribution manifold fitted at the bottom of the tank which enables an even flow distribution to be achieved within the tank. This distribution pattern will enable a baffle factor for the tank of 0.3 to be achieved.

In order to achieve the required log removal value (LRV) for viruses, free chlorine will be dosed directly into the feed main upstream of the CCT. The required dose or *Ct* (disinfectant concentration X time) for chlorine inactivation of coxsackievirus 5 is 11.5 mg.mins/L at a pH of less than 7.5 with a water temperature of greater than 5°C (Black *et al.,* 2009).

The aim of the CCT is to achieve 4 Log virus removal by chlorine inactivation. Chlorine will be dosed in the form of sodium hypochlorite (refer to chemical dosing). As the chlorine is added the following reactions will occur resulting in chlorine decay:

- Break point chlorination of the residual chloramines in the RO permeate (assumed at 1 mg/L as monochloramines)
- Break point chlorination of free ammonia remaining in the RO permeate (assumed at 0mg/L as N)
- Inactivation of viruses to 4 LRV based on a *Ct* value of 11.5mg/L.min with a pH of ≤7.5 and a temperature of ≥ 5°C.
- Chlorine decay as a function of hydraulic retention time in the CCT assumed to be 0.2mg/L

The “*Ct* value” which is calculated by the C, in mg/L as determined at the end of the process, with the corresponding “disinfection contact time” T, in minutes.

Temperature pH and total chlorine are monitored into the CCT to free chlorine residual is monitored post CCT to confirm the Ct value.

A DN300 magnetic flow meter is located on the feed main to the CCT to accurately record flows into, and out of, the CCT so that the hydraulic retention time of the CCT to be calculated.

13.3.2 TANK SYNOPSIS

The CCT is a 9.75m diameter x 11.182m tall (wall height) HDG Steel panel tank with internal reinforced PVC Elvaloy liner. All process connections are 316 stainless steel and flanged to AS2129 Table D. The tank roof is fully self-supporting and includes an apex-mounted stationary vent for natural ventilation. One wall mounted vent has been provided for fill and draw air displacement. All internal exposed roof steelwork and part of the top wall panelling has been epoxy coated to prevent corrosion due to concentrated chlorine build up through repetitive condensation and evaporation on the steelwork surfaces.

For man access purposes two 600dia manways have been included. The first manway is for man access and egress while the second is intended for insertion of forced air ventilation apparatus.

As there are no maintainable items on the roof no permanent means of access to roof has been provided. The stationary vent is designed to operate without inspection and the wall mounted vent can be accessed using a “Cherry-picker” or similar. All level instrumentation has been located at low level for access and maintenance purposes.

The process connections have been located at levels that suit the incoming/outgoing pipework configuration and the location of the horizontal and vertical seams on the tank.

The internal distribution manifold is a DN350 stainless steel pipe with 300x 15mm dia holes drilled across its length. This ensures even distribution across the tank.

13.4 CCT SAMPLING

Online analysis record the water quality of the following parameters into and out of the CCT to ensure breakpoint chlorination occurs to achieve the required LRV:

- pH into the CCT;
- Temperature into the CCT;
- Total Chlorine in to the CCT;
- Free Chlorine out of the CCT.

All of the online analyzers with the exception of the temperature probe, which is located in pipe, are located on a wet rack.

14.0 DECHLORINATION

Following breakpoint chlorination through the CCT dechlorination is required to achieve the final product water target chlorine residual of less than 0.5mg/L. This is achieved by dosing sodium bisulphite to the chlorinated water. Mixing occurs via a static mixer and into the product water tank. The total chlorine is monitored with an online total chlorine analyser.

In addition prior to entering the product water tank the product water is monitored for final pH and conductivity using online analsyers located on a wet rack.

15.0 PRODUCT WATER TANK AREA;

The product water area consists of the following:

- Incoming rising main from the CCT
- Product Water tank
- Product Water overflow gravity main
- Product Water Pumps
- Service Water Pumpset
- Chemical Dosing
- Delivery rising main to Orica (final user)

15.1 PRODUCT WATER RISING MAINS

The rising mains shown in Table 26 discharge into the Product Water tank:

Table 26: Incoming Rising Mains

Description	Name	Diameter
Major pipeline discharging into Product Water Tank	CCT discharge rising main	400

15.2 OUTGOING MAINS

The rising and gravity mains shown in Table 27 discharge from the Product Water tank.

Table 27: Outgoing Mains

Description	Name	Diameter
Major Pipes from the Product Water Tank	Product water outlet main to the common suction header to the Product Water and Service Water pumps	400
	Overflow from Product water tank	400

15.3 PRODUCT WATER TANK

15.3.1 DESIGN

The product water tank provides4200kL storage equating to approximately 12 hours hydraulic retention time at Stage 1 and 9 hours at Stage 2 under average flow conditions of 139L/s.

A DN350 magnetic flow meter was located on the outlet to the product water tank to accurately record flows into the Orica site. A second magnetic flow meter located at the Orica tank is used as the custody transfer metering point for the Orica site.

15.3.2 TANK SYNOPSIS

The Product Water Tank is a 27.75m diameter x 8.84m tall (wall height) HDG Steel panel tank with internal reinforced PVC Elvaloy liner. All process connections are 316 stainless steel and flanged to AS2129 Table D. The tank roof is fully self-supporting and includes an apex-mounted stationary vent for natural ventilation. Two wall mounted vents have been provided for fill and draw air displacement.

For man access purposes two 600dia manways have been included. The first manway is for man access and egress while the second is intended for insertion of forced air ventilation apparatus.

As there are no maintainable items on the roof no permanent means of access to roof has been provided. The stationary vent is designed to operate without inspection and the wall mounted vent can be accessed using a “Cherry-picker” or similar. All level instrumentation has been located at low level for access and maintenance purposes.

The process connections have been located at levels that suit the incoming/outgoing pipework configuration and the location of the horizontal and vertical seams on the tank.

15.4 PRODUCT WATER PUMPS

The product water pumps transfer water from the product water tank to the end user Orica.

The product water pumps are located outside adjacent to the Product Water tank. The product water pumps have on-line redundancy with a duty/ stand-by arrangement. The product water pumps were fitted with variable speed drives to enable a level set point to be maintained within the Orica tank.

The design basis for the product water pumps is shown in Table 28:

Table 28: Product Water Pumps Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	139
Head at duty point	m	450
Motor Power	kW	
Type	-	Dry Mounted Centrifugal

15.5 PRODUCT WATER SAMPLING

Following discharge from the product water pumps online analysis of the product water for the following parameters occurs:

- pH;
- Conductivity;
- Temperature;
- Turbidity;
- Total Chlorine.

All of the online analyzers with the exception of the temperature probe, which is located in pipe, are located on a wet rack.

15.6 SERVICE WATER

A service water system is provided using product water stored in the product water tank. Two vertical multistage centrifugal pumps are installed operating on variable speed drives in a duty/standby configuration.

The service water system provides water for the following applications:

- Carrier water for the sulphuric acid dosing
- Carrier water for the chloramine dosing using aqueous ammonia
- Carrier water for the chloramine dosing using sodium hypochlorite
- Hose reals for wash down around the MWAWTP

The service water system is provided as a complete skid including interconnecting pipework and valves as well as a 100L accumulator vessel. The vessel is manufactured in accordance with AS1210 and is required to be registered as a pressure vessel with WorkCover.

15.6.1 DESIGN BASIS

The design basis for the service water pumpset is shown in Table 29.

Table 29: Service Water Pumpset Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	Movitec VSF 24/16
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1
Minimum capacity per pump	L/s	1.1
Nominal capacity per pump	L/s	7.1
Head at duty point	m	65
Motor Power	kW	11
Type	-	Vertical multistage centrifugal
Accumulator Vessel		
Manufacturing standard	-	AS1210
Volume	L	100

16.0 CHEMICAL NEUTRALISATION SYSTEM;

The Neutralisation Tank is an above ground FRP tank with an active storage capacity of 30KL. The tank is designed to collect both MF and RO Clean-In-Place (CIP) washes and provides a location for neutralisation prior to discharge to the backwash handling system. The tank is fitted with a two level sensors operating in duty/duty operation. External to the tank two neutralisation pumps, dry mounted centrifugal pumps operate in a duty/standby configuration as shown in Table 30.

The pH and Total chlorine residual within the tank is monitored online during the mixing by the neutralisation pump. The operator then determines which neutralisation chemical is required i.e. the addition of acid to reduce the pH from 14 to 7 or the addition of caustic soda to increase the pH from 2 to 7 or the addition of SBS to reduce the total chlorine residual to 0 mg/L.

Once neutralised the content of the tank is gravity transferred to the backwash handling system.

Table 30: Chemical Neutralisation Pumps Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	ISO150x125-250
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1

Parameter	Units	Value
Nominal capacity per pump	L/s	33.3
Head at duty point	m	5.4
Motor Power	kW	5.5
Type	-	Dry Mounted Centrifugal

17.0 BACKWASH HANDLING SYSTEM

17.1 BACKWASH HANDLING PIT

Following final selection of both the membrane vendors in PALL for the MF and GE for the RO the detailed design volumes required was as contained in Table 31 below. Both the backwash volumes from the MF and chemical neutralisation volumes increased at detailed design when compared to TOC design based on Stage 2 volumes provided by the vendors. The MF backwash at Stage 2 increases to 7kL and the chemical neutralisation tank increased to 30kL. At TOC the assumption were 3 kL backwash and 15kL chemical neutralisation tank.

In addition to the pumped flows there are various gravity flows which also need to pass into the backwash handling system. Two of these are overflows from the degas sump and the chemical neutralisation tank. Calculating overflow scenarios with regards a volume is difficult as the duration of the events can vary depending on numerous factors. These factors are identified below in Table 31 and apportioned a volume.

Table 31: Overflow Information

Source of Gravity Flow	Max Flow (L/s)	Cause of flow	Duration	Potential total Flow (kL)	Frequency/ Risk of Occurrence
Floor drains in main process building – Hose wash down	4	1. Hose down for maintenance purposes	5 mins	1.2	High
		2. Hose left on by accident	1 hour	7.2	Low
Degas Sump Overflow	147	1. CCT Feed Pumps failure but level sensors operating and shut down RO on HH	1 min	9	Low
		2. Operators closed valve on outlet to degas sump to CCT feed	indefinitely	530 kL/hr	Low
		3. Failure of both level indicators in the degas sump and CCT pumps fail and power failure on switch room 2 but not switch room 1 so the RO is operational but downstream is not.	indefinitely	530 kL/hr	Low
		4. Power failure of switch board 2 which controls all	indefinitely	530 kL/hr	Low

Source of Gravity Flow	Max Flow (L/s)	Cause of flow	Duration	Potential total Flow (kL)	Frequency/ Risk of Occurrence
		of the degas sump instrumentation and CCT feed pumps. Whilst RO feed pumps remain operational as power supplied from switch room 1.			
Chemical Neutralisation Overflow	33.3	1. Chemical neutralisation tank full with 2 No. CIP volumes and 3rd CIP underway.	7 mins	14 kL	Low
		2. Chemical neutralisation tank level sensors fail and PLC does not flag a discrepancy.	7 mins	14 kL	Low

All of the above assumptions with the exception of the hose wash down for maintenance present a very low risk of occurring and also require multiply system failures to occur for the level with in the tanks not to be detected by the instrumentation provided.

As such the above assumptions where used in sizing the backwash handling system volume as shown in Table 32.

Table 32: Detailed Design Volumes and Flows Stage 2

Waste Stream	Pumped or Gravity flow	Max Flow Rate	Units	Duration of Activity	Volumes discharged over a 1 hour period		
MF Backwash instantaneous rate Air Scour High Rate	Pumped	95.8	L/s	27 secs/ backwash	17	kL	Assumes 6 backwashes per hour assuming all 3 trains backwash twice
MF Backwash instantaneous rate low rate	Pumped	57.5	L/s	1 min/ backwash	21	kL	Assumes 6 backwashes per hour assuming all 3 trains backwash twice
Neutralisation Tank dump	Pumped	33.3	L/s	14.8 minutes	30	kL	Assumes neutralisation tank dumped at maximum flow
Instrumentation drains	Gravity	0.3	L/s	52 instrument s at	1.2	kL/hr	

Waste Stream	Pumped or Gravity flow	Max Flow Rate	Units	Duration of Activity	Volumes discharged over a 1 hour period	
				400ml/min		
Floor drains in main process building – Hose wash down	Gravity	4	L/s	Assumes 2 hoses running	1.2	5 mins
Degas Sump Overflow	Gravity	147	L/s	Based 300mm Freeboard		Dependant on overflow scenario
Chemical Neutralisation Overflow	Gravity	33.3	L/s	Based 300mm Freeboard	14	kL
TOTAL					84.4	kL/hr
Volume in Backwash tank remaining after discharge of 39kL/hr to sewer					45.1	kL/hr
Safety Margin					10	%

Consequently the overall backwash handling system was sized at 50kL. This includes an additional 10% spare capacity as a safety factor. The degas sump overflow line is considered too great a flow rate to provide any significant storage buffer within the backwash handling system and as such was excluded from the calculations. An overflow pipeline from the Backwash Handling pit is included between the pit and local sewer to transfer overflows from the Degas Sump.

Due to the potential for a large volume of water to be overflowed via the degas sump overflow and the limits on discharge off site as contained in Table 33 an analysis was carried out on the feasibility of diverting the degas sump overflow to the Hunter River as this is the only location which is capable of handling the degas sump overflows.

Table 33: Flow Limits to Discharge Off Site

Location	Discharge Flow Limit (L/s)
Hunter River	253
Burwood WWTW	50
Mayfield West P.S	11

Hydraulically to gravity flow to the Hunter River requires 0.5 bar of residual head. The degas sump is currently 3m tall and will have a driving head of 0.3 bar. As such under the current design the degas sump overflow cannot gravity feed to the River and are diverted to the backwash handling system. The rational is based on the following that the degas sump will overflow to the backwash handling system under the following failure mode:

- CCT feed pumps fail;
- Level within the degas sump rises and the duty/duty level transmitters both fail
- Resulting in the failure of the RO feed pumps to turn off on high level.

17.2 BACKWASH HANDLING PUMPS

The Backwash Handling pumps are submersible solids handling pumps located on guiderails within the Backwash Handling pit. The pumps operate on variable speed drives in a duty/stand-by configuration.

The driver behind the pumps running on variable speed drives is that the output from the works to the local sewer is capped at 11L/s as advised by Hunter Water networks due to capacity limitations downstream of the nominated sewer discharge point. As such the pumps maintain their output via feedback from the DN100 flowmeter located in the discharge main to the sewer.

Table 34: Backwash Handling System Pumps Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	KSB
Model	-	Amarex NF 80/220/034 ULG150
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	11
Head at duty point	m	5.7
Motor Power	kW	1.9
Type	-	Submersible

18.0 ANCILLARY EQUIPMENT;

18.1 COMPRESSED AIR

There are a number of processes that require compressed air to provide either mechanical actuation or a purging/cleaning operation.

Compressed air users are as follows:

- Pneumatically actuated valves
- Chemical dosing pumps
- MF system
    - Air scour during backwash
    - MIT

Each of the users requires, as a minimum, an air quality that complies with ISO 8573.1 as defined by the equipment vendors and laid out in table 35a.

Table 35a: Required Purity of Compressed Air Parameter	Purity Class (ISO 8573.1)	Unit	Value
Solid Particles	2	Maximum number of particles per m^3	1-5µm – 10 0.5-1µm – 1000 0.1-0.5µm – 100,000
Water	4	Pressure Dew Point ºC	+3
Oil	2	mg/m^3	0.1

Reliable compressed air supply is critical to plant operation. The compressor system is required to provide duty / standby operation with automated cut-over on a fault condition, automated duty cycling, and a lead-and-lag option to enable both compressors to operate simultaneously in the event of a large pressure deficit within the system such as at system start-up.

To provide the required air volume, pressure and quality the compressed air system has been designed as two separate streams in a duty/stand-by arrangement with both streams discharging into a common dry air receiver. All users require a minimum of 6bar(g) pressure to operate effectively and as such a single dry air receiver sized for all users is sufficient.

Each individual stream consists of the following:

- Oil-lubricated screw compressor with integral pressure control instrumentation, control panel, and inlet filters.
- Wet air receiver to provide pulsation dampening and condensate (water and oil) collection
- Pre-dryer particulate filter to remove solid particulates and some oil
- Refrigerant dryer to remove the remaining water water
- Post-dryer particulate filter to remove the remaining particulates and oil

All air receivers are manufactured in accordance with AS1210 and are required to be registered as pressure vessels with WorkCover.

18.1.1 DESIGN BASIS

The design basis for the air compressor is shown in Table 35b.

Table 36b: Air Compressor Design Basis

Parameter	Units	Value
Compressor		
Manufacturer	-	Ingersoll-Rand
Model	-	UP5-30-10
Number of compressors	No.	2
Number of duty compressors	No.	1
Number of assist/stand-by compressors	No.	1
Nominal capacity per compressor	Nm^3/hr	282
Nominal delivery pressure	kPa(g)	850-900
Maximum delivery pressure	kPa(g)	1000
Motor Power	kW	30
Type	-	Oil-lubricated screw
Wet Air Receiver		
Manufacturer	-	CAPS
Model	-	VR1000
Number of Receivers	No.	2
Nominal capacity	m^3	1
Manufacturing standard	-	AS1210
Rated pressure	kPa(g)	1100
Pre-dryer particulate and coalescing filter		
Manufacturer		Conquest
Model	-	G95U
Design capacity	Nm^3/hr	342
Rated pressure	kPa(g)	1600
Particulate removal	ISO 8573.1 purity class	2
Oil Removal	ISO 8573.1 purity class	4
Dryer		
Manufacturer	-	Conquest
Model	-	HX251K
Type	-	Refrigerant
Design Capacity	Nm^3/hr	480
Rated Pressure	kPa(g)	1600
Water Removal	ISO 8573.1 purity class	4
Pre-dryer particulate and coalescing filter		
Manufacturer	-	Conquest

Parameter	Units	Value
Model	-	G95H
Design capacity	Nm³/hr	342
Rated pressure	kPa(g)	1600
Particulate removal	ISO 8573.1 purity class	2
Oil Removal	ISO 8573.1 purity class	2
Dry Air Receiver		
Manufacturer	-	CAPS
Model	-	VR4000
Number of Receivers	No.	1
Nominal capacity	m^3	4
Manufacturing standard	-	AS1210
Rated pressure	kPa(g)	1050

19.0 CHEMICAL DOSING

19.1 AQUEOUS AMMONIA

19.1.1 DESIGN BASIS

Aqueous ammonia is dosed to pre-form chloramines which are used to provide disinfection through the MWAWTP. Aqueous ammonia will be provided at a concentration of 32%.

Table 37a: Aqueous Ammonia Storage and Dosing Requirements

Dose Point	Pre MF Feed pumps
Methodology / control	Flow paced
Anticipated dose of aqueous ammonia	0.7 mg/L
Anticipated daily usage	10 L/day
Required dosing range	0.6-1 mg/L
Storage Volume	6 kL

19.1.2 PUMPS

Aqueous ammonia is dosed to the chloramine mixing panel using two digital dosing pumps operating in a duty/standby configuration. The pumps include their own variable stroke adjuster and flow meter for flow pacing.

Table 38b: Aqueous Ammonia Pump Design Basis Parameter	Units	Value
Pump		
Manufacturer	-	Grundfos
Model	-	DDA-FCM 7.5/10
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	0.0075 – 7.5
Pump maximum discharge head	m	100
Means of flow control	-	Integral stroke controller set manually

19.2 SULPHURIC ACID

19.2.1 DESIGN BASIS

pH adjustment pre RO to minimise scaling of the RO membranes and for pH adjustment within the chemical neutralisation system. Sulphuric Acid will be stored at a concentration of 98% and diluted within the dosing skid with product water at a dilution ratio of 25:1 (water:acid).

Table 39: Sulphuric Acid Storage and Dosing Requirements

Dose Point 1	Pre RO
Methodology / control	Flow paced
Anticipated dose of 98% Sulphuric Acid	mg/L
Anticipated daily usage	41 mg/L
Required dosing range	40-47 mg/L
Dose Point 2	Chemical Neutralisation
Methodology / control	Bolus dosing to a pH target
Anticipated daily usage	35 -137 L dependant on MF and RO CIP frequency
Storage Volume	16 kL

19.2.2 PUMPS

Two digital dosing pumps operating in a duty/standby configuration. for the pre RO pH adjustment. The pumps include their own variable stroke adjuster and flow meter for flow pacing.

Two pneumatic diaphragm dosing pumps operating in a duty/standby configuration for the chemical neutralisation.

Table 40: Sulphuric Acid Pump Design Basis

Parameter	Units	Value
Pump – Pre-RO Feed		
Manufacturer	-	Grundfos
Model	-	DDA-AR 30/4
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	0.003 – 30
Pump maximum discharge head	m	40
Means of flow control	-	Integral stroke controller set manually
Pump – Chemical Neutralisation		
Manufacturer	-	Wilden
Model	-	P025
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	0.185 - 150
Pump maximum discharge head	m	86
Means of flow control	-	Compressed air line filter regulator

19.3 CITRIC ACID

19.3.1 DESIGN BASIS

Citric acid is used to clean both the MF and RO membranes as part of the CIP process. Citric Acid will be provided at a concentration of 50%.

Table 41: Citric Acid Storage and Dosing Requirements

Dose Point	MF and RO CIP
Methodology / control	Bolus
Anticipated dose of 50% Citric Acid	20,000 mg/L
Anticipated MF CIP usage	187 L per skid

Anticipated RO CIP usage	323 L per train both stages
Required dosing range	20,000 mg/L
Storage Volume	IBC configuration with a 2 kL day tank

19.3.2 PUMPS

Two pneumatic diaphragm dosing pumps operating in a duty/standby configuration for the the MF and RO CIP processes.

Table 42: Citric Acid Pump Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	Wilden
Model	-	P100
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	322.6 - 910
Pump maximum discharge head	m	86
Means of flow control	-	Compressed air line filter regulator

19.4 CAUSTIC SODA

19.4.1 DESIGN BASIS

Caustic soda is used to adjust the pH of the RO permeate pre CCT, to clean the MF and RO membranes as part of the CIP process and to neutralise acids within the chemical neutralisation system. Caustic soda is provided at a concentration of 30% to prevent issues with freezing during the winter months of operation.

Table 43: Caustic Soda Storage and Dosing Requirements

Dose Point	MF CIP
Methodology / control	Bolus
Anticipated dose of 30% caustic soda	10,000mg/L
Anticipated usage	176 L/CIP

Dose Point	RO CIP
Methodology / control	Bolus
Anticipated dose of 30% caustic soda	1,500 mg/L
Anticipated usage	39 L/CIP
Dose Point	pH adjustment pre CCT
Methodology / control	Flow paced
Anticipated dose of 30% caustic soda	5mg/L
Anticipated daily usage	31 L/day
Required dosing range	5-6mg/L
Dose Point	Chemical Neutralisation
Methodology / control	Bolus
Anticipated usage per CIP	132 L/MF CIP 229 L/RO CIP
Storage Volume	14 kL

19.4.2 PUMPS

Two digital dosing pumps operating in a duty/standby configuration.for the pre-CCT pH adjustment. The pumps include their own variable stroke adjuster and flow meter for flow pacing.

Two pneumatic diaphragm dosing pumps operating in a duty/standby configuration for the chemical neutralisation, MF CIP, and RO CIP processes.

Table 44: Caustic Soda Pump Design Basis

Parameter	Units	Value
Pump – Pre-CCT		
Manufacturer	-	Grundfos
Model	-	DDA-AR 30/4
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	0.003 – 30
Pump maximum discharge head	m	10
Means of flow control	-	Integral stroke controller set manually
Pump – Chemical Neutralisation, MF CIP & RO CIP		
Manufacturer	-	Wilden
Model	-	P100
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	38.7 – 820.9
Pump maximum discharge head	m	86
Means of flow control	-	Compressed air line filter regulator

19.5 SODIUM BISULPHITE

19.5.1 DESIGN BASIS

Sodium Bisulphite will be used for dechlorination of the overflow streams to the Hunter River including RO brine and off spec product water (post CCT pre product water tank), the product water to ensure effluent quality compliance, RO membrane preservation (CIP) and chemical neutralisation of the EFM cleans carried out on the MF. Sodium Bisulphite will be provided at a concentration of 32%.

Table 45a: Sodium Bisulphite Storage and Dosing Requirements

Dose Point	Overflows to Hunter River
Methodology / control	Flow paced
Anticipated dose of 32% Sodium Bisulphite	3 mg/L
Anticipated daily usage	5 L/day
Required dosing range	3-17 mg/L
Dose Point	Product Water
Methodology / control	Flow paced
Anticipated dose of 32% Sodium Bisulphite	1.7 mg/L
Anticipated daily usage	9 L
Required dosing range	1.5-2 mg/L
Dose Point	RO Preservation
Methodology / control	Bolus
Anticipated dose of 32% Sodium Bisulphite	10,000mg/L
Anticipated usage	252 L/CIP
Dose Point	Chemical Neutralisation
Methodology / control	Bolus
Anticipated dose of 32% Sodium Bisulphite	150 mg/L
Anticipated usage	2.2 L/CIP
Storage Volume	14 kL

19.5.2 PUMPS

Two pneumatic diaphragm dosing pumps operating in a duty/standby configuration for membrane preservation, chemical neutralisation and dechlorination of product water used RO flush.

Three digital dosing pumps operating in a duty/duty/standby configuration for dechlorination of the product water and overflows to the Hunter River. The pumps include their own variable stroke adjuster and flow meter for flow pacing.

Table 46b: SBS Pump Design Basis Parameter

Table 40b: SBS Pump Design Basis Parameter	Units	Value
Pump – membrane preservation, chemical neutralisation and dechlorination of product water		
Manufacturer	-	Wilden
Model	-	P025
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	8.8 - 504
Pump maximum discharge head	m	86
Means of flow control	-	Compressed air line filter regulator
Pump – Chemical Neutralisation, MF CIP & RO CIP		
Manufacturer	-	Grundfos
Model	-	DDA-AR 30/4
Number of pumps	No.	3
Number of duty pumps	No.	2
Number of stand-by pumps	No.	1
Pump flow range	L/hr	0.03 – 30
Pump maximum discharge head	m	10
Means of flow control	-	Integral stroke controller set manually

19.6 ANTISCALANT

19.6.1 DESIGN BASIS

Antiscalant is added to the RO feed water to prevent scaling of the RO membranes by increasing the amount of soluble salts that will stay in solution rather than precipitating out onto the RO membranes

Antiscalant's are chemicals that interact with the surface of the RO membrane. They work by interfering with the precipitation reaction in three primary ways; threshold inhibition, crystal modification, and dispersion. Threshold inhibition is how the antiscalant keeps supersaturated solutions of some sparingly soluble salts in solution. Crystal modification occurs when the negatively charged antiscalant molecule attacks the positively charged scale formation, thereby interrupting the propagation process. Dispersancy happens when antiscalant molecules attach themselves to scale formation creating higher anionic centres creating repulsive forces between the colloidal groups so that they do not form larger conglomerates.

The effectiveness of the antiscalant depends on the concentration factor (RO recovery), water composition, and pH.

Table 47a: Antiscalant Storage and Dosing Requirements

Dose Point	Pre RO
Methodology / control	Flow paced
Anticipated dose of 100% antiscalant	3 mg/L
Anticipated daily usage	7 L/day
Required dosing range	2-4 mg/L
Storage Volume	IBC configuration with a 2 kL day tank

19.6.2 PUMPS

Two digital dosing pumps operating in a duty/standby configuration. for prevention of scaling of the RO membranes. The pumps include their own variable stroke adjuster and flow meter for flow pacing.

Table 48b: Antiscalant Pump Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	Grundfos
Model	-	DDA-FCM 7.5/10
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	0.0075 – 7.5
Pump maximum discharge head	m	100
Means of flow control	-	Integral stroke controller set manually

19.7 RO CLEANING PRODUCT

19.7.1 DESIGN BASIS

The RO cleaning product is either hydrochloric acid (HCl), ethylenediamine tetra acetic acid (EDTA), sodium lauryl sulphate (SLS), or a propriety cleaning chemical suggested by the RO membrane manufacturer. The chemical is delivered to site as a liquid in 1kL containers. Hydrochloric Acid will be provided at a concentration of 33%. EDTA will be provided at a concentration of 40%.

Table 49a: RO Cleaning Product Storage and Dosing Requirements

Dose Point	RO CIP
Methodology / control	Bolus
Anticipated dose of RO cleaning product	5,000 mg/L of HCl at 33% 10,000 mg/L of EDTA at 40%
Anticipated usage	130 L/CIP HCl 203 L/CIP EDTA
Storage Volume	IBC configuration with a 2 kL day tank

19.7.2 PUMPS

Two digital dosing pumps operating in a duty/standby configuration. for cleaning RO membranes. The pumps include their own variable stroke adjuster and flow meter for flow pacing.

Table 50b: RO Cleaning Product Pump Design Basis

Parameter	Units	Value
Pump		
Manufacturer	-	Wilden
Model	-	P025
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	129.5 – 508.1
Pump maximum discharge head	m	86
Means of flow control	-	Compressed air line filter regulator

19.8 SODIUM HYPOCHLORITE

19.8.1 DESIGN BASIS

Sodium hypochlorite is dosed to pre-form chloramines, for cleaning the MF membranes during either an EFM or a CIP clean and for virus inactivation via break point chlorination in the CCT.

Table 51a: Sodium Hypochlorite Storage and Dosing Requirements

Dose Point	Pre MF as Chloramines
Methodology / control	Flow paced
Anticipated dose of 12.5% Sodium Hypochlorite	2.9 mg/L
Anticipated daily usage	82 L/day
Required dosing range	2.5-3.5 mg/L
Dose Point	MF EFM
Methodology / control	Bolus
Anticipated dose of 12.5% Sodium Hypochlorite	500 mg/L
Anticipated usage	20 L/CIP
Required dosing range	
Dose Point	MF CIP
Methodology / control	Flow paced
Anticipated dose of 12.5% Sodium Hypochlorite	1000 mg/L
Anticipated usage	41 L/CIP
Dose Point	Pre CCT
Methodology / control	Flow paced
Anticipated dose of 12.5% Sodium Hypochlorite	6.2 mg/L

Anticipated daily usage	99 L/day
Required dosing range	6 -8 mg/L
Storage Volume	30 kL

19.8.2 PUMPS

Two pneumatic diaphragm dosing pumps operating in a duty/standby configuration for MF EFM and CIP.

Two digital dosing pumps operating in a duty/standby configuration for chloramine dosing. The pumps include their own variable stroke adjuster and flow meter for flow pacing.

Two digital dosing pumps operating in a duty/standby configuration for virus removal through the CCT. The pumps include their own variable stroke adjuster and flow meter for flow pacing.

Table 52b: Sodium Hypochlorite Pump Design Basis

Parameter	Units	Value
Pump – MF EFM and CIP		
Manufacturer	-	Wilden
Model	-	P025
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	81.1 - 197
Pump maximum discharge head	m	86
Means of flow control	-	Compressed air line filter regulator
Pump – Chloramine Dosing		
Manufacturer	-	Grundfos
Model	-	DDA-AR 30/4
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	0.03 – 30
Pump maximum discharge head	m	10
Means of flow control	-	Integral stroke controller set manually
Pump – Virus removal at the CCT		
Manufacturer	-	Grundfos
Model	-	DDA-AR 30/4
Number of pumps	No.	2

Parameter	Units	Value
Number of duty pumps	No.	1
Number of stand-by pumps	No.	1
Pump flow range	L/hr	0.03 – 30
Pump maximum discharge head	m	10
Means of flow control	-	Integral stroke controller set manually

20.0 MAIN PROCESS BUILDING

The Main Process building consists of two compartments – the HP RO Pump room and the Water Process Area. The HP RO Pump room is approximately 10m wide by 18.9m long which houses the pumps and compressed air system The Water Process Area houses the MF and RO systems inside an approximate floor area of 18.9m wide by 45.3m long. The overall building height is approximately 10m at the eave. In addition to the normal access doors, a roller door serves each compartment. A double-tier door is provided at the drywall between these compartments to allow the access of an on-site scissor lift.

The entire building is of steel construction portal frame construction. It adjoins the Education Annex at the eastern side and the Switchroom at the southern end. A common precast concrete wall is utilised to separate the different compartments/buildings.

An overhead crane serves each compartment; a 2.5 tonne crane runs east-west in the HP RO Pump Room, whilst a 2.0 tonne crane runs north-south in the Water Process Area. Crane maintenance platforms are provided for each compartment High bay lights are provided in each compartment above the crane system.

A cantilever awning is extended over the western side to provide weather proofing to the Chemical Bunds. A set of monorail beams is installed at the underside to allow lifting of chemicals in IBC's (intermediate bulk containers). Each monorail is rated for 1.75 tonnes SWL.

The roof is of Colorbond® steel sheeting with polycarbonate translucent roof sheets to provide at least 10% natural lighting. The roof is insulated at the steel sheeting. The walls are precast concrete panels along the eastern side and southern side, where it is adjoining the Education Annex and the Switchroom respectively. Colorbond® steel cladding is provided to the northern and western face.

Natural ventilation is provided via the louvres along the western face near the base of the wall and wind driven rotary ventilators at the roof. Given the generous headroom inside the building, the ventilation system has been sized for one air change for every two hours. A dedicated exhaust is required for the air compressors inside the HP RO Pump room.

Rainwater is collected along the box gutters at the eastern and western side of main roof. The awning also has a box gutter along the outside edge. Each box gutter has a header box at each end and discharges via DN200 down pipes. The design rainfall intensity is 280mm/hour for a 1 in 100 year storm event.

Access point attachments and roof anchor points are also provided for maintenance access to the main roof and awning.

acoustic and sound proofing is to be verified on site by measurements. It is anticipated the inclusion of stuck-on acoustic blankets are needed inside the HP RO Pump room.

21.0 EDUCATION ANNEX

This building is a separate package solely handled by an external architect, QOH Architect which provided a stand-alone design report for this building. The main interface with the Main Plant Building is the viewing windows at the common wall along the eastern side. A deluge fire system is installed over these windows with the sprinklers inside the Water Process Area.

22.0 AMENITIES BUILDING

A pre-fabricated building is located at the north-eastern corner of the site. The Amenities building includes a control room, comms room, meals room, changing rooms and unisex WC, laundry and laboratory. The prefabricated building sits on footing system consists of a strip raft with concrete block piers. The subfloor space is skirted by timber lattice and houses the following services.

- DN25 potable water line (extended from the existing potable water supply line into the site);
- Rainwater system is integral with the prefabricated building supply and the connection point is at each corner of the building. Sewer connection is vai the subfloor space to existing sewers to the south.Power supply is from the Switchroom.;
- Fibre optic cables are looped from the Switchroom.
- Telecommunications line is to be bundled with Education Annex building.

23.0 SWITCHROOM

Switchroom 2 houses the MCC's and VVSD's It is of standard construction of other switchrooms for HTA. It consists of an undercroft and computer floor. The HVAC system is provided by three split units. An automated gas fire suppressant system is provided which detects fires in the switchroom and releases gas from on-site cylinders to smother the fire.

24.0 CIVIL WORKS

24.1 YARD PIPING

Document KI-LT-ME-003 lists all the pipes on site including size, material and flow. Valves associated with the yard piping can be found in Document KI-LT-ME-016. The yard piping will consist of the following items:

- Major Pipes
  - Raw Water to MF Skids
  - MF Skids to RO Feed Tank
  - RO feed tank to RO Skids
  - RO Skids to Degasser
  - Degasser to Chlorine Contact Tank
  - Chlorine Contact Tank to Product Water Tank
  - Product Water Tank to Site Boundary

- Minor Pipes
  - MF Backwash
  - Strainer Backwash
  - RO Flush
  - Brine
  - Off – Specification Water
  - CIP System
  - Chemical System
  - Instrumentation
  - Stormwater
  - Sewer
  - Potable Water
  - Fire Water
- Additional Yard Piping
  - Service Water
  - Rainwater drainage from electrical switchroom, high pressure pumps building, main plant building and education annex

24.2 STORMWATER DRAINAGE

All stormwater from the higher ground to the south of the KIWS site is to be intercepted in a cut-off channel and conveyed to the piped stormwater system in Channel Road. The higher ground is mostly made up of land owned by Telstra and a High Voltage Overhead Power Line Easement. The channel is to be designed to convey the 1 in 100 year average recurrence interval (ARI) peak flow.

A stormwater piped reticulation system is to be provided on the KWIS site to convey the 1 in 10 year ARI peak flows. Excess flow up to the 1 in 100 year ARI is to be conveyed overland via internal roads to Channel Road. The pipe reticulation system will collect and convey runoff from the water tanks, pump slabs, switchroom, main plant building, site area and roads to the Channel Road stormwater system.

Roof runoff from the Education Annex will be directed to a rainwater tank and reused for landscape watering.

24.3 ROADWORKS

The scope of roadworks is based upon delivery vehicle access requirements to the chemical off-loading areas, pumps, buildings and coach access to the education annex.

24.3.1 ROAD PAVEMENT

For flexible pavements a design traffic volume of 1 x 10^7 ESA is to be adopted for the industrial site.

For rigid pavements the design is to be in accordance with the Cement and Concrete Association of Australia "*Industrial Pavements – Guidelines for Design, Construction and Specification*". Adopt a design traffic load of 5 repetitions per day over 50 years.

Subgrade – the laboratory testing of 2 samples by RCA Geotechnical indicated soaked CBR values in the range of 8% to 45%. For flexible pavement design, adopt a design subgrade CBR of 8%. For rigid pavement design adopt an equivalent subgrade modulus of 20 MPa and a Poissons ratio of 0.4.

All turning areas will consist of a concrete pavement and straight sections of road will consist of a flexible pavement. Refer to Drawing 15270 – 880 for pavement details.

24.3.2 ROAD LANE WIDTHS AND TURNING RADII

The roadway is to be for one way traffic only. The road pavement is to have a one way crossfall at 3%. Roll kerb is to be provided on both sides of the road and a kerb with gutter on the low side of the road. The road width considers the following:

- 7m from back of kerb to back of kerb for the circuit road, that is 5.8m pavement width; and
- 4.5m from back of kerb to back of kerb (3.3m pavement width) for the bus way to the Education annex.

All road radii are to be adequate for a 19m long rigid transportation vehicle.

For the chemical delivery area, roll kerb is to be provided on the southern side and a raised footpath on the northern side adjacent to the chemical bunds to allow for the off-loading of IBC's. The chemical delivery road pavement width is to be 4.0m.

24.4 CHEMICAL UNLOADING BAYS

The chemical unloading bays are a bunded structure with a holding capacity of 9 cubic metres of spillage in accordance with AS 3780.

24.5 LANDSCAPING

All unsealed areas to be covered with a 100 mm thick layer of crushed rock (nominal size 20mm) and compacted to provide a low permeability layer to mitigate the infiltration of surface runoff into the contaminated sub-strata (see Earthworks Section 27.6).

Low shrubs are to be provided at the front of the site between Channel Road and the Education Annex.

24.6 FENCING

Fencing to the rear and side boundaries to be 2.21 m high 'manproof wire mesh fence' as per drawing 15270-882 and 15270-883 – Standard Fence and Bollard details, Sheets 1 and 2.

Fencing to the front of the site will be detailed by the architect.

Fencing in the Chemical Bunds is detailed with the structural drawing 15270-540.

24.7 EARTHWORKS

The KIWS site has the potential to contain slag and contaminants such as polycyclic aromatic hydrocarbons (PAHs) and tar. Suspected areas of contamination have been capped with 2m of coal washery reject (CWR) material. Other areas with lower potential for contamination may have less than 2m of capping material. The objectives of the capping layer are to:

- Provide a physical barrier, and
- Minimise the infiltration of rain water to the underlying groundwater.

The design is to avoid or minimise the penetration of the capping layer. Where the capping layer is to be penetrated the guidelines as set out in the report “Steel River Project – Contamination Guidelines” are to be followed as closely as possible.

The Douglas Partners report “Geotechnical Assessment – Proposed Pump Station KIWS, Mayfield West” indicates that materials excavated from the following areas can be reused as backfill against the backwash pump station sump and as foundation fill for the main plant building:

- Below the Raw Water Tank,
- Backwash Pump Station sump, and
- Services Trench.

Compaction densities, loose layer thickness, compaction equipment, rainwater management have all been assessed and covered in the report.

In conclusion, all material excavated from the site (except for particles greater than 150mm in size and the top 100 to 150mm which may contains organic matter) can be reused as structural fill.

25.0 MAJOR PIPELINES

Three (3) below ground pipelines are to be constructed from/to the boundary of the KIWS plant. These pipelines include the following:

1. ***Pipe A*** - Brine discharge pipeline from KIWS to Burwood Beach Catchment and connecting to an existing gravity trunk sewer at Maitland Road (refer to Figure 25-1);
2. ***Pipe B*** - Backwash, Overflow and Off-Specification Water from KIWS to Shortland WWTW existing discharge pipeline (refer to Figure 25-1); and
3. ***Pipe C*** - Raw Water (treated effluent) from Shortland WWTW existing discharge pipeline to KIWS (refer to Figure 25-1).

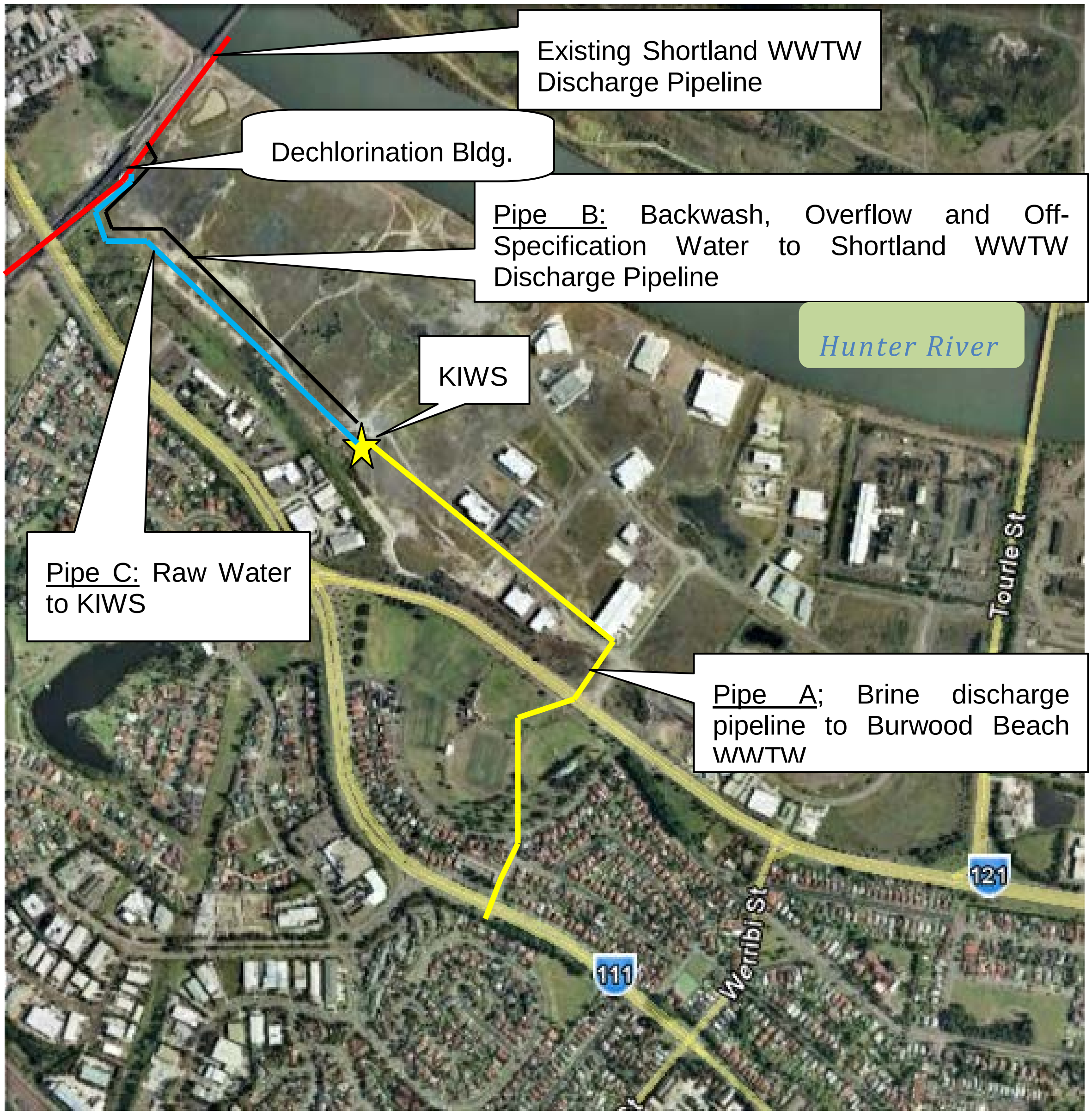


Figure 25-1 Pipelines

25.1 LAND OWNERSHIP

25.1.1 GENERAL

25.1.1.1 Pipe A

The brine pipeline from KIWS is proposed to discharge into Burwood Beach Sewerage Catchment via an existing gravity trunk sewer at Maitland Road. The pipeline takes the following route:

- Channel Road footpath,
- Steel River Boulevard footpath,
- Industrial Drive crossing,
- Stevenson Park,
- Purdue Avenue footpath.
- Maitland Road crossing, and
- Maitland Road footpath.

The landowners of the road reserves, Newcastle City Council (NCC) and the NSW Roads and Maritime Services (RMS) were both contacted to determine their requirements for constructing water service pipelines in the footpath and across the road. When crossing major roads such as Industrial Drive and Maitland Road both authorities required that the pipeline crossing be via trenchless technology and at right angles to the road.

25.1.1.2 Pipe B

Carrying backwash, overflow, brine and off-specification water from KIWS to Shortland WWTW existing discharge pipeline (refer to Figure 25-1).

25.1.1.3 Pipe C

Carrying raw water (treated effluent from Shortland WWTW existing discharge pipeline) to KIWS (refer to Figure 25-1).

Pipes B and C will be located in a 6 m wide easement for effluent pipelines as identified in DP 270249, registered on 16 November 2009 with the Registrar General. Both pipelines will connect to the existing Shortland WWTW discharge pipeline, which is located in an easement, identified as easement ‘A’ in DP 270247. The easement is designated for sewer mains. Easement ‘A’ is located adjacent to Australian Rail Track Corporation Ltd (ARTC) land and the connection of the new pipelines to the existing pipeline will take place in easement ‘A’ and immediately outside of the ARTC land.

25.1.2 APPROVALS RISK

Correspondence from both NCC and RMS indicates that the risk of not being able to construct the pipeline in the road reserve is low. Both authorities have provided their route and method of construction preferences and neither has raised objections to the pipeline. The proposed pipelines and any connections to existing pipelines will not be occurring on ARTC land, thus no approval to construct will be required from ARTC.

25.2 ENVIRONMENTAL

The areas of land for the KIWS project include the lots within the Steel River Development for the main plant location and the pipeline routes through Steel River, Road Reserves and Stevenson Park.

The Steel River Development has a long history of use, including agriculture in the mid-1800s' although from the 1930's the main site use became a disposal and fill site for slag and other waste from BHP operations. Stevenson Park was also used for waste disposal, both municipal waste and BHP waste, prior to being levelled and a remediation program for use as a sporting recreation park.

A Review of Environmental Factors (REF) confirmed that the subject land area is not host to any known threatened ecological communities or individual flora and fauna species. Existing trees within Stevenson Park are to be avoided as a requirement of Newcastle City Council for social values rather than conservation values.

A desktop indigenous heritage assessment was undertaken for the project, which did not identify any known indigenous heritage sites within the locality of Steel River or Stevenson Park, however this does not remove responsibility from HWC/HTA in relation to heritage and the 'due diligence' approach as outlined in NSW OEH 2010 guidelines should be adhered to and recorded.

Operational noise limits for the KIWS plant are limits allocated to each lot, and each lot may have different noise allocations, as part of the development management of Steel River. Only the Steel River Community Association and Newcastle City Council may approve a change in the noise allocations. These operational noise limits have been considered during concept and detailed design. Details of the operational noise criteria are found in the KIWS REF appendices and the Steel River Strategic Impact Assessment Study (SIAS).

There is some potential that patches of Potential Acid Sulfate Soils will be encountered particularly during pipeline trench excavations between the KIWS plant site and the Shortland Dechlorination building in Steel River. Appropriate monitoring, soil testing and if required treatment on site and/or disposal offsite will be required.

Groundwater is expected to be encountered in Stevenson Park and also in some areas of the KIWS plant site and the pipeline route from the KIWS plant to the Shortland WWTW dechlorination building in Steel River. Extracted groundwater will need to be either contained on site for removal or disposed off appropriately. Requirements for any disposal, either to commercial liquid waste processor or to sewer, will include water quality sampling and testing for contaminants. A sewer access point is available in Steel River and approval for disposal is being sought from HWC, however disposal of contaminated groundwater will have concentration limits imposed to protect the overall functionality of the WWTW, and volume disposal limits will occur during periods of high rainfall in the WWTW catchment. A licence for groundwater interference / extraction is required under the Water Act 1912.

Soil conditions are varied and within the Steel River site, contaminated soil / fill material conditions, beyond the existing Coal Washery Rejects used for site capping, are not expected to be encountered in large quantities. Therefore, the design and construction programs do not require penetration of the capping layer, ie no deeper than 2 m. Any construction likely to affect the capping layers within the KIWS plant site and the pipelines within Steel River will need to be carried out in accordance with the *Steel River Project Construction Guidelines* (2002, URS), which have been adopted by the Steel River Community Association.

A Construction Management Plan, a Construction Environmental Management Plan and an Operational Environmental Management Plan are to be developed and approved by the Steel River Community Association prior to the commencement of construction.

A certification process for the notification of the contamination status for each lot in Steel River was developed and is outlined in the *Remediation Validation Steel River Site* (URS, 2004). The certificates are attached to land title and development information and include the following:

- ***Certificate A*** - confirms that the capping and regrading were completed in accordance with requirements of the RAP/EIS;
- ***Certificate B*** - confirms that the lot, as remediated, is suitable for certain types of development;
- ***Certificate C*** - confirms that a proposed development is suitable for the site and that a Construction Management Plan has been prepared that details how the proposed development will not compromise the site remediation;
- ***Certificate D*** - confirms that the site has been developed in accordance with the Construction Management Plan; and
- ***Post Certification System*** – confirms that an Environmental Management Plan has been prepared to direct the operation in a manner consistent with the site remediation.

Certificates A and B have been provided for each of the KIWS property lots (87, 88, 89 and 90) within Channel Road Steel River. Certificates C and D will be required as part of the HTA construction program and will need to be determined by an appropriate contaminated site specialist.

Soils / materials required to be removed from site are to be assessed and classified in accordance with the NSW guidelines *Classifying Waste* (NSW DECC, 2009). This will determine the need for materials to be disposed as contaminated material and therefore Special Waste, and more expensive to dispose, or as general soil waste at usual waste disposal costs. Any soil and fill material excavated during the construction program is to be disposed off at a licensed waste receiver facility.

Large blocks of slag and concrete footings from the previous location of electricity towers are likely to be encountered along the pipeline route between the KIWS lots and the Shortland WWTW dechlorination building. Materials such as these will need to be disposed off from site.

25.3 CONSTRAINTS

- Prior to commencement of construction undertake AHIMS heritage search to confirm no new Aboriginal Heritage sites are registered since 2008;
- Groundwater license is likely to be required under the Water Act 1912;
- Trade Waste agreement required with HWC to dispose of construction water directly into sewer;
- Construction Management Plan and Construction Environmental Management Plan to be approved by the Steel River Community Association;
- Achieving Certification C & D in accordance with the Steel River Community Association requirements;
- Construction Management Plan must address the requirements of the Steel River Project Construction Guidelines (2002, URS);

- Disposal of soil / fill material offsite to a licensed waste receiver facility; and
- Meeting operation noise limits imposed by the Steel River Strategic Impact Assessment Study.

