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Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets

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Document Owner	Head of Asset Management
Subject Matter Expert	Infrastructure Standards Team
References	Refer to Appendix B – References of this document

Version review

Revision	Reviewed by	Approved by	Date approved	Revision type/summary
1	Infrastructure Standards Team, Commissioning Manager	Head of Asset Management	20/09/2023	Consolidation of two superseded specifications, “Pr8871 - Specification for Commissioning of Network Project Assets” and “Pr8874 - Commissioning and Handover Specification Treatment plants”.
2	Infrastructure Standards Team, Commissioning Manager	Head of Asset Management	12/10/2023	Updates to Section 11.1 to add reference to Appendix C, and include Appendix D CMP template example

Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets

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1. Purpose

The purpose of this specification is to define Unitywater's requirements for commissioning and handover of assets including but not limited to the asset types in Table 1 - Definition of asset descriptors used in this specification.

Table 1 - Definition of asset descriptors used in this specification

Asset Type/Scope	Description
Complex Assets	Sewage Treatment Plants (STP)
	Recycled Water Treatment Plants
Active Assets	Sewage pump stations
	Water booster pump stations including potable and recycled water
	Reservoirs
	Chemical Dosing Facilities (not within a complex asset)
	Odour Control Facilities (not within a complex asset)
	Vacuum or low pressure sewer
Passive Assets	Trunk sewer mains
	Rising mains
	Reticulation sewer mains
	Recycled water mains
	Trunk water mains
	Reticulation water mains

1.1. Active and Complex Assets

To ensure that all equipment and systems are installed, are compliant with the requirements of the scope of works and can operate in accordance with relevant specifications prior to operation of the plant under service conditions.

1.2. Passive Assets

Demonstrate that passive assets will hold the required pressure as per the scope of works and manufacturers specifications and are SEQ Code compliant.

2. Scope

This specification applies to all assets when performing commissioning activities for the above-mentioned assets. Commissioning requirements are for each asset type irrespective of the size of the project.

This specification applies when handing over assets and documentation associated with the above-mentioned assets.

The following aspects are addressed within this specification:

- Planning, design and construction requirements to enable commissioning commencement;
- Commissioning sequence and methodology for commissioning;
- Roles and responsibilities of key commissioning roles;

- Commissioning management:
  - Objectives, management structure and communication protocols;
- Commissioning methodology;
- Punchlist – Omissions and/or Defects;
- Project specific documentation;
- Asset specific data and operational documentation, required to be handed over.

This specification applies to the commissioning and handover of assets:

- Being constructed directly for Unitywater; or
- For a Contractor or Developer who will hand over the ownership of the constructed works to Unitywater; or
- For Private owners who will retain ownership but will require Unitywater to operate or monitor the asset.

3. Planning

During project planning, commissioning sequencing and impacts to operations must be considered. Operational risks should be considered and this could impact the project delivery method. This may entail an increase in the commissioning program during the strategic planning phase. Commissioning planning will:

- Guide the attention to detail of planning documents, project requirements and describe appropriate managerial controls for commissioning schedules, costs and quality.
- Develop contractual terms to support the time and resources necessary for planning and performing commissioning.
- Check that provisions for FAT participation by suppliers and manufacturers is suitably addressed in contracts.
- Develop and document agreements for commissioning and test acceptance criteria that build predictability for the final performance testing, timeline lengths and UW participation in tests.
- Confirm interaction of works with other utilities and availability of utilities needed for all commissioning activities.

Operational readiness and handover planning will:

- Plan the design of assets with completion and operations in mind, so that deficiencies are eliminated as early as possible.
- Describe plans, to be implemented in the design phase, to build familiarity with new assets for operational teams, including actions to align SMEs of suitable disciplines with plans, project descriptions and (standardised) system definitions.
- Develop contractual terms to support the time and resources necessary for planning and performing operational readiness and handover.
- Confirm any ongoing requirements with other utilities and availability of utilities needed for continued operations.

3.1. SEQCode Compliance

For some asset commissioning, there is a requirement to comply with the SEQCode. This specification is in addition to the SEQ Code. In the event of ambiguity, discrepancy, divergence or inconsistency of technical requirements in or between documents, this document takes precedence over SEQCode standard documents. Where conflicts exist between this specification and any statutory requirement, the statutory requirement prevails.

3.2. Connections Approvals for Developers

Commissioning and handover activities related to connections to Unitywater's water and sewerage infrastructure including infrastructure that will be constructed by a developer are specified in *Pr9253 - Connections Administration Manual*. Deviation from the requirements listed in this specification may be considered in some circumstances. As a minimum requirement, the developer must demonstrate achievement of the objectives and requirements of *Pr9253,* the BP9256 Connections Policy and the SEQ Code.

If applicable to a connection approval, a Developer shall apply for Water Infrastructure Agreements, as per *Pr9253 - Connections Administration Manual*. WIAs outline the process and obligations for developers to plan and deliver water assets. Developers must plan to fulfil any commissioning requirements specified in a WIA.

4. Design

During the design phase of the project, further consideration of commissioning activities shall be reviewed, along with involvement by the Unitywater Commissioning Manger and Contractor's Commissioning Manger. Apply the following approaches to guide the integration of commissioning considerations into the design phase.

- Allow opportunity for the commissioning manager to review concept documents, design documents and construction documents to assure that assets can be commissioned correctly.
- Require vendors, original equipment manufacturer (OEMs) to provide detailed information on the operational needs of their equipment/materials.
- Coordinate early with commissioning operations and maintenance SMEs and take advantage of their expertise to help identify potential errors and omissions early in the design process, ultimately reducing installation issues and ensuring commissioning success.
- Ensure milestones for completion of systems and coordination with Unitywater are suitable and detailed in the construction management plan.
- Document the procurement and supply chain readiness of new technologies, maintenance equipment and specialist services.

5. Construction

5.1. Overview

The construction phase will generally include the following, in preparation for dry commissioning, as a minimum:

- Those inspections, checks and tests recommended by the manufacturer of any items of equipment;
- Inspections to ascertain that all equipment, as installed, is in good order and condition and conforms to the requirements of the approved design and the Scope of Work;
- Noise tests of plant and equipment;
- FAT's and SAT's of plant, equipment and PLC/RTU/SCADA;
- Material tests and manufacturing tests;
- Mechanical equipment tests;
- Electrical equipment tests including full functionality (during FAT); and
- Control and monitoring equipment tests.

For full details of what is involved with construction completion, refer to individual technical specifications.

Prior to progressing from the construction phase, any necessary work must be undertaken including but not limited to:

- Temporary connections and disconnections;
- Connection of instruments or other equipment;
- Cleaning of vessels, tanks, pipelines and equipment;
- Safety measures; and
- Other preparations for carrying out testing and commissioning.

The construction stage includes all checks that are required prior to energisation. Energisation of equipment is the point at which commissioning sequences may start.

5.2. Documentation

During the construction period a neatly marked set of site record drawings detailing completed works shall be maintained on site. Drawings shall be kept current with the work as it progresses and shall be subject to inspection at any time.

A pre-requisite for commencement of dry commissioning activities shall be the communication to the commissioning team of any issues that arose during the construction phase. These must be documented in the Punchlist (Section 10). Any Punchlist items not resolved during the construction phase must be communicated to the Unitywater Commissioning Manager and the Contractor's Commissioning Manager.

Communication of project events that occurred during construction that could impact commissioning include but are not limited to the following:

- Technical difficulties;
- Unexpected work;
- Work that was more complex than was expected.

5.3. General Equipment

Installation checks must include the following as a minimum:

- Check for completeness of installation;
- Correct equipment installation, fixing, alignment and safety features/guarding in place;
- Inspections and (where required) approvals to ascertain compliance with statutory requirements and regulations;
- Electrical installation in compliance with relevant codes and standards;
- Instrument mounting, location and servicing access;
- Correct lubrication of all equipment and lubrication and levels checked;
- Assessment of serviceability and safe operational access to equipment, especially valves and instrumentation;
- Cable ducts sealed;
- Labelling and painting of ductwork and pipework to suit specified requirements;
- Safety signs erected and warning notices installed;
- Correct hazardous zone rating of equipment and compliance with relevant codes and standards;
- Statutory testing of installed/supplied lifting equipment and pressure systems; and
- All rubbish removed, all items painted and water tight, confirmation that all sumps, drains, services, etc. are finalised.

5.4. Mechanical

Any mechanical inspections, certifications and/or approvals of any equipment as required by the vendor, legislative requirements, the approved design and the Scope of Work.

The details of a specific mechanical testing shall be detailed on the ITC/ITP and shall align with any vendor specific and/or equipment requirements.

Mechanical equipment tests include at least the following:

- Verify factory assembled equipment have not been damaged by installation;
- All delivery blocks have been removed and equipment ready for operation;
- Check that equipment is correctly lubricated and lubrication reservoirs charged with suitable lubricant;
- Check clearance, end play and operation of major bearings;
- Check alignment of drive systems;
- Check tightness of all parts;
- Correct installation of guards, trip wires and other personnel safety equipment;
- Ensure the system has been cleaned and flushed; and
- Check of lifting facilities.

5.5. CCTV Inspection of Pipework

CCTV inspection of all pipework of internal nominal bore diameter of 150mm or greater, and all buried structures is required. The CCTV inspection must demonstrate the completeness and integrity of the assets' construction and/or installation (including seals), the absence of debris, and suitability of its condition and conformance to the design and Scope of Work and in accordance with *Pr9770 – Specification for Sewer CCTV Inspection and Laser Profiling* and/or *WSA-05 2020 – Conduit Inspection Reporting Code of Australia*.

5.6. Hydrostatic/Pressure Testing

Hydrostatic testing of tanks, pipes and other structures will be carried out as a dry commissioning/construction activity. Filling of structures must be carried out in a controlled and safe manner. Monitoring and recording regimes for the hydrostatic testing must be followed to the satisfaction of the Unitywater.

Hydrostatic testing of civil structures and pipework shall be performed in accordance with Unitywater's Standard Specifications as listed in Appendix B – References.

