PROCESS, INSTRUMENTATION AND CONTROLS

Rockwell PLC - Hardware Implementation Standard

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Watercare

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More information

If you have further queries, please contact the **Digital Control Systems** team at: DigitalControlSystems@water.co.nz

DOCUMENT CONTROL

Document owner   Control Systems Architect

Review   Control Systems Manager

Version history

Version	Description of revision	Released by	Date
1	First release	W Strydom	07/06/2024
1.1	Table 3 updated on List of available products and their use	W Strydom	03/12/2024

This document takes effect on the date of release and supersedes all prior versions.

Approvers / Reviewers

Name	Title	Role
Rodney Micallef	Control Systems Architect	Author/ Reviewer
Preesen Moodley	Control Systems Team Lead	Reviewer
Waldo Strydom	Principal Asset Lifecycle Engineer	Reviewer
Anthony Yung	Control Systems Manager	Approver / Document Owner

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1. Purpose

1.1 Background

1.1.1 Objectives

The objective of this document is to provide a standard for the design of control system components for new Watercare sites and when upgrading existing sites. This document provides guidance on:

- The selection of Rockwell PLC components. This includes approved components which should be specified in the design and alternatives that shall not be used. The objective is to standardise components used, minimising variability, risk and the number of spares kept by the Watercare store facilities.
- How to utilise communication ports of the processor and communication modules.
- Wiring of communication and power to the various IO modules

1.1.2 Audience

This document is intended for Watercare personnel, contractors and consultants involved in the electrical and control systems design of network sites (transmission and local networks), and facilities. This includes control systems architects, consultants and electrical design engineers designing the control systems and networking components for new sites and upgrades of existing sites.

1.1.3 Scope

The scope of this document is to include all Rockwell branded PLC hardware that can be utilised within Watercare's control systems environment.

It also includes components that can be used for upgrades but are not allowed on new facilities. The base requirements for programming software implementation within new facilities is also mentioned in this document.

1.1.4 Out of Scope

This document does not cover any PLC configuration components used to program the Rockwell PLC processors.

1.2 Compliance requirements

Compliance with this standard is required for all Watercare sites using Rockwell branded PLCs. Section 3 below indicates where this equipment should be used in Watercare facilities. Exceptions to this standard are not permitted.

1.3 Supporting documentation

Refer to Rockwell's product online documentation for the most current supporting documents.

1.4 Abbreviations

Table 1: Abbreviations

Abbreviation	Description
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
EOL	End of Life
IO	Input / Output
OT	Operational Technology
PLC	Programmable Logic Controller
SLA	Service Level Agreement
VAC	Alternate Current Voltage
VDC	Direct Current Voltage

2. Overarching Principles

2.1 Hardware Replacement

All Rockwell programmable logic controllers (PLCs) in Watercare's control systems environment must use one of the following replacement approaches:

1. The PLC equipment referred to in this document must have a vendor support agreement in place with a minimum service level agreement (SLA) of next business day on site for failed or faulty components.
   - The project or initiative procuring the PLC is responsible for funding the first 12 months of the support agreement for that device. Beyond the first 12 months support will the funded via a Watercare digital operational budget.
   - This support agreement must be maintained for the operational life of the PLC.
   - This agreement must align with current Watercare digital practices for maintaining support for a given vendor's equipment.

2. Spares are held and managed by Watercare's Digital Control System Team at the Head Office.

3. Spares are held and managed by Watercare.

2.2 Standardisation

The objective of having this hardware implementation standard is to ensure that Watercare minimises the variety of Rockwell PLC components across all water and wastewater treatment plants and minimise the number of spares kept in storage.

2.3 Product Lifecycle Status

Rockwell Automation categorizes its products into different stages of the lifecycle to provide customers with clarity on the support and services available. What follows is an overview of these stages.

2.3.1 Active

- Products in the "Active" stage are actively sold, supported, and enhanced by Rockwell Automation.
- These products receive regular updates, including firmware upgrades, software patches, and technical support.
- Customers can purchase new licenses, spare parts, and accessories for products in this stage.
- Rockwell Automation continues to invest in research and development to improve and expand the capabilities of active products.

2.3.2 Active Mature

- "Active Mature" products are still supported and maintained by Rockwell Automation but may be approaching the later stages of their lifecycle.
- While new features and enhancements may be less frequent, basic support, including technical assistance and spare parts availability, is still provided.

- Customers can expect continued access to documentation, training, and software updates for active mature products.
- Rockwell Automation may recommend migration paths or upgrades to newer products as alternatives become available.

2.3.3   End of Life

- Products designated as "End of Life" (EOL) have reached the final stage of their lifecycle and are no longer actively sold by Rockwell Automation.
- Limited support is available for EOL products, typically including critical security patches, technical assistance, and access to historical documentation.
- Spare parts availability may become limited, and repairs could be subject to component availability.
- Rockwell Automation provides guidance and assistance to help customers transition to alternative solutions, including upgrades or replacements with newer products.