25.4 WATER HAMMER ANALYSIS

A water hammer analysis for the Shortland rising main was carried out at the detailed design stage and concluded the following:

- Undesirable high pressure conditions do not exist following pump failure in the reclaimed water pipelines to the outfall or to the raw water tank. Therefore additional surge protection is not required.
- Vacuum and column separation does occur in the existing cement-lined ductile iron pipeline to the outfall, approximately 1000 meters downstream of the Shortland WWTW reclaimed effluent pumps.
- For the reclaimed effluent pipeline to the raw water tank, column separation will only occur if the flow control valve closure time is less than 15 seconds. The valve closure time should be 15 seconds or longer.

25.5 GEOTECHNICAL

For the section of Pipe A within the Steel River Industrial Estate, a geotechnical investigation was carried out by RCA Australia for Hunter Water Australia in December 2008. A copy of this geotechnical report (RCA ref 6744A-401/0) is available on Sharepoint. Borelogs SR02 to SR07 and SR18 are applicable to this section of pipeline. Bore depths ranged from 0.5m to 2.0m. No groundwater flows were encountered in any of the boreholes during the fieldwork. Borehole SR07, at Steel River Boulevard near industrial Drive was terminated at 0.5m as a result of encountering slag skulls. If thrust boring is proposed for the Industrial Drive crossing, there is the potential to encounter slag layers and possible large cemented slag skulls.

For the section of Pipe A from Industrial Drive, Mayfield West to Maitland Road, Warrabrook, a geotechnical investigation was carried out by Coffey Geotechnics for Hunter Water Australia in February 2009. Borelogs TL13 to TL19 are applicable to this section of pipeline. Bore depths ranged from 0.9m to 2.0m. No groundwater flows were encountered in any of the boreholes during the fieldwork. Borelogs TL13 to TL16 are located in Stevenson Park. Boreholes TL14 and TL15 were terminated at 0.9m upon encountering slag. Pipeline foundation materials are expected to be mainly fill consisting of Sand and Gravelly Sand and some settlement can be expected. Pipes with flexible joints or flexible pipes such as HDPE are recommended.

Pipe B and Pipe C are proposed to be constructed in a common trench (refer to Figure 25-1). These pipelines are within the Steel River Industrial Estate and a geotechnical investigation was carried out by Douglas Partners for the Hunter Treatment Alliance in November 2011. Borelogs 1 to 8 are applicable to this section of pipeline. Bore depths ranged from 2.95 m to 3.0m. Groundwater flows were encountered in Bores 7 and 8 and seepage in Bore 2. During the construction of the pipelines between Bores 7 and 8 additional construction safeguards may be required, for example; reduced lengths of open trenching, use of trench boxes, spear points, etc.

25.5.1 ADDITIONAL GEOTECHNICAL

At road crossing where thrust boring or alternative form of trenchless technology is proposed, additional geotechnical investigation was carried out. Minimum borehole depths of 5m were specified.

25.6 SERVICES

25.6.1 SURVEY

A topographic survey of the route of the pipelines was carried out by GeoSurv Surveyors.

25.6.2 BELOW GROUND

The presence of below ground services along the route of the pipelines was investigated by contacting “Dial Before You Dig” (DBYD). The location and level of services were pot-holed by Advanced Ground Locators, a services search company.

25.7 HYDRAULIC DESIGN

The design criteria for this project have been supplied by Hunter Water Corporation. The design of the pipes is based on the peak flows that can potentially be conveyed in each of the pipelines.

25.7.1 FLOWS

Pipe A – brine pipeline, has been sized to convey a flow rate of 52 L/s (Stage 2); Stage 1 flow will be 39 L/s. The hydraulic head losses through the proposed pipe (200 mm nominal diameter oPVC , PN12) was assessed using a spreadsheet method. The calculations by spreadsheet are available on SharePoint.

The overflow pipe from the raw water tank (Pipe B) has been sized to convey a flow rate of 253 L/s. The estimated length of the pipe from the raw water tank to the high point before gravitating to the Hunter River via the existing Shortland WWTW discharge pipeline is approximately 610 m. The estimated fittings and pipe friction loss, assuming a 560 mm external diameter HDPE pipe, PN8, SDR 21 is 3.64 m. The overflow level in the raw water tank has been set at RL 16.35 m AHD, thus the invert level of the pipe at the high point needs to be below RL 12.20 m AHD. The calculations by both the FATHOM hydraulic model and by spreadsheet are available on SharePoint.

The raw water feed pipe (Pipe C) has been sized to convey a flow rate of 253 L/s. The estimated length of the pipe from Shortland WWTW discharge pipeline to the raw water tank is approximately 740 m. The available hydraulic head is the difference between the barometric loop pipe obvert level of RL18.20 m AHD (refer to HWC drawing 14508-67) and the raw water tank TWL of RL 16.05 m AHD. The estimated hydraulic losses through the proposed 710mm external diameter HDPE pipe, PN8, SDR 21 and fittings was estimated to be 3.17m. It is proposed to raise the invert of the barometric loop to at least RL 20.20 m AHD. The calculations by both the FATHOM hydraulic model and by spreadsheet are available on SharePoint.

25.8 CONNECTION TO EXISTING PIPELINES

Two of the three pipelines (pipes B and C) will connect to the Shortland WWTW effluent discharge pipe and the remaining pipe A will connect to a new maintenance hole on a trunk sewer at No. 30 Casuarina Circuit, Warrabrook.

25.8.1 CUT-INS

Pipe A is proposed to tie into a new maintenance hole to be constructed on a 300 mm diameter VCP trunk sewer at No. 30 Casuarina Circuit, Warrabrook. The trunk sewer is fed by wastewater pump station WWPS No. S167. During tie-in the WWPS will need to be temporarily shut down.

The connection of Pipe B and Pipe C to the existing Shortland WWTW effluent discharge pipe is shown on KIWS drawing 15270 – 087 and 088. Detail B on the drawing shows the location of isolation and control valves as well as the proposed method for jointing the proposed pipes to the existing pipes. During the cutting in of the proposed pipes to the existing pipes, the Shortland WWTW discharge pipe will need to be shut down.

25.8.2 TRENCH EXCAVATION

25.8.2.1 Pipes 'B' and 'C'

From the various geotechnical reports, excavation is expected to generally comprise sandy silt/silty sand filling with slag inclusions. It is thus expected that trench excavation would be with hydraulic excavators using buckets fitted with rock teeth and that there may be some locations where cemented slag filling or higher strength bands of rock may be encountered.

With an average depth to invert of 1.5 m, no groundwater is expected to be encountered under normal weather conditions. However an extensive period of wet weather could result in groundwater being encountered in the area adjacent to the railway corridor (refer to boreholes 7 and 8 on Douglas Partners drawing no. 3) and at the south-west corner of Lot 90, DP 270249 (refer to borehole no. 2 on Douglas Partners drawing no. 1). It is expected that this could be managed by sump and pump dewatering. Where trench depth exceeds 1.2 m, then trench battering or shoring will be required.

26.0 ELECTRICAL DESIGN

26.1 OVERVIEW

An initial total order of cost (TOC) design was completed by the Hunter Treatment Alliance (HTA) for the Mayfield West WTP. The TOC design has been utilised as the basis for the electrical design development.

The electrical design covers all electrical works associated with the KIWS Mayfield West Advanced Water Treatment Plant (AWTP) excluding the Exhibition Centre.

This electrical design includes the following major design components:

- Dual 1500kVA Ausgrid kiosk transformers.
- Main switchboard (MSB)
- Main switchroom

- Harmonic filtering
- Variable speed drives
- Uninterruptable power supply
- Distributed control system.
- Site internal and external light & power.
- Cabling and reticulation.

26.2 POWER SUPPLY

26.2.1 HV VS LV METERING

An initial investigation was undertaken into the cost savings associated with the site being metered as a HV vs LV customer. The capital costs comparison of a HV and LV metered design were provided to HWC for review in the form of a technical memo "HV Customer Technical Memorandum" refer Appendix A.

Following review of the technical memo by HWC a direction was given to remain as an LV customer. At the time of writing this report an application for connection (AFC) has been submitted with Ausgrid (refer Appendix B) and a design information package is currently being produced. A third party ASP3 designer is still to be engaged to complete the HV design once the design information package is received.

26.2.2 MAXIMUM DEMAND

A maximum demand has been completed for the current and future site load and is attached to this document (refer Appendix C).The site maximum demand is as follows:

- Current – 2070A
- Future – 2607A

Two 1500kVA kiosk transformers are to be installed to supply the site load.

26.2.3 SUPPLY CONFIGURATION

Each individual 1500kVA supply transformer supplies a separate bus section within the MSB via an air circuit breaker (ACB).

Transformer 1 supplies switchboard Bus A via ACB1, and transformer 2 supplies switchboard Bus B via ACB2. A bus-tie separates Bus A and Bus B and under the sites normal operating scenario is selected in the in the open position.

A "two out of three" mechanical keyed interlocking system is provided between ACB1, ACB2 and the bus-tie. The mechanical interlocking allows only two of the three ACB's to be closed at any one time and ensures both transformers are not able to be paralleled and feed the same bus segment at the same time.

26.2.4 SUPPLY REDUNDANCY

In the event of a power supply failure on either supply transformer the plant shall perform a controlled shutdown.

It shall be possible under the current site maximum demand for a single transformer to supply the entire site load. Isolating the failed transformer and closing the bus-tie will allow the plant to be able to be started again.

Under the future loading scenario a single transformer is not capable of running the entire site at maximum capacity. In this instance the site shall be configured to run at a reduced capacity during a single transformer failure scenario until power to the faulty transformer is restored.

Note the splitting of the site loads across the transformers has been undertaken to try and balance the site loading on the two supply transformers. Due to the plants process arrangement it was not possible to adequately split duty/standby loading across either transformer to provide immediate redundancy in the event that one transformer failed. Given that the ability to adequately transfer the site load across to a single transformer is available it was agreed with HWC that the splitting of duty/standby loads was not required.

26.2.5 ACB SWITCHING

A standalone ACB remote control panel is being installed within the main switchroom to allow the ACB's to be opened and closed whilst not standing in front of the ACBs in the blast zone. The ACB panel is installed at the end of the switchroom and includes indicating lamps for ACB closed, ACB open and ACB ready to close.

A three position open/normal/close selector switch is provided for each ACB. Each selector switch is located behind an 81/3 keyed locked door to ensure operation only by a qualified electrician. The ready to close indicator alerts the operator that ACB spring is charged and the breaker is available to be closed.

Note prior to switching the ACB's via the remote ACB panel the operator must ensure the correct manual keying configuration is performed at the ACB cubicles.

26.2.6 HARMONICS

Two 300 amp rated active harmonic filters are to be installed to correct power supply harmonic distortion introduced via the site non-linear loads. Each active harmonic filter shall be connected on either side of the bus-tie and under the normal operating scenario with the bus-tie in the open position shall provide power quality compensation for Bus A and Bus B respectively.

Each active harmonic filter shall include two sets of proprietary 3000/5A current transformers (CT's) with each CT set containing an individual CT on each of the three phases. The dual CT arrangement is being provided to allow both filters to provide power quality compensation when the bus-tie has been closed and a single transformer is supplying the site load. In this scenario the active harmonic filters will be working in parallel.

The active harmonic filtering capacity has been sized to accommodate the current maximum site non-linear load. Harmonic distortion levels will be monitored during initial operation via the power meters.

It is expected that extra harmonic compensation may be required to accommodate the future site load. In the event of this a 100Amp unit would be added to each side of the bus-tie and paralleled with the existing 300A unit. The necessity to install a second parallel AHF unit shall be determined in the future following the upgrade works and after power quality data can be accurately reviewed.

26.3 EARTHING

The earthing of the AWTP shall be in accordance with an MEN earthed system as defined within Australian Standard AS3000, with the MEN link located within the main switchboard.

Earthing design of the kiosk transformer area is being carried out by a specialist ASP3 designer with the requirements to be integrated into the overall site earthing philosophy.

A distributed earthing system is also to be installed at the plant in accordance with the TOC design basis. The distributed earthing system utilises the structural reo to bond the various concrete slabs to the copper earth grading ring.

Equipotential bonding is also required to be carried out onsite in accordance with the requirements of AS3000. Equipotential bonding is to be installed between the switchroom earth bar and motor plinths, cable ladder, structural steel framing, electrical panels etc.

26.4 NEW ELECTRICAL SWITCHROOM

The new main switchboard and associated VSD starter panels shall be housed in a new switchroom attached to the main plant building.

The switchroom shall include:

- Computer type flooring
- Air conditioning (vendor package)
- VESDA fire detection
- PIR detector and door switches connected to the site security system
- All other relevant requirements of STS500

The new switchroom will house the following equipment:

- New main switchboard (MSB)
- Wall mounted and free standing VSDs
- Two free standing 300A active harmonic filter panels
- Remote air circuit breaker (ACB) control panel
- Two uninterruptable power supplies including individual battery cabinets
- SCADA communications cabinet
- Desk and drawing shelves as per STS500 requirements
- Wall mounted L&P distribution board

26.4.1 AIR CONDITIONING

A dedicated switchroom air conditioning system is to be installed within the main switchroom in accordance with STS500 requirement.

The air conditioning system is being sized and designed by a package vendor supplier.

The heat loading calculations within the switchroom were completed as part of the electrical design and passed to the air conditioning supplier for sizing of the air conditioning units. The results of the switchroom heat loading and have been are included below.

Table 53: Switchroom Heat Loading

Equipment Load	Heat Loss (W)	No. of Units [1]	Total (kW)
160kW VSD	4036	1	4.036
90kW VSD	2065	7	14.455
30kW VSD	799	1	0.799
22kW VSD	717	1	0.717
15kW VSD	392	3	1.176
11kW VSD	320	1	0.32
3kW VSD	144	1	0.144
300A Accusine AHF	10000	2	20
Motor Choke (VW3A5101)	150	1	0.15
Motor Choke (VW3A5102)	250	4	1
Motor Choke (VW3A5103)	350	1	0.35
Motor Choke (VW3A5104)	430	4	1.72
Communications Cabinet	1000	1	1
UPS1 (10kVA)	988	1	0.988
UPS2 (6kVA)	655	1	0.655
Main Switchboard	4000	1	4
	W/m^2	**m^2**	
Lighting	10	146.64	1.5
Future			
160kW VSD	4036	1	4.036
90kW VSD	2065	2	4.13
[1] Duty/Assist load only included in calculation			
		Total Heat Load*	**kW**
		Current	53.0
		Future	61.1

* Excludes solar heat loading.

26.4.2 VARIABLE SPEED DRIVES

A combination of wall mounted and free standing variable speed drive (VSD) panels are to be installed within the main switchroom.

In accordance with the manufacturers requirements an assessment was completed on each VSD to determine the motor cable run length and the consequent requirement for the inclusion of a motor choke.

All VSDs that include a motor choke are to be installed within a common enclosure in accordance with HWC requirements. Schneider Electric completed an investigation into the panel size and air flow requirements for the VSD & motor choke panels which has been integrated into the VSD schedule for procurement.

All variable speed drives are based on the Schneider Altivar61 VSD. As all VSD supplied loads are centrifugal pumps the higher rated Altivar71 VSD was not required.

26.4.3 FIRE DETECTION SYSTEM

In accordance with STS500 a VESDA fire detection system has been installed within the main switchroom for early warning and alarming to the SCADA in the event that a fire starts within the switchroom.

The VESDA system warning alarm is integrated into the ACB control panel and allows the main incomer ACB's and bus-tie ACB to be shunt tripped in the event of a warning fire alarm. The shunt tripping of the main circuit breakers is able to be bypassed via a selector switch located on the front of the ACB panel.

26.4.4 SITE SECURITY SYSTEM

The site security system is to be designed by others. The PIR and door limit switches within the switchroom are required to be integrated into the site security system.

An allowance has been made within the electrical design to pick up hardwired contacts from the building security system for interfacing to the main Quantum PLC and ultimately the site SCADA system.

All cabling associated with the building security system is to be detailed as part of the security system design.

26.5 MAIN SWITCHBOARD

A single Main Switchboard (MSB) is to be installed onsite and will supply the entire electrical load at the AWTP.

The MSB design is based on the B&R signature series switchboard.

The MSB include the following:

- Dual incomer 2500A rated Masterpact air circuit breakers
- 2500A rated non-auto bus-tie circuit breaker
- Ausgrid supply authority metering CT compartments.
- Power monitoring and surge protection.
- DOL, FWD-REV and VSD motor starter cubicles.
- Feeder cells.
- PLC & instrumentation cubicle.
- Communications cubicle.
- 240VAC and 24VDC UPS distribution.
- 24VDC motor starter distribution (individual section for each bus).
- Spare feeder and starter cells

The main switchboard is a double sided design and is to be constructed in accordance with the requirements of STS500.

Adequate spare capacity is to be provided within the switchboard to meet STS500 requirements. The switchboard manufacturer's detailed construction drawings shall be reviewed during the construction phase to ensure compliance with the spare capacity requirement.

26.5.1 MOTOR STARTER DESIGN

The three types of motor starters within the main switchboard are:

- Direct on-line (DOL)
- Forward-Reverse (FWD-REV) DOL
- Variable speed drive (VSD)

26.5.1.1 DOL

The DOL and FWD-REV DOL starter circuits are based on the standard HWC TesysT smart overload design.

All DOL motors that meet the 35000kWh power consumption per annum threshold as detailed in STS500 also include a proprietary voltage module installed within the starter that allows key power monitoring data to be logged and displayed via the SCADA.

In accordance with the manufacturers type 2 coordination tables the motor circuit breaker has been selected from the Schneider NSX-MA range.

An Auto/Off/Test three position selector switch located on the motors local control panel (LCP) allows the motors control mode to be selected.

Under normal operation the motor is selected to Auto and is controlled via the main Quantum CPU via a Ethernet link to the TesysT smart overload module. The TesysT unit is Modbus scanned via a network over Ethernet (NOE) module located within the main Quantum rack.

Selecting the Auto/Off/Test selector switch to the test position allows the motor to be started and stopped via the start and stop pushbuttons at the local control panel.

In line with the current HWC standard motor starter design there are no indicating lamps installed on the motor starter cell. A HMI located on the front of the PLC compartment is utilised for display of the motor state. Only a single door interlocked isolator is located on the starter door.

26.5.1.2 VSD

The VSD starter circuit is based on the standard HWC VSD design.

In order to satisfy the earth fault loop impedance calculation requirement of AS3000 the motor circuit breaker is based on the Schneider NSX range with a Micrologix 6.2 trip unit.

An Auto/Off/Test three position selector switch located on the motors local control panel (LCP) allows the motors control mode to be selected.

Under normal operation the motor is selected to Auto and is controlled via the main Quantum CPU via a Modbus link to the VSD. The VSD is Modbus scanned via a network over Ethernet (NOE) module located within the main Quantum rack.

Selecting the Auto/Off/Test selector switch to the test position allows the motor to be started and stopped via the start and stop pushbuttons at the local control panel. When starting the VSD in test the drive speed is determined by the preset speed that has been configured within the VSD.

In line with the current HWC standard motor starter design there are no indicating lamps installed on the motor starter cell. A HMI located on the front of the PLC compartment is utilised for display of the motor state. Only a single door interlocked isolator is located on the starter door.

26.5.2 HMI

In line with the standard HWC switchboard design a 15 inch Magelis touch panel is located on the outer door of the PLC and instrumentation cubicle.

The touch panel performs the following main functions:

- Display of motor status information (running, stopped, fault etc.).
- Resetting of motor faults
- Analog display of any 4-20mA instrumentation signals directly supplied from the main switchboard.

Note it is not the intention for the touch panel to be configured with all of the information associated with a SCADA client.

26.5.3 24VDC MOTOR STARTER DISTRIBUTION

In line with standard HWC switchboard design practice the motor starter control supplies shall be supplied via a non-backed up 24VDC dual redundant supply.

A 40A dual redundant supply is to be installed either side of the bus-tie to supply the associated motor starters that are directly fed from that side of the bus.

Table 2 below includes a breakdown of the 24VDC power supply demand for Bus A and Bus B motor starters respectively.

Table 54: 24VDC Motor Distribution Power Supply Demand

Starter Type	24V DC Load (W)	24VDC Load (A)	Quantity	Total Load (A)
Bus A				
Variable Speed Drives	30	1.25	15	18.75
Tesyst Smart Overloads	22	0.92	5	4.58
Bus A				
Variable Speed Drives	30	1.25	11	13.75
Tesyst Smart Overloads	22	0.92	7	6.42
			Total Bus A Load	23.33
			Total Bus A Load	20.17

26.6 UNINTERRUPTABLE POWER SUPPLIES

There are two uninterruptable power supplies (UPS) and associated battery banks to be installed within the main switchroom.

A 10kVA UPS and 6kVA UPS shall supply the control network and SCADA network respectively.

26.6.1 CONTROL NETWORK UPS

The control network UPS system consists of the following:

- 10kVA single phase UPS
- 100Ah battery bank installed within a dedicated battery cabinet
- Battery charger
- 240VAC UPS distribution chassis located within the main switchboard
- 24VDC UPS distribution cubicle located within the main switchboard

A transfer switch supplied via a dedicated feed from either side of the bus tie supplies the UPS. The transfer switch allows the operator to transfer the UPS supply between the two transformers in the event that a single transformer is offline. The transfer switch also includes an off position to allow the UPS to be isolated.

A plug and socket arrangement using Marechal decontactors is installed between the UPS supply transfer switch and UPS input, and the UPS output and main switchboard. The plug and socket arrangement allows the UPS to be manually bypassed using a bypass lead in the event that the UPS is required to be removed from site.

The UPS output supplies a 240VAC distribution chassis within the main switchboard. Dual circuit breakers on the 240VAC chassis feed dual redundant 24VDC power supplies that supply a separate 24VDC distribution cubicle within the main switchboard.

The control network UPS supplies the following equipment onsite:

- Remote IO Panels
- PLC equipment
- Control network Ethernet switches
- Selected digital dosing pumps required for the flushing process

Refer to Appendix D for the UPS loading calculations.

26.6.2 SCADA NETWORK UPS

The SCADA network UPS system consists of the following:

- 6kVA single phase UPS
- 65Ah battery bank installed within a dedicated battery cabinet
- UPS 240VAC load centre wall mounted within the main switchroom

The connection arrangement between the main switchboard and the SCADA UPS is the same configuration as that for the control network UPS expect that the UPS output supplies a wall mounted 240VAC load centre.

The SCADA network UPS supplies all SCADA communications equipment located within the main switchroom, administration building, and exhibition centre. An individual UPS supply is also fed from this UPS supply for the ViewX client located within the main plant building.

Refer to Appendix D for the UPS loading calculations.

26.7 COMMUNICATIONS ARCHITECTURE

The communication architecture within the site is split into two physically separate and unique networks, which are the SCADA and Control Networks respectively. The sites main Quantum CPU acts as the link between the Control and SCADA networks and allows information to be passed from the control network to the SCADA network.

26.7.1 CONTROL ETHERNET NETWORK

The plant control Ethernet network consists of the following:

- Main Quantum rack
- Distributed Advantys Remote IO (RIO) Racks (18 in total)
- TesysT smart overloads
- Variable speed drives

The main Quantum PLC rack includes a CPU that contains the control program for the entire site, IO modules for monitoring and control of local equipment, and network over Ethernet (NOE) modules for Modbus scanning of the remote equipment.

There are three NOE modules installed within the main PLC, with each module tasked with Modbus scanning a separate part of the Control Network.

The Control Network is broken into the following three networks:

- TesysT smart overloads and variable speed drives Control Network
- Indoor Control Network - Main plant building RIO racks (1 to 10)
- Outdoor Control Network - External RIO racks (11 to 18)

The control network has been split into the three sections to reduce network traffic on the NOE cards which are scanning large amounts of critical and non-critical data. The breakdown also has the added benefit of simplifying fault interrogation as the network is able to be isolated into smaller sections.

The TesysT and variable speed drive control network is a star connected copper network. Each individual TesysT unit and variable speed drive is connected to one of three Connexium managed switches within the main switchboard via a Cat5e STP Ethernet cable. The managed switches are then each connected to the other with a single connection point back to the NOE module.

The NOE associated with the TesysT and variable speed drive control network also performs the role of the DHCP server within the proprietary Faulty Device Replacement (FDR) software which is to be implemented.

The indoor and outdoor RIO control networks both include a fibre ring topology which comprises a series of smaller fibre rings patched at the main switchroom to create two large rings. The exception to this ring methodology is the RO and MF skid RIO racks (4 to 10) which are star connected within the indoor control network. The star configuration was adopted in this instance as the installation of fibre patch leads in the field over the proposed distances and installation environment was considered impractical. Cat5e STP Ethernet cabling has been selected to help ensure noise immunity on these runs.

26.7.2 SCADA ETHERNET NETWORK

The SCADA Ethernet network is a standalone network that has been designed in accordance with the requirements of the HWC ICT group.

The SCADA network consists of the following major components:

- Redundant SCADA servers
- ViewX SCADA clients
- Redundant offsite communications paths (Next G and DSL)

The SCADA network is distributed between the following four areas within the plant:

- Administration Building
- Main Switchroom
- Exhibition Centre
- Main Plant Building

A fibre ring is utilised to connect between the administration building, main switchroom and exhibition centre. The main plant building is connected to the SCADA network via a single Cat5e Ethernet connection from the main switchroom.

The administration building is the main operator control centre on the site and includes SCADA server A and associated ViewX clients for monitoring and control of the site.

SCADA server B is located within a dedicated free standing communications cabinet within the main switchroom which includes a rack mounted ViewX client.

The communications cabinet within the exhibition centre is utilised to house a number of network switches which feed a large number of data outlets located within the building.

The SCADA Ethernet network communicates to the HWC wide area network via an ADSL connection or backup 3G modem.

A SCADApack 330E RTU is installed as an interface to the PLC control system.

26.7.3 ORICA COMMUNICATIONS

The design of the communication link between the AWTP and the Orica site has been removed from this project and included within the product water pipeline contract.

The AWTP PLC shall communicate with the Orica site via the SCADApack 330E RTU over the 3G network.

26.8 REMOTE IO PANELS

In accordance with the TOC design basis a total of 18 remote IO panels have been installed onsite to provide local power, control and monitoring of instrumentation and valves. The remote IO panels have been positioned throughout the site to best suit the equipment distribution and optimize cabling lengths.

The remote IO panels are to be constructed in accordance with the requirements of STS500 and shall include a dedicated support frame.

Each remote IO panel includes the following equipment:

- Electrical 81/3 key locked outer doors
- Surge protection (outdoor panels only)
- 24VDC power supply
- Advantys remote IO
- Connexium Ethernet switch
- Fibre optic patch panel
- Fuses, links, terminals, LPU’s etc.

26.9 LOCAL CONTROL PANELS

In accordance with the requirements of STS500 all motors onsite include a local control panel to enable manual start/stop control.

In contrast to existing HWC projects the test/off/auto switch has been relocated from the front of the motor starter cubicles on the MCC to the local control panel as per HWC direction.

Each local control panel includes the following:

- Start pushbutton
- Stop pushbutton
- Full current isolator (panels below 55kW only)
- Test/off/auto selector switch
- Emergency stop pushbutton

A separate design exists for the indoor and outdoor local control panels. The main difference between the two LCP designs is the inclusion of an operator WWT5 key locked outer door on the outdoor panels that ensures the test/off/auto selector switch is not accessible by unauthorised persons.

26.9.1 EMERGENCY STOP PUSHBUTTONS

An AS4024.1 risk assessment has been completed for each of the motors onsite and is included in Appendix E.

Category 1 E-stops have been included on all motor starters in line with the following philosophy:

- This is the standard design on previous HTA projects and the standard installation practice across HWC sites.
- Local Estop provided on pumps so that equipment can be easily stopped in the field in the event of operational issues such as water leaks, noisy/faulty pump operation etc.
- Local control stations in the field have locked outer door, and the Estop would be the only readily accessible control to quickly stop equipment locally (apart from unlocking the local control panel outer door first).

26.10 SITE CABLE RETICULATION

A site cable reticulation plan of the major cable routes has been developed in conjunction with HTA designers. The cable reticulation design consists of:

- Underground conduit and pit system external to the main plant building
- Cable ladder system within the main plant building and chemical area
- Cast in situ conduits within the main plant building concrete slab

Cabling routes throughout the site have been sized to meet the requirements of STS500 for spare capacity and also segregation.

The cable reticulation design onsite has been completed for major cable routes only. All cable tray and ladder required for final terminations to electrical equipment are to be site run by the electrical contractor.

Note: A direction has been received from HWC, in lieu of the requirements of STS500, that control cabling is able to be stacked within the cable ladder system as long as the bottom control cabling is easily accessible for replacement if required.

26.11 LIGHTING AND POWER

26.11.1 L&P DISTRIBUTION

The lighting and power distribution panel boards which service the KIWS facility are located and described follows:

- DB-01 is installed within the main switchroom and services the lighting and power requirements of the switchroom, building externals and yard.
- DB-02 is located within the main plant building and services the lighting and power outlets within the main plant building, RO HP pump room, crane access platforms and chemical and backwash areas.
- DB-03 Exhibition room L&P DB provided by others to service all L&P requirements within the exhibition centre.
- DB-04 Administration Building L&P DB provided by others to service all L&P requirements within the administration centre.
- DB-01 is installed within the work shed and services all the lighting and power requirements associated with the shed.

During early design development, and in conjunction with the proposed HTA construction methodology, it was confirmed that a separate L&P DB (DB-02) was to be provided within the main plant building to allow early installation and energisation of services in the plant area, to assist with equipment fit out during the construction period.

Each L&P DB is to be a proprietary wall mounted, 250amp rated chassis style, with a minimum of 36 poles and suitably IP rated for its mounted location.

26.11.2 LUMINAIRE SELECTION AND SIZING

The lighting design has selected quality energy efficiency and robust industrial fittings which provide the relevant luminance to each area of the facility in accordance with AS/NZS1158, AS/NZS1680 and Hunter Water STS500. The uniformity of manufacturer will allow for a minimal inventory of replacement lamps.

The fluorescent fittings are rated to IP65 and are of robust stabilised polycarbonate construction.

All other fittings are rated to a minimum of IP65 and of aluminium construction with stainless steel fittings to prevent corrosion.

Refer Appendix F for the site luminance level layout.

26.11.2.1 Interior Lighting

The indoor lighting consists predominantly of roof mounted high bay fittings with fluorescent fittings included at the CIP area (which is densely occupied with mechanical equipment), and also underneath and on the crane maintenance access platforms.

The design has strategically placed these fittings to allow access for installation and maintenance. In addition, the EYE LAMA High Bay fittings include a fast fit socket to facilitate rapid connection and disconnection.

It is imperative that the location of mechanical equipment is considered prior to installation of the fittings to ensure maintenance access via an elevated work platform.

The switchroom features economical fluorescent luminaries, with every second fitting provided as a maintained emergency fitting in accordance with STS500. Note that the installation of these fittings should occur following the installation of the air conditioning ductwork, to ensure correct siting.

The luminance level within the main switchroom has been provided in accordance with 240lux requirement as per STS500.

26.11.2.2 Exterior Lighting

High performance floodlights have been selected for the building externals, chemical area and roadway lighting. Where possible, the building structure has been utilised for mounting, which has minimised the amount of light poles required.

Lower wattage confined area luminaires will mount above each personnel access door to provide safe passage and building security.

Each external pumping station area is serviced via wall mounted floodlights.

An individual light and dedicated switch has been provided for all remote IO panel locations outside of the main plant building to provide maintenance lighting. The light is to be mounted below the shelter which is being installed above all outdoor RIO panels.

26.11.3 LIGHTING CONTROL

Lighting contactors are included within each DB for switching of selected lighting and also for testing of the emergency fittings.

The following sections describe the style and method of lighting control within the facility:

26.11.3.1 Indoor Lighting

Local switches are provided at each of the three personnel access (PA) doors into the main plant building. Similarly the RO HP room includes dual switching at the two PA doors. Both of these areas are serviced via lighting contactors within their respective distribution boards.

The switchroom includes direct switching from each of the PA doors.

26.11.3.2 Exterior Security Lighting

The lighting at the front of the main plant building, including the carpark areas, access gates and above doors, will be controlled via a sunset switch, such that they will be on at all times between dusk and dawn. This will provide safe passage to staff and also benefit security for the facility. An override control switch located on DB-01 is included for testing and isolation purposes.

26.11.3.3 Chemical Area and Roadway

In addition to dual outdoor switches, at either end of the facility, a PLC output will allow for automated control of the street lighting and chemical area lighting, such that they can be switched via the SCADA and can also interact with the security system to switch on automatically following a security breach.

Note the security system functionality is not included within HWA's scope and therefore integration with the lighting system is to be provided by the security system designer as required.

26.11.3.4 Pumping Stations and Work Areas

The lighting at each outdoor pumping station, raw water storage and degassing area have each been provided with a local switch.

26.11.4 EMERGENCY LIGHTING

Each internal area of the facility features emergency fittings, which activate during a power outage to provide safe egress to personnel.

Emergency lighting testing circuits, within each DB, will test the installed emergency fittings by discharging the batteries for duration of two (2) hours. This mandatory testing is a requirement of AS/NZ 2293.

The plant building features high bay fittings which have an inherent warm-up period upon initialisation.

The following requirement is stipulated in AS2293.1 - where the combination of lamps and control gear utilized in the normal lighting luminaires is such that the lamps might not restrike immediately after restoration of the normal supply, provision of a time delay or other suitable means to maintain the operation of the emergency lighting for the period necessary to allow the normal lighting lamps to restrike.

In accordance with the above requirement the lighting circuit for the high bay lighting within the main plant building includes a timer circuit to ensure the emergency lighting is maintained until the high bay lighting restrikes.

26.11.5 POWER OUTLETS

All outlets onsite are Clipsal 56 series in accordance with STS500 excluding the red UPS GPO's located within the main switchroom and main plant building.

The outlets have been located on the site in accordance with direction from HWC maintenance group.

Outlets have also been included to service portable sump pumps within the chemical dosing bunds and auto samplers.

The switchroom communications rack and plant building SCADA panel include an individual double socket single phase UPS outlet.

During the design process, Hunter Water advised that multi-phase outlets were not required within the main plant building or yard, but instead only within the work shed.

In addition to general and special purpose outlets, the L&P DB's also service fixed appliances including roller doors and chemical delivery hoists and switchroom air conditioners.

26.12 ELECTRICAL MODELING SOFTWARE

The KIWS electrical distribution system has been modeled using PowerCAD electrical design software.

A PowerCAD report has been generated and is attached as Appendix G.

26.13 SHORTLAND DECHLORINATION FACILITY

A new valve actuator (VC1002) is being installed at the existing Shortland Dechlorination Facility to divert the effluent from Shortland WWTW to the Mayfield AWTP. The Shortland Dechlorination Facility is a separate standalone installation.

The electrical installation of the new valve actuator will include:

- Modification of an existing spare cell in the existing site switchboard MCC7000 to provide a circuit breaker feeder for the new valve actuator.
- Connections to the existing PLC for control and monitoring. The site PLC has been recently upgraded to a new Schneider Quantum system.
- Associated modifications to the existing PLC and SCADA/Telemetry system

The Dechlorination Facility PLC communicates to the Shortland WWTW and the HWC Head Office SCADA system via a 3G network arrangement. If the Dechlorination system fails, pumping of effluent from the Shortland WWTW is inhibited. The existing communication pathway will be used to provide communication and control links between the new Mayfield AWTP control system and the existing Shortland WWTW and Dechlorination Facility sites.

27.0 KIWS EDUCATION ANNEX

27.1 INTRODUCTION

This report describes the Design Development and Construction Documentation phases for the proposed education annex at Hunter Water's Waste Water Treatment Plant in Channel Road, Steel River, NSW (lots 807 + 808).

The report is a final designer's report. It follows on from the concept design report prepared by GHD dated August 2011.

The strategy for the Design Development and Construction Documentation has resulted from;

- a Scope of Work (Architectural) document referenced KI-SC-AR-001,
- a Meeting with Hunter Treatment Alliance (HTA) to discuss the Architectural scope on the 28th August 2012
- a Progress meeting with HTA held on the 26th September 2012

27.2 DESIGN DEVELOPMENT

The concept design prepared by GHD established the Education Annex's siting, plan arrangement, vehicular access, construction system, form and appearance, landscaping, energy efficiency features and potential flexibility.

27.2.1 DESIGN CHANGES

Whilst these have essentially remained unchanged during the design development and construction documentation stages, several Minor changes were made to the design of the Education Annex.

These changes include;

- The floor level – as requested it was lowered to be 400mm below the main plant room to better suit the fall of the land

- The position and number of viewing windows into the Main Plant Building changed slightly. Three windows were provided as this was the best outcome given the requirements of the structural precast panels and the viewing area required.
  - The entry façade stepped forward – as requested an additional urinal and female toilet were incorporated. This pushed out the kitchenette and entry space providing more articulation to the Channel Rd façade.
  - 2 additional car parking spaces have been provided (as requested by HTA) adjacent to the disabled car space.
  - The courtyard/breakout space has been fenced as requested.
  - Extra egress doors were included to accommodate the anticipated population.
  - Precast concrete walls were changed to reinforced concrete blockwork as per the structural engineer's directive.
  - Landscaping not included in the scope of works.
  - Photovoltaic cells were not included as request by HTA

27.3 BUILDING CODE ANALYSIS

The Education Annex is a class 9b, type C construction building adjacent to the Main Plant Building (also type C construction).

27.3.1 ACCESSIBILITY

All parts of the Annex are accessible with the exception of the Male and Female Toilets. A separate accessible toilet in accordance with AS1428.1 – 2009 has been provided. The required minimum clearances at doorways have been provided in accordance with AS1428.1 -2009.

27.3.2 FIRE COMPARTMENTATION/ SEPARATION

As requested by HTA, the Annex has been designed as a separate fire compartment to the Plant Building. This is due to the fact that the treatment room in the Plant Building will not have a fire detection system. The wall separating the Plant Building and Annex is a fire wall. The design of the fire wall has been covered in the Plant Building documentation (by others). The viewing windows' drencher system has been design by the Hydraulics Engineer.

27.3.3 POPULATION

A population of 47 can be derived from the Annex's floor area (BCA).

27.3.4 SANITARY FACILITIES

The number of sanitary facilities was as instructed by the HTA. This is greater than the required number based upon occupancy and complies with the BCA.

Accessible WC	1	WC
	1	basin
Female	3	WCs (1 in Accessible WC)
	2	basins
Male	1	WC
	2	urinals
	2	basins

27.3.5 EGRESS

The population estimate has also informed the egress design in the number of required exits. Because each space (the Auditorium and Exhibition Space) will possibly accommodate more than 50 people, they each require 2 exits even though all areas are within 20m of the Main Entry. Two extra egress doors have been provided.

The required aggregate unobstructed width is 1500mm. This is achieved.

27.3.6 SECTION J

The Education Annex has been designed in accordance with Section J. A Section J report is attached as an Appendix to this Design Report.

27.4 INTER-DISCIPLINE COORDINATION

27.4.1 SUB-CONSULTANTS

Hunter Treatment Alliance provided structural and civil engineering services for the project as secondary consultants.

As head consultant QOH Architects engaged the following sub-consultants;

- Electrical Projects Australia (electrical)
- Edwards and Vickerman (mechanical)
- McCallum Plumbing & Fire Consultants Australia (hydraulic)

All three sub-consultants have worked in accordance with the provided ICT Design document (issue draft v1.1).

27.4.2 CHANGES TO THE SCOPE OF WORK

Requested changes to the brief have been accommodated in the documentation as variations to the original contract. The changes to the scope of work include;

- additional floor boxes
- additional power outlets
- additional data outlets
- drenchers to the viewing windows

27.4.3 COORDINATION

QOH Architects has reviewed the structural engineers' documents against the full documentation set received at the time of writing this report. Final structural and civil documents had not been received at the time of writing this report.

The sub-consultants have certified that their design and documentation meets statutory requirements. These are attached as Appendices to this Design Report.

27.5 MECHANICAL DESIGN AND DOCUMENTATION

The scope of the mechanical services included air conditioning to the auditorium and exhibition space as well as mechanical ventilation to the toilets and kitchen. The fan coil units for the air conditioning are located in the ceiling space (generally above the toilets) with ducting to the ceiling mounted registers in the various rooms. Outdoor condenser units are located at ground level for ease of maintenance in dedicated louvred enclosure with sufficient open area to provide good airflow.   A dedicated mechanical services board is also located in this enclosure.

The fresh air intake for the ducted air conditioning is located in the ceiling of the awning at the front of the building. Outside air relief is provide to the main ceiling space by in wall louvres with dampers at each end of the building. The exhaust for the toilets and the kitchen are via roof mounted cowls.

27.6 ELECTRICAL DESIGN AND DOCUMENTATION

The scope of the electrical services included lights, power and data. The electrical distribution board is located in the storeroom. A fire indicator panel is located in the foyer.

Floor boxes in the auditorium and exhibition space provide flexibility in addition to wall mounted power and data outlets.

The energy efficient fluorescent lighting has been specified throughout the project. Combinations of troffers, down lights, surface mounted lights have been used internally. Dimmable lights have been provided in the auditorium and exhibition space. Externally wall mounted lights have been specified along with down lights in the front awning.

27.7 HYDRAULIC DESIGN AND DOCUMENTATION

The hydraulic services included design and documentation of sanitary drainage and the cold and hot water service.

The roof water is harvested to a rainwater tank, reused to flush the toilets and connected to external hose taps. A rain saver device provides automatically provides mains water when the water in the rainwater tank is depleted.

A small electric hot water system mounted at high level in the storeroom provides hot water to the kitchen and the hand basins.

A window drencher system has been documented to protect the viewing windows in the firewall that separates the plant building and the education annex.

A dual pillar fire hydrant (designed by others as part of the main plant building) also provides protection to the education annex.

27.8 SAFE DESIGN REPORT

A safe design report has been prepared for this project. Refer to Appendix E.

28.0 ACOUSTIC DESIGN REVIEW

A final acoustic review was performed SKM to investigate the effect of minor changes to equipment placement during the detailed design.

With the exception of the R.O. flush pumps (R.O. permeate) and the chemical transfer pumps (caustic soda, SBS, R.O. cleaning chemical & sodium hypochlorite), the revised project sound power levels are much lower for plant items than those used in the 2011 assessment . On average sound power levels are between 10-30 db(a) lower than previously identified. The pumps being the exception have increased noise levels of between 2 dB(A) and 3 dB(A) higher than those in the 2011 model. The R.O. flush pumps (R.O. permeate) show an increase of 20 dB(A), from 75 dB(A) to 95 dB(A).

The 2012 design and revised layout is, on balance, likely to remain compliant however this cannot be quantitatively demonstrated without remodelling the site taking account of the new source and building locations and new noise emission data.

On the basis of this review, progressing to construction stage for this design without remodelling poses only a small risk that compliance will not be obtained in practice. In addition there are a number of additional mitigation measures which can be installed post construction to ameliorate any excessive noise emissions.

Some of the potential measures may require design at this stage so that they can be built in practice without excessive cost or retrofitting. Determination of whether these measures would be required could be undertaken at the compliance testing phase of the project, however undertaking such measures with a fully operational plant can sometimes prove more costly than putting these measures in place during the initial construction. This is a risk that the alliance needs to bear in mind.

Examples of possible measures are listed below:

- Three sided noise wall around the R.O. flush pumps, similar in design to those recommended for the raw water product feed pumps outlined in the 2011 report;
- Addition of acoustic absorption to the internal faces of pump walls identified in the 2011 report;
- Secondary 2-3 m noise wall around the perimeter of the site or at strategic locations around the boundary

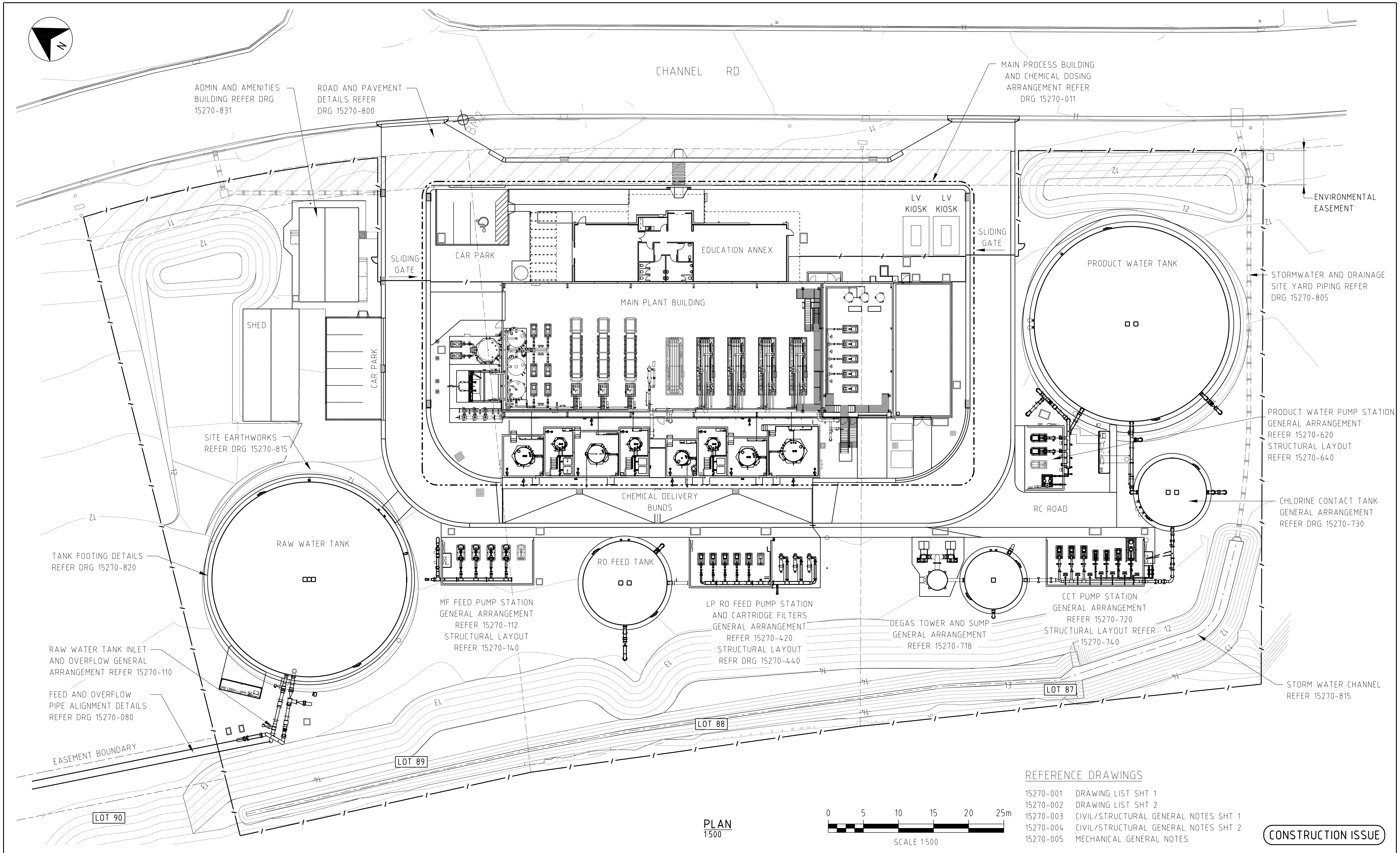
The alliance has also advised that whilst the site was previously proposed to occupy two Lots on the Steel River Site, the perimeter fence will now cover three Lots. As the method for modelling and compliance testing is based on an ‘area noise allowance’, the additional Lot area may provide additional flexibility in the noise criteria and predictions. Ultimately, corrections to take account of the additional land area from Lot 3, may reduce the total noise emission from the site and therefore make complying with the criteria more achievable. This would only be confirmed through modelling or compliance measurement.

A full copy of the noise report has been included in Appendix E

29.0 MAIN PLANT BUILDING - BUIDLING CODE ANALYSIS COMPLIANCE

The Main Plant Building is a class 8, type C construction adjacent to the Educational Annex. A review of the final design was performed by Dix Gardner Pty Ltd. and Design Compliance Certificate has been included in Appendix F

APPENDIX A. Drawing 15208-010



REFERENCE DRAWINGS

15270-001	DRAWING LIST SHT 1
15270-002	DRAWING LIST SHT 2
15270-003	CIVIL/STRUCTURAL GENERAL NOTES SHT 1
15270-004	CIVIL/STRUCTURAL GENERAL NOTES SHT 2
15270-005	MECHANICAL GENERAL NOTES

CONSTRUCTION ISSUE

No.	REVISION DETAILS	DWN	DATE
0	ISSUED FOR CONSTRUCTION	DV	18.12.12
D	ISSUED FOR WORKSHOP	DV	18.09.12
C	RE-ISSUED FOR REVIEW	DV	24.08.12
B	ISSUED FOR REVIEW	DV	27.06.12
A	ISSUED FOR IDC	DV	14.06.12

CONSULTANT DETAILS:

CONSULT. REFERENCE No.

