GUIDERA O'CONNOR PTY LTD

ECI Design Report

FOR THE

WATERPROOFING EASTERN ADELAIDE PROJECT

Client: Town of Walkerville

Contract Number:

Issue Number: C

Date: 14/7/15

Copy Number: 1

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GO

1 Revisions

Project Management Plan Revision Record				
Revision	**Date**	**Revision Description**	**Prep. By:**	**Authorised By:**
A	2/2/15	Issued for Approval	M Lee	N Atkinson
B	7/7/15	Issued for Approval	M.Cerro	N Atkinson
C	14/7/15	Issued for Approval	M.Cerro	N Atkinson

Register of Controlled Project Management Plans Issued		
Location & Person Issued to	**Date**	**Copy No.**

2 Introduction

2.1 BACKGROUND

The Waterproofing Eastern Adelaide Project involves construction of a system of wetlands, pumping stations and aquifer storage and retrieval (ASR) bore fields within the River Torrens catchment. The system will harvest, store and treat stormwater for subsequent distribution and reuse as a non-potable, recycled water resource for eastern Adelaide.

Guidera O'Connor (GO) was selected as the Mechanical & Electrical and Integrated Communications and Controls Package contractor for the Early Contractor Involvement (ECI) phase of the Waterproofing Eastern Adelaide project in April 2014.

This design report has been compiled throughout the ECI phase to clarify the project scope, deliverables and the standard to which all work must be completed. This design report is based on previous works completed by GO of similar nature to this project, as well as, consultation with key stakeholders during this period.

A number of possible design configurations have been considered to date with an emphasis on cost reductions through an amended and reduced scope of work. These options have been presented to Wallbridge & Gilbert (W&G), as Town of Walkerville's (TOW) designated representative, and a number of arrangements have been accepted in principle.

A Total Contract Cost (TCC) estimate for the revised scope of works is to be submitted to TOW.

2.2 PURPOSE OF THIS DOCUMENT

This document is required as one of the ECI deliverables. It describes the design and infrastructure scope which will subsequently be costed as a Total Contract Cost (TCC) and summarises or references key technical standards and performance requirements of the work to be undertaken.

2.3 PROJECT LOCATION

The Waterproofing Eastern Adelaide project consists of 8 construction sites. These include;

Felixstow Reserve Treatment Site:

The Extraction Pumping Station is to be sited at the north western corner of the site and will draw water from Fourth Creek .The Felixstow Reserve wetland and biofilters are to be located alongside Langman Grove adjacent the River Torrens. Treated water will be collected within the Injection Pump Station and pumped to Aquifer Storage and Recovery (ASR) boreholes: two located at Marden and one existing at Hamilton Reserve. Access to the site is available via Sycamore Terrace and Riverside Drive.

Marden Reserve Extraction Pump Station, Booster Pump Station and ASRs

The design and scope for this part of the scheme has been based on preliminary requirements which should include the following.

The Marden Pump Station to extract water from Third Creek. This water will be treated through a Media filter and pumped to the Marden Reserve Booster Pump Station located alongside Lower Portrush Road adjacent the NE Busway. Two storage tanks will collect bore water from the nearby Marden ASR boreholes and the Hamilton borehole for reticulation. A new reticulation pump station will be installed to pump water into the distribution network. Access to the site is available via Lower Portrush Road.

Shakespeare Booster Pump Station

The Shakespeare Reserve Booster Pump Station is to be located alongside Shakespeare Avenue adjacent Third Creek. One storage tank will collect bore water for reticulation. A new booster pump station will be installed to pump water into the distribution network. Access to the site is available via Shakespeare Avenue.

Langman Booster Pump Station

The Langman Booster Pump Station is to be located on Langman Reserve alongside Wyatt Road. A new booster pump station will be installed to pump water into two storage tanks for reticulation into the distribution network. Access to the site is available via Windarra Avenue.

Scales Reserve ASR

An existing ASR bore is located at Scales reserve. The bore will receive water for injection from the reticulation network. Water from the bore will be used to irrigate adjacent reserve and to supply Marden Tanks.

2.4 ECI PROJECT SCOPE

The scope of the ECI phase is to:

- Lead the design process to the final concept stage
- Ensure an easily buildable design
- Produce an open book estimate as the design progresses
- Monitor the effect of design changes
- Provide a robust construction cost.

The deliverables are:

- Final concept design that meets the process design and stakeholder requirements
- Site Investigation Reports
- ECI Design Program
- Value Management Report
- ECI HAZOP Report

- Design Report (this document)
- Construction Program
- Construction Estimate and Construction Offer
- Design Drawings and P&ID's for Tender
- Instrumentation and Equipment Schedules for Tender
- Control Philosophy, SCADA and Telemetry
- Single Line Diagrams for Tender
- Design Departure Schedule

2.5 ECI DESIGN DEVELOPMENT

A number of workshops / meetings were undertaken during the ECI phase involving:

- Team alignment
- Process reviews
- Commissioning strategy
- Contract sequencing
- Value management workshop
- Design review meetings

Design deliverables have been developed to enable an accurate total contract cost to be completed.

An estimate has been produced based on these drawings and documentation.

Care has been taken at every stage of the design to minimise costs with the overall goal not to exceed the budget allocations for the Project where possible.

3 Project Scope (Design & Construct Phase)

Introduction

The scope of works to be delivered during the design and construct phase is described within this section. In addition, a Construction Estimate has been produced separately as a deliverable for the ECI Project.

The limit of the scope is shown on the Process and Instrumentation Diagrams (P&IDs) with Tie-in Points (TP).

3.1 SCOPE OF WORKS

The scope of works includes detailed design, supply and installation, construction, testing and commissioning the following;

Felixstow Treatment Site;

- Extraction screen and pipe,
- Extraction Pump Station including pumps, pump chamber, discharge pipework, valves, flow meter, controls and electrical.
- Access track
- Flow distribution control valves and flow meters

- Bore Injection Pump Station including pumps, pump chamber, discharge pipework, valves, flow meter, controls and electrical.
- Provision for future screen filter
- Control Building
- UV disinfection unit at bore 2 site
- All control and communication system equipment including PLCs, HMIs, RTUs, Sim Cards, Modems, aerials, managed routers and all associated cabling. Design
- Detailed mechanical, electrical, instrumentation and control design associated with the identified infrastructure.

Marden Extraction Site;

- Extraction screen and pipe,
- Extraction Pump Station including pumps, pump chamber, discharge pipework, valves, flow meter, controls and electrical.

Marden Media Filters and UV Site;

- Media filters to treat the water from the Extraction Pump Station.
- Preliminary only as this site may need the addition of a booster Pump Station to provide sufficient pressure for the correct operation of the media filters.
- UV disinfection unit
- Including civil works, interconnecting pipework, valves, flow meter, controls and electrical.
- All control and communication system equipment including PLCs, HMIs, RTUs, Sim Cards, Modems, aerials, managed routers and all associated cabling. Design
- Detailed mechanical, electrical, instrumentation and control design associated with the identified infrastructure.

Marden Reserve Booster Pump Station and ASRs;

- Two new bore heads including bore pump, associated pipework, valves, instrumentation, controls, bore enclosure, switchboard and communication equipment at Marden Reserve.
- One new bore head including bore pump, associated pipework, valves, instrumentation, controls, bore enclosure, switchboard and communication equipment at Hamilton Reserve.
- Two Distribution Network Storage Tanks aboveground, including instrumentation.
- Access track, fence and gates
- Control Building incorporating pump room and switchboard room.
- Booster Pump Skid including pumps, adjacent pipework, valves, instrumentation, controls and electrical.
- All control and communication system equipment including PLCs, HMIs, RTUs, Sim Cards, Modems, aerials, managed routers and all associated cabling.

Shakespeare Reserve Booster Pump Station;

- Distribution Network Storage Tank partially buried, including instrumentation.

- Access track
- Control Building incorporating pump room and switchboard room.
- Booster Pump Skid including pumps, adjacent pipework, valves, instrumentation, controls and electrical.
- All control and communication system equipment including PLCs, HMIs, RTUs, Sim Cards, Modems, aerials, managed routers and all associated cabling.

Langman Booster Pump Station;

- 'Pump in Can' Booster Pump set including pumps, adjacent pipework, valves, instrumentation, controls and electrical.
- Two Storage Tanks buried, including instrumentation.
- All control and communication system equipment including PLCs, HMIs, RTUs, Sim Cards, Modems, aerials, managed routers and all associated cabling.

Scales Reserve ASR;

- One new bore head including bore pump, associated pipework, valves, instrumentation, controls, bore enclosure, switchboard and communication equipment

3.2 DESIGN

- Detailed mechanical, electrical, instrumentation and control design associated with the identified infrastructure.
- Process design has been undertaken by Town of Walkerville principal process designer, Wallbridge and Gilbert. GO will undertake detailed design and deliver the plan encompassing the process design requirements described by W&G.

Other design deliverables;

- Four building certifications, Marden, Felixstow, Shakespeare and Langman.
- Sound Engineering for the six buildings and seven bore heads, this includes post construction testing to ensure the design meet EPA requirements
- Prelims & General Construction Facilities
- Site establishment facilities for all sites shall include:
    - Management and supervision
    - Site facilities
    - Miscellaneous plant and small tools
    - Site craneage
    - Survey and set out
    - Service locations
    - Concrete, hydro and soil compaction testing
    - Preparation of the site for site establishment
    - Site establishment including offices and amenities, as required
    - IT & Communications for construction office, as required
    - Temporary power supply
    - Potable water supply
    - Construction water supply

- Temporary fencing and signage

Civil services as shown on the tender drawings including:

- Access roads into and around the plant
- Site pipework
- Manholes as shown on the tender drawing
- Valve boxes
- Walkways and paths
- Bollards
- Fencing
- Signage
- Cable containment and trenching
- Draw pits and covers
- Service water hose points
- Site access parking
- Hard standing areas
- Lighting comprising road lighting & targeted task lighting
- Surface water & stormwater drainage system
- All earthworks associated with the construction of the sites' tanks, pits, pumping stations, pipework, buildings, external switchboards and equipment enclosures
- Construction of concrete slabs and associated footings for the pumping station buildings submersible pump enclosures, switchboards and valve chamber
- Construction of ASR bore fields
- Repair to roads and curbing
- All associated pipework, hoses and hose reels, valves and instrumentation, as per the relevant P&ID.

Structural:

The sites' buildings include the Marden and Shakespeare Pumping Stations, the Felixstow UV Disinfection Building and Bore Head Enclosures.

Buildings will include:

- All earthworks associated with the construction of the buildings
- Detailed excavation for the construction of concrete footings and slabs at grade
- Detailed excavation for the electrical conduits and pipe that will be cast into the concrete. Not all of which is shown on the IFT drawings.
- Concrete and steel reinforcement work, including footings, footing beams and slabs walls, as may be required, for each of the buildings
- Concrete and steel reinforcement work associated with the Bore Head enclosures.
- Supply and install conduits for building services, major power, monitoring and control, etc
- Building elements including structural steel work, precast concrete panels, metal cladding, walls, roofs, ceilings, windows and doors.

- All building services including all lighting, minor power, ventilation and where applicable, air conditioning, fire protection services (as required by the Building Code of Australia, water supply, sewerage and stormwater drainage services).
- Power supply connection to building services and equipment
- Structural steel and concrete reinforcement bonding points for lightning protection and earthing system.
- Bond structural steel and concrete reinforcements to Earthing System

Mechanical Equipment (Pumps)

Pumps required for the project include, but are not necessarily limited to;

- Marden Extraction Pump Station including 2 duty pumps.
- Marden Media Filters.
- Felixstow Extraction Pump Station including 2 duty pumps.
- Felixstow Injection Pump Station including 2 duty pumps.
- Hamilton Reserve Borehole 1 duty Pump
- Marden Reticulation Pump Skid including 3 duty pumps.
- Scales Reserve Borehole 1 duty Pump
- Shakespeare Booster Pump Station including 3 duty pumps.
- Langman Booster Pump Station including 3 duty pumps.
- All pipework, valves, fittings and instrumentation as per the relevant P&ID's

ASR Bore fields

ASR bore fields constructed by others include:

- Marden Reserve (two new bores)
- Hamilton Reserve (one existing bore)
- Scales Reserve (one existing bore)
- Each bore head will have the following features;
    - Enclosure for the mechanical and electrical equipment as shown in the IFT drawings
    - Concrete footing and thrust block, designed by WG
    - Inlet flow control valve and flow meter
    - Bore pump controlled by a variable speed drive and pump riser pipe
    - Pressure relief valve
    - Discharge valving and controls

Tanks

The tanks required for this project include, but are not necessarily limited to the following;

- Marden Distribution Network Storage Tanks (2 x 250kL, Above ground – Steel/Lined)
- Shakespeare Network Storage Tank (250kL, partially buried - Concrete)
- Langman Network Storage Tanks (2 x 250kL, buried - Concrete)
- All pipework, valves, fittings and instrumentation as per the relevant P&ID's

GO

No provision for wetland or bio-filter construction has been made in the GO estimate.

UV Disinfection Units:

One UV disinfection station will be installed at the Felixstow Control building. The UV disinfection unit will consist of:

- A single UV disinfection unit
- All pipework, valves, fittings and instrumentation as per the relevant P&ID's
- Service water pipework, valves and hoses, pipe flushing and general wash down

One UV disinfection station will be installed at the Marden Pump Station. The UV disinfection unit will consist of:

- A single UV disinfection unit
- All pipework, valves, fittings and instrumentation as per the relevant P&ID's
- Service water pipework, valves and hoses, pipe flushing and general wash down

Electrical, instrumentation and control

This area includes but is not limited to the following items:

- SA Power Networks metering and protection
- Electrical supply switchboards, including motor control centres (MCC's) for all motors, distribution boards for general lighting, power and miscellaneous equipment.
- VSDs as required in pumping stations
- Control cabinets
- Field cabling as required
- All instrumentation as per the P&IDs

Allowances have been made for the following:

- Felixstow
    - Free space in the control building
    - Transformer sizing (By others)
    - Main switchboard free space

Security

There are no electronic security systems on switchboards.

SCADA System

PC-based SCADA system for operator interfacing, monitoring and control of the plant

This will include, but is not necessarily limited to:

- Dual-redundant server PCs
- I/O Server PC

- Operator workstation PC
- Remote laptop PC
- Alarm/paging system
- Report printer
- Network switch
- Telemetry System will be further developed during the construction phase
- Telemetry system to allow the remote monitoring of the plant
- This will include, but is not necessarily limited to a:
- Primary telemetry link (such as ADSL/VPN, UHF Radio or Next G)
- Secondary telemetry link (for dialup remote access)

Testing and commissioning:

- Operator training
- O&M manuals

3.3 EXCLUSIONS

- Process design (by W&G) Submission based on drawing issued at tender time only.
- Civil, structural and building detail design (by W&G or building supplier), Submission based on drawing issued at tender time only.
- Wetland and bio-filter construction
- All interconnecting, distribution and disposal pipelines external to the seven main construction sites in accordance with the relevant P&ID's
- All pipe work/conduit passing through or under the wetland clay liner as marked on the drawings and PID's
- All SA Power Networks connected transformers
- Process engineering support during commissioning provided via W&G
- Sampling and water analysis costs during commissioning
- The removal and disposal of all contaminated water
- The removal and disposal of all contaminated soil
- Drilling, casing, testing & commissioning of any bores
- The removal and disposal of all contaminated soil
- Drilling, casing, testing & commissioning of any bores

3.4 LATE ISSUES REGISTER

A number of late issues were captured in the construction estimate. These issues are either as a product of late notifications by TOW or, late issues identified by GO in the later stages of the Construction Estimate production. These items are identified separately and summarised below in Table 3.1.

Table 3.1:Late Issues Register

Item no.	Change	Change Originator	W&G Comments

Item no.	Change	Change Originator	W&G Comments
1			
2			
3			
4			

4 Design Principles

4.1 STATEMENT OF INTENT

The intention of the design is to provide fit for purpose water extraction and distribution system and ancillary equipment that meet the requirements of the brief and the specifications, and is safe to operate for TOW and provides economic, environmental and social benefits.

4.2 PROCESS DESIGN

The design has been developed to ensure that unless otherwise directed, the process design requirements, as described within W&G mechanical and electrical brief and integrated communication and control brief, are delivered.

4.3 DESIGN LIFE

The minimum life requirements for designing and selecting new plant and equipment were stated and are summarised below in Table 4.1.

Table 4.1: Minimum Design Life

Asset	Minimum Design Life
Concrete water retaining structures	80 years
Buildings – structural	50 years
Buildings - roofing and walling	25 years
Buried pipe	80 years
Above ground pipe - metallic	50 years
Above ground pipe - plastic	15 years
Mechanical plant	25 years
Electrical plant	15 years
Instrumentation, control and SCADA	5-10 years
Other specialist equipment	As recommended

For mechanical, electrical and instrumentation equipment preference will be made for equipment with a life expectancy that demonstrates the lowest net present value while not compromising the performance of the plant.

4.4 DESIGN TEMPERATURES

Mechanically ventilated buildings

Switchboards, control and equipment panels, instrumentation, PLC's and mechanical plant installed within fully enclosed mechanically ventilated buildings will be suitable for operation indoors under the following service conditions:

- Maximum ambient air temperature of 50°C
- Minimum ambient air temperature of 0°C

Air conditioned buildings

Switchboards, control and equipment panels, instrumentation, PLC's and mechanical plant installed within a fully enclosed air-conditioned building will be suitable for operation indoors under the following service conditions:

- Maximum inside air temperature of 35°C
- Minimum inside air temperature of 10°C

Outdoors

Switchboards, control panels and associated control equipment including instrumentation and PLC's not installed within a fully enclosed building will be suitable for operation outdoors under the following service conditions:

- Maximum ambient air temperature of 50°C
- Minimum ambient air temperature of 0°C

All other items of equipment installed outdoors (e.g. mechanical plant) will be rated for the following:

- Maximum ambient air temperature of 50°C
- Minimum ambient air temperature of 0°C

4.5 ENVIRONMENTAL

Noise

All the pump station bore heads and booster pump sets will be designed to;

- Meet the EPA target values of 45dBA at night and 52dBA during the day
- Take a conservative approach to the design of buildings that house equipment known to be noisy specifically, pumps, Maric and flow control valves
- Reduce the openings in the buildings to a minimum
- Use sound attenuating louvers and ducts
- Use acoustic roller doors where necessary

4.6 REDUNDANCY

The following design principles will be employed for redundancy:

- Provide multiple pumping equipment to enable system to operate at reduced capacity when a single unit fails as per the P&ID. Install systems that allow flexibility
- Utilise more than one source of water supply, where practicable
- Provide means to dispose of excess flows, particularly, from storm events.
- Equipment is to be as shown on the P&ID's and Mechanical Schedules
- Structures and equipment will be designed to enable isolation for maintenance as per the P&IDs.

4.7 WHS IN DESIGN

General

Work Health Safety (WHS) design aspects i.e. safety in design will be further considered in the development of the detailed design.

It is expected that the pump stations will be operated and maintained by suitably trained and competent individuals in accordance with statutory requirements & TOW safe systems of work.

Amenities

Toilets and hand washing facilities will not be provided.

Platforms and handrails

Handrails and platforms suitably designed in accordance with AS 1657-2013 will be installed to allow access to operate and maintain all plant. Kick rails will be provided wherever there is a risk of personnel working below the walkway level. Maximum weight of removable grating panels or lids will be 20kg.

Walkways will have a minimum width of 750 mm.

Manual handling

Manual handling should be minimised and avoided wherever possible. Where this is not possible and where materials or equipment weigh more than 20kg, alternatives such as lifting equipment or mechanical material transfer systems will be provided.

Access

The plant will be designed for access to equipment for operation & maintenance purposes. This is will be done to ensure that adequate access is provided to enable safe operation and maintenance of plant and equipment. Wherever possible, equipment will be located such that it is accessible from ground level.

Valves and valve handles will be situated to provide easy access for operation and maintenance. Motorised mechanisms will be provided as per the P&ID to reduce the possibility of repetitive strain injuries.

Confined spaces

The design of the pump stations should be based upon eliminating confined spaces where possible. Where confined spaces cannot be avoided, then selection of mechanical and electrical plant items will be made which minimises the need for accessing these areas.

Access to tanks without a provided stairway, constitutes a confined space entry. Where applicable, anchor points will be provided for fall prevention/protection and will conform to the requirements of AS 1891.3 and AS 1891.4.

All confined space entry requirements will need to be managed by suitably trained competent employees in accordance with statutory requirements and TOW safe systems of work.

Equipment

Enclosures will be avoided (including acoustic enclosures) where possible. Where acoustic enclosures are provided they will have an appropriate fit-for-purpose IP rating. Hinged panels for normal operation requirements are preferable.

It should be possible to remove all panels by one person for maintenance access. The mass of any individual panel will not exceed 20 kg. Larger panels may be selected providing they can be removed easily by lifting facilities.

Where possible access manhole lids will be manufactured from lightweight materials and will be hinged.

Machine guarding must be in place to ensure a safe working place for all employees in accordance with relevant standards. Machine guarding will be designed to provide easy access to the rotating equipment for inspection and minor maintenance as required by the manufacturer. Machine guarding must conform to AS 4024.1-2006 to prevent access to moving parts of machinery.

Lifting equipment must be designed with a lifting capacity in excess of weight of the equipment to be lifted.

Large equipment that generally does not require frequent removal may be positioned so mobile cranes can be used for lifting. The removal of all equipment must be possible without the removal of structural items. Lifting points are to be easily and safely accessible.

Where equipment is indoors and requires lifting for maintenance, the designer needs to ensure that there is sufficient headroom between the ceiling and adjacent equipment for both the lifting block and the equipment being removed.

Mobile lifting equipment may also be considered providing that access is suitable and the weight of the equipment is within the capacity of the mobile equipment. Access for mobile lifting equipment to smaller pieces of equipment such as pumps and compressors needs to be carefully considered as this type of equipment is often situated close together.

Bore heads will be located so the bore pumps can be removed. They must be positioned away from overhead power lines. There must be enough access space for the crane or truck that is required to do the lifting.

Manually operated lifting equipment may be used where the frequency of use and amount of effort does not justify the use of power operated equipment. Such equipment must:

- Be designed with a lifting capacity in excess of weight of the equipment to be lifted
- Be appropriately signed with its safe lifting capacity
- Should minimise the stress on plant operators in accordance with manual handling requirements
- Be provided with safe access for operation, maintenance and inspection.

Electrical and Controls

Emergency stop push buttons will be labelled indicating the equipment they control.

Local electrical isolators will be labelled to enable their easy identification.

RCD protection will be fitted to all electrical outlets. Switchboards must be sign-posted warning of the electrical hazard.