2.3.4   Discontinued

- "Discontinued" products are no longer supported or maintained by Rockwell Automation, and technical assistance, spare parts, and documentation for discontinued products may be extremely limited or unavailable.
- Alternative solutions may be required to ensure continued operation and support.

Product lifecycle statuses can be checked by visiting the following website:
https://www.rockwellautomation.com/fr-fr/support/product/product-compatibility-migration/product-lifecycle-status.html

3.   Hardware Selection

Rockwell has many product ranges of PLC hardware to suit a vast array of control and monitoring applications. The following section highlights which product range and applicable model numbers are allowed to be used at Watercare facilities.

Table 2 shows the product range and where they're expected to be used at Watercare facilities.

Table 2: Rockwell PLC product range

Application	Product Range	Watercare Usage
Small	MicroLogix	Do Not Use
Mid-Range	CompactLogix	Small Treatment Plants (<2,000 IOs)
Large	ControlLogix or CompactLogix	Large Treatment Plants (>2,000 IOs)

MicroLogix shall not be used as a main control component within a plant unless this comes as part of a packaged unit.

> **Note**: A packaged unit refers to a self-contained system that integrates various control systems components including the main processor, sensors, and actuators. This unit interfaces to the main plant control system via a communication link or IOs.

The number of IOs (2,000) provided above to assist with the definition of small and large treatment plants is only indicative. The Watercare control systems architecture and operations teams should be contacted to discuss the best suited product range for a particular application.

Control and monitoring of small applications shall be carried out using CompactLogix.

The following sections lists all the components available by the PLC manufacturer, Rockwell Automation, and which components shall be used.
Column Legend:

- **Standard Use**: These are the components that form part of the Watercare Rockwell PLC hardware standard. These components can be used without restriction.
- **Do Not Use**: These components shall not be used. Selection of these components in an electrical design will lead to this design being rejected at the review stages.
- **Special Permission**: These are components that require special **written** permission from the Digital Control System Team before being utilised. Special reasons must exist and must be given before these components can be utilised. A permission request form is available at the end of this document.

Table 3: List of available products and their use

Product Range	Product Family	Standard Use	Do Not Use	Special Permission (Upgrades)	Processor / Communication (or IO Modules) Model Allowed
ControlLogix	5580	✓			
ControlLogix	5570	✓			1756-L71
CompactLogix	5480		✓		
CompactLogix	5380	✓			5069-L310ER, 5069-L330ER, 5069-L340ER, 5069 AENTR when using the 5069 series as IO.
CompactLogix	5370			✓	1769-L33ER
MicroLogix	870		✓		
MicroLogix	850		✓		
MicroLogix	820		✓		
MicroLogix	710		✓		
MicroLogix	1400		✓		
Point IO		✓			1734-AENT
Flex IO				✓	1794-AENTR
Flex IO 5000		✓			5094-AENT, 5094-AENTR

Note: Link to Rockwell PLC Family Range Information:
https://www.rockwellautomation.com/en-us/products/hardware/allen-bradley/programmable-controllers/all-products.html

3.1 Hardware Lifecycles

The following diagrams indicate where the PLC product families presented in this document (as standard use or special permission use) reside in their respective product lifecycle.
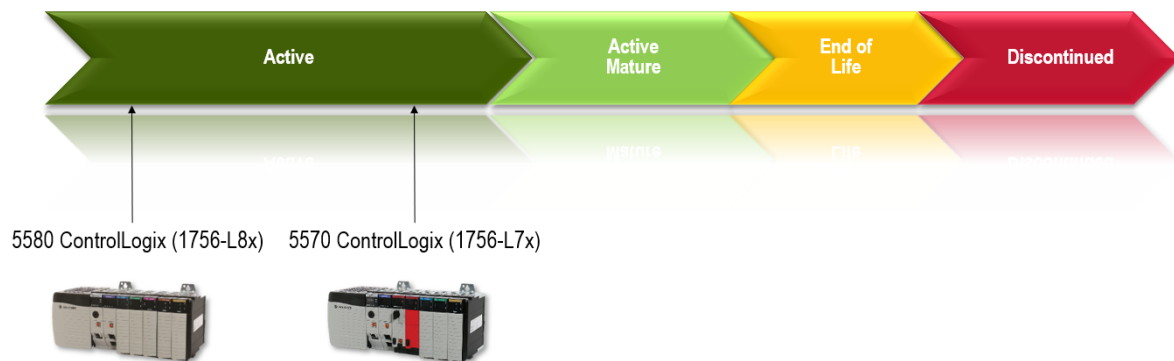