HUNTER WATER

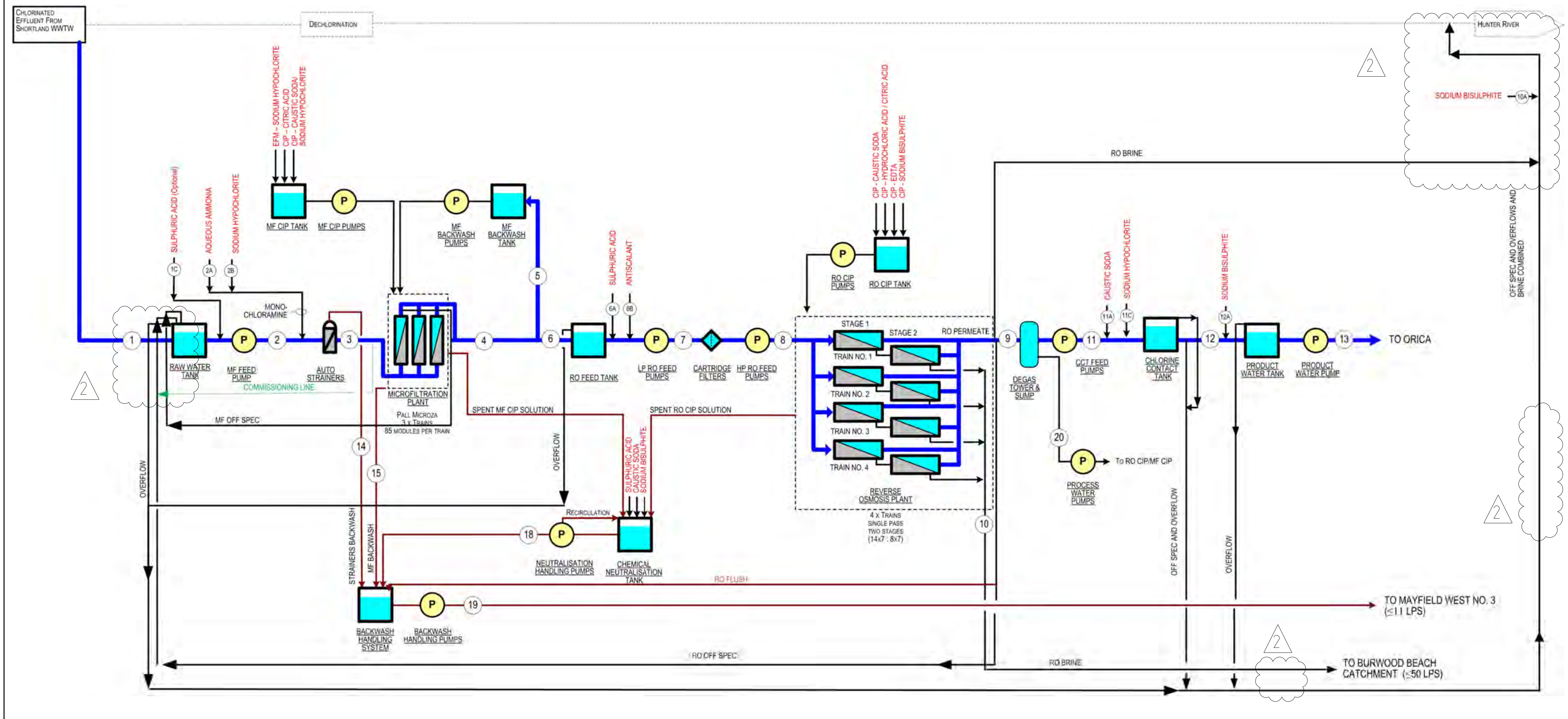
	NAME	DATE	COMPANY
DESIGNED	IT	14.06.12	HTA
DRAWN	DV	14.06.12	HTA
CHECKED	DR	18.12.12	HTA
APPROVED	JMcG	18.12.12	HTA

TITLE:
CG370001
MAYFIELD WEST AWTP (KIWS)
RT-MAW
SITE GENERAL ARRANGEMENT
PLAN

SIZE	SCALE	INDEX No.	DRAWING No.	SHEET	REV No.
A3	1:500		15270	010	0

12/18/2012 3:02:41 PM

APPENDIX B. Mayfield West AWTP - Process Flow Diagram and Mass Balances



9 MLD 90%Tile Water Quality 3Yrs	Shortland WWTW Effluent/Raw Water (1a)	Shortland WWTW Effluent Ion Balanced by RO Projections (1b)	OPTIONAL: Secondary Effluent plus Sulphuric Acid (1c)	MF Feed pumps (2)	Secondary Effluent plus preformed Monochloramines (2A/2B)	Auto Strainer product (3)	MF Filtrate (4)	MF Backwash (5)	Net MF Filtrate (6)	MF Filtrate Plus Sulphuric Acid (6A)	Acdified Effluent Plus Antiscalant (6B)	LP RO Feed (7)	HP RO Feed (8)	RO Rejection Rates %
Design Flow (MLD)	12.80	12.80		12.80	12.80	12.70	12.70	0.635	12			12	12	
Design Flow (L/s)	135	135		146	135	145	139	45	146			138	138	
Maximum flow (L/s)	250	250		205	250	204	243	45	179			147	147	
Minimum flow (L/s)	80	80		49	80	48	46	45	49			138	138	
Operating Head (m)	35	35		40		30	10	20	10			10	150	
Dose rate (mg/L)					2					41.4	4.3			

9 MLD 90%Tile Water Quality 3Yrs	Combined RO Permeate (9)	RO Brine (10)	RO Permeate Plus Sodium Bisulphite (10 A)	Brine to Hunter River or Burwood Beach Catchment (10 B)	Post Degas Tower/CCT Feed pumps (11)	Caustic Soda (11A)	Sulphuric Acid (11B)	Sodium Hypochlorite (11C)	Chlorine Contact (12)	Sodium Bisulphite (12A)	Product Water (13)	90%tile Water Quality Requirement	Strainer Backwash (14)	MF Backwash Discharge (15)	Neutralisation (18-EFM)	Neutralisation (18-SBS)	Backwash Handling (19)
Design Flow (MLD)	9	3		3	9.0				9		9	9	0.10	0.635	0.07	0.07	0.8
Design Flow (L/s)	104	26		26	104				104		104		0.7	45			9
Maximum flow (L/s)	104	26		26	104				104		135		1.0	45			15
Minimum flow (L/s)	121	30		30	121				121		72		0.2	45			9
Operating Head (m)	10	30		30	15				10		45		30	20			5
Dose rate (mg/L)			3					6.2		1.2					500	179	

CONSTRUCTION ISSUE

No	REVISION DETAILS	DWN	DATE
2	REVISED AS CLOUDED	AF	29.11.12
1	REVISED AS CLOUDED	DV	20.08.12
0	ISSUED FOR CONSTRUCTION	DV	11.07.12
C	REISSUED FOR REVIEW	DV	29.06.12
B	ISSUED FOR REVIEW	DV	03.06.12
A	PRELIMINARY FOR IDC REVIEW	TTR	11.05.12

CONSULTANT DETAILS

CONSULT. REFERENCE No.

HUNTER WATER

DESIGNED	ZM	DATE 11.05.12	COMPANY HTA
DRAWN	TTR	DATE 11.05.12	COMPANY HTA
CHECKED	KM	DATE 11.07.12	COMPANY HTA
APPROVED	MR	DATE 11.07.12	COMPANY HTA

TITLE:
CG370001
MAYFIELD WEST AWTP (KIWS)
RT-MAW
PROCESS FLOW DIAGRAM

SIZE A3 | SCALE NTS | INDEX No. | DRAWING No. 15270 | SHEET 022 | REV No. 2

APPENDIX C. Mayfield West AWTP - Process Design Criteria

APPENDIX D. Electrical

Appendix A: HV Customer Technical Memorandum

Hunter Water Australia

Technical Memorandum

26/09/2012

To	John McGuinness	**From**	Callum Menzies
CC	David Bowerman, Kevin Burgess		

Subject: KIWS Transformer Arrangement – HV Customer Issues – Review

Author: Kevin Burgess

HWA has investigated potential cost and project scheduling issues associated with the KIWS Plant being supplied as a HV customer by Ausgrid rather than as an LV customer.

All of the details and costs are subject to final confirmation by Ausgrid of their requirements.

Ausgrid will confirm their requirements after submission of a new Application for Connection (AFC) and payment of fees for issuing a new Design Information Package.

11kV CUSTOMER INSTALLATIONS VERSUS LV CUSTOMER INSTALLATIONS

The typical single line diagram for the proposed HV customer configuration is shown in an attached sketch.

The 11kV customer layout assumes two 1500kVA kiosk transformers as per the original TOC layout, but in the 11kV customer case, these kiosk transformers would be supplied and owned by HWC. The following additional equipment would also be required for a typical HV customer installation:

- Ausgrid High Voltage Connection (HVC) enclosure. This is typically a ring main unit in an outdoor type enclosure (similar to a kiosk enclosure). This is installed on the customer's property and requires a similar sized easement to that of a kiosk transformer. This is the extent of the Ausgrid supply, all other HV equipment is the responsibility of the customer.
- Customer 11kV switchboard which includes 11kV metering equipment and feeders to the 11kV/415V Transformers. HWC has agreed in this case to accept an outdoor type 11kV switchboard.

OUTDOOR 11kV SWITCHBOARD

Typical details of the 11kV outdoor switchboard required are provided in the following attached Schneider Electric drawings:

579782-01-0	11kV SM6 Type Switchgear Details (only 2 outgoing switches required for KIWS)
517554-01-0	11kV Outdoor Switchboard General Arrangement

The 11kV switchgear would include:

- Incomer(with protection), metering section to Ausgrid requirements and two feeders
- Mild Steel enclosure with harsh environment rated paint protection system

- Stainless steel metering panel on the outside of the enclosure to meet Ausgrid requirements
- Remote operator panel to permit remote operation of all switchgear

The Schneider budget price for the supply of this outdoor switchboard is $140,000, with an estimated delivery of 14 -16 weeks after placement of order.

HWA recommends that even though the switchboard is rated for outdoor installation, it should preferably be installed under a protective weatherproof awning to facilitate maintenance and inspection in inclement weather.

OUTDOOR 11kV/415V KIOSK TRANSFORMER

Typical details of the 11kV/415V 1500kVA Kiosk Transformers are provided in the following Schneider Electric drawing:

9223 2692 11kV/415V 1500kVA KPX Type Kiosk

Each 11kV/415V Kiosk Transformer would include:

- Mild Steel enclosure with harsh environment rated paint protection system
- RM6 type Circuit Breaker with transformer protection on 11kV incomer
- 2500A Masterpact Air Circuit Breaker (ACB) on 415V side of the transformer
- Inter trip between ACB and 11kV RM6 circuit breaker
- Remote Operation of both the 11kV circuit breaker and 415V ACB via separate stainless steel operator panel.

Installation of the kiosk requires a concrete pad rather than the pier arrangement on the Ausgrid style kiosks.

HWC either has or is in the process of developing a standard specification for these styles of kiosks as part of a separate HV upgrade project. At present HWA has not reviewed this standard, but it is assumed that the above Schneider arrangement would comply with HWC requirements.

The Schneider budget price for the supply of the outdoor Kiosks is $110,000 each, with an estimated delivery of 16 weeks after placement of order.

It is noted that the quoted cost for a 1500kVA kiosk transformer is significantly higher than that previously advised by Ausgrid for an Ausgrid standard Kiosk ($81,451) on March 2012.

The reasons for the higher cost would include:

- Remote operation on switchgear
- 415V ACB rather than disconnect switch

Both of the above are HWC requirements.

Also it is assumed that Ausgrid have a bulk supply contract with Schneider, which may offer more competitive pricing.

SITE LAYOUTS

The site layout for the additional customer HV equipment has not yet been finalised with HTA, but it is assumed that the new Kiosks would be located close to the main switchroom rather than on the site boundary (as required for the LV customer arrangement).

CABLING COST ISSUES

The HV customer arrangement will result in higher 11kV cabling costs, however this should be offset by the reduction in 415V mains cabling cost if the new 1500kVA kiosks are located close to the main switchroom rather than on the site boundary.

HV EARTHING ISSUES

Minor additional costs will be associated with additional earthing for the customer 11kV installation.

CIVIL COST ISSUES

The original TOC LV supply arrangement would have included civil footings for two Ausgrid 1500kVA kiosk Transformers.

The Proposed HV customer supply arrangement requires civil footings for:

- One Ausgrid HVC electrical enclosure
- One 11kV Outdoor Switchboard (weather protective awning is also recommended)
- Two separate 1500kVA kiosk transformers

HTA will confirm additional civil costs separately.

PROJECT SCHEDULING ISSUES

The processing of the Ausgrid Application for Connection and supply of the associated Design Information Package (DIP) may take slightly longer than that for an LV customer, but this is difficult to forecast.

The ASP3 design and certification for the contestable work (i.e. installation of Ausgrid HVC) should take no longer than for an LV customer.

The design of the customer HV installation is not “contestable work” and as such does not need formal Ausgrid certification prior to commencement of construction. The customer design and installation does need review and inspection by Ausgrid prior to commissioning. This means that the procurement of the HV switchboard and Kiosk Transformers should be able to commence shortly after the receipt of the Ausgrid Design Information Package.

David Griffiths from Power Solutions indicated that a typical customer HV design should take approximately 12 weeks. As part of this design, the following design aspects need to be prepared and submitted to Ausgrid for review and approval:

- Site HV earthing study
- Protection coordination study (including coordination with Ausgrid network protection systems)

As noted earlier, the estimated delivery period for the Schneider 11kV equipment is 16 weeks after placement of order. The time periods for preparation of technical and commercial specifications, HWC review of technical specifications, tendering and tender assessment would be additional to this.

Possible sources of delays to the power supply installation and commissioning would include:

- Ausgrid delays with supply of information
- Ausgrid inspections and any identified corrective actions prior to commissioning of the system
- Preparation of HWC HV maintenance and operating procedures for the site (see below) and review and acceptance of these by Ausgrid (a pre-requisite for final commissioning)

GENERAL AUSGRID HV CONNECTION REQUIREMENTS

The general Ausgrid requirements for HV connections are detailed in Ausgrid Specification NS195.

Some points to note in this specification are:

- The Customer must establish testing intervals for protection systems associated with the Customer's Installation, and agreed protocols for the coordination of maintenance activities with Ausgrid. A copy of the proposed maintenance plan shall be forwarded to Ausgrid prior to commissioning the Customer's Installation.
- The customer shall prepare an integrated Installation Safety Management Plan in accordance with the Ausgrid's Customer Installation Safety Plan and Standard Form Customer Connection Contract. This shall be lodged with Ausgrid prior to the commissioning of the Customer's Installation. The plan should be based on appropriate risk analysis techniques (and include non-compliant equipment, upgrade and refurbishment programs, site hazards, etc.).
- The Customer's Installation Safety Management Plan shall include Operating Procedures, and shall ensure that the Customers Installation is at all times operated in accordance with those Procedures. The Operating Procedures shall comply with the procedures detailed in Australian Standard AS 2467, and the NSW Service and Installation Rules.
- The Operating Procedures shall incorporate similar principals to Ausgrid's Electrical Safety Rules covering all aspects of operating the Customer's HV Installation. An up-to-date HV line diagram of the Customer's Installation shall be prominently displayed in an appropriate location within the Customer's premises (e.g. Customer's HV switchroom).

Since HWC is already a HV customer, and is presently in the process of upgrading equipment at other HWC HV customer sites, the preparation of the above documentation should present little challenge for HWC. However site specific documentation will still need to be submitted and approved prior to commissioning. It is assumed that all of the above maintenance and operating documentation would be prepared by HWC.

ENERGY COST ISSUES

HV customer connection offers two advantages in terms of energy costs:

- Lower kWH rate

- Averaging of maximum demand charges over each of the two transformers. As an LV customer, maximum demand charges generally apply to each individual transformer maximum demand.

The potential energy cost savings of the plant being supplied as a HV rather than an LV customer have been estimated separately by HWC.

SUMMARY OF ESTIMATED COST DIFFERENCES

TOC LV CUSTOMER COSTS	**KIOSK RATING 1500kVA**
Ausgrid Customer Contribution for first Kiosk	$37,053
Cost of second Kiosk	$81,451
AUSGRID TOTAL	$118,504
Typical cost for ASP3 Design	$15,000
TOTAL (not incl other Ausgrid fees)	**$133,504**

HV CUSTOMER COSTS (outdoor type HV Switchboard)

Typical Ausgrid customer contribution for HVC	$45,000	Advice from D. Griffiths at Power Solutions in phone conversation – subject to confirmation by Ausgrid DIP.
Typical ASP3 Design for HVC	$15,000	Advice from D. Griffiths at Power Solutions in phone conversation
Typical HV Design for customer equipment (by ASP3 designer & not including HWA electrical management)	$40,000	Advice from D. Griffiths at Power Solutions in phone conversation
Typical supply only cost of customer HV switchboard (outdoor type)	$140,000	Schneider budget cost in email of 25/9/12
Typical cost for two 1500kVA Kiosks @ $110,000 each	$220,000	Schneider budget cost in email of 25/9/12
Additional site installation cost Craneage, HV earthing etc	$10,000	Estimation
Additional civil works for two additional footings and earthing	TBC	To be confirmed separately by HTA
Additional HTA costs for procurement & design	TBC	To be confirmed separately by HTA
HWA electrical management of additional work including review of equipment procurement technical specifications.	$20,760	Advised by HWA in email to HTA 11/9/12
INDICATIVE ESTIMATE (not incl. other Ausgrid fees)	**$490,760**	**Plus HTA costs not yet confirmed**

<u>ADDITIONAL ESTIMATED COSTS</u> **$357,256 not including HTA & civil costs**

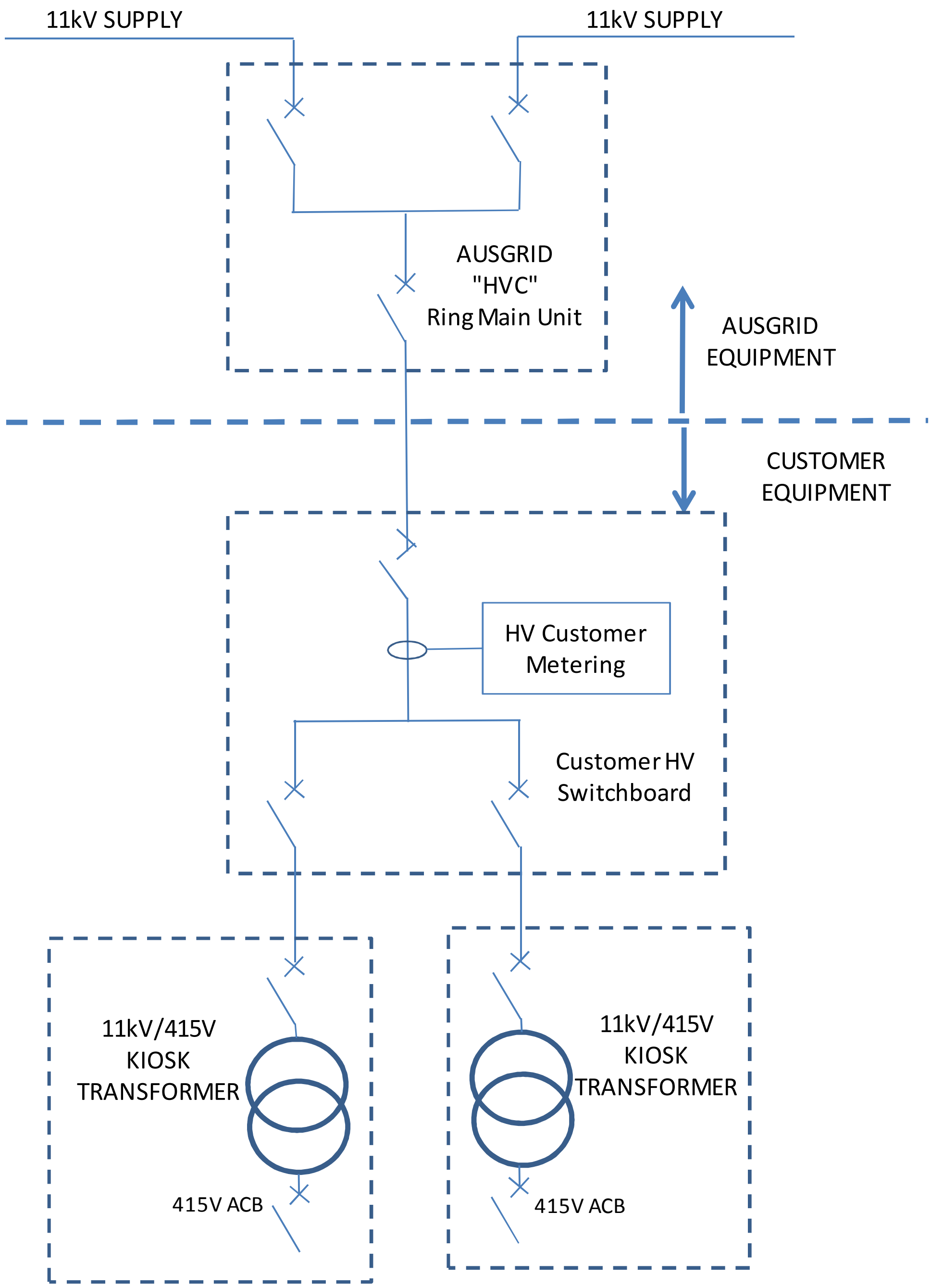
Hunter Water Australia

ATTACHMENTS:

- Typical HV Customer Arrangement
- Typical Equipment Photos
- Copy of Schneider Budget Quote Email
- Copy of Ausgrid Email - Capital Contribution Cost

SCHNEIDER ELECTRIC DRAWINGS

- 579782-01-0 11kV SM6 Type Switchgear Details (only 2 outgoing switches required for KIWS)
- 517554-01-0 11kV Outdoor Switchboard General Arrangement
- 9223 2692 11kV/415V 1500kVA KPX Type Kiosk



TYPICAL HV CUSTOMER ARRANGEMENT

Hunter Water Australia

TYPICAL EQUIPMENT PHOTOS

Typical Schneider SM6 Outdoor Switchboard Arrangement

Typical Schneider KPX Outdoor Kiosk Arrangement (on concrete pad)

Hunter Water Australia

COPY OF SCHNEIDER BUDGET QUOTE EMAIL   Page 1 of 2

Kevin Burgess

From: dale.bromfield@schneider-electric.com
Sent: Tuesday, 25 September 2012 9:30 AM
To: Kevin Burgess; Callum Menzies
Cc: allen.scariot@schneider-electric.com
Subject: Re: Fw: SM6 Switchboard with Metering + 1500KVA Kiosk
Attachments: DM1-GC88-IM-IM-IM.dwg.zip; SM6 6 way outdoor hsg.dwg.zip; P1010031.JPG.zip; P1010030.JPG.zip; 92232692.pdf.zip; ~6052321.JPG.zip

Hi Kevin

Budget Prices as follows:

Outdoor 11kV SM6 Switchboard complete with:

- [illegible] (with protection), metering section to Ausgrid requirements and two feeder switches [illegible]
- [illegible]
- Stainless steel metering panel on the outside of the enclosure to meet Ausgrid requirements [illegible]
- Remote operation panel to permit remote operation of all switchgear [illegible]

Budget $148K

Delivery 14-16 weeks

Outdoor 1500kVA Kiosk, complete with remote operator panel for HV RMU and LV ACB

- 1500kVA 11/433
- [illegible] RMU in MV End
- 2500A ACB in LV
- Both Remote Operation
- Stainless Panel for operation

Budget $116K

Delivery 16 weeks

- We will not require the 1500kVA kiosk to be configured with an 11kV ring main connection (just individual direct feeds from the 11kV switchboard), but would you still recommend SM6 distribution switches and HV protection in the kiosk (alternative would be to have SM6 distribution circuit breakers with protection units in the outdoor 11kV switchboard and no HV switchgear in the transformer kiosk – but this would make the SM6 switchboard larger) [illegible]. Connection can be direct to transformer for SM6.
- I assume that the 1500kVA kiosk offered could be mounted similar to the standard Ausgrid civil arrangements (ie on pier) [illegible] to Aus Grid Standards.

Regards
Dale Bromfield

Dale Bromfield | Schneider Electric | Infrastructure Business | Australia | Sale Engineer
Phone: +61 2 9125 [illegible] | Fax: +61 2 [illegible] | Mobile: 0409 [illegible]
Email: [illegible] | Site: [illegible] | Address: 78 Waterloo Road, Macquarie Park, NSW 2113 AUSTRALIA
[illegible]

Allen Scariot/AU/Schneider
[illegible] 04:37 PM

To Dale Bromfield/AU/Schneider@AsiaPacific
cc
Subject Fw: SM6 Switchboard with Metering + 1500KVA Kiosk

Hi Dale,

Can you look after Kevin.

Thank-You !

Regards,
Allen Scariot

Allen Scariot | Schneider Electric | Infrastructure Business | Australia | Key Account Manager - NSW Utilities
Phone: +61 2 [illegible] | Fax: +61 2 [illegible] | Mobile: [illegible]
Email: [illegible] | Site: [illegible] | Address: 78 Waterloo Road, Macquarie Park, NSW 2113 AUSTRALIA
[illegible]

----- Forwarded by Allen Scariot/AU/Schneider on [illegible] PM -----

Kevin Burgess <Kevin.Burgess@hwa.com.au>
[illegible] PM

To "allen.scariot@schneider-electric.com" <allen.scariot@schneider-electric.com>
cc Callum Menzies <Callum.Menzies@hwa.com.au>
Subject SM6 Switchboard with Metering + 1500KVA Kiosk

Allen

COPY OF SCHNEIDER BUDGET QUOTE EMAIL Page 2 of 2

Thanks for the attached information.

Can you please advise budget pricing for:

Outdoor 11kV SM6 Switchboard complete with:

- incomer(with protection), metering section to Ausgrid requirements and two feeder switches
- Steel enclosure with top of the range paint protection system
- Stainless steel metering panel on the outside of the enclosure to meet Ausgrid requirements
- Remote operator panel to permit remote operation of all switchgear

Outdoor 1500kVA Kiosk, complete with remote operator panel for HV RMU and LV ACB

Notes:

- We will not require the 1500kVA kiosks to be configured with an 11kV ring main connection (just individual direct feeds from the 11kV switchboard), but would you still recommend SM6 distribution switches and HV protection in the kiosk (alternative would be to have SM6 distribution circuit breakers with protection units in the outdoor 11kV switchboard and no HV switchgear in the transformer kiosk – but this would make the SM6 switchboard larger)
- I assume that the 1500kVA kiosk offered could be mounted similar to the standard Ausgrid civil arrangements (ie on piers)

Regards

Kevin Burgess
Electrical Engineer
Hunter Water Australia Pty Limited
PO Box 5007 HRMC 2310
19 Spit Island Close, Steel River, Mayfield West NSW 2304
P +61 2 4941 4965
F +61 2 4941 5011
Please consider the environment before printing this e-mail notice

From: allen.scariot@schneider-electric.com [mailto:allen.scariot@schneider-electric.com]
Sent: Tuesday, 11 September 2012 5:18 PM
To: Kevin Burgess
Subject: SM6 Switchboard with Metering + 1500KVA Kiosk

Hi Kevin,

Please find attached drawings / photos as promised.

SM6

1500KVA Kiosk

Please let me know if you require further information.

Regards,
Allen Scariot

Allen Scariot | Schneider Electric | **Infrastructure Business** | **Australia** | **Key Account Manager - NSW Utilities**
Phone: +61 2 9125 8069 | **Fax:** +61 2 9888 7593 | **Mobile:** (0413) 433 869
Email: allen.scariot@schneider-electric.com | **Site:** www.schneider-electric.com.au | **Address:** 78 Waterloo Road, Macquarie Park, NSW 2113 AUSTRALIA
*** Please consider the environment before printing this e-mail

Hunter Water Australia

COPY OF AUSGRID EMAIL - CAPITAL CONTRIBUTION COSTS

From: Andrew Busch [mailto:abusch@ausgrid.com.au]
Sent: Tuesday, March 13, 2012 4:16 PM
To: Victor Archer
Subject: Re: SC-03645 - Initial Offer from Ausgrid - additional information

Hi Victor,

As requested the current prices for the Kiosk options are as follows.

K-Type 1500kVA Kiosks
For first Kiosk, the customer contribution is $37053
For the second Kiosk the price is $81,451

L-type 1000kVA Kiosks
For first Kiosk, (1000kVA) $19,833
For the second Kiosk $65,572

If your designer decides that the L type Kiosk solution meets your requirements it will be cheaper and not require the yearly outage for maintenance.

Please note :

These figures do not include any of the installation costs.

The differences in prices between the first and second kiosks is due to the first Kiosk being classified as free issue, please refer to the initial offer letter for more information

Also these are only estimates at this stage and will be confirmed at certification stage.

Regards,

Andrew Busch | Engineer | Contestability | Ausgrid

Level BLOCK A, 145 Newcastle Road Wallsend NSW 2287 AUSTRALIA
: 02 4035 4136 (Extn 44136) | : 02 4035 1842 (Extn 51842) | : 0409 905 351 | : abusch@ausgrid.com.au |

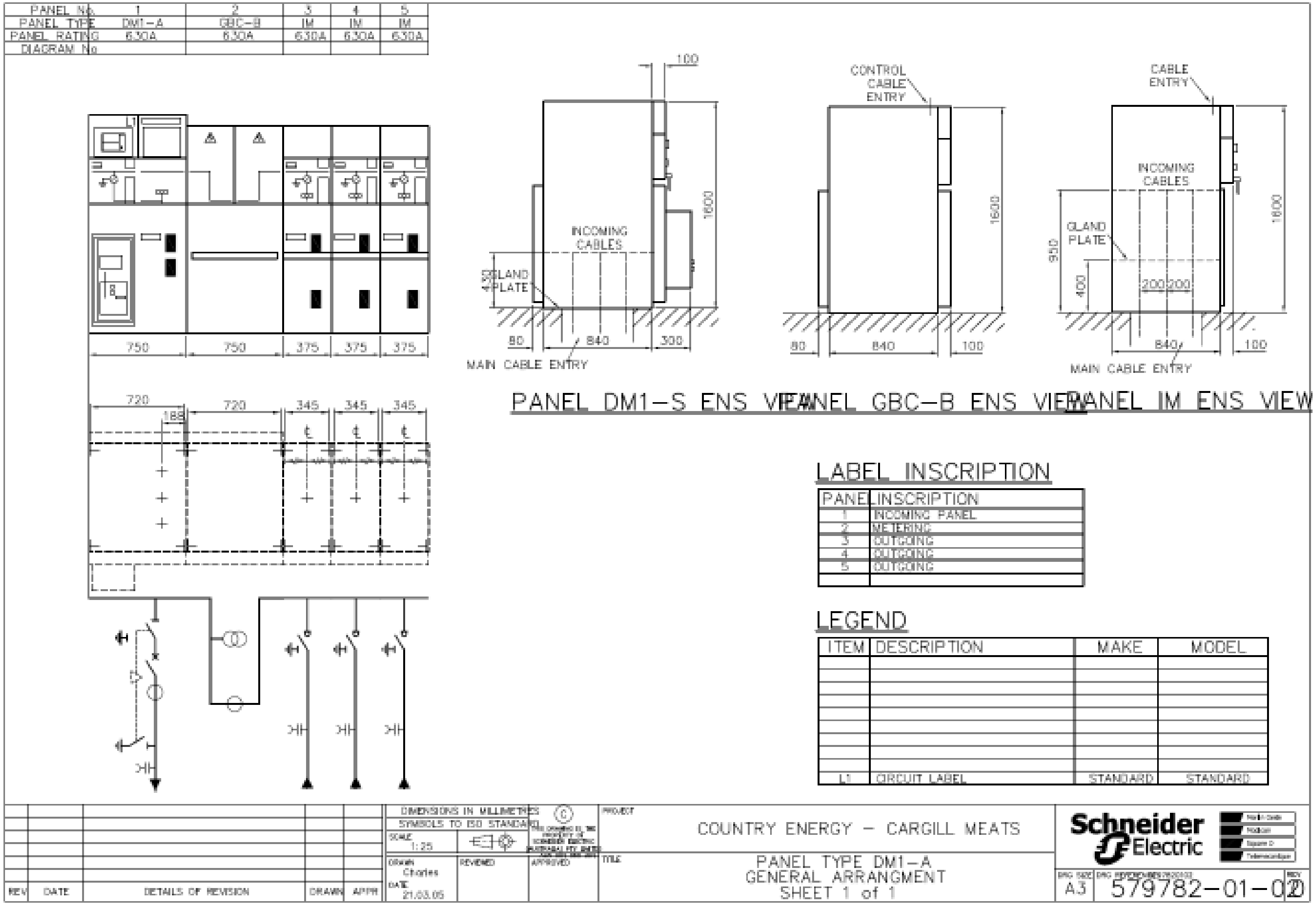
Please consider the environment before printing this email
----- Forwarded by Andrew Busch/energyAustralia/AU on 13/03/2012 04:04 PM -----

Andrew Busch/energyAustralia/AU

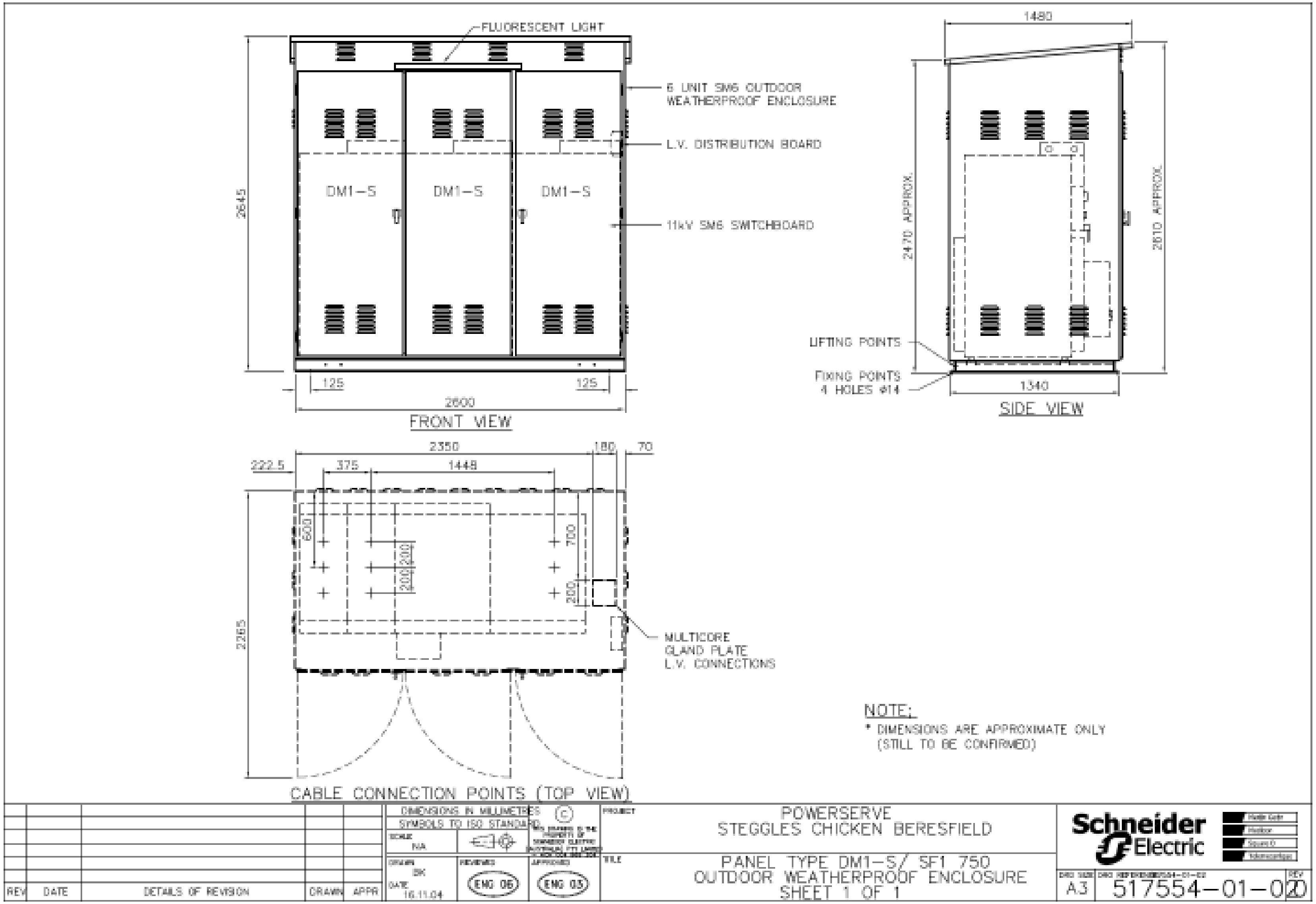
13/03/2012 03:51 PM

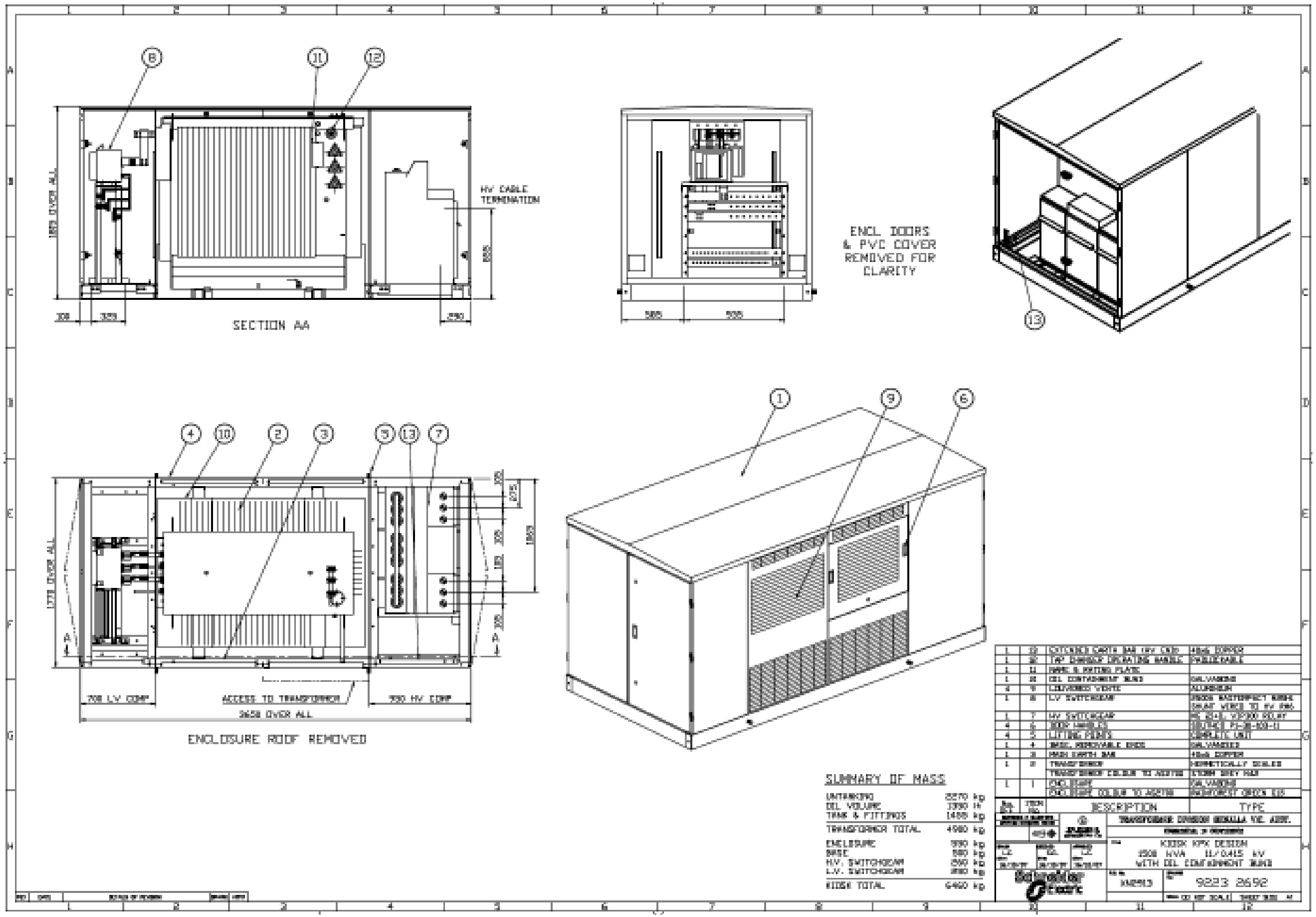
To victor.archer@htalliance.com.au
cc
Subject SC-03645 - Initial Offer from Ausgrid

SCHNEIDER 11kV EQUIPMENT DRAWINGS



PANEL No. 1 2 3 4 5
PANEL TYPE DM1-A GBC-B IM IM IM
PANEL RATING 630A 630A 630A 630A 630A
DIAGRAM No
750 750 375 375 375
720 720 345 345 345
185
INCOMING CABLES
GLAND PLATE
MAIN CABLE ENTRY
80 840 300 1600 100
CONTROL CABLE ENTRY
80 840 100 1600
CABLE ENTRY
950 400 200 200 840 100 1600
PANEL DM1-S ENS VIEW
PANEL GBC-B ENS VIEW
PANEL IM ENS VIEW
LABEL INSCRIPTION
PANEL INSCRIPTION
1 INCOMING PANEL
2 METERING
3 OUTGOING
4 OUTGOING
5 OUTGOING
LEGEND
ITEM DESCRIPTION MAKE MODEL
L1 CIRCUIT LABEL STANDARD STANDARD
REV DATE DETAILS OF REVISION DRAWN APPR
DIMENSIONS IN MILLIMETRES
SYMBOLS TO ISO STANDARD
SCALE 1:25
DRAWN Charles
DATE 21.03.05
REVIEWED
APPROVED
PROJECT
COUNTRY ENERGY - CARGILL MEATS
TITLE
PANEL TYPE DM1-A
GENERAL ARRANGMENT
SHEET 1 of 1
Schneider Electric
DRG SIZE A3
579782-01-02


FLUORESCENT LIGHT
6 UNIT SM6 OUTDOOR WEATHERPROOF ENCLOSURE
L.V. DISTRIBUTION BOARD
11kV SM6 SWITCHBOARD
DM1–S
DM1–S
DM1–S
2645
125
125
2600
FRONT VIEW
1480
2470 APPROX.
2810 APPROX.
LIFTING POINTS
FIXING POINTS 4 HOLES Ø14
1340
SIDE VIEW
2350
180
70
222.5
375
1448
600
200
200
700
200
2265
MULTICORE GLAND PLATE L.V. CONNECTIONS
CABLE CONNECTION POINTS (TOP VIEW)
NOTE:
* DIMENSIONS ARE APPROXIMATE ONLY
(STILL TO BE CONFIRMED)
REV
DATE
DETAILS OF REVISION
DRAWN
APPR
DIMENSIONS IN MILLIMETRES
SYMBOLS TO ISO STANDARD
SCALE
N/A
DRAWN
BK
DATE
16.11.04
REVIEWED
ENG 06
APPROVED
ENG 03
PROJECT
POWERSERVE
STEGGLES CHICKEN BERESFIELD
TITLE
PANEL TYPE DM1–S/ SF1 750
OUTDOOR WEATHERPROOF ENCLOSURE
SHEET 1 OF 1
Schneider Electric
A3
517554–01–02
REV
D



SECTION AA
HV CABLE TERMINATION
1889 OVER ALL
ENCL DOORS & PVC COVER REMOVED FOR CLARITY
1778 OVER ALL
708 LV COMP
ACCESS TO TRANSFORMER
3658 OVER ALL
930 HV COMP
ENCLOSURE ROOF REMOVED
SUMMARY OF MASS
TRANSFORMER TOTAL 4980 kg
ENCLOSURE 990 kg
BASE 580 kg
H.V. SWITCHGEAR 260 kg
L.V. SWITCHGEAR
KIOSK TOTAL 6460 kg
DESCRIPTION
TYPE
KIOSK KPX DESIGN
1500 kVA 11/0.415 kV
WITH OIL CONTAINMENT BUND
9223 2692

Appendix B: Ausgrid Application for Connection

APPLICATION FOR CONNECTION

Ausgrid

To be completed in BLOCK LETTERS by the electrical contractor or agent, on behalf of the customer.

A **Site Establishment Fee** as detailed in ES5 may apply to this installation. You will be notified if a Site Establishment Fee applies to this installation when your Job Number is issued. The Site Establishment Fee is charged when the Notification of Service Work is received.

Fax Sydney and Tuggerah (02) 4399 8007
Email to: ea.datanorth@ausgrid.com.au
Fax Local Call 1300 662 089
(Not to be used for Muswellbrook)
Fax Muswellbrook (02) 6542 9037
Email to ea.datamuswellbrook@ausgrid.com.au

RETAILER: Country Energy
NMI:

INSTALLATION ADDRESS

Property Name: Kooragang Island Industrial Water Treatment Plant
Pole/Pillar ID:
Floor: **Unit**: **Street**: **Lot/RMB**: Lot 87 /270249
Existing Meter ID:
Street: Channel Road
Nearest Cross Street: Frost Drive
Suburb: Mayfield West (Steel River) **Postcode**: 2304

Office Use Only
Job Number
Site Establishment Fee to be applied ☐

CUSTOMER AND POSTAL ADDRESS

First Name (or Company Name): Hunter Water Corporation
Phone:
Last Name:
Mobile:
Floor: **Unit**: **Street No**: **PO Box**: HRMC 5171 **Street**:
Street (cont): **Suburb**: Newcastle **Postcode**: 2300

ELECTRICAL CONTRACTOR/AUTHORISED SERVICE PROVIDER

Electrical Contractor Name: To be advised **Licence Number**: **Contact Phone Number**:
Authorised Service Provider Name: **Licence Number**: **Contact Phone Number**:
Email Address (Preferred Option of Returning Job Number): **Fax Number**:
E/C or ASP Postal Address:

SERVICE, DEMAND AND LOAD DETAILS (please tick)

Connection Type
- New ☒
- Alteration ☐
- Upgrade ☐
- Separation ☐
- Amalgamatio ☐
- Grid Connected Genration System ☐

Service Type
- Overhead ☐
- Underground ☒
- UGOH ☐
- Off Pole Transformer ☐
- Upgrade to TOU: Y

Service Size
- 100A ☐
- 200A ☐
- 400A ☐
- Other 2020A

Number of Installations
- Single Installation ☒
- Multiple Installation ☐
- Number of House Services:
- Number of Units:

Premise Type
- Domestic: Torrens ☐ Strata ☐
- Commercial ☐
- Builders Service Perm ☐
- Special Small Service (Indicate type of SSS below) ☐
- Other: Industrial..............

Supplementary AFC

If the installation is one of the following types you must also complete and attach the **Supplementary Application for Connection.**
- New electrical work over 20kW ☒
- Services greater than 100 Amps ☒
- CT metered installations (CT Metering Form MUST be submitted) ☒
- New HV installations and those requiring more than 100 Amps of additional load ☐
- Multiple living unit developments (more than six units) ☐
- Installations located in rural or outlying areas ☐
- Work where the proposed equipment may cause excessive fluctuation of voltage (eg welders, x-ray machines) ☐
- Equipment > 75A per phase (Power Quality Form MUST be submitted) ☒
- Grid Connected Generation System ☐

Calculated Maximum Demand in Each Phase (Amps)

	A	B	C
Proposed	2020 Amps	2020 Amps	2020 Amps
Existing			

Service Length:
Existing Service Rating:

Details of Job: Hunter Treatment Alliance (HTA) is building the Kooragang Island Industrial Water Treatment Plant for HWC to supply recycled water to the Orica Kooragang Island plant. The proposed power supply arrangement for the HWC plant is two 1500kVA kiosk transformers

Print Name: Callum Menzies....... Signature [signature] Date 5/11/12......

SUPPLEMENTARY

APPLICATION FOR CONNECTION

Ausgrid

To be lodged with the Application for Connection. Refer to document ES1.

	FAX
Tuggerah	(02) 43998007
Email to ea.datanorth@ausgrid.com.u	
Free Call (Not to be used for Muswellbrook)	1300 662089
Muswellbrook	(02) 65429037
Email to ea.datamuswellbrook@ausgrid.com.au	

This form is required for:

- ☐ New electrical work over 20kW (Part A, B, C);
- ☐ Multiple living unit developments (more than 6 units) (Part A, B, C);
- ☐ For services greater than 100 Amps (Part A, B, C);
- ☐ CT metered installations. **NOTE: The installation WILL NOT be energised unless all the information required on the CT Metering form has been provided and processed (Clause 4.5 of ES1).** (Part A, B, C);
- ☐ Rural or outlying areas (Part A, B & C);
- ☐ New HV installations and those requiring more than 100kW or additional load (Part A, B, C, D);
- ☐ Work where the proposed equipment may cause excessive distortion, fluctuation or unbalance of voltage (Part A,B,C,D);
- ☐ All new and altered Solar Grid Connected generation installations (Part A, E)
- ☐ All other new and altered Grid Connected generation Installations (Part A, C, E)

Please complete this form in BLOCK LETTERS.

PART A INSTALLATION ADDRESS

Property Name: KOORAGANG ISLAND IND. WATER PLANT

Floor: **Unit:** **Street No.:** **RMB/Lot:**

Street: CHANNEL ROAD

Suburb: MAYFIELD WEST

Cross Street: FROST

Existing Meter ID:

Pole Pillar ID:

PART B INSTALLATION LOAD DETAILS

Residential Portion

No living units:	
No of bedrooms per unit:	
Gas hot water (yes/no):	
Lift(s) and start current:	
Car park ventilation current rating:	
Air conditioning (yes/no):	
Air conditioning rating:	

Commercial Portion

Total floor area with air/con:	m^2
Total office floor area without air/con:	m^2
Car park floor area:	m^2
Warehouse floor area:	m^2
Commercial areas for food handling (yes/no):	

Industrial Portion

Number of factory units:	
Total floor area of all factory units:	m^2

PART C DIAGRAM

Refer to attached Main Switchboard single line diagrams SK10357 Sheets 30, 31, 32, 35, 36

Part D – Power Quality. Attach Power Quality Assessment form if any of the following are proposed:

Variable Speed Drives, switched-mode power supplies or other rectifiers > 75A per phase	☐
Motors exceeding the limits set out in the Service and Installation Rules of NSW	☐
Arc furnaces, welders or harmonic filters	☐
Unbalanced loads (Phase-Phase connected or single phase > 75A)	☒
Power Factor Correction capacitor banks	☐
Other voltage distorting or fluctuating equipment > 75 per phase, or installation with a large deployment of computer servers or IT equipment	☐
High Voltage Connections	☐

Part E- Grid Connected Generation Systems. Full details of any Grid Connected Generation Systems (Refer to Section 8 of the Service & Installation Rules of NSW)

Make/Model:			
Inverter Details			
Size of Inverter: (Nominal Rating)	kW	Is Inverter an Approved Type? (CEC) YES ☐ NO ☐ If No, Attach Certificate of Suitability	
No. of Phases:	1☐ 3☐		
No. of Inverters:		CEC Accredited Installer Number	
Total kW's to be Connected (Single Phase)	kW's	Solar Panel Details Number ____ Total Rating ____kW	Other Generator details (Wind etc.) Type____ Total Rating ____ kW

Note: The Metering Configuration must be Net Metering

The installation must be: -

a) Designed and installed by a CEC accredited person

b) Comply with all CEC guidelines

Part F - Additional Comments: 658A of VSD load on Transformer 1 (max motor size 132kW)

646A of VSD load on Transformer 2 (max motor size 90kW)

POWER QUALITY ASSESSMENT

This form is required if ANY piece of Low Voltage equipment has a rating of greater than 75A per phase or any High Voltage Connection Application.

List ALL proposed / expected equipment in the installation that may result in voltage fluctuations or distortion.

NOTE: The installation WILL NOT be energised unless all the information required on this form has been provided and processed.

Submit in conjunction with an Application for Connection or as requested by Ausgrid

Please complete this form in BLOCK LETTERS.

PART A INSTALLATION ADDRESS

Property Name
KOORAGANG ISLAND INDUSTRIAL WATER TREATMENT PLANT

Floor

Unit

Street No. 87

RMB/Lot 270249

Street CHANNEL RD

Suburb MAYFIELD WEST (STEEL RIVER)

Cross Street FROST DRIVE

Existing Meter ID

Pole Pillar ID

PART B INSTALLATION NON LINEAR/ FLUCTUATION LOAD DETAILS

Description	kVA/kW	Amp	Number of operations/hr	Design Standard	Mitigation Measures
DISTORTING LOADS					
1 Phase capacitor-filtered or conventional rectifier					
3 Phase 6-pulse capacitor filtered rectifier / Variable Speed Drives					
3 Phase 6 pulse capacitor filtered rectifier with series inductor > 3% or DC drive / VSD					
3 Phase 6 pulse inductor filtered rectifier / VSD					
3 Phase 12 pulse rectifier / VSD					
AC voltage regulator					
Variable voltage variable frequency (VVVF) Drive	872 kW	1304 A			2 x 300A ACTIVE HARMONIC FILTERS
Switch mode power supplies					
Power Factor Correction					ABOVE ACTIVE HARMONIC FILTERS
Unknown					
FLUCTUATING LOADS					
Rating of the largest motor	132 kW	240 A	/		VSD
Rating of the second largest motor	90 kW	122 A	/		VSD
Rating of other frequently fluctuating loads:					
Other:					
SPECIAL EQUIPMENT					
X-Ray or Magnetic Resonance Imaging Devices					
Welding plant rating					
Arc furnaces rating					
Unbalanced loads (e.g PH-N / PH-PH loads)					
Other:					
TOTAL APPARENT POWER RATING					

PART C REFERENCES TO SIMILAR INSTALLATIONS OR COMMENTS

A 300A ACTIVE HARMONIC FILTER WILL BE INSTALLED ON EACH SIDE OF MAIN SWITCHBOARD
ACTIVE HARMONIC FILTER WILL ALSO PROVIDE POWER FACTOR CORRECTION.