The following criteria will be adopted:

Lighting levels will conform to the Building Code of Australia and AS 1680.1:2006 as a minimum and where necessary be increased to ensure there is adequate illumination for operations and maintenance personnel

Lighting levels around the pump stations will be set so that adequate illumination for employees to perform their duties safely can be achieved

Where applicable light columns that can be lowered to the ground to enable safe changing of light fittings will be provided

Consideration will be given to the location of wall mounted light fittings. It is not intended that in-situ stairways and platforms be provided to give access to all light fittings however, the detailed design should ensure that adequate access is provided to enable the use of mobile plant e.g. cherry pickers and such like.

Sensor lighting should be provided at major access points to the various sites and individual locations on the sites.

WHS in operations

Work health and safety during operational activities will be in accordance with the required standards and regulations, including the following:

AS 2865	Safe working in a confined space
AS 4024.1	Safety of machinery
SafeWork SA	Manual Handling guidelines
HB9-1994	Occupational personal protection

4.8 PROCESS PIPEWORK

The following criteria will be adopted when considering the detailed design and location of process pipework. These criteria will include but not limited to:

- Process pipework conveying hot fluids or gases where the surface temperature of the pipework is likely to exceed 50°C, will be provided with thermal insulation or a protective barrier
- All above ground process pipework will be colour coded and labelled in accordance with applicable Australian Standards.
- External pipework should be robust and protected against accidental damage where necessary
- External pipework containing hazardous or dangerous goods should be in containment areas in case of breakage or leakage
- Pipework will incorporate flushing and vent points as per the P&ID's.

4.9 SAFETY EQUIPMENT

Fire protection

The buildings will be protected with fire extinguishers and blankets. The placement and frequency of fire extinguishers is in accordance with AS 2444. Fire blankets will also be provided in the office areas of the pumping station buildings in accordance with AS 3504. As the proposed buildings are not greater than 300m² no fire suppression system is required.

Foam type fire extinguishers will be provided in accordance with AS/NZS 1841.1 and AS/NZS 1841.4.

Powder type fire extinguishers will be provided in accordance with AS/NZS 1841.1 and AS/NZS 1841.5.

Carbon dioxide type fire extinguishers will be provided in accordance with AS/NZS 1841.1 and AS/NZS 1841.6.

4.10 HYDRAULICS

The main process (liquid) streams are treated and untreated stormwater. These streams are conveyed in pipes and culverts under either gravity or pressure systems. The hydraulic design criteria will include:

- Optimise liquid velocity in pressure systems for energy efficiency and low capital cost.
- Maintain cleansing velocities.
- Select pressure rating of pipes above the maximum pressure which could occur in the system.
- Incorporate flushing/scour points, inspection points and gas release in pipework system
- All pipe sizing and pump duties are shown on P&ID
- This scope of work will be completed by Wallbridge and Gilbert.

5 Standards and Specifications

5.1 INTRODUCTION

This section defines the technical standards and specifications associated with the scope of works and materials described in Section 0.

5.2 PRECEDENCE

The following documentation list is provided in order of highest to lowest precedence. In the event of any ambiguity or conflict of information, the document of higher precedence will prevail.

- AS 4000 "General Conditions of Contract"
- GO TCC Estimate
- GO Design Report (this document)
- Total Contract Cost (TCC) Schedules, GO;
- ECI Tender Drawings, GO; (refer 14.2 Drawing)
- Technical Standards and Guidelines; as referenced within this document
- Australian Standards; as referenced within this document.
- Other standards; as referenced within this document.

5.3 STANDARDS AND SPECIFICATIONS

Materials and workmanship will comply with the Specification and relevant Australian Standards, statutory guidelines, as referenced in this document.

6 Functional Design

6.1 WATER PROOFING THE EAST PROJECT

Water Proofing the East Project involves installing infrastructure capable of capturing, treating and supplying up to 450 ML of stormwater annually to replace current and future potable water demands. Stormwater will be harvested from the existing stormwater network. Stormwater will be predominantly harvested in winter and treated in the system of artificial wetlands and bio-filters, then stored in the underground aquifer for summer recovery and reuse.

This Design Report covers all Mechanical, Electrical and Integrated Communication and Control works and associated civil and structural work for the WPE project.

6.2 FELIXSTOW TREATMENT SITE

The following is our understanding of the injection/extraction process. This needs to be confirmed by the process & hydraulic designers.

The Felixstow Extraction Pump Station will divert storm water from Fourth Creek to the Felixstow Settlement Pond. An extraction screen will be constructed on Fourth Creek to divert water into the pump chamber.

There will be two duty pumps installed. The maximum output of the pump station will be 50 L/s at 200 kPag pressure. The flow will be controlled to maintain required water level in the Felixstow Settlement Pond. Extraction will be permissible if water quality measurements taken for pH, turbidity and salinity are within pre-defined operational limits.

Water from the Settlement Pond will gravitate to the extraction pit, weir and screen where it will further gravitate to the biofilters and wetland. The wetlands are hydraulically controlled by an extraction pit and weir located at the western end of the site prior to entering the injection pump chamber.

Water colour will be addressed if it is found an issue in the future. The water colour issue is not included in the current scope of works.

From the injection pump station water will be injected to one existing (Hamilton) and two new (Marden) ASR bores at a maximum duty of 50 L/s at 1000 kPag using two duty pumps. Water flow from the injection pump station will be UV disinfected at 50 mJ/cm2 dose before entering the ASR bores.

6.3 MARDEN PUMP STATION

The existing Hamilton and two new Marden bores will receive water from the Felixstow Treatment Site. Injection flow rate for each bore will be controlled and maintained within a predefined range using automatic control valve and flow meter at each bore.

Bore extraction will take priority over bore injection. Extraction will be permissible if water quality measurement taken for salinity is within pre-defined operational limits. Water from bores will be pumped to the Distribution Network Storage Tanks. The level in the tank will determine number of pumps required for extraction. Maximum water flow from each bore pump will be 15 L/s.

From the Distribution Network Storage Tanks, water will be pumped by the Reticulation Pump Skid into the Distribution Network. Three duty pumps will operate to maintain pressure and flow within the predefined demand curve. Maximum duty will be 60 L/s at 900 kPa pressure.

From the Reticulation Pump Skid, water will be distributed to the Shakespeare and Langman systems.

6.4 SHAKESPEARE PUMP STATION

The Shakespeare storage and pumping site will receive water from the TBA and Marden pump stations. Water flow into the Shakespeare Network Storage Tank will be controlled by two modulating valves.

From the Network Storage Tank, water will be pumped by the Booster Pump Skid to Langman Pump Station and into the Distribution Network. Three duty pumps will operate to maintain pressure and flow within the predefined demand curve. Maximum duty will be 50 L/s at 900 kPa pressure.

6.5 LANGMAN PUMP STATION

The Langman storage and pumping site will receive water from the Shakespeare pump station. Water flow into the Langman Network Storage Tanks will be controlled by a Maric Flow Control valve.

From the Network Storage Tanks, water will be pumped by the Booster Pump Skid to into the Distribution Network. Three duty pumps will operate to maintain pressure and flow within the predefined demand curve. Maximum duty will be 50 L/s at 500 kPag pressure.

7 Civil

7.1 SITE DRAINAGE

Philosophy

External pavement design will incorporate adequate surface falls for stormwater runoff.

Building floor levels will be reviewed to ensure compliance with 1 in 100 year flooding event levels have been adequately catered for.

Stormwater from buildings will be diverted to the local stormwater system.

Drainage conduits DN 300 mm and above will be reinforced concrete rubber-ring jointed pipes conforming to AS 4058. Pipes and culverts will be Class '2' in all situations unless otherwise noted on the Drawings.

Minor stormwater pipes (e.g. downpipe connections) of size DN 225 mm and below will be solvent welded and solid walled uPVC pipes to Sewer Class SH conforming to AS 1260 unless otherwise shown on the Drawings. DN 100 mm will be the minimum pipe size installed. The minimum grade and minimum pipe cover will be in accordance with AS 3500.3.

7.2 ROADS

Un-sealed Tracks

Unsealed tracks shown accessing the pump stations will be constructed of 150mm thick PM2/20 compacted to 98% MMDD.

Sealed roads

Existing council roads will be remediated with spray seal as per existing surface.

The road reinstatement will be to match the existing pavement and will be to the satisfaction of the Council or Authority responsible for the roadway.

7.3 SITE REMEDIATION / LANDSCAPING

Site landscaping includes grassing and gravel finishes. Generally, the areas surrounding buildings and process structures are of gravel finish, and open areas are of grass finish.

Gravelled areas will consist of 40 mm single size gravel 150 mm thick layer with geotextile blanket underneath.

7.4 THRUST BLOCKS

Thrust blocks will be installed on all flexible jointed pipes (eg rubber ring joint, gibault joint etc) under pressure and at locations as indicated on the Drawings. Thrust blocks will be sized and installed in accordance with WAT-1205 of WSA 03-2002.

Polyethylene pipes when joined using butt weld joints or electro fusion to AS/NZS 4130 in buried application do not require thrust blocks.

All thrust blocks will be designed to resist the maximum pressure in the pipeline which typically is the test pressure. An allowable horizontal bearing pressure of the supporting soil will be taken into account the as recommended in the geotechnical engineer. Thrust blocks will have minimum cover of 0.5 metre above the concrete to the final surface level and will be constructed against undisturbed natural soil.

A suitably experienced Engineer will be engaged to observe the thrust block excavations and confirm that the foundation materials have properties consistent with the design assumptions.

Concrete for the thrust blocks, anchors, and concrete pipe supports will be in accordance with the Concrete Specification. Faces of the concrete against the side of the trench will be poured against a sound undisturbed face. All other faces will be formed concrete faces.

A layer of 'Fortecon' or an approved equivalent will be placed between the pipe and the concrete for compression thrust blocks located at bends.

7.5 TRENCHES

Trenches will be excavated evenly to achieve the required grade and cover to the top of the pipeline including allowance for bedding. The cover provided will not be less than 800 mm in trafficable area and not less than 600 mm in easements.

Trenches will be excavated with clean cut sides, free from all protuberances and with the bottoms evenly graded.

Trenches will be of sufficient depth to allow a minimum separation from any obstruction from any other service as nominated in Table 4.1 of the WSA 03-2002 and Table 3.1 of the WSA 04-2005.

The minimum trench width for pipe installation will be in accordance with the WSCM Section B.

Shoring will be provided in accordance with the relevant statutory requirements and as required to support the wall of the excavation and to prevent any movement which can in any way injure personnel or endanger any adjacent pavements, buildings, conduits, or other structures.

7.6 GEOTECHNICAL

Geotechnical investigations have been undertaken at the following sites by Wallbridge & Gilbert:

- Felixstow Reserve and
- Langman Reserve

Details of the geotechnical conditions are available within the following reports:

- "Proposed Wetland Felixstow Reserve, Felixstow, Geotechnical Investigation" dated May 2014.
- "Proposed Biofilter and Tanks Max Amber Reserve, Paradise, Geotechnical Investigation" dated December 2014.
- "Proposed Water Storage Tanks, Langman Reserve, Burnside, Geotechnical Investigation" dated October 2014.

Proposed site works

Site works will include:

- Clearing and grubbing
- Stripping, stockpile and respreading of topsoil
- Excavation and trenching
- Removal and disposal of surplus and contaminated soil
- Importing of fill material and re-use of excavated material
- Backfill, bulk fill and compaction

General requirements for the site preparation and works are included on the civil and structural drawings.

Any non-engineered fill and any organic topsoil will be stripped from the proposed building areas. Following stripping, the exposed upper 200 mm of soil will be moisture conditioned to within ±2% of the optimum moisture content and compacted with a vibrating pad foot roller to achieve a dry density ratio of at least 98% based on Standard compaction (AS1289 5.1.1). Any soft, wet, weak or organic materials encountered during compaction will be removed and replaced with compacted select fill.

Select imported fill required to achieve design levels will comprise a quarry sand, quarry rubble or recycled pavement material with a soaked CBR of at least 15%. The fill will be compacted in layers not exceeding 200 mm in loose thickness to achieve a dry density ratio of at least 95% based on Modified compaction (AS 1289 5.2.1).

8 Structural

8.1 STRUCTURAL SCOPE

The scope of structural specification is as described in Section 2 – Introduction and Section 0 – Project Scope

Structural items included in Section 0 – Structural specification are non-liquid retaining and liquid retaining concrete structures and steel framed buildings.

8.2 SITE WIDE DESIGN PARAMETERS

Importance level to the National Construction Code (NCC)

In accordance with the NCC Guidelines buildings and structures within this WPE project have Importance Level classification of 2.

Design life and annual probability of exceedance

The design life of various asset components is included in Section 4 – Design Principles Table 4.1.

In accordance with Section B1.2 of the BCA and AS/NZS 1170.0, the annual probability of exceedance for ultimate limit state events, based on the design life of structures given in Section 4, are set out in Table 8.1.

Structure Type	Design Life	Annual probability of exceedance	
		Wind	Earthquake
Concrete liquid storage tanks, excluding tank roof covers	80 years	1:1000	1:1000
Buildings, concrete structures, covers to tanks and other structures	≤ 50 years	1:500	1:500

Table 8.1: Design life and annual probability of exceedance for ultimate limit state

The annual probability of exceedance for serviceability limit state for wind is 1:25, as per AS/NZS1170.0 Appendix C.

AS1170.4 does not stipulate any serviceability limit state annual probability of exceedance for earthquake in Importance Level 1, 2 or 3 structures – refer AS 1170.4 Cl 2.2. However, as AS 3735 requires consideration of serviceability limit state earthquake effect for liquid retaining structures, an annual probability of exceedance of 1:25 has been chosen, to be consistent with AS1170.5 for similar importance level structures.

The annual probability of exceedance for temporary construction loads is 1:100, using a design life of 6 months, as per AS/NZS 1170.0.

Ambient air and liquid temperature

- Ambient air
  - Minimum 0 C
  - Maximum 50 C

- Water (unless confirmed otherwise by the process design)
  - Minimum 5C
  - Maximum 30C

8.3 DESIGN LOADS

Permanent loads will include the self-weight of all structural elements, using the following densities:

- Concrete 25 kN/m3
- Steel 78.5 kN/m3

Superimposed permanent loads

- Metal roof cladding - proprietary data (normally 0.05kPa)
- Services hung from electrical switch room roof - to be assessed for each case
- Building services (other) 0.10kPa
- Ceiling (non-fire rated) 0.20kPa

Mechanical equipment loads

Mechanical equipment self-weight will be included as imposed loads for the purpose of structural analysis. Equipment loads will be verified by the equipment supplier / vendor and will clearly state if they are allowable (working) stress design loads or ultimate limit state design loads and be factored accordingly.

Equipment load includes piping self-weight, pipe supports, insulation, cabling and cable trays that form part of the supplied equipment. If this information is unavailable from the vendor when required for structural design of the supporting structures, the mechanical design team will advise on suitable allowance to be made.

The reactions supplied by vendors will include empty, operating, test, upset, dynamic, seismic and wind loads as applicable. Reactions will be provided in/about horizontal and vertical directions. The vendors shall also supply the location of the centre of gravity of the equipment.

Where applicable dynamic loads or affects resulting from rotating, reciprocating and vibrating machinery and any associated impact forces are to be advised by the vendor. Structures supporting such machinery will be assessed for frequency response.

Hydrostatic loads

The following densities will be used for liquids:

- Fresh water, reuse water 1000 kg/m3

Imposed (live) loads, Q

Design imposed loads will be in accordance with AS/NZS 1170.1. The following imposed loads are applicable to the project.

(a) Non-trafficable roof live load, Qroof

Primary structural elements

- 0.25 kPa

Secondary structural elements (eg. Purlins, secondary beams) for sheet metal roofs

- (1.8/A) + 0.12 (≥ 0.25 kPa) on tributary area

(b) Floor live loads (other areas)

- Amenities building floor: 3 kPa
- Switch room floor: equipment load (≥ 5 kPa) + 5 kPa on remaining areas
- Stairs/working platforms/covers to pump: 4 kPa
- Access walkways: 2.5 kPa
- Rollover bunded slabs on ground/wash down areas etc.: 1 x 16 t axle load or 10 kPa
- Bunded slabs on ground: equipment load (≥ 5 kPa) + 5 kPa on remaining areas

(c) Loads on pipe supports

The loads will be supplied by the piping designer.

Combinations for loads on pipe supports:

- Longitudinal pipe loads need not be considered in conjunction with earthquake loads
- Piping longitudinal thermal loads may be reduced by 50% when used in combination with wind loads.

(d) Thrust forces

Forces caused by pipe/ducting heads internal pressures and flow velocities in pipes will be considered in the design of thrust blocks, pipe penetrations through walls and slabs and pipe supports. Design approach to be in accordance with water supply code of Australia, Part 1: Planning and Design, WSA 03-2002 V2.3. Loads will be obtained from a pipe stress analysis or determined by simple rational methods of calculation.

8.4 WIND LOADS

Design wind speeds

Design wind loads shall be calculated in accordance with AS/NZS 1170.2, using Basic Wind Speeds for Region A1, Terrain Category 2.5 and Directional Multipliers applicable to the location of the site.

Basic directional wind speeds are as follows:

Structures with design life of 80 years

- V25 = 37m/s serviceability limit state
- V1000 = 46m/s ultimate limit state

Structures with design life of ≤ 50 years

- V25 = 37m/s serviceability limit state
- V500 = 45m/s ultimate limit state

8.5 GROUNDWATER AND EARTH PRESSURE LOADS

Groundwater and earth pressure shall be calculated using information provided in the Geotechnical Report and AS4678.

Surcharge loads on retained earth

- Construction surcharge = 10 kPa or small vibrating roller 3 t x 1.8 m wide
- Operational surcharge = 10 kPa

Flotation

Design for resistance to flotation will be in accordance with AS/NZS 1170.0 with load cases rearranged as follows:

Ed = 0.9 G + 1.2 Fgw

Ed = Design action effect

Fgw = load corresponding to groundwater level

Resistance to uplift due to groundwater level will be calculated based on the weight of structure and weight of soil on any outstands only.

A sensitivity check on buoyancy effects shall be carried out, taking into consideration fluctuations in groundwater due to seasonal effects and variations in operating levels.

For flotation due to design flood condition, weight of plant and equipment and retained liquids to normal operating level can also be used in calculating resistance to flotation.

Significant structures will be surrounded by Ag drains to channel accumulated drainage water to control points.

Earthquake Loads

Ultimate limit state earthquake loads shall be calculated in accordance with AS 1170.4, based on probability of exceedance given in other section and using the following factors:

- Probability Factor
  - Buildings kp = 1.0
  - Storage Tanks, kp = 1.8
- Hazard Factor Z = 0.10
- Site sub-soil class Class De
- Design Category II (all structures are less than 25 m tall)

Convective and impulsive contents (liquid retaining structures)

Convective and Impulsive loading from stored liquid in liquid retaining structures shall be determined in accordance with NZS 3106 Cl. 2.2.9.2 for both principal plan dimensions of the tank. For the purpose of this load assessment, the level of stored liquids shall be the level under normal operating conditions.

Thermal load effects

Where subject to direct solar radiation, the temperature gradient for concrete liquid retaining structures shall be assessed in accordance with AS3735 Cl. 2.2.1.

The positive and negative temperature gradients to be used in the design for full and empty tanks shall be the most critical between code parameters and those calculated using operating liquid temperatures coinciding with ambient air temperature variations.

8.6 STRUCTURAL STEELWORK

Steel structures will be designed in accordance with AS/NZS 4100.

- Hot-rolled plates, floor plates and slabs will be in accordance with AS/NZS 3678
- hot-rolled bars and sections will be in accordance with AS/NZS 3679.1
- Welding will be in accordance with AS 1554.
- Coatings for steel work, where applicable, will be in accordance with AS 4680, TS 12 and TS 82.

8.7 STEEL REINFORCEMENT

Steel reinforcement materials will be supplied in accordance with AS/NZS4671.

8.8 CONCRETE WORK

Concrete supply will generally be in accordance with AS1379.

Portland and blended cements will be in accordance with AS 3972.

Supplementary cementitious materials (fly ash) for use with portland cement will be in accordance with AS 3582.1.

Formwork for the pouring of concrete will be in accordance with AS3610.

Concrete work will be tested in accordance with AS 1012.

Liquid retaining structures will be designed in accordance with AS 3735.

Earthquake loads on liquid retaining structures will be in accordance with NZS 3106.

- Load combinations for serviceability will include tank-empty and tank-full cases as well as short-term and long-term effects (AS 3735 Cl. 2.4).
- Limiting steel stresses for serviceability will satisfy design parameters in Table 3.2 and Table 3.5 of AS 3735.

Concrete structures that are non-liquid retaining will be designed in accordance with AS 3600.

Load combinations for serviceability ultimate limit state will be in accordance with AS/NZS 1170.0.

8.9 DURABILITY / EXPOSURE CLASSIFICATION

Non-liquid retaining concrete structures: Buildings and others concrete will have a minimum Grade S40 in accordance with.

Exposure classification is in accordance with AS 3600:2001, Table 4.3.

Precast panels (interior / exterior) exposure B1, 30 mm cover (with calcite admixture)

In situ concrete (non-aggressive soil face / other) exposure A2, 50 mm cover

Liquid retaining concrete structure concrete shall be minimum Grade S40 in accordance with.

Exposure classification is in accordance with AS3600:2001, Table 4.3.

- Wet face – submerged : exposure U, 65 mm cover
- Wet face – splash zone: exposure U, 65 mm cover
- Non-aggressive Soil / exposed face: exposure A2, 50 mm cover

8.10 FIRE RESISTANCE LEVELS IN BUILDINGS

Fire resistance levels for structural elements shall be determined in accordance with AS 3600:2001, Section 5 and the NCC and any subsequent relaxations.

Fire separation requirements between electrical and switch rooms and other rooms contained within the same building: FRL – 120/120/120.

9 Buildings

9.1 GENERAL REQUIREMENTS

This section describes the requirements for the permanent site buildings.

Sections 9.2 through 9.9 provide the general requirements applicable to all buildings. This is followed by specific requirements applicable to each building. The specific requirements for each building will govern over the general requirements, and are provided as follows:

- Section 9.11 – Marden Booster Pump Station Building
- Section 9.12 – Felixstow Control Building
- Section 9.13 – Shakespeare Booster Pump Station Building

All buildings will be designed and constructed to meet the requirements of the National Construction Code (NCC), Australian Building Code and relevant Australian Standards.

All buildings will be of steel frame construction.

9.2 STEEL FRAME

The main structural system is a steel portal frame.

9.3 WALLS

Exterior walls will consist of:

- Steel framed structural system.
- Expansion joints at all structural columns.
- Colorbond sheet cladding or equivalent on external side with pale eucalypt Colorbond finish
- Thermal and noise insulation as required
- Profiled foam weather stop trims at all material junctions.

Penetrations

Penetrations through the wall cladding will be minimised and will be grouped together where possible.

All penetrations will be sealed with profiled foam weather stop trims.

9.4 ROOFING

Roofing will consist of:

- Colorbond roof sheeting, cold-rolled gutter stormwater collection system, with external overflow
- Profiled foam weather stop trims under all flashings.
- Thermal insulation
- Have a light-green eucalyptus finish
- Protrude minimum of 50 mm across the stormwater gutter.
- Lashing points for temporary access.