Figure 1: ControlLogix product lifecycle
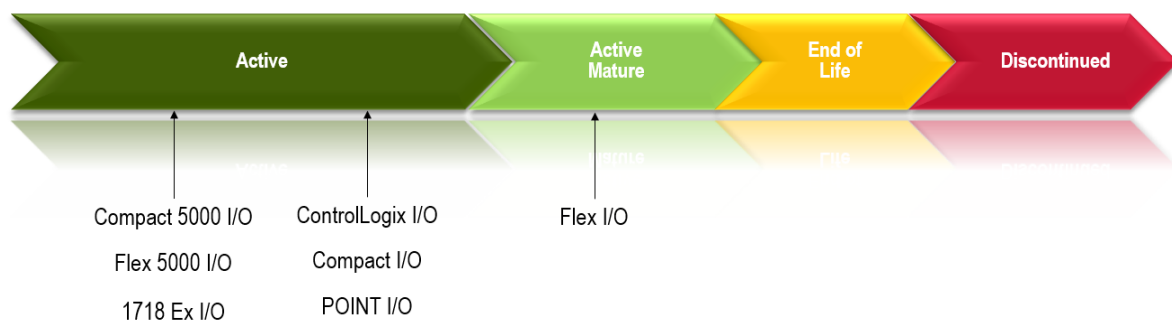

Figure 2: CompactLogix product lifecycle

Figure 3: Input Output product lifecycle

3.2   ControlLogix

Table 4: List of ControlLogix products that can be used within Watercare.

Part Number	Description	Standard Use	Special Permission
Power Supply Modules			
1756-PB75	ControlLogix, Power Supply Module, 24V DC Power	✓	
1756-PA75	ControlLogix, Power Supply Module, 230 AC Power		✓
Controller Modules			
1756-L71	ControlLogix, Controller Module, 2 MB	✓	
Communication Modules			
1756-EN2T	ControlLogix, Communications Module, Single Port Ethernet/IP		✓
1756-EN2TR	ControlLogix, Communications Module, Dual Port Ethernet/IP	✓	
Historian Modules			
1756-HST2G	ControlLogix, Historian Module, FactoryTalk Machine Edition	✓	
Miscellaneous Hardware			
1756-N2	ControlLogix, Empty Slot Cover	✓	

The list does not contain any IO modules. This standard does not currently cover this category of ControlLogix components.

Any requirement for IO modules in this category shall be discussed with the Watercare's Digital Control System Team prior to implementation.

It is acceptable to use the hardware mentioned in Table 4 above with Point IO, Flex IO modules or the CompactLogix 5069 series used as IO instead of the ControlLogix family of IO module products. The decision flowchart presented in Section 4 should be used to determine which remote IO product range shall be used.

Figure 4: ControlLogix product illustration

3.3   CompactLogix

3.3.1   Green Fields Installations

This section applies to green field installations. New installation shall only have CompactLogix components listed in the Table 5 below.

Table 5: List of acceptable CompactLogix components

Part Number	Description	Standard Use	Special Permission
Controller Modules			
5069-L310ER	CompactLogix, Controller Module, 1 MB Ethernet/IP	✓	
5069-L330ER	CompactLogix, Controller Module, 3 MB Ethernet/IP	✓	
5069-L340ER	CompactLogix, Controller Module, 4 MB Ethernet/IP	✓	
Communication Modules			
5069-AENTR	CompactLogix, Communications Module, Compact 5000 EtherNet/IP Interface	✓	
IO Modules			
5069-IB16	CompactLogix, DI Module, 16-Point Sinking	✓	
5069-OB8	CompactLogix, DO Module, 8-Point 24VDC	✓	
5069-OB16	CompactLogix, DO Module, 16-Point Sourcing High-Current	✓	
5069-OW4I	CompactLogix, DO Module, 4-Point Normally Open Relay	✓	
5069-OW16	CompactLogix, DO Module, 16-Point Normally Open Relay	✓	
5069-IF8	CompactLogix, AI Module, 8-Channel Current/Voltage	✓	
5069-OF4	CompactLogix, AO Module, 4-Channel Current/Voltage	✓	
5069-OF8	CompactLogix, AO Module, 8-Channel Current/Voltage	✓	

Figure 5: CompactLogix product illustration

3.3.2 Brown Field Installations

This section applies to brown field installations already using the 1769 product range. Where an existing CompactLogix PLC with its associated IO modules exist, if the site does not use the 5069-range listed in the previous section, it is not practical to replace IO modules to match the Watercare standard listed above.

Table 6: List of 1769 range IO modules that can be used with installations that use this range of products.

Part Number	Description	Standard Use	Special Permission
Power Supply Modules			
1769-PB4	CompactLogix, Power Supply Module, 24VDC 4A/2A		✓
Controller Modules			
1769-L33ER	CompactLogix, Controller Module, 2MB Ethernet		✓
Communication Modules			
1769-AENTR	CompactLogix, Communications Module, Dual Port EtherNet/IP Interface		✓
IO Modules			
1769-IQ32	CompactLogix, DI Module, 32-Point 24VDC Sink/Source		✓
1769-OB16	CompactLogix, DO Module, 16-Point 24VDC Source		✓
1769-OB32	CompactLogix, DO Module, 32-Point 24VDC Source		✓
1769-IF8	CompactLogix, AI Module, 8-Point Current/Voltage		✓
1769-IF16C	CompactLogix, AI Module, 16-Point Current		✓
1769-OF4	CompactLogix, AO Module, 4-Point Current/Voltage		✓
1769-OF8C	CompactLogix, AO Module, 8-Point Current		✓
1769-IF4XOF2	CompactLogix, Mixed IO Module, 4-Point AI/2-Point AO		✓
Miscellaneous Hardware			
1769-CRR3	CompactLogix, Right-to-Right 1M Expansion Cable		✓
1769-ECL	CompactLogix, Left End Cap/Terminator		✓
1769-ECR	CompactLogix, Right End Cap/Terminator		✓