Appendix C: Load Schedule

KIWS ELECTRICAL LOAD LIST - SUMMARY SHEET

Total Site Load	
	Amps
Plant Load - Current	2070.965
Plant Load - Future	2607.715

MSB Load Split - Current	
Transformer	**Amps**
Transformer 1	1135.405
Transformer 2	935.56

VSD Load Split - Current	
Transformer	**Amps**
Transformer 1	686.33
Transformer 2	645.99

MSB Load Split - Future	
Transformer	**Amps**
Transformer 1	1507.805
Transformer 2	1099.91

VSD Load Split - Future	
Transformer	**Amps**
Transformer 1	1058.73
Transformer 2	783.74

TAG_NO	STATUS	DESCRIPTION	POWER kW	PID DRAWING NO	VSD / DOL	TF 1 or 2	DUTY FACTOR	LOAD FACTOR	NOM. AMPS	LOAD AMPS	COMMENTS
PU4801	Duty	Product Water Transfer Pump 1	150	15270-045	VSD	1	1	0.95	270	256.5	Final rating to be confirmed
PU4802	Standby	Product Water Transfer Pump 2	150	15270-045	VSD	1	0	0.95	270	0	Final rating to be confirmed
PU4803	Future	Product Water Transfer Pump 3	150	15270-045	VSD	1	0	0.95	270	0	Final rating to be confirmed
H2801	Duty	MF CIP Tank Heater	106	15270-046	SUPPLY	1	1	1	175	175	
PU2001	Duty	MF Feed Pump 1	90	15270-023	VSD	1	1	0.95	122	115.9	
PU2002	Duty	MF Feed Pump 2	90	15270-023	VSD	1	1	0.95	122	115.9	
PU2003	Duty	MF Feed Pump 3	90	15270-023	VSD	1	1	0.95	122	115.9	
PU2004	Standby	MF Feed Pump 4	90	15270-023	VSD	1	0	0.95	122	0	
PU2005	Future	MF Feed Pump 5	90		VSD	1	0	0.95	122	0	
CM8200	Duty	Air Compressor 1	30	15270-050	SUPPLY	1	1	0.85	55	46.75	
CM8201	Standby	Air Compressor 2	30	15270-050	SUPPLY	1	0	0.85	55	0	
PU3900	Duty	RO Flush Pump 1	22	15270-053	DOL	1	1	0.95	36.5	34.675	
PU2801	Duty	MF CIP Pump 1	15	15270-046	VSD	1	1	0.85	28	23.8	
PU2802	Standby	MF CIP Pump 2	15	15270-046	VSD	1	0	0.85	28	0	
PU4001	Duty	CCT Feed Pump 1	15	15270-043	VSD	1	1	0.95	28	26.6	
PU4002	Duty	CCT Feed Pump 2	15	15270-043	VSD	1	1	0.95	28	26.6	
PU4003	Standby	CCT Feed Pump 3	15	15270-043	VSD	1	0	0.95	28	0	
F4004	Duty	Degas Fan 1	7.5	15270-043	DOL	1	1	0.95	14	13.3	
F4005	Standby	Degas Fan 2	7.5	15270-043	DOL	1	0	0.95	14	0	
PU8401	Duty	Backwash Handling Pump 1	1.9	15270-049	VSD	1	1	0.9	5.7	5.13	
PU8402	Standby	Backwash Handling Pump 2	1.9	15270-049	VSD	1	0	0.9	5.7	0	
LCP8202	Duty	Air Dryer	1.58	15270-050	Supply	1	1	0.95	7	6.65	
LCP8203	Standby	Air Dryer	1.58	15270-050	Supply	1	0	0.95	7	0	
ST1501	Duty	Auto Strainer 1	0.38	15270-024	DOL - REV	1	1	0.9	1	0.9	
ST1502	Duty	Auto Strainer 2	0.38	15270-024	DOL - REV	1	1	0.9	1	0.9	
ST1503	Duty	Auto Strainer 3	0.38	15270-024	DOL - REV	1	1	0.9	1	0.9	
DB02	Duty	DB02 - Main Plant Building L&P DB	-	-	Supply	1	1	1	30	30	
DB03	Duty	DB03 - Admin Building L&P DB	-	-	Supply	1	1	1	30	30	
DB04	Duty	DB04 - Exhibition Centre L&P DB	-	-	Supply	1	1	1	50	50	
DB05	Duty	DB05 - Work Shed L&P DB	-	-	Supply	1	1	1	30	30	
UPS1	Duty	UPS1 - Control Network UPS	-	-	Supply	1	1	1	30	30	
PU2006	Duty	RO HP Pump 1	90	15270-029	VSD	2	1	0.95	145	137.75	
PU2007	Duty	RO HP Pump 2	90	15270-029	VSD	2	1	0.95	145	137.75	
PU2008	Duty	RO HP Pump 3	90	15270-029	VSD	2	1	0.95	145	137.75	
PU2009	Duty	RO HP Pump 4	90	15270-029	VSD	2	1	0.95	145	137.75	
PU2010	Future	RO HP Pump 5	90	15270-029	VSD	2	0	0.95	145	0	
H3801	Duty	RO CIP Tank Heater	53	15270-047	SUPPLY	2	1	1	90	90	
PU3800	Duty	RO CIP Pump 1	30	15270-047	VSD	2	1	0.85	53	45.05	
PU3801	Standby	RO CIP Pump 2	30	15270-047	VSD	2	0	0.85	53	0	
PU2010	Duty	MF Backwash Pump 1	22	15270-028	VSD	2	1	0.85	38	32.3	
PU2011	Standby	MF Backwash Pump 2	22	15270-028	VSD	2	0	0.85	38	0	
PU3001	Duty	RO LP Pump 1	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3002	Duty	RO LP Pump 2	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3003	Duty	RO LP Pump 3	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3004	Duty	RO LP Pump 4	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3005	Standby	RO LP Pump 5	15	15270-029	DOL	2	0	0.95	28	0	
PU3006	Future	RO LP Pump 6	15	15270-029	DOL	2	0	0.95	28	0	
PU8701	Duty	Service Water Pump 1	11	15270-053	VSD	2	1	0.9	19.6	17.64	
PU8702	Standby	Service Water Pump 2	11	15270-053	VSD	2	0	0.9	19.6	0	
PU8001	Duty	Process Water Pump 1	5.5	15270-052	DOL	2	1	0.9	10.3	9.27	
PU8002	Standby	Process Water Pump 2	5.5	15270-052	DOL	2	0	0.9	10.3	0	
PU8450	Duty	Neutralization Pump 1	5.5	15270-048	DOL	2	1	0.9	11	9.9	
PU8451	Standby	Neutralization Pump 2	5.5	15270-048	DOL	2	0	0.9	11	0	
PU5001	Duty	Ammonia Dosing Pump	0.15	15270-055	Digital	2	1	1	0.5	0.5	
PU5002	Standby	Ammonia Dosing Pump	0.15	15270-055	Digital	2	0	1	0.5	0	
PU5201	Duty	Dosing Pump	0.15	15270-056	Digital	2	1	1	0.5	0.5	
PU5202	Standby	Dosing Pump	0.15	15270-056	Digital	2	0	1	0.5	0	
PU5701	Duty	Chemical Dosing Pump	0.15	15270-059	Digital	2	1	1	0.5	0.5	
PU5702	Standby	Chemical Dosing Pump	0.15	15270-059	Digital	2	0	1	0.5	0	
PU5903	Duty	Chemical Dosing Pump	0.15	15270-062	Digital	2	1	1	0.5	0.5	
PU5904	Standby	Chemical Dosing Pump	0.15	15270-062	Digital	2	0	1	0.5	0	
PU5905	Duty	Chemical Dosing Pump	0.15	15270-062	Digital	2	1	1	0.5	0.5	
PU6100	Duty	Chemical Dosing Pump	0.15	15270-063	Digital	2	1	1	0.5	0.5	
PU6101	Standby	Chemical Dosing Pump	0.15	15270-063	Digital	2	0	1	0.5	0	
PU6503	Duty	Chemical Dosing Pump	0.15	15270-066	Digital	2	1	1	0.5	0.5	
PU6504	Standby	Chemical Dosing Pump	0.15	15270-066	Digital	2	0	1	0.5	0	
PU6505	Duty	Chemical Dosing Pump	0.15	15270-066	Digital	2	1	1	0.5	0.5	
PU6506	Standby	Chemical Dosing Pump	0.15	15270-066	Digital	2	0	1	0.5	0	
-	Duty	Chemical Unloading CP	-	-	Supply	2	1	1	20	20	
DB01	Duty	DB01 - Switchroom L&P DB	-	-	Supply	2	1	1	50	50	

TAG_NO	STATUS	DESCRIPTION	POWER kW	PID DRAWING NO	VSD / DOL	TF 1 or 2	DUTY FACTOR	LOAD FACTOR	NOM. AMPS	LOAD AMPS	COMMENTS
PU4801	Duty	Product water transfer pump 1	150	15270-045	VSD	1	1	0.95	270	256.5	Final rating to be confirmed
PU4802	Duty	Product water transfer pump 2	150	15270-045	VSD	1	1	0.95	270	256.5	Final rating to be confirmed
PU4803	Standby	Product water transfer pump 3	150	15270-045	VSD	1	0	0.95	270	0	Final rating to be confirmed
H2801	Duty	MF CIP Tank Heater	106	15270-046	SUPPLY	1	1	1	175	175	
PU2001	Duty	MF Feed Pump 1	90	15270-023	VSD	1	1	0.95	122	115.9	
PU2002	Duty	MF Feed Pump 2	90	15270-023	VSD	1	1	0.95	122	115.9	
PU2003	Duty	MF Feed Pump 3	90	15270-023	VSD	1	1	0.95	122	115.9	
PU2004	Duty	MF Feed Pump 4	90	15270-023	VSD	1	1	0.95	122	115.9	
PU2005	Standby	MF Feed Pump 5	90	15270-023	VSD	1	0	0.95	122	0	
PU2006	Duty	RO HP Pump 1	90	15270-029	VSD	2	1	0.95	145	137.75	
PU2007	Duty	RO HP Pump 2	90	15270-029	VSD	2	1	0.95	145	137.75	
PU2008	Duty	RO HP Pump 3	90	15270-029	VSD	2	1	0.95	145	137.75	
PU2009	Duty	RO HP Pump 4	90	15270-029	VSD	2	1	0.95	145	137.75	
PU2010	Duty	RO HP Pump 5	90	15270-029	VSD	2	1	0.95	145	137.75	
H3801	Duty	RO CIP Tank Heater	53	15270-047	SUPPLY	2	1	1	90	90	
CM8200	Duty	Air Compressor 1	30	15270-050	SUPPLY	1	1	0.85	55	46.75	
CM8201	Standby	Air Compressor 2	30	15270-050	SUPPLY	1	0	0.85	55	0	
PU3800	Duty	RO CIP Pump 1	30	15270-047	VSD	2	1	0.85	53	45.05	
PU3801	Standby	RO CIP Pump 2	30	15270-047	VSD	2	0	0.85	53	0	
PU3900	Duty	RO Flush Pump 1	22	15270-053	DOL	1	1	0.95	36.5	34.675	
PU2010	Duty	MF Backwash Pump 1	22	15270-028	VSD	2	1	0.85	38	32.3	
PU2011	Standby	MF Backwash Pump 2	22	15270-028	VSD	2	0	0.85	38	0	
PU2801	Duty	MF CIP Pump 1	15	15270-046	VSD	1	1	0.85	28	23.8	
PU2802	Standby	MF CIP Pump 2	15	15270-046	VSD	1	0	0.85	28	0	
PU4001	Duty	CCT Feed Pump 1	15	15270-043	VSD	1	1	0.95	28	26.6	
PU4002	Duty	CCT Feed Pump 2	15	15270-043	VSD	1	1	0.95	28	26.6	
PU4003	Standby	CCT Feed Pump 3	15	15270-043	VSD	1	0	0.95	28	0	
PU3001	Duty	RO LP Pump 1	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3002	Duty	RO LP Pump 2	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3003	Duty	RO LP Pump 3	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3004	Duty	RO LP Pump 4	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3005	Duty	RO LP Pump 5	15	15270-029	DOL	2	1	0.95	28	26.6	
PU3006	Standby	RO LP Pump 6	15	15270-029	DOL	2	0	0.95	28	0	
PU8701	Duty	Service Water Pump 1	11	15270-053	VSD	2	1	0.9	19.6	17.64	
PU8702	Standby	Service Water Pump 2	11	15270-053	VSD	2	0	0.9	19.6	0	
F4004	Duty	Degas Fan 1	7.5	15270-043	DOL	1	1	0.95	14	13.3	
F4005	Standby	Degas Fan 2	7.5	15270-043	DOL	1	0	0.95	14	0	
PU8001	Duty	Process Water Pump 1	5.5	15270-052	DOL	2	1	0.9	10.3	9.27	
PU8002	Standby	Process Water Pump 2	5.5	15270-052	DOL	2	0	0.9	10.3	0	
PU8450	Duty	Neutralization Pump 1	5.5	15270-048	DOL	2	1	0.9	11	9.9	
PU8451	Standby	Neutralization Pump 2	5.5	15270-048	DOL	2	0	0.9	11	0	
PU8401	Duty	Backwash Handling Pump 1	1.9	15270-049	VSD	1	1	0.9	5.7	5.13	
PU8402	Standby	Backwash Handling Pump 2	1.9	15270-049	VSD	1	0	0.9	5.7	0	
LCP8202	Duty	Air Dryer	1.58	15270-050	Supply	1	1	0.95	7	6.65	
LCP8203	Standby	Air Dryer	1.58	15270-050	Supply	1	0	0.95	7	0	
ST1501	Duty	Auto Strainer 1	0.38	15270-024	DOL - REV	1	1	0.9	1	0.9	
ST1502	Duty	Auto Strainer 2	0.38	15270-024	DOL - REV	1	1	0.9	1	0.9	
ST1503	Duty	Auto Strainer 3	0.38	15270-024	DOL - REV	1	1	0.9	1	0.9	
PU5001	Duty	Ammonia Dosing Pump	0.15	15270-055	Digital	2	1	1	0.5	0.5	
PU5002	Standby	Ammonia Dosing Pump	0.15	15270-055	Digital	2	0	1	0.5	0	
PU5201	Duty	Dosing Pump	0.15	15270-056	Digital	2	1	1	0.5	0.5	
PU5202	Standby	Dosing Pump	0.15	15270-056	Digital	2	0	1	0.5	0	
PU5701	Duty	Chemical Dosing Pump	0.15	15270-059	Digital	2	1	1	0.5	0.5	
PU5702	Standby	Chemical Dosing Pump	0.15	15270-059	Digital	2	0	1	0.5	0	
PU5903	Duty	Chemical Dosing Pump	0.15	15270-062	Digital	2	1	1	0.5	0.5	
PU5904	Standby	Chemical Dosing Pump	0.15	15270-062	Digital	2	0	1	0.5	0	
PU5905	Duty	Chemical Dosing Pump	0.15	15270-062	Digital	2	1	1	0.5	0.5	
PU6100	Duty	Chemical Dosing Pump	0.15	15270-063	Digital	2	1	1	0.5	0.5	
PU6101	Standby	Chemical Dosing Pump	0.15	15270-063	Digital	2	0	1	0.5	0	
PU6503	Duty	Chemical Dosing Pump	0.15	15270-066	Digital	2	1	1	0.5	0.5	
PU6504	Standby	Chemical Dosing Pump	0.15	15270-066	Digital	2	0	1	0.5	0	
PU6505	Duty	Chemical Dosing Pump	0.15	15270-066	Digital	2	1	1	0.5	0.5	
PU6506	Standby	Chemical Dosing Pump	0.15	15270-066	Digital	2	0	1	0.5	0	
-	Duty	Chemical Unloading CP	-	-	Supply	2	1	1	20	20	
DB01	Duty	DB01 - Switchroom L&P DB	-	-	Supply	2	1	1	50	50	
DB02	Duty	DB02 - Main Plant Building L&P DB	-	-	Supply	1	1	1	30	30	
DB03	Duty	DB03 - Admin Building L&P DB	-	-	Supply	1	1	1	30	30	
DB04	Duty	DB04 - Exhibition Centre L&P DB	-	-	Supply	1	1	1	50	50	
DB05	Duty	DB05 - Work Shed L&P DB	-	-	Supply	1	1	1	30	30	
UPS1	Duty	UPS1 - Control Network UPS	-	-	Supply	1	1	1	30	30	

Appendix D: UPS Loading Calculations

REMOTE IO PANEL CONTROL SUPPLY LOADING			
DESCRIPTION	**PWR SUPPLY 240VAC RATING (A)**	**PWR SUPPLY LOADING %**	**PWR SUPPLY 240VAC LOADING (A)**
RIO Panel 1	2.48	65	1.6
RIO Panel 2	2.48	41	1.0
RIO Panel 3	2.48	62	1.5
RIO Panel 4	2.48	80	2.0
RIO Panel 5	2.48	80	2.0
RIO Panel 6	2.48	80	2.0
RIO Panel 7	2.48	80	2.0
RIO Panel 8	2.48	80	2.0
RIO Panel 9	2.48	80	2.0
RIO Panel 10	2.48	80	2.0
RIO Panel 11	2.48	51	1.3
RIO Panel 12	2.48	55	1.4
RIO Panel 13	1.22	35	0.4
RIO Panel 14	1.22	30	0.4
RIO Panel 15	1.22	51	0.6
RIO Panel 16	1.22	48	0.6
RIO Panel 17	1.22	34	0.4
RIO Panel 18	2.48	76	1.9
REMOTE IO PANEL LOGIC SUPPLY LOADING			
DESCRIPTION	**PWR SUPPLY 240VAC RATING (A)**	**PWR SUPPLY LOADING %**	**PWR SUPPLY 240VAC LOADING (A)**
RIO Panel 1	0.62	72	0.4
RIO Panel 2	0.62	48	0.3
RIO Panel 3	0.62	48	0.3
RIO Panel 11	1.22	60	0.7
RIO Panel 12	0.62	72	0.4
RIO Panel 13	0.62	48	0.3
RIO Panel 14	0.62	48	0.3
RIO Panel 15	0.62	48	0.3
RIO Panel 16	0.62	48	0.3
RIO Panel 17	0.62	72	0.4
RIO Panel 18	1.22	60	0.7
QUANTUM PLC RACK LOADING			
Description	**Quantity**	**Load (A)**	**Total Load (A)**
Digital Input Module	2	0.33	0.7
Digital Output Module	1	1.10	1.1
Analogue Input Module	1	0.24	0.2
Ethernet Module	3	0.75	2.3
Processor	1	2.16	2.2
MISC			
Description	**Quantity**	**kW**	**Load (A)**
Sodium Bisulphite Pump 1	1	0.15	0.65
Sodium Bisulphite Pump 2	1	0.15	0.65
Sodium Bisulphite Pump 3 (Standby)	0	0.15	0.65
		TOTAL LOAD	37.9
TOTAL LOAD INCLUDING 0.8 DIVERSITY FACTOR			30.3
TOTAL LOAD INC. 30% SPARE CAPACITY AS PER STS500			39.4

Description	Quantity	Power (W)	Current (A)	Total Load (A)	Comments
Main Switchroom Comms Cabinet					
SCADA Server IBM 7945G2M	1	750	3.3	3.3	Includes monitor power requirements
DSL Router C2901-VSEC-CUBE	1	150	0.7	0.7	
Ethernet Switch WS-C3560X-24PS-S	1	715	3.1	3.1	
Admin Building					
SCADA Server IBM 7945G2M	1	750	3.3	3.3	Includes monitor power requirements
Ethernet Switch WS-C3560X-24PS-S	1	715	3.1	3.1	
3G Router Cisco2901/K9	1	150	0.7	0.7	
Exhibition Centre					
Ethernet Switch WS-C3560X-24PS-S	3	715	3.1	9.3	
Main Plant Building					
SCADA Server IBM 7945G2M	1	750	3.3	3.3	Includes monitor power requirements
TOTAL LOAD				26.6	
TOTAL LOAD INCLUDING 0.6 DIVERSITY FACTOR				16.0	
TOTAL LOAD INC. 30% SPARE CAPACITY AS PER STS500				20.8	

Appendix E: AS4024.1 Risk Assessment

AS4024 Risk Assessment Worksheet

Date: 13/11/2012
Attendees: Kevin Burgess (HWA), Craig Johnston, Nevin Zang, John McGuiness (CH2MHill)
Revision: A

EQUIP TYPE	TAG_NO	STATUS	DESCRIPTION	MANUF.	POWER kW	PID DRAWING NO	VSD / DOL	AS4024 Estop Assessment S	F	P	Cat.	COMMENTS
1	CM8200	Duty	Air Compressor 1 & 2	Ingersoll Rand	22	15270-050	SUPPLY					
	CM8201	Standby		Ingersoll Rand	22	15270-050	SUPPLY					Packaged Systems - Design by equipment supplier
2	F4004	Duty	Degas Fan 1 & 2	Aerovent	15	15270-043	DOL					
	F4005	Standby		Aerovent	15	15270-043	DOL	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of fan in field in the event of operating issues. Fans fully enclosed.
3	H2801	Duty	MF CIP Tank Heater	Grimwood	105	15270-046	SUPPLY	S1			1	Heater only, no Estop provided. Heater includes proprietary internal overtemperature cutout
4	PU2001	Duty	MF Feed Pump 1 to 5	KSB	90	15270-023	VSD					
	PU2002	Duty		KSB	90	15270-023	VSD					
	PU2003	Duty		KSB	90	15270-023	VSD	S1				Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
	PU2004	Standby		KSB	90	15270-023	VSD					
	PU2005	Future		KSB	90		VSD				1	
5	PU2801	Duty	MF CIP Pump 1 & 2	KSB	15	15270-046	VSD					
	PU2802	Standby		KSB	15	15270-046	VSD	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
6	PU3900	Duty	RO Flush Pump 1 & 2	KSB	22	15270-053	DOL					
	PU3902	Standby		KSB		15270-053	Diesel	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
7	PU4001	Duty	CCT Feed Pump 1, 2, 3	KSB	15	15270-043	VSD					
	PU4002	Duty		KSB	15	15270-043	VSD					Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
	PU4003	Standby		KSB	15	15270-043	VSD	S1			1	
8	PU4801	Duty	Product water transfer pump 1, 2, 3(Fut)	KSB	132	15270-045	VSD					
	PU4802	Standby		KSB	132	15270-045	VSD					Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
	PU4803	Future		KSB	132	15270-045	VSD	S1			1	
9	PU8401	Duty	Backwash Handling Pump 1 & 2		1.9	15270-049	VSD					
	PU8402	Standby		KSB	1.9	15270-049	VSD	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
10	ST1501	Duty	Auto Strainer 1, 2, 3	AMIAD	0.38	15270-024	DOL - REV					
	ST1502	Duty		AMIAD	0.38	15270-024	DOL - REV					Control System Category 1 Estop to be provided to permit easy stopping of Strainer in field in the event of operating issues. Auto strainer is fully enclosed.
	ST1503	Duty		AMIAD	0.38	15270-024	DOL - REV	S1			1	
11		Duty	Air Dryer 1 & 2	Conquest	1.58	15270-050	SUPPLY					Packaged Systems - Design by equipment supplier
		Duty		Conquest	1.58	15270-050	SUPPLY					
12	H3801	Duty	RO CIP Tank Heater	Grimwood	48	15270-047	SUPPLY	S1			1	Heater only, no Estop provided. Heater includes proprietary internal overtemperature cutout
13	PU2006	Duty	RO HP Pump 1 to 5	KSB	90	15270-029	VSD					
	PU2007	Duty		KSB	90	15270-029	VSD					
	PU2008	Duty		KSB	90	15270-029	VSD					Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
	PU2009	Duty		KSB	90	15270-029	VSD					
	PU2010	Future			90	15270-029	VSD	S1			1	
14	PU2010	Duty	MF Backwash Pump 1 & 2	KSB	22	15270-028	VSD					
	PU2011	Standby		KSB	22	15270-028	VSD	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
15	PU3001	Duty	RO LP Pump 1 to 5	KSB	15	15270-029	DOL					
	PU3002	Duty			15	15270-029	DOL					
	PU3003	Duty			15	15270-029	DOL	S1				Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
	PU3004	Duty			15	15270-029	DOL					
	PU3005	Standby			15	15270-029	DOL					
	PU3006	Future		KSB	15		DOL				1	
16	PU3800	Duty	RO CIP Pump 1 & 2	KSB	30	15270-047	VSD					
	PU3801	Standby		KSB	30	15270-047	VSD	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
17	PU5001	Duty	Ammonia Dosing Pump 1	Grundfos	0.015	15270-055	Digital					Digital dosing pumps supplied from local earth leakage protected single phase switched outlet (GPO). Dosing pumps located inside cabinet (in bunded area) and dosing lines are "pipe in pipe". Dosing points (remote from pumps) are to be covered with clear splash screen to protect personnel in the event of any leaks or breaks. No Estop system to be provided.
	PU5002	Standby	Ammonia Dosing Pump 2	Grundfos	0.015	15270-055	Digital					
	PU5201	Duty	Sulphuric Acid Dosing Pump 1	Grundfos	0.015	15270-056	Digital					
	PU5202	Standby	Sulphuric Acid Dosing Pump 2	Grundfos	0.015	15270-056	Digital					
	PU5204	Duty	Sulphuric Acid Dosing Pump 4	Wilden	-	15270-057	Air driven					Air operated dosing pumps located inside cabinet (in bunded area) and dosing lines are "pipe in pipe". Dosing points (remote from pumps) are to be covered with clear splash screen to protect personnel in the event of any leaks or breaks. No Estop system to be provided.
	PU5205	Standby	Sulphuric Acid Dosing Pump 5	Wilden	-	15270-057	Air driven					
	PU5401	Duty	Citric Acid Dosing Pump 1	Wilden	-	15270-058	Air driven					
	PU5402	Standby	Citric Acid Dosing Pump 2	Wilden	-	15270-058	Air driven					
	PU5701	Duty	Caustic Soda Dosing Pump 1	Grundfos	0.015	15270-059	Digital					Digital dosing pumps supplied from local earth leakage protected single phase switched outlet (GPO). Dosing pumps located inside cabinet (in bunded area) and dosing lines are "pipe in pipe". Dosing points (remote from pumps) are to be covered with clear splash screen to protect personnel in the event of any leaks or breaks. No Estop system to be provided.
	PU5702	Standby	Caustic Soda Dosing Pump 2	Grundfos	0.015	15270-059	Digital					
	PU5703	Duty	Caustic Soda Dosing Pump 3	Wilden	-	15270-060	Air driven					Air operated dosing pumps located inside cabinet (in bunded area) and dosing lines are "pipe in pipe". Dosing points (remote from pumps) are to be covered with clear splash screen to protect personnel in the event of any leaks or breaks. No Estop system to be provided.
	PU5704	Standby	Caustic Soda Dosing Pump 4	Wilden	-	15270-060	Air driven					
	PU5901	Duty	SBS Dosing Pump 1	Wilden	-	15270-061	Air driven					
	PU5902	Standby	SBS Dosing Pump 2	Wilden	-	15270-061	Air driven					
	PU5903	Duty	SBS Dosing Pump 3	Grundfos	0.015	15270-062	Digital					Digital dosing pumps supplied from local earth leakage protected single phase switched outlet (GPO). Dosing pumps located inside cabinet (in bunded area) and dosing lines are "pipe in pipe". Dosing points (remote from pumps) are to be covered with clear splash screen to protect personnel in the event of any leaks or breaks. No Estop system to be provided.
	PU5904	Standby	SBS Dosing Pump 4	Grundfos	0.015	15270-062	Digital					
	PU5905	Duty	SBS Dosing Pump 5	Grundfos	0.015	15270-062	Digital					
	PU6100	Duty	Antiscalant Dosing Pump 1	Grundfos	0.015	15270-063	Digital					
	PU6101	Standby	Antiscalant Dosing Pump 2	Grundfos	0.015	15270-063	Digital					
	PU6301	Duty	RO Cleaning Product Pump 1	Wilden	-	15270-064	Air driven					Air operated dosing pumps located inside cabinet (in bunded area) and dosing lines are "pipe in pipe". Dosing points (remote from pumps) are to be covered with clear splash screen to protect personnel in the event of any leaks or breaks. No Estop system to be provided.
	PU6302	Standby	RO Cleaning Product Pump 2	Wilden	-	15270-064	Air driven					
	PU6501	Duty	Hypo Dosing Pump 1	Wilden	-	15270-065	Air driven					
	PU6502	Standby	Hypo Dosing Pump 2	Wilden	-	15270-065	Air driven					

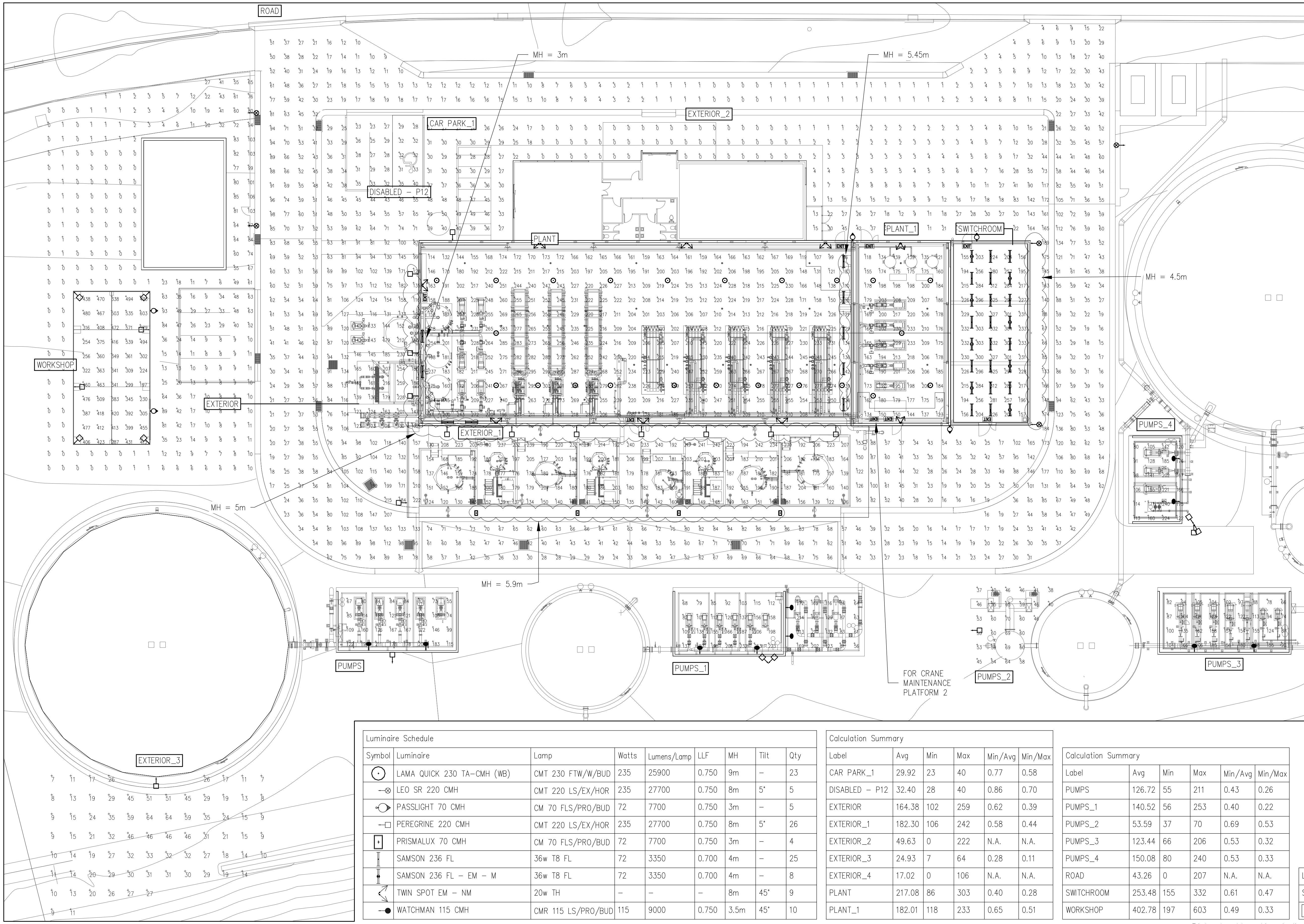
EQUIP TYPE	TAG_NO	STATUS	DESCRIPTION	MANUF.	POWER kW	PID DRAWING NO	VSD / DOL	AS4024 Estop Assessment				COMMENTS
								S	F	P	Cat.	
	PU6503	Duty	Hypo Chemical Dosing Pump 3	Grundfos	0.015	15270-066	Digital					Digital dosing pumps supplied from local earth leakage protected single phase switched outlet (GPO). Dosing pumps located inside cabinet (in bunded area) and dosing lines are "pipe in pipe". Dosing points (remote from pumps) are to be covered with clear splash screen to protect personnel in the event of any leaks or breaks. No Estop system to be provided.
	PU6504	Standby	Hypo Chemical Dosing Pump 4	Grundfos	0.015	15270-066	Digital					
	PU6505	Duty	Hypo Chemical Dosing Pump 5	Grundfos	0.015	15270-066	Digital					
	PU6506	Standby	Hypo Chemical Dosing Pump 6	Grundfos	0.015	15270-066	Digital					
18	PU8001	Duty	Process Water Pump 1 & 2	KSB	5.5	15270-052	DOL	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
	PU8002	Standby		KSB	5.5	15270-052	DOL					
19	PU8450	Duty	Neutralization Pump 1 & 2	KSB	5.5	15270-048	DOL	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
	PU8451	Standby		KSB	5.5	15270-048	DOL					
20	PU8701	Duty	Service Water Pump 1 & 2	KSB	11	15270-053	VSD	S1			1	Control System Category 1 Estop to be provided to permit easy stopping of pump in field in the event of operating issues. Pumps fully enclosed.
	PU8702	Standby		KSB	11	15270-053	VSD					
21			Chemical Unloading CP/Outlets				SUPPLY	S1			1	Tanker unloading is manual operation with driver in attendance at all time. Site chemical storage tanks have visual, analogue and high level indication. Chemical tanks are in bunded area. Truck is in separate bunded area. Control Category 1 minimum required. Estop to isolate power to outlets used for truck transfer pump will be control category 2 type using proprietary safety relay. This will provide local reset function if Estop operated. Tank high level cutout will isolate power to outlets via hard wired control category 1 arrangement. Tank analogue level and bund level switch will also isolate power to outlets via PLC output interlock as additional protection.

NOTE

Local Estop provided on pumps so that equipment can be easily stopped in the field in the event of operational issues such as water leaks, noisy/faulty pump operation etc

Local control stations in the field have locked outer door, and the Estop would be the only readily accessible control to quickly stop equipment locally (apart from unlocking the local control panel outer door first).

Appendix F: Lighting Luminance Layout



Luminaire Schedule

Symbol	Luminaire	Lamp	Watts	Lumens/Lamp	LLF	MH	Tilt	Qty
	LAMA QUICK 230 TA-CMH (WB)	CMT 230 FTW/W/BUD	235	25900	0.750	9m	–	23
	LEO SR 220 CMH	CMT 220 LS/EX/HOR	235	27700	0.750	8m	5°	5
	PASSLIGHT 70 CMH	CM 70 FLS/PRO/BUD	72	7700	0.750	3m	–	5
	PEREGRINE 220 CMH	CMT 220 LS/EX/HOR	235	27700	0.750	8m	5°	26
	PRISMALUX 70 CMH	CM 70 FLS/PRO/BUD	72	7700	0.750	3m	–	4
	SAMSON 236 FL	36w T8 FL	72	3350	0.700	4m	–	25
	SAMSON 236 FL – EM – M	36w T8 FL	72	3350	0.700	4m	–	8
	TWIN SPOT EM – NM	20w TH	–	–	–	8m	45°	9
	WATCHMAN 115 CMH	CMR 115 LS/PRO/BUD	115	9000	0.750	3.5m	45°	10

Calculation Summary

Label	Avg	Min	Max	Min/Avg	Min/Max
CAR PARK_1	29.92	23	40	0.77	0.58
DISABLED – P12	32.40	28	40	0.86	0.70
EXTERIOR	164.38	102	259	0.62	0.39
EXTERIOR_1	182.30	106	242	0.58	0.44
EXTERIOR_2	49.63	0	222	N.A.	N.A.
EXTERIOR_3	24.93	7	64	0.28	0.11
EXTERIOR_4	17.02	0	106	N.A.	N.A.
PLANT	217.08	86	303	0.40	0.28
PLANT_1	182.01	118	233	0.65	0.51

Calculation Summary

Label	Avg	Min	Max	Min/Avg	Min/Max
PUMPS	126.72	55	211	0.43	0.26
PUMPS_1	140.52	56	253	0.40	0.22
PUMPS_2	53.59	37	70	0.69	0.53
PUMPS_3	123.44	66	206	0.53	0.32
PUMPS_4	150.08	80	240	0.53	0.33
ROAD	43.26	0	207	N.A.	N.A.
SWITCHROOM	253.48	155	332	0.61	0.47
WORKSHOP	402.78	197	603	0.49	0.33

Luminaire Schedule

Symbol	Luminaire	MH	Qty
EXIT	EXIT SIGN JUMBO CLEVERS	2.5m AFL	8

This Layout must be read in conjunction with the lighting design details issued in a separate document (when provided).

CAUTION– Due to variations in, luminaire manufacture, lamp & electrical supply, there will be some variation in the actual illumination levels from those nominated in the above scheme –CAUTION

THIS MATERIAL IS CONFIDENTIAL

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NO.	DESCRIPTION	DRAWN	DATE
0	ISSUED FOR CONSTRUCTION	SL	06.12.12

REVISIONS

EYE LIGHTING

MAYFIELD WEST AWTP
PROPOSED LIGHTING LAYOUT & RESULTING ILLUMINANCE

DATE	DESIGNED BY	CHECKED BY	SCALE	DWG. NO.	REV.
06.12.12	SL	PRT	1:400 @ A3	E12-195-100	0

This layout is set for lighting application purposes to provide information on luminaires data used, indicative locations, quantities, and illumination output results. It is based on information provided at the time of issue, with specific lighting parameters, dimensions and luminaire photometry selected for this project. Any alteration to the above may compromise the illumination output results, its compliance with the relevant requirement and installation performance. Uncertainties are expected in the measured/calculated values in accordance with Australian standard on lighting system performance – accuracies and tolerances, due to the complexity of the calculation, the tolerances in photometry and manufacturing, the site conditions and tolerances of the measuring instruments. Therefore individual grid points values are not guaranteed and illumination output should only be used as a guidance or for evaluation purposes.

Appendix G: PowerCAD LV Power Modelling Report

The KIWS Electrical distribution network has been modelled utilising PowerCAD electrical modelling software.

A number of warning messages, shown in "red" within the report, have been generated within the software and relate to the incompatibility of the motor protection device.

This error is inherent to modelling in PowerCAD as the correct circuit breakers for Type 2 co-ordination as per Schneider's recommendations are not able to be selected within the model. In lieu of this the circuit breaker ratings have been selected to conform with the manufacturers requirements.

Hunter Water Australia
19 Spit Island Close
Mayfield West

Hunter Water Australia

POWERCAD
Cable Selection & Electrical Design Program

Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:31 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

CURRENT CARRYING CAPACITY - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 1,130.8 kVA (1,632 A/phase)
Load Power Factor : 0.967 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 4.26 %

Distribution	Cable Size (mm²)	Cable Length (m)	Sel. Crit.	M.D. (A)	Cable Cap. (A)	Drat. Factor
T1 (1,500 kVA, 11kV/400V)	M.D. : 1,130.8 kVA					
MSB (3ø) 30	6×500	30.0	P	1,632.2	2,848.7	0.79
P56 (3ø) RO Flush Pump 1 6,21	25	70.0	I	56.8	58.2	0.60
P59 (3ø) Degas Fan 2 21	4	40.0	I	14.6	18.6	0.60
P62 (3ø) Degas Fan 1 21	4	40.0	I	14.6	18.6	0.60
P65 (3ø) Auto Strainer 1 21	2.5	120.0	S	1.2	12.5	0.50
P68 (3ø) Auto Strainer 2 21	2.5	120.0	S	1.2	12.5	0.50
P71 (3ø) Auto Strainer 3 21	2.5	120.0	S	1.2	12.5	0.50
P74 (3ø) MF CIP Tank Heater	95	110.0	I	151.6	158.6	0.65
P77 (3ø) Air Compressor 1	35	30.0	I	85.0	85.8	0.66
P80 (3ø) Air Compressor 2	35	30.0	I	85.0	85.8	0.66
VSD-MF Feed Pump 1 (3ø) 21	95	15.0	I	181.8	216.8	0.78
P23 (3ø) MF Feed Pump 1	120	105.0	I	168.0	189.0	0.70
VSD-MF Feed Pump 2 (3ø) 21	95	15.0	I	181.8	216.8	0.78
P26 (3ø) MF Feed Pump 2	120	105.0	I	168.0	189.0	0.70
VSD-MF Feed Pump 3 (3ø) 21	95	15.0	I	181.8	216.8	0.78
P29 (3ø) MF Feed Pump 3	120	105.0	I	168.0	189.0	0.70
VSD-MF Feed Pump 4 (3ø) 21	95	15.0	I	181.8	216.8	0.78
P32 (3ø) MF Feed Pump 4	120	105.0	I	168.0	189.0	0.70
VSD-CCT Feed Pump 1 (3ø) 21	10	15.0	I	29.9	39.8	0.78
P35 (3ø) CCT Feed Pump 1	10	70.0	I	28.1	37.8	0.60
VSD-CCT Feed Pump 2 (3ø) 21	10	15.0	I	29.9	39.8	0.78
P38 (3ø) CCT Feed Pump 2	10	70.0	I	28.1	37.8	0.60
VSD-CCT Feed Pump 3 (3ø) 21	10	15.0	I	29.9	39.8	0.78
P41 (3ø) CCT Feed Pump 3	10	70.0	I	28.1	37.8	0.60
VSD-MF CIP Pump 1 (3ø) 21	10	15.0	I	29.9	39.8	0.78
P44 (3ø) MF CIP Pump 1	10	105.0	V	28.1	42.9	0.65
VSD-MF CIP Pump 2 (3ø) 21	10	15.0	I	29.9	39.8	0.78
P47 (3ø) MF CIP Pump 2	10	105.0	V	28.1	42.9	0.65
VSD-BW Handling Pump 1 (3ø) 21	4	15.0	F	5.6	22.6	0.78
P50 (3ø) BW Handling Pump 1	2.5	115.0		5.2	19.1	0.66
VSD-BW Handling Pump 2 (3ø) 21	4	15.0	F	5.6	22.6	0.78
P53 (3ø) BW Handling Pump 2	2.5	115.0		5.2	19.1	0.66
VSD-Product Water Pump 1 (3ø) 21	185	15.0	P	275.4	339.3	0.78
P17 (3ø) Product Water Pump 1	2×95	45.0	I	256.5	326.2	0.70
VSD-Product Water Pump 2 (3ø) 21	185	15.0	P	275.4	339.3	0.78

Hunter Water Australia
19 Spit Island Close
Mayfield West

Cable Selection & Electrical Design Program

Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:31 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

CURRENT CARRYING CAPACITY - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Sel. Crit.	M.D. (A)	Cable Cap. (A)	Drat. Factor
P20 (3ø) Product Water Pump 2	2×95	45.0	I	256.5	326.2	0.70
L&P DB04 ADMIN BUILDING (3ø)	35	115.0	I	80.0	91.0	0.70
L&P DB03 EXH ROOM (3ø)	50	60.0	I	100.0	108.5	0.70
L&P DB05 WORK SHED (3ø)	35	125.0	I	80.0	91.0	0.70
L&P DB01 MAIN SWITCHROOM (3ø)	50	20.0	I	125.0	140.8	0.80
L&P DB02 MAIN PLANT BUILDING (3ø)	50	50.0	I	100.0	108.5	0.70

I = Current, V = V.Drop, T = Target V.Drop, F = Fault, S = Size, P = Protection, Blank = User, N = No Cable

Cable choice is locked.

[6] Separate earth is used.

✕ This switch board/circuit contains errors. Refer to the footnotes for an explanation.

[21] Cable protective device errors.

[30] There are final sub-circuits on this switch board containing errors.

Hunter Water Australia
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Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:31 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**

1,500 kVA 400/230V 50Hz

CURRENT CARRYING CAPACITY - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 732.5 kVA (1,057 A/phase)
Load Power Factor : 0.916 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 3.23 %

Distribution	Cable Size (mm²)	Cable Length (m)	Sel. Crit.	M.D. (A)	Cable Cap. (A)	Drat. Factor
T2 (1,500 kVA, 11kV/400V)	M.D. : 732.5 kVA					
MSB-01 (3ø) 30	4×500	30.0		1,057.2	2,047.7	0.79
P32 (3ø) RO LP Pump 1 21	10	85.0	I	28.1	33.0	0.60
P35 (3ø) RO LP Pump 2 21	10	85.0	I	28.1	33.0	0.60
P38 (3ø) RO LP Pump 3 21	10	85.0	I	28.1	33.0	0.60
P41 (3ø) RO LP Pump 4 21	10	85.0	I	28.1	33.0	0.60
P44 (3ø) RO LP Pump 5 21	10	85.0	I	28.1	33.0	0.60
P47 (3ø) Neutralisation Pump 1 21	4	110.0	V	11.4	19.8	0.60
P50 (3ø) Neutralisation Pump 2 21	4	110.0	V	11.4	21.8	0.66
P53 (3ø) Process Water Pump 1 21	4	70.0	V	11.4	20.2	0.65
P56 (3ø) Process Water Pump 2 21	4	70.0	V	11.4	20.5	0.66
P59 (3ø) RO CIP Tank Heater	50	120.0	V	69.3	106.0	0.65
P62 (3ø) Truck Fill Panel	10	70.0	I	32.0	38.5	0.70
P65 (3ø) Truck Fill Panel	10	70.0	I	32.0	38.5	0.70
P68 (3ø) Truck Fill Panel	10	70.0	I	32.0	38.5	0.70
P71 (3ø) Truck Fill Panel	10	70.0	I	32.0	38.5	0.70
P74 (3ø) Truck Fill Panel	10	70.0	I	32.0	38.5	0.70
VSD-MF Backwash Pump 1 (3ø) 21	16	15.0	I	46.0	53.0	0.78
P20 (3ø) MF Backwash Pump 1	16	110.0	I	42.4	52.6	0.65
VSD-RO HP Pump 1 (3ø) 21	95	15.0	I	176.5	216.8	0.78
P2 (3ø) RO HP Pump 1	95	30.0	I	162.6	184.1	0.79
VSD-RO HP Pump 2 (3ø) 21	95	15.0	I	176.5	216.8	0.78
P5 (3ø) RO HP Pump 2	95	30.0	I	162.6	184.1	0.79
VSD-RO HP Pump 3 (3ø) 21	95	15.0	I	176.5	216.8	0.78
P8 (3ø) RO HP Pump 3	95	30.0	I	162.6	184.1	0.79
VSD-RO HP Pump 4 (3ø) 21	95	15.0	I	176.5	216.8	0.78
P11 (3ø) RO HP Pump 4	95	30.0	I	162.6	184.1	0.79
VSD-RO CIP Pump 1 (3ø) 21	25	15.0	I	61.5	71.0	0.78
P14 (3ø) RO CIP Pump 1	25	120.0	I	56.8	69.5	0.65
VSD-RO CIP Pump 2 (3ø) 21	25	15.0	I	61.5	71.0	0.78
P17 (3ø) RO CIP Pump 2	25	120.0	I	56.8	69.5	0.65
VSD-Service Water Pump 1 (3ø) 21	6	15.0	I	23.1	28.9	0.78
P26 (3ø) Service Water Pump 1	4	55.0	I	21.0	26.6	0.72
VSD-Service Water Pump 2 (3ø) 21	6	15.0	I	23.1	28.9	0.78
P29 (3ø) Service Water Pump 2	4	50.0	I	21.0	26.6	0.72
VSD-MF Backwash Pump 2 (3ø) 21	16	15.0	I	46.0	53.0	0.78

Hunter Water Australia
19 Spit Island Close
Mayfield West

POWERCAD
Cable Selection & Electrical Design Program

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Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:31 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

CURRENT CARRYING CAPACITY - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Sel. Crit.	M.D. (A)	Cable Cap. (A)	Drat. Factor
P23 (3ø) MF Backwash Pump 2	16	110.0	I	42.4	52.6	0.65

I = Current, V = V.Drop, T = Target V.Drop, F = Fault, S = Size, P = Protection, Blank = User, N = No Cable

Cable choice is locked.
X This switch board/circuit contains errors. Refer to the footnotes for an explanation.
21 Cable protective device errors.
30 There are final sub-circuits on this switch board containing errors.

Hunter Water Australia

19 Spit Island Close
Mayfield West

Hunter Water Australia

Ph No. : 49 414835   Mobile No. : 0418205367   Fax No. : 49 415012   Email : callum.menzies@hwa.com.au

POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:34 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

VOLTAGE DROP - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 1,130.8 kVA   (1,632 A/phase)
Load Power Factor : 0.967 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 4.26 %

Distribution	Cable Size (mm²)	Cable Length (m)	Sel. Crit.	Volt Drop (V)	Volt Drop (%)	Accum. V.Drop (%)	F.SubCct V.Drop (%)
T1 (1,500 kVA, 11kV/400V)	Total Drop : 4.26% (Site Maximum : 5%)						
MSB (3ø) [30]	6×500	30.0	P	0.905	0.23	2.73	2.50
P56 (3ø) RO Flush Pump 1 [6,21]	25	70.0	I	5.146	1.29	1.51	1.29
P59 (3ø) Degas Fan 2 [21]	4	40.0	I	4.534	1.13	1.36	1.13
P62 (3ø) Degas Fan 1 [21]	4	40.0	I	4.534	1.13	1.36	1.13
P65 (3ø) Auto Strainer 1 [21]	2.5	120.0	S	1.312	0.33	0.55	0.33
P68 (3ø) Auto Strainer 2 [21]	2.5	120.0	S	1.312	0.33	0.55	0.33
P71 (3ø) Auto Strainer 3 [21]	2.5	120.0	S	1.312	0.33	0.55	0.33
P74 (3ø) MF CIP Tank Heater	95	110.0	I	6.268	1.57	1.79	1.57
P77 (3ø) Air Compressor 1	35	30.0	I	2.615	0.65	0.88	0.65
P80 (3ø) Air Compressor 2	35	30.0	I	2.615	0.65	0.88	0.65
VSD-MF Feed Pump 1 (3ø) [21]	95	15.0	I	1.138	0.28	2.01	1.50
P23 (3ø) MF Feed Pump 1	120	105.0	I	5.642	1.41	1.41	1.41
VSD-MF Feed Pump 2 (3ø) [21]	95	15.0	I	1.170	0.29	2.02	1.50
P26 (3ø) MF Feed Pump 2	120	105.0	I	5.642	1.41	1.41	1.41
VSD-MF Feed Pump 3 (3ø) [21]	95	15.0	I	1.138	0.28	2.01	1.50
P29 (3ø) MF Feed Pump 3	120	105.0	I	5.642	1.41	1.41	1.41
VSD-MF Feed Pump 4 (3ø) [21]	95	15.0	I	1.170	0.29	2.02	1.50
P32 (3ø) MF Feed Pump 4	120	105.0	I	5.642	1.41	1.41	1.41
VSD-CCT Feed Pump 1 (3ø) [21]	10	15.0	I	1.508	0.38	3.20	2.60
P35 (3ø) CCT Feed Pump 1	10	70.0	I	5.876	1.47	1.47	1.47
VSD-CCT Feed Pump 2 (3ø) [21]	10	15.0	I	1.508	0.38	2.10	1.50
P38 (3ø) CCT Feed Pump 2	10	70.0	I	5.876	1.47	1.47	1.47
VSD-CCT Feed Pump 3 (3ø) [21]	10	15.0	I	1.508	0.38	2.10	1.50
P41 (3ø) CCT Feed Pump 3	10	70.0	I	5.876	1.47	1.47	1.47
VSD-MF CIP Pump 1 (3ø) [21]	10	15.0	I	1.508	0.38	3.10	2.50
P44 (3ø) MF CIP Pump 1	10	105.0	V	9.172	2.29	2.29	2.29
VSD-MF CIP Pump 2 (3ø) [21]	10	15.0	I	1.508	0.38	3.10	2.50
P47 (3ø) MF CIP Pump 2	10	105.0	V	9.172	2.29	2.29	2.29
VSD-BW Handling Pump 1 (3ø) [21]	4	15.0	F	0.654	0.16	2.89	2.50
P50 (3ø) BW Handling Pump 1	2.5	115.0		6.169	1.54	1.54	1.54
VSD-BW Handling Pump 2 (3ø) [21]	4	15.0	F	0.654	0.16	2.89	2.50
P53 (3ø) BW Handling Pump 2	2.5	115.0		6.169	1.54	1.54	1.54
VSD-Product Water Pump 1 (3ø) [21]	185	15.0	P	1.062	0.27	1.99	1.50
P17 (3ø) Product Water Pump 1	2×95	45.0	I	2.239	0.56	0.56	0.56
VSD-Product Water Pump 2 (3ø) [21]	185	15.0	P	1.062	0.27	1.99	1.50

Hunter Water Australia
19 Spit Island Close
Mayfield West

Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:34 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

VOLTAGE DROP - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Sel. Crit.	Volt Drop (V)	Volt Drop (%)	Accum. V.Drop (%)	F.SubCct V.Drop (%)
P20 (3ø) Product Water Pump 2	2×95	45.0	I	2.239	0.56	0.56	0.56
L&P DB04 ADMIN BUILDING (3ø)	35	115.0	I	9.330	2.33	4.06	1.50
L&P DB03 EXH ROOM (3ø)	50	60.0	I	4.540	1.13	2.86	1.50
L&P DB05 WORK SHED (3ø)	35	125.0	I	10.14	2.54	4.26	1.50
L&P DB01 MAIN SWITCHROOM (3ø)	50	20.0	I	1.975	0.49	2.22	1.50
L&P DB02 MAIN PLANT BUILDING (3ø)	50	50.0	I	3.783	0.95	2.67	1.50

I = Current, V = V.Drop, T = Target V.Drop, F = Fault, S = Size, P = Protection, Blank = User, N = No Cable
Accumulative Voltage Drop (%) at a Switch Board Includes the Final Sub-Circuit Voltage Drop.