Pressure tests on pipe work and equipment shall be carried out in accordance with manufacturers specifications and Unitywater's Standard Specification as listed in Appendix B – References.

Water tightness tests and hydrostatic tests on all new, modified or refurbished water retaining structures.

5.7. Water Quality Requirements

For water sites/assets the requirements of *Pr9032 - Procedure for Managing Water Quality During Mains Commissioning* are to be adhered to. Any checks required during construction are to be completed and documented prior to any flushing taking place.

5.8. Electrical

Electrical tests prove the integrity of the installation and any safety systems. Factory acceptance tests must be performed on the following to ensure compliance with the approved design and the Scope of Work.

- Switchboards, MCC, RTU/PLC and Remote IO Panels, control panels, vendor panels (if supplied) to demonstrate full functionality.
- RTU, PLC and SCADA code.
- Equipment and electrical components, including any pre-packaged items of equipment or instrumentation e.g. generators.

Testing and calibration of flow measuring equipment (for recording or controlling both water and air flow rates) at the supplier's premises prior to delivery to site. Calibration certificates for flow measuring equipment as well as other analytical and process instrumentation is required as part of Handover (see Section 11 Handover and Deliverables).

Checking the RTU, PLC input and output wiring to ensure they are in accordance with the approved design and the Scope of Work.

5.9. Control Systems

Control system equipment shall be installed and tested as per the manufacturers requirements. This includes testing of fibre optic and other communications cables.

5.10. Factory Acceptance Testing (FAT)

As a minimum, all prefabricated mechanical systems, pumping units, electrical panels, cabinets, and kiosks must be factory inspected and tested (FAT). Other equipment that requires factory acceptance testing along with the type of test may be specified in the contract, Scope of Work, design documents or other asset specifications.

Unitywater may nominate additional hold and inspection points during FAT activities.

ITPs and ITCs for FAT must be reviewed by Unitywater prior to the commencement of testing. FAT must be of enough length to allow for testing, correction of defects and retesting.

Unitywater representatives may be present at any or all of the tests for the purpose of observation, result verification, obtaining technical verification, Operator training or any other purpose. This will be further specified within the relevant Scope of Work or Contract documents.

All Punchlist items from any FAT must be rectified and the FAT performed again to ensure full compliance before proceeding to site testing.

5.10.1 Mechanical Testing

Compliance with manufacturers specifications and Unitywater's specifications must be demonstrated at FAT for mechanical equipment.

Evidence of any certifications and approvals shall be provided. The scope of FAT for mechanical equipment should be identified through that equipment type which may be covered under individual mechanical specifications.

5.10.2 Certified Testing for Flow Measuring Equipment

Certified testing at the supplier's premises for flow measuring equipment must be as detailed below:

- Hydrostatic testing of the primary device to 1.5 times the maximum working head. The pressure must be indicated and maintained for a period of not less than three (3) minutes. If a reduction in pressure occurs the item must be corrected and re-tested to the specified requirement;
- Wet flow testing under simulated working conditions of the primary and secondary devices. Velocities passing through the primary device must be comparable with those that would occur under the flow rates nominated by the Contractor's design or this PPR (whichever is greater). Flows tested must be at intervals across the full flow range to sufficiently demonstrate the manufacturer's specified accuracy has been achieved; and
- Electrical inspection and checking of the secondary equipment utilising simulated input signals.

A test certificate must be supplied that shows the actual percentage error at 10% intervals over the whole range tested.

Some tests must be witnessed by Unitywater representatives or their respective agent. The Scope of Works or Contract will details who is responsible for witnessing the test.

As a minimum, accuracy must be ± 2% of the output value and guaranteed figures must be achieved.

5.10.3 Chemical System Testing

Sweep, thoroughly flush and remove from all chemical tanks, lines and metering pumps and clean off all solids, swarf, etc., before filling and testing. Avoid any metallic contamination of storage tanks.

Hydrostatically test chemical storage tanks and obtain evidence of appropriate chemical resistance for each individual tank.

Rectify faults, including any leaks, vibrations, excessive splashing, sagging of pipe works, and inaccessibility of valves, fittings and equipment, looseness of fixtures, poorly aligned pipe work, to the satisfaction of the Superintendent, and successfully re-test the equipment.

5.10.4 Pumps Set Tests

Pump set tests and performance requirements are detailed in *Pr9693 - Specification for Mechanical Installations*.

Pump test certificates and pump performance curves covering the tests must be provided for each pump set. Performance curves must cover head, quantity, efficiency, power and net positive suction head (NPSH).

5.10.5 Valve Tests

Hydrostatically test valves in accordance with the *Pr9693 - Specification for Mechanical Specification*. After the satisfactory completion of the hydrostatic, installation and other tests specified, valves must be tested whilst under expected operational hydraulic pressures, as follows:

- Manual valves – Open and close valves to check the ease of operation and the position indicator;
- Pneumatic actuated valves – During the test, only clean and dry compressed air must be used. Check all functions of pneumatic actuators, including the operation of the limit switches, protection devices, position indicators, controls, etc.; and
- Electric actuated valves – Check all functions of electric actuators, including the operation of limit switches, protection devices, position indicators, controls, etc.

5.10.6 Switchboards Inspections

All switchboards, including main switchboards, MCCs, PLC and Remote IO panels, control panels and vendor control panels, must be tested at the manufacturer's premises. The whole switchboard must be factory tested to ensure correct function and operation. Delivery of switchboards or accessories to site must not occur until all tests have been satisfactorily completed and all Punchlist items rectified. Factory test certificates must be submitted after test completion, and prior to dispatch from the manufacturer's premises.

The items on the switchboard that are to be checked include as a minimum:

- Busbar configuration and support system for consistency and compliance with type test/verified design certificates (if applicable);
- Sealing of fully welded seams (where applicable);
- Equipment mounting and cable supports to ensure adequate fixing and bracing;
- Operating handles and interlocks for correct functioning;
- Withdrawable equipment for free movement, operation of shutters and interlocks;
- Clearance and creepage distances and degrees of protection;
- Doors and access covers for sealing;

- Bolted and screwed connections for tightness and adequate contact;
- Label wording and annunciator window engraving against relevant schedules; and
- Visual inspection to verify all equipment and wiring is in accordance with the approved design documents and the Scope of Work.

5.10.7 Electrical Testing of Switchboards

The following electrical tests are to be carried out on the switchboard as part of the FAT as a minimum:

a) Insulation test of all power wiring with 1000 V insulation tester, tested phase to phase, phase to neutral and neutral to earth;

b) For switchboards containing busbars, a 2.5 kV high potential test, maintained for not less than 1 minute, with minimum 5mA leakage current followed by repeat of test (a) above. The test to be applied phase to phase, phase to neutral and neutral to earth. Any leakage current or change in insulation resistance is to be reported to the Unitywater Project Manager;

c) Test and record earth continuity of earth busbar and earthing conductors;

d) Test all protection equipment and relays by secondary injection of the current transformers circuits;

e) Test phase fail relays, phase reversal relays with correct and reversed phase sequence to ensure correct operation. Also test relays by removing one fuse;

f) Test operation of all RCD circuit breakers and combined RCD/GPO units. Units must trip when leakage exceeds 30mA;

g) Test voltmeter and voltmeter selector switch (where applicable) for correct voltage indication;

h) Test each motor starter for correct operation and functionality with all other drives and equipment turned off. Test must include operation of thermal overload, phase failure, over temperature devices, variable speed etc., with starter selected for both manual and automatic operation. Test operation of all indicating lamps, meters, control devices and RTU/PLC I/O whether hard wired or via communications;

i) Checking IP rating of all enclosures, all cable glands are sealing on cable sheaths and all unused cable entries are properly plugged;

j) Checking electrical insulation integrity in accordance with the approved design documents and all applicable legislative requirements; and

k) Checking electrical earthing integrity in accordance with approved design documents and all applicable legislative requirements.

Further testing may be required during construction of the switchboard at the discretion of Unitywater.

The final test must occur following completion of all work on the switchboard. The final test must include testing/record of verification in accordance with AS/NZS 61439 (where applicable) and simulation of site conditions for all operating modes, control functions and instrumentation loops.

5.10.8 Functional Testing of Electrical Switchboards and Systems

Each and every control wire in the switchboard must be checked for correct function and marked off on the schematic drawings. These drawings must be amended to reflect the final connections of the switchboard as despatched from the workshop. Copies of these marked schematics must be submitted to the Unitywater Project Manager prior to mechanical completion.

All control circuits must be energised at their operating voltage and all pushbuttons, indicating lights and switches must be installed to fully and correctly simulate all field devices. Each feature of the circuit must then be checked by operation of the switches and pushbuttons.

VSDs must be tested by monitoring speed changes of a small three phase motor while the variable speed drive input signal is being varied.

All protective relays must be tested on at least three points on their protection curve by secondary injection.

All current transformers and direct connected metering and protection equipment must be tested by primary injection to prove correct polarity and CT ratios for ratio error and phase angle error.

Each analogue loop must be injected with a variable input signal equivalent to its specified input and the signal must be varied over its entire range to test the operation of associated indicators, controllers and recorders. In the case of controllers, outputs must be monitored and the set points checked for correct operation, including the operation of any associated process alarms.

Marked up drawings and test sheets must be provided detailing the results and extent of the functional testing. All issues or Punchlist items shall be recorded in a Switchboard FAT Punchlist and evidence of retesting must be provided. In instances where some FAT Punchlist items are not rectified prior to shipping to site, these items must be recorded on the Punchlist. The Switchboard FAT Punchlist must be included as part of the switchboard handover documentation (see Section 10.2 Punchlist Identification).

5.10.9 Functional PLC and SCADA Factory Acceptance Test

Factory acceptance test (FAT) of the software must be carried out in a suitable environment and must consist of any RTU/PLC and SCADA systems fully configured exactly as per the final installation on site.

The FAT must be in accordance with the FAT sheets. The FAT must test all aspects of the RTU/PLC and SCADA programs to ensure compliance with the Functional Description and Functional Specification.