Figure 6: CompactLogix 1769 product illustration

3.4 Distributed I/O Selection – Point IO

Table 7: List of Point IO products that can be used

Part Number	Description	Standard Use	Special Permission
Power Supply Modules			
1734-EP24VDC	Point IO, Power Supply Module	✓	
Communication Modules			
1734-AENT	Point IO, Communications Module, Single EtherNet/IP Interface	✓	
1734-AENTR	Point IO, Communications Module, Dual EtherNet/IP Interface	✓	
IO Modules			
1734-IB8	Point IO, DI Module, 8-Point Sinking Input	✓	
1734-OB8	Point IO, DO Module, 8-Point 24VDC Source	✓	
1734-IE8C	Point IO, AI Module, 8-Point Current	✓	
1734-OE4C	Point IO, AO Module, 4-Point Current	✓	

Figure 7: Point IO module

3.5   Distributed I/O Selection – Flex 5000 IO

Table 8: List of Flex 5000 IO products that can be used

Part Number	Description	Standard Use	Special Permission
Communication Modules			
5094-AENT	Flex IO, Communications Module, Single EtherNet/IP Interface	✓	
5094-AENTR	Flex IO, Communications Module, Dual EtherNet/IP Interface	✓	
IO Modules			
5094-IB32	Flex 5000 IO, DI Module, 32-Point Sinking Input	✓	
5094-OB16	Flex 5000 IO, DO Module, 16-Point 24VDC Source	✓	
5094-IF8	Flex 5000 IO, AI Module, 8-Point Current/Voltage	✓	
5094-OF8	Flex 5000 IO, AO Module, 8-Point Current/Voltage	✓	
Terminal Bases			
5094-TB3	Flex 5000 Terminal Base	✓	

Note: This product range is a direct replacement to the Flex IO range listed in the next section.

Figure 8: Flex 5000 IO

3.6   Distributed I/O Selection – Flex IO

The Watercare control systems architecture and operations teams must be contacted prior to the utilising of any Flex IO products.

It is strongly desirable that Flex IO systems are upgraded with the Flex 5000 product range where practical.

Table 9: List of Flex IO products that can be used

Part Number	Description	Standard Use	Special Permission
Power Supply Modules			
1794-PS13	Flex IO, Power Supply Module, 230VAC In / 24VAC Out		✓
Communication Modules			
1794-AENTR	Flex IO, Communications Module, EtherNet/IP Interface		✓
IO Modules			
1794-IB32	Flex IO, DI Module, 32-Point Sinking Input		✓
1794-OB16	Flex IO, DO Module, 16-Point 24VDC Source		✓
1794-IE12	Flex IO, AI Module, 12-Point Current/Voltage		✓
1794-OE4	Flex IO, AO Module, 4-Point Current/Voltage		✓
Terminal Bases			
1794-TB3	Flex Terminal Base, Cage clamp, 16 IO	✓	
1794-TB3G	Flex Terminal Base, Grounded Screw Clamp, 36 IO	✓	
1794-TB32	Flex Terminal Base, Cage clamp, 32 IO	✓	

Note: Flex IO products can strictly be used only if there are already Flex IO devices installed within a facility to be expanded.