Cable choice is locked.
[6] Separate earth is used.
✕ This switch board/circuit contains errors. Refer to the footnotes for an explanation.
[21] Cable protective device errors.
[30] There are final sub-circuits on this switch board containing errors.

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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:34 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

VOLTAGE DROP - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 732.5 kVA (1,057 A/phase)
Load Power Factor : 0.916 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 3.23 %

Distribution	Cable Size (mm²)	Cable Length (m)	Sel. Crit.	Volt Drop (V)	Volt Drop (%)	Accum. V.Drop (%)	F.SubCct V.Drop (%)
T2 (1,500 kVA, 11kV/400V)	Total Drop : 3.23% (Site Maximum : 5%)						
MSB-01 (3ø) 30	4×500	30.0		1.010	0.25	2.75	2.50
P32 (3ø) RO LP Pump 1 21	10	85.0	I	7.253	1.81	2.07	1.81
P35 (3ø) RO LP Pump 2 21	10	85.0	I	7.253	1.81	2.07	1.81
P38 (3ø) RO LP Pump 3 21	10	85.0	I	7.253	1.81	2.07	1.81
P41 (3ø) RO LP Pump 4 21	10	85.0	I	7.253	1.81	2.07	1.81
P44 (3ø) RO LP Pump 5 21	10	85.0	I	7.253	1.81	2.07	1.81
P47 (3ø) Neutralisation Pump 1 21	4	110.0	V	8.738	2.18	2.44	2.18
P50 (3ø) Neutralisation Pump 2 21	4	110.0	V	8.738	2.18	2.44	2.18
P53 (3ø) Process Water Pump 1 21	4	70.0	V	5.846	1.46	1.71	1.46
P56 (3ø) Process Water Pump 2 21	4	70.0	V	5.846	1.46	1.71	1.46
P59 (3ø) RO CIP Tank Heater	50	120.0	V	5.960	1.49	1.74	1.49
P62 (3ø) Truck Fill Panel	10	70.0	I	7.855	1.96	2.22	1.96
P65 (3ø) Truck Fill Panel	10	70.0	I	7.855	1.96	2.22	1.96
P68 (3ø) Truck Fill Panel	10	70.0	I	7.855	1.96	2.22	1.96
P71 (3ø) Truck Fill Panel	10	70.0	I	7.855	1.96	2.22	1.96
P74 (3ø) Truck Fill Panel	10	70.0	I	7.855	1.96	2.22	1.96
VSD-MF Backwash Pump 1 (3ø) 21	16	15.0	I	1.477	0.37	3.12	2.50
P20 (3ø) MF Backwash Pump 1	16	110.0	I	8.746	2.19	2.19	2.19
VSD-RO HP Pump 1 (3ø) 21	95	15.0	I	1.132	0.28	3.04	2.50
P2 (3ø) RO HP Pump 1	95	30.0	I	1.946	0.49	0.49	0.49
VSD-RO HP Pump 2 (3ø) 21	95	15.0	I	1.132	0.28	3.04	2.50
P5 (3ø) RO HP Pump 2	95	30.0	I	1.946	0.49	0.49	0.49
VSD-RO HP Pump 3 (3ø) 21	95	15.0	I	1.132	0.28	3.04	2.50
P8 (3ø) RO HP Pump 3	95	30.0	I	1.946	0.49	0.49	0.49
VSD-RO HP Pump 4 (3ø) 21	95	15.0	I	1.132	0.28	3.04	2.50
P11 (3ø) RO HP Pump 4	95	30.0	I	1.946	0.49	0.49	0.49
VSD-RO CIP Pump 1 (3ø) 21	25	15.0	I	1.274	0.32	3.07	2.50
P14 (3ø) RO CIP Pump 1	25	120.0	I	8.399	2.10	2.10	2.10
VSD-RO CIP Pump 2 (3ø) 21	25	15.0	I	1.274	0.32	3.07	2.50
P17 (3ø) RO CIP Pump 2	25	120.0	I	8.399	2.10	2.10	2.10
VSD-Service Water Pump 1 (3ø) 21	6	15.0	I	1.899	0.47	3.23	2.50
P26 (3ø) Service Water Pump 1	4	55.0	I	8.819	2.20	2.20	2.20
VSD-Service Water Pump 2 (3ø) 21	6	15.0	I	1.899	0.47	3.23	2.50
P29 (3ø) Service Water Pump 2	4	50.0	I	8.018	2.00	2.00	2.00
VSD-MF Backwash Pump 2 (3ø) 21	16	15.0	I	1.477	0.37	3.12	2.50

Hunter Water Australia
19 Spit Island Close
Mayfield West

Hunter Water Australia

POWERCAD
Cable Selection & Electrical Design Program

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Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:34 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

VOLTAGE DROP - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Sel. Crit.	Volt Drop (V)	Volt Drop (%)	Accum. V.Drop (%)	F.SubCct V.Drop (%)
P23 (3ø) MF Backwash Pump 2	16	110.0	I	8.746	2.19	2.19	2.19

I = Current, V = V.Drop, T = Target V.Drop, F = Fault, S = Size, P = Protection, Blank = User, N = No Cable

Accumulative Voltage Drop (%) at a Switch Board Includes the Final Sub-Circuit Voltage Drop.

Cable choice is locked.

X This switch board/circuit contains errors. Refer to the footnotes for an explanation.

21 Cable protective device errors.

30 There are final sub-circuits on this switch board containing errors.

Hunter Water Australia
19 Spit Island Close
Mayfield West

Hunter Water Australia

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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:29 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

CABLE DATA - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 1,130.8 kVA (1,632 A/phase)
Load Power Factor : 0.967 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 4.26 %

Distribution	Cable Size (mm²)	Cable Length (m)	Insulation/ Sheath Type	Cond. Matrl.	Cable Cap. (A)	Cable Code	Neutral Size (mm²)	Earth Size (mm²)	Cond. Op. Temp. (°C)
T1 (1,500 kVA, 11kV/400V)	1,500 kVA (5.2% Impedance) (M.D. : 1,130.8 kVA)								
MSB (3ø) 30	6×500	30.0	XLPE 90°C/PVC	Cu	2,848.7	5	6×500	No Earth	38.3
P56 (3ø) RO Flush Pump 1 6,21	25	70.0	PVC 90°C/PVC	Cu	58.2	5	No	10	57.2
P59 (3ø) Degas Fan 2 21	4	40.0	PVC 90°C/PVC	Cu	18.6	5	No	2.5	51.0
P62 (3ø) Degas Fan 1 21	4	40.0	PVC 90°C/PVC	Cu	18.6	5	No	2.5	51.0
P65 (3ø) Auto Strainer 1 21	2.5	120.0	PVC 90°C/PVC	Cu	12.5	5	No	2.5	25.2
P68 (3ø) Auto Strainer 2 21	2.5	120.0	PVC 90°C/PVC	Cu	12.5	5	No	2.5	25.2
P71 (3ø) Auto Strainer 3 21	2.5	120.0	PVC 90°C/PVC	Cu	12.5	5	No	2.5	25.2
P74 (3ø) MF CIP Tank Heater	95	110.0	XLPE 90°C/PVC	Cu	158.6	6	95	25	50.1
P77 (3ø) Air Compressor 1	35	30.0	XLPE 90°C/PVC	Cu	85.8	5	35	10	52.8
P80 (3ø) Air Compressor 2	35	30.0	XLPE 90°C/PVC	Cu	85.8	5	35	10	52.8
VSD-MF Feed Pump 1 (3ø) 21	95	15.0	XLPE 90°C/PVC	Cu	216.8	6	No	25	61.4
P23 (3ø) MF Feed Pump 1	120	105.0	XLPE 90°C/PVC	Cu	189.0	17	No	3×16	50.2
VSD-MF Feed Pump 2 (3ø) 21	95	15.0	XLPE 90°C/PVC	Cu	216.8	6	No	25	61.4
P26 (3ø) MF Feed Pump 2	120	105.0	XLPE 90°C/PVC	Cu	189.0	17	No	3×16	50.2
VSD-MF Feed Pump 3 (3ø) 21	95	15.0	XLPE 90°C/PVC	Cu	216.8	6	No	25	61.4
P29 (3ø) MF Feed Pump 3	120	105.0	XLPE 90°C/PVC	Cu	189.0	17	No	3×16	50.2
VSD-MF Feed Pump 4 (3ø) 21	95	15.0	XLPE 90°C/PVC	Cu	216.8	6	No	25	61.4
P32 (3ø) MF Feed Pump 4	120	105.0	XLPE 90°C/PVC	Cu	189.0	17	No	3×16	50.2
VSD-CCT Feed Pump 1 (3ø) 21	10	15.0	PVC 90°C/PVC	Cu	39.8	5	No	4	57.2
P35 (3ø) CCT Feed Pump 1	10	70.0	XLPE 90°C/PVC	Cu	37.8	17	No	3×1.5	37.9
VSD-CCT Feed Pump 2 (3ø) 21	10	15.0	PVC 90°C/PVC	Cu	39.8	5	No	4	57.2
P38 (3ø) CCT Feed Pump 2	10	70.0	XLPE 90°C/PVC	Cu	37.8	17	No	3×1.5	37.9
VSD-CCT Feed Pump 3 (3ø) 21	10	15.0	PVC 90°C/PVC	Cu	39.8	5	No	4	57.2
P41 (3ø) CCT Feed Pump 3	10	70.0	XLPE 90°C/PVC	Cu	37.8	17	No	3×1.5	37.9
VSD-MF CIP Pump 1 (3ø) 21	10	15.0	PVC 90°C/PVC	Cu	39.8	5	No	4	57.2
P44 (3ø) MF CIP Pump 1	10	105.0	XLPE 90°C/PVC	Cu	42.9	17	No	3×1.5	49.0
VSD-MF CIP Pump 2 (3ø) 21	10	15.0	PVC 90°C/PVC	Cu	39.8	5	No	4	57.2
P47 (3ø) MF CIP Pump 2	10	105.0	XLPE 90°C/PVC	Cu	42.9	17	No	3×1.5	49.0
VSD-BW Handling Pump 1 (3ø) 21	4	15.0	PVC 90°C/PVC	Cu	22.6	5	No	2.5	41.8
P50 (3ø) BW Handling Pump 1	2.5	115.0	XLPE 90°C/PVC	Cu	19.1	17	No	2.5	27.1
VSD-BW Handling Pump 2 (3ø) 21	4	15.0	PVC 90°C/PVC	Cu	22.6	5	No	2.5	41.8
P53 (3ø) BW Handling Pump 2	2.5	115.0	XLPE 90°C/PVC	Cu	19.1	17	No	2.5	27.1
VSD-Product Water Pump 1 (3ø) 21	185	15.0	XLPE 90°C/PVC	Cu	339.3	6	No	70	60.0
P17 (3ø) Product Water Pump 1	2×95	45.0	XLPE 90°C/PVC	Cu	326.2	17	No	6×16	44.7
VSD-Product Water Pump 2 (3ø) 21	185	15.0	XLPE 90°C/PVC	Cu	339.3	6	No	70	60.0

Hunter Water Australia
19 Spit Island Close
Mayfield West

Cable Selection & Electrical Design Program

Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:29 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

CABLE DATA - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Insulation/ Sheath Type	Cond. Matrl.	Cable Cap. (A)	Cable Code	Neutral Size (mm²)	Earth Size (mm²)	Cond. Op. Temp. (°C)
P20 (3ø) Product Water Pump 2	2×95	45.0	XLPE 90°C/PVC	Cu	326.2	17	No	6×16	44.7
L&P DB04 ADMIN BUILDING (3ø)	35	115.0	XLPE 90°C/PVC	Cu	91.0	5	35	10	49.6
L&P DB03 EXH ROOM (3ø)	50	60.0	XLPE 90°C/PVC	Cu	108.5	5	50	16	52.1
L&P DB05 WORK SHED (3ø)	35	125.0	XLPE 90°C/PVC	Cu	91.0	5	35	10	49.6
L&P DB01 MAIN SWITCHROOM (3ø)	50	20.0	XLPE 90°C/PVC	Cu	140.8	6	50	16	65.2
L&P DB02 MAIN PLANT BUILDING (3ø)	50	50.0	XLPE 90°C/PVC	Cu	108.5	5	50	16	52.1

Cable choice is locked.
[6] Separate earth is used.
✗ This switch board/circuit contains errors. Refer to the footnotes for an explanation.
[21] Cable protective device errors.
[30] There are final sub-circuits on this switch board containing errors.

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Project :

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Printed : 14 Dec 2012 12:29 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

CABLE DATA - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 732.5 kVA (1,057 A/phase)
Load Power Factor : 0.916 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 3.23 %

Distribution	Cable Size (mm²)	Cable Length (m)	Insulation/ Sheath Type	Cond. Matrl.	Cable Cap. (A)	Cable Code	Neutral Size (mm²)	Earth Size (mm²)	Cond. Op. Temp. (°C)
T2 (1,500 kVA, 11kV/400V)	1,500 kVA (5.2% Impedance) (M.D. : 732.5 kVA)								
MSB-01 (3ø) 30	4×500	30.0	XLPE 90°C/PVC	Cu	2,047.7	6	4×500	No Earth	35.8
P32 (3ø) RO LP Pump 1 21	10	85.0	PVC 90°C/PVC	Cu	33.0	5	No	4	41.9
P35 (3ø) RO LP Pump 2 21	10	85.0	PVC 90°C/PVC	Cu	33.0	5	No	4	41.9
P38 (3ø) RO LP Pump 3 21	10	85.0	PVC 90°C/PVC	Cu	33.0	5	No	4	41.9
P41 (3ø) RO LP Pump 4 21	10	85.0	PVC 90°C/PVC	Cu	33.0	5	No	4	41.9
P44 (3ø) RO LP Pump 5 21	10	85.0	PVC 90°C/PVC	Cu	33.0	5	No	4	41.9
P47 (3ø) Neutralisation Pump 1 21	4	110.0	PVC 90°C/PVC	Cu	19.8	5	No	2.5	32.7
P50 (3ø) Neutralisation Pump 2 21	4	110.0	PVC 90°C/PVC	Cu	21.8	5	No	2.5	32.7
P53 (3ø) Process Water Pump 1 21	4	70.0	PVC 90°C/PVC	Cu	20.2	5	No	2.5	46.7
P56 (3ø) Process Water Pump 2 21	4	70.0	PVC 90°C/PVC	Cu	20.5	5	No	2.5	46.7
P59 (3ø) RO CIP Tank Heater	50	120.0	XLPE 90°C/PVC	Cu	106.0	6	50	16	36.7
P62 (3ø) Truck Fill Panel	10	70.0	PVC 90°C/PVC	Cu	38.5	5	10	4	47.0
P65 (3ø) Truck Fill Panel	10	70.0	PVC 90°C/PVC	Cu	38.5	5	10	4	47.0
P68 (3ø) Truck Fill Panel	10	70.0	PVC 90°C/PVC	Cu	38.5	5	10	4	47.0
P71 (3ø) Truck Fill Panel	10	70.0	PVC 90°C/PVC	Cu	38.5	5	10	4	47.0
P74 (3ø) Truck Fill Panel	10	70.0	PVC 90°C/PVC	Cu	38.5	5	10	4	47.0
VSD-MF Backwash Pump 1 (3ø) 21	16	15.0	PVC 90°C/PVC	Cu	53.0	5	No	6	62.9
P20 (3ø) MF Backwash Pump 1	16	110.0	XLPE 90°C/PVC	Cu	52.6	17	No	3×2.5	42.8
VSD-RO HP Pump 1 (3ø) 21	95	15.0	XLPE 90°C/PVC	Cu	216.8	6	No	25	60.2
P2 (3ø) RO HP Pump 1	95	30.0	XLPE 90°C/PVC	Cu	184.1	17	No	3×16	56.7
VSD-RO HP Pump 2 (3ø) 21	95	15.0	XLPE 90°C/PVC	Cu	216.8	6	No	25	60.2
P5 (3ø) RO HP Pump 2	95	30.0	XLPE 90°C/PVC	Cu	184.1	17	No	3×16	56.7
VSD-RO HP Pump 3 (3ø) 21	95	15.0	XLPE 90°C/PVC	Cu	216.8	6	No	25	60.2
P8 (3ø) RO HP Pump 3	95	30.0	XLPE 90°C/PVC	Cu	184.1	17	No	3×16	56.7
VSD-RO HP Pump 4 (3ø) 21	95	15.0	XLPE 90°C/PVC	Cu	216.8	6	No	25	60.2
P11 (3ø) RO HP Pump 4	95	30.0	XLPE 90°C/PVC	Cu	184.1	17	No	3×16	56.7
VSD-RO CIP Pump 1 (3ø) 21	25	15.0	PVC 90°C/PVC	Cu	71.0	5	No	6	62.9
P14 (3ø) RO CIP Pump 1	25	120.0	XLPE 90°C/PVC	Cu	69.5	17	No	3×4	43.3
VSD-RO CIP Pump 2 (3ø) 21	25	15.0	PVC 90°C/PVC	Cu	71.0	5	No	6	62.9
P17 (3ø) RO CIP Pump 2	25	120.0	XLPE 90°C/PVC	Cu	69.5	17	No	3×4	43.3
VSD-Service Water Pump 1 (3ø) 21	6	15.0	PVC 90°C/PVC	Cu	28.9	5	No	2.5	59.5
P26 (3ø) Service Water Pump 1	4	55.0	XLPE 90°C/PVC	Cu	26.6	17	No	3×1.5	45.9
VSD-Service Water Pump 2 (3ø) 21	6	15.0	PVC 90°C/PVC	Cu	28.9	5	No	2.5	59.5
P29 (3ø) Service Water Pump 2	4	50.0	XLPE 90°C/PVC	Cu	26.6	17	No	3×1.5	45.9
VSD-MF Backwash Pump 2 (3ø) 21	16	15.0	PVC 90°C/PVC	Cu	53.0	5	No	6	62.9

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Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

CABLE DATA - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Insulation/ Sheath Type	Cond. Matrl.	Cable Cap. (A)	Cable Code	Neutral Size (mm²)	Earth Size (mm²)	Cond. Op. Temp. (°C)
P23 (3ø) MF Backwash Pump 2	16	110.0	XLPE 90°C/PVC	Cu	52.6	17	No	3×2.5	42.8

Cable choice is locked.
× This switch board/circuit contains errors. Refer to the footnotes for an explanation.
21 Cable protective device errors.
30 There are final sub-circuits on this switch board containing errors.

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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:33 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

FAULT LEVEL - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 1,130.8 kVA (1,632 A/phase)
Load Power Factor : 0.967 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 4.26 %

Distribution	Cable Size (mm²)	Cable Length (m)	Selection Criteria	Fault Level (kA)
T1 (1,500 kVA, 11kV/400V)	1,500 kVA (5.2% Impedance) (M.D. : 1,130.8 kVA)			
MSB (3ø) 30	6×500	30.0	P	40.84
P56 (3ø) RO Flush Pump 1 6,21	25	70.0	I	3.99
P59 (3ø) Degas Fan 2 21	4	40.0	I	1.17
P62 (3ø) Degas Fan 1 21	4	40.0	I	1.17
P65 (3ø) Auto Strainer 1 21	2.5	120.0	S	0.27
P68 (3ø) Auto Strainer 2 21	2.5	120.0	S	0.27
P71 (3ø) Auto Strainer 3 21	2.5	120.0	S	0.27
P74 (3ø) MF CIP Tank Heater	95	110.0	I	8.17
P77 (3ø) Air Compressor 1	35	30.0	I	11.52
P80 (3ø) Air Compressor 2	35	30.0	I	11.52
VSD-MF Feed Pump 1 (3ø) 21	95	15.0	I	27.92
P23 (3ø) MF Feed Pump 1	120	105.0	I	8.88
VSD-MF Feed Pump 2 (3ø) 21	95	15.0	I	27.35
P26 (3ø) MF Feed Pump 2	120	105.0	I	8.84
VSD-MF Feed Pump 3 (3ø) 21	95	15.0	I	27.92
P29 (3ø) MF Feed Pump 3	120	105.0	I	8.88
VSD-MF Feed Pump 4 (3ø) 21	95	15.0	I	27.35
P32 (3ø) MF Feed Pump 4	120	105.0	I	8.84
VSD-CCT Feed Pump 1 (3ø) 21	10	15.0	I	7.17
P35 (3ø) CCT Feed Pump 1	10	70.0	I	1.43
VSD-CCT Feed Pump 2 (3ø) 21	10	15.0	I	7.17
P38 (3ø) CCT Feed Pump 2	10	70.0	I	1.43
VSD-CCT Feed Pump 3 (3ø) 21	10	15.0	I	7.17
P41 (3ø) CCT Feed Pump 3	10	70.0	I	1.43
VSD-MF CIP Pump 1 (3ø) 21	10	15.0	I	7.17
P44 (3ø) MF CIP Pump 1	10	105.0	V	0.99
VSD-MF CIP Pump 2 (3ø) 21	10	15.0	I	7.17
P47 (3ø) MF CIP Pump 2	10	105.0	V	0.99
VSD-BW Handling Pump 1 (3ø) 21	4	15.0	F	3.17
P50 (3ø) BW Handling Pump 1	2.5	115.0		0.26
VSD-BW Handling Pump 2 (3ø) 21	4	15.0	F	3.17
P53 (3ø) BW Handling Pump 2	2.5	115.0		0.26
VSD-Product Water Pump 1 (3ø) 21	185	15.0	P	30.42
P17 (3ø) Product Water Pump 1	2×95	45.0	I	20.04
VSD-Product Water Pump 2 (3ø) 21	185	15.0	P	30.42

Hunter Water Australia
19 Spit Island Close
Mayfield West

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Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:33 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

FAULT LEVEL - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Selection Criteria	Fault Level (kA)
P20 (3ø) Product Water Pump 2	2×95	45.0	I	20.04
L&P DB04 ADMIN BUILDING (3ø)	35	115.0	I	3.46
L&P DB03 EXH ROOM (3ø)	50	60.0	I	8.18
L&P DB05 WORK SHED (3ø)	35	125.0	I	3.19
L&P DB01 MAIN SWITCHROOM (3ø)	50	20.0	I	18.08
L&P DB02 MAIN PLANT BUILDING (3ø)	50	50.0	I	9.58

I = Current, V = V.Drop, T = Target V.Drop, F = Fault, S = Size, P = Protection, Blank = User, N = No Cable

Cable choice is locked.
[6] Separate earth is used.
✕ This switch board/circuit contains errors. Refer to the footnotes for an explanation.
[21] Cable protective device errors.
[30] There are final sub-circuits on this switch board containing errors.

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Hunter Water Australia

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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:33 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

FAULT LEVEL - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 732.5 kVA (1,057 A/phase)
Load Power Factor : 0.916 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 3.23 %

Distribution	Cable Size (mm²)	Cable Length (m)	Selection Criteria	Fault Level (kA)
T2 (1,500 kVA, 11kV/400V)	1,500 kVA (5.2% Impedance) (M.D. : 732.5 kVA)			
MSB-01 (3ø) 30	4×500	30.0		39.10
P32 (3ø) RO LP Pump 1 21	10	85.0	I	1.43
P35 (3ø) RO LP Pump 2 21	10	85.0	I	1.43
P38 (3ø) RO LP Pump 3 21	10	85.0	I	1.43
P41 (3ø) RO LP Pump 4 21	10	85.0	I	1.43
P44 (3ø) RO LP Pump 5 21	10	85.0	I	1.43
P47 (3ø) Neutralisation Pump 1 21	4	110.0	V	0.46
P50 (3ø) Neutralisation Pump 2 21	4	110.0	V	0.46
P53 (3ø) Process Water Pump 1 21	4	70.0	V	0.68
P56 (3ø) Process Water Pump 2 21	4	70.0	V	0.68
P59 (3ø) RO CIP Tank Heater	50	120.0	V	4.50
P62 (3ø) Truck Fill Panel	10	70.0	I	1.70
P65 (3ø) Truck Fill Panel	10	70.0	I	1.70
P68 (3ø) Truck Fill Panel	10	70.0	I	1.70
P71 (3ø) Truck Fill Panel	10	70.0	I	1.70
P74 (3ø) Truck Fill Panel	10	70.0	I	1.70
VSD-MF Backwash Pump 1 (3ø) 21	16	15.0	I	10.50
P20 (3ø) MF Backwash Pump 1	16	110.0	I	1.53
VSD-RO HP Pump 1 (3ø) 21	95	15.0	I	26.60
P2 (3ø) RO HP Pump 1	95	30.0	I	15.85
VSD-RO HP Pump 2 (3ø) 21	95	15.0	I	26.60
P5 (3ø) RO HP Pump 2	95	30.0	I	15.85
VSD-RO HP Pump 3 (3ø) 21	95	15.0	I	26.60
P8 (3ø) RO HP Pump 3	95	30.0	I	15.85
VSD-RO HP Pump 4 (3ø) 21	95	15.0	I	26.60
P11 (3ø) RO HP Pump 4	95	30.0	I	15.85
VSD-RO CIP Pump 1 (3ø) 21	25	15.0	I	14.90
P14 (3ø) RO CIP Pump 1	25	120.0	I	2.20
VSD-RO CIP Pump 2 (3ø) 21	25	15.0	I	14.90
P17 (3ø) RO CIP Pump 2	25	120.0	I	2.20
VSD-Service Water Pump 1 (3ø) 21	6	15.0	I	4.39
P26 (3ø) Service Water Pump 1	4	55.0	I	0.73
VSD-Service Water Pump 2 (3ø) 21	6	15.0	I	4.39
P29 (3ø) Service Water Pump 2	4	50.0	I	0.79
VSD-MF Backwash Pump 2 (3ø) 21	16	15.0	I	10.50

Hunter Water Australia
19 Spit Island Close
Mayfield West

Cable Selection & Electrical Design Program

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Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:33 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

FAULT LEVEL - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Selection Criteria	Fault Level (kA)
P23 (3ø) MF Backwash Pump 2	16	110.0	I	1.53

I = Current, V = V.Drop, T = Target V.Drop, F = Fault, S = Size, P = Protection, Blank = User, N = No Cable

Cable choice is locked.

X This switch board/circuit contains errors. Refer to the footnotes for an explanation.

21 Cable protective device errors.

30 There are final sub-circuits on this switch board containing errors.

Hunter Water Australia
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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:28 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA 400/230V 50Hz

EARTH FAULT LOOP IMPEDANCE - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 1,130.8 kVA (1,632 A/phase)
Load Power Factor : 0.967 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 4.26 %

Distribution	Cable Size (mm²)	Cable Length (m)	Max Zs (Ohms)	Zs (Ohms)	Device Model	Curve Type	Trip Unit	Trip Setting (A)	Device Rating (A)
T1 (1,500 kVA, 11kV/400V)	1,500 kVA (5.2% Impedance [0.001676 + j0.00533 Ohms])								
MSB (3ø) 30	6×500	30.0		0.0065	NW25 H1		Micrologic	2,500	1000-2500
P56 (3ø) RO Flush Pump 1 6,21	25	70.0	0.6827	0.1994	NS80H MA		MA80	80	80
P59 (3ø) Degas Fan 2 21	4	40.0	2.6665	0.5281	NS80H MA		MA25	25	25
P62 (3ø) Degas Fan 1 21	4	40.0	2.6665	0.5281	NS80H MA		MA25	25	25
P65 (3ø) Auto Strainer 1 21	2.5	120.0	32.1145	1.8190	NS80H MA		MA2.5	3	2.5
P68 (3ø) Auto Strainer 2 21	2.5	120.0	32.1145	1.8190	NS80H MA		MA2.5	3	2.5
P71 (3ø) Auto Strainer 3 21	2.5	120.0	32.1145	1.8190	NS80H MA		MA2.5	3	2.5
P74 (3ø) MF CIP Tank Heater	95	110.0	0.1381	0.1110	NS160SX		STR22SE	152	64-160
P77 (3ø) Air Compressor 1	35	30.0	0.3492	0.0767	NS100SX		TM100D	85	80-100
P80 (3ø) Air Compressor 2	35	30.0	0.3492	0.0767	NS100SX		TM100D	85	80-100
VSD-MF Feed Pump 1 (3ø) 21	95	15.0	0.1784	0.0195	NS250SX		STR22SE	186	100-250
P23 (3ø) MF Feed Pump 1	120	105.0	0.1784	0.0792	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-MF Feed Pump 2 (3ø) 21	95	15.0	0.1784	0.0196	NS250SX ME		STR22ME	182	132-220
P26 (3ø) MF Feed Pump 2	120	105.0	0.1784	0.0793	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-MF Feed Pump 3 (3ø) 21	95	15.0	0.1784	0.0195	NS250SX ME		STR22ME	182	132-220
P29 (3ø) MF Feed Pump 3	120	105.0	0.1784	0.0792	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-MF Feed Pump 4 (3ø) 21	95	15.0	0.1784	0.0196	NS250SX ME		STR22ME	182	132-220
P32 (3ø) MF Feed Pump 4	120	105.0	0.1784	0.0793	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-CCT Feed Pump 1 (3ø) 21	10	15.0	0.8374	0.1084	NS100SX ME		STR22ME	30	30-50
P35 (3ø) CCT Feed Pump 1	10	70.0	0.8374	0.5674	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-CCT Feed Pump 2 (3ø) 21	10	15.0	0.8374	0.1084	NS100SX ME		STR22ME	30	30-50
P38 (3ø) CCT Feed Pump 2	10	70.0	0.8374	0.5674	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-CCT Feed Pump 3 (3ø) 21	10	15.0	0.8374	0.1084	NS100SX ME		STR22ME	30	30-50
P41 (3ø) CCT Feed Pump 3	10	70.0	0.8374	0.5674	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-MF CIP Pump 1 (3ø) 21	10	15.0	0.8374	0.1084	NS100SX ME		STR22ME	30	30-50
P44 (3ø) MF CIP Pump 1	10	105.0	0.8374	0.8341	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-MF CIP Pump 2 (3ø) 21	10	15.0	0.8374	0.1084	NS100SX ME		STR22ME	30	30-50
P47 (3ø) MF CIP Pump 2	10	105.0	0.8374	0.8341	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-BW Handling Pump 1 (3ø) 21	4	15.0	6.9741	0.1973	NS100SX ME		STR22ME	24	24-40
P50 (3ø) BW Handling Pump 1	2.5	115.0	6.9741	1.9438	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-BW Handling Pump 2 (3ø) 21	4	15.0	6.9741	0.1973	NS100SX ME		STR22ME	24	24-40
P53 (3ø) BW Handling Pump 2	2.5	115.0	6.9741	1.9438	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-Product Water Pump 1 (3ø) 21	185	15.0		0.0122	NS630bN		Micrologic	315	252-630
P17 (3ø) Product Water Pump 1	2×95	45.0		0.0247	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-Product Water Pump 2 (3ø) 21	185	15.0		0.0122	NS630bN		Micrologic	315	252-630

Hunter Water Australia
19 Spit Island Close
Mayfield West

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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:28 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

EARTH FAULT LOOP IMPEDANCE - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Max Zs (Ohms)	Zs (Ohms)	Device Model	Curve Type	Trip Unit	Trip Setting (A)	Device Rating (A)
P20 (3ø) Product Water Pump 2	2×95	45.0		0.0247	n.a.	n.a.	n.a.	n.a.	n.a.
L&P DB04 ADMIN BUILDING (3ø)	35	115.0	0.3710	0.2849	NS100SX		TM80D	80	64-80
L&P DB03 EXH ROOM (3ø)	50	60.0	0.2968	0.0998	NS100SX		TM100D	100	80-100
L&P DB05 WORK SHED (3ø)	35	125.0	0.3710	0.3094	NS100SX		TM80D	80	64-80
L&P DB01 MAIN SWITCHROOM (3ø)	50	20.0	0.1897	0.0375	NS160SX		TM125D	125	100-125
L&P DB02 MAIN PLANT BUILDING (3ø)	50	50.0	0.2968	0.0837	NS100SX		TM100D	100	80-100

Cable choice is locked.
6 Separate earth is used.
✗ This switch board/circuit contains errors. Refer to the footnotes for an explanation.
21 Cable protective device errors.
30 There are final sub-circuits on this switch board containing errors.

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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:28 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA 400/230V 50Hz

EARTH FAULT LOOP IMPEDANCE - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 732.5 kVA (1,057 A/phase)
Load Power Factor : 0.916 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 3.23 %

Distribution	Cable Size (mm²)	Cable Length (m)	Max Zs (Ohms)	Zs (Ohms)	Device Model	Curve Type	Trip Unit	Trip Setting (A)	Device Rating (A)
T2 (1,500 kVA, 11kV/400V)	1,500 kVA (5.2% Impedance [0.001676 + j0.00533 Ohms])								
MSB-01 (3ø) 30	4×500	30.0	0.0214	0.0069	NT12 H2		Micrologic	1,125	500-1250
P32 (3ø) RO LP Pump 1 21	10	85.0	1.3825	0.5701	NS80H MA		MA50	50	50
P35 (3ø) RO LP Pump 2 21	10	85.0	1.3825	0.5701	NS80H MA		MA50	50	50
P38 (3ø) RO LP Pump 3 21	10	85.0	1.3825	0.5701	NS80H MA		MA50	50	50
P41 (3ø) RO LP Pump 4 21	10	85.0	1.3825	0.5701	NS80H MA		MA50	50	50
P44 (3ø) RO LP Pump 5 21	10	85.0	1.3825	0.5701	NS80H MA		MA50	50	50
P47 (3ø) Neutralisation Pump 1 21	4	110.0	3.4068	1.3651	NS80H MA		MA12.5	13	12.5
P50 (3ø) Neutralisation Pump 2 21	4	110.0	3.4068	1.3651	NS80H MA		MA12.5	13	12.5
P53 (3ø) Process Water Pump 1 21	4	70.0	3.4068	0.9179	NS80H MA		MA12.5	13	12.5
P56 (3ø) Process Water Pump 2 21	4	70.0	3.4068	0.9179	NS80H MA		MA12.5	13	12.5
P59 (3ø) RO CIP Tank Heater	50	120.0	0.2806	0.1945	NS100SX		STR22SE	70	40-100
P62 (3ø) Truck Fill Panel	10	70.0	0.7787	0.4722	NS100SX		TM40D	32	32-40
P65 (3ø) Truck Fill Panel	10	70.0	0.7787	0.4722	NS100SX		TM40D	32	32-40
P68 (3ø) Truck Fill Panel	10	70.0	0.7787	0.4722	NS100SX		TM40D	32	32-40
P71 (3ø) Truck Fill Panel	10	70.0	0.7787	0.4722	NS100SX		TM40D	32	32-40
P74 (3ø) Truck Fill Panel	10	70.0	0.7787	0.4722	NS100SX		TM40D	32	32-40
VSD-MF Backwash Pump 1 (3ø) 21	16	15.0	0.8437	0.0728	NS100SX ME		STR22ME	48	48-80
P20 (3ø) MF Backwash Pump 1	16	110.0	0.8437	0.4868	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-RO HP Pump 1 (3ø) 21	95	15.0	0.1423	0.0200	NS250SX ME		STR22ME	177	132-220
P2 (3ø) RO HP Pump 1	95	30.0	0.1423	0.0382	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-RO HP Pump 2 (3ø) 21	95	15.0	0.1423	0.0200	NS250SX ME		STR22ME	177	132-220
P5 (3ø) RO HP Pump 2	95	30.0	0.1423	0.0382	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-RO HP Pump 3 (3ø) 21	95	15.0	0.1423	0.0200	NS250SX ME		STR22ME	177	132-220
P8 (3ø) RO HP Pump 3	95	30.0	0.1423	0.0382	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-RO HP Pump 4 (3ø) 21	95	15.0	0.1423	0.0200	NS250SX ME		STR22ME	177	132-220
P11 (3ø) RO HP Pump 4	95	30.0	0.1423	0.0382	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-RO CIP Pump 1 (3ø) 21	25	15.0	0.4083	0.0656	NS100SX ME		STR22ME	62	48-80
P14 (3ø) RO CIP Pump 1	25	120.0	0.4083	0.3485	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-RO CIP Pump 2 (3ø) 21	25	15.0	0.4083	0.0656	NS100SX ME		STR22ME	62	48-80
P17 (3ø) RO CIP Pump 2	25	120.0	0.4083	0.3485	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-Service Water Pump 1 (3ø) 21	6	15.0	1.0467	0.1754	NS100SX ME		STR22ME	24	24-40
P26 (3ø) Service Water Pump 1	4	55.0	1.0467	0.7052	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-Service Water Pump 2 (3ø) 21	6	15.0	1.6798	0.1754	NS100SX ME		STR22ME	24	24-40
P29 (3ø) Service Water Pump 2	4	50.0	1.6798	0.6570	n.a.	n.a.	n.a.	n.a.	n.a.
VSD-MF Backwash Pump 2 (3ø) 21	16	15.0	0.5774	0.0728	NS100SX		TM63D	50	50-63

Hunter Water Australia
19 Spit Island Close
Mayfield West

Cable Selection & Electrical Design Program

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Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:28 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

EARTH FAULT LOOP IMPEDANCE - (UNBALANCED LOAD)

Distribution	Cable Size (mm²)	Cable Length (m)	Max Zs (Ohms)	Zs (Ohms)	Device Model	Curve Type	Trip Unit	Trip Setting (A)	Device Rating (A)
P23 (3ø) MF Backwash Pump 2	16	110.0	0.5774	0.4868	n.a.	n.a.	n.a.	n.a.	n.a.

Cable choice is locked.
× This switch board/circuit contains errors. Refer to the footnotes for an explanation.
21 Cable protective device errors.
30 There are final sub-circuits on this switch board containing errors.

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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:25 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

HARMONICS - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 1,130.8 kVA (1,632 A/phase)
Load Power Factor : 0.967 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 4.26 %

Distribution	Fund. Current (A)	True RMS Current (A)	Har. RMS Current (A)	True P.F.	Disp. P.F. (cos ø)	THD ref. fund. (%)	THD ref. RMS (%)	K Factor
T1 (1,500 kVA, 11kV/400V)	M.D. : 1,130.8 kVA, P.F. : 0.967 lag							
MSB (3ø) 30	1,598.241	1,632.165	331.042	0.967 lag	0.987 lag	20.713RWBø	20.282RWBø	4.204
P56 (3ø) RO Flush Pump 1 6,21	56.835	56.835	0.000	0.840 lag	0.840 lag	0.000	0.000	1.000
P59 (3ø) Degas Fan 2 21	14.552	14.552	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
P62 (3ø) Degas Fan 1 21	14.552	14.552	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
P65 (3ø) Auto Strainer 1 21	1.208	1.208	0.000	0.680 lag	0.680 lag	0.000	0.000	1.000
P68 (3ø) Auto Strainer 2 21	1.208	1.208	0.000	0.680 lag	0.680 lag	0.000	0.000	1.000
P71 (3ø) Auto Strainer 3 21	1.208	1.208	0.000	0.680 lag	0.680 lag	0.000	0.000	1.000
P74 (3ø) MF CIP Tank Heater	151.554	151.554	0.000	1.000	1.000	0.000	0.000	1.000
P77 (3ø) Air Compressor 1	85.000	85.000	0.000	1.000	1.000	0.000	0.000	1.000
P80 (3ø) Air Compressor 2	85.000	85.000	0.000	1.000	1.000	0.000	0.000	1.000
VSD-MF Feed Pump 1 (3ø) 21	167.983	181.770	69.441	0.893 lag	0.966 lag	41.338RWBø	38.203RWBø	12.378
P23 (3ø) MF Feed Pump 1	167.983	167.983	0.000	0.850 lag	0.850 lag	0.000	0.000	1.000
VSD-MF Feed Pump 2 (3ø) 21	167.983	181.770	69.441	0.893 lag	0.966 lag	41.338RWBø	38.203RWBø	12.378
P26 (3ø) MF Feed Pump 2	167.983	167.983	0.000	0.850 lag	0.850 lag	0.000	0.000	1.000
VSD-MF Feed Pump 3 (3ø) 21	167.983	181.770	69.441	0.893 lag	0.966 lag	41.338RWBø	38.203RWBø	12.378
P29 (3ø) MF Feed Pump 3	167.983	167.983	0.000	0.850 lag	0.850 lag	0.000	0.000	1.000
VSD-MF Feed Pump 4 (3ø) 21	167.983	181.770	69.441	0.893 lag	0.966 lag	41.338RWBø	38.203RWBø	12.378
P32 (3ø) MF Feed Pump 4	167.983	167.983	0.000	0.850 lag	0.850 lag	0.000	0.000	1.000
VSD-CCT Feed Pump 1 (3ø) 21	28.066	29.875	10.238	0.907 lag	0.966 lag	36.479RWBø	34.270RWBø	14.937
P35 (3ø) CCT Feed Pump 1	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
VSD-CCT Feed Pump 2 (3ø) 21	28.066	29.875	10.238	0.907 lag	0.966 lag	36.479RWBø	34.270RWBø	14.937
P38 (3ø) CCT Feed Pump 2	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
VSD-CCT Feed Pump 3 (3ø) 21	28.066	29.875	10.238	0.907 lag	0.966 lag	36.479RWBø	34.270RWBø	14.937
P41 (3ø) CCT Feed Pump 3	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
VSD-MF CIP Pump 1 (3ø) 21	28.066	29.875	10.238	0.907 lag	0.966 lag	36.479RWBø	34.270RWBø	14.937
P44 (3ø) MF CIP Pump 1	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
VSD-MF CIP Pump 2 (3ø) 21	28.066	29.875	10.238	0.907 lag	0.966 lag	36.479RWBø	34.270RWBø	14.937
P47 (3ø) MF CIP Pump 2	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
VSD-BW Handling Pump 1 (3ø) 21	5.153	5.564	2.098	0.895 lag	0.966 lag	40.707RWBø	37.703RWBø	15.784
P50 (3ø) BW Handling Pump 1	5.153	5.153	0.000	0.780 lag	0.780 lag	0.000	0.000	1.000
VSD-BW Handling Pump 2 (3ø) 21	5.153	5.564	2.098	0.895 lag	0.966 lag	40.707RWBø	37.703RWBø	15.784
P53 (3ø) BW Handling Pump 2	5.153	5.153	0.000	0.780 lag	0.780 lag	0.000	0.000	1.000
VSD-Product Water Pump 1 (3ø) 21	256.463	275.447	100.486	0.899 lag	0.966 lag	39.181RWBø	36.481RWBø	10.347
P17 (3ø) Product Water Pump 1	256.463	256.463	0.000	0.900 lag	0.900 lag	0.000	0.000	1.000
VSD-Product Water Pump 2 (3ø) 21	256.463	275.447	100.486	0.899 lag	0.966 lag	39.181RWBø	36.481RWBø	10.347

Hunter Water Australia
19 Spit Island Close
Mayfield West

Hunter Water Australia

Cable Selection & Electrical Design Program

Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:25 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

HARMONICS - (UNBALANCED LOAD)

Distribution	Fund. Current (A)	True RMS Current (A)	Har. RMS Current (A)	True P.F.	Disp. P.F. (cos ø)	THD ref. fund. (%)	THD ref. RMS (%)	K Factor
P20 (3ø) Product Water Pump 2	256.463	256.463	0.000	0.900 lag	0.900 lag	0.000	0.000	1.000
L&P DB04 ADMIN BUILDING (3ø)	80.000	80.000	0.000	1.000	1.000	0.000	0.000	1.000
L&P DB03 EXH ROOM (3ø)	100.000	100.000	0.000	1.000	1.000	0.000	0.000	1.000
L&P DB05 WORK SHED (3ø)	80.000	80.000	0.000	1.000	1.000	0.000	0.000	1.000
L&P DB01 MAIN SWITCHROOM (3ø)	125.000	125.000	0.000	1.000	1.000	0.000	0.000	1.000
L&P DB02 MAIN PLANT BUILDING (3ø)	100.000	100.000	0.000	1.000	1.000	0.000	0.000	1.000

Cable choice is locked.
6 Separate earth is used.
✗ This switch board/circuit contains errors. Refer to the footnotes for an explanation.
21 Cable protective device errors.
30 There are final sub-circuits on this switch board containing errors.

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Mayfield West

Cable Selection & Electrical Design Program

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Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:25 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

HARMONICS - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 732.5 kVA (1,057 A/phase)
Load Power Factor : 0.916 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 3.23 %

Distribution	Fund. Current (A)	True RMS Current (A)	Har. RMS Current (A)	True P.F.	Disp. P.F. (cos ø)	THD ref. fund. (%)	THD ref. RMS (%)	K Factor
T2 (1,500 kVA, 11kV/400V)	M.D. : 732.5 kVA, P.F. : 0.916 lag							
MSB-01 (3ø) 30	1,005.763	1,057.228	325.840	0.916 lag	0.963 lag	32.397RWBø	30.820RWBø	8.528
P32 (3ø) RO LP Pump 1 21	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
P35 (3ø) RO LP Pump 2 21	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
P38 (3ø) RO LP Pump 3 21	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
P41 (3ø) RO LP Pump 4 21	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
P44 (3ø) RO LP Pump 5 21	28.066	28.066	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
P47 (3ø) Neutralisation Pump 1 21	11.390	11.390	0.000	0.820 lag	0.820 lag	0.000	0.000	1.000
P50 (3ø) Neutralisation Pump 2 21	11.390	11.390	0.000	0.820 lag	0.820 lag	0.000	0.000	1.000
P53 (3ø) Process Water Pump 1 21	11.390	11.390	0.000	0.820 lag	0.820 lag	0.000	0.000	1.000
P56 (3ø) Process Water Pump 2 21	11.390	11.390	0.000	0.820 lag	0.820 lag	0.000	0.000	1.000
P59 (3ø) RO CIP Tank Heater	69.282	69.282	0.000	1.000	1.000	0.000	0.000	1.000
P62 (3ø) Truck Fill Panel	32.000	32.000	0.000	1.000	1.000	0.000	0.000	1.000
P65 (3ø) Truck Fill Panel	32.000	32.000	0.000	1.000	1.000	0.000	0.000	1.000
P68 (3ø) Truck Fill Panel	32.000	32.000	0.000	1.000	1.000	0.000	0.000	1.000
P71 (3ø) Truck Fill Panel	32.000	32.000	0.000	1.000	1.000	0.000	0.000	1.000
P74 (3ø) Truck Fill Panel	32.000	32.000	0.000	1.000	1.000	0.000	0.000	1.000
VSD-MF Backwash Pump 1 (3ø) 21	42.415	45.991	17.780	0.891 lag	0.966 lag	41.920RWBø	38.660RWBø	15.487
P20 (3ø) MF Backwash Pump 1	42.415	42.415	0.000	0.830 lag	0.830 lag	0.000	0.000	1.000
VSD-RO HP Pump 1 (3ø) 21	162.606	176.538	68.740	0.890 lag	0.966 lag	42.274RWBø	38.937RWBø	12.624
P2 (3ø) RO HP Pump 1	162.606	162.606	0.000	0.880 lag	0.880 lag	0.000	0.000	1.000
VSD-RO HP Pump 2 (3ø) 21	162.606	176.538	68.740	0.890 lag	0.966 lag	42.274RWBø	38.937RWBø	12.624
P5 (3ø) RO HP Pump 2	162.606	162.606	0.000	0.880 lag	0.880 lag	0.000	0.000	1.000
VSD-RO HP Pump 3 (3ø) 21	162.606	176.538	68.740	0.890 lag	0.966 lag	42.274RWBø	38.937RWBø	12.624
P8 (3ø) RO HP Pump 3	162.606	162.606	0.000	0.880 lag	0.880 lag	0.000	0.000	1.000
VSD-RO HP Pump 4 (3ø) 21	162.606	176.538	68.740	0.890 lag	0.966 lag	42.274RWBø	38.937RWBø	12.624
P11 (3ø) RO HP Pump 4	162.606	162.606	0.000	0.880 lag	0.880 lag	0.000	0.000	1.000
VSD-RO CIP Pump 1 (3ø) 21	56.835	61.522	23.554	0.892 lag	0.966 lag	41.443RWBø	38.286RWBø	14.899
P14 (3ø) RO CIP Pump 1	56.835	56.835	0.000	0.840 lag	0.840 lag	0.000	0.000	1.000
VSD-RO CIP Pump 2 (3ø) 21	56.835	61.522	23.554	0.892 lag	0.966 lag	41.443RWBø	38.286RWBø	14.899
P17 (3ø) RO CIP Pump 2	56.835	56.835	0.000	0.840 lag	0.840 lag	0.000	0.000	1.000
VSD-Service Water Pump 1 (3ø) 21	20.979	23.100	9.668	0.877 lag	0.966 lag	46.084RWBø	41.854RWBø	16.341
P26 (3ø) Service Water Pump 1	20.979	20.979	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
VSD-Service Water Pump 2 (3ø) 21	20.979	23.100	9.668	0.877 lag	0.966 lag	46.084RWBø	41.854RWBø	16.341
P29 (3ø) Service Water Pump 2	20.979	20.979	0.000	0.860 lag	0.860 lag	0.000	0.000	1.000
VSD-MF Backwash Pump 2 (3ø) 21	42.415	45.991	17.780	0.891 lag	0.966 lag	41.920RWBø	38.660RWBø	15.487

Hunter Water Australia
19 Spit Island Close
Mayfield West

Cable Selection & Electrical Design Program

Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:25 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

HARMONICS - (UNBALANCED LOAD)

Distribution	Fund. Current (A)	True RMS Current (A)	Har. RMS Current (A)	True P.F.	Disp. P.F. (cos ø)	THD ref. fund. (%)	THD ref. RMS (%)	K Factor
P23 (3ø) MF Backwash Pump 2	42.415	42.415	0.000	0.830 lag	0.830 lag	0.000	0.000	1.000

Cable choice is locked.
✕ This switch board/circuit contains errors. Refer to the footnotes for an explanation.
21 Cable protective device errors.
30 There are final sub-circuits on this switch board containing errors.