Penetrations through the roofing will be minimised and will be grouped together where possible.

9.5 INSULATION

Insulation design will consider climatic conditions, building construction type, passive solar design, and auxiliary heating and/or cooling.

Insulation for roofing will consist of polyester insulation with sisalation to lined areas

Insulation for ceilings will consist of polyester insulation.

Insulation for walls will consist of:

- Polyester insulation with sisalation to external walls (lined and unlined)
- Polyester insulation to internal walls

9.6 FLOORING

Flooring will generally consist of the exposed concrete slab with no additional surfaces or finishing. Where floor coverings or finishing is required, this will be in accordance with the tender drawings

9.7 DOORS

The following door types will be provided, where specified:

- Hinged internal doors
- Hinged external doors
- Roller doors

Where sound attenuation is required, hinged doors will be steel clad solid-core without glazing.

Doors details will be as specified on the design drawings

9.8 WINDOWS

All windows will be fixed, as specified on the design drawings.

9.9 SECURITY

All external doors and windows will be lockable as per TOW technical standard.

No electrical security alarms will be provided.

9.10 VENTILATION

Mechanical ventilation will be provided and will comprise the following:

- Inlet ducting with rain louvres and vermin mesh
- Evaporator pads to inlet ducts
- Fans capable of providing not less than 15 air changes per hour
- Outlet vents with rain louvres and vermin mesh
- Thermostat and water circulation pump

9.11 MARDEN BOOSTER PUMP STATION BUILDING

The Marden Booster Pump Station Building layout will be as shown on drawing G220-006-04 (refer appendices).

The design and layout of the Marden Booster Pump Station Building will be as described in Table 9.1.

Fittings for the Marden Booster Pump Station Building will be provided as described in Table 9.2.

Table 9.1 – Design and layout of Marden Booster Pump Station Building

DESIGN ELEMENT	SPECIFICATION
Structural	Steel frame construction as per Section 9.2
Walls	Exterior walls as per Section 9.3;
Roofing	Roofing as per Section 9.4
Ceiling	None
Insulation	Insulation as per Section 9.5
Flooring	Exposed concrete floor slab, as described in Section 9.6
Doors	External doors will be steel clad solid-core construction, for noise attenuation, as per Section 9.7; Hinged External Doors Internal doors will be as per Section 9.7; Hinged Internal Doors Roller doors will be standard doors without noise attenuation Quantities as per the layout drawings
Windows	As per the layout drawings
Security	None

Fittings

Fittings, including furniture and equipment, will be provided for each room as described in the following tables and the tender drawings:

Table 9.2 – Fittings for entrance / sign-in area

ITEM	SPECIFICATION
1 x Frame for staff contact list	Easy loader poster frame, wall mounted A4 size, single sided mini-frame in matt natural aluminium
1 x Entrance matting	Nuway, reversible matting. Combination EPDM wiper strips/Aluminium scraper strips and rubber spacers With recess frame (Nuway, Aluminium).

9.12 FELIXSTOW CONTROL BUILDING

The Felixstow Building layout will be as shown on drawing G220-006-05 (refer appendices).

The design and layout of the Felixstow Building will be as described in Table 9.3.

Fittings for the Felixstow Building will be provided as described in Table 9.4.

Table 9.3: Design and layout of Felixstow Building

DESIGN ELEMENT	SPECIFICATION
Structural	Steel frame construction as per Section 9.2
Walls	Exterior walls as per Section 9.3;
Roofing	Roofing as per Section 9.4
Ceiling	None
Insulation	Insulation as per Section 9.5
Flooring	Exposed concrete floor slab, as described in Section 9.6
Doors	External doors will be steel clad solid-core construction, for noise attenuation, as per Section 9.7; Hinged External Doors Internal doors will be as per Section 9.7; Hinged Internal Doors Roller doors will be standard doors without noise attenuation Quantities as per the layout drawings
Windows	As per the layout drawings
Security	None

Fittings

Fittings, including furniture and equipment will be provided for each room as described in the following tables and the drawings:

Table 9.4: Fittings for entrance / sign-in area

ITEM	SPECIFICATION
1 x Frame for staff contact list	Easy loader poster frame, wall mounted A4 size, single sided mini-frame in matt natural aluminium
1 x Entrance matting	Nuway, reversible matting. Combination EPDM wiper strips/Aluminium scraper strips and rubber spacers With recess frame (Nuway, Aluminium).

9.13 SHAKESPEARE BOOSTER PUMP STATION BUILDING

The Shakespeare Booster Pump Station Building layout will be as shown on drawing G220-006-07 (refer appendices).

The design and layout of the Shakespeare Booster Pump Station Building will be as described in Table 9.5.

Fittings for the Shakespeare Booster Pump Station Building will be provided as described in Table 9.6.

Table 9.5 – Design and layout of Shakespeare Booster Pump Station Building

DESIGN ELEMENT	SPECIFICATION
Structural	Steel frame construction as per Section 9.2
Walls	Exterior walls as per Section 9.3;
Roofing	Roofing as per Section 9.4
Ceiling	None
Insulation	Insulation as per Section 9.5
Flooring	Exposed concrete floor slab, as described in Section 9.6
Doors	External doors will be steel clad solid-core construction, for noise attenuation, as per Section 9.7; Hinged External Doors Internal doors will be as per Section 9.7; Hinged Internal Doors Roller doors will be standard doors without noise attenuation Quantities as per the layout drawings
Windows	As per the layout drawings
Security	None

Fittings

Fittings, including furniture and equipment, will be provided for each room as described in the following tables and the tender drawings:

Table 9.6 – Fittings for entrance / sign-in area

ITEM	SPECIFICATION
1 x Frame for staff contact list	Easy loader poster frame, wall mounted A4 size, single sided mini-frame in matt natural aluminium
1 x Entrance matting	Nuway, reversible matting. Combination EPDM wiper strips/Aluminium scraper strips and rubber spacers With recess frame (Nuway, Aluminium).

10 Mechanical Equipment

10.1 GENERAL

This section describes the minimum requirements for design, supply, installation, testing and commissioning of mechanical plant and equipment included in the Scope of Works.

10.2 SPACING BETWEEN EQUIPMENT

In the selection and placement of equipment, Contractor will ensure that access and egress requirements are maintained in accordance with the South Australian Work, Health and Safety Regulations.

Plinths for equipment will be located with consideration to operating and maintenance access. Manufacturer's recommendations for minimum maintenance access will be followed.

A minimum clear distance of 600 mm will be maintained between equipment, including concrete plinths, for personnel access.

A minimum clear distance of 750 mm will be maintained between equipment, including concrete plinths, where maintenance is required.

10.3 MATERIAL STORAGE AND HANDLING

The equipment manufacturer's recommendations for stacking or storage will be implemented where applicable.

All equipment will be inspected immediately upon receipt on site. The Internal spaces of equipment will be checked for foreign materials, which, if found will be cleared. Anti-brinelling devices will only be removed after the equipment is placed in its final location.

All pipes and valves will have protective end covers fitted to prevent ingress of water or dirt. Bevels on butt welding fittings and flanges will also be suitably protected.

Surfaces of piping components will be kept free of foreign materials such as grease, paint, oil and the like.

Stainless steel components and equipment will be stored, away from storage areas for carbon steel and other materials to avoid direct contact between carbon steel and stainless steel. Stainless steel materials will be stored on non-metallic pallets.

10.4 GENERAL EQUIPMENT SUPPLY

All plant and equipment will be designed, supplied, installed, tested and commissioned in accordance with the relevant specifications, the P&IDs, the GA drawings, structural drawings, referenced standards and codes, and any instructions and drawings supplied by equipment vendors and suppliers.

Installation of the equipment will not commence until 14 days after the pouring of the concrete foundations unless approved otherwise by the Project Manager.

Equipment will be designed to prevent the accumulation of spilled material, dust and water.

Where equipment or machinery is required to be assembled outdoors, it will not be carried out in wet or dusty conditions unless the work area is suitably protected.

Non-structural fastenings including flanges, guards, and mounting points for mechanical equipment will have the fasteners coated with a suitable anti-seize compound at final assembly.

10.5 EQUIPMENT SCHEDULES

The equipment to be supplied, installed, tested and commissioned under this Contract is detailed in the Mechanical, Valve and Instrument Equipment Schedules located in the Technical Schedule.

10.6 ELECTRIC MOTORS

All motors will be supplied in accordance with the sizes, type and quantities shown on the Mechanical Schedule and P&IDs.

All due care will be taken when handling motors to avoid damage through impact and improper shaft loading. Temporary shaft locking devices will be used, during installation and removed upon completion. All lifting, positioning and alignment of motors will be carried out using proper lifting points and alignment screws only.

Driven equipment and motors will be mounted together on a common base where practicable. The equipment will be so designed as to prevent thrust loads being transmitted to the motor.

10.7 GUARDING

All drives and couplings will be suitably guarded in accordance with AS 4024 and the Occupational Health and Safety regulations. All guards will be rigid, removable and totally enclose the drive and exposed shafts, and be designed to facilitate a 50% increase in diameter of the drive and drive pulleys.

10.8 EQUIPMENT BASES

Equipment bases will be rigidly constructed of fabricated steel unless otherwise approved.

Equipment will be assembled and mounted on the base in the shop prior to delivery where applicable.

Bases will be designed to avoid the accumulation of foreign matter such as dirt or water.

Where mild steel fabricated bases are supplied they will be galvanised

10.9 LEVELING AND ALIGNMENT OF EQUIPMENT

Contractor will supply all equipment required for the levelling and alignment of machinery and rotating equipment. This will include all shims, packers, jacking screws, and verified measuring equipment necessary to complete the works.

All drive and driven equipment, whether pre-assembled or not, will be properly aligned once installed. Contractor will check the alignment of the rotating elements in the equipment where relevant and correct the alignment as necessary.

All equipment will be aligned in accordance with the manufacturer's requirements and tolerances. Where equipment is sourced from multiple manufacturers, the most stringent tolerances will apply.

Packers will be of sufficient size to sustain an effective load bearing area and will be of one piece thickness. Shims will be of the same size as the packer. Shim material will be brass or stainless steel. Aluminium stock is not acceptable.

Pumps, fans and compressor bases will have blocks and adjusting screws to assist the alignment of all components.

Where alignment adjustment is required, electric motors will be moved in preference to driven equipment.

No loads will be applied to shafts and other rotating elements to alter the alignment.

All adjusting screws will be wrapped with "Denso" tape after final alignment.

As a minimum, alignment will be undertaken using dial indicators to measure coupling flange offset and angular misalignment as the shafts are rotated through 360°.

Allowance will be made for potential movements such as thermal expansion or contraction, installation of flanges and pipework, and hydraulic loading during alignment of drive and driven equipment.

Field alignment test records will be completed and recorded as part of the quality surveillance requirements.

All Quality requirements will be described in the Project Quality Management Plan.

10.10 GROUTING AND PERMANENT FIXING

Grouting materials and methods will be in accordance with the following:

- Cement grout will be prepared from cement, clean dry sharp sand and an approved expanding additive. The materials will be mixed in strict proportions and will be thoroughly mixed dry before any water is added. The prepared grout will be dry packed and firmly tamped or rammed.
- Epoxy mortar will be prepared and applied in accordance with the manufacturers written instructions.
- Concrete surfaces will be scabbled and prepared for grouting and all load surfaces and tolerance tube pockets thoroughly cleaned. The equipment will be grouted with an approved non-shrink, non-rust epoxy grout mix and struck off square with the sole, bed or base plate periphery.
- Secondary grouting and edging will be with an approved non-shrink, non-rust grout mix.
- Base-plates will be supported during grouting on blocks or wedges, which will be removed after the grout has hardened. Base plates may be supported by locking jack screws or, for small base-plates, by the double nut method.
- After grouting the plant, the Contractor will finish the exposed surfaces of the foundation and plinth smooth and even with edges bevelled at 45°.
- All anchor bolts will be re-torqued after final set of grout.

10.11 WELDING AND CUTTING FOR EQUIPMENT ON SITE

Welding will be adequate for the equipment design and mechanical requirements, and will comply with the requirements of AS 1554 for structural welding or AS4041 for pipework welding.

Where welding is required, the work will be planned in sections that permit a maximum amount of welding to be completed at ground level.

All welding will be performed with the earth lead attached firmly and as closely to the striking arc as possible, to avoid damage to bearings and gears by direct or stray electrical currents.

All flame cutting will comply with the requirements of AS 1674.

10.12 PASSIVATION

All stainless steel items will be passivated prior to delivery to site by pickling bath where possible. Where site welds occur, damaged during delivery or installation the Contractor will re-passivate the affected areas.

10.13 PROPRIETY EQUIPMENT PAINTING STANDARDS

Unless stated otherwise all propriety or package equipment will be painted to the manufacturer's standard specification.

10.14 NOISE AND VIBRATION

The Contractor will design and install process equipment, pipework and valves in a manner to minimise the transmission of vibration and noise from rotating or reciprocating equipment.

10.15 TAG NUMBERS

All equipment and valves will be tagged as per the Mechanical Equipment and Valve Schedules. The tags will be stamped stainless steel or engraved on white Traffolyte, in black Arial text 3 mm high. The tag will be permanently fixed and located so that the tag number is easily visible.

10.16 PIPEWORK

General

Contractor will supply and install all pipework including valves, fittings, etc. and associated pipe supports and anchors as shown on the drawings.

Pipe classes are shown on the Pipe Schedule.

Pipe materials are shown on the Pipe Schedule.

Buried flexible pipelines will be installed in accordance with AS/NZS 2566.2. Buried pipework will be clearly marked in situ as well as on plans.

Stainless steel

Unless otherwise specified, all stainless steel pipework will be manufactured from Grade 316L or Grade 316 stainless steel tube and fittings.

All instrumentation tubing will be manufactured from Grade 316 stainless steel seamless tube and suitable for use with Grade 316 stainless steel compression fittings. Stainless steel will not be painted.

PVC pipes and fittings

Underground PVC pressure pipe and fittings will be mPVC Series 2 and will comply with AS 4765.

Aboveground PVC pressure pipe and fittings will be uPVC Series 1 and will comply with AS 1477.

PVC non-pressure drain, waste and vent pipe and fittings will comply with AS/NZS 1260.

HDPE

HDPE pipe will be used above ground only where shown on the contract drawings. Any other above ground use must be approved by the Superintendent. Underground HDPE pressure pipe and fittings will comply with AS/NZS 5065.

Pipe identification

All above ground pipes will be labelled with the fluid being conveyed. Colours and labelling of pipework will be as per AS1345.

Connections to Existing Services

Contractor will complete all connections to existing services for the contract.

- Jointing — general
    - Jointing will be carried out in accordance with the manufacturer's written instructions and will be within the pipe joint deflection specified.
- Jointing — plastic pipes
    - Contractor will ensure that all work associated with the laying of plastic pipes is carried out under the direct supervision of a person with accredited training for the given product.
- Jointing — expansion
    - Where pipework is exposed or subject to temperature variations. The installation will include expansion loops or other approved devices to take account of thermal expansion. Expansion joints, anchors and guides will be sized to accommodate movement due to the thermal and operational load.

Pipe supports and anchors

All pipework must be adequately supported to prevent sagging and excessive distortion. Brackets, hangers, saddles, straps and supports will be used where necessary. They will be in accordance with the manufacturer's requirements, and at sudden changes in direction.

Materials of construction will be mild steel, hot dip galvanised. Stainless steel grade 316 supports will be used for supports that are submerged or within 300 mm of Top Water Level (TWL).

For pipes that are greater than DN100, brackets, hangers, saddles, straps and supports will provide a continuous support for at least 120 degrees of the circumference and will generally be a minimum of 25 mm wide.

Where movement is likely to occur due to thrust pressures, the pipework should be fixed firmly in place, such that the support is designed to withstand (absorb) the maximum force.

The seats of the supports between the bolted straps and pipe will be 1 mm insertion rubber or HDPE slip bearing inserts.

Supports for above ground plastic pipework will be designed to allow for thermal variations to prevent abrasion and wear on the outer pipe surface, due to an expansion and contraction of the pipe material.

10.17 FLANGES

Unless specified or shown otherwise, all flanges will be in accordance with AS 4087 PN16.

Flanges will have a pressure rating equivalent to the rated pressure of the adjacent pipe.

Flange gaskets will be 3 mm thick full face type EPDM or an approved neoprene.

The contractor will assemble these connections in accordance with GO's Flange Bolting Sequence & Torque Wrench Settings Procedure.

If plastic flanges are used then a suitable metallic backing flange will also be provided.

Bolts and nuts for the flange connections will be selected in accordance with AS 4087.

The bolt lengths will be such that after the joint has been completed, the bolt will protrude through the nut, but not more than 25 mm.

Bolt materials will be mild steel, hot dip galvanised. Stainless steel grade 316 will be used on pipes that are stainless steel, submerged or within 300 mm of Top Water Level (TWL).

Dissimilar metal flanges shall be insulated.

All buried flange joints shall be wrapped using petroleum tape/mastic and PVC overwrap (Denso or approved equivalent).

10.18 FLEXIBLE RUBBER COUPLINGS

Flexible rubber couplings for suction and discharge connections to mechanical equipment will have integral duck and rubber flanges. Couplings will be equipped with galvanised steel flange retaining rings. Couplings will be selected to match pipeline and/or equipment connections size and meet the operating conditions.

Flexible rubber couplings installed adjacent to a wafer type or other through bolted type valve or fitting will be equipped with a steel spacer flange to prevent distortion of the rubber coupling flange.

Control rods, consisting of at least two bolts will be provided where necessary to limit extension of the coupling.

10.19 CAST-INS

Cast-in's that penetrate reinforced concrete walls or floors, of water retaining structures will be SS 316 or superior. All other pipe that passes through walls or floor will be the same as the parent pipe.

10.20 VALVES

General

All valve sizes, type and quantities are shown on the Valve Schedule and P&IDs.

Valve selection will consider corrosion issues and possible blockages.

All valves of the same size, duty and type will be identical. All parts of valves will be suitable for the design pressure and temperature conditions and duty.

Valves will be located and/or orientated so that manual operation may be carried out with ease.

Valves will generally be clockwise to close unless otherwise specified

All valves and their actuators will be installed in accordance with the manufacturer's instructions. They will be easily accessible for maintenance purposes and be capable of being removed from their location in a pipeline without obstruction by the pipeline or other equipment. Unions may be installed for this purpose on pipes DN100 and smaller.

Valves will be designed and manufactured in accordance with the relevant Australian and ISO standards. All valves and actuators installed will have a proven record of reliable operation in water treatment plant environments and will have readily available spare parts.

Valves will be of standard and proven design to give good performance in meeting the specified operating conditions. The valve will be capable of opening against full unbalanced head and closing against full flow and will open and close smoothly without vibration or cavitation.

The maximum effort required at the hand wheel will not exceed 150 Nm under the worst conditions of differential head or unseating force. If Gear operators are provided to meet the above they will be watertight and if installed in a pit or aboveground to be provided with an indicator to show the valve position.

The size, shape, strength and rating of all parts will be of sufficient strength to provide an ample factor of safety under all working conditions.

10.21 VALVE TYPES

Resilient seated gate valves

All resilient seated gate valves will comply with AS 2638.2.

Knife edged gate valve

Knife gate valves will be uni-directional knife edge gate valves of self-cleaning design, with a minimum bore of 100% pipe area.

Valve construction will conform to AS 6401 with materials suitable for corrosive and abrasive sewage grit, sludge and scum slurries and operating in an aggressive environment. Basic material requirements will conform to AS 6401 Table 2.1.

Knife gate valves will be of the lugged wafer type with 316 stainless steel bodies and 316 stainless steel gates. Spindles will be of the rising type. The valves will be bonneted.

The spindle will be stainless steel rising spindle type with a full depth square thread.

The valves will have self-cleaning features and be able to cut and dislodge stringy material that may be caught during closing. There will be no protrusion into raw sewage flow as the flow may contain rags and stringy material.

The valves will preferably be drop tight in the closed position. The maximum permissible leakage will be 40 mL/min/25 mm of nominated diameter.

The maximum effort required at the hand wheel will not exceed 150N under the worst conditions of differential head or unseating force. Parts in turning or sliding contact will be of dissimilar corrosion resistant material.

Diaphragm valves

All manual diaphragm valves will have bonnet assemblies with a rising hand wheel design where the mild steel spindle is lubricated after each operation or the spindle is of stainless steel and will have a distinctive visual indicator.

All solids carrying lines will be equipped with full bore valves. Weir type valves may only be used on air or water pipelines.

Butterfly valves

Butterfly will have a minimum bore of 100% of the pipe area. Butterfly valves will conform to AS 4795. Butterfly valves will be installed so that they can be readily removed from the pipework.

The valve bodies will be lugged to attach the valve to the pipeline. Valve lugs will be drilled and tapped to AS 4087 PN16. This is to allow for isolation and removal of downstream pipework.

Unless specified or required otherwise, the pressure rating will be not less than 1000kPa.

Valve discs will be made of cast iron, ductile iron or stainless steel with no external ribs transverse to the flow. Disc will seat at a 90 degrees angle to the axis of the pipeline.

Butterfly valves in chambers or aboveground will be equipped with an indicator to show the disc position.

Valve seats will be designed to be drop tight in both directions at the pressure differentials applicable to the supplied valve classes.

Lever operated butterfly valve will have notch position setting plates.

Ball valves

Ball valves will have a minimum bore of 100% of the pipe area. All ball valves will comply with AS 4796.

Stainless steel ball valves will be Stainless steel 316 with PTFE seats.

PVC Ball valve materials will comply with Appendix D of AS 4796.

Non-return valves

Non-return valves will be orientated in the horizontal plane and generally will have the same nominal diameter as the pipework.

The tilt-disc type, Non-return (reflux) valves 80 mm diameter and over will be cast iron body, counter-balanced lever swing gate type with a clear opening at least equal to that of the connecting pipe. These valves will comply with AS 4794.

Reflux valves for water piping less than 100 mm diameter could be bronze body full bore type with freely moving bronze disc, and will comply with AS1628.

All reflux valves will be fitted with a type 316 stainless steel spindle extension, 'O' ring sealed and provision for limit switch where necessary. The plain bearings will be of the self-lubricating sleeve type.

Electric Valve Actuators

Automated valves will be provided complete with all actuators, positioners, pilot valves, solenoid valves, internal piping, strainers and the like, so that they are a complete and operable. Valves supplied with electric actuators will have limit switches to show when the valve is either open or closed.

Electric valve actuators will comply with relevant Australian standards and requirements of the Electrical section of the Specifications. The electric actuators will be complete with position indicator, travel & torque limit switches and hand wheel override. The manual drive will disengage when the motor drive is started.

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Valve coatings

Coating of cast and ductile iron valves will comply with AS 4158.

Markings

The following lettering will be cast on the body of the valves equal to or greater than 100 mm diameter:

- Manufacturer's Brand
- Valve size
- Pressure rating kPa
- If applicable an arrow denoting the preferred sealing direction or flow direction (check valves only)

The face of each hand wheel will be clearly marked with the words OPEN and SHUT with arrows adjacent to indicate the direction of rotation to which each refers.