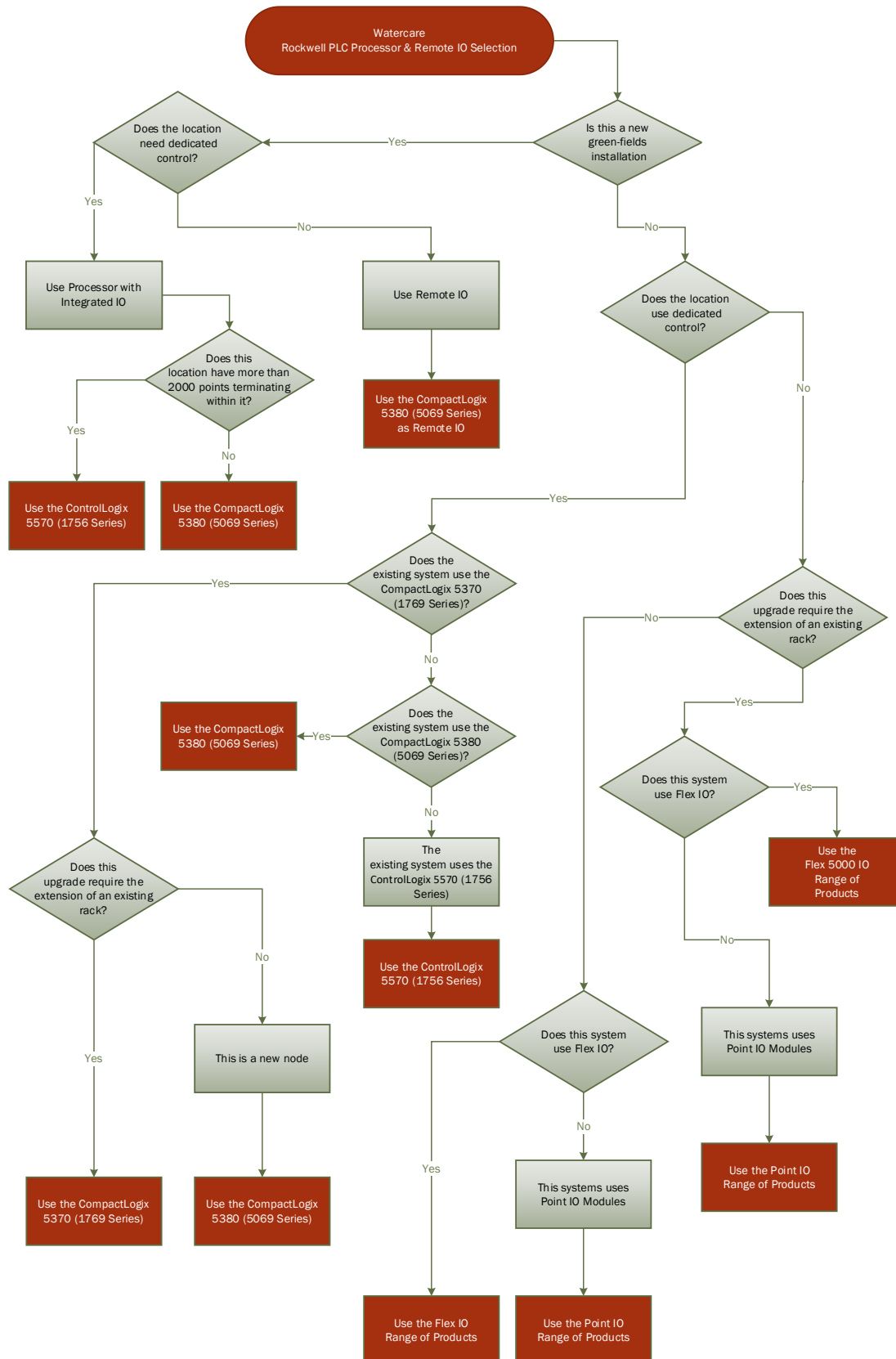**Figure 9**: Flex IO configuration

4. Equipment selection process

Figure 10: Equipment selection flowchart

5. Communication Port Standards

5.1 Communications Overview

The communication information in this section only covers systems with no redundancy requirements.

Communications between processors, remote IO and SCADA PCs shall occur on the Plant network as shown in the diagram below. No direct communication links shall occur above level 2 as per the Purdue enterprise reference model. (Ref: https://www.nist.gov/image/figure-1-purdue-model-computer-integrated-manufacturing)
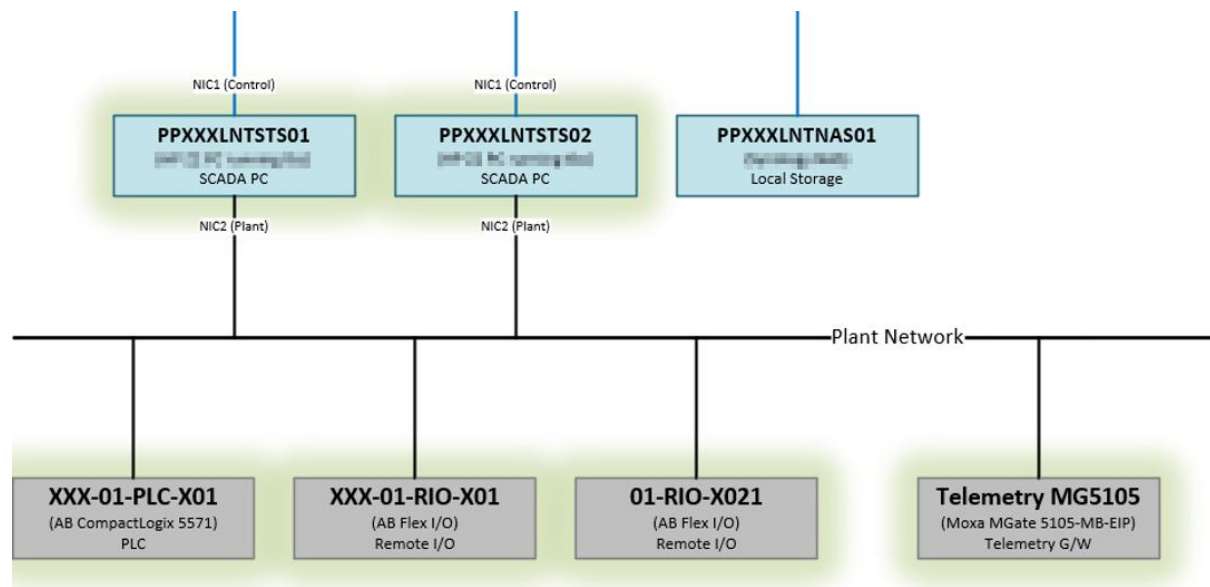

Figure 11: Remote IO and SCADA PCs on Plant network

This document is not intended to provide all the information required to adequately design Rockwell PLC networks. Watercare's Digital Control System Team needs to be consulted during the network design process.