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Cable Selection & Electrical Design Program

Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:36 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

MAXIMUM DEMAND SUMMARY - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 1,130.8 kVA (1,632 A/phase)
Load Power Factor : 0.967 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 4.26 %
Installation Type : AS/NZS 3000:2007 Commercial

Distribution	Power Factor	Red ø (A)	White ø (A)	Blue ø (A)	Max ø (A)	Diversity
T1 (1,500 kVA, 11kV/400V)	M.D. : 1,130.8 kVA, P.F. : 0.967 lag					
MSB (3ø) 30	0.967 lag	1,632.2	1,632.2	1,632.2	1,632.2	
P56 (3ø) RO Flush Pump 1 6,21	0.840 lag	56.8	56.8	56.8	56.8	1
P59 (3ø) Degas Fan 2 21	0.860 lag	14.6	14.6	14.6	14.6	0.5
P62 (3ø) Degas Fan 1 21	0.860 lag	14.6	14.6	14.6	14.6	0.5
P65 (3ø) Auto Strainer 1 21	0.680 lag	1.2	1.2	1.2	1.2	1
P68 (3ø) Auto Strainer 2 21	0.680 lag	1.2	1.2	1.2	1.2	1
P71 (3ø) Auto Strainer 3 21	0.680 lag	1.2	1.2	1.2	1.2	1
P74 (3ø) MF CIP Tank Heater	1.000	151.6	151.6	151.6	151.6	1
P77 (3ø) Air Compressor 1	1.000	85.0	85.0	85.0	85.0	0.5
P80 (3ø) Air Compressor 2	1.000	85.0	85.0	85.0	85.0	0.5
VSD-MF Feed Pump 1 (3ø) 21	0.893 lag	181.8	181.8	181.8	181.8	STD U/S
P23 (3ø) MF Feed Pump 1	0.850 lag	168.0	168.0	168.0	168.0	1
VSD-MF Feed Pump 2 (3ø) 21	0.893 lag	181.8	181.8	181.8	181.8	STD U/S
P26 (3ø) MF Feed Pump 2	0.850 lag	168.0	168.0	168.0	168.0	1
VSD-MF Feed Pump 3 (3ø) 21	0.893 lag	181.8	181.8	181.8	181.8	STD U/S
P29 (3ø) MF Feed Pump 3	0.850 lag	168.0	168.0	168.0	168.0	1
VSD-MF Feed Pump 4 (3ø) 21	0.893 lag	181.8	181.8	181.8	181.8	STD U/S
P32 (3ø) MF Feed Pump 4	0.850 lag	168.0	168.0	168.0	168.0	STD
VSD-CCT Feed Pump 1 (3ø) 21	0.907 lag	29.9	29.9	29.9	29.9	STD U/S
P35 (3ø) CCT Feed Pump 1	0.860 lag	28.1	28.1	28.1	28.1	0.5
VSD-CCT Feed Pump 2 (3ø) 21	0.907 lag	29.9	29.9	29.9	29.9	STD U/S
P38 (3ø) CCT Feed Pump 2	0.860 lag	28.1	28.1	28.1	28.1	0.5
VSD-CCT Feed Pump 3 (3ø) 21	0.907 lag	29.9	29.9	29.9	29.9	STD U/S
P41 (3ø) CCT Feed Pump 3	0.860 lag	28.1	28.1	28.1	28.1	STD
VSD-MF CIP Pump 1 (3ø) 21	0.907 lag	29.9	29.9	29.9	29.9	STD U/S
P44 (3ø) MF CIP Pump 1	0.860 lag	28.1	28.1	28.1	28.1	0.5
VSD-MF CIP Pump 2 (3ø) 21	0.907 lag	29.9	29.9	29.9	29.9	STD U/S
P47 (3ø) MF CIP Pump 2	0.860 lag	28.1	28.1	28.1	28.1	0.5
VSD-BW Handling Pump 1 (3ø) 21	0.895 lag	5.6	5.6	5.6	5.6	STD U/S
P50 (3ø) BW Handling Pump 1	0.780 lag	5.2	5.2	5.2	5.2	0.5
VSD-BW Handling Pump 2 (3ø) 21	0.895 lag	5.6	5.6	5.6	5.6	STD U/S
P53 (3ø) BW Handling Pump 2	0.780 lag	5.2	5.2	5.2	5.2	0.5
VSD-Product Water Pump 1 (3ø) 21	0.899 lag	275.4	275.4	275.4	275.4	STD U/S
P17 (3ø) Product Water Pump 1	0.900 lag	256.5	256.5	256.5	256.5	0.5

Hunter Water Australia
19 Spit Island Close
Mayfield West

Hunter Water Australia

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POWERCAD
Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:36 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T1**
1,500 kVA
400/230V 50Hz

MAXIMUM DEMAND SUMMARY - (UNBALANCED LOAD)

Distribution	Power Factor	Red ø (A)	White ø (A)	Blue ø (A)	Max ø (A)	Diversity
VSD ✗ VSD-Product Water Pump 2 (3ø) 21	0.899 lag	275.4	275.4	275.4	275.4	STD U/S
P20 (3ø) Product Water Pump 2	0.900 lag	256.5	256.5	256.5	256.5	0.5
L&P DB04 ADMIN BUILDING (3ø)	1.000	80.0	80.0	80.0	80.0	STD U/S
L&P DB03 EXH ROOM (3ø)	1.000	100.0	100.0	100.0	100.0	STD U/S
L&P DB05 WORK SHED (3ø)	1.000	80.0	80.0	80.0	80.0	STD U/S
L&P DB01 MAIN SWITCHROOM (3ø)	1.000	125.0	125.0	125.0	125.0	STD U/S
L&P DB02 MAIN PLANT BUILDING (3ø)	1.000	100.0	100.0	100.0	100.0	STD U/S

Cable choice is locked.
6 Separate earth is used.
✗ This switch board/circuit contains errors. Refer to the footnotes for an explanation.
21 Cable protective device errors.
30 There are final sub-circuits on this switch board containing errors.

Hunter Water Australia
19 Spit Island Close
Mayfield West

Hunter Water Australia

Cable Selection & Electrical Design Program

Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012
12:36 pm

Designed By :
Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

MAXIMUM DEMAND SUMMARY - (UNBALANCED LOAD)

SUPPLY (L.V. Side) : 400/230V 50Hz
Load Maximum Demand : 732.5 kVA (1,057 A/phase)
Load Power Factor : 0.916 lag
Max. Allowable Site Voltage Drop : 5 %
Actual Site Voltage Drop : 3.23 %
Installation Type : AS/NZS 3000:2007 Commercial

Distribution	Power Factor	Red ø (A)	White ø (A)	Blue ø (A)	Max ø (A)	Diversity
T2 (1,500 kVA, 11kV/400V)	M.D. : 732.5 kVA, P.F. : 0.916 lag					
MSB-01 (3ø) 30	0.916 lag	1,057.2	1,057.2	1,057.2	1,057.2	
P32 (3ø) RO LP Pump 1 21	0.860 lag	28.1	28.1	28.1	28.1	1
P35 (3ø) RO LP Pump 2 21	0.860 lag	28.1	28.1	28.1	28.1	1
P38 (3ø) RO LP Pump 3 21	0.860 lag	28.1	28.1	28.1	28.1	1
P41 (3ø) RO LP Pump 4 21	0.860 lag	28.1	28.1	28.1	28.1	1
P44 (3ø) RO LP Pump 5 21	0.860 lag	28.1	28.1	28.1	28.1	STD
P47 (3ø) Neutralisation Pump 1 21	0.820 lag	11.4	11.4	11.4	11.4	0.5
P50 (3ø) Neutralisation Pump 2 21	0.820 lag	11.4	11.4	11.4	11.4	0.5
P53 (3ø) Process Water Pump 1 21	0.820 lag	11.4	11.4	11.4	11.4	0.5
P56 (3ø) Process Water Pump 2 21	0.820 lag	11.4	11.4	11.4	11.4	0.5
P59 (3ø) RO CIP Tank Heater	1.000	69.3	69.3	69.3	69.3	1
P62 (3ø) Truck Fill Panel	1.000	32.0	32.0	32.0	32.0	0.25
P65 (3ø) Truck Fill Panel	1.000	32.0	32.0	32.0	32.0	0.25
P68 (3ø) Truck Fill Panel	1.000	32.0	32.0	32.0	32.0	0.25
P71 (3ø) Truck Fill Panel	1.000	32.0	32.0	32.0	32.0	0.25
P74 (3ø) Truck Fill Panel	1.000	32.0	32.0	32.0	32.0	0.25
VSD-MF Backwash Pump 1 (3ø) 21	0.891 lag	46.0	46.0	46.0	46.0	STD U/S
P20 (3ø) MF Backwash Pump 1	0.830 lag	42.4	42.4	42.4	42.4	0.5
VSD-RO HP Pump 1 (3ø) 21	0.890 lag	176.5	176.5	176.5	176.5	STD U/S
P2 (3ø) RO HP Pump 1	0.880 lag	162.6	162.6	162.6	162.6	1
VSD-RO HP Pump 2 (3ø) 21	0.890 lag	176.5	176.5	176.5	176.5	STD U/S
P5 (3ø) RO HP Pump 2	0.880 lag	162.6	162.6	162.6	162.6	1
VSD-RO HP Pump 3 (3ø) 21	0.890 lag	176.5	176.5	176.5	176.5	STD U/S
P8 (3ø) RO HP Pump 3	0.880 lag	162.6	162.6	162.6	162.6	1
VSD-RO HP Pump 4 (3ø) 21	0.890 lag	176.5	176.5	176.5	176.5	STD U/S
P11 (3ø) RO HP Pump 4	0.880 lag	162.6	162.6	162.6	162.6	1
VSD-RO CIP Pump 1 (3ø) 21	0.892 lag	61.5	61.5	61.5	61.5	STD U/S
P14 (3ø) RO CIP Pump 1	0.840 lag	56.8	56.8	56.8	56.8	0.5
VSD-RO CIP Pump 2 (3ø) 21	0.892 lag	61.5	61.5	61.5	61.5	STD U/S
P17 (3ø) RO CIP Pump 2	0.840 lag	56.8	56.8	56.8	56.8	0.5
VSD-Service Water Pump 1 (3ø) 21	0.877 lag	23.1	23.1	23.1	23.1	STD U/S
P26 (3ø) Service Water Pump 1	0.860 lag	21.0	21.0	21.0	21.0	0.5
VSD-Service Water Pump 2 (3ø) 21	0.877 lag	23.1	23.1	23.1	23.1	STD U/S
P29 (3ø) Service Water Pump 2	0.860 lag	21.0	21.0	21.0	21.0	0.5

Hunter Water Australia
19 Spit Island Close
Mayfield West
Ph No. : 49 414835 Mobile No. : 0418205367 Fax No. : 49 415012 Email : callum.menzies@hwa.com.au

Cable Selection & Electrical Design Program

Project :

File : KIWS PowerCAD Model_LATEST
Printed : 14 Dec 2012 12:36 pm

Designed By :

Standards : AS/NZS 3000:2007/Amdt 1:2009, AS/NZS 3008.1.1:2009/Amdt 1:2011

Transformer: **T2**
1,500 kVA
400/230V 50Hz

MAXIMUM DEMAND SUMMARY - (UNBALANCED LOAD)

Distribution	Power Factor	Red ø (A)	White ø (A)	Blue ø (A)	Max ø (A)	Diversity
VSD ✗VSD-MF Backwash Pump 2 (3ø)21	0.891 lag	46.0	46.0	46.0	46.0	STD U/S
P23 (3ø) MF Backwash Pump 2	0.830 lag	42.4	42.4	42.4	42.4	0.5

Cable choice is locked.
✗ This switch board/circuit contains errors. Refer to the footnotes for an explanation.
21 Cable protective device errors.
30 There are final sub-circuits on this switch board containing errors.

APPENDIX E. Mayfield West AWTP - Final Acoustic Design Review

Sinclair Knight Merz
100 Christie Street
St Leonards NSW 2065 Australia
Postal Address
PO Box 164 St Leonards NSW 2065 Australia

Tel: +61 2 9928 2100
Fax: +61 2 9928 2500
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John McGuinness
Hunter Treatment Alliance
Unit 8
27 Annie Street
Wickham
NSW 2293

31/01/2013 *EN03307*

Dear John,

Kooragang Island Reverse Osmosis Treatment Plant - Acoustic Design Review

1. Background

In December 2011, SKM undertook acoustic modelling to identify a noise abatement scheme at the proposed Kooragang Island Reverse Osmosis (RO) Plant. The modelling included a number of assumptions in terms of plant data, potential plant locations and operating scenarios. Following this modelling exercise, the Hunter Treatment Alliance design team has refined the site plan and been provided with manufacturer noise data for the majority of plant on site.

The mitigation scheme was designed to demonstrate compliance against criteria set out in the 2002 Hatch Engineering document '*A Review of Noise Amenity Criteria to Industrial Noise Policy Guidelines for the Steel River Site'*. This report was commissioned to overlay the Steel River Strategic Impact Assessment Study (SIAS), and to set project site criteria that complied with the NSW Industrial Noise Policy (NSW INP). The criterion is derived as an allowed noise allocation for a given Land Lot or land area, rather than a specific level at a sensitive receiver.

The nature of the criteria meant that the noise modelling for the proposed plant was undertaken in accordance with ISO 8297 ' *Acoustics – Determination of sound power levels of multisource industrial plants for evaluation of sound pressure levels in the environment – Engineering method*'.

The outcome of the 2011 SKM assessment was a noise mitigation scheme that, through computation modelling, demonstrated compliance with the required criteria. Mitigation measures included recommendations for building envelope materials, acoustic walls and internal wall treatments. All the recommended mitigation measures were incorporated into the project design.

2. Scope

The Hunter Treatment Alliance has developed the initial reverse osmosis plant design and is at the stage of finalising the 'Issue for Construction' (IFC) drawings. The most recent design has been modified from that assessed in the SKM 2011 report. As a result of these amendments, the alliance has commissioned SKM to undertake a review of the design change to identify potential implications on the acoustic performance of the following the design amendments.

This letter aims to provide the following:

- A review the current site layout with comparisons against the original design
- Undertake quantitative comparison of manufacturer's equipment noise data with those levels assumed within the 2011 noise models
- Provide a qualitative indication of compliance with noise criteria following construction and operation of the current design
- Provide an indication of any potential noise control measures resulting from the design modifications
- Provide a qualitative risk assessment for progressing the new design without undertaking detailed acoustic modelling. This would include potential post-construction mitigation measures which could be adopted should non-compliance be determined following changes to the concept design.

This report does not replicate the detail of the earlier 2011 SKM report, nor provide final guarantees that the current design will comply with the project criteria. The report will highlight areas of risk and potential ways of mitigating the risk acoustically.

3. Design Amendments

3.1 Layout

The new layout of the RO plant has been amended from the previously assessed design as follows:

- Removal of (a) (the) blower from the design
- Relocations of strainers to closer to the drain pit
- Relocation of (a) (the) large water tank
- Relocation of RO feed pumps from inside to outside of the existing building envelope.
- Relocation of (a) (the) raw water storage tank
- Relocation of (a) (the) RO feed tank
- Relocation of the administration and amenities building

The changes to the design from the proposed new layout and the previously assessed 2011 design layout are provided in **Appendix A.** The change in design is likely to have an acoustic benefit in certain areas, but may increase noise emissions in others. A detailed review has been provided in **Section 4**.

3.2 Plant Emission Data

At the time of the 2011 SKM report, manufacture's data for pumps and other noise sources was not available and therefore estimates for equipment gathered from similar projects, or calculated from empirical formula was assumed. As the design has progressed, data for operational noise emissions has been sourced. These noise levels have been confirmed through discussions with equipment manufacturers and the alliance.

In the main, assumed noise emissions for the 2011 SKM report are expected to be conservative, with the majority of emission levels being reduced as equipment manufacturer data has become available. The reduction of noise levels of plant is likely to assist in meeting compliance at the project boundary.

4. Acoustic Review of Design

4.1 Plant Layout Impact

The 2011 layout is presented in **Appendix A.1,** with the current plant layout in **Appendix A.2**. There are a number of changes to the layout, mostly relating to the movement of liquid storage tanks, but also slight changes to the dimensions of the main plant building.

The blower proposed in the 2011 design has been removed from the current design. Although this is a removal of a noise source from the site, the contribution of noise from the blower was minimal in terms of other site emissions. Therefore it is unlikely to have a significant impact on noise emissions from the current design.

The relocation of liquid storage tanks has an impact on the propagation of sound from the site, as the size of these means they act like noise barriers. Previously the storage tanks were located at a reasonable distance away from the main site building and dominant noise source across the site. The tanks have now been moved in closer to sources with the raw water tank increased in diameter. This is likely to result in an increase in performance of these as noise barriers when compared to the previous layout.

The change in size and dimension of the main plant building is minor and unlikely to have a noticeable difference in terms of emissions, as the overall emitting surface areas are similar for both designs.

The greatest potential impact, in terms of acoustics and revised layout, is likely to result from the relocation of the RO feed pumps to an external area; previously they were located within the main building. These pumps are now located to the south of the site, between the MF feed pumps and the CCT pump station, where Switch Room 2 building used to be.

Although the RO feed pumps have been relocated externally, the sound power of these assumed within the 2011 SKM model was very conservative. Previously the RO feed pumps were assumed to have a sound power level of 110-112dB (A) whereas the information supplied by the alliance, following discussions with the manufacturers, shows levels in the region of 80dB (A). While this is a relatively large reduction, the relocation to an external area still has the potential for them to increase localised noise levels at the compliance/modelling locations, of a magnitude enough to show non-compliance. Therefore without remodelling, addressing the noise associated with the RO Feed Pumps should be considered. For control measures please refer to **Section 5**.

4.2 Plant Emission Data Impact

A review of the plant list has been completed. This compares the assumed sound power of plant items in the 2011 model compared with those obtained from manufacturers and issued by the alliance for this work.

With the exception of the R.O. flush pumps (R.O. permeate) and the chemical transfer pumps (caustic soda, SBS, R.O. cleaning chemical & sodium hypochlorite), the revised project sound power levels are much lower for plant items than those used in the 2011 assessment . On average sound power levels are between 10-30 db(a) lower than previously identified. The pumps being the exception have increased noise levels of between 2 dB(A) and 3 dB(A) higher than those in the 2011 model. The R.O. flush pumps (R.O. permeate) show an increase of 20 dB(A), from 75 dB(A) to 95 dB(A).

The RO flush pumps are the most likely to cause a non-compliance issue across the site due to the identified increase, however assuming that the noise from this can be controlled in the same way as other external pumps across the site, compliance would still be achievable. In the 2011 noise model, the externally placed MF backwash pumps initially demonstrated non compliance and were then mitigated to meet operational criteria by a simple noise barrier. A similar barrier scheme is expected to be suitable for controlling the newly located RO flush pumps.

In addition, it is recommended that where a noise barrier is considered for noise control for the R.O. flush pump, a high performance acoustic absorber should be installed to the internal faces of the wall. This will control reflected noise and in most cases can reduce noise emissions in the localised area by up to 4dB (A). Further discussion is presented in **Section 5.**

The other increase in noise as a result of the revisions to noise emissions is associated with the chemical transfer pumps. These pumps are located in close proximity to the main plant building and as such are afforded relatively good shielding by other plant, building walls, and tanks located on the outer perimeter of the site. The increase in noise emissions from these pumps is unlikely to be noticeable above other noise source on the site and is expected to blend with noise radiating from the facade of the main plant building at the emissions are of a similar level.

At least five externally located pumps reduce in level by up to 10 dB(A) for the new design when compared to the previously assumed levels in the 2011 model. Given that the increase in chemical transfer pump noise is up to a maximum of 3dB (A) per pump, cumulatively the increases in noise of the chemical pumps is unlikely to be discernible when other noise sources across the site are taken into account.

5. Compliance & Recommendations

The 2012 design and revised layout is, on balance, likely to remain compliant however this cannot be quantitatively demonstrated without remodelling the site taking account of the new source and building locations and new noise emission data.

On the basis of this review, progressing to construction stage for this design without remodelling poses only a small risk that compliance will not be obtained in practice. In addition there are a number of additional mitigation measures which can be installed post construction to ameliorate any excessive noise emissions.

Some of the potential measures may require design at this stage so that they can be built in practice without excessive cost or retrofitting. Determination of whether these measures would be required could be undertaken at the compliance testing phase of the project, however undertaking such measures with a fully operational plant can sometimes prove more costly than putting these measures in place during the initial construction. This is a risk that the alliance needs to bear in mind.

Examples of possible measures are listed below:

- Three sided noise wall around the R.O. flush pumps, similar in design to those recommended for the raw water product feed pumps outlined in the 2011 report;
- Addition of acoustic absorption to the internal faces of pump walls identified in the 2011 report;
- Secondary 2-3 m noise wall around the perimeter of the site or at strategic locations around the boundary

The alliance has also advised that whilst the site was previously proposed to occupy two Lots on the Steel River Site, the perimeter fence will now cover three Lots; although the plant will be restricted to the initial two. As the method for modelling and compliance testing is based on an ‘area noise allowance’, the additional Lot area may provide additional flexibility in the noise criteria and predictions. Ultimately, corrections to take account of the additional land area from Lot 3, may reduce the total noise emission from the site and therefore make complying with the criteria more achievable. This would only be confirmed through modelling or compliance measurement.

6. Summary

The Hunter Treatment Alliance is undertaking final construction design for the proposed Reverse Osmosis Water Treatment plant on the Steel River Development Site, Newcastle. Following SKMs noise report in 2011, a number of site revisions have been made. Therefore as part of the final design process, SKM has been commissioned to undertake a review of the revised design and identify risk to compliance.

The review has shown that the new site layout and confirmed plant emissions are likely to comply with the allotted criteria for the site, however this cannot be confirmed without more detailed modelling. This assessment is qualitative and is based on the benefits of the new layout, and ranks the benefits against the dis-benefits of each option. Following discussions with the alliance design team, mitigation measures at this stage in the construction phase would be deferred until commissioning testing.

This report includes some mitigation measures which may be applied, should non-compliance be identified following commissioning. Assuming contingency is made for future mitigation measures, a complying design should be achievable in its current form.

In summary, given the number of plant items which were conservatively modelled for the 2011 report, and the relatively few showing increases in levels, the cumulative noise from the site is unlikely to change significantly from the initial model. Therefore the current 2012 design is likely to show compliance.

I hope this is satisfactory at this stage of the project. Should you have and questions or require further clarification, please do not hesitate to contact me.

Regards,

Daniel Clare
Acoustic Engineer
Phone: 0434518532
E-mail: dxclare@globalskm.com

Appendix A.1 Site Layout 2011

Appendix A.2 Site Layout 2012

APPENDIX F. Mayfield West AWTP – Main Plant Building Design Compliance Certificate

Design Compliance Certificate

Pursuant to Section 109R of the Environmental Planning & Assessment Act 1979, SEPP (Infrastructure) 2007

Certification No: **018/12**

Subject Land: 15-19 Channel Road, **MAYFIED WEST**

Local Government Area: Newcastle City Council

Applicant: John McGuinness
Address: Hunter Treatment Alliance
Unit 8, 27 Annie Street, Wickham NSW 2293

Owner: Hunter Water Corporation
Address: 15-19 Channel Road, Mayfield West

Description of Development: KIWS Hunter Treatment Plant

BCA Classification: Class 8

Contractor: TBA

Plans and Specifications assessed: As Listed in Schedule 1

Statutory Certification:
Pursuant to the provisions of Section 109R(2) of the Environmental Planning and Assessment Act 1979, Dix Gardner Pty Ltd hereby certifies that the building works have been designed in accordance with the Building Code of Australia 2012, subject to the attached Conditions.

Conditions: As listed in Schedule 2

Building Surveyor:
Name: Sydney Norman BUTT
Accreditation No: BPB 0054
Accreditation Body: Building Professionals Board

Signature: ______________________ **Determination Date:** 29 November 2012

Level 4,
155 Castlereagh Street
Sydney NSW 2000
Tel: 02 9279 3657
Fax: 02 9279 3686

ABN 19 090 427 446 | Email: admin@dixgardner.com.au | Web: www.dixgardner.com.au

Level 2, 25 Watt Street
P.O. Box 1809
Newcastle NSW 2300
Tel: 02 4927 1822
Fax: 02 4927 1844

SCHEDULE 1

Schedule of approved plans and specifications

- Plans prepared by Hunter Water, Project No.CG370001 MAYFIELD WEST AWTP (KIWS):

Drawing Number	Sheet Number	Revision / Issue	Date
15270	10	D	14/06/12
15270	300	0	11/09/12
15270	301	0	11/09/12
15270	302	0	11/09/12
15270	320	0	07/08/12
15270	350	B	28/09/12
15270	351	B	28/09/12
15270	352	B	28/09/12
15270	353	A	10/10/12
15270	354	B	28/09/12
15270	355	B	28/09/12
15270	850	B	12/10/12
15270	851	B	12/10/12
15270	852	B	12/10/12
15270	853	B	12/10/12
15270	338	0	08/10/12
15270	337	0	08/10/12

SCHEDULE 2

Conditions of Certification

1. Conditions prescribed by the Environmental Planning & Assessment Regulation 2000

a) Erection of Signs:

A sign must be erected in a prominent position on any site on which building work, subdivision work or demolition work is being carried out:

i. detailing the name, address and telephone number of the Principal Certifying Authority (where applicable) for the work, and
ii. nominating the name of the principal contractor (if any) for the building work and a telephone number on which that person may be contacted outside working hours, and
iii. stating unauthorised entry to the site is prohibited.

Any such sign is to be maintained while the building work, subdivision work or demolition work is being carried out, but must be removed when the work has been completed.

Note:

- *This condition does not apply in relation to building work, subdivision work or demolition work that is carried out inside an existing building that does not affect the external walls of the building*
- *This condition does not apply in relation to Crown Building work that is certified, in accordance with section 109R of the Act, to comply with the technical provisions of the State's building laws.*

b) Shoring and adequacy of adjoining property:

i. If the development involves an excavation that extends below the level of the base of the footings of a building on adjoining land, the person having the benefit of the certificate must be at a person's own expense:

- protect and support the adjoining premises from possible damage from the excavation, and
- where necessary, underpin the adjoining premises to prevent any such damage

ii. The condition referred to in subclause (i) does not apply if the person having the benefit of the certificate owns the adjoining land or the owner of the adjoining land has given consent in writing to that condition not applying.

2. General

1. All building works associated with the subject development are to be carried out in accordance with the approved documentation listed above in Schedule 1.

2. The handling and or removal of any hazardous or industrial waste arising from the demolition activities is to be removed and or transported in accordance with the requirements of relevant authorities.

3. All demolition activities are to be carried out within the site.

4. The contractor must take all necessary precautions before and during demolition works strictly in accordance with AS 2601 'Demolition of Structures'.

5. Prior to works commencing the demolition contractor shall carry out an investigation of the building and site and advise this office of any matters relating to hazardous materials, interference of services or other matters which may influence the proposed demolition procedures.

6. The site shall be fully fenced off at the allotment boundaries to prevent unauthorised and unobstructed public access to the addressed allotment.

7. All electrical cables and the like shall be disconnected prior to the commencement of demolition works.

8. When the demolition site adjoins a street or public walkway a solid hoarding shall be erected on the street boundary to the satisfaction of council.

9. Notice displaying 'Danger Demolition Works In Progress' or similar are to be fixed to the hoarding.

10. All asbestos on site shall be removed by an accredited asbestos removalist registered with the Occupation Health and Safety Authorities.

11. Dust creating material, unless thoroughly dampened shall not be thrown or dropped from the building but shall be lowered by hoisting apparatus.

APPENDIX G. Mayfield West AWTP – Educational Annexure - Design Compliance Certificates

BCA SECTION J REPORT

1. INTRODUCTION

1.1 PURPOSE OF THE REPORT

The purpose of this report is to assess the requirements under Section J of the Building Code of Australia 2011 (BCA) in regard to the proposed Education Annex for the Kooragang Industrial Waster Scheme (KIWS) facility at Mayfield West. This report will demonstrate the measures and methods adopted in the Construction Certificate documentation to meet these requirements.

1.2 EXTENT OF WORK

The project consists of the construction of a new education annex that will adjoin a new water treatment plant building. The new annex will consist of an exhibition space and auditorium with associated wet area facilities. The BCA requirements of the new plant building are being assessed separately.

The new annex is single storey. The construction is generally structural masonry with fibre cement infill panels above windows and doors, and metal roof sheeting. The primary steel structure will be partially supported by the adjacent plant building (construction of steel frame with precast concrete walling)

The annex will be air-conditioned with the exception of the toilets, store room and kitchenette. The adjoining plant building will not be air conditioned.

All new services will be provided in accordance with the requirements of Section J.

All new roofing, external walling and flooring will be in accordance with the requirements of Section J.

2. SECTION J ASSESSMENT

Education Annex

Building Classification: 9b (assembly building)

Climate Zone: 5

2.1 PART J1 – BUILDING FABRIC

PART	DESCRIPTION	REQUIRED	PROVIDED
J1.1	Class 9b with conditioned spaces	Section J applies to the envelope of the conditioned space only.	Refer to details below.
J1.2	Thermal Construction - Insulation	To be in accordance with AS NZS 4859.1	Readily achievable. Check installation on site.
J1.3	Roof and Ceiling Construction	Min R Value 3.7 (Summer/downwards) Roof Colour: Colorbond “Windspray” Surface solar absorptance : 0.58 Required insulation Thermal break min R0.2 required.	R-value calculation for roof system are taken from Bradford “Safebridge” product literature. Anticon SB110 blanket R 2.5 (Foil backed) All roof framing is steel therefore a thermal break has been provided. (see specification)
J1.4	Roof lights	N/A	

PART	DESCRIPTION	REQUIRED	PROVIDED
J1.5a	External Walls NE Wall SE wall NW Wall **Note -** *Lightweight wall based on ICANZ handbook W0300 Masonry walls based on BCA 2012*	 Min R Value 2.3 (Shading projection is 30º) Min R Value 2.8 (Shading projection is <30 º) Min R Value 2.8 (Shading projection is <30 º) Required Insulation Proposed Insulation	 **Masonry wall (NE, SE & NW walls);** Outdoor Air Film R 0.04 Render R 0.02 concrete block R 0.20 Airspace R 0.17 75mm Steel Stud R 0.0 Insulation ** 10mm Plasterboard R 0.06 Indoor Air Film R 0.12 Total R Value = R1.98 **R 2.19 75mm glass wool batts R2.2
		***Note** – a thermal break of R0.02 is required for steel stud framed walls with lightweight external cladding and no lining or lining fixed directly to the same studwork* Required Insulation Proposed Insulation	**Fibre cement clad walls (NE, SE & NW walls);** Outdoor Air Film R 0.04 9mm FC cladding R 0.045 Airspace R 0.187 75mm Steel Stud R 0.0 Insulation * 10mm Plasterboard R 0.06 Indoor Air Film R 0.12 Total R Value = R 0.331 * R 2.5 75mm glass wool batts R2.5
	SW Wall (adjoining Plant building) **Note -** *Precast concrete wall based on BCA 2012* New envelope walls meet the R Value required.	Min R Value 1.8 (Shaded by more than 60 degrees) 200mm thick solid concrete, Density is >220kg/m³ Required Insulation Proposed Insulation	**Precast concrete wall (SW wall);** Outdoor Air Film R 0.04 200mm Precast concrete R 0.09 Airspace R 0.17 75mm Steel Stud R 0.0 Insulation *** 10mm Plasterboard R 0.06 Indoor Air Film R 0.12 Total R Value = R1.98 ***R 0.82 75mm glass wool batts R1.0
J1.6	**Floors** Slab on ground without in-slab heating or cooling	Nil.	

2.2 PART J2 – GLAZING

The new windows comply with the requirements of Section J Part J2. Refer to Glazing Calculator in appendix 1 of this report.

2.3 PART J3 – BUILDING SEALING

PART	DESCRIPTION	REQUIRED	PROVIDED
J3.1	Application of Part	This part is applicable	Refer to details below
J3.2	Chimneys and Flues	Not applicable	Not applicable
J3.3	Roof Lights	Not Applicable	Not Applicable
J3.4	Windows and Doors Seals are required, however not applicable where windows comply with AS2047. Seals are required to doors forming part of the envelope. Self closing doors	 No Yes Yes	 Compliance with AS2047 is required in the project Specification. Draft protection seals and nylon brush seals are required in the project Specification. Main entry door D20 is self closing.
J3.5	Exhaust Fans	Nil – no exhaust fans are provided to conditioned space.	Not applicable
J3.6	Construction of roofs, walls and floors	These elements need to be constructed to minimise air leakage when forming part of the envelope of a conditioned space.	Standard construction techniques are shown on construction drawings and will satisfy this requirement. Compliance with this requirement can be verified on site.
J3.7	Evaporative Coolers	Nil	Not applicable

2.4 PART J4 – DELIBERATELY LEFT BLANK IN BCA 2012

2.5 PART J5 – AIR CONDITIONING AND VENTILATION SYSTEMS

Refer to the Mechanical Engineers design certificate attached in appendices to this report for compliance with Part J5.

The selected mechanical contractor is to provide a design certificate that confirms compliance with the requirements of Part J5.

2.6 PART J6 – ARTIFICIAL LIGHTING AND POWER

Refer to the Electrical Engineers design certificate attached in appendices to this report for compliance with Part J6.

2.7 PART J7 – HOT WATER SUPPLY

There is an electric 50L storage hot water unit to supply hot water to the amenities and kitchenette. Refer to the Hydraulic Engineers documentation for information on the selected hot water system.

2.8 PART J8 – ACCESS FOR MAINENANCE

PART	DESCRIPTION	REQUIRED	PROVIDED
J8.1	Application of Part	Applicable	Refer to details below.
J8.2	Access for maintenance must be provided to all plant, equipment and components that require maintenance including a) adjustable or motorised shading devices b) time switches and motion detectors c) room temperature thermostats d) plant thermostats such as on boilers and refrigeration units e) motorised air dampers and control valves f) reflectors lenses and diffusers of light fittings g) heat transfer equipment.	 a) N/A b) Yes c) Yes d) Yes e) Yes f) Yes g) Yes	Where required access will be achieved via standard maintenance measures
J8.3	Facilities for energy monitoring	Not applicable	

3.0 CONCLUSION

This assessment is based on the drawings provided to the Hunter Treatment Alliance for ICT.

This report has summarised the measures shown on the submitted documents and demonstrates that the performance requirements of Section J of the Building Code of Australia can be achieved by the project.

Appendix 1 – BCA Volume one Glazing Calculator

BCA VOLUME ONE GLAZING CALCULATOR (first issued with BCA 2012)

Building name/description	Application	Climate zone
KIWS Education Annex	**other**	**5**

Storey: **1**

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		**108m²**		**35m²**				**35.5m²**	**159m²**
Option B									*n/a*
Glazing area (A)		*38.6m²*		*2.45m²*				*8.64m²*	*13m²*

Number of rows preferred in table below **12** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total U-Value (AFRC)	SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	W21	NE		2.40	4.80		4.3	0.45	1.800	3.220	0.56	0.82	0.97	0.88	11.52	33% of 100%
2	W22	NE		2.85	0.60		6.0	0.37	3.020	2.850	1.06	0.00	0.06	0.33	1.71	1% of 100%
3	W24	NE		2.40	6.00		4.3	0.45	1.800	3.220	0.56	0.82	0.97	0.88	14.40	41% of 100%
4	W25	internal		1.67	2.00		3.5	0.61			2.00	0.00	0.64	0.54	3.34	25% of 10%
5	W26	internal		1.67	3.00		3.5	0.61			2.00	0.00	0.64	0.54	5.01	38% of 10%
6	W27	internal		1.67	3.00		3.5	0.61			2.00	0.00	0.64	0.54	5.01	38% of 10%
7	D20	NE		2.40	1.54		5.9	0.65	2.660	2.700	0.99	0.30	0.64	0.49	3.70	8% of 100%
8	D21	NW		2.40	1.52		5.9	0.65	*2.500*	4.440	*0.00*	*2.04*	*1.00*	*1.00*	3.65	51% of 87%
9	D28	SE		2.40	1.02		5.9	0.59	1.800	3.840	0.47	1.44	0.97	0.95	2.45	100% of 20%
10	D29	NE		2.40	1.20		4.4	0.50	1.800	3.220	0.56	0.82	0.97	0.88	2.88	9% of 100%
11	D20 sidelights	NE		2.40	1.82		4.3	0.60	2.660	2.700	0.99	0.30	0.64	0.49	4.37	9% of 100%
12	D21 Sidelights	NW		2.40	2.08		4.3	0.46	*2.500*	4.440	*0.00*	*2.04*	*1.00*	*1.00*	4.99	49% of 87%

if inputs are valid

ELECTRICAL PROJECTS AUSTRALIA Pty Limited

386 Maitland Road Mayfield 2304 NSW
PO Box 365 Mayfield 2304 NSW
p: (02) 4967 5999 f: (02) 4967 5933
e: mail@electricalprojectsaustralia.com.au
ABN 72 053 112 502

16 November 2012

Quinn O'Hanlon Architects
PO Box1813
NEWCASTLE
NSW 2300

Attention: Mt T Hulme

Dear Sir,

Re: KIWS ADUCATION ANNEXE
CERTIFICATE OF DESIGN – ELECTRICAL

SUBJECT PREMISES CHANNEL ROAD, KOORAGANG

Pursuant to the provisions of **Clause A2.2 of the national Construction Code,** I hereby certify that the above design is in accordance with normal engineering practice and meets the requirements of the National Construction Code, Part 7 of the Environmental Planning and Assessment Regulations, relevant Australian Standards and relevant conditions of Development Consent. In particular the design is in accordance with the following:

NCC E4.2, E4.4 and AS 2293.1 – Emergency Lighting
NCC E4.5, E4.7 & E4.8 and AS 2293.1 – Exit Lighting
AS1680 – Interior Lighting
NCC Part J6 and J8
NCC E2.2a, E2.2b and AS1670.1 – Smoke Detection and Alarm Systems
AS/NZS 1158.3.1 – External Lighting

I am an appropriately qualified and competent person in this area and as such can certify that the design and performance of the design systems comply with the above and which are detailed on the following drawings.

12190-E00 COVER SHEET
12190-E01 POWER LAYOUT
12190-E02 LIGHTING LAYOUT
12190-E03 SINGLE LINE AND CONTROL DIAGRAM.

I possess Indemnity Insurance to the satisfaction of the building owner or my principal.

Full Name of Designer: Paul Malanchuk
Qualifications: B.E (Electrical)
Address of Designer: 386 Maitland Road, Mayfield
Business Telephone No: 02) 4967 5999 Fax No: 02) 4967 5933
Name of Employer: Electrical Projects Australia

Yours faithfully,

Paul Malanchuk
Director

MECHANICAL SERVICES
REFRIGERATION
VENTILATION
DUST EXTRACTION

Edwards & Vickerman Consulting Engineers Pty Ltd
156 Bruce Street, Cooks Hill, NSW 2300
Telephone: (02) 4929 3334
Facsimile: (02) 4943 3434

21st November 2012

C/O Troy Zwart
QUINN O'HANLON ARCHITECTS PTY LTD
Lower Ground Floor, T & G Building,
41-45 Hunter Street,
NEWCASTLE, NSW2300

Dear Sir,

Re: KIWS – EDUCATION ANNEX , MAYFIELD WEST
CERTIFICATE OF DESIGN – MECHANICAL SERVICES

Pursuant to the provisions of **Clause A2.2 of the Building Code of Australia,** I hereby certify that the above design is in accordance with normal engineering practice and meets the requirements of the Building Code of Australia, Part 7 of the Environmental Planning and Assessment Regulations, relevant Australian Standards and relevant conditions of Development Consent. In particular the design is in accordance with the following:

The Building Code of Australia BCA 2012
AS1668.1
AS1668.2
Section J Part 5 & J8 of the BCA 2012

I am an appropriately qualified and competent person in this area and as such can certify that the design and performance of the design systems comply with the above and which are detailed on the following drawings.

M-00	LEGEND, NOTES & DRAWING LIST
M-01	HVAC LAYOUT, EQUIPMENT SCHEDULES & FUNCTIONAL CONTROL DESCRIPTIONS
M-02	DETAILS & SINGLE LINE DIAGRAM

Edwards & Vickerman Consulting Engineers Pty Ltd possesses Indemnity Insurance to the satisfaction of the building owner or my principal.

Full Name of Designer: **Jonathan Vickerman**
Qualifications: **M.A.I.R.A.H**
Name of Employer: **EDWARDS & VICKERMAN CONSULTING ENGINEERS PTY LTD**

Yours faithfully,

J. Vickerman

Jonathan Vickerman
Managing Director

McCALLUM PFCA
PLUMBING & FIRE CONSULTANTS AUSTRALIA

PO Box 96 Charlestown NSW 2290
PHONE: 02 4946 2633
FACSIMILE: 02 4946 2611
EMAIL: rob@pfca.net.au
Suite 5 / 35 Smith Street Charlestown

Date: 21 November, 2012
Reference no: 1984-712U

Quinn O'Hanlon Architects
NSW 2300
PO BOX 1813, NEWCASTLE

ATTENTION: Tim Hulme

Certificate of Design: Fire Hydrant, Fire Hose Reel and Hydraulic Services

Subject Premises: Kooragang Education Annex

We McCallum Plumbing & Fire Consultants Australia being Hydraulic services design consultants hereby certify that this office is responsible for the Hydraulic, Window Drencher and Fire Hose Reel service design of the building work shown on Drawing 15270 (Revision 0), Drawing 15271 (Revision 0) and Drawing 15272 (Revision 0) and that this work was designed in accordance with the relevant provisions of the standard building codes and SAA codes as listed below, and in accordance with accepted engineering practice and principles.

- BCA Clause E1.4 - Fire Hose Reels
- BCA Clause J7.2 - Hot Water Supply
- AS 2441 – 2005 - Installation of Fire Hose Reels
- AS/NZS 3500 - Plumbing & Drainage
- AS 2118.2 – 2010 – Automatic Fire Sprinkler Systems Part 2: Drencher Systems.

The compliance of the hydrant system is by others. This certificate covers the location of the fire hydrant providing protection to the Education Annex in accordance with the requirements of the following standard.

- AS 2419.1 – 2005 - Fire Hydrant Installations Part 1: System Design, Installation and Commissioning

Sincerely,

Robert McCallum (Director)
ASSOC.DIP. ENG.(PLUMB.), M.AHSCA, OMIE*Aust* CEngO

Water Utilities Australia
Kooragang Water

Kooragang Water Pty Ltd

WIC Act licence application

13 April 2022

Attachment 40:

BRU Upgrade Concept Report

KWIS Expansion

Final TOC Design Report

Document No: 184-SE-GE-000-ML-003

May 2020

DOCUMENT REVISION HISTORY

Rev.	Description	Reviewed By	Review Date	Approved By	Approval Date
A					
B					
C					
D					

TABLE OF CONTENTS

INTRODUCTION

PURPOSE OF REPORT

This Design Report (DR) is prepared per the KIWS Expansion Preliminary Design & TOC Development Scope of Works Feb 2020, which requires the preparation of a DR to provide design information obtained during the completion of the TOC process. The DR was prepared by SUEZ Water Ltd on behalf of Water Utilities Australia (WUA). The DR provides a basis on which the TOC (Target Outturn Cost) for the project was estimated.

REFERENCE DOCUMENTATION

In addition to this report the following documentation was used as the basis of design.

- Appendix A: RFI information provided by WUA
- Appendix B: Project Technical Requirements (NOW SUPERSEDED BY THIS TOC DESIGN REPORT)

SCOPE OF WORK FOR KIWS DESIGN

The Scope of Work (SOW) for the KIWS Expansion is summarised below and comprises of two separable portions includes the following key items:

(SEPARABLE PORTION A)

Design of a Brine Recovery unit (BRU) to treat up to 1.5MLD of the brine produced from the existing KIWS RO. The BRU product water is then added to the existing RO feed tank for retreatment by the existing KIWS AWRP RO units. This aims to increase the overall plant production capacity to a maximum of 10.5MLD, subject to the influent flows from Shortland WTTW being sufficient.

(SEPARABLE PORTION B)

Design of a second Product Water Tank (PWT No. 2) to provide additional redundancy for the plant.

SCOPE EVOLUTION AND CLARIFICATIONS

A summary of the scope development or change from the original offer submitted to WUA on the 31st Jan 2020 and the Project Technical requirements submitted on the 25/03/2020 and approved by WUA on 8/04/2020 in the response to RFI#4 (184-SE-PM-000-IR-004) to the design freeze milestone of May 2020 is provided in KIWS Expansion Project - Exclusions_Clarifications Register (184-SEV-CM-000-LI-002). Note: The previously submitted PTR is not superseded by this TOC Design Report.

SEPERABLE PORTION A

DESIGN INPUTS

The Process Flow Diagram in Appendix C Drawings shows the updated process as a result of the KIWS Expansion. The following design inputs have been used to design the BRU treatment process.

HYDRAULIC DESIGN

Based on the information provided by WUA, the maximum daily production capacity of the existing KIWS is 9 MLD. This production capacity is dependent on the availability of secondary treated effluent provided from Shortland WWTW (Owned and Operated by Hunter Water). Based on this information the hydraulic design of the BRU is as detailed in Table 1 below.

Table 1 Summary of the Proposed Design Capacity of the BRU

DESCRIPTION	CAPACITY (MLD)	NUMBER OF BRU IN OPERATION
Nominal Capacity	1.5	2 BRU online
Minimum Capacity	0.75	1 BRU online 1 BRU offline (for a recovery clean ~12 hours)
Zero Production	0	2 BRU offline

Table 2 Summary of the BRU in operation compared to the existing RO trains

Description	Number of Existing RO Trains in Operation	Number of BRU in Operation
Nominal Capacity	3 or 4 online	2 BRU online
Minimum Capacity	2 online	1 BRU online 1 BRU offline (for a recovery clean ~12 hours)
Zero Production	0 online	2 BRU offline

HYDRAULIC CAPACITY OF THE EXISTING RESIDUAL HANDLING SYSTEM

The existing KIWS treatment plant discharges brine produced by the RO trains to the sewer network off site which is a sub-system that eventually leads to the Burwood Beach WWTW. This sub system is currently hydraulically limited to accept up to 50 L/s of instantaneous flow (4.32 MLD) from the existing KIWS plant.

As a result of the installation of the BRUs under the KIWS expansion plant, the instantaneous brine flow produced by the plant is significantly reduced when the BRU is in operation to a maximum of 1.5 MLD. As such, Burwood Beach WWTW will not be affected hydraulically by the Expansion project.

The option remains to divert the existing RO trains brine directly to the sub-system rather than processing through the new BRUs.

WATER QUALITY TARGETS

The water quality targets for the BRU permeate are based on the existing contractual limits established in the water supply contract between WUA and Orica.

It should be noted that these water quality targets and any associated guarantees are outside SUEZ's contractual obligations under all phases of the KIWS Expansion Project.

The treated water targets for this scheme are summarised below in Table 3 below.

Table 3 Summary of the existing Water Quality Targets between WUA and Orica

	ASSESSABLE PARAMETER	UNITS	50%ILE	90%ILE	MAX
1	TDS	mg/L		<50	
2	Chloride	mg/L		<15	
3	Calcium	mg/L		<5	
4	pH	mg/L		5.5 - 7.5	
5	Total Hardness	mg/L $CaCO_3$		<10	30
6	M Alkalinity	mg/L $CaCO_3$		<20	
7	Total Silica (SiO_2)	mg/L		<2	
8	Iron	mg/L		<0.015	
9	Copper	mg/L		<0.05	0.1
10	Total N	mg/L N	<1.8	<2.5	
11	Ammonia (free)	mg/L N		<0.5	
12	Faecal Coliforms	col/100mL		Not Detectable	
13	Somatic Coliphage	-		Not Detectable	

14	Cryptosporidium	No./50L		Not Detectable	
15	TOC	mg/L C		<1	
16	Total Phosphorus	mg/L P		<0.05	
17	TSS	mg/L		<2	
18	Chloramine	mg/L		<0.5	1
19	Aluminium	mg/L		<0.1	
20	Temperature	°C		<27	27
21	Potassium	mg/L		<3	
22	Zinc	mg/L		<0.2	
23	Fluoride	mg/L		<0.1	
24	Sulphate	mg/L		<5	
25	Carbon dioxide	mg/L		<5	
26	Sodium	mg/L		<15	
27	Hexavalent Chromium	mg/L		<0.002	
28	Arsenic	mg/L		<0.002	

These water quality targets have been used as the design basis to identify the required water quality of the BRU permeate such that there is no risk to WUA in maintaining their contractual water quality requirement to Orica. In order to consistently meet these contractual water quality parameters, an evaluation of the process risks was undertaken using SUEZ WTS proprietary RO projection software.

This assessment evaluated two scenarios to achieve the 90th%tile water quality stated in table 3 above, those being:

A) The existing RO permeate at a max of 9 MLD blended directly with BRU permeate at a max of 1.5MLD.
B) The BRU permeate blended with MF filtrate in the RO feed tank and retreated via the existing RO trains to produce a max of 10.5 MLD.

The RO water quality projections indicated that under scenario A, there is a significant risk of producing noncompliant final product water, mainly on the parameter of TDS. In order to mitigate this risk, Scenario B was selected for as the basis of design.

BRU INLET WATER QUALITY REQUIREMENTS

In order to establish the BRU inlet water quality (i.e. the existing RO trains combined brine quality), operational data of the inlet quality to the existing RO trains between 2017 and 2020 was used as inputs to the RO projection software. The minimum and maximum inlet water quality conditions used to design the BRU are included in Table 4 below.

Table 4 Inlet Water Quality to the existing RO trains

PARAMETER	UNITS	MIN	MAX
Calcium	mg/L	25.5	34.10
Magnesium	mg/L	8.31	12.89
Sodium	mg/L	70	108.00
Potassium	mg/L	12.8	22.90
Ammonia - N (NH4)	mg/L	0.5	2.20
Barium	mg/L	0.01	0.01
Strontium	mg/L	0.18	0.18
Iron	mg/L	0.04	0.04
Manganese	mg/L	0	0.00
Sulphate	mg/L	51	83.00
Chloride	mg/L	96.4	147.96
Fluoride	mg/L	0.51	0.82
Nitrate	mg/L	20	37.10
Bromide	mg/L	0	0.00
Phosphate as O-PO_4	mg/L	2	12.87
Boron	mg/L	0.1	0.12
Silica	mg/L	5	10.60
Hydrogen Sulphide	mg/L	0	0.04

Bicarbonate	mg/L	60	87.43
Carbon Dioxide	mg/L	TBC	TBC
Carbonate	mg/L	TBC	TBC
TDS	mg/L	356.6	558.00
Temperature	°C	15 -30	15 -30
pH	-	6.3	7.00
Conductivity at 25°C	µS/cm	676	913.00
Monochloramine	mg/L as Cl_2	0.6	0.5 to 1.5

Using the above information, projections were conducted to determine the expected RO brine concentrations at min and 90th%tile conditions at minimum expected temperate of 14°C and a high of 30° with a membrane life of 0 years and 5 years to establish the full range of BRU feed water quality as contained in Table 5 below.

Table 6 below contains the projected BRU permeate quality using the brine concentrations discussed above. Projects were again carried out at minimum expected temperate of 14°C and a high of 30° at a membrane life of 0 years and 5 years to establish the full range of BRU permeate water quality. Over the range of operating conditions, certain parameters in the BRU permeate feed were projected to be at the upper limit of the required final water quality. Specifically, for TDS <50mg/L, chloride <15mg/L and Ammonia <0.5mg/L.

At this upper limit blending 1.5 MLD of BRU permeate directly with 9MLD of existing RO permeate, there is a risk of producing water outside of the water quality targets required by Orica from WUA. As such projections were repeated on a blend of MF filtrate and BRU permeate followed by retreatment through the existing RO trains. This solution as previously discussed provides the least risk to the product water quality as shown in Table 7 below.