All software must be fully factory tested prior to installation at site.

A FAT report, including the amendment records and remedy/exception sheets, must be submitted to the Unitywater Project Manager prior to completion of the FAT. All Punchlist items from any FAT must rectified and the FAT performed again to ensure full compliance before proceeding to site testing.

Where possible, the switchboard FAT should be carried out in conjunction with the RTU/PLC and SCADA FAT.

5.10.10 Electric Motors

Each electric motor must be routinely tested by the motor manufacturer at its premises in accordance with AS 1359, Part 60. Type certificates for each motor type and size, together with routine test certificates, must be submitted to Unitywater before delivery to the site.

All protective devices (e.g. thermistors, seal failure and the like) must be connected during testing of motors.

5.11. Completion of Construction

Upon completion of construction, a Construction Testing Report containing all results from the tests and checks must be completed and submitted prior to commencement of commissioning activities. Passive assets do not require a Construction Testing Report.

The requirements for approval of the Construction Testing Report must include, as a minimum:

a) Demonstration of successful completion of all testing works and checks;

b) Completed testing ITPs and/or ITCs, and FAT reports;

c) Completed test certificates and test reports for all equipment and instrumentation; and

d) A complete report presenting all results at the end of testing for all process units, equipment and instrumentation, conforming to the requirements of this specification and the Scope of Works.

The consideration of commissioning works during the construction phase aims to enables a smooth takeover of the assets and systems by operations. In preparation for assets to be available/ready for Dry Commissioning (and prior to energisation) the following actions must be completed during the construction phase.

- Punchlist walk throughs with relevant nominees including construction and operations team members;
- Ensure adequate resources and facilities for Dry commissioning are available, including necessary subject matter experts (SMEs) and third-party participants;
- Ensure the Unitywater Commissioning Manager has received construction handover documents;
- Ensure communication lines have been defined and agreed;
- Checking factory works testing and on-site inspections and tests;
- Inspection of all installed components including civil, mechanical, electrical and control systems;
- Checking to establish that facilities, equipment and ancillary systems have been constructed, installed, manufactured and/or supplied as specified; and
- Testing and verification of equipment and any manual protection settings, to ensure the installation complies with the detailed design and is safe and ready for energisation of power supplies.

The following may be prerequisite conditions for dry commissioning:

- Procure commissioning materials, including spare parts.
- Document the parties assigned with responsibility for closing risk register and HAZOP action items.
- Understand the use of safety management system software and the use of facilities for implementation of project management processes.
- Review safety and form alignment on the interface of construction with commissioning during dry commissioning meetings.
- Perform environmental management and organise equipment to eliminate or mitigate environmental hazards according to the plan.

6. Commissioning Methodology

The following sections detail the Commissioning Methodology required for each asset type/class.

For full details and explanation of each Commissioning Phase see Section 7 Commissioning Management Plan.

6.1. Complex Assets

Complex Assets require the full commissioning sequence as detailed in Section 7 Commissioning Management Plan.

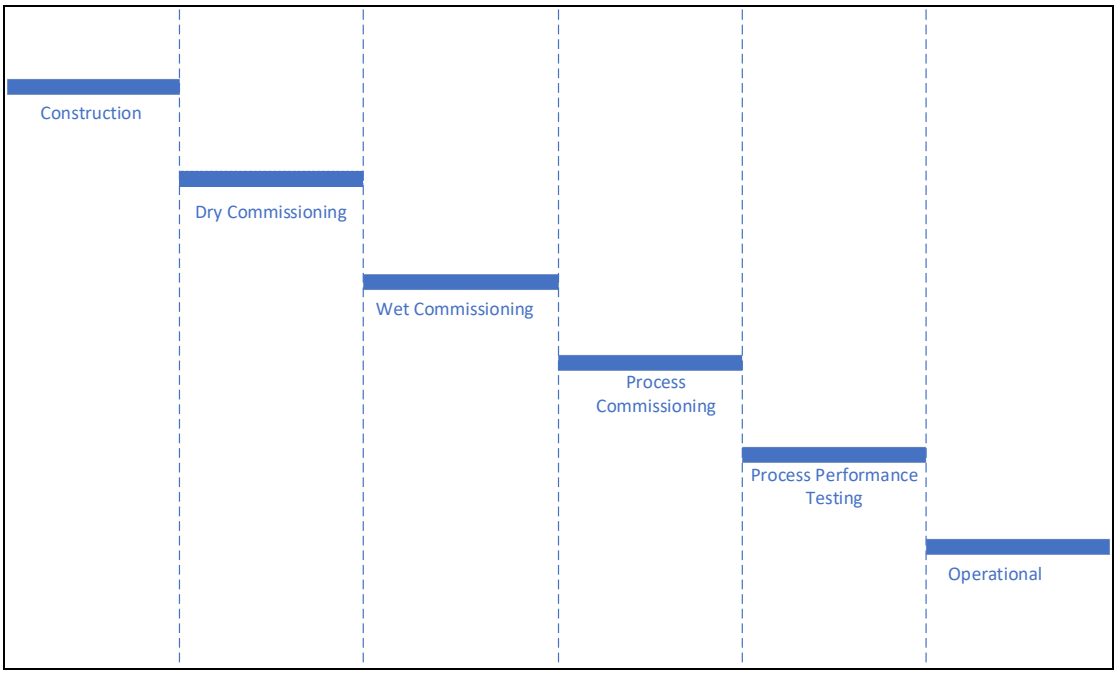
The steps include:

- Dry Commissioning;
- Wet Commissioning;
- Process Commissioning; and
- Process Performance Testing.

After Process Performance Testing the asset becomes Operational. Further performance testing/review may be included within the Contract or Scope of Works.

Figure 1 - Complex Assets Flowchart below provides an overview.

Figure 1 - Complex Assets Flowchart



6.2. Active Assets

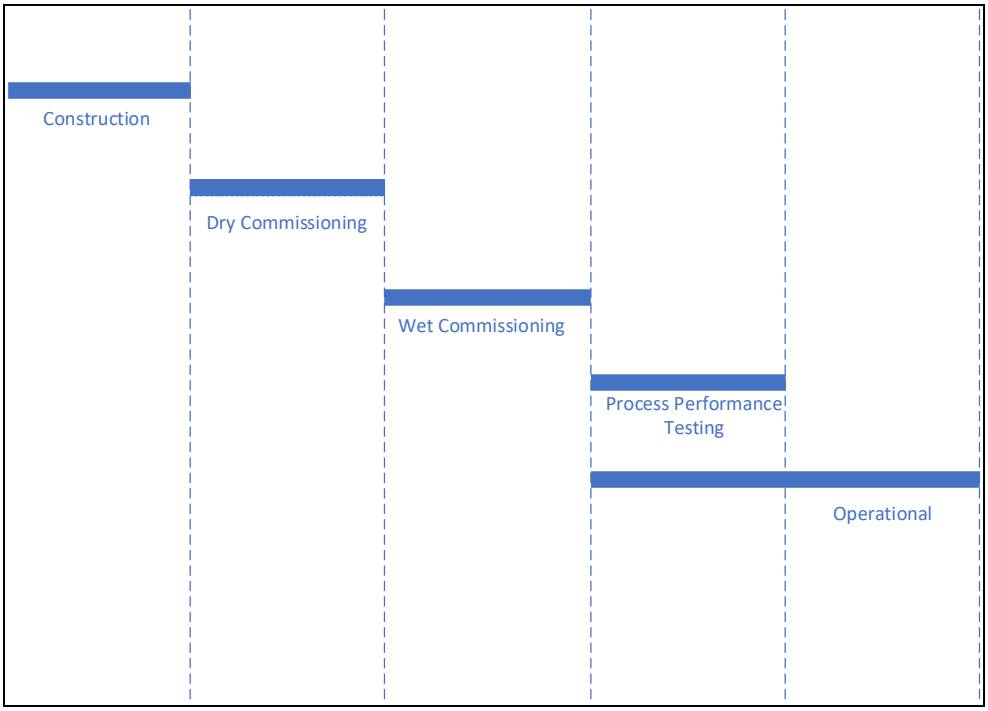
Active Assets require the following commissioning steps for completion:

- Dry Commissioning;
- Wet Commissioning;
- Process Performance Testing during Operation.

After Wet Commissioning the asset becomes operational and performance is to be monitored to ensure compliance with the design and Project scope.

Figure 2 - Active Assets Flowchart below provides an overview.

Figure 2 - Active Assets Flowchart



The following additional requirements may be relevant to Water assets to complement the commissioning process:

- *Pr9032 - Procedure for Managing Water Quality During Mains Commissioning*;
- *F10045 - Water Quality Mains Commissioning Form*;
- *F8927 - Worksheet WPSs*;
- *F8941 - Check Sheet Template PRVs*;
- *F8922 - Worksheet – PRVs.*

The following additional requirements may be relevant to Sewer assets to complement the commissioning process:

- *F8940 - Check Sheet Template Overflow and Emergency Storage*;
- *F8943 - Check Sheet Template SPSs*;
- *F8917 - Worksheet – Overflow and Emergency Storage*;
- *F8924 - Worksheet – SPSs.*

The following additional requirements may be relevant to Reservoirs to complement the commissioning process.

- *Pr9821 - Specification for Reservoir Design and Construction*;
- In Development – Specification for Reservoir Refurbishment;
- In Development – Roof Flooding Tests.