Table 10: List of communication modules and processors included in this standard

Product Range	Processor Model	Comms Ports
ControlLogix 5570	1756-L71	0
CompactLogix 5380	5069-L310ER	2
CompactLogix 5380	5069-L330ER	2
CompactLogix 5380	5069-L340ER	2
CompactLogix 5370	1769-L33ER	2
Product Range	**Communication Module Model**	**Comms Ports**
ControlLogix 5570	1756-EN2T	1
ControlLogix 5570	1756-EN2TR	2
CompactLogix 5380	5069 AENTR	2
CompactLogix 5370	1769-AENTR	2
Point IP	1734-AENT	1

Point IP	1734-AENTR	2
Flex IO	5094-AENTR	2
Flex 5000 IO	1794-AENT	1
Flex 5000 IO	1794-AENTR	2

Where possible single interface processors and communication modules with single interfaces shall be used where no redundancy is required.

The Rockwell products selected in this standard are only able to communicate via the EtherNet/IP communication standard.

A communication gateway shall be used where communication between Rockwell products and Modbus RTU or Modbus TCP protocols are implemented.
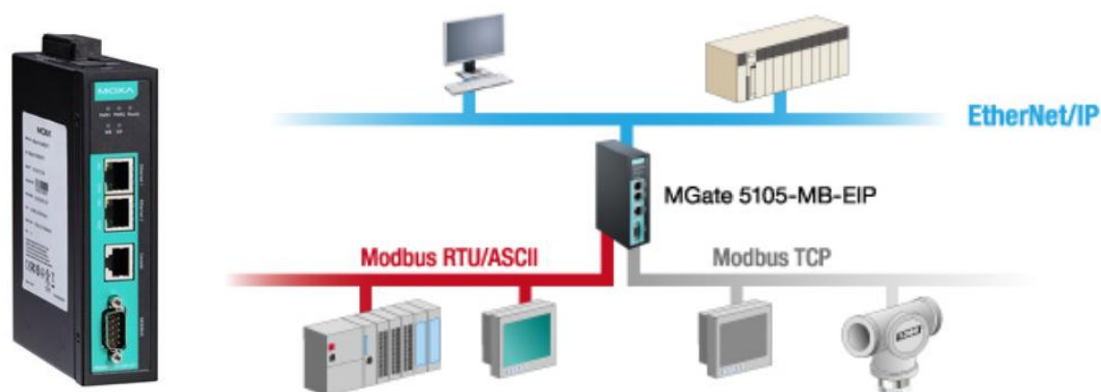.

.
Figure 12: MOXA MGate 5105-MB-EIP gateway used for this type of communication

Ethernet/IP shall be used for any communication upstream of the Processor with the SCADA software via IO Software.

Please refer to the Operational Technology Network Switch Procurement Standard for the selection of network equipment for Rockwell Automation Platforms

5.2 Communication Protocols

Table 11: Communication protocol compatibility for the equipment used

Product Range	Communication Module / Processor Model	Protocols Compatibility
ControlLogix 5570	1756-EN2T, 1756-EN2TR	Ethernet/IP
CompactLogix 5380	5069-L310ER, 5069-L330ER, 5069-L340ER, 5069 AENTR	Ethernet/IP
CompactLogix 5370	1769-L33ER, 1769-AENTR	Ethernet/IP
Point IP	1734-AENT, 1734-AENTR	Ethernet/IP
Flex IO	5094-AENTR	Ethernet/IP
Flex 5000 IO	1794-AENT, 1794-AENTR	Ethernet/IP
MOXA Mgate	MGate 5105-MB-EIP	Ethernet/IP, Modbus TCP/RTU/ASCII, MQTT

5.3   Processor Type 1 – ControlLogix 5570 – Model 1756-L71

The 1756-L71 processor does not have an on-board ethernet communication port. A communication card is required for the unit to communicate to the network. The dual port 1756-EN2TR shall be utilised to enable ethernet communications. The second port must remain unused where no network redundancy is required.

5.4   Processor Type 2 – CompactLogix 5380 – Model 5069-L310ER/L330ER/L340ER

The 5069-L310ER, 5069-L330ER and 5069-L340ER processors have two onboard ethernet ports. When utilised in a network without network redundancy only one port shall be connected to the network while the other must remain unconnected. Where a 5069-L310ER, 5069-L330ER or 5069-L340ER processors are used a 5069 AENTR is not required.
When the CompactLogix 5380 is used as remote IO then the 5069 AENTR shall be used for communications to the network.