All valves will be identified with SS316 or white PVC valve tags showing stating their valve tag as per section 10.15.

10.22 PUMPS

General

For materials of construction, make model and duty refer to the Mechanical Equipment Schedule.

The pump selection will take into account the NPSH available & NPSH required by the pump for the full range of flow rates and operating conditions specified by the process design.

Pumps, motors, and ancillary components will be suitable for continuous full load duty. Motors will not be overloaded for any condition of pump operation. High speed pumps with speeds in excess of 3000 rpm will not be considered.

The pump assembly and drive components will be mounted and aligned on a common base plate. The base plate will be of suitable size and substantial construction to ensure minimal distortion throughout its operational life. Base plates will be provided with drain holes. Hot dipped galvanised contact points for pumps and motors will be machined after galvanising.

Castings will be free of cracks, shrink holes, blow holes, scale, blisters and other defects. Repairs of cast components will only be carried out with prior approval of the Superintendent.

All drive and couplings will be suitably guarded in accordance with AS 4024.1— Safety in Machinery, to comply with all WHS requirements.

All process pumps will be fitted with single cartridge type, mechanical seals with suitable materials selected for the operating environment.

Lifting lugs will be provided to facilitate handling during installation maintenance and removal.

GO

Mechanical seals

Mechanical seals will be provided on all shafts of a reliable design appropriate for the service conditions (i.e. fluid being pumped, pressure, temperature and hazardous area classification).

Unless the pump vendor supplies a specific mechanical seal type, it is expected that all mechanical seals will be of the balanced and multi-spring cartridge type with self-aligning stationary. The mechanical seal arrangement will be designed in such a manner that it allows easy access to remove and exchange the seal without the need to disassemble the entire pump.

Seals of ceramic on carbon faces or solid silicon carbide on carbon will be preferred. Hastelloy C springs, EPR O-rings and stainless steel mounting sleeve and sealing flange will also be preferred.

The mechanical seal will always be lubricated to protect the seal in dry running cases.

Bearings and lubricants

Anti-friction bearings within the pump (excluding motor bearings) will be selected for a minimum service life of 50,000 hours in continuous pump operation at rated conditions (calculated in accordance with AS 2729).

High-grade industrial bearings or precision bearings will be used.

The pump bearings will be in accordance with the following:

- pump bearings will be steel caged ball bearings, sealed to prevent contamination and fitted in machined housings located with dowels to assist maintenance
- bearing housings will be either split or easily removable from the rotating element for ease of service
- Rolling element retainers will be one-piece pressed steel or bronze. Riveted metal or non-metallic retainers are not acceptable.
- Bearings will be designed for all thrust forces in both directions during starting, running, stopping, and for the complete operating speed range.
- All pump and motor units are to be adequately lubricated and protected against brinelling prior to transporting to site.

Pump performance and selection

Pumps will be designed to perform the duties and operate across the ranges as specified on the relevant data sheets. Pump head curves will rise continuously from design head point(s) to shut off.

Each pump will be designed to ensure that there will be an adequate margin between required NPSH and available NPSH for satisfactory operation at run out conditions.

Gear driven pumps will not be considered.

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Rationalisation

When supplying multiple pump sets, the variety, range and number of models will be minimised in order to maximise interchange-ability and minimise spares stock holding.

Markings and nameplates

All pumps will have a nameplate containing the following information:

- manufacturer's name
- pump model, size, and serial number
- impeller type and size
- pump speed (r/min)
- pump capacity (m^3/hr)
- pumping differential head (m)
- recommended lubricant and fill levels

All pumps will have a direction of rotation arrow cast into pump casings and/or indicated on a stainless steel plate mounted on the bearing housing or pump pedestal close to the drive end.

Prominent warning signs will be affixed to the pump for lubrication requirements.

Submersible pumps

Submersible pumps will be supplied with the following features as a minimum:

- The pump motor will be an integral part of the pump set, and be capable of operating partly or fully submerged as well as continuous operation with the motor exposed above the water level.
- All pumps larger than 10kW will be installed with guide systems and discharge connections that permit automatic connection of the pumps to the fixed discharge piping. In general, the guide rails will not penetrate the sump cover grating, which will be modified to suit the discharge pipe, and the electrical connections.

Positive displacement (piston diaphragm) pumps

Pump may be simplex or duplex arrangements to suit capacity and process requirements. The pump design will incorporate positive stroke return. The maximum stroking speed will not exceed 100 strokes per minute (spm). The pumps will be sized for their duty to give the optimum combination of accuracy of dose and range of operation covering all potential dosing requirements.

Multi-stage booster set

Booster sets will consist of a preassembled frame mounted package unit with close coupled motor centrifugal pumps, pressure accumulator vessel, interconnecting pipework, valves, instrumentation and cabling.

The pump system will be designed to maintain a constant pressure range, and to cope with large and sudden variations in operating capacity. The pumps will be provided with suction and discharge isolation valves to enable complete removal of the pump from the assembly, and non-return valves to protect the pump during non-operating periods. All pipework will be designed in accordance with the P&ID's.

The pump system will be equipped with a pressure vessel designed to control the spikes in demand from the high pressure stormwater reuse system. The minimum vessel pressure rating will be equal to the pump shut off head times a 1.5 safety factor.

The base plate will incorporate lifting lugs and will be sufficient rigid to support the assembly during lifting without detrimental deflection.

Electrical and Controls

The control system will manage the operation of all the pumps, including duty changeover between pumps, motor protection, pressure control (within the operating range established locally), fault diagnostics, and remote start/stop from the main plant PLC. Pump system faults will be sent to the main PLC.

10.23 INLET SCREENS

The Inlet Screens will meet the requirements of the Process Plant and Equipment section of this specification and the P&ID.

The screens will be packaged plant made of stainless steel 316. The screen will not be removable from the flow channel.

10.24 UV DISINFECTION

The UV system will meet the requirements of the Process Plant and Equipment section of this specification and the P&ID.

The UV systems are required to be USEPA certified.

The construction will be predominantly stainless steel 316.

10.25 FLOW METERS

For materials of construction, make model and duty refer to the Instrument Schedule.

The flow meters will be supplied and installed at the locations as shown on the drawings and in accordance with the P&IDs. The flow meters will be capable of displaying instantaneous flow rate.

All flow meters will be provided with flanges to AS 4087 PN16.

10.26 MECHANICAL/CHEMICAL ANCHORS

Materials for anchors and supports will comply with the following:

- anchors and supports located under or within 300 mm of a water surface will be stainless steel 316

- anchors and supports located greater than 300 mm from the water surface will be galvanised steel
- anchors located in buildings (not subject to being wet) will be galvanised steel

Where dissimilar metals are encountered, (e.g. stainless steel anchors with aluminium handrail posts) the anchors will be insulated.

11 Electrical and Controls

11.1 SUMMARY

This section provides an overview of the Concept Design of the Electrical and Controls Scope of Work associated with the project.

The report includes:

- Switchboards
- Package Plant switchboards listing
- Drives
- Motorised valves
- PLC
- SCADA
- Telecommunications
- Lighting and Small Power for Pump stations
- Earthing
- Lightning Protection
- Plant Cabling

11.2 INTEGRATION APPROACH

Electrical systems will be designed in accordance with AS 3000 and AS3008.

Future Requirements

1. No allowances above general industry standard allowances have been made for future capacity in the electrical systems and power supplies, except as highlighted / detailed in the P&ID's & SLD's.
2. There is a spare allowance for the Control system I/O capacity, 20% spare capacity.

Standards

Particular standards and regulations relevant to the work include but are not necessarily limited to the following:

Table 11.1: Applicable Australian Standards

Document Number	Title
AS 1680	Interior Lighting
AS 2293	Emergency escape lighting and exit signs for buildings
AS/NZS 3000	Electrical installations (known as the Australian / New Zealand Wiring Rules)
AS/NZS 3008.1	Electrical installations – Selection of cables – Cables for alternating voltages up to and including 0.6/1kV
AS/NZS 3439	Low-voltage switchgear and control gear assemblies
AS 60529	Degrees of protection provided by enclosures (IP Code)

11.3 POWER SUPPLY CHARACTERISTICS

The electrical supply associated with this site will have the following characteristics:

Nominal LV System Voltage:	400/230V AC
Nominal Control Voltage:	230V AC
	24V DC
Frequency:	50 Hz
Single Phase Power Supplies:	230V AC
Control Power Supplies:	230V AC, 24V DC (preferred voltage)
System of Earthing:	MEN system

11.4 SA POWER NETWORKS SUPPLIES

All work is to comply with the current SA Power Networks Service and Installation Rules (September 2012). This includes provision of the following requirements:

- Meter Panels
- Power Factor Correction
- Harmonics
- Motor Starting Currents

Refer to SA Power Networks Service rules for details.

The main transformers, HV Cable, HV switchgear will be provided and installed by SA Power Networks.

SA Power Networks transformers are to be provided at the treatment, ASR bore sites and the pump stations.

Plant maximum demand & Transformer or power supply sizing

The Plant Maximum Demand was determined based on details of the Mechanical Equipment provided.

The maximum demand calculation considers:

- Loaded kW ratings
- Diversity factors.

The resultant Plant Maximum Demand has been calculated, as per **Error! Reference source not found.**, with 20% spare allowance made for the associated increase in maximum demand for future equipment. These figures should be fully reviewed during the detail design phase following final equipment selection and sizing.

Site	Site Maximum Demand	Single Line Diagram
Felixstow Treatment	337A	13062-SLD01-02-RevB
Marden Pump Station	367A	13062-SLD01-03-RevB
Marden – Hamilton Bore 1	86A	13062-SLD01-03-RevB
Marden Extraction Pump Station	TBA	
Marden Media Filter and Booster PS	TBA	
Shakespeare Pump Station	148A	13062-SLD01-04-RevB
Langman Pump Station	200A	13062-SLD01-04-RevB

Consumer mains cables are based on nominated maximum demand and voltage drop.

The SA Power Networks supplies are as follows:

Input Voltage 11kV 3 phase 50 Hz

Output Voltage 400Vac 3 Phase & Neutral 50Hz

Each area is to be supplied with an SA Power Networks Supply or Transformer as follows:

Table 11.2: Proposed Transformer Sizes

Site	Transformer Size
Felixstow Treatment	100kVA
Marden Extraction Pump Station	TBA

Site	Transformer Size
Marden Booster Pump Station	315kVA
Marden – Hamilton Bore 1	Existing Supply
Shakespeare Booster Pump Station	200kVA
Langman Booster Pump Station	200kVA

These are preliminary design values only, and are to be confirmed by SA Power Networks and the detailed design.

SA POWER NETWORKS POWER QUALITY REQUIREMENTS

Harmonic Filters, Power factor correction and assisted starters are required as per the SA Power Networks supply requirements. The following sections detail the SA Power Networks requirements for all sites.

Refer to the SA Power Networks service and Installation rules for complete details. Sections of the rules are as per the following sections:

Power Factor

Refer to SA Power Networks service Rules section 6.5.3 for requirements for Power Factor Correction.

The customer must ensure that, at times of monthly maximum demand, the power factor of the electrical installation is maintained within the relevant range set out the Table 11.3 below. At all other times, the customer must take all reasonable steps to maintain power factor within that same relevant range.

Table 11.3: SA Power Networks Power Factor Requirements

Supply voltage	Maximum demand of electrical installation					
Load kVA	Up to 100kVA		100kVA to 2MVA		Exceeding 2MVA	
Load Type	Minimum lagging	Minimum leading	Minimum lagging	Minimum leading	Minimum lagging	Minimum leading
<6.6kV	0.80	0.80	0.85	0.80	0.90	0.85
6.6kV to 66kV	0.80	0.80	0.85	0.85	0.90	0.90

Power Supply Harmonics

Refer to SA Power Networks service Rules section 6.5.4 for requirements for Harmonics.

The customer must ensure that harmonic distortion caused by the electrical installation or by any appliances is not in excess of the limits prescribed in AS/NZS61000 part 3.2, 3.4 & 3.12 for low voltage and part 3.6 for high voltage. No supply shall make a contribution to harmonic voltage distortion of the Network greater than the values listed in the Table below.

Maximum allowable harmonic distortion at the point of common coupling (PCC) is as follows:

Table 11.4: SA Power Networks Harmonics Requirements

Harmonic Details	Max Allowable Harmonics
Total harmonic distortion	1.67 %
Any individual odd harmonic	1.33 %
Any individual even harmonic	0.67%

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Motor Starting Requirements

Refer to SA Power Networks service Rules section 6.5.10 for details. The current taken by a motor of a type mentioned in this clause under the conditions of starting shall not exceed the values in the following Tables (Tables 6.7 and 6.8 in the SA Power Networks service rules).

The kW ratings referred to in this clause refer to a motors output rating. The total motor load is the combined output ratings of motors installed in the particular electrical installation from which the proposed motor is to be supplied and includes the proposed motor. No limitation need be placed on the starting current of any three phase motor which is not frequently started and the rating of which does not exceed 10 per cent of the total motor load installed.

Table 11.5: 3phase Motor Starting Requirements

Motor Size	Allowable Current – I (amps)
not exceeding 1.5 kW	I = 26 Amperes
exceeding 1.5 kW, but not exceeding 3.75 kW	I = (Motor kW x 17.5) Amperes
Exceeding 3.75 kW	(a) I = (Motor kW x 3.5) + 53 Amperes, or
	(b) I = total kW of motors installed x 1.1 Amperes
	Where, I = the starting current of the largest of the other motors installed calculated in accordance with (a) above, whichever is the greatest.

Table 11.6: SA Power Networks 1phase Motor Starting Requirements

Motor Voltage	Motor Size	Allowable Current – I
230 Volts	All sizes	I = 45 Amperes
400 Volts or greater	Not exceeding 1.5 kW	I = 45 Amperes
	Exceeding 1.5 kW, But not exceeding 3.75kW	I = (Motor kW x 9.5) + 26 Amperes

11.5 SINGLE LINE DIAGRAMS

The following single line diagrams have been prepared for the project:

Table 11.7: Switchboard Single Line Diagrams

Document Number	Title	Agency
13062-SLD01-02-RevB	Waterproofing The East Single Line Diagram Langman Grove	APC Integration
13062-SLD01-03-RevB	Waterproofing The East Single Line Diagram Marden	APC Integration
13062-SLD01-04-RevB	Waterproofing The East Single Line Diagram Remote Booster Stations	APC Integration

11.6 MAIN SWITCHBOARDS

The main switchboards (MCCs) are to be located indoors at the following sites:

- Felixstow Treatment
- Marden Pump Station
- Shakespeare Pump Station

The remaining MCCs are located outdoors at the following sites:

- Marden Extraction Pump Station
- Langman Pump Station

Other switchboards are located at strategic locations at the ASR Bore Sites and local pump stations (packaged switchboards).

Where proprietary switchboards/ control panels are provided, they will be to the manufacturers standard specifications and therefore not necessarily compliant to the following specific details.

The Switchboards and control panels shall be free standing, floor mounting, front access, of totally enclosed metal clad construction.

Cable zones shall be adequately sized for installing cables (including allowance for bending) and easy access to terminations.

All main switchboards shall be constructed according to the following requirements:

- Manufactured in line with nominated Australian Standards.
- All switchboards are to be constructed from Powder Coat mild steel.
- Front access, floor mounted, with bottom cable entry via gland plates, top entry in pump station building for pump skids and controls
- Power sections of switchboard are to be segregated from PCS sections.
- MCCB's utilised for circuit protection and isolation

- Form 1 segregation in main switchboards and motor starters
- interfaced with the PLC for sequencing and monitoring
- 24Vdc control voltage
- 230Vac operated contactors
- Soft Starters to be mounted in the MCC panels
- VSDs in pump stations to be mounted on Packaged switchboards
- Contain incoming SA Power Networks Metering Section and facilities to connect to a remote SA Power Networks Metering box located external to the Switch room or switchboard
- Multifunction Power Metering for Main Incomer monitoring
- Environmental protection to IP51 (indoor switchboards)
- Environmental protection to IP56 (outdoor switchboards)
- The rating of the equipment shall be as specified on the Single Line Diagrams.
- The busbars and connections shall be of high conductivity copper and these and their insulated supports shall be mechanically strong and able to withstand all the stresses which may be imposed upon them in ordinary working due to variations in load and temperature, and due to short circuit conditions.
- Their design shall also take into consideration the requirement for transportation as a fully assembled switchboard and ensure that the integrity of all busbar joints and insulation will not be degraded as a result of handling and transport.
- The sheet steel shall have a minimum thickness of 1.6 mm. Doors shall be no greater than 800mm in width. All outer doors to be lockable (Pad lockable isolators).
- All Switchboards and control panels shall be fitted with interior lights, switched by opening the external doors.
- Control panels shall be fitted with a GPO's for maintenance and programming.
- All Switchboards and control panels plinths shall have an allowance for bolting the plinth to the floor or concrete base.
- All equipment within a switchboards and control panels shall be installed on mounting plates affixed to the interior of the panel.
- All equipment shall be installed not greater than 2100 mm above ground or floor level.

The following table lists the switchboards and control panels:

Table 11.8: Proposed Switchboards

Switchboard or Control Panel Requirements	Single Line Diagram	Comments
Third Creek Extraction Pump Station Switchboard	13062-SLD01-01-RevB	Includes PCS / Communications section. Supplied from Marden Booster Pump Station Switchboard. To be Confirmed during detail design
Fourth Creek Extraction Pump Station Switchboard	13062-SLD01-02-RevB	Includes PCS / Communications section. Supplied from Felixstow UV Switchboard.
Fourth Creek Injection Pump Station Switchboard	13062-SLD01-02-RevB	Includes PCS / Communications section. Supplied from Felixstow UV Switchboard.
Felixstow Biofilters Control Panel	13062-SLD01-02-RevB	Includes PCS / Communications section. Supplied from Felixstow UV Switchboard.
Felixstow UV Switchboard	13062-SLD01-02-RevB	Includes PCS / Communications section. SAPN Metering in separate panel
Marden - Hamilton Bore 1 Switchboard	13062-SLD01-03-RevB	Includes PCS / Communications section. Supplied from Marden Booster Pump Station Switchboard.
Marden Bore 2 Switchboard	13062-SLD01-03-RevB	Includes PCS / Communications section. Supplied from Marden Booster Pump Station Switchboard.
Marden Bore 3 Switchboard	13062-SLD01-03-RevB	Includes PCS / Communications section. Supplied from Marden Booster Pump Station Switchboard.
Marden Booster Pump Station Switchboard	13062-SLD01-03-RevB	Includes PCS / Communications section. SAPN Metering in separate panel
Shakespeare Booster Pump Station Switchboard	13062-SLD01-04-RevB	Includes PCS / Communications section. SAPN Metering in separate panel
Langman Booster Pump Station Switchboard	13062-SLD01-04-RevB	Includes SA Power Networks Metering and PCS / Communications section.

Control Voltages

All control systems will use 24V DC control Circuits.

230V AC control may be used for contactors (>15kW) and supplies to instruments i.e. Analysers, flow meters and control systems components.

Instrument signal are to be 4-20mA current loops.

PLC/RTU I/O is to be 24V DC.

Indicator Lights are to be 24V DC only, LED type.

Power Monitoring

All main switchboards shall include power monitoring on incoming SA Power Networks supplies. The Switchboards will be provided with an integrated Power monitoring for connection to PCS system with the following minimum requirements:-

- Load kW;
- Load kWHr (total);
- Load kVA;
- Load Power Factor;
- Load Amps;
- Modbus Communications preferred;

Outdoor Panels

Cable entry to be from below

To be IP56 rated.

Front access for all outdoor switchboards shall be provided by hinged lockable doors. Opening the doors shall give access to a dead front panel on which controls and indication is mounted.

Equipment installed in outdoor panels shall be protected against the effects of excessive temperature.

This protection will by:-

- De-rating equipment to accommodate the ambient temperature which is expected within the panel; and
- Ventilation is provided to ensure that the panel internal temperature does not exceed the equipment temperature rating; and

Additional design and construction features to improve the security of the cubicles from theft and vandalism shall include the following:-

- No controls or indication devices on the outside of the panels;
- ASR Bore panels shall be low height outdoor panels

Note: All padlocks to be keyed alike by the customer following final handover.

Indoor Panels

All Switchboards and control panels are to be mounted on a robust Channel plinth, a minimum of 75mm high. Cable entry can be from above or below.

Switchboards and control panels are to be IP51 where water is not in close proximity, IP54 where water/pumps are adjacent to the switchboard.

Starter Types and Controls

Motor Starters and Control Equipment will be as per the following sections.

No Flow monitoring as per P&IDs.

Non-Package Direct on Line Starters (DOL)

DOL Starters can be used if the inrush current meets the SA Power Networks requirements, refer section 11.4.

Non-Package Soft Starters (SS)

Soft Starters are used for larger motors when DOL starters cannot be used.

DOL Starters can be used in lieu of Soft Starters on Packaged switchboards if the inrush current meets the SA Power Networks requirements, refer section 11.4

Non-Package Variable Speed Drives (VSD)

Motor Starters for pumps where flow rate control is required

Non-Package Motorised Valves

This for the control of Motorised valves such as Rotork Valves.

Non-Package Solenoids

Control of Solenoid Valves for control systems (where required)

Earthing

Earthing shall meet AS 3000 as required and every metal part not intended to be live shall be effectively connected to the earth bar.

Internal LV and ELV Wiring

All wiring shall be carried out in a neat and acceptable manner, and shall be either loomed with protection or enclosed within approved wiring ducts (generally slotted PVC ducts). Wiring to equipment on doors is to be properly supported and sheathed, using terminations as the only means of support is not permitted.

Wiring duct lids shall have positive continuous clipping along the entire length of the duct. No equipment is to be mounted on or in ducts. Wiring ducts shall not be filled beyond 75% capacity and provisions shall be made to allow for the installation of field cables in bottom ducts.

Current ratings for cables are to be suitable for the application (loading and protection). All Earth wiring will be coloured and rated as per AS3000.

Cable Sizes and General Requirements

Wiring is to comply with the following requirements:

1. The preferred conductor sizes for control wiring will be 0.75mm^2 flexible.
2. Within the switchboard, where high-density wiring exists (e.g. PLC/RTU I/O), the minimum size for control wiring is 0.5mm^2 (This requirement does not apply when a proprietary cable (with plug(s)) is sourced)
3. The minimum size for lighting and 230V control will be 1.0mm^2.
4. The minimum size for 230V power will be 2.5 mm^2.
5. Use manufacturers preformed busbar or links between circuit breakers and contactors.
6. The sizes of power cables for motor drives will be as specified in AS 3008.1.1.
7. All control cables are to be Flexible PVC insulated, V75 rated.
8. All flexible power cables are to Flexible PVC insulated, V90 rated.
9. All cabling will be provided with sufficient spare length to allow movement of the termination location.
10. All cabling (where possible) shall be enclosed in slotted PVC duct or expandable sleeving.
11. All looming will be neat and straight and will be held by cable ties.
12. All analogue cabling shall be installed in screened cable and heat shrinked at each end.
13. All screened cables in panels are to have the screens earthed at the main outgoing terminal strips.
14. All incoming cable cores are to be terminated, including spare cores.
15. All phase colouring that has been "lugged" will be heat shrinked with phase colours.
16. Electrical tape is not to be used in lieu of heat-shrink sleaving.