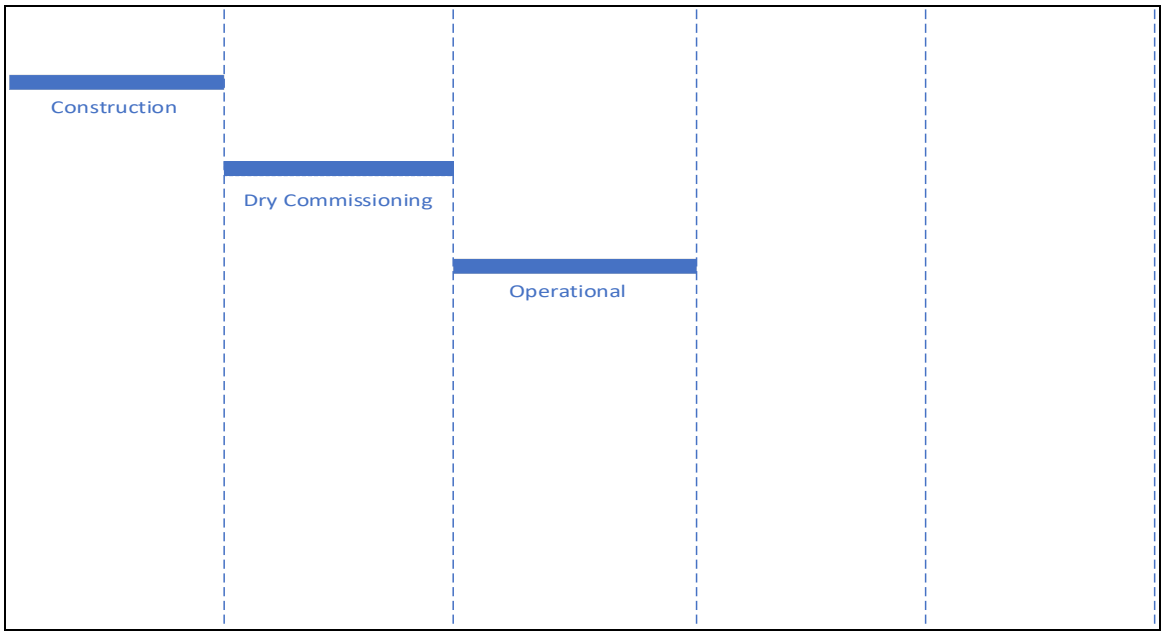
6.3. Passive Assets

Passive Assets require the following commissioning steps for completion:

- Dry Commissioning;
- Operation.

Figure 3 - Passive Assets Flowchart below provides an overview.

Figure 3 - Passive Assets Flowchart



The following additional requirements are relevant to Water assets to complement the commissioning process.

- *Pr9032 – Procedure for Managing Water Quality During Mains Commissioning*;
- *F10045 – Water Quality Mains Commissioning Form.*

The following additional requirements are relevant to Sewer assets to complement the commissioning process:

- None.

7. Commissioning Management Plan

The below is the extent of a CMP required for a complex asset and not all details are required for commissioning some Active assets or Passive assets.

The CMP is to address sequence, methodology and work pack management (where applicable) for all commissioning to be undertaken in accordance with this Specification.

The CMP shall also address performance criteria as set out in the Project requirements.

Where the SEQCode applies, the CMP must fulfil the default requirements outlined in the *SEQCode*, and/or Unitywater's Standard Specifications as appropriate.

The CMP must fully define the checks, inspections, performance tests and other tests that are proposed to be carried out to ensure that the Works are complete and operational in accordance with the Project requirements. The CMP must define Hold and Witness points. There must be a Hold Point at the completion of each commissioning stage, prior to commencement of the next stage.

The submission and acceptance of the CMP will be a Hold Point. Commissioning must not commence until the CMP has been reviewed and accepted by Unitywater. In some projects the CMP acceptance is required prior to being provided Possession of Site.

All commissioning documents must be submitted prior to commencing wet commissioning for review and acceptance. Documents must contain the Unitywater witness and hold points.

The CMP must include the following information as a minimum (refer to Appendix D – Template Example Commissioning Management Plan for an example layout):

- Purpose of the Commissioning Plan;
- Scope of the Commissioning Plan;
- Objectives of the works
- Overview of commissioning works to be undertaken;
- Commissioning team organisational structure and resourcing, including:
    - Nominated Contractor's Commissioning Manager;
    - Nominated commissioning lead engineers for each engineering discipline, including process, civil, mechanical, electrical and control;
    - A description of the roles and responsibilities of all team members;
    - Overall organisational chart and communication protocols to apply during commissioning and Process Performance Testing;
    - The responsibilities of all required roles during commissioning and Process Performance Testing;
- Construction verification requirements and methodology, including any additional punchlisting process/procedure not covered in Section 10 Punchlist – Omissions and/or Defects.
- Punchlisting requirements and how any Punchlist item will be generated and maintained throughout the project.
- Procedures for all commissioning requirements, covering each of the scope items included in the Scope of Work and/or Contract; the details provided must include:

  - The full methodology, sequence, monitoring and acceptance criteria which will be applied to each Commissioning inspection and test;
  - The fault simulation, plant shutdown, restart, flow variations, set point variations and associated measures to be applied to each test;
  - All Dry Commissioning, Wet Commissioning, Process Commissioning and Process Performance checklists and procedures, inclusive of all inspection and test plans (ITPs) and/or inspection and test check sheets (ITCs);
- The methodology and tests which will be implemented during commissioning and Process Performance Testing to prove that the plant is consistent with the approved design and operates in accordance with requirements of the Scope of Works and/or the Contract. As a minimum, this must include:
  - Commissioning risk management plan;
  - Definition of plant commissioning areas and battery limits;
  - Details of all Factory Acceptance Testing;
  - Details of all site testing, including site acceptance testing;
  - Details of the Dry Commissioning, Wet Commissioning and Process Commissioning methodologies;
  - Details of all Process Performance Testing, including the proposed operating conditions and operational parameters to ensure that each process unit is tested at the specified and critical loads; and
  - Documentation for completion of each factory acceptance tests (FATs) including but not limited to material tests, manufacturing tests, mechanical equipment tests, electrical equipment tests, control and monitoring equipment tests. FAT check sheets must cover every aspect of operation for every item of equipment;
- Details of commissioning information management including a register of all commissioning documentation to be used;
- Outline of the processes and responsibilities during the transition phases from Construction to Commissioning, and Commissioning to Practical Completion. This may include preparation and submission of a Control Systems Change Management Form to Unitywater's Operational Technology Team addressing all relevant information as detailed in Unitywater's Control Systems (OT) Change Request Procedure, including but not limited to:
  - Functional Specification;
  - Functional Description;
  - Rollback Plan;
  - FAT/SAT sheets;
  - Drawings;
  - I/O lists; and
  - List of OT and IT assets with cyber security details (make/model of control, firewalls, PLC, switch equipment);
- A detailed commissioning program for the proposed testing, commissioning and Process Performance Testing; the program must take the form of a Gantt Chart and identify dates and duration of all activities for all tests and Hold Points;

- A detailed commissioning risk assessment, including a commissioning risk workshop to identify key risks and risk mitigation measures and develop safety procedures; the Contractor's proposed safety procedures must be detailed in the CMP;
- Details of any training required for Unitywater Operations and Maintenance team members at completion of the project; and
- Supporting documentation including but not limited to Commissioning Method Statements, ITPs, ITCs, FAT forms and SAT forms as a minimum. Note that ITP/ITC may be used across multiple stages of commissioning for individual equipment.

For complex assets, commissioning documents shall include Commissioning Method Statements (CMS), ITPs and ITCs for each single system of plant.

The CMP is to be considered as a live document, to be updated to accommodate changes during the delivery of the project and inclusion of new information as applicable. The CMP requires flexibility and adaptability to change (organisational, technological, regulatory) and must allow for control of plant performance risks that arise during commissioning activities.

The Contractor's Project Manager must be able to be analyse the progress of the CMP over the course of the project to measure changes in risk.

7.1.1 Commissioning Check Sheet Templates

Unitywater has developed some Commissioning check sheet (FAT, ITC) Templates. These may be provided by Unitywater for each phase of commissioning. Some testing requirements and Unitywater's minimum expectations are captured in these templates. Their use does not necessarily constitute compliance with this specification or relevant scope of works/contracts. Adjustments may be made during the project to accommodate actual work or bespoke documents may be used.

8. Commissioning Sequence

Commissioning and Process Performance Testing will be broken down into the following stages:

1. Dry Commissioning;
2. Wet Commissioning;
3. Process Commissioning;
4. Process Performance (/Operational).

Not all asset types/classes require all stages of commissioning and this is detailed in Section 6 Commissioning Methodology.

The following sections detail what is involved within in each stage and pre-requisites to move to the next stage.

8.1. Dry Commissioning

8.1.1 Overview

Dry Commissioning is defined in Appendix A – Definitions/Acronyms. Dry Commissioning is the testing of each individual component for correct installation and operation prior to Wet Commissioning.

Dry Commissioning comprise checks after energisation.

During the construction phase, all pre-energisation checks must be completed and signed off by the Unitywater Commissioning Manager and the Contractor's Commissioning Manager. After this hold point energisation may occur.

The following are tests that may only be performed after energisation:

- Check direction of rotation of electric motors;
- Configuration of any settings that could not be configure prior to energisation (i.e. VFD, motor protection relays, etc);
- Functional tests of individual pieces of equipment;
- Instrument calibration.

The minimum requirements for Dry Commissioning tests are defined in the following sections. The required Dry Commissioning checks must be completed and detailed in the relevant sections of the Inspection and Testing Plans. Completion of all Dry Commissioning activities is required prior to moving to Wet Commissioning.

In addition to the tests in the following sections, developers shall apply for connection approvals and comply with dry commissioning tests of active assets according to *Pr9253 - Connections Administration Manual.* Inspections and requirements for Unitywater witnessing tests are also specified in *Pr9253 - Connections Administration Manual*.

8.1.2 Documentation

Inspection and Testing Plans (ITP) and / or Inspection and Testing Checksheets (ITC) shall be used to record the outcome of testing and verification of testing completed during the dry commissioning phase.

ITPs and ITCs shall be prepared for all equipment dry commissioning checks. All ITPs/ITC's shall be reviewed and approved prior to commencing dry commissioning. ITP/ITC must contain relevant "Witness" and "Hold points" that require Unitywater approval before commencing the next step. Quality requirements for commissioning documentation are detailed in Section 11 Handover and Deliverables of this Specification.

Witness testing may include function sequences, load testing, pressure testing, manufacturer's proof of design testing, fault conditions, and inputting signals to simulate alarm conditions.