5.5   Processor Type 3 – CompactLogix 5370 – Model 1769

The 1769-L33ER processor has two onboard ethernet communication ports. When utilised in a network without network redundancy only one port shall be connected to the network while the other must remain unconnected.

5.6   Remote IO Type 1 – Flex 5000 IO

Two types of communication modules are available in the Flex 5000 range of products, one with dual and one with a single communication interface. The dual port 5094-AENTR module shall be used for redundant networks. The single port 5094-AENT shall be used where no network redundancy is being used.

5.7   Remote IO Type 2 – Flex IO

One type of communication module is available in the Flex range of products. This module has two communication interfaces. When utilised in a network without network redundancy only one port shall be connected to the network while the other must remain unconnected.

5.8   Remote IO Type 3 – Point IO

Two types of communication modules are available in the Point IO range of products, one with dual and one with a single communication interface. The dual port 1734-AENTR module shall be used for redundant networks. The single port 1734-AENT shall be used where no network redundancy is being used.

6.   Power Supplies

This section covers the preferred power supply requirements for PLC equipment.

The choice between using 230VAC and 24VDC depends on many factors, including safety considerations, system complexity, component availability, and regulatory requirements.
24VDC systems are considered safer than 230VAC systems because lower voltages pose reduced risks of electric shock. In environments where personnel will come in contact with electrical equipment, such as industrial settings, 24VDC systems are preferred to minimize the risk of injury.

24VDC powered Rockwell PLC platforms shall be utilised within new Watercare installations. Utilisation of the components referred to in prior sections ensures that no PLC equipment is directly powered by 230VAC power.

7. Redundant PLC Systems

Redundant systems shall be developed in collaboration with the Watercare's Digital Control System Team.
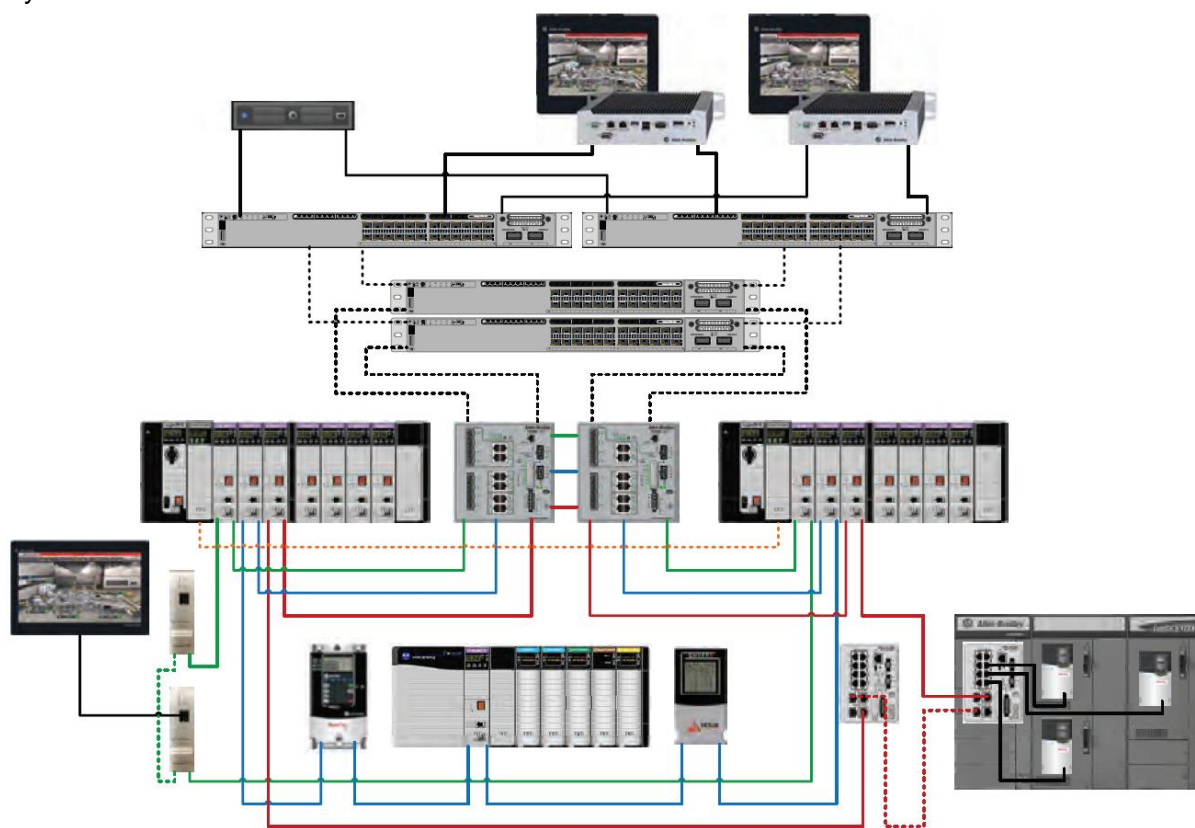

Figure 13: Illustration of systems with redundant processors and redundant networking

8. Rockwell PLC Based Platforms HMI Standards

Watercare's Digital Control System Team should be contacted for assistance regarding Transmission and Treatment Plants Local HMI Standards.