Table 5 Feed Water Quality to Brine Recovery Unit (BRU) i.e. Projected Brine water quality from existing RO trains

MINIMUM						90%ile			
Parameter	Units	14 °C / 0 Yrs.	14 °C / 5 Yrs.	30 °C / 0 Yrs.	30 °C / 5 Yrs.	14 °C / 0 Yrs.	14 °C / 5 Yrs.	30 °C / 0 Yrs.	30 °C / 5 Yrs.
Calcium	mg/L	102.06	102.04	102.37	101.95	137.01	136.34	136.79	136.60
Magnesium	mg/L	33.25	33.25	33.35	33.22	51.81	51.55	51.74	51.66
Sodium	mg/L	280.08	279.97	280.87	279.56	433.86	431.66	432.87	432.49
Potassium	mg/L	51.17	51.12	51.28	50.94	91.98	91.47	91.51	91.58
Ammonia - N (NH4)	mg/L	1.99	1.98	1.98	1.96	8.75	8.67	8.55	8.63
Barium	mg/L	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Strontium	mg/L	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Iron	mg/L	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Manganese	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sulphate	mg/L	204.16	204.17	204.83	204.07	380.59	378.93	370.13	369.29
Chloride	mg/L	418.67	418.74	420.11	418.51	604.30	601.54	603.83	602.76
Fluoride	mg/L	2.04	2.03	2.04	2.03	3.31	3.30	3.32	3.31
Nitrate	mg/L	79.97	79.92	80.17	79.73	149.12	148.39	148.57	148.53
Bromide	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Phosphate as O-PO_4	mg/L	7.99	7.98	8.01	7.97	51.83	51.62	51.89	51.76
Boron	mg/L	0.26	0.22	0.19	0.16	0.32	0.27	0.20	0.23
Silica	mg/L	19.95	19.91	19.96	19.80	42.45	42.17	42.12	42.21
Hydrogen Sulphide	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bicarbonate	mg/L	236.81	236.31	236.77	235.01	272.24	269.82	280.91	282.19
Carbon Dioxide	mg/L	62.68	62.55	50.76	51.58	38.70	38.38	33.12	32.52
Carbonate	mg/L	0.08	0.08	0.11	0.11	0.18	0.18	0.25	0.26
TDS	mg/L	1439.40	1438.64	1442.96	1435.94	2228.67	2216.83	2223.60	2222.42
Flow	m3/hr/skid	46.80	46.80	46.80	46.80	62.34	62.34	62.34	62.34
Temperature	°C	14.00	14.00	30.00	30.00	14.00	14.00	30.00	30.00

Pressure	kPa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Osm. Pressure	kPa	0.86	0.86	0.90	0.90	1.25	1.25	1.32	1.32
pH	-	6.78	6.78	6.77	6.76	7.03	7.03	7.01	7.02
Conductivity at 25C	µS/cm	2250.00	2249.00	2255.00	2246.00	3304.00	3288.00	3297.00	3294.00

Table 6 Projected BRU Permeate Water Quality

		MINIMUM				90%ILE			
Parameter	Units	**14 °C / 0** Yrs.	14 °C / 5 Yrs.	30 °C / 0 Yrs.	30 °C / 5 Yrs.	14 °C / 0 Yrs.	14 °C / 5 Yrs.	30 °C / 0 Yrs.	30 °C / 5 Yrs.
Calcium	mg/L	0.19	0.29	0.35	0.55	0.17	0.27	0.33	0.51
Magnesium	mg/L	0.05	0.07	0.09	0.14	0.06	0.10	0.11	0.17
Sodium	mg/L	3.40	5.29	6.27	9.58	4.57	7.06	8.41	12.90
Potassium	mg/L	1.30	2.00	2.36	3.55	2.04	3.13	3.67	5.58
Ammonia - N (NH_4)	mg/L	0.09	0.13	0.15	0.22	0.22	0.33	0.39	0.60
Barium	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Strontium	mg/L	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Iron	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sulphate	mg/L	0.41	0.64	0.72	1.12	0.58	0.90	1.02	1.58
Chloride	mg/L	4.10	6.39	7.47	11.44	5.66	8.76	10.22	15.70
Fluoride	mg/L	0.04	0.07	0.08	0.12	0.08	0.12	0.12	0.17
Nitrate	mg/L	1.52	2.36	2.78	4.21	2.47	3.81	4.49	6.85
Bromide	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Phosphate	mg/L	0.17	0.26	0.30	0.46	0.96	1.48	1.71	2.61
Boron	mg/L	0.15	0.15	0.15	0.13	0.17	0.17	0.14	0.19
Silica	mg/L	0.34	0.52	0.63	0.97	0.57	0.89	1.07	1.66
Hydrogen Sulphide	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bicarbonate	mg/L	3.94	5.21	6.17	8.71	4.18	5.56	6.91	9.93
Carbon Dioxide	mg/L	135.49	135.39	116.01	115.95	134.79	133.80	121.86	122.15
Carbonate	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDS	mg/L	15.70	23.39	27.53	41.19	21.74	32.57	38.60	58.46
Flow	m3/hr (per Skid)	23.39	23.41	23.40	23.39	31.17	31.16	31.16	31.15
Temperature	°C	14.00	14.00	30.00	30.00	14.00	14.00	30.00	30.00
Pressure	kPa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Osm. Pressure	kPa	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.11
pH	-	4.74	4.86	4.90	5.05	4.77	4.89	4.93	5.08
Conductivity at 25°C	µS/cm	31.00	43.00	49.00	71.00	41.00	57.00	67.00	98.00

Table 7 Retreated Final Water Quality Min, and continued the next page 90%tile for information only

	MINIMUM					
Parameter	Units	Target as Product	14 °C / 0 Yrs.	14 °C / 5 Yrs.	30 °C / 0 Yrs.	30 °C / 5 Yrs.
Calcium	mg/L	< 5	0.04	0.06	0.07	0.11
Magnesium	mg/L	N/A	0.01	0.02	0.02	0.03
Sodium	mg/L	< 15	0.52	0.82	0.96	1.49
Potassium	mg/L	< 3	0.20	0.31	0.37	0.57

Ammonia - N (NH4)	mg/L	< 0.5	0.01	0.02	0.03	0.04
Barium	mg/L	N/A	0.00	0.00	0.00	0.00
Strontium	mg/L	N/A	0.00	0.00	0.00	0.00
Iron	mg/L	< 0.015	0.00	0.00	0.00	0.00
Manganese	mg/L	N/A	0.00	0.00	0.00	0.00
Sulphate	mg/L	N/A	0.06	0.09	0.11	0.17
Chloride	mg/L	< 15	0.55	0.86	1.01	1.57
Fluoride	mg/L	< 0.1	0.01	0.01	0.01	0.02
Nitrate	mg/L	< 2.5	0.24	0.37	0.43	0.67
Bromide	mg/L	N/A	0.00	0.00	0.00	0.00
Phosphate	mg/L	< 0.05	0.03	0.04	0.04	0.07
Boron	mg/L	N/A	0.06	0.07	0.08	0.09
Silica	mg/L	< 2	0.07	0.10	0.12	0.19
Hydrogen Sulphide	mg/L	N/A	0.00	0.00	0.00	0.00
Bicarbonate	mg/L	N/A	1.75	1.98	2.11	2.58
Carbon Dioxide	mg/L	< 5	61.66	61.92	50.20	50.57
Carbonate	mg/L	< 5	0.00	0.00	0.00	0.00
TDS	mg/L	< 50	3.54	4.77	5.36	7.59

90%ile						
Parameter	Units	Target as Product	14 °C / 0 Yrs.	14 °C / 5 Yrs.	30 °C / 0 Yrs.	30 °C / 5 Yrs.
Calcium	mg/L	< 5	0.05	0.08	0.09	0.14
Magnesium	mg/L	N/A	0.02	0.02	0.03	0.04
Sodium	mg/L	< 15	0.90	1.40	1.65	2.56
Potassium	mg/L	< 3	0.39	0.61	0.72	1.12
Ammonia - N (NH_4)	mg/L	< 0.5	0.06	0.09	0.12	0.18
Barium	mg/L	N/A	0.00	0.00	0.00	0.00
Strontium	mg/L	N/A	0.00	0.00	0.00	0.00
Iron	mg/L	< 0.015	0.00	0.00	0.00	0.00
Manganese	mg/L	N/A	0.00	0.00	0.00	0.00
Sulphate	mg/L	N/A	0.11	0.17	0.19	0.30
Chloride	mg/L	< 15	0.99	1.55	1.80	2.81
Fluoride	mg/L	< 0.1	0.01	0.02	0.02	0.03
Nitrate	mg/L	< 2.5	0.47	0.74	0.87	1.34
Bromide	mg/L	N/A	0.00	0.00	0.00	0.00
Phosphate	mg/L	< 0.05	0.15	0.23	0.26	0.41
Boron	mg/L	N/A	0.07	0.09	0.10	0.10
Silica	mg/L	< 2	0.14	0.22	0.27	0.41
Hydrogen Sulphide	mg/L	N/A	0.00	0.00	0.00	0.00
Bicarbonate	mg/L	N/A	1.67	2.08	2.39	3.26
Carbon Dioxide	mg/L	< 5	35.09	35.25	29.38	29.59

Carbonate	mg/L	< 5	0.00	0.00	0.00	0.00
TDS	mg/L	< 50	5.03	7.30	8.52	12.70
Flow	m3/hr/skid		109.48	109.34	109.40	109.46
Temperature	°C	< 27	14.00	14.00	30.00	30.00
Pressure	kPa	N/A	0.00	0.00	0.00	0.00
Osm. Pressure	kPa	N/A	0.02	0.02	0.02	0.03
pH	-	5.5 - 7.5	4.96	5.05	5.09	5.22
Conductivity at 25C	μS/cm	< 30	11.00	14.00	16.00	22.00

Table 8 BRU Brine quality Minimum and 90%tile for Information only

		MINIMUM				90%ile			
Parameter	Units	14 °C / 0 Yrs.	14 °C / 5 Yrs.	30 °C / 0 Yrs.	30 °C / 5 Yrs.	14 °C / 0 Yrs.	14 °C / 5 Yrs.	30 °C / 0 Yrs.	30 °C / 5 Yrs.
Calcium	mg/L	203.84	203.87	204.35	203.27	273.82	272.34	273.18	272.52
Magnesium	mg/L	66.42	66.45	66.60	66.28	103.55	102.98	103.34	103.08
Sodium	mg/L	556.49	554.89	555.36	549.32	863.07	856.04	857.10	851.55
Potassium	mg/L	101.00	100.28	100.16	98.29	181.90	179.76	179.30	177.47
Ammonia - N (NH4)	mg/L	3.89	3.83	3.81	3.70	17.28	17.00	16.70	16.65
Barium	mg/L	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Strontium	mg/L	1.44	1.44	1.44	1.43	1.44	1.44	1.44	1.43
Iron	mg/L	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Manganese	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sulphate	mg/L	569.78	569.74	554.07	549.72	989.14	983.45	951.49	950.89
Chloride	mg/L	832.85	831.45	832.56	825.26	1202.84	1194.02	1197.12	1189.08
Fluoride	mg/L	4.03	4.00	4.00	3.94	6.54	6.48	6.52	6.44
Nitrate	mg/L	158.34	157.55	157.51	155.19	295.74	292.90	292.57	290.03
Bromide	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Phosphate	mg/L	15.80	15.70	15.71	15.47	102.69	101.74	102.04	100.85
Boron	mg/L	0.37	0.29	0.23	0.19	0.47	0.37	0.26	0.27
Silica	mg/L	39.55	39.31	39.28	38.62	84.32	83.43	83.14	82.71
Silica	mg/L	39.55	39.31	39.28	38.62	84.32	83.43	83.14	82.71
Hydrogen Sulphide	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Bicarbonate	mg/L	266.35	264.50	285.42	281.98	270.67	266.59	305.95	303.28
Carbon Dioxide	mg/L	136.52	136.22	116.82	116.58	137.30	136.06	124.21	124.25
Carbonate	mg/L	0.05	0.05	0.08	0.07	0.05	0.05	0.08	0.08
TDS, mg/l	mg/L	2820.60	2813.77	2820.97	2793.13	4393.93	4358.99	4370.63	4346.76
Flow	m3/hr/skid	23.41	23.39	23.40	23.41	31.17	31.18	31.18	31.19
Temperature	°C	14.00	14.00	30.00	30.00	14.00	14.00	30.00	30.00
Pressure	kPa	5.55	9.05	3.59	5.52	7.59	12.34	4.95	7.55
Osm. Pressure	kPa	1.63	1.63	1.71	1.70	2.42	2.40	2.54	2.53
pH	-	6.46	6.46	6.45	6.45	6.43	6.43	6.43	6.43
Conductivity at 25°C	µS/cm	4210.00	4202.00	4209.00	4172.00	6158.00	6115.00	6129.00	6096.00

REJECT STREAM QUALITY

The proposed concentrations of selected pollutants in the BRU brine stream are compared with the current Trade Waste Limits and summarised below in 9. It can be seen that as a result of reconcentrating the original brine stream the final pollutants whilst lower in volume exceed some of the existing trade waste limits. Both TDS and Total nitrogen current limits are exceeded in the BRU reject stream. As such WUA has provided these new expected maximum concentration limits and the Trade Water Agreement between WUA and Hunter Water has been amended as shown below. The RO concentrate will continue to be discharged to the Waratah Catchment which contributes to the Burwood Beach WWTW.

No additional work has been conducted to determine the impact of additional sulphate on the downstream sewerage system with regards to odour. It should be noted that the sulphate concentration of the BRU brine stream around 1000mg/L of SO_4. Whilst this is double the existing brine, with a sulphate concentration of 490mg/L the mass loading with regards to sulphate is similar.

Therefore, no allowance is made in the TOC design for H_2S control at the downstream sewerage system.

The resulting brine TDS from the BRU is in the order of 4,450mg/L as the 90%tile compared to 2,260mg/L currently. On a mass load basis this is similar to that discharged currently to Burwood Beach WWTW.

Table 9 Comparison of the Potential Concentrations of Assessable Pollutants in the existing Backwash and Brine Streams Concentrate Against HWCs Current Trade Waste Limits.

Assessable Pollutant	Current Trade Waste Concentration Limit	Current Trade Waste Maximum Daily Mass based on 3 ML/d	Expected Maximum Concentration in Concentrate (New BRU 1.5 MLD)	Amendment to Trade Waste Concentration Limit	Amendment Trade Waste Maximum Daily Mass based on 3 ML/d
Biochemical Oxygen Demand	500 mg/L	1500 Kg/d	N/A	N/A	N/A
Total Suspended Solids	500 mg/L	1500 Kg/d	N/A	N/A	N/A
Total Dissolved Solids	4,000 mg/L	12,000 Kg/d	4,356 mg/L	5,000 mg/L	
Ammonia as N	50 mg/L	150 Kg/d	22 mg//L	N/A	N/A

Total Kjeldahl Nitrogen as N	150 mg/L	450 Kg/d	17 mg/L	N/A	N/A
Total Phosphorus as P	20 mg/L	60 Kg/d	34 mg/L	40 mg/L (as P)	N/A
pH	6.5 -10	6.5 -10	6.4 (maybe lower)	6 – 10	6 – 10

LOG REMOVAL VALUES (LRV)

It is anticipated that there will be no change to the existing LRV credits. Noting that the addition of the BRU does not provide any additional LRV credits to KIWS.

PROCESS OVERVIEW OF THE BRINE RECOVERY UNIT

Updated TOC submission ACMMs are included in Appendix D.

The BRU system is designed to produce a nominal capacity of 1.5ML/d of permeate over any 24-hour period this does not include a recovery clean of the BRU membranes.

During recovery cleans and maintenance periods the BRU will be turned off and zero additional production will occur. Where possible recovery cleans, and planned maintenance should be conducted at times when the main plant output capacity is less than 9MLD.

Chloramine Dosing Pre-BRU

In order to maintain a disinfection residual and prevent biofouling through the BRU, chloramine dosing will occur upstream of the low pressure pumps. The proposed BRU membranes are not chlorine tolerant and therefore no free chlorine is permitted to pass through to the BRU membranes. The chloramines are dosed at a target dose rate of 0.5 – 1.5 mg/L. Chloramine is formed in-situ and dosed into the plant upstream of the BRU process and is used instead of proprietary biocides. This chloramine dose is a top-up dose only to ensure the total chloramines to the BRU is around 2mg/L.

Carrier water is added to each separate chemical i.e. sodium hypochlorite and aqueous ammonia, these two diluted streams are then combined in a static mixer, to form chloramines on a new monochloramines dosing skid located in the existing sodium hypochlorite dosing bund.

Chloramine dosing rate is confirmed online prior to the low pressure pumps. The analyser monitors both chloramines and the free ammonia residual of the feed water using An online ORP meter will be used to continuously monitor the potential for free chlorine and stop feed to the BRU system if high ORP levels, indicative of free chlorine, are detected. The intention is to always maintain a free ammonia residual through the BRU plant to ensure that there is no free chlorine in the feed water which would oxidize the BRU membranes.

Anti-scalant Dosing Pre-BRU

The concentration of contaminants in brine can sometimes exceed solubility limits, which results in scaling of the membranes. To minimise this impact a proprietary anti-scalant is dosed prior to the BRU system. This will be the same anti-scalant already used on site.

The anti-scalant Hypersperse MDC714 is propriety chemical supplied by SUEZ WTS and is dosed at a target of 6.5 mg/L with a minimum dose of 2.7mg/l and maximum dose rate of 7.4mg/L.

Acid Dosing Pre-BRU

A complementary method of scaling control is to dose acid into the BRU feed with the intent to control the brine pH to limit $CaCO_3$ scaling potential.

An acid dose in the order of 115 mg/L has been incorporated into the design to allow the brine pH to be adjusted to 6.2 and reduce the concentrate stream LSI.

In order to reduce scaling of the BRU membranes Sulphur acid dosing occurs upfront of the BRU.

Carrier water is added to the sulphuric acid to dilute to reduce health and safety issues with acid dosing around site. The sulphuric acid is dosed to achieve a target pH of 6.2. The pH is monitored with an online pH meter.

BRU Inlet Sampling

Following discharge from the existing RO brine line, online analysis of the combined BRU inlet feed for the following parameters occurs:

- pH
- Conductivity
- Monochloramines
- Total Phosphorus

All the online analyzers are located on two wet racks. The pH, conductivity and chloramines are located on one wet rack located on one of the BRU skids. The total phosphorus analyzer has its own separate wet rack and is located next to the existing wet racks which sample the main RO plant.

LP BRU Feed Pumps

The LP BRU pumps transfer water from the RO Brine line through the cartridge filters and HP BRU Feed pumps into the BRU system.

The LP BRU Pumps are vertical, multistage centrifugal pump with inlet and outlet ports on same the level located inside the main process building. The pumps operate on a duty/duty basis. The LP BRU pumps are designed to provide enough head to pump through the cartridge filters and maintain a minimum of 2.5 bars suction head at the HP BRU Pumps. The pumps operate as variable speed units with their outputs controlled by the pressure in the suction of the BRU HP Pumps.

Table 10: BRU LP Feed Pumps Design Basis

PARAMETER	UNITS	VALUE
Pump		
Manufacturer	-	Grundfos
Model	-	CRNE 64-2-1
Number of pumps	No.	2
Number of duty pumps	No.	2
Number of standby pumps	No.	1 boxed spare
Nominal capacity per pump	m^3/hr	62.4
Head at duty point	Bars	3.5
Motor Power	kW	18.5
Type	-	vertical, multistage centrifugal pump

BRU Cartridge Filters

To mitigate the risk of solids being pumped into the BRU trains causing mechanical failure of the BRUs membranes cartridge filters have been included between the LP and HP BRU Feed pumps. There are 3 horizontally mounted cartridge filters units operating duty/duty/duty (operator adjustable).

Each cartridge filter consists of three 60” long cartridges that provide nominal filtration to 5 µm.

Table 11: BRU Cartridge Design Basis

Parameter	Units	Value
Cartridge Filter		
Manufacturer	-	SUEZ WTS
Model	-	HF.zS05-40-SE
Nominal filter pore size	µm	5
Number of cartridge filters	No.	3
Number of duty cartridge filters	No.	3
Number of standby cartridge filters	No.	0
Maximum capacity per cartridge filter	m^3/hr	23
Maximum pressure drop before cartridge replacement	Bars	3

Brine Recovery Unit

The BRU system allows pure water to pass through the membrane and retains the dissolved mineral salts, bacteria, and other particles no matter how fine. RO brine from the existing plant is forced through the RO membrane with a combined pump and cartridge configuration as shown below:

- Low pressure (LP) BRU feed pumps
- BRU Cartridge filters
- High pressure (HP) BRU feed pumps

The BRU system consists of a two-stage single pass system with no recirculation. The BRU system is designed to operate at an average flux of 16 Lm^2/hr. To satisfy the production requirements two parallel trains are required.

BRU REVERSE OSMOSIS MEMBRANES

The TOC design is based on WTS standard unit using AG-400, LF, 34 type, with a total of 18 housings and 108 elements in a 5:4 array.

BRU FLUX CONTROL

The BRU is made up of a series of RO membranes that are housed inside a pressure vessel. As the feed flows past the RO membranes the concentration of the salts on the feed side increases. As a result, the osmotic pressure along the vessel increases and the osmotic pressure in the second stage is higher than the first stage. However, the applied pressure at the first stage is higher than the second stage. Thus, the net driving force is higher in the first stage, and results in higher flux in the first stage. To balance the fluxes between stages there are several options available. An alternate option is to throttle permeate from the Stage 1. This equalises the driving pressure across the system and provides flux control for typical conditions. For the purposes of the TOC design a valve with lagging has been used however an orifice plate would also be suitable. It is recommended that any throttling equipment is lagged to reduce noise.

BRU ENERGY RECOVERY

There is no allowance for energy recovery scope in the Expansion TOC design.

HP BRU Feed Pumps

The HP BRU pumps provide the necessary increase in pressure to achieve the required osmotic pressure across both stages of the BRU RO membranes.

The HP BRU Pumps are vertical, multistage centrifugal pump located on the BRU skids. The pumps are arranged to provide a dedicated HP pump per BRU train. No online stand-by is provided, however boxed spare is provided to allow quick pump replacement in the event of a pump failure.

The pumps each operate with variable speed drives and are controlled based on the output flow rate of the relevant BRU train to which they are connected. There are several parameters that may alter the pump speed including:

1. No. of RO trains on-line
2. HP pump Inlet (suction) pressure
3. Fouling factor on the BRU membranes
4. Temperature of the treated water
5. Required flux across the BRU membranes

Table 12: BRU HP Feed Pumps Design Basis

PARAMETER	UNITS	VALUE
Pump		
Manufacturer	-	Grundfos
Model	-	CRN 95-8-2
Number of pumps	No.	2

Number of duty pumps	No.	2
Number of standby pumps	No.	1 (Boxed spare)
Nominal capacity per pump	m^3/hr	62.3
Minimum head at nominal capacity	Bars	4.1
Design head at nominal capacity	Bars	14.6
Maximum head at nominal capacity	Bars	16.3
Motor Power	kW	55
Type	-	vertical, multistage centrifugal pump

BRU System

Table 13 BRU Design Basis

DESCRIPTION	2 PRIMARY RO ONLINE	3 PRIMARY RO ONLINE
No. of BRU Operational	1	2
Feed flow per BRU	62.4m3/hr	46.8m3/hr
Inlet Pressure	250-300 kPa	250-300 kPa
Max Operating Pressure	1,500 kPa	1,100 kPa
Min Operating Pressure	900 kPa	600 kPa
Average Flux	15.5lmh	11.2lmh

The purified water passes through the membrane to process or second pass BRU units while the concentrated mineral salts are rejected to the low quality BRU Reject. The MWAWTP BRU system comprises of the 2 trains at Stage 1 and 2 trains at Stage 2.

- Note: It is not the design intent to claim any LRV from the BRU system.

BRU Flushing

On a shutdown it is necessary to remove the brine from the BRU membranes immediately. In order to remove the brine the BRU undergoes a flush using a volume of approximately 2.1 m³ per train of RO permeate stored in the degas sump. Each BRU train is flushed for approximately 3 mins to remove any salts deposited on the membranes.

The intent of the KIWS expansion project is to use the existing RO Flush Pumps to carry out the BRU flushes. The existing RO flush pumps are dry-mounted end-suction centrifugal pumps operating fixed speed in a duty/stand-by arrangement. They are located alongside the CCT Feed pumps and Process Water pumps within a sound-proofing enclosure by the Degas Sump.

There are several situations where a BRU flush cycle needs to be initiated. Typically, it will occur as a BRU train is taken off-line when less than 2 RO trains are in operation. However, consideration for a site power failure event was incorporated into the original KIWS project. As such one of the RO Flush pumps is powered by a diesel engine. Control of the pump is via the site switchboard, as per all other pumps, but it can operate a complete flush cycle for all RO trains and BRU trains in the event of a power failure. Its fuel tank is a double-contained 80L vessel that will provide one month's service between re-fills based on an operating philosophy currently in place.

The required flush flow rate for the BRU trains is significantly lower than that provided by the existing RO flush pumps. As such a recirculation line will be installed under the expansion project. This will enable the flush flow to the BRU trains to be limited to the required flow rate.

The design basis for the RO Flush pumps is shown in Table 14:

Table 14: RO Flush Pumps Design Basis

PARAMETER	UNITS	VALUE
Pump		
Manufacturer	-	KSB
Model	-	Electric: ISO125x80-400 Diesel: ISO80x50-250
Number of pumps	No.	2
Number of duty pumps	No.	1
Number of standby pumps	No.	1
Nominal capacity per pump	L/s	20
Head at duty point	M	45
Nominal capacity required per BRU train	L/s	11

Head at duty point for BRU flushing	M	45
Recycle flow rate to CCT pumps suction during a BRU flush cycle.	L/s	9
Motor Power	kW	Electric: 22 Diesel: N/A
Type	-	Dry Mounted Centrifugal

RO Clean In Place (CIP) System

The RO system is cleaned using a combination of warmed filtrate and chemicals to assist in the removal of the following:

- Organic matter: Caustic / EDTA Solution
- Dissolves inorganic matter such as hardness and metals (iron): Citric Acid/HCl Solution:

The CIP takes approximately 8 hours per train and occurs on a monthly basis or as required.

The RO CIP feed pipework into the RO trains also includes a cartridge filter similar to those used on the RO Feed pipeline. The unit ensures that no solids from the recirculating CIP process are able to return to the membranes potentially causing damage.

The design basis for the RO CIP system is shown in Table 15:

Table 15: RO CIP Pumps Design Basis

PARAMETER	UNITS	VALUE
Tank		
Volume	kL	10
Pump		
Manufacturer	-	TBC
Model	-	TBC
Number of New CIP Pumps	No.	2
Number of duty pumps (For BRU)	No.	1
Number of standby pumps (For BRU)	No.	1

Number of duty pumps (For Main RO)	No.	2
Number of standby pumps (For Main RO)	No.	0
Nominal capacity per pump	L/s	8-15
Head at duty point	M	41
Motor Power	kW	15
Type	-	Dry Mounted Centrifugal
Tank Heater		
Type	-	Flanged Immersion
Connection Diameter	Mm	200
Power	kW	53
Cartridge Filter		
Manufacturer	-	Pall Corporation
Model	-	2HFHK-6G97H13 - CH13008
Nominal filter pore size	µm	1
Number of cartridge filters	No.	1
Number of duty cartridge filters	No.	1
Number of standby cartridge filters	No.	0
Design flow capacity	L/s	37
Maximum pressure drop before cartridge replacement	M	10

BRU Process Warranty Condition

The following details outlined below are the required conditions to provide both the membrane warranty and the BRU production flow rate. Note this is subject to finalisation of a contractual agreement and is subject to change.

Table 16: BRU Process Warranty Conditions

PARAMETER	MIN	MAX
Feed Flow per Train	45m3/hr	62.5
Feed phosphate		<58.5mg/L
Feed Conductivity	1,436 µs/cm	4,000µs/cm
Feed TDS	880 mg/L	2580 mg/L
pH for product	4.7	5.5
Outlet Permeate Conductivity	30 µs/cm	250 µs/cm
Outlet Permeate TDS	15mg/L	125mg/L
Flow Guarantee	50% of the minimum design flow as BRU permeate flow	

CHEMICAL DOSING

AQUEOUS AMMONIA

Purpose:

Aqueous ammonia is dosed to pre-form chloramines which are used to provide disinfection through the BRU. Aqueous ammonia is provided at a concentration of 32%.

Table 17: Aqueous Ammonia Dosing Requirements

DOSE POINT	PRE BRU FEED PUMPS
Methodology / control	Flow paced
Anticipated dose of aqueous ammonia	0.3 mg/L
Anticipated daily usage	4 L/day

Required dosing range	0.2-0.5 mg/L
Dose Point	Pre BRU Feed pumps

Aqueous Ammonia Pumps

Two new (2) aqueous ammonia dosing pumps (duty/standby) located on a new dosing skid inside an extension to the existing bund.

Digital dosing pumps of the same type and brand to those on the existing KIWS chemical dosing pumps will be provided.

Each dosing pump has a manual stroke adjustment and electronic (4-20 mA) speed control for flow pacing.

Sulphuric Acid

Purpose:

pH adjustment pre RO to minimise scaling of the BRU membranes. Sulphuric Acid is provided at a concentration of 98%.

Table 18: Sulphuric Acid Storage and Dosing Requirements

Dose Points	Pre RO
Methodology / control	Flow paced
Anticipated dose of 98% Sulphuric Acid	115 mg/L
Anticipated daily usage	169 L/day
Required dosing range	78-143 mg/L
Dose Points	Pre RO

Sulphuric Acid Pumps

Two (2) sulphuric acid dosing pumps located on a new dosing skid inside the existing bund are required (duty/standby) for the pre BRU pH adjustment.

Digital dosing pumps of the same type and brand to those on the existing KIWS chemical dosing pumps will be provided.

Each dosing pump has a manual stroke adjustment and electronic (4-20 mA) speed control for flow pacing.

Antiscalant

Purpose:

Antiscalant is added to the BRU feed water to prevent scaling of the BRU membranes by increasing the amount of soluble salts that will stay in solution rather than precipitating out onto the BRU membranes.

Antiscalant's are chemicals that interact with the surface of the RO membrane. They work by interfering with the precipitation reaction in three primary ways: threshold inhibition, crystal modification, and dispersion. Threshold inhibition is how the antiscalant keeps supersaturated solutions of some sparingly soluble salts in solution. Crystal modification occurs when the negatively charged antiscalant molecule attacks the positively charged scale formation, thereby interrupting the propagation process. Dispersancy happens when antiscalant molecules attach themselves to scale formation creating higher anionic centres creating repulsive forces between the colloidal groups so that they do not form larger conglomerates.

The effectiveness of the antiscalant depends on the concentration factor (BRU recovery), water composition, and pH.

Table 19: Antiscalant Storage and Dosing Requirements

DOSE POINT	PRE BRU
Methodology / control	Flow paced
Anticipated dose of 100% antiscalant	6.5 mg/L
Anticipated daily usage	21 L/day
Required dosing range	2.7-6.5 mg/L

Antiscalant Pumps

Two (2) antiscalant dosing pumps(duty/standby) located on a new dosing skid inside the existing bund are required for the pre BRU scalant suppression.

Digital dosing pumps of the same type and brand to those on the existing KIWS chemical dosing pumps will be provided.

Each dosing pump has a manual stroke adjustment and electronic (4-20 mA) speed control for flow pacing.

Sodium Hypochlorite

Purpose:

Sodium hypochlorite is dosed to pre-form chloramines to provide disinfection through the BRU. Sodium Hypochlorite is provided at a concentration of 12.5%.

Table 20: Sodium Hypochlorite Storage and Dosing Requirements

DOSE POINT	PRE BRU AS CHLORAMINES
Methodology / control	Flow paced
Anticipated dose of 12.5% Sodium Hypochlorite	1.4 mg/L
Anticipated daily usage	6 L/day
Required dosing range	0.7-2.2 mg/L

Sodium Hypochlorite Pumps

Two (2) Sodium Hypochlorite dosing pumps(duty/standby) located on a new dosing skid inside the existing bund are required for the pre BRU dosing.

Digital dosing pumps of the same type and brand to those on the existing KIWS chemical dosing pumps will be provided.

Each dosing pump has a manual stroke adjustment and electronic (4-20 mA) speed control for flow pacing.

SEPERABLE PORTION B

OVERALL SITE LAYOUT

Overall site layout is shown on the sketch drawing refer to Appendix C.

The BRU will be installed within the existing process building and the Product Water tank No.2 installed within the existing site boundaries. An assessment of the need for this tank was carried out and the findings contained in Appendix E.

CIVIL WORKS

NEW PRODUCT WATER TANK (PWT#2)

The new product water tank will be a nominal 2ML capacity tank located in the north east corner of the existing site. The TWL in the new tank will be at the same level as the existing tank to preserve hydraulic symmetry and the tank will have a diameter of 17.53m. The tank construction will be identical to the existing tank – galvanised steel bolted panels with a PVC liner, secured to a reinforced concrete ring beam foundation.

In order to accommodate the tank on the site, the existing demountable office building and workshop/store building will be relocated. The foundation of the workshop/store will be demolished to allow construction of the ring beam foundation for the tank. Refer to the section below for further details.

For the purposes of the TOC design, it has been assumed that the geotechnical conditions are uniform across the site and that the bearing capacity of the sub-grade at the location of the new tank is adequate to support the tank without ground improvement measures.

Table 21: New Product Water Tank Design Basis Parameter

	Units	Value
Tank		
Effective Volume	kL	1948
Construction	-	Galvanised steel bolted panels –walls and roof panel thickness varies 8mm (base) to 3mm (top)
Liner	-	0.6mm reinforced PVC
Foundation		Reinforced concrete ring beam
Nominal dimensions:		
Diameter:	M	17.57
Height:	M	9.25 (to eave)
Base level	mRL	11.80

BWL	mRL	12.03
TWL	mRL	20.10
Overflow	mRL	20.20
Gross volume	kL	2243
Connections:		
Inlet & Discharge	Mm	2 x DN450 Table D flange
Overflow	Mm	1 x DN450 Table D flange
Roof vent	Mm	1 x DN300
Roof Manway	Mm	750 x 750
Side manway	Mm	DN600
Drain	Mm	DN150
Instruments	Mm	2 x DN50
Spares		TBD

YARD PIPING

The yard piping will consist of the following items (refer to drawing 184-GE-000-LI-001 or details):

The connections to and from Product Water Tank No. 2 will be arranged to allow each tank to be operated in isolation or both tanks to be operated in parallel. The feed to the new product water tank will be taken from the discharge from the CCT immediately upstream of the connection to the existing tank. The discharge from the new tank will be connected to the existing suction line between the existing tank and the product water tanks. Both of these tie-ins will be made above ground with new DN450 stainless-steel 316L spools and appropriate valving.

The feed line will run in spiral weld stainless steel 316L (SWSS) around the perimeter of the existing product water tank just above ground level with a deviation to clear the low-level access hatch and overflow line. Once clear of these obstructions, the feed line will transition below ground and the pipe material will change from DN450 SWSS to DN560 HDPE PN8 at an above ground flange connection. The underground line will run in a northerly direction towards the site boundary, crossing above the existing product water and brine lines. The crossing will be concrete encased to protect both lines. Just inside the site boundary, the line will join a common trench with the discharge line. Both pipes will be lead outside the boundary into the road, crossing over the existing sewer line with the crossing again concrete encased to protect the lines. The two lines will then run in the road in a north westerly direction to the northern end of the site to clear the existing stormwater drainage system before turning through 90 degrees to run back into the site. Once within the site boundary, the two lines will transition above ground and back to DN450 SWSS to make valved connections to the new tank.

The discharge line follows the same route and will be laid in common trench with the feed line until the line re-enters the site at the southern end. At this point the discharge line will diverge from the feed line and run buried in a westerly direction under the plant access road until it reaches the existing tank. The line will transition above ground at a flanged connection to DN450 SWSS and tie into the product water pump suction line on the north side of the existing tank.

Depth of bury (to invert) for both lines will vary to a maximum depth of 1.6m. Areas subject to traffic loading may require concrete encasement. HDPE jointing will be butt welded, except in constricted areas where electrofusion couplings will be employed.

The overflow line from the new tank will run above ground in DN450 SWSS along the northern site boundary and tie into the main site overflow to the north west of the existing Raw Water tank.

STORMWATER DRAINAGE

No inclusion in the TOC has been made for modification of the existing storm water drainage system. The major pipeline details detailed above will not impact existing site drainage.

EARTHWORKS

The original earthworks strategy for the KIWS site was as follows:

Due to the KIWS site having the potential to contain slag and contaminants such as polycyclic aromatic hydrocarbons (PAHs) and tar. Suspected areas of contamination were capped with 2m of coal washery reject (CWR) material. Other areas with lower potential for contamination have less than 2m of capping material. The objectives of the capping layer was to:

- Provide a physical barrier, and
- Minimise the infiltration of rainwater to the underlying groundwater.

The TOC design is to avoid or minimise the penetration of the capping layer. If at detail design it proves necessary to penetrate the capping layer the guidelines as set out in the report “Steel River Project – Contamination Guidelines” are to be followed as closely as possible.

BUILDING RELOCATION

A new foundation slab on ground, nominal thickness 100mm will be prepared adjacent to the northern site boundary for the relocation of the existing workshop/store. The building is steel framed with colourbond cladding. Once emptied, fixtures and fittings removed, the electrical services will be disconnected. The building will then be dis-assembled and re-assembled over the new slab. The existing slab will then be demolished to make way for construction of footings for the new product water tank and the relocated demountable office.

The existing demountable office building will be relocated to new footings constructed in the area currently occupied by the workshop and store. Once emptied and services disconnected, the building will be split in half and craned onto the new footings before reconnecting the two halves. Footings will incorporate suitably rated hold down fixtures for the building legs.

ROADWORKS

A new concrete access road, approximately 25m long and 4m wide, will be constructed from the western boundary of the car park, leading to the relocated workshop/store. The kerb and gutter at the junction with the site access road will be replaced with a rollover kerb.

ENVIRONMENTAL

No inclusion in the TOC design has been made for SUEZ to gain any permits, planning applications, updates to the REF, indigenous heritage assessment, acid sulphate soils, groundwater treatment, contaminated soil assessment or certification post construction. This is not an exclusive list and all permits etc are the responsibility of the WUA.

Soils / materials required to be removed from site are to be assessed and classified in accordance with the NSW guidelines Classifying Waste (NSW DECC, 2009). This will determine the need for materials to be disposed as contaminated material and therefore Special Waste, and more expensive to dispose, or as general soil waste at usual waste disposal costs. Any soil and fill material excavated during the construction program is to be disposed at a licensed waste receiver facility.

GEOTECHNICAL

No inclusion in the TOC design has been made for new geotechnical investigations. These are the responsibility of the client and shall be provided to SUEZ for consideration into the detailed design phase of the Product Water No.2 foundations should this not be removed from the scope of works.

BELOW GROUND

The presence of below ground services along the route of the pipeline was investigated by contacting “Dial Before You Dig” (DBYD) and review of the existing civil drawings. Pending on the Product Water No.2 scope, underground laser scanning might be required during this TOC design phase.

TIE-INS AND SURVEY

The tie-ins required for the new product water tank will be located above ground at the inlet and outlet connections to the existing product water tank. The tie-in activities will require that the plant be shut down while these connections are made. To minimise interruptions in production it is planned to effect these tie-ins as part of a program of early works scheduled to take place during a 20-day shutdown in Orica operations in October 2020. During this period AWRP production will not be required.

A GPR survey of the existing services on the frontage of the plant will be undertaken prior to finalising the route of the balance lines for final design.

MECHANICAL DESIGN

NOISE

Designs have been developed based on the boundary noise limits stipulated by the EPA as follows:

- Night 30db(A) at the site boundary
- Day 48db (A) at the site boundary
- Workplace noise exposure requirements inside the building based on operators and visitors presence

A preliminary noise study has been carried out on the BRU solution and a copy of the report is provided in Appendix F. The results of the study indicate that no additional acoustic treatment will be required for the new drives to maintain noise levels within the building below workplace noise exposure limits. Acoustic treatment will however be provided to the BRU brined discharge control valve. No allowance at TOC design has been made for increasing the acoustic attenuation within the main process building.

LAYOUT AND ACCESS

The layout of mechanical equipment has followed the conventions described in the Project Technical Requirements. In addition to these conventions, the following considerations have been taken into account (Refer to 184GE-000-DA-001)-:

- The BRU skid has been designed to house the two BRU streams on the one skid. All instrumentation, valves and equipment have been located on the edge of the skid for accessibility.
- A clear distance of 1.5m has been allowed at each end of the BRU skid for removal and replacement of the membrane modules.
- The Eastern end of the BRU skid has been aligned with the end of the original KIWS design intent for future expansion of the MF Skids. This maintains the access corridor inside the building as part of the original KIWS design intent.
- The BRU and LP Pump skids have been positioned “in-pipework” in the East-West orientation rather than the previous initial TOC layout of a “side-by-side” arrangement. This maximise the accessibility between the BRU skids and the existing RO Skid 4 to the South, I/O Panel and Cartridge Filter to the North). This layout enables the site scissor EWP to have clear access to the full length of the RO Skid 4 and BRU skids as required for maintenance. The position also creates over 1.6m clear to open the BRU I/O panels on either side of the skid.
- The LP Pump skid position on the Western end of the BRU skids not only allows for better access and maintenance then previous versions of the TOC layout but also minimises noise transmission to the Eastern boundary.
- The Standpipe and LP Pumps are separated to maintain a thoroughfare from the existing personnel door. The pipe from the Standpipe to LP pump suction is raised above this thoroughfare.
- Outside the personnel door, Tie-in Point 01 on the MF header is angled at 45 degrees away from the building to minimise obstruction of the thoroughfare to the door.

TIE-INS AND SURVEY

There are numerous proposed tie-ins with the existing process. The tie-in activities will require that the plant be shut down while these connections are made. To minimise interruptions in production it is planned to effect these tie-ins as part of a program of early works scheduled to take place during a 20-day shutdown in Orica operations in October 2020.

The shut down period will be used for the disconnection, modification and reconnection of existing pipe sections as required for each tie-in. An isolation valve, spool and blind flange arrangement have been allowed for each tie-in where reconnection is not possible at the time of the shut down. This will enable the connection of the tie-ins to be completed at a later date without interrupting the ongoing plant operation after the shut down.

A 3D laser scan has been undertaken to assist with the detailed design of the tie in connections.

Refer to 184-SEV-GE-000-LI-003 Termination Schedule (Appendix G) which contains information regarding TP connections. The following sections describe the methods of modifying the existing pipework to accommodate the KIWS Expansion requirements and maintain operation of the plant following the October shut down and completion of the Early Works portion of this project.

TP01

The new DN150 BRU Permeate to the existing DN400 MF Header at TP01.

Refer to Figure 1 for TP01 details.

The MF Header will be cut on the overhead horizontal length located outside the main process building. The resulting spool from this cut section to the above ground section of pipework will be removed by disconnecting the transition between above and below ground pipework at the connecting flanges. The MF Header spool shall then be modified as follows:

- Cut out a section of the spool above the flange to be replaced with a new reducing tee and wafer body check valve.
- Weld the flanged section of spool to the reducing tee (DN400 x DN150).
- Weld two new DN400 slip-on flanges for installation of the check valve. One flange on the top end of the tee, one on the bottom of the remaining section of DN400 spool.
- Reconnect the flange to the PE pipe at ground level. Install the check valve and elbow section above.
- Reattach the overhead horizontal section using a Straub Grip Coupling (or similar)

The new DN150 BRU Permeate pipework shall be installed as follows:

- Weld a DN150 slip on flange to the reducing tee.
- Install a lugged butterfly valve on the flange
- (if required, install a blind flange on the upstream side of the butterfly valve for double isolation until connection can be made to the BRU)
- Run the new DN150 pipe up and above the MF Header into the building.

A new pipe support will be required for the DN150 BRU Permeate Pipework. The design will be bespoke to suit the location.

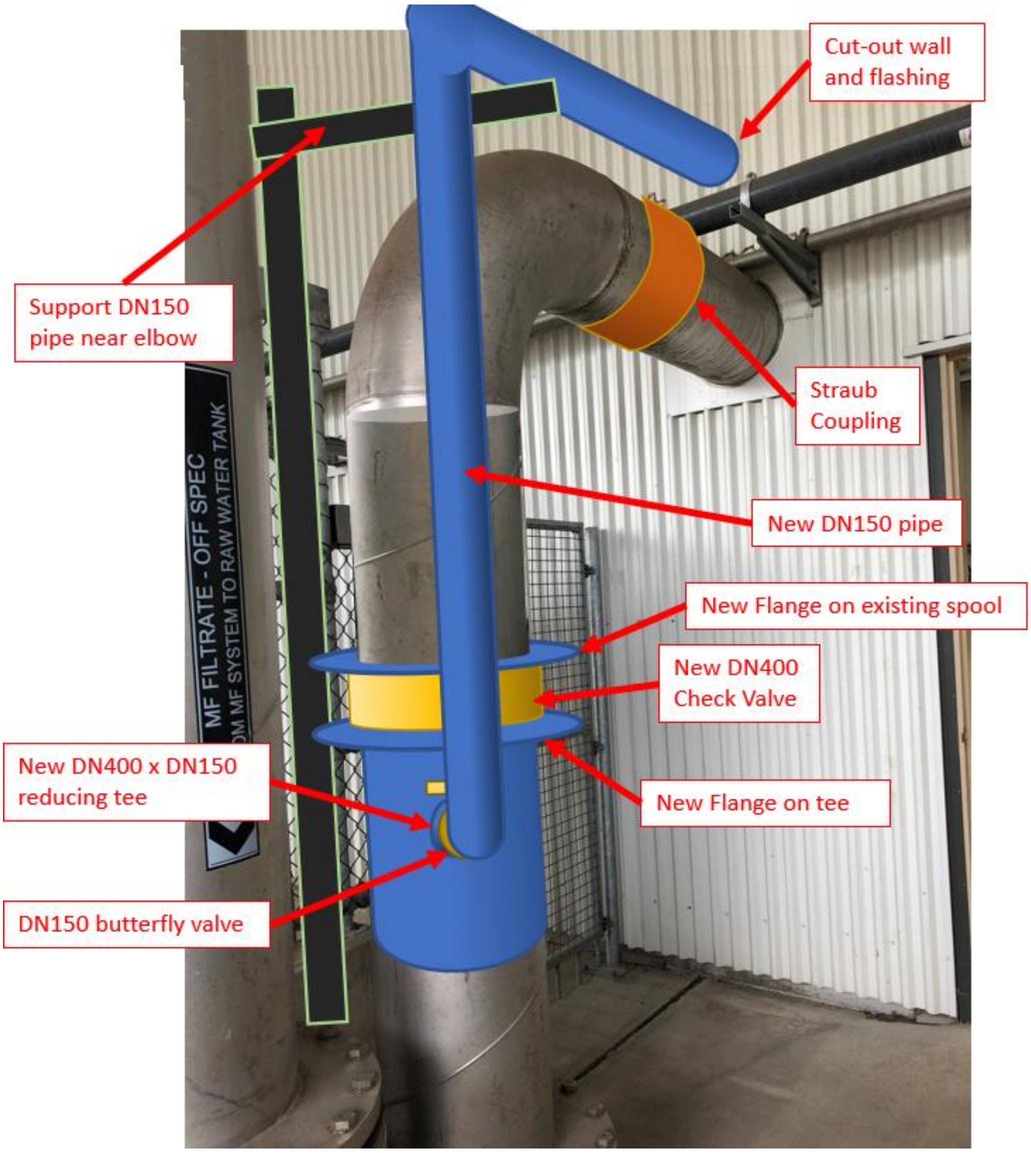

Figure 1. Tie-in Point 01 - BRU Permeate to MF Header

TP03

The new DN80 BRU Brine Discharge will connect to the existing DN200 Brine Outlet at TP03. Refer to Figure 2 for TP03 layout.

A section of the existing Brine Outlet pipework will be cut and replaced by a new pipe assembly as follows:

- DN200 spool with DN20 half coupling for drain connection
- DN200 x DN100 reducing tee for TP03, butt welded to the drain spool at one end, flange at the other for installation of check valve
- DN200 wafer-bodied duocheck valve
- DN200 spool with flange for check valve
- Install new assembly in existing pipework with a Straub Grip Coupling at either end.

The new DN80 pipework shall be assembled as follows:

- Weld DN100 x DN80 reducing insert in the tee
- Weld DN80 BRU Brine pipework with elbow to run below the existing pipework

- Install DN80 lugged butterfly valve upstream of the elbow with flanges either side.
- (if required, install a blind flange on the upstream side of the butterfly valve for double isolation until connection can be made to the BRU)

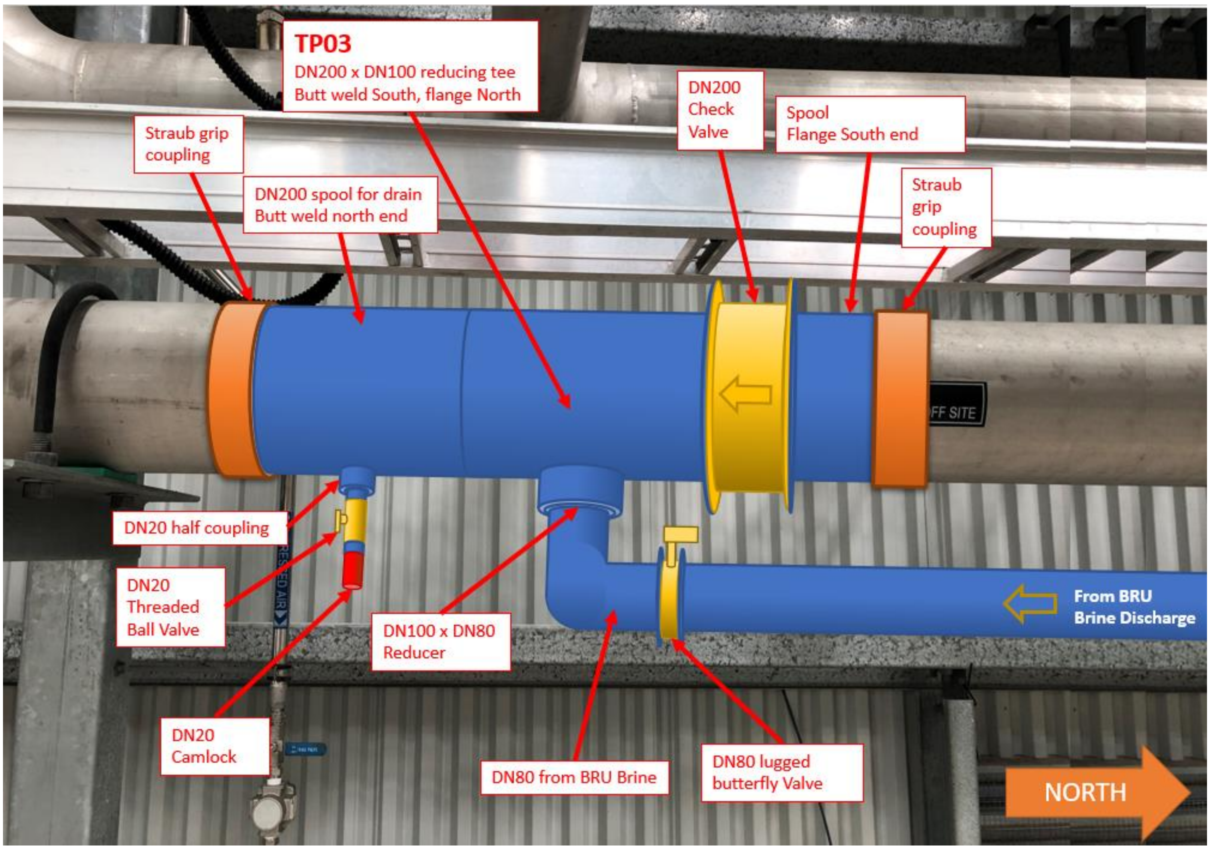

Figure 2. TP03 - BRU Brine Discharge to Brine Outlet

TP05 & TP06 – PWT Interconnecting Pipework (Separable Portion B)

The interconnecting pipework between Product Water Tank No. 1 and Product Water Tank NO. 2 are connected at the existing pipework via TP05 (Inlet) and TP06 (Outlet). Connecting to the existing pipework on PWT1 negates modifications to the tank.

TP05

TP05 requires the following modifications to the PWT No. 1 inlet pipework from the CCT. Refer to Figure 3 for the existing layout and Figure 4 for the TP05 arrangement.

- Cut the inlet pipework upstream of the existing off spec branch
- Disconnect flanges at off spec branch isolation valve and “Flange A of the expansion joint to remove existing section.
- Take the off spec tee and cut to shorten on the PWT1 branch. Weld a slip-on flange for connection to the lugged butterfly valve.
- Pre-fabricate a new DN400 equal tee with one end extended and slip-on flange welded to each end and the branch.
- Connect the long side of the new tee to Flange A (Expansion joint).
- Reinstall the existing actuated butterfly valve to the other end of the new tee (valve has now moved away from PWT1).
- Reconnect the modified off spec tee to the butterfly valve and off spec branch.
- Reconnect to existing pipework using a Straub Grip coupling.

The preparation of this section of pipework will require modification to the electrical cable tray and isolation switches shown behind the existing pipework in Figure 3.