8.1.3 Mechanical Equipment

Mechanical equipment tests include at least the following:

- Test feedback, control and overload equipment, including safety checks;
- Check valve positions;
- Check direction of rotation and performance of electric motors;
- Dry run of rotating equipment;
- Functional tests of equipment;
- Testing and adjustment of safety devices;
- Check valve over full operational span and positions/feedback over full operational span.

8.1.4 Electrical Equipment

At completion of installation work, and prior to energisation of all low and extra low voltage circuits, Testing, using appropriate Testing equipment, must be undertaken as required by AS/NZS 3000 and/or as follows:

- Insulation resistance testing;
- Continuity testing including point to point testing;
- Earth continuity, resistance and leakage;
- Fault loop impedance;
- Polarity testing;
- Phase rotation.

A record of each test all readings must be maintained and recorded in the ITP/ITC and must be approved by Unitywater prior to energisation.

Circuits must meet requirements of relevant codes and standards.

After energisation electrical equipment tests/records must include at least the following:

- Voltage tests;
- Trip tests;
- Configuration of parameters within equipment including but not limited to VFD, instruments, other electronic devices, range settings;
- Full functional testing of all equipment.

8.1.5 Control Systems

General equipment tests include at least the following:

- Configuration of parameters within equipment including but not limited to VFD, instruments, other electronic devices, range settings;
- Full functional testing of individual pieces of equipment to ensure correct SCADA/PLC feedback and control;
- Simulation of fault conditions.

8.1.6 Completion of Dry Commissioning

After Dry Commissioning all equipment should be fully operational and ready for Wet Commissioning. Wet Commissioning will complete any testing/commissioning activities that could not be completed in Dry Commissioning due to operational and/or equipment constraints in that phase.

8.2. Wet Commissioning

8.2.1 Overview

Wet Commissioning is defined in Appendix A – Definitions/Acronyms.

A System is defined in Appendix A – Definitions/Acronyms and Wet Commissioning is to occur on single systems first prior to multiple systems working together.

The Wet Commissioning Stage will follow on from the Dry Commissioning Phase, once it is verified that all of the components of each subsystem have been fully Dry Commissioned.

This commissioning stage tests and demonstrates, as far as possible, the capacity and performance of all equipment and single systems. This commissioning stage also tests normal process control and operation of multiple systems operating together.

Wet Commissioning will be carried out using fluid as specified in the Contract documents.

For complex assets, on completion of the Dry Commissioning of all system components, the equipment within the system will be set to operate as far as is practicable to confirm reliable operation on either potable water or plant service water.

Each piece of equipment will be required to operate for minimum periods as defined in the Project Scope or contract. Where minimum times are not stipulated in the Project Scope or Contract, then each piece of equipment will be required to operate for a minimum of 48 hours.

All necessary temporary equipment including pumps, hoses and temporary control systems required shall be provided.

Wet Commissioning shall include the following tasks:

- Adjustment of equipment and control settings including calibration of instruments;
- Site Acceptance Testing (SAT) of the RTU/PLC/SCADA software (see Section 8.2.3 for full details);
- Testing of single and multiple systems continuous operation;
- The operation of mechanical, electrical and control systems under process conditions that represent the anticipated operating conditions;
- Plant start-up and shutdown testing;
- Operation of all auxiliaries / standby equipment;
- Method of isolation of plant equipment for safe shut down and maintenance procedure, including valves on piping infrastructure are proved to be isolated, under pressure, to prevent unintended discharge or leakage during Wet Commissioning;
- Demonstration of the operator after hours call out systems and/or correct alarming to site SCADA system or the Control Room.

Single System components will be brought on-line and tested as a System to confirm that the System performs as required. Each single System shall be tested over its full range of operating conditions. The performance of each single System and its components shall be determined so that the System operation can be assessed for compliance with Scope of Works or Project Requirements. Any non-compliance shall be rectified or logged in the Punchlist.

The following sections detail the completion requirements prior to moving on to the next phase of commissioning.

Note that in some cases, subject to agreement with Unitywater; Wet Commissioning may be completed in conjunction with Process Commissioning. The segmented approach is not suitable, so a change to a more integrated approach is required. It may be impractical to undertake Wet Commissioning independently of Process Commissioning due to the potential need for large volumes of test water. If this is the case, as much as practical of the plant operation sequences shall be tested in a ‘Dry’ environment (Dry Commissioning) prior to commencing Wet Commissioning.

8.2.2 Documentation

Inspection and Testing Plans (ITP) and Inspection and Testing Checksheets (ITC) shall be used to record the outcome of testing and verification of testing completed during the Wet Commissioning phase.

ITPs and ITCs shall be prepared for all equipment Wet Commissioning checks. These should essentially follow on from the work already completed during Dry Commissioning.

All Wet Commissioning ITPs/ITC's shall be reviewed and approved (by Unitywater) prior to commencing Wet Commissioning. ITP/ITC must contain relevant Unitywater Witness and Hold points that require Unitywater approval before commencing the next step.

The structure and contents of commissioning documents is explained in Section 7 Commissioning Management Plan of this specification, along with documentation and quality recording requirements.

8.2.3 Control Systems

During Wet Commissioning, a RTU/PLC/SCADA SAT shall be undertaken and shall include the following tests.

- General system testing including device communication and IO verification;
- Full Site Acceptance Testing of RTU, PLC and SCADA code;
- Full functional testing of single and multiple systems to ensure correct RTU/PLC/SCADA feedback and control as defined in the Functional Specification;
- Simulation or creation of fault conditions to ensure the Control System operates as intended;
- Tuning of control loops;
- Checking of all interlocks and control logics including making any modifications required; and
- Testing of start-up and shutdown of the system.

The following functions shall be monitored during the single System tests:

- Process timing sequences will be evaluated and adjusted to suit the dynamic requirements, where possible;
- Where appropriate, the equipment will be operated in AUTO and be adjusted via the SCADA system;
- Automatic duty changeover where appropriate;
- Response to imposed disruptions in operating points and requirements across the full design operating range;
- Current draw and operational performance of all mechanical equipment;
- Operation under programmed control modes.

8.3. Process Commissioning

8.3.1 Overview

Process Commissioning is defined in Appendix A – Definitions/Acronyms and is only relevant for Complex Assets.

Process commissioning is the process of introducing the process fluid (sewage, water, chemical etc) into the asset.

Process commissioning for Complex Assets shall include the following:

- Commissioning of the complete system(s) on process fluid (sewage, water, chemicals etc);
- The operation of mechanical, electrical and control systems under process conditions that represent the anticipated operating conditions;
- Start up and shutdown testing;
- Operation of all auxiliaries / standby equipment;
- Final adjustment of equipment and control settings;
- Final tuning of control loops;
- Final checking of all interlocks and control logics including any required modifications;
- Final checking of all equipment;
- Testing of continuous operation;
- Performance testing to establish that the operation of the plant conforms with the specified requirements and the design intent and any statutory regulations.

During this phase, Unitywater team members (e.g. Commissioning team, Network Operations, Treatment Plant Operators, Water Quality etc) will be in attendance to witness the proper operation and maintenance of the plant.

Additional items identified during this phase are to be recorded in the Punchlist.

Upon completion of SAT, the Contractor shall provide a complete list of control instrument set points and alarm signal settings which have been determined during the successful operation of the plant and include these in the commissioning documentation.

8.3.2 Sewage Treatment Plant

For STP, Process Commissioning is the process of introducing sewage into the plant, establishing the biological treatment and testing the operation of overall plant process. The plant must be brought on-line with process fluid/product and all the systems necessary to operate the asset must be fully tested and commissioned.

Unitywater Commissioning Manager (or their delegate) must approve all commissioning documentation of the Wet Commissioning phase as complete prior to progressing to the Process Commissioning phase.

Process Commissioning can only be concluded where all process units (including both new and refurbished systems) and all equipment is operating under continuous automatic operation.

Process Commissioning of STP plant shall include the following additional assurances:

- Preliminary testing to confirm that the plant is capable of meeting the requirements of the Process Performance Test;
- Establishment and stabilisation of the biological treatment process;
- Training of operators and demonstration of maintenance activities.

8.3.3 Documentation

Process Commissioning documents (CMS, ITP and ITC) shall be reviewed and approved by Unitywater Commissioning Manager prior to commencing. Commissioning documentation and quality recording requirements are detailed in Section 11 Handover and Deliverables of this Specification.

All monitoring and performance parameters, including but not limited to information, experiences and instrument readings (flow, effluent quality, noise, odour, vibration, power draw), are to be documented during Process Commissioning.

For complex assets, information shall be integrated into the following documentation:

- Functional Description;
- Functional Specification;
- Drawings, including P&ID and electrical;
- Operational documents, i.e. SOP, UPG, manuals.

Process Commissioning determines the control instrument set points and alarm signal settings during the successful operation of the plant. For complex assets, a list of set points and alarm settings must be included in the Functional Description and Functional Specification.

At STPs, a complete list of all the parameters and settings for electrical drives and starters shall also be provided, indicating where the default values have been changed. These shall generally be stored on the SCADA Engineering Workstation, however if this is not specified they shall be handed over as part of the requirements detailed in Section 11 Handover and Deliverables.

Where work packs are used, a Process Commissioning Work pack shall be prepared including a CMS, ITP and ITC similar to those used in wet commissioning to document the Process Commissioning stage. Commissioning documentation and quality recording requirements are detailed in Section 11.2 Commissioning Information of this Specification.

Additional documentation including requirement for weekly summary of commissioning activities/changes performed by contractor, outcomes, and 3 week look ahead are required where commissioning is extended for more than 4 weeks.

8.3.4 Control Systems

The RTU/PLC/SCADA SAT shall confirm all test results were successful during Wet Commissioning.

The same functions as those listed in Wet Commissioning (Section 8.2.3) shall be automatically controlled and monitored during Process Commissioning (multiple system tests operating together).