Wire Identification

1. Each end of every control and PLC core will be fitted with a wire-marking ferrule showing the appropriate wire number.
2. Wherever possible, wire numbers are to be generated using a standard number printing facility.
3. The terminations on PLC cards may be wired without identification if
    a. the wiring is clearly shown on the documentation or
    b. if pre-wired connectors are used, or
    c. there is not sufficient space.
4. Manufacturer's standard pre-wired looms should be used where possible.
5. Unused I/O to be terminated where possible

GO

Standard WIRE Colours

Power, Control and PLC wiring in switchboards and control panels will be as described by Table 11.9.

Wire Colours for Power, Control and PLC wiring are listed below.

Three Phase supplies (3 phase) and all 400V wiring are to use phase colours as follows with suitable phase markings:-

Actives U – Red, V – White, W – Blue

Neutral N – Black

Refer to the following table for wire colours.

Table 11.9: Switchboard Wire Colours

Voltage	Variant	Positive / Active	Negative / Neutral
230V	AC	R/W/B	Black
230V Switch-wire	AC	White	
24V	DC	Orange	Grey
24V	AC	Brown	Grey
Digital Inputs	DC	Orange	Grey
Digital Outputs	DC	Orange	Grey
Analog I/O		Violet	Violet

Indicating Lights

Indicating lights shall be of flush pattern, of 24VDC high intensity LED type.

Labelling

A main Switchboard rating name plate (as per AS3439) is to be fitted.

All Supplies and equipment will be clearly labelled with the designated reference.

11.7 LOCAL CONTROLS

All required local switchboard controls will be located (where required):-

Outdoor panels: behind an escutcheon panel;

Indoor Panels: On the Panel outer doors;

11.8 PACKAGED SWITCHBOARDS

Specific features:

- Environmental protection to IP51 (indoors in pump stations)
- Environmental protection to IP56 (outdoors)

- Busbar rating as per single line diagrams
- Fault levels as per single line diagrams
- Painted Zinc Seal metal construction for switchboards

The control system is to include all specified no flow protection systems.

The Packages will incorporate control systems for pump controls. Control is to include auto restart after power failure, so no operator intervention is required.

Note: Where Soft Starters have been nominated, it is up to the Packaged Skid Supplier to nominate the suitable starting method, taking into account the SA Power Networks requirements. Soft Starters have been nominated, as the motor starting currents are not yet defined.

Isolation of the Skid electrics shall be by a lockable isolator on the Skid Switchboard/Control Panel

Package plant switchboards and panels

The Pump Skid Packages will have an integrated control system. This will be interfaced with the overall plant control system (PCS).

The PCS interface is either by hard wired I/O interfacing (preferred method) or a fieldbus (such as Modbus / Profibus / ControlNet) using communications links.

The interface shall have the following minimum features:

Pump Control and Status:	Start, stop commands
	Ready (auto), Run, Fault status for each pump
	Pressure Set point to skid (where applicable)
	Level, pressure from skid (where applicable)
Pump Duty Selection:	Duty selection will be part of PLC control i.e. section of duty and standby pumps.

The Package control systems will control the operation of the packaged plant in all modes of control, with the PCS providing only high level controls and receiving status indication.

The Hardwired option provides limited control and status of the package, but enables simpler fault finding.

11.9 VARIABLE SPEED DRIVES

All Variable Speed Drives (VSD's) will be mounted in the respective switchboard.

Specific Features:

- Environmental Protection to IP20
- Ethernet Communication Modules
- Control over Ethernet
- Hard wired I/O available

11.10 UV FILTER INTERFACES

Where designated as a future item, allowance will be made for power supplies and control interfacing.

The UV unit will only be provided with one 3phase supply, which will be for the UV unit, control power

Interfacing with the PCS is by hard wired interface only.

Typical signals required are:

- Digital Inputs to PCS: 6 off
- Digital Outputs from PCS: 2 off
- Analog Inputs to PCS: 2 off
- Analog outputs from PCS: 2 off

11.11 DRIVES SCHEDULE

Refer to mechanical drive schedule and single line diagrams for further details.

11.12 LOCAL CONTROL PANELS

No allowances have been made for any field based local control panels. All local control requirements are to be integrated into the respective switchboard.

11.13 LOCAL ISOLATORS

Refer single line and electrical typical diagrams for indicative requirements.

The following is a summary of allowances made;

- All drives which could have public access will NOT be provided with a local motor isolator.
- All 230V AC instruments which could have public access will NOT be provided with a local isolator.
- Motorized valves will NOT be provided with a local isolator.

11.14 FIELD INSTRUMENTATION

Refer to instrument schedules and P&IDs for instrument details.

All field instrumentation is included in the mechanical scope of supply. This includes instrumentation to measure process variables (for example Level Transmitters) and instrumentation to provide process interlock signals (for example Level Switches).

All instrumentation will interface with the PCS via hard wired analogue and digital signals.

11.15 INSTALLATION

General

All installation work is to be carried out as per Australian Standards AS3000 and AS3008.

Motor Isolators

All motors in the Pump Houses are to be installed with motor isolators.

All motors on outdoor sites are to be installed with motor isolators only if they are in secure locations.

All other motors will need to have isolators installed in Switchboards i.e. ASR Bore pumps.

Cables and Cable Installation

Main Power Cables are to be XLPE/PVC type and sub-mains will generally be XLPE/PVC cables.

Feeder Power Cables are to be PVC/PVC type.

Where VSD's are used in pump stations, special cables are to be selected to reduce EMI effects (screened power Cables).

Where VSD's are Bore pumps, standard cables may be used, as there will be no exposed cables. The cable must be installed in steel conduit outside of the bores.

Cable ladder will be used in pump stations and buildings where embedded conduits are not practicable or where cabling needs to be routed externally from the conduit. Hot Dipped Galvanised Heavy Duty Cable Ladder has been selected for use in pump stations.

Power cables have been sized in line with Australian Standards for voltage drop and de-rating factors. The Full Load Current taken by the drives have been taken from the drives list.

Fibre Optic cables are to be used between Area control panels and ASR Switchboards.

Instruments and controls are to be wired in Screened Instrolex or equivalent instrument cables.

Fibre cables are to be supplied and installed as per manufacturer's requirements.

Communication cables will be selected to suit the PCS system used

Suitable allowance is to be made for glanding and termination of cables.

Trenching and Conduits

All underground cables will be protected by conduit. The installation works will include trenching (common trench with pipework), boring and the supply and installation of all conduit inclusive of draw wires, ducting and cable pit installation, backfilling and trench restoration for all the communication network and I/O's cabling. The conduit and cable routes shall follow the routes shown on the drawings and generally follow the pipe work routes.

Fibre optic cable shall link between the PLC and Remote I/O's. The fibre optic cable is to be multimode and suitable for installation via underground conduit and pit network.

Pump house

All services are to be run on cable ladder in the buildings or conduits in the foundation.

All sections of cable ladder will be connected to earth via an earth connection through the cable to the point of supply and hence through to the earth grid. Hold down bolts will not be used for earthing.

All lighting and services are to be accessible for maintenance.

GPO's and light switches to be mounted at one metre above floor level.

All services will be supplied from the pump house switchboard. All RCD's will be in the Power and light chassis of the switchboard.

Power and Lighting Distribution

Each main switchboard per site will include a Power and Lighting Chassis, with allowances for the following supplies:

- Emergency Lights;
- Exit Lights;
- Building Internal Lighting;
- Building External security Lighting;
- 1 off 3phase 20Amp GPO;
- 2 off 1 phase 10Amp GPO;

RCD's are to be used for all light and power supplies.

11.16 PLANT CONTROL SYSTEMS

This section details the control system requirements. The control system shall be PLC based, with applicable controller (CPU) module, communications module and I/O modules to suit site requirements.

Following a value engineering review with the stakeholders, it was concluded to use a virtual WAN over the Next G network.

The proposed network topology is shown in **Figure 11-1**.

Controller(s) at the various sites shall be non-redundant, and shall operate independently of the SCADA system. That is if the SCADA server fails, then the control system shall continue to operate based on the SCADA set-points last specified prior to failure.

The scope of supply of communication equipment will include Sim Cards, Modems, aerials, managed routers and all associated cabling.

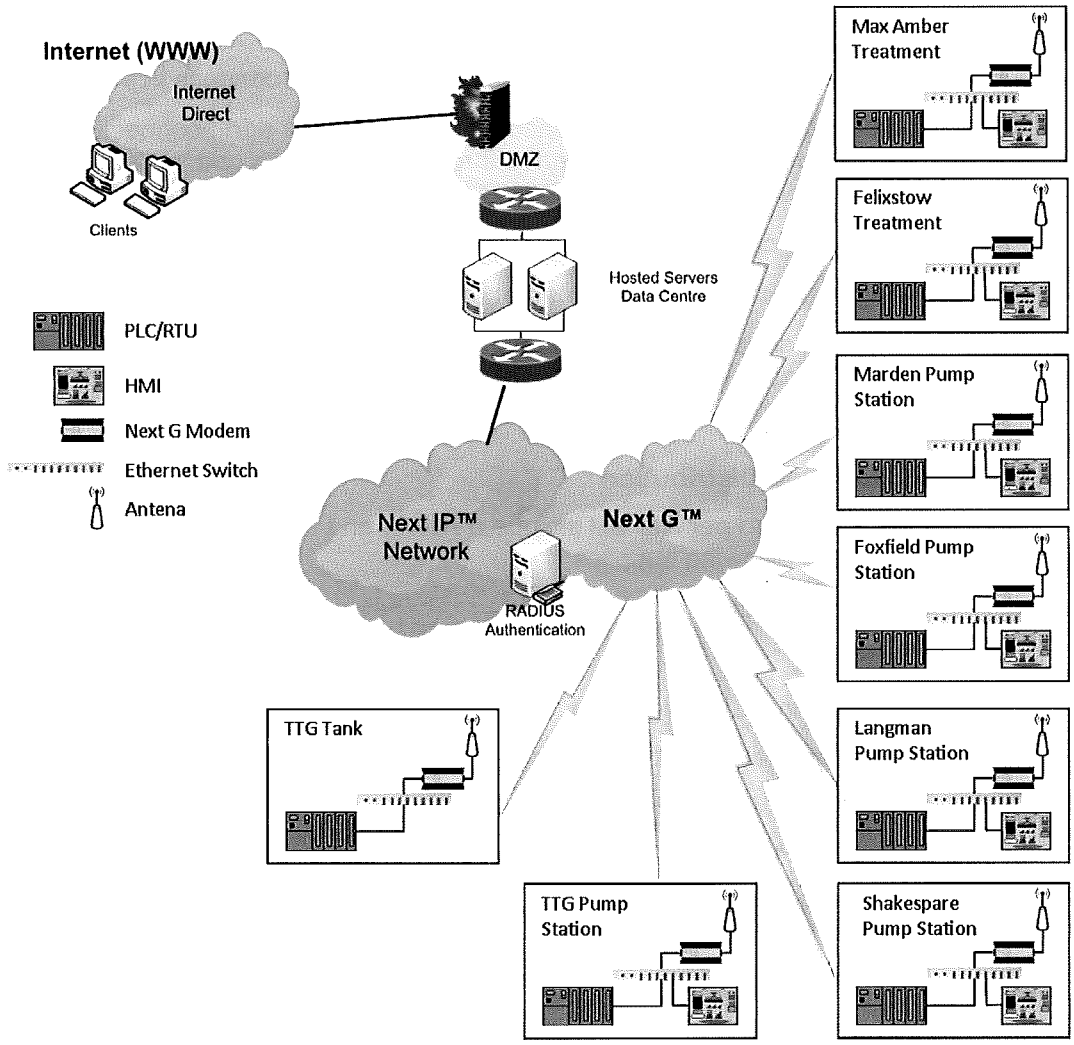

Figure 11-1: Network Topology - Overview

Communications Matrix

Table 11.10 indicates the anticipated peer-to-peer communications between sites over the Next G network to perform the necessary control and monitoring functions required by the system. As indicated by this table, each of the remote sites shall communicate to the SCADA server to provide indication to and accept control commands from the SCADA system.

Table 11.10: Communications Matrix

	PLC-Felixstow Treatment	PLC-Marden Pump Station	PLC- Marden Extraction Pump Station	PLC-Langman Pump Station	PLC-Shakespare Pump Station	SCADA Server
PLC-Felixstow Treatment		√				√
PLC-Marden Pump Station	√		√		√	√
PLC-Marden Extraction Pump Station		√				√
PLC-Langman Pump Station					√	√
PLC-Shakespare Pump Station		√		√		√

Peer-to-peer communications

As per Table 11.11, TBA can receive requests for water from the Shakespeare Pump Station when the corresponding storage tanks are low. At which point water will be ported from the Max Amber storage tanks to the site that sent the request.

The Marden Pump Station can receive requests for water from the Shakespeare Pump Station when the Shakespeare storage tank is low. When requested, water is ported from the Marden storage tanks to the Shakespeare storage tank. If the Marden storage tanks are low bore extraction will start from the Hamilton and Marden bores as required. When this occurs Marden informs Felixstow Treatment to stop bore injection into the bores that are being extracted. Once Marden finishes extracting from the bores Felixstow Treatment is informed that bore injection can resume.

The Shakespeare Pump Station can receive requests for water from the Langman Pump Station when the Langman storage tank/s are low.

Site Control System Requirements

Each site will operate independently using their respective pressure sensors to determine when the booster pumps are to run. This assumes that the line pressure between sites is maintained.

Furthermore appropriate checks will be made for pipe line leaks using the pressure and flow readings from each site.

For further information refer to section 6 Functional Design.

11.17 PCS HARDWARE AND TECHNICAL REQUIREMENTS

PCS Hardware

The PCS hardware shall be sourced from one of the following:

1. Schneider
2. Siemens
3. Rockwell Automation

All control system and networking components are to be supplied by the same vendor (Packaged plants excluded). This is to ensure that all the components are well integrated so that both the integrator and end user will not experience the common problems of interfacing different vendors' equipment.

IO Interfacing

The PCS shall be capable of interfacing with field equipment and instrumentation via hardwired I/O or an open standard protocol or industry recognised digital bus system i.e. ProfiNet, Profibus, ControlNet, Modbus, Ethernet TCP-IP or Modbus TCP-IP.

I/O module diagnostics shall be available in both the software and on the hardware itself by way of LED indicators. It shall be possible for the SCADA system to read the status of the control system.

Failure states of digital and analogue output modules shall be configurable (i.e. fail to off state, fail to on state, or fail to last state remaining unchanged).

Local HMI

On-Site monitoring and control can be achieved by a local HMI. The display shall be minimum 10.4" colour SVGA touch screen.

11.18 PCS SOFTWARE

Functional Design Specification (FDS)

A FDS for each site is to be developed from the control philosophy and P&IDs. The FDS shall define the following:

1. Full detailed plant control implementation;
2. SCADA Displays including screen layouts;
3. Control Architecture or hardware configuration;
4. Start permissives, interlocking and faults;
5. Set points adjustment;

6. Sequence Logic and calculations;
7. Alarm listing & prioritisation;
8. Trending;
9. Reporting;
10. Event logging.

Software Structure

The control system software shall be structured in a logical and legible manner while complying with TOW standards.

Due to the control requirements between sites, the control system software shall be designed in a manner such that the control reverts to a designated state in the event of communications failure, if there is a process dependency between any given sites. This designated state shall be defined in conjunction with the process and safety requirements of the system.

The software shall be designed to ensure that transfer between automatic and manual PID control (i.e. for VSD speed control) shall be bumpless.

Power Failure

Following restoration of power, the control system shall automatically restart at the respective sites following a time delay (i.e. to allow for the power supply to stabilise).

This will also be a requirement for the packaged skid control systems.

11.19 SCADA SYSTEM TECHNICAL REQUIREMENT

SCADA Specification

The SCADA software shall be from one of the following:

1. Schneider Clear SCADA;
2. Siemens WinCC;
3. Rockwell Automation Factory Talk View.
4. GE iFix

The SCADA system software shall be fully compatible with the proposed control system hardware and software. Mechanisms for remote access for configuration and monitoring functionality shall also be made available.

Central SCADA

The SCADA system shall be based on a virtual server located at a Data Centre. The SCADA sever shall be connected to via a private virtual WAN over the 3G network using fixed IP addresses for each site. The SCADA server shall be configured with the necessary firewalls and robust security measures to reduce the likelihood of unauthorized access. Any equipment associated with the SCADA server (i.e. server

hardware, networking equipment, etc.) shall be housed in a server room type environment.

The SCADA system shall be accessed via a web interface being capable of both monitoring and controlling the overall system.

SCADA license

The SCADA full server license shall have sufficient capacity to cover the requirements of the PCS with 20% spare capacity. Depending on the selected SCADA system vendor, this spare capacity shall be applied on a point count or screen count basis.

Remote Monitoring

The central SCADA server shall provide access to the SCADA system via remote desktop functionality. Typically this will allow operations, maintenance and business users to access the SCADA system at all times.

The Remote Client licensing shall allow remote users to access the SCADA system regardless of location. Three (3) floating client licences shall be provided. Remote access shall be facilitated using the VPN. In this way local users in the council office or mobile laptop remote users can access SCADA via the VPN.

A single laptop installed with SCADA client licensing for remote access and PLC programming software shall be supplied to the client. The intent of this laptop shall be to allow dedicated "on-call" operations or maintenance personnel to access the system remotely.

Security Requirements

Security for access level control shall be implemented via user and password combinations. As a minimum the SCADA system shall be configured with the following security levels:

1. View Only – Allows personnel to monitor SCADA screens only with no access to control functionality;
2. Operator – Allows personnel to monitor and control devices and units/systems, including modification of operational Set points;
3. Supervisor – Allows personnel to monitor and control devices and units/systems, including modification of operational Set points, tuning parameters and configuration settings.

Security for remote access of the SCADA system shall also be configured with user and password combinations to prevent unauthorised access.

SCADA Hardware Specifications

The SCADA server, operator workstation and remote laptop hardware specification shall as a minimum, conform to the SCADA vendor requirements for server and client hardware.

Software

The SCADA system software shall include, but is not limited to, all the programming software, communications drivers and licenses. No logic shall be programmed into the SCADA system to perform control functionality; any such logic should be contained in the PCS only.

Historian

A set of data for archiving shall be defined and agreed by the Town of Walkerville Council. The hard disk capacity of the SCADA server shall be sufficient for 10 years of historian data storage. The historian license is to be included. This is to be based on 1750 digital and 750 analogues historian points and assumed average 2000 digital events per hour, 1000 analogue events per hour (2000 digital changes per hour and 1000 analogue changes per hour).

Trending

Trending shall be provided for all analogue transmitters (including flow meters, pressure transmitters and analytical transmitters), Power Monitors and site power usage. The trending details shall be specified in the FDS and agreed by the Town of Walkerville Council.

Reporting

The SCADA system shall be capable of periodically generating pre-configured reports or generating reports on request by operators (i.e. customisable report data). Typical pre-configured reports shall include the following:

1. Plant flow metering – Daily volumes
2. Total site kWh energy consumption
3. Hours run for equipment
4. Chemical consumption
5. Water quality

These reports shall be available for printing or emailing to specified personnel. The report outputs shall be capable of being exported to a selectable format (i.e. Microsoft Excel, Microsoft Word, Microsoft Access, etc.).

It is preferred that reports are generated by a package which is integral to the SCADA system software. The reporting license is to be provided.

Alarm Requirements

The alarm system shall provide indications to operators of abnormal or dangerous conditions as detected by the control system. Alarms shall be configured for the SCADA system in accordance with the principles defined in the International Standard ISA 18.2 (Management of Alarm Systems) or EEMUA 191 (Alarm Systems). Alarms shall include those detected directly in the field (i.e. pump fault, or level switch indication), or those derived within the control system (i.e. valve failed to open, analyser low level, communications failure between sites).

Standard alarm functionality shall be required as a minimum including:

1. Multiple alarm priority levels
2. Alarm area categorisation (for the purpose of filtering alarms)
3. Alarm acknowledgement, and enabling/disabling (by personnel with appropriate security access).

SMS Alarms

The SCADA system shall provide capability to "dial-out" SMS or Email Alarms to remote personnel. The preferred method for SMS or Email Alarming is a software based system (communicating with the SCADA system directly) with external connection via a Next G modem for SMS Alarms.

The SMS/Email Alarm software shall be capable of being configured with a customisable roster (i.e. different operations personnel) and escalation strategy (i.e. dialling backup operators or system supervisors).

SMS/Email Alarms shall be inhibited or masked during communication failures.

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HMI's

A single HMI touch panel shall be provided and installed at each site. This HMI is to achieve on-site monitoring and control. The display shall be minimum 10.4" colour SVGA touch screen.

Database Requirements

All software is to be compliant with the Town of Walkerville Software and Database Development standard, version 0.6 dated 18th May 2012.

Control System I/O summary

The following is a list of proposed Control system I/O for each area:

Table 11.11: Proposed PCS I/O

PLC System and Area	Sum of DI	Sum of DO	Sum of AI	Sum of AO
PLC - Max Amber Booster PS	30	5	4	5
RIO Max Amber - Fifth Creek Extraction	23	3	5	0
RIO Max Amber - Fifth Creek Injection	33	3	14	7
RIO Max Amber - Bore 1	17	2	9	4
RIO Max Amber - UV & Bore 2	24	2	12	3
RIO Max Amber - Bore 3	17	2	9	3
PLC - Felixstow UV	12	5	5	1
RIO Felixstow - Fourth Creek Extraction	23	3	5	0
RIO Felixstow - Fourth Creek Injection	22	3	4	3
RIO Felixstow - Biofilters	19	0	19	5
PLC - Marden Booster PS	24	4	4	4
RIO Marden - Hamilton Bore 1	17	2	9	3
RIO Marden - Marden Bore 2	17	2	9	3
RIO Marden - Marden Bore 3	17	2	9	3
PLC - Shakespeare	32	7	4	4
~~PLC - TTG PS~~	~~24~~	~~4~~	~~4~~	~~4~~
~~PLC - TTG Tank~~	~~5~~	~~2~~	~~2~~	~~0~~
~~PLC - Foxfield~~	~~28~~	~~5~~	~~4~~	~~4~~
PLC - Langman	29	5	5	4
Grand Total-Hard Wired I/O	**384**	**55**	**130**	**56**

The above table refers to the following type of PCS inputs and outputs:

DI Digital Inputs

DO Digital Outputs

AI Analogue Inputs

AO Analogue Outputs

Soft I/O is I/O within the PCS (Not Hard wired).