Figure 3. Existing PWT1 Inlet

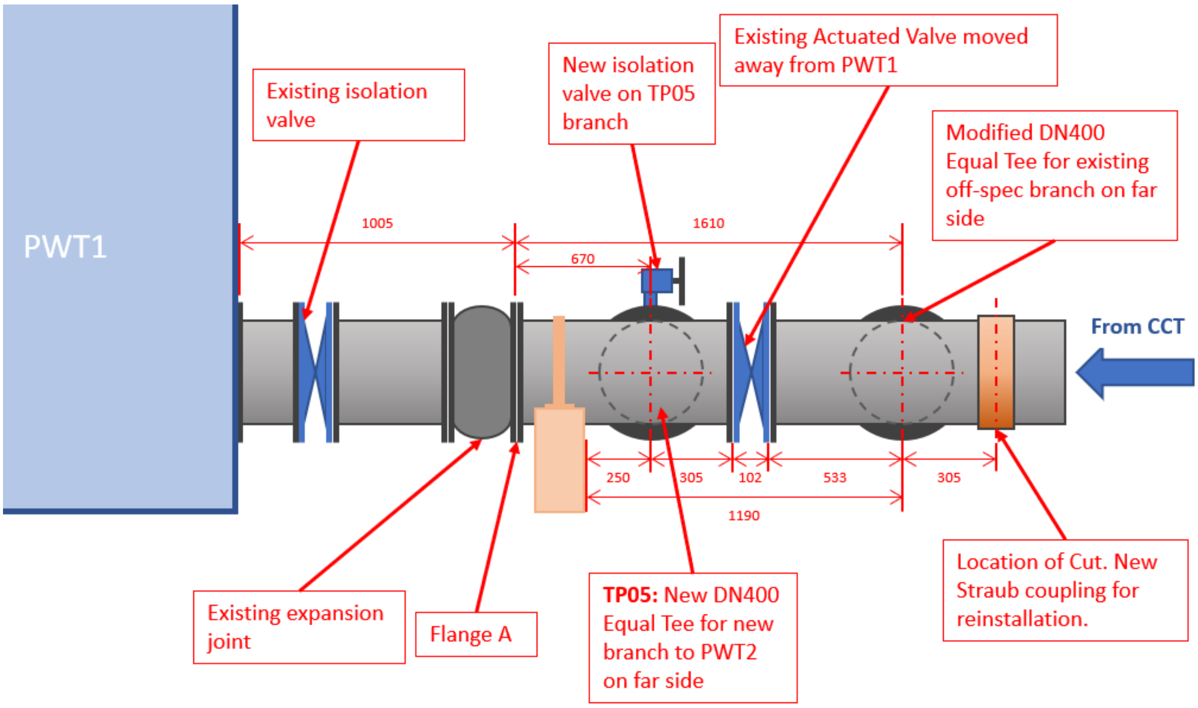

Figure 4. TP05 - PWT Balance Pipework from PWT1 Inlet

TP06

TP06 branches to the PWT No. 2 outlet off the pipework from PWT No.1 to the product water pump. The following modifications are required. Refer to Figure 5 and Figure 6 for existing arrangement and Figure 7 for the new arrangement.

- Cut the pipe close to the branch to Product Water Pumps (see Figure 5 and Figure 6)
- Disconnect at the expansion joint flange (flange A, Figure 7) and remove pipe
- Pre-fabricate a new DN400 equal tee with one end extended and slip-on flange welded to the extension and the branch.
- Fabricate a new DN400 spool to rise and turn parallel to the wall and meet the existing pipe where previously cut
- Install new tee and new sections with Straub grip coupling between and at the cut.
- Reconnect flange A
- Install a lugged butterfly isolation onto to the new branch and seal with temporary blind flange.

The installation of TP06 will require modification to the electrical cable tray and relocation of the PIT on the existing pipework.

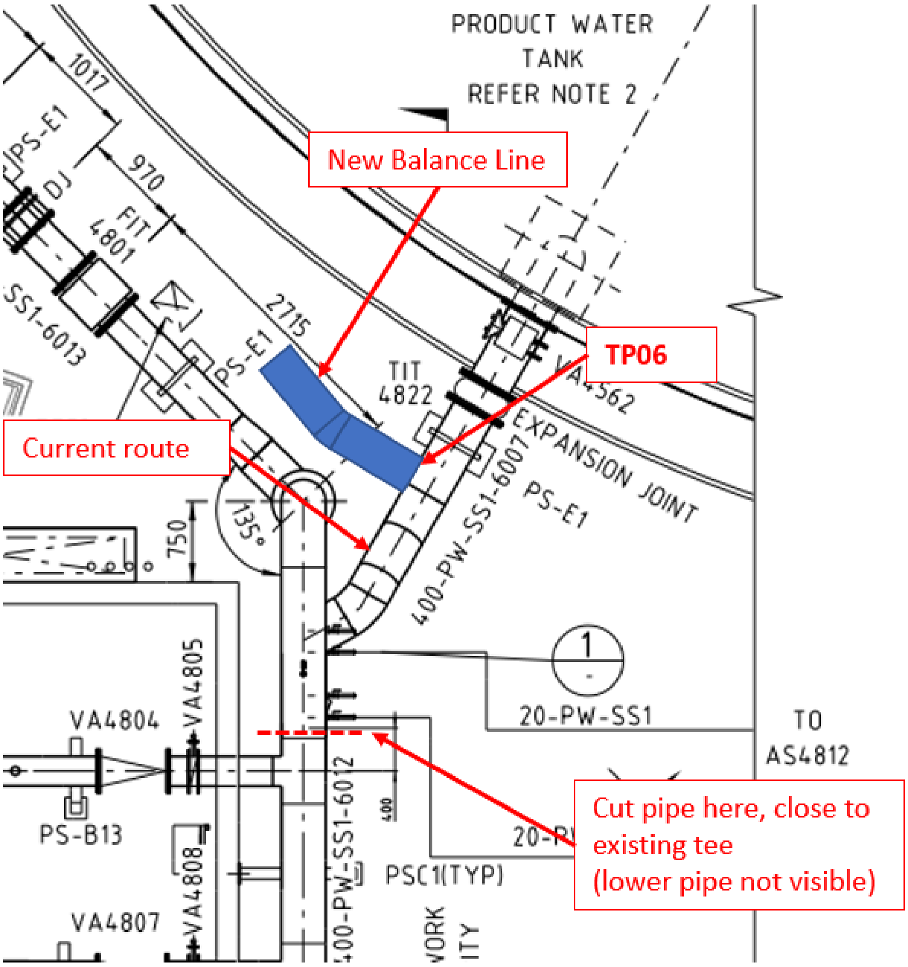

Figure 5. TP06 - Sketch of existing (ref. Drawing No. 15270-620)

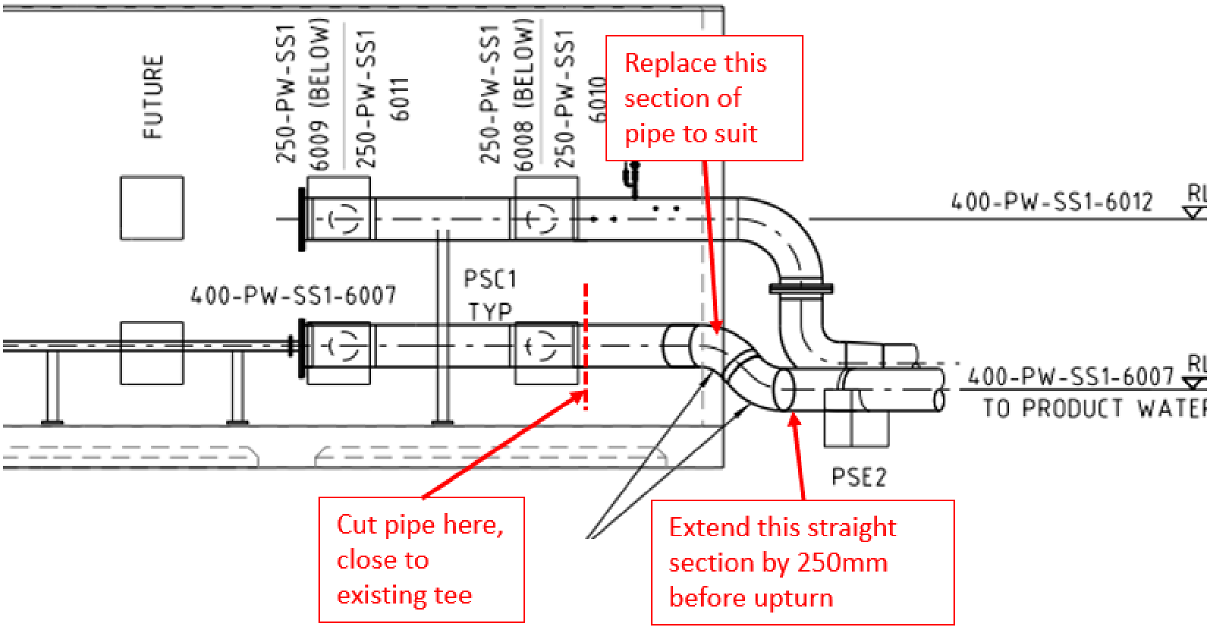

Figure 6. TP06 - modifications required. (ref Drawing No 15270-621)

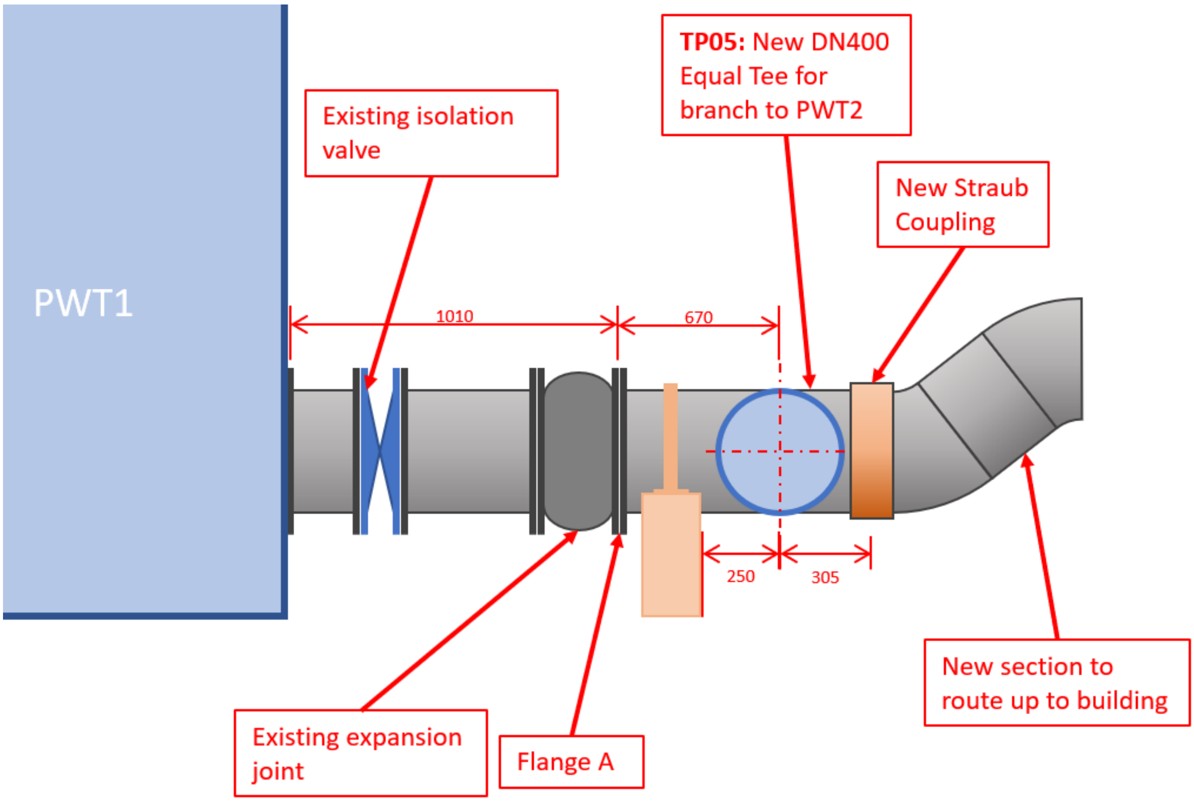

Figure 7. TP06 – PWT No. 1 interconnecting pipework to PWT2 Outlet

TP12 & TP24 – RO Flush Diversion to CCT Feed Pump Suction

TP12 enables excess water from the existing RO Flush Pump to be diverted away from the BRU flush pipework to the CCT Feed Pump Suction pipework via TP24.

TP12 will be assembled as follows (refer to Figure 8):

- Remove existing DN200 pipe from Flange "A" to Flange "B"
- Bore DN200 pipe on the vertical length and weld DN65 branch.
- Run DN65 piping through existing opening in wall above the existing DN350 pipe
- Allow flanges and spacer spool midway for installation of valves:
  - 1x Isolation Butterfly Valve
  - 1x Duocheck Valve (wafer body)
- Support pipe off block wall using Unistrut or similar.

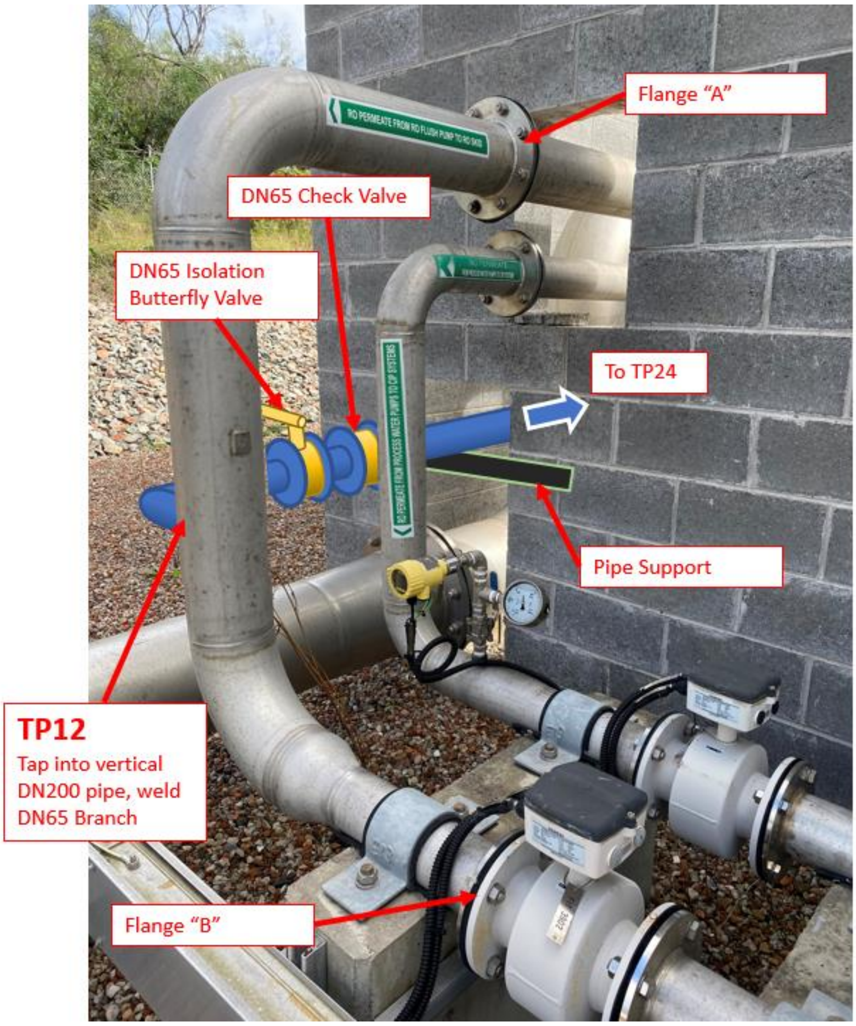

Figure 8. TP12 – BRU Flush diversion from RO Flush pipework

The DN65 pipework from TP12 enters through the existing penetration in the blockwork wall and is routed around the existing DN350 pipework to TP24. This length shall be prefabricated to suit the routing with DN65 flanges at either end to mate with the duocheck wafer valve at TP12 and a new modulating butterfly valve at TP24.

TP24 will replace the existing DN200 blind flange on the common Suction Pipework of the CCT Feed Pumps.

The new DN65 spool from the check valve to TP24 shall be fabricated with a custom oversized flange to mate the pipework to the DN200 flange. This is because there is limited clearance between the flange and the DN350 pipe.

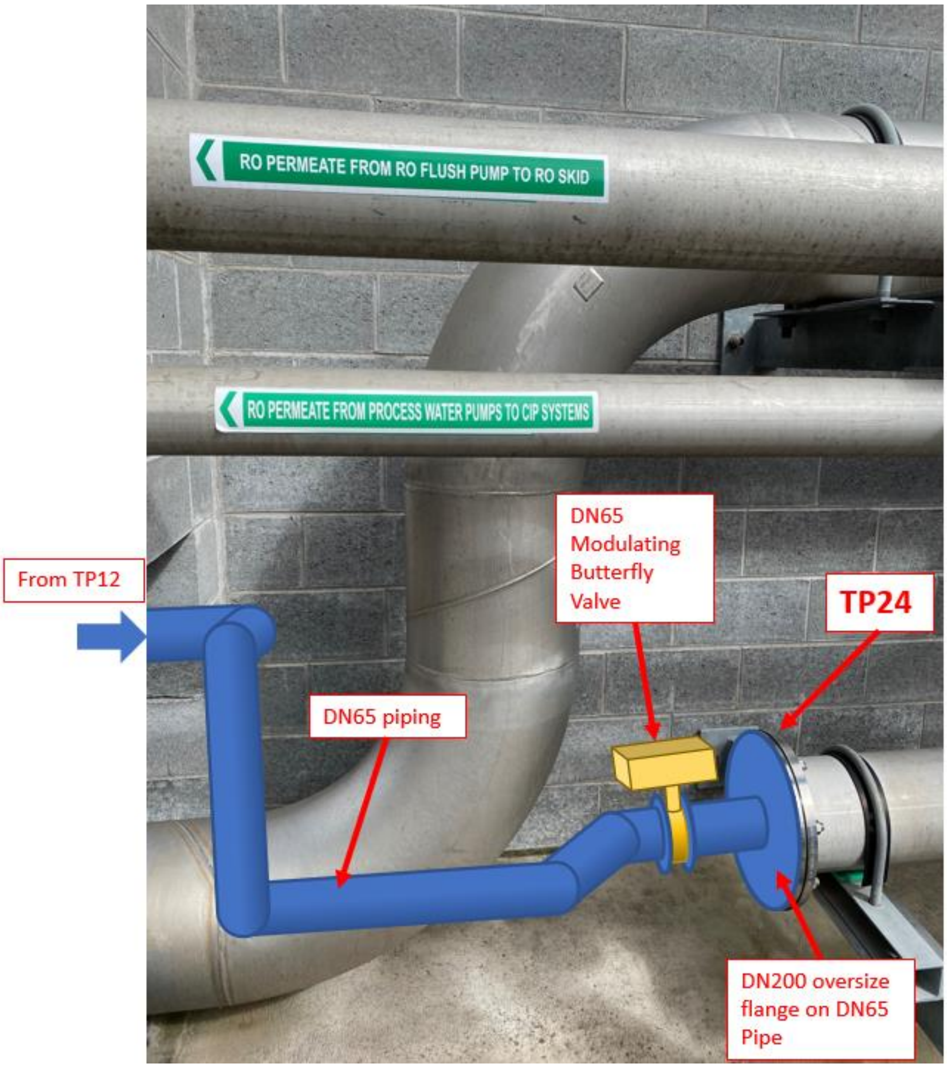

Figure 9. TP24 - BRU Flush Diversion to CCT Feed Pumps

Other Tie-in Points

Tie-in points with nil or minor modifications are as follows.

TP02 & TP04

No modifications required to the existing pipework as these pipes have existing blind flanges. The blind flange will be removed and connected to a flanged reducer for the new pipework. A lugged butterfly valve is to be installed on the BRU side of the reducer with a temporary blind flange for double isolation.

TP08, TP09, TP10, TP15, TP17, TP19 & TP22 – CIP and Chemicals
The following Tie-in Points are on PVC pipework:

- TP08 – BRU CIP Brine Side to Existing RO CIP inlet
- TP09 – BRU CIP Permeate Side to Existing RO CIP inlet
- TP10 – BRU Inlet CIP to Existing RO CIP Tank
- TP15 – Aqueous ammonia tank outlet to aqueous ammonia dosing skid
- TP17 – Sulphuric Acid tank outlet to Sulphuric Acid dosing skid
- TP19 – Antiscalant tank outlet to antiscalant dosing skid
- TP22 – Sodium Hypochlorite tank outlet to Sodium Hypochlorite dosing skid
-

These will be cut and replaced with tee fittings and solvent welded to the existing pipework. An isolation valve will be installed on the branch of the tees and a blind flange or cap installed for temporary double isolation during the Early Works phase of the project until the connections can be made under Separable Portion A.

TP11 – Compressed Air
TP11 will branch from the Compressed Air header to supply the BRU skid. The header will be cut and a DN50 x DN20 reducing tee will be installed with Straub Couplings either side. An isolation ball valve with a cap will be installed on the branch until connection can be made to the BRU.

TP13, TP16 & TP23 – Service Water to Chemical Dosing Skids
Service Water TPs will branch from the Service Water header to supply the dosing skids. The header will be cut and a DN20 equal tee will be installed. An isolation ball valve with a cap will be installed on the branch during the Early Works phase of the project until the connections can be made under Separable Portion A..

TP14, TP18, TP20 & TP21 – Return to Chemical Tanks from Dosing Skids
No modification to existing pipework required. The chemical pipework returning from the dosing skid to the chemical tanks will connect to the existing spare flanges on the tanks. It should be noted that each return line will be a separate pipe and shall only become a combined section of pipework at the tank. This is based on operation feedback of the original KIWS design and modifications on site to mitigate ongoing operational issues regarding the vent lines.

EQUIPMENT SELECTIONS

STANDPIPE

A Standpipe has been included upstream of the LP Pumps in order to prevent the pumps running dry or cavitating due to insufficient NPSHa. The standpipe accounts for fluctuating supply of brine to the LP pumps during RO transient phases and unusual operating conditions such as RO maintenance or low supply periods.

The primary supply to the standpipe is the RO Brine stream discharged from the RO trains. A DN50 supply line is also drawn from the BRU Permeate stream to supplement the RO brine stream during RO transient phases. The BRU Permeate inlet is controlled by a float/altitude valve.

The Standpipe is 1600mm tall, fabricated from DN600 Schedule 10S 316 Stainless Steel pipe, enclosed at the top and bottom. It is equipped with the following features (refer to Figure 10):

- A LIT to detect the water level dropping below an acceptable level should the supply from the RO trains cease while the BRU feed pumps are operating. The BRU LP and HP feed pumps will be programmed to stop in such an event to prevent damage.
- An air/vacuum release valve
- A pressure relief valve
- Isolation valves on all inlets and outlets
- Drain

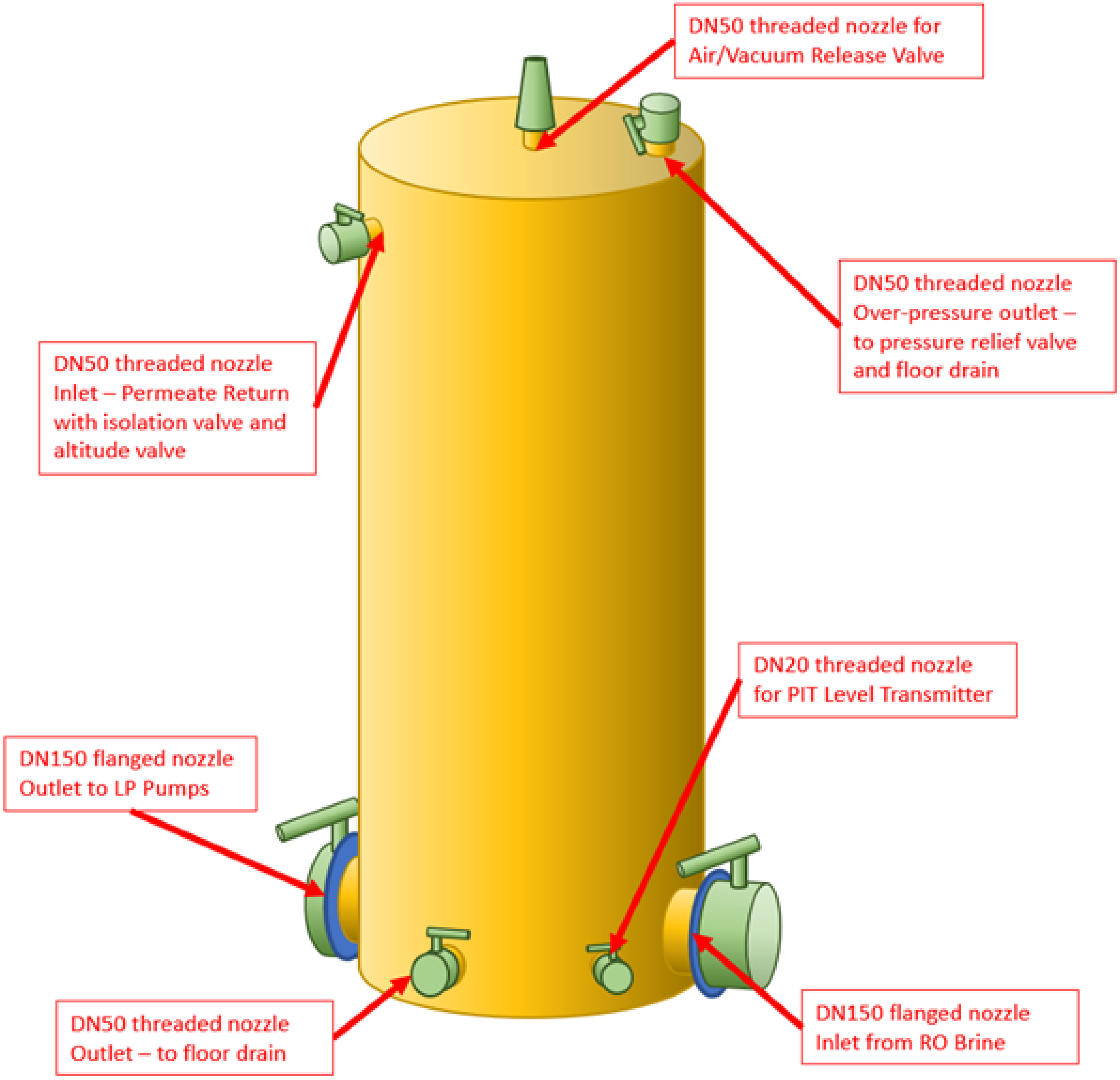

Figure 10. Standpipe

As the standpipe is enclosed and receiving RO Brine under pressure it must be considered a pressure vessel and as such must be designed, tested, commissioned and reported in accordance with AS4041.

Maximum normal operating pressure from the RO Brine stream should not exceed 205 kPa. The hydrotest pressure at 1.25 times max operating pressure shall be 260 kPa which is within the DN600 Schedule 10S pressure rating of 2,110 kPa (at up to 50°C). The pressure relief valve shall be set to a suitable pressure above 260 kPa for protection of the RO feed pumps.

PUMPS

BRU LP FEED AND BRU HP PUMPS

The BRU LP Feed and HP pumps have been selected as vertical inline multistage centrifugal type to maximise packaging efficiency and serviceability on the respective skids.

Process details for the BRU LP and HP Pumps have been previously described in this report.

RO FLUSH PUMPS

No allowance in the TOC design has been made to replace the existing RO pumps. Modification to the existing pipework to facilitate BRU flushing using existing equipment has been described in TP12 and TP24 above.

RO CIP PUMPS

The existing RO CIP Pumps are oversized for the duty on the BRU CIP system. The existing RO CIP Pumps will be replaced with smaller ones to meet the required duty points of both the RO system (duty/duty) and the BRU system (duty/standby). A boxed spare will be provided.

The replacement pump specifications are:

Motor Power Rating	22kW, 4 pole
Suction size	125mm
Discharge size	80mm
Impeller diameter	350mm

The pump selection takes in to account the existing footprint, physical position and orientation of the existing pumps. The only pipework modification is on the discharge spool to accommodate a smaller flange.

CHEMICAL DOSING PUMPS

The chemical dosing pumps are digital dosing pumps to match the existing dosing systems.

PIPEWORK

The new pipework will follow the material convention and design approach outlined in 184-SE-GE-000-MP-002 Project Technical Requirements.

Where possible, existing pipe supports will be used. It is assumed that these supports have sufficient capacity to carry the new pipes (spatially and structurally). This is particularly noted for new pipes on the Western wall of the Main Process Building.

Where new pipe supports are required, where possible the designs have been selected from the existing designs detailed in drawings 15270-890-893. This will maintain consistency across site and make use of existing resources.

The double-contained Chemical dosing pipes run from the dosing skids at high level along the Main Process Building external wall before turning into the building. The wall structure is assumed to be sufficient to support the dosing pipes on standard pipe supports without additional bracing.

VALVES

Valves are selected using the specifications outlined in 184-SE-GE-000-MP-002 Project Technical Requirements with the exception of the large bore Non-Return Valves on Brine, Water and Air. These shall be Duocheck valves (wafer body) rather than swing check valves to reduce size, weight and cost.

Valve materials shall follow the following convention. Exceptions during detailed design shall be reviewed as required.

Fluid	Body Material	Seat/Seal Material
Brine/Permeate	SS316	EPDM or PTFE
Product Water	DI FBE or SS316	EPDM or PTFE
Chemical	PVC-U	PTFE
Sulphuric Acid	PTFE-pipelined steel	PTFE

Automated valves are either pneumatically actuated or electrically actuated. Actuated valves inside the Main Process Building make use of the available compressed air system. The actuated valve on the BRU flush diversion is electrically actuated due to the remote location.

STRAINERS AND FILTERS

Strainers and Filters will be incorporated in the process design as required and will follow the design approach outlined in 184-SE-GE-000-MP-002 Project Technical Requirements.

BRU FEED CARTRIDGE FILTERS

The BRU Feed Cartridge Filters are as outlined in 184-SE-GE-000-MP-002 Project Technical Requirements.

STATIC MIXERS AND CHEMICAL INJECTION QUILLS

Chemicals will be injected via retractable injection quills upstream of the LP Feed Pumps.

The quills are to be installed with 75mm spacing to enable removal and re-installation for maintenance.

A static mixer is located immediately downstream of the injection quills. A 1,500mm straight length of pipe has been included downstream of the mixer to allow the requisite downstream mixing distance (5-10 times pipe diameter).

ACCESS, LIFTING AND MAINTENANCE

No inclusion in the TOC design has been made for additional lifting equipment within the existing main process building. The TOC design intent is that the BRU units and associated pumps can be accessed and removed in the same way as the existing MF and RO skids.

Electrical Design

Power Supply Maximum Demand

The KIWS expansion will generate an additional electrical demand of 193kVA. For more details, refer to power supply maximum demand estimate 184-SEV-EL-000-CN-001.

As shown on single line diagram SK10357-037, the new loads will be connected to Bus B of the existing Main Switchboard (MSB). Bus B was selected as it is the least loaded bus and grouping the equipment on one bus is consistent with the original design intent.

Brine Recovery Units (BRU) Skids

The two new Brine Recovery Units (BRU) skids come complete with a control panel that is connected offsite prior to arrival on the KIWS site, to all motors, VSD, instruments, actuated valves and PLC systems fitted to the skids. This includes a 55kW HP pump on each skid.

New power supply feeders and network communication services will be installed to interface the BRU skids to existing power reticulation and ICS (PLC/SCADA) systems.

As shown on drawings SK10357-732 and 733, spare modules in the existing Main Switchboard (MSB) will be modified as required to establish the new power supply feeders. This will include new protection equipment (MCCB, MCB etc) and all other parts and accessories needed.

New power supply feeder cables will be installed.

New Cat 5E cables will be installed to connect the BRU Skids to RIO Panel 2 as shown on Remote IO Panels communications architecture layout SK10357-322. The existing ethernet switch in RIO Panel 2 has only one spare port, so a new ethernet switch will be installed.

BRU Low Pressure Pumps

New power supply and control cables will be installed to interface the two new 18.5kW BRU Low Pressure Pumps to the main switchboard and plant ICS.

The existing Main Switchboard (MSB) will be modified as required to fitout two motor starter modules. Refer to drawing SK10357-128_01 for an example of a similar circuit already at KIWS. As shown on drawings SK10357-732 and 733, spare modules in the existing Main Switchboard (MSB) will be utilised to accommodate the new protection equipment (MCCB, MCB etc) and all other parts for the motor starters. Variable speed drives will be mounted on the switchroom walls. Local control panels will be installed for each pump.

New PLC IO, as noted under section 'BRU LP Pumps' of PLC IO and SCADA Point Count Estimate 184-SE-AU-000-LI-001, will be installed in PLC compartment of the existing Main Switchboard (MSB).

Cable support system for BRU Skids and LP Pumps

New cable support systems will be installed for the new power supply and ICS interface services for the new BRU Skids and LP Pumps. This will include a penetration (core drilling) in switchroom wall, cable ladder, conduits, supports and brackets, earthing connections, and all other parts required to complete the installation.

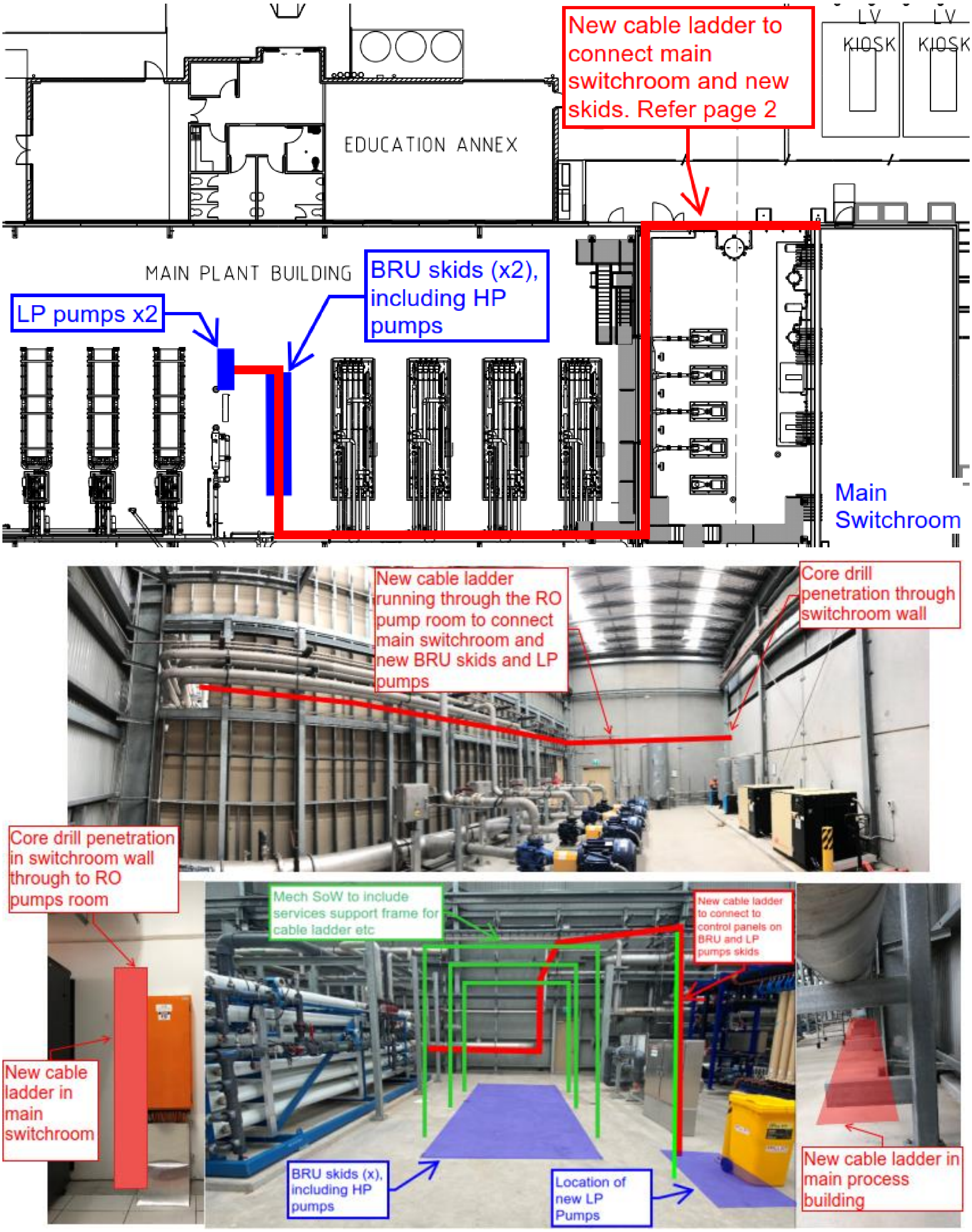

Figure 10: Proposed route for power supplies and ICS communication interface to BRU and LP Pumps Skids

Balance of Plant Equipment and Chemical Dosing Pumps

This section refers to the equipment listed in PLC IO list 184-SEV-AU-000-LI-00 (Appendix G) 1 under sections (a) Chemical Dosing Pumps and (b) Balance of Plant Instrumentation and Actuated Valves.

The chemical dosing systems and balance of plant instrumentation and actuated valves will be installed and connected to the existing power reticulation and ICS (PLC/SCADA) systems.

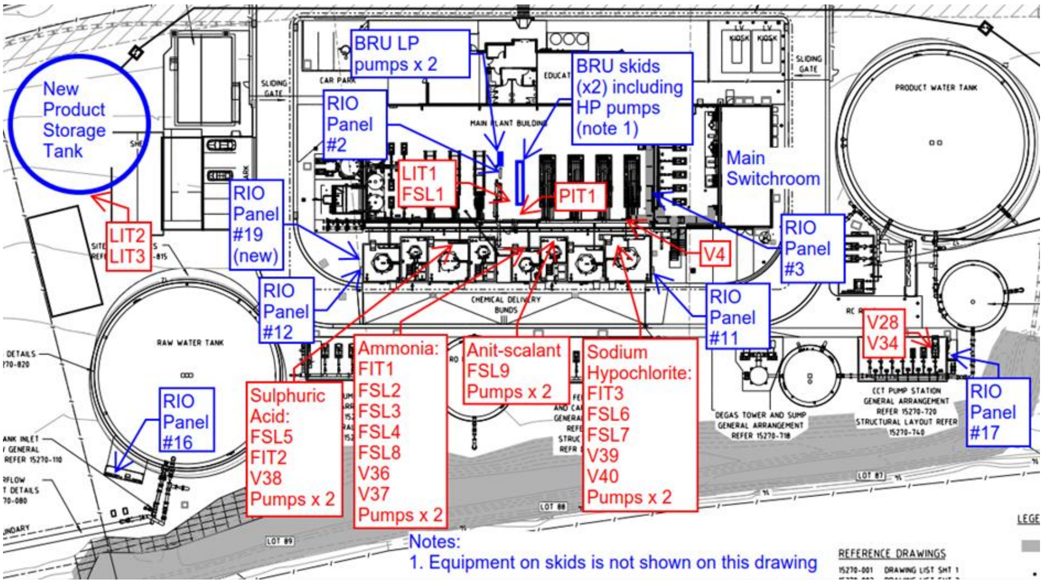

Figure 11: Location of Balance of Plant Equipment and Chemical Dosing Pumps

All eight (8) new chemical dosing pumps are rated at no more than 0.5kW each. Supply voltage is 230Vac.

Three (3) of the actuated valves require a 230Vac supply, these are V4, V28 and V34. All other actuated valves and solenoids are rated 24Vdc.

The existing Auxiliaries Distribution Board module and 24Vdc supply section of the existing Main Switchboard (MSB) will be modified as required to provide power supply to the new chemical dosing pumps and actuated valves.

Existing PLC IO in RIO panels 2, 3 and 17 will be utilised as described in PLC IO list 184-SE-AU-000-LI-001.

A new remote IO panel, RIO panel 19, will be installed in the chemical storage area at the location shown on drawing SK10357-777. It will include ethernet switches, Advantys IO components, DC power supplies, termination blocks, interposing relays, surge diverters, panel wiring any other parts necessary to complete the panel. New PLC IO to be installed in RIO panel 19 as noted in PLC IO list 184-SE-AU-000-LI-001.

New RIO panel 19 will be connected to the KIWS ICS network by way of a new Cat 5E cable from existing RIO Panel 12 as shown on Remote IO Panels communications architecture layout SK10357-325.

The proposed route for new services from the main switchroom to the chemical storage/dosing pumps area is shown in Figure 12. The proposed route uses some of the existing underground conduits and cable ladders associated to the chemical storage tank farm.

Existing cable support systems (cable ladder) will be extended to accommodate the power supplies and ICS interfaces to equipment in the chemical storage area and other locations as shown on Figure 11.

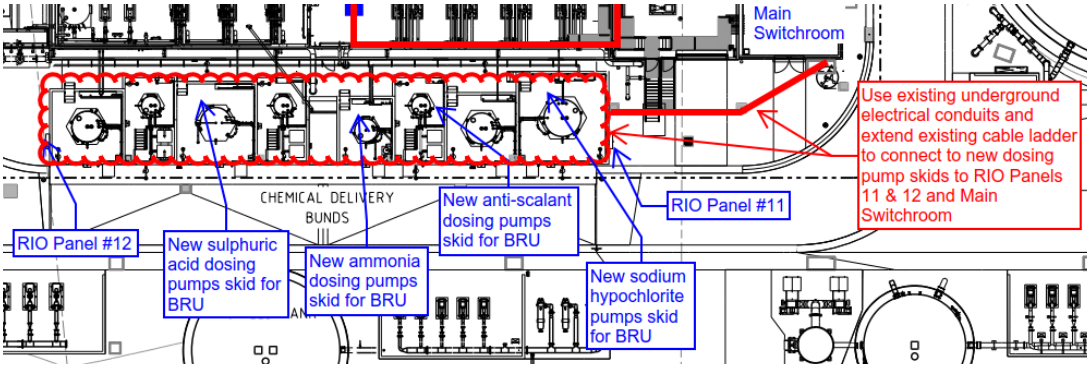

Figure 12: Proposed route for power supplies and ICS communication interface to Chemical Dosing Skids

Maintenance Shed, Demountable Office and Construction Site Office

Figure 13 shows the proposed new locations for the existing maintenance shed and demountable office. It also shows the proposed location of a temporary new construction site office.

Existing power and communications/IT services will be disconnected, extended and reconnect to the maintenance shed and demountable office in the new locations. This will include a review of the existing cable rating and full replacement of the cables if deemed necessary.

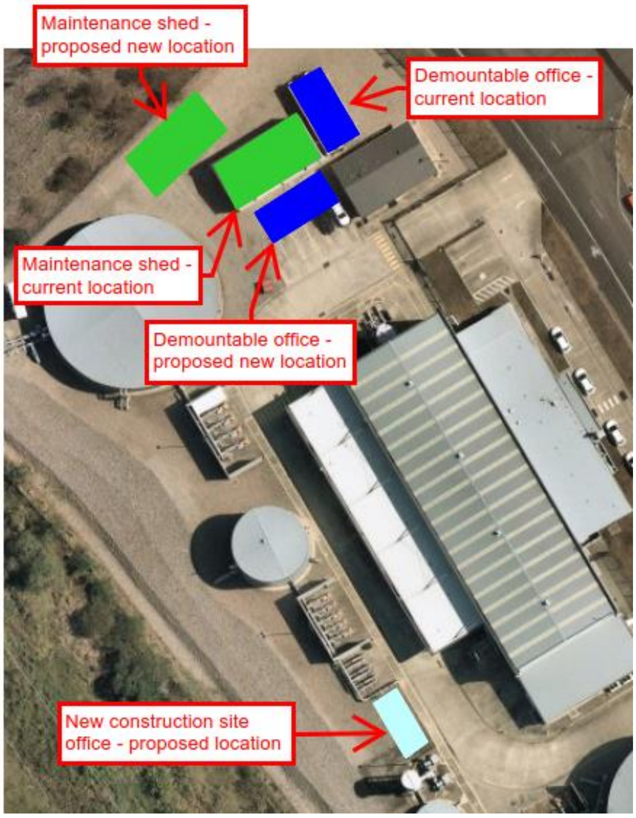

Figure 13: Proposed location for maintenance shed, demountable office and construction site office

Product Water Storage Tank

Two new level transmitters (dP Cells) will be installed at the base of a new 2ML product water storage tank.

New underground electrical conduits, pits and cables will be installed to connect the level transmitters to the existing ICS (PLC/SCADA) system at RIO panel 16 as shown on Figure 14. Existing PLC IO in RIO panels 16 will be utilised as described in PLC IO list 184-SE-AU-000-LI-001.

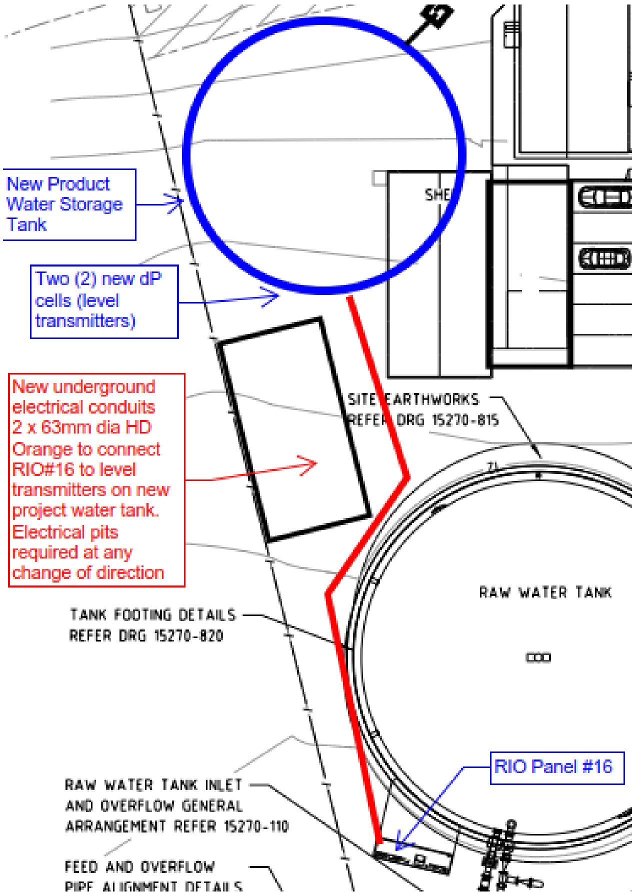

Figure 14: Proposed route for ICS interface connection to Product Storage Tank

BRU HISTORIAN MONITORING

The following BRU trends will be included in the onsite Historian data collection software:

- BRU feed free chlorine
- BRU feed pH
- BRU feed conductivity
- BRU feed temperature
- Differential pressure across the BRU
- BRU outlet conductivity
- BRU permeate flow rate
- BRU brine flow

OPERATIONS AND MAINTANINCE REQIUREMENTS

REDUNDANCY AND DOWNTIME CONSIDERATIONS

The mechanical system related to the BRU have been designed as duty only with an on the shelf critical spare provided. Should one of the BRU require maintenance the additional production capacity of 0.75MLD will be lost during this down time. Should both BRUs require maintenance the additional production capacity of 1.5MLD will be lost during this down time.

PLANT AVAILABILITY

There are several complex factors that govern the actual instantaneous design capacity of the BRU, but the focus is predominantly on the level of reliability of water supply. Based on this priority the following minimum requirements have been identified:

- The BRU plant will have a summer (Oct – March) availability to provide at least 42 ML over a 30 day period (equals 94% Availability), as there is limited flow from the existing RO plants brine stream to 'catch up'; and
- The BRU plant will have a winter (April – September) availability to provide at least 40 ML over a 30 day period (equals 90% Availability),as there is limited flow from the existing RO plants brine stream to 'catch up'; and

A nominal plant design capacity of 1.5 ML/d has been adopted for the design of the plant. To ensure sufficient supply at all times, it is proposed that the capacity of the BRU plant will be designed such that a minimum of 1.125 ML/d can be produced over any 24 hour period (allowing for 1 BRU off-line for 12 hours in a 24 hour period) , during scheduled maintenance and periods when a membrane recovery clean is undertaken on either of the BRU systems (one skid at a time), ensuring all critical spares are available on site.

Our definition of availability assumes that a complete critical spares inventory is available at all times and that a PLC failure is classified as an abnormal breakdown and thus outside minimum the availability targets stated above.

ESTIMATED OPEX

The estimated operational costs within the boundaries of KIWS Expansion is presented in the TOC development report (184-SEV-PU-000-RP-001). This estimation accounts for power, chemicals, operation personnel and maintenance cost.

The estimate is based on:

- Chemical and Power cost are based on that 3 MLD feed water to BRUs is available on average.
- Chemical and Power cost are based on the current rate and prices.
- The maintenance cost only includes preventative and corrective maintenance, but not any renewals.
- The maintenance cost does not include the separable portion B.
- Additional 0.5 x FTE operator is required to operate and maintain new BRUs.
- The BRU control system is fully integrated into the existing Plant PLC/SCADA.
- The existing spare parts at KIWS will be shared with BRUs.

The following items are excluded from the estimate:

- BRU membrane replacement
- BRU membrane service agreement fee
- External sample analysis
- Any renewals and spare parts

COMMISSIONING AND PERFORMANCE TESTING

The approach to commissioning and performance testing for the completed BRU installation will be as follows:

After pre-commissioning activities, where all equipment tests are recorded, all instruments are calibrated, FAT and SAT are completed according to the commissioning plan, BRU system and piping are properly flushed, RO membranes are loaded and mapping of the pressure vessels is completed, the performance tests will include 4 main steps:

- Operability of the BRU skids in automatic mode to demonstrate adjustment to the main plant production capacity (main plant flow to be ramped up and down as required):
    - Starting 1 BRU low flow, high flow,
    - transition to 2 BRU low flow, high flow,
    - transition to 1 BRU (2nd BRU flushing and stand-by),
    - stopping last BRU (and flushing),

this sequence of ramping up and down performed 2 times without fault.

- BRU production capacity performed on the two BRU operated in parallel without fault:
    - Test low flow: 2 hours stable with no fault – demonstrate permeate flow, unit recovery control
    - Test high flow: 2 hours stable with no fault – demonstrate permeate flow, unit recovery control
- Stable production capacity and water quality:
    - 10 days of performance testing with no fault (interlock): BRU ramping up and down according to availability of brine from the main plant
    - Demonstrate stable permeate production, stable recovery,
    - Demonstrate stable control and accurate dosing of chemicals: including chloramination, sulphuric acid and antiscalant dosing based on set point, acid dosing based on pH control
    - Demonstrate water quality based on
        - on-line instruments (feed water pH, conductivity, chloramine, free chlorine, ORP, temperature; permeate water conductivity),
        - with 2 grab samples for full analysis of feed water, permeate and brine performed by external NATA accredited lab – parameters according to feed water quality and permeate water projections, brine according to discharge licence parameters.
- Production capacity data to set the zero of the membrane normalisation for long term membrane warranty.
- After successful capacity and water quality test, demonstrate an automatic CIP on each BRU unit with the appropriate chemicals.

During the stable production capacity 10 day test, water will be discharged to supply, provided compliance with critical control point parameters are maintained.

APPENDIX A: RFIs AND SUPPORTING DOCMENTATION

APPENDIX B: PROJECT TECHNICAL SPECIFICATON – SUPERSEDED

APPENDIX C: DRAWINGS

APPENDIX D: ACMM

APPENDIX E: NOISE REPORT

APPENDIX F: PRODUCT WATER TANK NO. 2 ASSESSMENT

APPENDIX G: TECHNICAL SCHEDULES

APPENDIX H: REVIEWS – HAZOP AND LAYOUT

APPENDIX I: DESIGN MANAGEMENT PLAN

APPENDIX J: SCOPE OF WORKS

Kooragang Water Pty Ltd

WIC Act licence application

13 April 2022

Attachment 41:

KIWS Interconnections Diagram

KIWS Interconnections Diagram