9. Software Implementation

9.1 Programming Software

All the processor modules referred to in this document are programmed using the Studio 5000 Logix Designer. This programming platform shall be delivered and installed on a dedicated server or on the SCADA server at the time when a new installation so that the system can be configured and maintained without needing additional software and licencing throughout its lifetime.

9.2 PLC Configuration Software and SCADA Standards

This document does not cover the PLC and SCADA configuration.

9.3 System Layout

Systems utilising Rockwell PLC's shall include the following software for the monitoring, control, and programming of the site.

- AVEVA System Platform SCADA System
- Kepware IO Server
- Studio 5000 Logix Designer

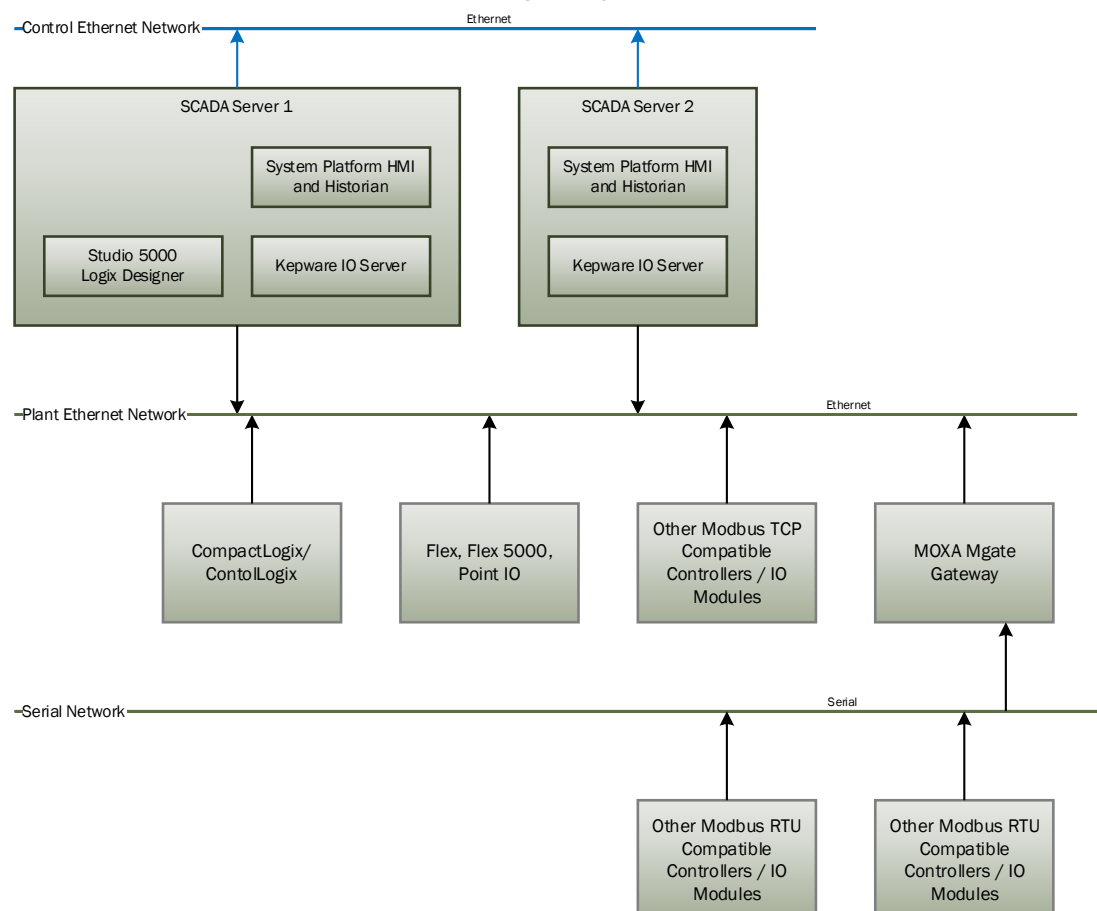Software versions are to be confirmed at design stage.

Figure 14: Overview schematic of a non-redundant control system using Rockwell PLCs and software

10. Conformally Coated Equipment

Conformally coated products shall be installed at any location where environmental stresses such as moisture, chemicals and dust might impact the performance of any Rockwell products or shorten their expected lifespan.

The product lists in this document do not list any conformally coated products. Conformally coated products are not available for the entire Rockwell PLC and remote IO range.

Watercare's Digital Control System Team should be contacted for assistance regarding the selection of the right conformally coated products.

Appendix A: Rockwell PLC – Non-standard equipment use authorisation form

Facility Code	
Facility Name	
Facility Type	
Facility Address	
Watercare Project Manager Name	
Component Part Number	
Component Description	
Reason for Non-Standard Requirement (Include Drawings or Diagrams)	
Estimated Project Commissioning date	
Date Response Required	
Signed / dated by applicant:	