11.20 DEMAND SITES

Water is delivered to customers via Demand Sites which at a minimum will consist of a flow totaliser and Next G connection back to the SCADA system to record the customer's water usage.

More complex Demand Sites may require the control of a valve to control the delivery of water (tank filling for example) and/or the interfacing to a flow meter to record flow rates.

Demand Sites will be powered by the most cost effective power source (mains, solar or battery).

Customers will usually only be able to use water during agreed time periods and flow rates to ensure the system's capacity is not exceeded at any point in time to the benefit of all users. The Automated Billing and Reporting System will need to provide this facility.

11.21 EARTHING REQUIREMENTS

The Earthing system will be an integral part of the Facility and will include:

- Electrical Fault Protection by automatic disconnection of the power supply to the faulty electrical device with exposed conductive parts. The disconnection to the affected device will be within the specified time and touch voltage levels.
- Provide continuous metallic connection to ground for the Facility's metallic structures and equipment neutrals.
- Provide a low impedance fault path capable of carrying the maximum earth fault current without danger of overheating and failing. Sizing of the earthing conductor and connections will be carried out in cable of cross sectional area appropriate to the fault current.
- Dissipate static charges and/or induced current from current carrying lines or parts there off.

Earthing system

Each area main switchboard will have a local Main Earth bar facility to pick up the local equipment earths and will be solidly bonded to the Earth via a minimum of two off 3m earth rods fully driven into the ground.

The neutral of each of the power systems will have a MEN link in the Main switchboard or SA Power Networks meter isolation panel.

Each Main Switchboard (including standalone pump skids) will have a local earthing system, installed to the requirements of AS3000.

Earth rods are to be supplied and installed as follows:

Length:	3,000mm;
Size:	19mm Diameter;
Type:	Copper rod;
No of Rods:	2 Minimum;
Connection:	CAD welded to Earth conductors;

Testing will be required to confirm that 2 earth rods are sufficient for each site.

Metal of main switchboards will be bonded together and earthed to the Main Earth systems. Earthing connections will be carried out in cable of cross sectional area appropriate to the fault current.

MEN links are required in the Main Switchboards.

Earthing of sub-boards and distribution boards

Metal of switchboards and distribution boards will be bonded together and earthed to the Main Facility Earth Bar system. Earthing connections will be carried out in cable of cross sectional area appropriate to the fault current.

This includes the various electrical control panels, junction boxes and motor isolators.

Cable ladder earthing

All sections of cable ladder will be connected to earth via an earth connection through the cable to the point of supply and hence through to the earth grid.

Motor earthing

All motors will be connected to earth via an earth connection through the cable to the point of supply and hence through to the earth grid.

Structure earthing and bonding

All structures are to be earthed to the earthing systems. The earth connection is to be such that the touch potential of a structure falls within safe working limits.

All structural metalwork or metallic equipment in the facility will be earthed where there is a risk of contact with live parts of faulty electrical equipment and cables or there is a risk that the fault current path may be via the structural steelwork.

This includes packaged skids, hand rails, grid mesh flooring, decking and walkways where there are lighting poles, electrical control panels, cable trays and cabling attached, supported or fixed to the adjacent structural steelwork members.

Earthing of concrete reinforcement

Concrete reinforcement will be connected to earth to achieve the required step and touch potential criteria through a bolted connection in a serviceable location.

Earth connections to be embedded in concrete or buried, earth connections to permanent outdoor structures and where earth connections are otherwise made inaccessible, will be made using exothermal welds (e.g. Cadweld).

Equipotential bonding and earthing of conductive pipework

In order to minimize the risks of voltage differences and thus meet step and touch potential criteria between the conductive pipework and earth during an electrical fault, conductive steel and pipework that is installed and accessible within the Electrical Installation and that is in contact with the ground will be equipotentially bonded and thus connected to the Main Facility Earth Bar.

The bonding will be achieved through a bolted connection in a serviceable location.

11.22 LIGHTNING PROTECTION

The Lightning Protection System outlined below is based on AS 1768 and the installation will comply with this Australian Standard.

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The prime aim of the lightning protection system is to dissipate lightning discharges while protecting personnel and equipment against dangerous potentials.

The proposed lightning protection system utilizes bonding conductors on building as the structures are all of low height and low risk.

12 Testing & Commissioning

12.1 GENERAL

All equipment covered by this Contract is subject to inspection and tests to the requirements of the Superintendent's Representative during manufacture, application of coating systems, erection and completion to prove compliance with the Specification and guaranteed performance.

The technical requirements for inspection and testing of electrical equipment and installation provided under the Contract shall be in accordance with AS3000.

The Contractor shall supply all plant, tools, gauges, instruments and materials required for the tests and carry out the tests to the satisfaction of the Superintendent's Representative.

The Principal reserves the right to inspect work in progress on any of the equipment to be supplied under this contract. Unsatisfactory workmanship shall be remedied at the Contractor's expense, and this shall include the replacement of any parts damaged during the reworking.

For witness and hold points only, the Superintendent's Representative shall be given 2 working days' notice of any testing to be carried out.

Test sheets shall be properly drawn up to record all parameters and results of all items to be tested.

Before undergoing formal works or site tests, the Contractor shall carry out preliminary tests to ensure that minor defects do not hold up formal tests.

All test equipment used during the tests shall have a certificate of accuracy which has been issued within the preceding 12 months.

Final test results and certificates shall be supplied to Superintendent's Representative. At their own discretion and at the Principal's expense, carry out any inspection or additional testing they deem necessary to satisfy themselves that the work complies with the contract requirements.

If any items of material or equipment fail to perform satisfactorily under test, the Superintendent's Representative may reject those items, which have failed.

The Contractor shall, at their expense and without delay make good or replace any rejected material or equipment to the satisfaction of the Superintendent's Representative.

12.2 WORKS TESTING

General

All equipment shall, as far as practicable, be routine tested at the works before delivery to site.

Equipment requiring works testing shall include but not be limited to the following sections.

Electrical switchboard and control panels

A Factory Acceptance Test (FAT) covering a complete simulation of the system including the Switchgear, Control panels, Control System and SCADA software is to be conducted off site and witnessed by Town of Walkerville or their representative.

The FAT will be conducted prior to the dispatch of hardware and software to site.

All testing to be conducted in compliance with the requirements of AS3000 and AS3439

The FAT shall include the following tests:

- Visual inspection and checking against the project Documents, including Physical construction;
- Wiring and Earthing checks:
    - Point to point wiring checks
    - Check all earth connections are correct and are connected to the earth system;
- Each cubicle shall be put through a series of witnessed tests to thoroughly test out all functions of control, including alarm, indication, pushbutton and contactor operations. External contact operations shall be simulated by application or removal of jumper links at appropriate terminals on the outgoing terminal blocks.
- Outputs shall be indicated on a suitable lamp or meter across respective output terminals
- Protection Relay setup and Operation;
- Switchgear Operational tests;
    - Interlock testing;
    - Operational checks of mechanical interlocks;
    - Operational checks of alarms, instruments and metering.
    - Check operation of door handles, mechanical interlocks, etc and freedom of operation of electrical switches
- Central Monitoring Centre Communications;
- Remote Site Communications (i.e. Remote Site SCADA communications)
- Standard logic modules type tests (e.g. drives, valves etc.)
- Instrumentation type tests (e.g. analogue transmitter and digital switches)
- SCADA interface tests
- All sequence operation tests
- Local and Remote control
- System Start-up Operation
- System Shutdown Operation

A database for defect logging and enhancement request shall be used to capture the defects and enhancements.

Mechanical Equipment Testing

All mechanical equipment shall include but not be limited to the following:

Table 12.1: Mechanical equipment works testing:

Equipment	Works Test	Standard/Details
Pumps	Performance	AS 2417 Grade 2
	Hydrostatic	1.25 times shut off pressure, 15 min; tested for leaking, Except sump and bore pumps type pumps.
Valves	Performance	To manufacturer's standard.
	Hydrostatic	1.25 times valve's pressure rating.
Chlorine equipment	Performance	To manufacturer's standard.
Tanks and vessels	Hydrostatic	Tested for leaking.
Other mechanical equipment	Performance	To manufacturer's standard.

The Superintendent reserves the right to inspect the equipment prior to delivery.

Performance Guarantee

The equipment shall perform in accordance with the performance requirements and operating conditions stated in this specification and on the Equipment Schedules.

Equipment manufacturers are to supply a written warranty period of twelve (12) months under the normal operating conditions indicated on the Schedules.

12.3 SITE TESTING

General

Site testing shall comprise all materials testing, compaction testing and equipment testing and commissioning. All materials and compaction testing shall be undertaken by a NATA registered laboratory. The cost of all testing as specified to demonstrate that the works conform to the Contract shall be borne by the Contractor.

In the event that the test results show that the materials or works do not meet specification requirements, the Contractor shall remove and replace, or make good, all at its own cost. Retesting shall be carried out to verify that specification requirements have been met and the costs of such results shall be borne by the Contractor. The Contractor shall supply to the Superintendent copies of all normal test results.

The Contractor shall provide the Superintendent with twenty-four hours' notice of its intent to begin testing, and shall provide access to the site at all times to allow the Superintendent to witness the testing. The Superintendent, at its discretion, may nominate the location of any specified tests and may ask for additional tests where required.

On completion of installation of all items of equipment, extensive and thorough component performance and systems tests shall be carried out by the Contractor, to determine successful operation of items of equipment plant characteristics and system operation under site conditions and the suitability of the plant for the duties specified.

All test equipment used during tests- shall have a certificate of accuracy, which has been issued within the preceding 12 months and copies sent to the Superintendent's Representative.

All tests shall be conducted at normal ambient temperature.

12.4 CONCRETE INSPECTION

The Contractor shall give sufficient notice to the Superintendent's Representative in order that inspection may be made at the following stages:

Base prior to placement of film underlay

Completed formwork, and reinforcement, cores and embedment fixed in place.

Commencement of concrete placing

Testing

Concrete sampling and testing shall be in accordance with AS 1012 at the frequency set out in Section 20 of AS 3600.

All concrete testing to be carried out by approved NATA testing Authority.

A copy of the certified record of the results of all authorised tests shall be forwarded to the Superintendent's Representative immediately after they are available. The original certified records shall be included in the Contractors QA Documentation.

If any such samples or tests show that the concrete does not comply with this Specification, the Superintendent's Representative may reject the work. All rejected

concrete shall be removed and replaced with satisfactory concrete, to the approval of the Superintendent's Representative and at the Contractor's expense.

Concrete rejection shall be in accordance with AS 3600, Clause 19.1.7. Where concrete has failed the Contractor shall remove the rejected concrete from the site.

12.5 COMPACTION

General

The Contractor shall be responsible for arranging all compaction testing to achieve the requirements indicated in the Construction Documents and this specification. All results shall be recorded by the Contractor on the Contractor's Inspection and Test Plan (ITP).

The contractor shall engage the services of a NATA registered laboratory to carry out all required testing. The NATA laboratory engaged by the Contractor may be directed by the Superintendent's Representative to undertake additional testing. The cost of such testing shall be borne by the Principal except in the case of failure where the costs of the initial and future testing to demonstrate compliance with the specification shall be at the Contractor's expense.

Density requirements

Works item	Minimum density ratio*	Moisture content
Bulk excavation surface:	95% STD	Within 3% of standard optimum
Bulk filling to: Embankments Building platforms selected material imported fill Pavements All other areas	 95% STD 100% STD 95%MOD 100% STD 95% STD	 Within 3% of standard optimum Within 3% of standard optimum Within 2% of modified optimum Within 3% of standard optimum -
Trench back-filling: Bedding, pipe support and back-filling	 In accordance with WSCM Section B	
Road pavements: Subgrade Sub base-quarry rubble Base-fine crushed rock	 100% STD 95%MOD 98%MOD	 Within 3% of standard optimum Within 2% of modified optimum Within 2% of modified optimum

Density ratio being field dry density divided by maximum dry density with respect to Standard (STD) AS 12895 1.1 or Modified (MOD) Compaction (AS 1289 5.2.1) or Density Index (DI) (AS 1289 5.6.1).

Frequency

The Contractor shall be responsible for arranging field density testing on all placed materials by a NATA registered laboratory. The Superintendent's Representative may carry out random field density tests on all placed materials to verify compliance with the densities as specified in this Specification.

The rates of testing in the pipe support and overlay material and the trench backfill material and the availability of certified test results shall be as specified in the Contractors' quality assurance system and as agreed by the Superintendent's Representative. The minimum frequency testing shall be as indicated in the table below:

GO

Frequency of density testing

	Frequency of density testing
Bulk excavation surface	Not less than one test per 1,000 m2 of area or three tests per visit (Whichever is higher).
Bulk filling: Embankment building platforms	Not less than one test per 400 m2 of area for each layer or one test per 200m3 or three tests per visit. Not less than one test
Trench back-filling: roadways other	Not less than one test per 100 m of trench length for every layer. Not less than one test per 100 m of trench length for
Road pavements	Not less than one test per 250m2 per layer, including subgrade.

Certificates

The Contractor shall submit, if requested, to the Superintendent's Representative all individual compaction test certificates. A copy of the results shall be submitted with the Quality Records.

The compaction test certificates shall show the location ie. pipeline chainage, and depth of each test together with certificates of compliance from the NATA registered laboratory confirming that; Compaction tests have been undertaken in accordance with the Test Plan; and the achieved compaction is in accordance with the specified requirements.

Such testing does not relieve the Contractor of any obligations in relation to the Defects Liability Period.

Compaction Failure

If a compaction test fails, further tests shall be carried out as required by the Superintendent's Representative to ascertain the full extent of the non-compliance. The Contractor shall re-compact all areas represented by the failed test, at the Contractor's expense, and shall repeat the compaction test within the representative zone.

If several areas of the trench fail the testing, the Superintendent's Representative may declare the entire section unsatisfactory. The Contractor shall, at the Contractor's expense, remove all trench fill along the run and replace the trench material and recompute. Compaction testing shall be repeated at the Contractor's expense.

12.6 HYDRAULIC TESTING

General

All pipe work shall be hydraulically tested to the pressure indicated in this Section of Specification.

The Contractor shall be responsible for supplying all the necessary equipment and labour for carrying out all the testing for the pipework.

Testing Requirements

All new pipelines shall be hydraulically tested as specified herein. The hydraulic testing shall be carried out by the Contractor at their expense.

The Contractor shall give the Superintendent's Representative not less than two working days' notice of intention to test a section of the pipeline.

The hydraulic testing shall not be carried out until at least seven (7) days after the pouring of the concrete thrust blocks

The Contractor shall, at their own expense, supply and install any necessary temporary plugs, caps or stops to the section of main to be tested and shall ensure that the main is adequately temporarily anchored prior to applying the test pressure.

The section of the pipework to be tested shall be filled with water at a rate sufficiently slow to ensure that all air is expelled. Air vents shall be kept open during filling until there is no further escape of air.

Water for testing shall be obtained from the water network.

The pipelines and associated connections shall be subjected to a hydrostatic test pressure of 1.25 times its' working pressure. This test pressure shall be maintained for a minimum of 30 minutes.

All leaks revealed by hydraulic testing shall be repaired by the Contractor at the Contractor's expense. Following any repairs the hydraulic test shall be repeated by the Contractor.

All repairs carried out by the Contractor shall be inspected and passed by the Superintendent's Representative before backfilling is continued.

12.7 COMMISSIONING AND TESTING

The commissioning phase shall be structured into the following:

- Construction verification

- Commissioning tests
- Process Commissioning

Construction Verification

Construction verification shall include, but not be limited to:

- Checking that the plant has been constructed and installed in accordance with Drawings, Specifications and standards.
- Cleaning and flushing of all pipework.
- Conduct static checks, including hydrostatic and pneumatic tests of pipework.
- Testing insulation and continuity of cables
- Conducting point to point unpowered loop checks
- Completing all outstanding items
- Submitting marked-up as-built Drawings.
- Submitting draft operation and maintenance manuals
- Cleaning the general site and remove all loose construction materials.

At this stage the equipment and plant will be considered as being ready for commissioning tests.

Commissioning Tests

Commissioning tests shall be undertaken to verify that the equipment is operating satisfactorily.

Prior to the commencement of the tests, all control system hardware i.e. PLCs/RTUs, network switches, communication modems and associated components, SCADA system hardware, etc. shall be installed in their appropriate housing on site and configured.

As part of this phase the communication links shall be tested between all possible sites. Where wireless communications are used (i.e. Radio or Next G), as-commissioned configurations shall be retained along with system performance results.

Commissioning tests shall include, but not be limited to:

- Energising and testing electrical control circuits.
- Energising and testing electrical power circuits.
- Testing all safety interlocks.
- Calibrating and testing all instrumentation.
- Testing drives in "auto" and "manual".
- Conducting loop checks on all instruments (field to local controller and local controller to plant PLC), including energisation and adjustment, as applicable.
- Device testing
- Proving the control sequencing, using the actual plant
- Testing the PLC sub-systems and tuning of control loops.
- Testing manual systems
- Optimising the performance of the plant
- Demonstrating that the guaranteed performance levels are being achieved by conducting performance tests

- Setting of set points within the PLC, SCADA and HMI

Process Commissioning

Process Commissioning shall be conducted once all other commissioning has been performed and the supervisor considers that the plant is complete and ready for operation.

The process commissioning will be led by a process engineer appointed by the Superintendents Representative. All cost associated with this engineer shall be borne by the client.

The process commissioning phase shall include testing and commissioning of the plant process control for compliance with the control philosophy and the FDS. As part of process commissioning, the entire system shall be tested with the use of water to mimic the final operation state.

As part of process commissioning, the system operational and alarm setpoints shall be tuned and set as required. At this point, the remote alarm system shall also be verified to ensure appropriate scheduling and annunciation settings have been configured.

Process commissioning shall also include verification of system failure alarms (i.e. communications failures, control system hardware failures, etc.) and the correct operation of the control system in such scenarios.

12.8 TRAINING

Operator training shall start during Commissioning Test phase. This informal training shall be concluded, with a formal half-day "hands-on" session to follow as part of the handover phase.

Nominated operations and maintenance personnel shall be trained to ensure that they have the required understanding of the mechanical plant, control and SCADA monitoring systems. Operations personnel shall be trained with a view to being able to operate and monitor the plant.

Maintenance training shall cover hardware configuration and software structures to enable personnel to debug and diagnose system faults. No allowances are required for specific equipment training such as:

- Pump maintenance
- PLC, RTU, SCADA, HMI development and coding

This training session shall cover the following topics as a minimum:

Operations:

- Overall Process Description
- Equipment Function
- SCADA System Overview
- Basic Functionality (i.e. system start up and shutdown, system log-in, etc.)
- Navigation
- Control & Monitoring Displays
- Alarm System Display & Management
- Trend System Display & Management

- Report System Display & Management
- Remote Access/Connectivity

Maintenance - Mechanical:

- Fault Diagnoses
- Equipment removal
- Maintenance Schedules

Maintenance - Software:

- Data Storage & Retrieval
- SCADA Hardware Maintenance
- Control System Overview (i.e. Network Architecture & Software)

Maintenance - Electrical/Controls:

- Control System Hardware Maintenance
- Basic Fault Finding Techniques
- Instrumentation and Calibration

13 DRAWINGS AND DOCUMENTATION

13.1 AS CONSTRUCTED DRAWINGS AND DOCUMENTATION

All new drawings shall comply with the relevant Australian Standards, and be supplied in AutoCAD and PDF format electronically.

As Constructed drawings will be submitted following updating red line mark up during commissioning.

13.2 OPERATING MANUALS

The manuals will be based around the manual template as shown in the appendices.

Two (2) complete bound sets of final approved operation and maintenance manual plus a PDF copy on CD will be issued to Town of Walkerville.