8.4. Process Performance Testing

Process Performance Testing is defined in Appendix A – Definitions/Acronyms. Proof of performance testing must include testing and monitoring to demonstrate that the plant / Process Unit conforms to the criteria specified in the Contract, including but not limited to the performance criteria and performance requirements.

Unitywater Commissioning Manager (or their delegate) must approve all commissioning documentation of the previous commissioning phase as complete prior to progressing to the Process Performance Testing phase.

8.4.1 Handover to Operations – Complex Assets

Upon completion of Wet Commissioning and/or Process Commissioning activities that form part of the (relevant) scope, control of the plant (or single system) may be handed over to Unitywater dependent upon the contractual terms.

Handover requirements of plant or system operation shall be detailed in the contract, however in the absence of details within the contract, the following shall apply.

Handover of plant or system to Unitywater is subject to the following conditions:

- Commissioning Work packs are completed and closed including all Inspection and Test Check sheets (ITC);
- All Punchlist items categorised “A”, “B”, “C” and “D” are closed;
- The plant or system is deemed to be wet commissioned and sewage or process fluid can be introduced into the plant or system;
- All handover deliverables have been received and accepted by Unitywater.

Upon handover to Unitywater, the plant (or sub-system) will be under control of Unitywater and the following applies:

- Access to the area is controlled by Unitywater;
- All commissioning activities will be coordinated by the Unitywater commissioning manager;

Members of the Contractor’s Commissioning team, such as PLC programmers and instrumentation technicians, shall assist in commissioning as required by the Unitywater Commissioning Manager.

8.4.2 Reliability Trial for Network Assets

Once Site Acceptance Testing has been completed and the plant is running to the satisfaction of Unitywater, a trial period shall follow, during which time the plant shall be operated as a complete unit and all equipment shall be run on a continuous basis as close as practicable to anticipated full-load conditions. The trial duration shall be 28 days unless specified otherwise. The trial shall be carried out as soon as practicable following SAT.

The Contractor shall provide Unitywater with a minimum of seven days’ notice in writing of intention to start the Trial. The Trial shall not commence until:

- SAT is complete;
- Operator Training has been completed (where applicable);
- Operating and Maintenance Manuals have been submitted;
- All Category A, B, C and D Punchlist items have been addressed.

During the Reliability Trial, the asset will be under Unitywater control.

8.5. Operational

8.5.1 Overview

This phase is where the asset is fully operational and may be subject to further performance testing as required by the Contract.

8.5.2 Documentation

During this phase, all documentation shall be finalised and updated to "As Constructed" revision. The following documents are a non-exhaustive list of operational documents that may be required as part of Handover (See Section 11 Handover and Deliverables for full requirements):

- Unit Process Guidelines (UPGs);
- Standard Operating Procedures (SOPs);
- Functional Description;
- Functional Specification;
- Operations and Maintenance Manuals;
- Drawings.

8.5.3 General Equipment

All equipment should be operating as per the specification and design requirements.

8.5.4 Mechanical Equipment

All equipment should be operating as per the specification and within design requirements.

8.5.5 Electrical Equipment

All equipment should be operating in automatic modes and as per the specification and within design requirements.

8.5.6 Control Systems

All equipment should be operating in automatic modes and as per the specification and within design requirements.

9. Roles and Responsibilities

9.1. Commissioning Organisation

The commissioning team will likely comprise personnel from various organisations. The below is a guide as to who may be required. However, the Project needs to determine what particular roles and responsibilities are required for the specific requirements of the project.

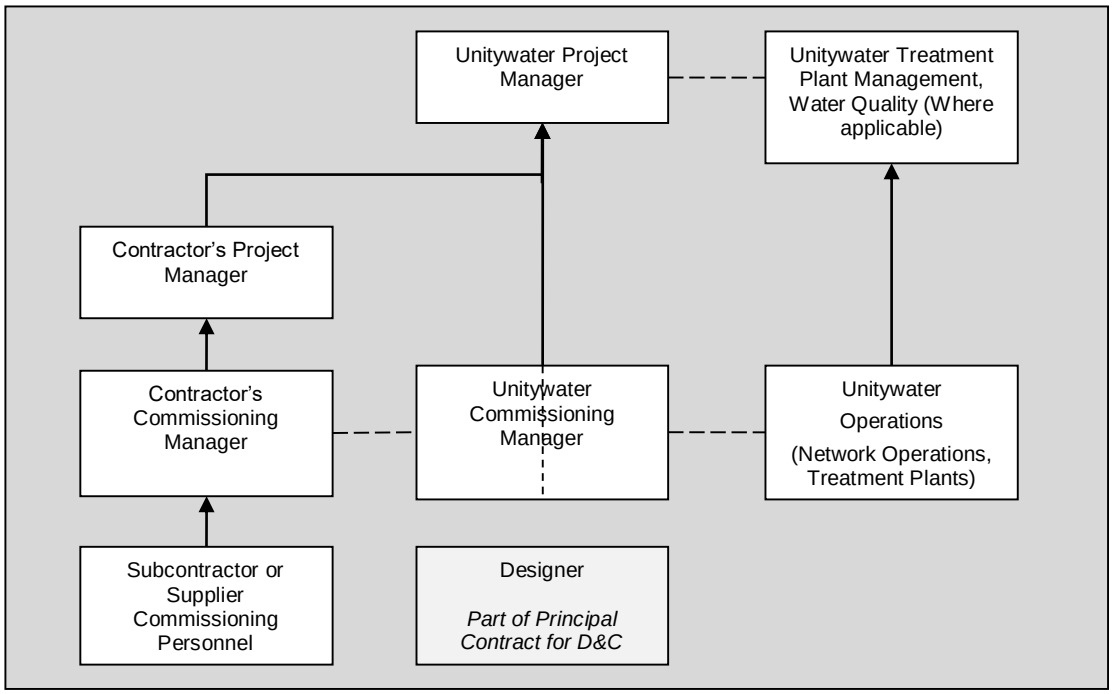
The below roles are not applicable to assets constructed by a Developer. A Developer must instead understand the roles and responsibilities as specified in *Pr9253 - Connections Administration Manual*.

The following nominated commissioning personnel are provided for reference only and the CMS for the work may allocate roles and responsibilities differently to what is shown. Note that multiple roles may be fulfilled by the same person for some projects:

- Unitywater Project Manager;
- Unitywater Commissioning Manager;
- Unitywater Treatment plants;

- Unitywater Network Operations;
- Unitywater Water Quality Team;
- Contractor's Project Manager;
- Contractor's Commissioning Manager;
- Designer

A typical Commissioning organisation structure is shown below:



9.2. Roles of Commissioning Team Members

9.2.1 Unitywater Project Manager

The Unitywater Project Manager will:

- Liaise with the Designer, Contractor teams and Unitywater teams;
- Manage Unitywater team members;
- Ensure that commissioning is completed in a timely and cost-effective manner;
- Adhere the 'Permit to Work' and tagging / isolation procedures;
- Ensure a seamless transition from the Contractor to Unitywater Commissioning and then to relevant Unitywater Operators;
- Ensure the commissioning requirements of this Specification are met;
- Ensure that all occupational health and safety and workplace regulations are met;
- Ensure that all environmental and quality assurance targets are met;
- Manage communication with Stakeholders;
- Delegate some authority/tasks to suitable personnel (e.g. Punchlist sign off); and
- Appoint responsible persons to OH&S requirements.

9.2.2 Unitywater Commissioning Manager

The Unitywater Commissioning Manager will:

- Report directly to the Unitywater Project Manager;
- Manage Unitywater commissioning team members;
- Liaise with the Contractor and Unitywater Operations team members;
- Ensure the Contractor's CMP, Method Statements and Inspection and Testing Plans are established and maintained, including maintaining traceability of all checks undertaken;
- They may organise the delivery of the on-the-job training for Operations and Maintenance teams;
- Adhere to 'Permit to Work' and tagging/isolation procedures;
- Ensure a seamless transition from the Contractor to Unitywater Commissioning;
- Manage the testing process for water quality and proving tests;
- Ensure the commissioning requirements of this Specification are met;
- Ensure that all occupational health and safety and workplace regulations are met;
- Ensure that all environmental and quality assurance targets are met;
- Sign off all Contractor commissioning documentation prior to Practical Completion; and
- Ensure completion of "As Commissioned" handover deliverables.

9.2.3 Unitywater Treatment Plants

Unitywater's Treatment plants Representative will:

- Operate the plant during process commissioning and performance testing;
- Adhere to 'Permit to Work', tagging and isolation procedures;
- Ensure that all occupational health and safety and workplace regulations are met;
- Ensure that all environmental and quality assurance targets are met;
- Ensure Operator and Maintenance team members are suitably trained; and
- Assist in preparing Risk Assessments.

9.2.4 Unitywater Network Operations

Unitywater's Network Operations Representative will:

- Operate the plant during process commissioning and performance testing;
- Adhere to 'Permit to Work', tagging and isolation procedures; and
- Assist in preparing Risk Assessments.

9.2.5 Unitywater Water Quality

Unitywater's Water Quality Representative will:

- Provide guidance on any necessary testing;
- Adhere to 'Permit to Work', tagging and isolation procedures;
- Review Risk Assessments (as required); and
- Review Commissioning Plan (as required).

9.2.6 Contractor's Project Manager

The Contractor's Project Manager shall:

- Achieve all requirements for the Project scope;
- Liaise with the Unitywater Project Manager and other relevant personnel;
- Manage the Contractor's commissioning team members;
- Ensure that dry commissioning and wet commissioning is completed in a timely and cost-effective manner as per the CMP;
- Adhere to the 'Permit to Work' and tagging / isolation procedures;
- Ensure a seamless transition from the Contractor to Unitywater Commissioning team members;
- Ensure the commissioning requirements of this Specification are met;
- Ensure that all occupational health and safety and workplace regulations are met; and
- Ensure that all environmental and quality assurance targets are met.