14 Appendices

14.1 TECHNICAL SCHEDULES

14.2 DRAWINGS

14.3 GEOTECHNICAL REPORTS

G220-005-10

LINE SYMBOLS

- MAIN PROCESS LINES
- SECONDARY PROCESS LINE
- OPEN CHANNEL
- INSTRUMENT SUPPLY OR CONNECTION TO PROCESS
- UNDEFINED SIGNAL
- PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL (DISCRETE)
- ELECTRIC SIGNAL (ANALOG)
- CAPILLARY TUBING
- HYDRAULIC SIGNAL
- SOFTWARE LINK
- EXISTING
- LIMIT OF VENDOR SUPPLY
- TERMINATION POINT (02)
- P=PIPING– REFER PIPE SPECS, MATERIAL AND ISOMETRICS I=INST– REFER INSTRUMENT INSTALLATION DETAILS
- IN LEFT/OUT RIGHT (XXX XXX XXX)
- OUT LEFT/IN RIGHT (XXX XXX XXX)
- FLOW ARROW
- CONNECTION (OF LINES)
- PIPELINES CONNECTED
- PIPELINES NOT CONNECTED
- PIPELINES NOT CONNECTED
- INSTRUMENT LINES NOT CONNECTED

PIPING VALVES (dynamic)

- VALVE, GENERAL SYMBOL
- VALVE, NORMALLY CLOSED (N.C.)
- GATE
- BALL
- GLOBE
- NEEDLE
- DIAPHRAGM
- BUTTERFLY
- KNIFE GATE
- PLUG
- ANGLE VALVE
- NON-RETURN
- HOSE BIB
- PINCH VALVE
- PENSTOCK

SELF ACTUATED REGULATORS AND VALVES

- PSV XXX (kPa) – PRESSURE RELIEF OR SAFETY VALVE SHOWING PRESSURE SETTING
- PSV XXX (kPa) – PRESSURE RELIEF OR SAFETY VALVE SHOWING PRESSURE SETTING
- PRV XXX – PRESSURE REGULATING
- PRV XXX – BACK PRESSURE REGULATING
- PCV XXX – PRESSURE REGULATING
- PCV XXX – BACK PRESSURE REGULATING

PSV - PRESSURE SAFETY VALVE
PRV - PRESSURE REGULATING VALVE
PCV - PRESSURE CONTROL VALVE

ACTUATORS

- PISTON
- DIAPHRAGM
- DIAPHRAGM, PRESSURE BALANCED
- SPRING - FOR PRESSURE RELIEF OR SAFETY VALVE ONLY
- HAND ACTUATED OR HANDWHEEL
- POSITIONER SHOWN ON UNSPECIFIED ACTUATOR.
- ROTARY MOTOR (MAY BE ELECTRIC HYDRAULIC or PNEUMATIC) (M)
- SOLENOID (S)
- WEIGHT
- FLOAT

EQUIPMENT DESIGNATION

EQUIPMENT DESCRIPTION — DAFT EFFLUENT PUMPS
AREA CODE — EQUIPMENT TYPE
EQUIPMENT NUMBER — EQUIPMENT NUMBER
65PP04
EQUIPMENT DESIGN DATA — FLOW: 320m³/HR; PRESSURE: 110 kPa; MOTOR: 15kW

ACTUATOR FAIL POSITIONS

- TWO WAY VALVE, FAIL OPEN
- TWO WAY VALVE, FAIL CLOSED
- THREE WAY VALVE, FAIL OPEN TO PATH A-C
- FOUR WAY VALVE, FAIL OPEN TO PATHS A-C & D-B
- ANY VALVE, FAIL LOCKED
- ANY VALVE, FAIL INDETERMINATE

THE FAILURE MODES INDICATED ARE THOSE COMMONLY DEFINED BY THE TERM "SHELF POSITION".
AS AN ALTERNATIVE TO THE ARROWS AND BARS, THE FOLLOWING ABBREVIATIONS MAY BE EMPLOYED:
FO - FAIL OPEN
FC - FAIL CLOSED
FL - FAIL LOCKED (LAST POSITION)
FI - FAIL INDETERMINATE

GENERAL EQUIPMENT ITEMS

- ROTARY MOTOR (M)
- AGITATOR, FAN, PROPELLER
- EXPANSION JOINT
- OPEN VENT GIVE NOTE IF RUN TO GRADE
- TUNDISH
- SPECTACLE BLIND, NORMALLY OPEN
- SPECTACLE BLIND NORMALLY CLOSED
- SPADE BLIND (or SLIP BLIND)
- SPACER
- RUPTURE DISK (or BURSTING DISK) PRESSURE RELIEF (PSE XXX)
- RUPTURE DISK (or BURSTING DISK) VACUUM RELIEF (PSE XXX)
- PIPING SPECIALITY (ref. PIPING SPECIALITIES LIST) (SP/XXX)
- TRAPPED DRAIN e.g. AUTO CONDENSATE RELEASE
- TRAPPED VENT e.g. AUTO AIR RELEASE
- FLOW CONTROL REGULATOR
- BELLMOUTH
- SPARGE PIPE

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- FLEXIBLE COUPLING
- REDUCER
- REDUCER (ECCENTRIC)
- CAP
- BLIND FLANGE
- NOZZLE
- FLANGED JOINT
- FLANGED VALVE
- HOSE COUPLING
- FLEXIBLE HOSE
- CAP

FLOW RATE PRIMARY ELEMENT SYMBOLS

- GENERAL SYMBOL (UNSPECIFIED) (FE XXX)
- PITOT TUBE or ANNUBAR (FE XXX)
- VORTEX METER (FE XXX)
- MAGNETIC FLOWMETER (FE XXX)
- POSITIVE DISPLACEMENT TYPE FLOWMETER C/W FLOW TOTALIZING INDICATOR (FQI XXX)
- VARIABLE AREA FLOW INDICATOR (FI XXX)
- TURBINE or PROPELLER METER (FE XXX)
- FLUME (FE XXX)
- SONIC FLOWMETER (FE XXX)
- VENTURI TUBE (FE XXX)
- FLOW ELEMENT, ORIFICE TYPE (FE XXX)
- WEIR (FG XXX)
- FLOWMETER (FE XXX)

EQUIPMENT (dynamic)

- PUMP GENERAL SYMBOL
- PUMP, CENTRIFUGAL
- PUMP, RECIPROCATING
- PUMP, HELICAL ROTOR
- PUMP, ROTARY VANE
- FAN / BLOWER / AIR COMPRESSOR
- GENERATOR (G)
- EJECTOR or EDUCTOR
- BELLOWS
- SILENCER
- STRAINER, Y-TYPE (FLANGED)
- STRAINER, GENERAL SYMBOL
- TRAP
- AIR DRYER
- WATER TRAP
- LUBRICATOR
- INLINE MIXER
- CALIBRATION CYLINDER
- PULSATION DAMPER
- PENSTOCK WEIR
- PENSTOCK OR STOPBOARD
- EXPANSION CHAMBER
- COCK & LANCE

GENERAL INSTRUMENT OR FUNCTION SYMBOLS

- PILOT LIGHT
- DIAPHRAGM SEAL
- UNDEFINED INTERLOCK LOGIC (I)
- PURGE or FLUSHING DEVICE (P)
- PUMP DRIVEN BY A VARIABLE SPEED MOTOR (SIC XXX) (M)
- SUMMING (Σ)
- ELECTRO-PNEUMATIC SIGNAL CONVERTER
- ELECTROMAGNETIC OR SONIC SIGNAL

INSTRUMENTS

ø12 mm TYP.	FIELD MOUNTED	PRIMARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	AUXILLARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	NORMALLY INACCESSIBLE TO OPERATOR (BEHIND THE PANEL)
DISCRETE INSTRUMENTS	X X	X X	X X	X X
COMPUTER FUNCTION	X X	X X	X X	X X
SHARED DISPLAY SHARED CONTROL	X X	X X	X X	X X
PROGRAMMABLE LOGIC CONTROL (P.L.C.)	X X	X X	X X	X X

PIPE SPECIFICATION INDEX

FLUID CODE	FLUID
AEA	AERATION AIR
ALS	ALUM SOLUTION
ASW	AIR SATURATED WATER
CEF	CLARIFIED EFFLUENT
CMA	COMPRESSED AIR
CST	CAUSTIC SOLUTION
DBS	DAFT BOTTOM SLUDGE
DRN	DRAIN
DS	DIGESTED SLUDGE
DTE	DAFT EFFLUENT
DTS	DAF THICKENED SLUDGE
EFW	EFFLUENT REUSE WATER
FIL	DEWATERED SLUDGE FILTRATE
FLA	FOUL AIR
GSL	GRIT SOLUTION
HYP	SODIUM HYPERCHLORITE SOLUTION
INA	INSTRUMENT AIR
ML	MIXED LIQUOR
MLR	MIXED LIQUOR RECYCLE ("A" RECYCLE)
POL	POLYMER SOLUTION
PTW	POTABLE WATER
RAS	RETURN ACTIVATED SLUDGE
RPE	RETURN PROCESS EFFLUENT
RSC	ACTIVATED SLUDGE REACTOR SCUM
RSW	RAW SEPTIC WASTE
SEW	SANITARY SEWER
STW	SCREENED SEPTIC WASTE
SEW	SUPERNATANT (FROM LAGOONS)
TEF	TREATED EFFLUENT
TS	THICKENED SLUDGE
TU	THICKENED UNDERFLOW
WAS	WASTE ACTIVATED SLUDGE

MAT'L CODE	MATERIAL	PIPE SPEC. REF.
316L	316L STAINLESS STEEL	AG1255-DN-106
ABS	ABS	AG1255-DN-108
CSG	CARBON STEEL GALVANIZED	AG1255-DN-104
DICL	DUCTILE IRON CEMENT LINED	AG1255-DN-102
FRP	FIBRE REINFORCED PLASTIC PIPING	AG1255-DN-112
HDPE	HDPE PE100 PN	AG1255-DN-110
MSCL	MILD STEEL CEMENT LINED	AG1255-DN-103
NYL	NYLON TUBE	AG1255-DN-111
PVC	uPVC	AG1255-DN-109
RCRJ	CONCRETE RUBBER RING JOINTS	AG1255-DN-107
SWSS	STAINLESS STEEL SPIRAL WELD	

PIPE LINE DESIGNATION

375-REC-3101-PVC

- 375 — PIPE SIZE
- REC — FLUID CODE (REFER TABLE ABOVE)
- 3101 — AREA CODE REFER TO AG1255.001-DN-152
- PVC — PIPE MATERIAL CODE (REFER TABLE ABOVE) LINE NUMBER

LETTER CODE FOR IDENTIFICATION OF INSTRUMENT FUNCTION

LETTER	FIRST LETTER: MEASURED OR INITIATING VARIABLE	FIRST LETTER: MODIFIER	SUCCEEDING LETTER: READOUT OR PASSIVE FUNCTION	SUCCEEDING LETTER: OUTPUT FUNCTION	SUCCEEDING LETTER: MODIFIER
A	ANALYSIS	-	ALARM	-	-
B	BURNER, FLAME	-	USERS CHOICE	USERS CHOICE	USERS CHOICE
C	USERS CHOICE	-	-	CONTROL	-
D	USERS CHOICE	DIFFERENTIAL	-	-	-
E	VOLTAGE	-	SENSOR	-	-
F	FLOW RATE	RATIO	-	-	-
G	USERS CHOICE	-	VIEWING DEVICE	-	-
H	HAND	-	-	-	HIGH
I	CURRENT (ELECTRICAL)	-	INDICATOR	-	-
J	POWER	SCAN	-	-	-
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE	-	CONTROL STATION	-
L	LEVEL	-	LIGHT	-	LOW
M	USERS CHOICE	MOMENTARY	-	-	MIDDLE INTERMEDIATE
N	USERS CHOICE	-	USERS CHOICE	USERS CHOICE	USERS CHOICE
O	USERS CHOICE	-	ORIFICE RESTR.	-	-
P	PRESSURE, VACUUM	-	POINT (TEST) CONNECTION	-	-
Q	QUANTITY	INTEGRATE, TOTALIZE	-	-	-
R	RADIATION	-	RECORD	-	-
S	SPEED, FREQUENCY	SAFETY	-	SWITCH	-
T	TEMPERATURE	-	-	TRANSMIT	-
U	MULTIVARIABLE	-	MULTI FUNCTION	MULTI FUNCTION	MULTI FUNCTION
V	VIBRATION, MECHANICAL ANALYSIS	-	-	VALVE, DAMPER, LOUVER	-
W	WEIGHT, FORCE	-	WELL	-	-
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS	-	RELAY, COMPUTE, CONVERT	-
Z	POSITION, DIMENSION	Z AXIS	-	DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	-

NOTES

1. AIR FLOW RATES ON P&ID's ARE STATED IN Sm^3/h, WHICH IS DEFINED AT "STANDARD" CONDITIONS OF 20°C, 101.3 kPa AND 55% RH

REV	DATE	DRN	DESCRIPTION
B	18-02-15	CO	ISSUE FOR TENDER
A	24-11-14	CO	ISSUE FOR HAZOP

Designed	CO	24-11-14	Authorised
Drawn	CO	24-11-14	Signature 10/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON Print Name
		Initials Date	

Company Name (If Not Guidera O'Connor)

Guidera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON, SOUTH AUSTRALIA 5031
TEL: 618 8239 9899 FAX: 618 8234 0855

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
SYMBOLS

Location	Project Number	Sheet Size
01	G220	A1

SHEET 10 OF 10

Drawing Number: G220-005-10 | Revision: B

G220-005-09

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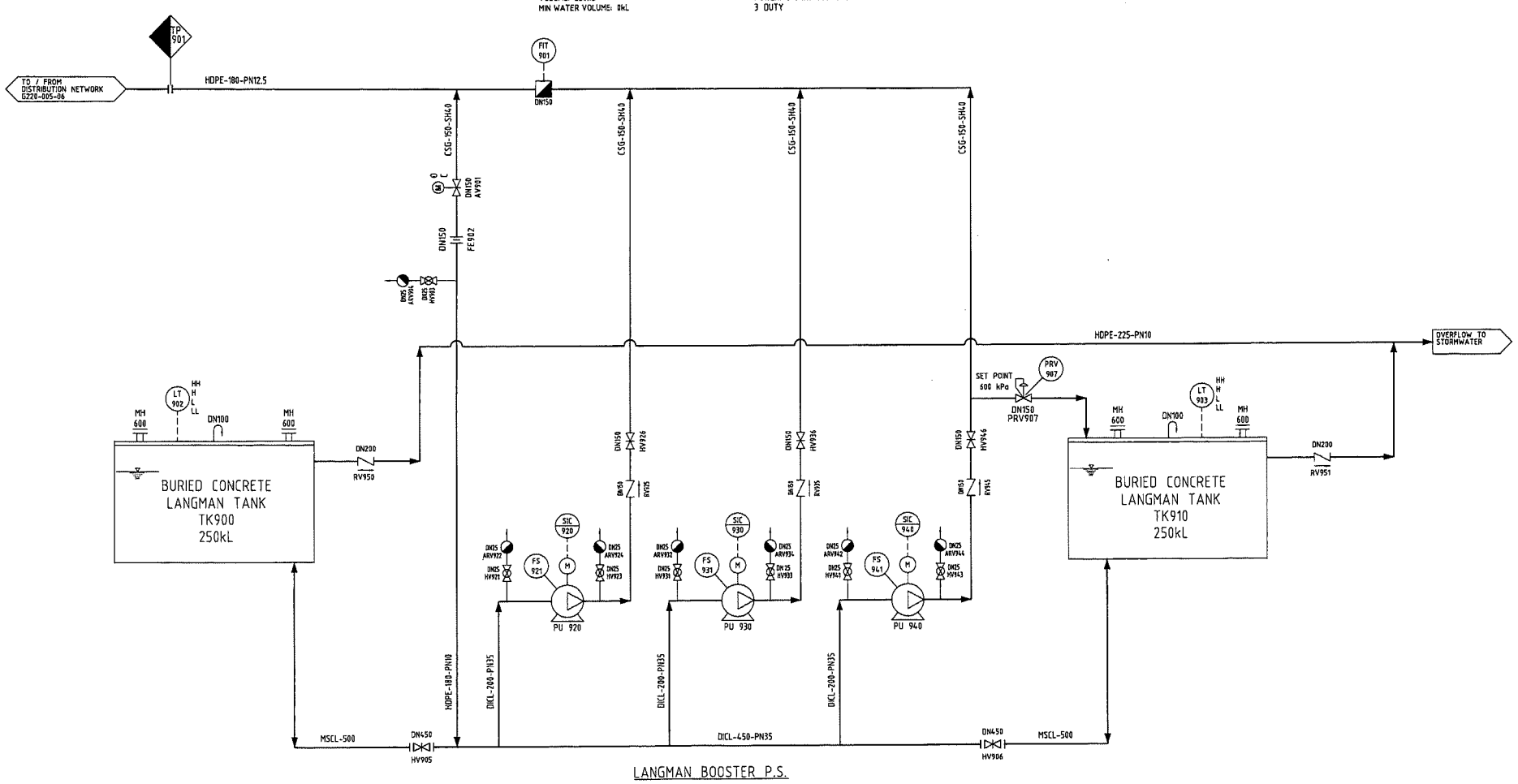
LANGMAN NETWORK
STORAGE TANK
TK900, TK910
VOLUME: 250kL
MIN WATER VOLUME: 0kL

LANGMAN BOOSTER PS
PU920, PU930, PU940
FLOW 5-50L/s @ 50mM DUTY TOTAL
POWER: 30.0kW PER PUMP
3 DUTY



LANGMAN BOOSTER P.S.

REVISIONS			
REV	DATE	DRN	DESCRIPTION
B	16-02-15	CD	ISSUE FOR TENDER
A	24-11-14	CD	ISSUE FOR HAZOP

Designed	CD	24-11-14	Authorised
Drawn	CD	24-11-14	Signature 10/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON
	Initials	Date	Print Name

Company Name
(If Not Guidera O'Connor)

Guidera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON
SOUTH AUSTRALIA 5031
TEL: (618) 8238 8888 FAX: (618) 8[illegible]

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
LANGMAN

Location	Project Number	Sheet Size
01	G220	A1

SHEET 9 OF 10

Drawing Number	Revision
G220-005-09	B

G220-005-08

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REVISIONS			
REV	DATE	DRN	DESCRIPTION
B	18-02-15	CD	ISSUE FOR TENDER
A	24-11-14	CD	ISSUE FOR HAZOP

Designed	CD	24-11-14	Authorised
Drawn	CD	24-11-14	Signature 18/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON
Initials		Date	Print Name

Company Name
(If Not Guildera O'Connor)

Guildera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON,
SOUTH AUSTRALIA 5031
TEL: 618 8208 8699 FAX: 618 8234 0955

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
FOXFIELD

Location	Project Number	Sheet Size
01	G220	A1

SHEET 8 OF 10

Drawing Number	Revision
G220-005-08	B

G220-005-07

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REVISIONS			
REV	DATE	DRN	DESCRIPTION
B	19-02-15	CO	ISSUE FOR TENDER
A	24-11-14	CO	ISSUE FOR HAZOP

Designed	CO	24-11-14	Authorised
Drawn	CO	24-11-14	10/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON
	Initials	Date	Print Name

Company Name
(If Not Guidera O'Connor)

Guidera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON
SOUTH AUSTRALIA 5031
TEL: 618 8238 9999 FAX: 618 82

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
TTG

Location	Project Number	Sheet Size
01	G220	A1

SHEET 7 OF 10

Drawing Number	Revision
G220-005-07	B

G220-005-06

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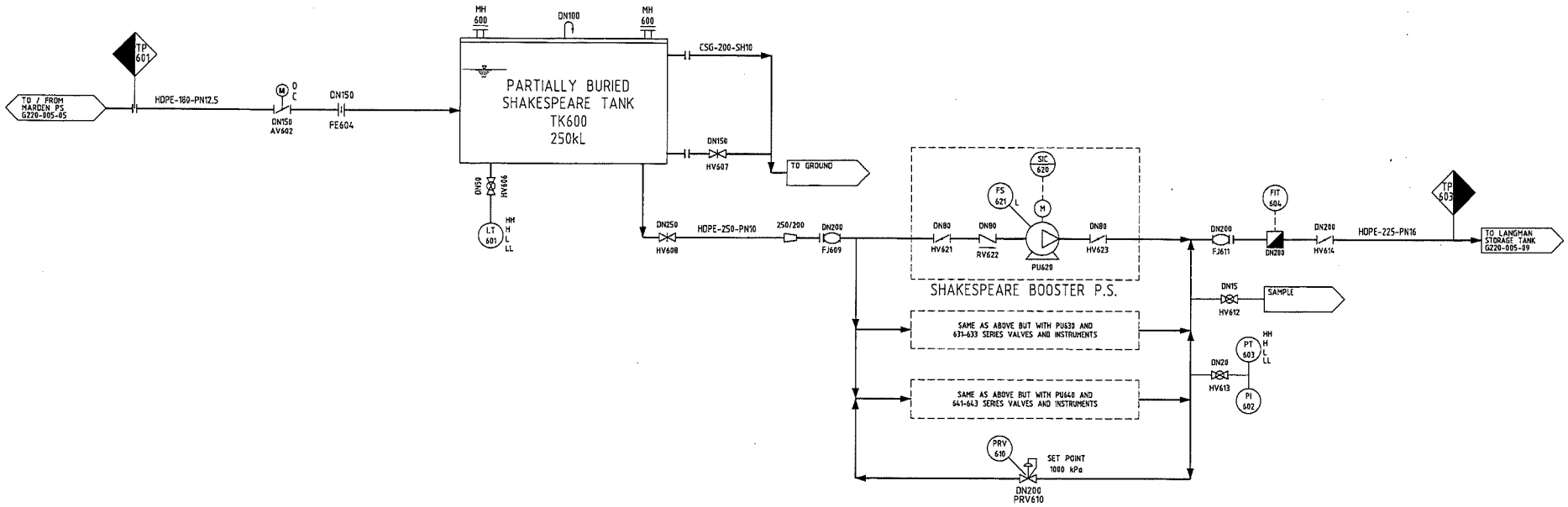
SHAKESPEARE NETWORK
STORAGE TANK
TK600
VOLUME: 250kL
MIN WATER VOLUME: 0kL

SHAKESPEARE BOOSTER PS
PU620, PU630, PU640
FLOW 5-50L/s @ 90mH DUTY TOTAL
POWER: 22.0kW
3 DUTY



REVISIONS			
REV	DATE	DRN	DESCRIPTION
C	18-02-15	CO	ISSUE FOR TENDER
B	18-02-15	CO	ISSUE FOR TENDER
A	24-11-14	CO	ISSUE FOR HAZOP

Designed	CO	24-11-14	Authorized
Drawn	CO	24-11-14	10/12/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON Print Name
Initials		Date	
Company Name (Do Not Guidera O'Connor)			

GO
Guidera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON, SOUTH AUSTRALIA 5031
TEL: 618 8238 9999 FAX: 618 8234 0855

WATERPROOFING EASTERN ADELAIDE STORMWATER HARVESTING & DISTRIBUTION SCHEME PROCESS & INSTRUMENT DIAGRAM SHAKESPEARE

Location	Project Number	Sheet Size
01	G220	A1

SHEET 6 OF 10

Drawing Number	Revision
G220-005-06	C

G220-005-05

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MARDEN NETWORK
STORAGE TANK
TK560, TK570
VOLUME: 250kL
MIN WATER VOLUME: 6.5kL

BOREHOLE PUMPS
PU500, PU520, PU540
EXISTING HAMILTON BORE 1 - FLOW 15L/s @ 105mH DUTY
NEW MARDEN BORE 2 & 3 - FLOW 15L/s @ 84mH DUTY PER BORE
POWER: 30kW PER BORE

MARDEN PS
PU575, PU580, PU585
FLOW 5-60L/s @ 90mH DUTY TOTAL
POWER: 30kW EACH PUMP
3 DUTY

FROM UV UNIT G220-005-04

HDPE-180-PN16 200/180

TP 501

DN25 ARV501 DN 25 HV501

FIT 501

FC 502

DN150 AV502

PIT 503 M

DN 15 HV503

DN25 ARV504 DN 25 HV504

BORE 1

PT 504 HH H L LL

FS 505

SIC 506

M

PU 500

DN25 ARV505 DN 25 HV505

PRV 507 DN65 PRV506

FIT 508 L

AIT 509 COND

DN150 HV508

DN150 HV509

TP 502

HDPE-180-PN16 180/250

DN15 HV507 SAMPLE

SCOUR TO GROUND

EXISTING HAMILTON BORE 1
PU-500

TP 503

HDPE-180-PN16 200/180

EXISTING MARDEN BORE SAME AS ABOVE, BUT WITH PU 520 PUMP AND 520 SERIES VALVES AND INSTRUMENTS

TP 504

HDPE-180-PN16 180/250

SCOUR TO GROUND

NEW MARDEN BORE 2
PU-520

TP 505

HDPE-180-PN16 200/180

EXISTING MARDEN BORE SAME AS ABOVE, BUT WITH PU 540 PUMP AND 540 SERIES VALVES AND INSTRUMENTS

TP 506

HDPE-180-PN16 180/250

SCOUR TO GROUND

NEW MARDEN BORE 3
PU-540

FROM UV UNIT G220-005-04

TP 507

HDPE-280-PN12.5

DN250 HV580

EXISTING SCALE BORE
PU-560

TP 509

HDPE-280-PN12.5 200/180

EXISTING MARDEN BORE SAME AS ABOVE, BUT WITH PU 560 PUMP AND 560 SERIES VALVES AND INSTRUMENTS

TP 510

HDPE-180-PN16 180/250

SCOUR TO GROUND

TO DISTRIBUTION NETWORK AND MARDEN TANKS

LOCAL IRRIGATION

MH 600 DN100 MH 600

DN250 HV560

ABOVE GROUND STEEL TANK TK-560 250kL

CSG-300-SH10

TO GROUND

DN25 HV561

DN150 HV562

DN250 HV563

DN250 HV570

ABOVE GROUND STEEL TANK TK-570 250kL

CSG-300-SH10

TO GROUND

HH H L LL LT 560

DN25 HV571

DN150 HV572

DN250 HV573

HDPE-250-PN10 250/200

DN200 FJ574

SIC 580

FS 581 L

M

DN100 HV581

DN100 RV582

DN100 HV583

PU580

MARDEN P.S.

DN200 FJ578

FIT 563 L

DN200

DN200 HV579

TP 508

TO DISTRIBUTION NETWORK G220-005-06

DN15 HV577 SAMPLE

SAME AS ABOVE BUT WITH PU585 AND 586-588 SERIES VALVES AND INSTRUMENTS

SAME AS ABOVE BUT WITH PU590 AND 591-593 SERIES VALVES AND INSTRUMENTS

PT 562 HH H L LL

DN20 HV576

PI 561

PRV 575

SET POINT 1000 kPa

DN200 PRV575

REVISIONS			
REV	DATE	DRN	DESCRIPTION
C	10-02-15	CO	ISSUE FOR REVIEW
B	10-02-15	CO	ISSUE FOR TENDER
A	24-11-14	CO	ISSUE FOR HAZOP

Designed	CO	24-11-14	Authorized
Drawn	CO	24-11-14	10/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON Print Name
Initials		Date	

Company Name (If Not Guidera O'Connor)

Guidera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON
SOUTH AUSTRALIA 5031
TEL: 618 8238 9999 FAX: 8181

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
MARDEN

Location	Project Number	Sheet Size
01	G220	A1

SHEET 5 OF 10

Drawing Number	Revision
G220-005-05	C

G220-005-04

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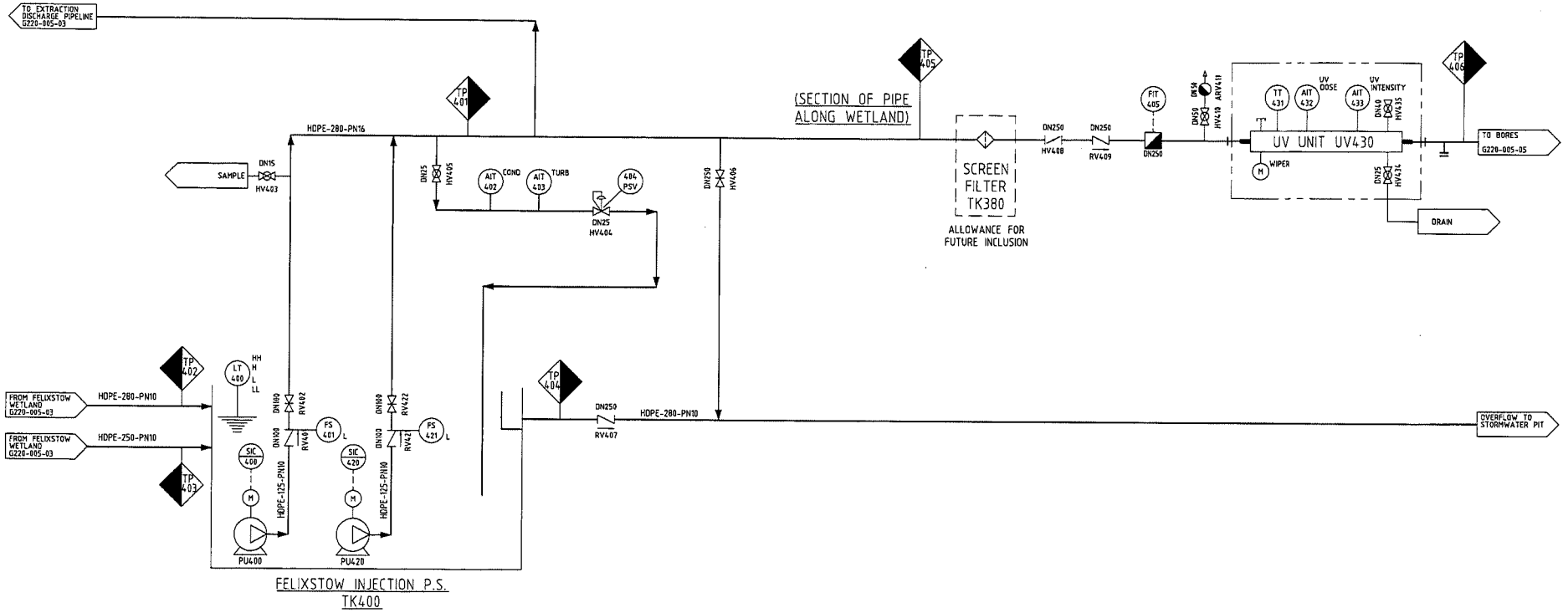
FELIXSTOW INJECTION P.S.
PUMPS: PU400, PU420
FLOW 50L/s @ 70mH DUTY TOTAL
POWER: 45kW EACH PUMP
2 DUTY

PUMP SUMP
TK400
Ø2.2m x 4.0 NOM. DEPTH
12kL

UV UNIT: UV410
MAX FLOW: 50 L/s
MIN FLOW: 12 L/s
MIN UV DOSE: 50mJ/ cm²
UV TRANSMITTANCE: 55%
POWER: 11.0kW
1 DUTY.



FELIXSTOW INJECTION P.S.
TK400

REVISIONS			
REV	DATE	DRN	DESCRIPTION
B	16-02-15	CO	ISSUE FOR TENDER
A	24-11-14	CO	ISSUE FOR HAZOP

Designed	CO	24-11-14	Authorised
Drawn	CO	24-11-14	10/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON Print Name
Initials		Date	

Company Name
Dr Not Guidera O'Connor)

Guidera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON, SOUTH AUSTRALIA 5031
TEL: (618 8238 0999 FAX: (618 8234 0965

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
FELIXSTOW

Location	Project Number	Sheet Size
01	G220	A1

SHEET 4 OF 10

Drawing Number	Revision
G220-005-04	B

G220-005-03

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SCREEN SC305
APERTURE: 6mm
FLOW: 50 L/s

FELIXSTOW EXTRACTION P.S.
PUMPS: PU300, PU330
FLOW 50L/s @ 20mH DUTY TOTAL
POWER: 15kW EACH PUMP
2 DUTY

PUMP SUMP
TK300
ø2.2m x 3.0m NOM. DEPTH
8kL

SCREEN SC315
APERTURE: 9mm
FLOW: 20 L/s

SCREEN SC310
APERTURE: 9mm
FLOW: 20 L/s

FROM DISTRIBUTION MAIN
HDPE-180-PN12.5
RV304
HV305
FE328
HDPE-280-PN10
FROM INJECTION PS DISCHARGE PIPELINE G220-005-04
HV306
RV307
FROM POTABLE WATER SUPPLY
HV313
TO STORMWATER
HV315
HV314
OVERFLOW TO SWALE
TO STORMWATER
TO STORMWATER
HV317
HV316
HV319
HV318
SAMPLE
HV303
HDPE-250-PN10
OVERFLOW TO FELIXSTOW WETLAND
FELIXSTOW SETTLEMENT POND TK310
SCREEN SC310
EXTRACTION PIT & WIER TK320
OVERFLOW
BIOFILTER 3 TK330
BIOFILTER 2 TK340
BIOFILTER 1 TK350
AV308
AV309
AV310
AV311
HDPE-180-PN10
COLLECTION PIT TK360
HDPE-280-PN10
HDPE-180-PN10
FOURTH CREEK FELIXSTOW
SCREEN SC305
PVC-375-PN10
HV302
RV301
HV332
RV331
HDPE-125-PN10
PU300
PU330
FELIXSTOW EXTRACTION P.S. SUBMERSIBLE PUMP ARRANGEMENT TK300
HV312
HDPE-180-PN10
SCREEN SC315
EXTRACTION PIT & WIER TK380
HV326
HV325
HV324
HV323
HV322
HV321
HV320
OVERFLOW TO STORMWATER
FELIXSTOW WETLAND TK370
HV319
HDPE-250-PN10
HDPE-180-PN10
HDPE-280-PN10
COLLECTION PIT TK390
HDPE-280-PN10
TO FELIXSTOW INJECTION PS G220-005-04
HDPE-250-PN10
TO FELIXSTOW INJECTION PS G220-005-05

REVISIONS			
REV	DATE	DRN	DESCRIPTION
B	10-12-15	CO	ISSUE FOR TENDER
A	24-11-14	CO	ISSUE FOR HAZOP

Designed	CO	24-11-14	Authorised
Drawn	CO	24-11-14	10/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON
Initials		Date	Print Name
Company Name (If Not Guildera O'Connor)			

Guildera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON
SOUTH AUSTRALIA 5031
TEL: 618 8238 6000 FAX: 618 (

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
FELIXSTOW

Location	Project Number	Sheet Size
01	G220	A1
SHEET 3 OF 10		
Drawing Number		Revision
G220-005-03		B

G220-001-01

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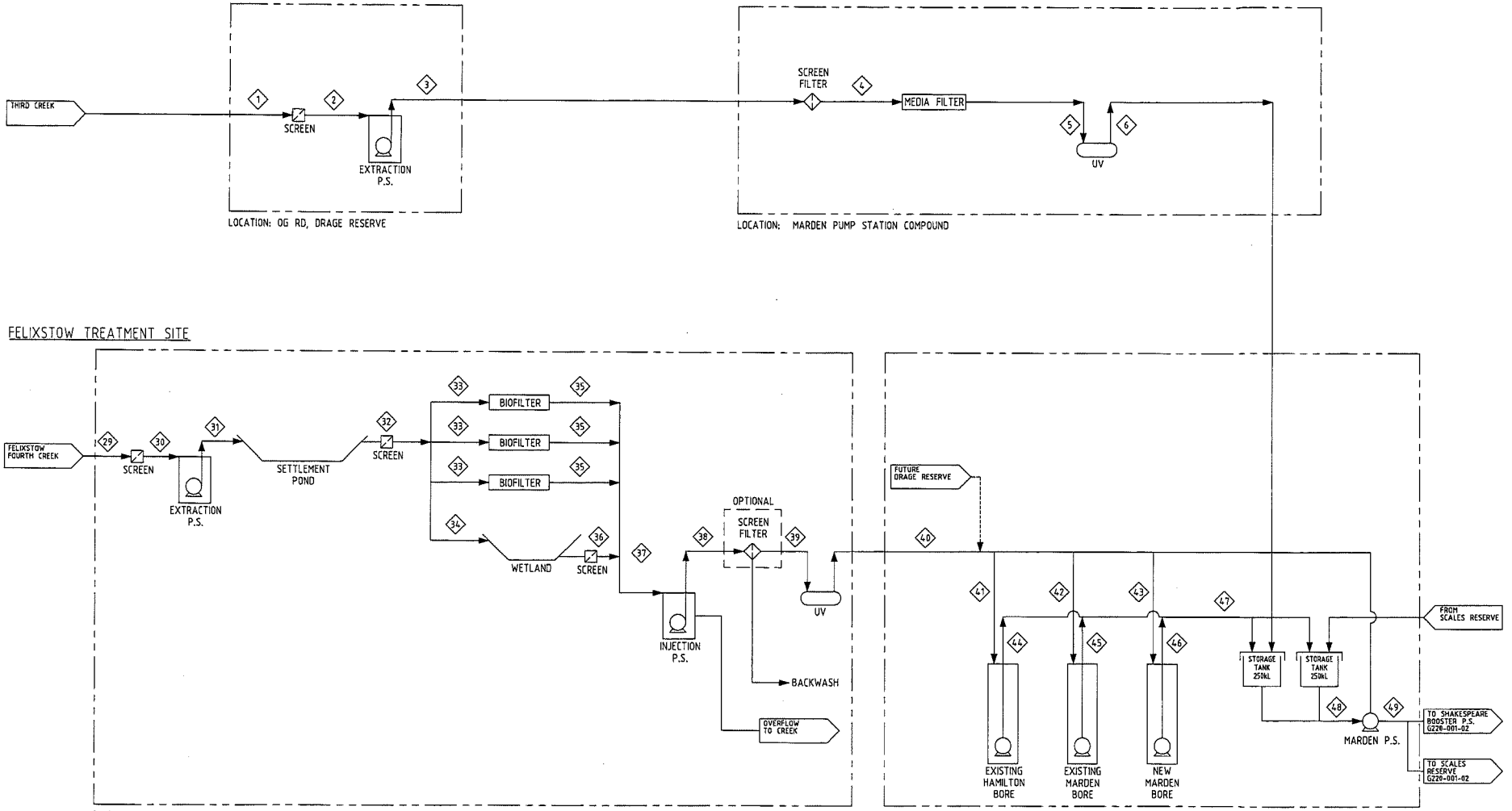

STREAM NUMBER	1	2	3	4	5	6	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
NOTES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FLUID TYPE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MINIMUM INSTANTANEOUS FLOW (L/sec)	0	0	0	0	0	15	25	25	25	25	0	0	0	0	12	12	12	12	10	10	10	12	12	12	12	5	5
MAXIMUM INSTANTANEOUS FLOW (L/sec)	20	20	20	20	20	20	50	50	50	50	15	20	15	20	50	50	50	50	17	17	17	15	15	15	50	60	60
FUTURE FLOWS (L/sec)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAX TDS (mg/L)	1200	1200	1200	1200	1200	1200	1200	1200	1200	-	100	-	-	-	1200	1200	1200	1200	1200	1200	1200	1500	1500	1500	1500	1500	1500
MAX NTU (mg/L)	200	200	200	200	5	5	200	200	200	200	200	200	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

NOTES:

1. BORE HEAD WORKS ARE TO BE COMPLETED BY THE MECHANICAL CONTRACTOR
2. PIPE WORK BETWEEN SITES SHALL BE BY CIVIL CONTRACTOR
3. MECHANICAL CONTRACTOR SHALL PROVIDE 5m OF PIPE WORK BEFORE AND AFTER MECHANICAL FITOUT
4. FLUID TYPES:
   RW - RAW WATER
   SW - SETTLED WATER
   RUW - RE-USE WATER
   FW - FILTERED WATER
   IW - INJECTION WATER
   EW - EXTRACTED WATER
5. FOR TIE-IN POINT REFER P&ID's.

REVISIONS			
REV	DATE	ORN	DESCRIPTION
C	18-07-15	CD	ISSUE FOR TENDER
B	18-02-15	CD	ISSUE FOR TENDER
A	24-11-14	CD	ISSUE FOR HAZOP

Designed	CD	24-11-14	Authorized
Drawn	CD	24-11-14	Signature 18/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON Print Name
Initials		Date	

Company Name (01 Not Guidera O'Connor)

Guidera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON, SOUTH AUSTRALIA 5031
TEL: 618 8236 9999 FAX: 618 8234 0855

WATERPROOFING EASTERN ADELAIDE STORMWATER HARVESTING & DISTRIBUTION SCHEME PROCESS FLOW DIAGRAM MAX AMBER / FELIXSTOW / MARDEN

Location	Project Number	Sheet Size
01	G220	A1

SHEET 1 OF 2

Drawing Number	Revision
G220-001-01	C

G220-001-02

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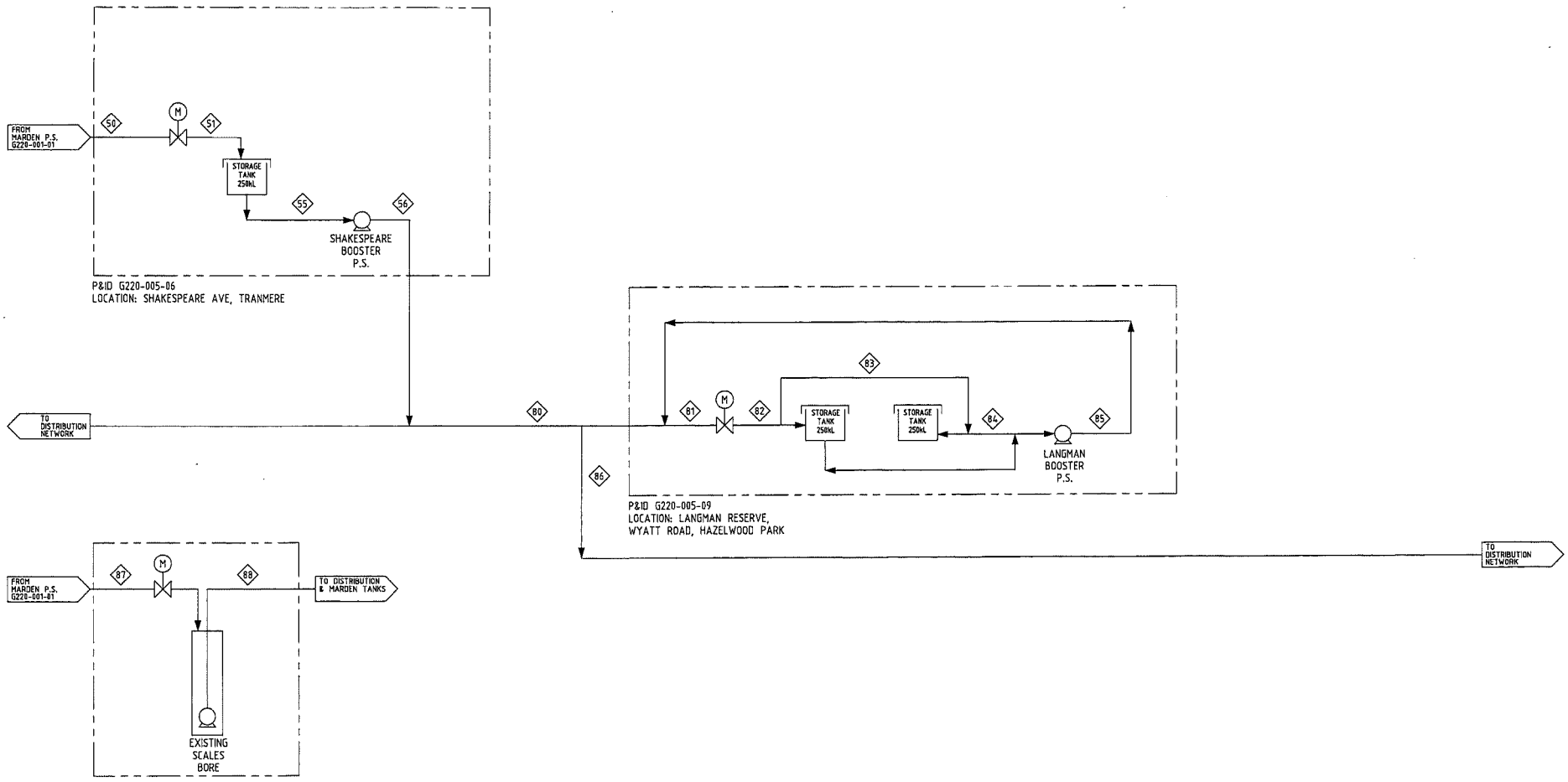

STREAM NUMBER	S0	S1	S5	S6	B0	B1	B2	B3	B4	B5	B6	S7	S8
NOTES	-	-	-	-	-	-	-	-	-	-	-	-	-
FLUID TYPE	-	-	-	-	-	-	-	-	-	-	-	-	-
MINIMUM INSTANTANEOUS FLOW (L/sec)	5	5	5	5	5	5	5	5	5	5	5	10	10
MAXIMUM INSTANTANEOUS FLOW (L/sec)	50	50	50	50	50	50	50	50	50	50	50	15	20
FUTURE FLOWS (L/sec)	-	-	-	-	-	-	-	-	-	-	-	-	-
MAX TDS (mg/L)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
MAX NTU (mg/L)	5	5	5	5	5	5	5	5	5	5	5	5	5

NOTES:

1. BORE HEAD WORKS ARE TO BE COMPLETED BY THE MECHANICAL CONTRACTOR
2. PIPE WORK BETWEEN SITES SHALL BE BY CIVIL CONTRACTOR
3. MECHANICAL CONTRACTOR SHALL PROVIDE 5m OF PIPE WORK BEFORE AND AFTER MECHANICAL FITOUT
4. FLUID TYPES:
   - RW - RAW WATER
   - SW - SETTLED WATER
   - RUW - RE-USE WATER
   - FW - FILTERED WATER
   - IW - INJECTION WATER
   - EW - EXTRACTED WATER
5. FOR TIE-IN POINT REFER P&ID's.

REVISIONS			
REV	DATE	DRN	DESCRIPTION
C	14-07-15	CO	ISSUE FOR TENDER
B	18-02-15	CO	ISSUE FOR TENDER
A	24-11-14	CO	ISSUE FOR HAZOP

			Authorized	
Designed	CO	24-11-14		
Drawn	CO	24-11-14	Signature	10/02/15 Date
Reviewed	NA	24-11-14	NEIL ATKINSON	
	Initials	Date	Print Name	
Company Name (If Not Guildera O'Connor)				

GO
Guildera O'Connor Pt. LTD
91 HOLLAND STREET, THEBAR
SOUTH AUSTRALIA 5031
TEL: 618 8238 8000 FAX: 618

WATERPROOFING EASTERN ADELAIDE STORMWATER HARVESTING & DISTRIBUTION SCHEME PROCESS FLOW DIAGRAM TTG / SHAKESPEARE / FOXFIELD / LANGMAN

Location	Project Number	Sheet Size
01	G220	A1

SHEET 2 OF 2

Drawing Number	Revision
G220-001-02	C

G220-005-01

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REVISIONS			
REV	DATE	DRN	DESCRIPTION
B	19-02-15	CO	ISSUE FOR TENDER
A	24-11-14	CO	ISSUE FOR HAZOP

Designed	CO	24-11-14	Authorised
Drawn	CO	24-11-14	10/02/15 (Date)
Reviewed	NA	24-11-14	NEIL ATKINSON
	Initials	Date	Print Name

Company Name
(If Not Guidera O'Connor)

GO
Guidera O'Connor Pt. LTD
31 HOLLAND STREET, THEBARTON,
SOUTH AUSTRALIA 5031
TEL: 618 8235 9999 FAX: 618 8234 0955

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
MAX AMBER RESERVE

Location	Project Number	Sheet Size
01	G220	A1

SHEET 1 OF 10

Drawing Number	Revision
G220-005-01	B

G220-005-02

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REVISIONS			
REV	DATE	ORN	DESCRIPTION
B	10-02-15	CD	ISSUE For IA
A	24-11-14	CD	ISSUE FOR IA.

Designed	CD	24-11-14	Authorised
Drawn	CD	24-11-14	10/02/15 Date
Reviewed	NA	24-11-14	Signature
	Initials	Date	NEIL ATKINSON Print Name

Company Name
Of Not Guidera O'Connor

Guidera O'Connor P[illegible] LTD
31 HOLLAND STREET, [illegible]
SOUTH AUSTRALIA 50
TEL: 618 8238 8699 F[illegible]

WATERPROOFING EASTERN ADELAIDE
STORMWATER HARVESTING & DISTRIBUTION SCHEME
PROCESS & INSTRUMENT DIAGRAM
MAX AMBER RESERVE

Location	Project Number	Sheet Size
01	G220	A1

SHEET 2 OF 10

Drawing Number	Revision
G220-005-02	B