9.2.7 Contractor's Commissioning Manager

The Contractor's Commissioning Manager shall:

- Report directly to the Contractor's Project Manager;
- Be responsible for commissioning tasks and deliverables as per the CMP;
- Manage and direct contractor commissioning team members;
- Liaise with the Unitywater's Commissioning Manager;
- Conduct the weekly Commissioning Meetings and take minutes (if applicable);
- Ensure that the Contractor's CMP, Method Statements and Inspection and Testing Plans are established and maintained, including maintaining traceability of all checks undertaken;
- Ensure that non-compliance reports are closed off;
- They may organise the delivery of training for Operations and Maintenance teams;
- Adhere the 'Permit to Work' and tagging/isolation procedures;
- Ensure a seamless transition from the Contractor to Unitywater Operations teams;
- Ensure the commissioning requirements of this Specification are met;
- Ensure that all occupational health and safety and workplace regulations are met;
- Ensure that all environmental and quality assurance targets are met; and
- Ensure all control systems reports are signed and cyber security standards are met.

9.2.8 Designer

Where applicable, the Designer or their Commissioning Representative will:

- Report directly to the Unitywater Project Manager or Contractor's Project Manager as required;
- Provide specialist input on the performance testing of specific equipment items during Wet Commissioning and Process Commissioning;
- Provide specialist input on the commissioning and optimisation of the overall process (if applicable);
- Where applicable, assist in delivering on-the-job training in process optimisation for the Operations and Maintenance teams; and
- Assist the Unitywater Commissioning Manager or Contractor's Commissioning Manager in achieving acceptable results during the Process Performance Test as required.

10. Punchlist – Omissions and/or Defects

10.1. Overview

A consolidated Punchlist containing any Omissions and/or Defects will be generated prior to, and maintained throughout the commissioning process to keep a comprehensive list of all items that will affect commissioning, operation and handover of the plant. The Contract/Scope of Work should nominate who is to maintain and control the Punchlist, however in the absence of this the Contractor's Project Manager is to maintain and control the Punchlist and Unitywater Project Manager must sign off closed out items.

Punchlists are typically comprised of physical items (non-complaint, defective or omitted) and unsubmitted handover deliverables, such as O&M manuals, training, drawings, etc. Each item on the punchlist is tracked through to item resolution. When the issue presents itself, there needs to be communication with the Commissioning Manager and the person who holds the responsibility to resolve the item. If the asset is being delivered by a Developer, items must be brought to the attention of UW Development Services.

Each item will be recorded including a classification on when it is to be resolved. The classifications are:

- Category A – Items to be rectified prior to Dry Commissioning
- Category B – Items to be rectified prior to Wet Commissioning
- Category C – Items to be rectified prior to Process Commissioning
- Category D – Items to be rectified prior to Process Performance Testing
- Category E – Items to be rectified prior to expiration of DLP (contract)

Progression to the next phase shall not occur until all relevant Punchlist items are closed out to the satisfaction of Unitywater. Defects and Omissions which are likely to impact on the next phase of commissioning shall be corrected and signed off by Unitywater Project Manager prior to the progression to the next phase of commissioning.

10.2. Punchlist Identification

At the completion of each phase, or at agreed times, a Punchlist identification walkthrough will be carried out by Unitywater to determine if any Omissions or Defects are encountered. Classifications are described is Section 10.1. The project team may agree to change the category of the Punchlist item during project phases.

11. Handover and Deliverables

11.1. General

Handover deliverables are separated into the following categories:

- Commissioning documentation – generally for use during project delivery and may have minimal use when equipment is in operation; and
- Operational documentation – documentation that will be used for the duration of the asset's life and includes drawings, manuals, asset data etc.

Commissioning handover deliverables may be numbered and named to align with Unitywater's *Pr8843 – Specification for Drawing, Document and Equipment Tag Numbering*. However, it may not be practical in some instances and using project naming conventions is acceptable.

All operational handover deliverables and documents shall be numbered and named according to *Pr8843 – Specification for Drawing, Document and Equipment Tag Numbering*. A typical structure for Handover Documentation is provided in Appendix C – Typical Handover Documentation Structure. This can be used for both commissioning and Operational information.

Where locks have not been provided by Unitywater then a full lock schedule including a plan showing the location of all locking mechanisms including a list of quantities by lock designation must be provided.

11.2. Commissioning Information

The following sections detail specific Commissioning documentation required as a minimum.

All documents shall be provided as electronic editable copies. Scanned PDF for ITC/ITP only is acceptable for final submission when showing physical signatures.

All documentation must be in the formats listed in Table 2 - Commissioning Information Document Format Requirements below.

Table 2 - Commissioning Information Document Format Requirements

Document Type	Format
Text	Microsoft Word and PDF
Drawings	AutoCAD and PDF
Diagrams	Micosoft Word, Excel or Visio AND PDF
Spreadsheets	Microsoft Excel

Electronic files must be provided on one or more of the following platforms:

- The nominated project management platform (e.g. Teambinder, Objective Connect etc); or
- USB stick; or
- Portable hard drive.

Commissioning documentation may be included as part of the CMP depending upon the complexity of the project. If not included with the CMP, timeframes for submission need to be agreed between Unitywater Project Manager and Contractor's Project Manager.

A complete set (all commissioning phases) of project specific Commissioning documentation shall be submitted to Unitywater for approval prior to commencement of commissioning activities. If no dates are specified in the contract, then these must be submitted a minimum of (2) weeks prior to commencement of commissioning activities.

Upon completion of each commissioning phase, the relevant completed Commissioning documentation shall be submitted to Unitywater for approval.

11.2.1 Final Commissioning Report

A Final Commissioning Report shall be submitted at the end of the Process Performance Test. The purpose of the Final Commissioning Report is to record the activities and results of the commissioning that is developed from the final CMP with all of its attached appendices.

The Final Commissioning report is to be a summary of the commissioning process and will include the following:

- Comments on any observed deficiencies in plant equipment design and performance;
- Any conclusions that would be helpful to operating and maintenance team members can be summarised at the end of the report;
- Completed Commissioning documents including all ITP/ITC (SAT results);
- A list of all the final setpoints and the methodology for optimisation of these setpoints;
- Punchlist.

11.2.2 Process Performance Test Report

A Process Performance Test Report shall be prepared on the completion of Process Performance Testing, outlining the results of all testing. The report shall include:

- Tables, graphs and calculations necessary for interpretation of the results;
- Flows, pollutant loads, chemical and power consumption (as required);
- Comparison of results with guarantee requirements;
- SCADA printouts detailing any alarms and reliability of equipment;
- Discussion on overall performance of equipment.

11.2.3 Contract and Construction Management Reports

Provide all relevant reporting details resulting from the management of the construction of the asset, including:

- Non-Conformance Register;
- Request for Information Register;
- Site Instructions to Contractor;
- Variations to Contract;
- Project Risk Register;
- Completed and signed off Construction ITP/ITC.

11.2.4 General/Other Reporting

Where applicable, provide details of all investigations undertaken as part of the delivery of the asset during the construction Phase. Reports required but not limited to:

- Risk Register;
- Radio Report;
- Acoustic Report;
- Lighting Report;
- QA Reporting including ITP register, Engineers Inspection Reports, Photos;
- Safety in Design, HAZID, HAZOP, CHAZOP and CHAIR reports resulting from the relevant workshops must be provided.

Other test results required may include:

- Compaction;
- Concrete;
- Water quality and/or water quality rest results;
- Geotechnical reports.

11.3. Handover of Operational Information

Handover deliverables comprise of documentation required to successfully operate and maintain the assets that are to be handed over.

The required deliverables include records from both the design and construction phases of the project. Documents developed through the project shall include the full revision history of each document with superseded versions included for reference purposes. Vendor documentation must detail maintenance requirements.

All documents shall be provided as electronic editable copies except for generic equipment manufacturer's manuals not specifically produced for the project.

A complete set of all As Constructed documentation must be provided showing in detail all elements of the Works and being clearly marked "As Constructed" with the relevant date, the relevant revision number and the final approval of an RPEQ designer for the as constructed revision or as required by *Pr8701 – Specification for Asset Information*.

The As Constructed documentation must be checked and certified by a Registered Professional Engineer of Queensland (RPEQ) and a suitable representative of the Contractor; for compliance with the Scope of Works and/or Contract. RPEQ certification must be provided for all designs, drawings, details, checking of shop drawings, any alterations from the original design or where otherwise required for any purpose.

As Constructed documentation encompasses the complete plant, i.e., new works as well as existing assets. Where existing documents for existing assets/plant are concerned, these must be amended, superseded or cancelled to ensure the as constructed package of documents is accurate.

Where the design requires an existing document to be amended, then all related documentation affected by this amendment must be similarly amended. A deliverables list should be provided which identifies all new documentation to be produced and existing documentation to be updated as part of the Scope of Works.

All documents prepared during the design, construction, commissioning and process performance testing phases must be included in the As Constructed documentation. The As Constructed documentation must contain a similar level of detail to the design documents and incorporate any changes in any engineering data from previous versions of the documents.

11.3.1 Electronic Versions of Documents

All documentation including but not limited to drawings, operating and maintenance manuals, vendor manuals etc must be provided in an electronic format.

All documents submitted must be in a form that can be edited at a later time so that they can be kept up to date.

All documentation must be in the formats listed in Table 3 - Document Format Requirements below.

Table 3 - Document Format Requirements

Document Type	Format
Text	Microsoft Word and PDF
Drawings	AutoCAD and PDF
Diagrams	Microsoft Word, Excel or Visio AND PDF
Spreadsheets	Microsoft Excel
Manufacturer/Vendor Manuals	PDF

Electronic files must be provided on one or more of the following platforms:

- The nominated project management platform (e.g. Teambinder, Objective Connect etc); or
- USB stick; or
- Portable hard drive.

11.3.2 Physical Versions of Documents

Where a hard copy of the documentation is required, a minimum of two copies in hardcover shall be supplied covering the extent of works.

The paper on which the hard copies are printed must be good quality to standard A4 size with the exception of drawings that must be Standard A3 size. The print must be clear and easily readable. Diagrams and photographs must be of a reasonable size and must be clearly reproduced. Ample diagrams and photographs must be provided and the contents must be well spaced and attractively laid out.

The documentation must be capable of being readily reproduced in a clear readable fashion by a photocopier or similar process.

The binding must be of the loose-leaf type and all pages machine punched. The binders are to be no more than 75% full.

The binder must be good quality hard plastic covered with title impressed and filled. They must have not less than four spring back binding clips and must be capable of being folded flat when open and remaining open when in use.

The documentation provided will be utilised for training the operating team members.

11.3.3 Drawings

All drawings associated with the assets shall be handed over and must conform to the requirements of this specification.

All drawings, irrespective of the source of the drawing and including drawings from vendors, third parties, and the like, must be in accordance with Unitywater's *Pr9080 - Specification for CAD/BIM Drafting and Modelling Standards*, with the exception of drawing numbering and file naming convention which shall be as per *Pr8843 – Specification for Drawing, Document and Equipment Tag Numbering*.

Survey work associated with new as-built documentation and those changes to existing documentation due to WUC (including plans, levels to AHD and coordinates) shall be certified by a licensed surveyor. Each as-built document submitted must be signed by a surveyor with an appropriate certificate where underground services are shown.

It is not acceptable to submit as-built documentation as part of a vendor manual.

The below sections detail discipline specific requirements of drawings.

11.3.3.1 Process Documentation for Complex Assets

Where applicable, the following must be provided:

- Process model files (BioWIN or an equivalent commercially available process modelling package), design criteria, and outputs in native electronic format. The model must also be calibrated during proof of performance testing and demonstrate compliance with any loading scenarios detaild in the Scope of Works and/or Contract.
- Process flow design documents which shows the major plant components, including existing assets incorporated in the plant.
- Process flow diagrams showing all plant process units and streams, and design flows (including ADWF, peak dry weather flow and peak wet weather / maximum design cases). The process flow diagrams must include all assets (existing and new) incorporated into the plant.
- Mass balance diagrams for solids, COD and nitrogen.
- Functional Description and Functional Specification.

11.3.3.2 Process Documentation for Active Assets

P&ID are required for all Complex Assets (including existing and new assets) and Active Assets.

Updates to existing P&ID are required where equipment already exists.

A complete list of tag numbers must be developed in accordance with *Pr8843 – Specification for Drawing, Document and Equipment Tag Numbering*, which specifies descriptors for all items depicted in the piping and instrumentation diagrams.

Complete single layer P&IDs must be prepared for all new systems. The P&IDs must be derived from the smart P&IDs.

The complete set of P&ID's must symbolise the complete systems, including all of the following assets:

- Equipment including mechanical equipment, piping, instrumentation, and control components;
- Pipelines, reducers, drain-lines, overflows, sample-lines, airlines and any other connecting pipework;
- Vessels and tanks;
- Valves and actuators, including process, sample, drain and air-bleed valves using approved symbols to differentiate types of valves and actuation;
- Pumps, blowers, compressors and other mechanical devices using symbols to explain how these are controlled;
- Motors and motor control units;
- Primary elements, instruments, interlocks, programmable controllers, signal paths, field instrument power sources, computer interfaces and local indicators;
- Control loops and high-level control logic showing overall interlock interactions between field instruments and field devices. Undefined links between field sensors and field actuating instruments via general or undefined process computing functions are not acceptable; and
- Any other equipment, including existing assets.

The following summary of basic concepts must be used in the preparation of P&IDs:

- All P&ID's must be in accordance with the Unitywater symbol library;
- All items must be laid out and connected in a logical and tidy manner such that the process is described accurately, using approved line thicknesses and other symbols to aid clarity;
- Sufficient space must be provided to allow all items to be easily read;
- Sufficient annotation using notes must be used to define general details of the control methodology;
- Vendor packages must be clearly denoted and details of relevant components shown;
- Major process flows must be shown as moving from left to right across the drawing;
- Process flows and/or Instrument and Control signals must enter or exit a drawing from right or left edges. No lines must enter or exit from the top or bottom;
- Lines shown in one order on a drawing must be shown in the same order on the next;
- Source and destination arrows must be shown only at the far right or left of a P&ID;
- Source or destination drawings must be inside the arrow bubble;
- The arrow bubble must point in the same direction as the direction of flow;
- The major process equipment item or instrument, which is the source or destination of the flow or signal, must be shown below the arrow;
- Lines must be alphabetized on a P&ID in a logical fashion and placed beside the arrows in order to allow the reader to readily identify which lines connect in adjacent P&IDs;

- The tags on adjacent, parallel lines must be aligned for ease of understanding;
- The equipment tag must be adjacent to the equipment illustration to ensure a clear association between the equipment and its tag;
- New and existing equipment must be clearly distinguished during design and then removed during “As Constructed” revision update;
- Where process lines cross, the vertical lines must be broken to allow unbroken horizontal lines. Arrow heads must be shown at each direction change unless several are close together on the drawing; and
- Line labels must be shown in the line. Valve labels must be shown adjacent to the valve, typically just below or to the right.

11.3.3.3 Plans, Civil, Structural and Mechanical Drawings and Hydraulic Profiles

Layout and sectional plans for all major items of equipment, road and civil works, structures, pipework and buildings must be provided.

Major items of equipment are to include all pumps, blowers and mechanical devices. Structures are to include all process tanks, storage tanks, sumps, pits, wells and the like. Road and civil works are to include all roads, drainage, slabs, foundations, pathways and any other work. Pipework is to include all connecting pipework, conduits and ducts.

In general, sufficient design documents at an appropriate scale must be provided so that the full details can be clearly understood.

All design documents and “As Constructed” documentation must include existing assets where works are conducted on existing assets.

The following documents are required:

- A site plan that shows the plant on one drawing;
- Where applicable, Site plans dividing the plant into a grid of equal sized square or rectangular segments with the grid segments having common boundaries such that the entire plant is depicted across the drawings in a continuous manner. The number of grids selected must be such that all elements on all of the plans are easily readable on A3 size paper;
- General layout plans;
- Show appropriate contours;
- (Where applicable) Hydraulic profile for the Works (including existing assets and waste disposal) at zero flow, ADWF and PWWF;
- Detailed layout and sectional plans for all water retaining structures showing construction details and location of all connections;
- Detailed layout and sectional plans for all buildings showing construction details, location of all equipment, bunds, electrical switchboards and cable trays, drains and all other details; and
- Sectional and layout plans for all road and civil works, showing all details, including proposed construction methods, drainage, materials of construction and the like.

As Constructed documentation must include level and co-ordinate information and also show the following information as a minimum:

- Diameter, material and class of each pipe;
- Types of bedding and limits thereof;
- Types of backfilling including road crossings;
- Alignment and level of mains at no less than 50 m spacing, at changes of alignment and grade, and at fittings;
- The level and location of all underground services;
- The level and location of all aboveground services;
- The level and location of all equipment and structures;
- Finished levels of floors, overflow structures/weirs and tops of walls of process units and storages;
- Any variations to the design including any alterations to any structures; and
- Ratings of the actual equipment installed for all items of equipment.

11.3.3.4 Electrical, Instrumentation and Control System Design Documentation

Complete manufacturing drawings shall be submitted for approval prior to manufacture of switchboards.

One complete set of drawings printed on A3 permanent water resistant paper is to be placed in the switchboard or switchroom within an A3 plastic binder pocket.

The following must be provided for the electrical, instrumentation and control system, including but not limited to the following:

- General arrangement design documents for all substations, switchboards, switchgear and control gear assemblies, enclosures, panels and equipment, showing both internal and external layout and mounting details of equipment and construction details including relevant construction notes and equipment list;
- Single line diagrams showing all equipment connected;
- Three line diagrams for relevant equipment including but not limited to circuit breakers, transfer switches, metering, protection relays, etc;
- Drives list (where applicable);
- Power Systems Analysis and Arc Flash Assessment Report including all calculations as per the requirements of *Pr10618 - Specification for Power Systems Analysis and Arc Flash Studies*;
- Individual motor starter schematics;
- Instrument schedules listing each item of instrumentation and including:
    - Tag number;
    - Process description/purpose;
    - Accuracy;
    - Input details such as signal type, range, etc.;
    - Output details such as signal type, range, etc.;

  - Operating range;
  - Calibration details;
  - Maximum working pressure;
  - Flange/mounting details (process connection); and
  - Manufacturer/model/make;
- Analogue and digital instrument loop diagrams;
- Full digital schematics for all electrical equipment, including connections to instruments and others, line numbering, wire numbering, terminal numbering, cross referencing, cable numbering, etc.;
- Cable schedules (in spreadsheet format) for cables, listing each power, communications, instrumentation and control system cable, including:
  - Cable number;
  - Origin;
  - Destination;
  - Nominal voltage (power and control only);
  - Type of cable;
  - Size of conductor;
  - Number of cores; and
  - Installation details such as cable route;
- Equipment layout and cable route design documents, installation details and trenching cross sections (including drainage), where applicable;
- Site conduit layout design documents and installation details;
- General light and small power layouts;
- External lighting plan and lighting control philosophy (where applicable);
- Lightning Report (if applicable)
- RTU/PLC I/O list, including hard wired I/O and assigned internal addressing/words for device communications;
- Control system network design documents;
- PLC rack layout design documents showing all control equipment and part numbers (where applicable);
- Functional Specification (complex assets only) detailing the PLC and operator interfaces for all plant operation, sequencing, alarming, set points, inputs and outputs.
- PLC program listing demonstrating that the code is complete, is fully commented and labelled and ready for handover.
- Conduit and cable pit schedule;
- Electrical equipment schedule.

Electrical documents must include at least the following information:

- Current transformer ratios;
- Circuit breaker and fuse current ratings;
- Ratings of capacitors, resistors and any other electrical devices;
- A short name description of each relay, timer or control device to describe its operation;
- A cross-reference system that indicates where each contact for a relay or timer is located (full drawing number is required); and
- A cross reference system that indicates where all electrical equipment, components or wiring continues, if the 'line' is broken, or where it originates from. All electrical components require cross referencing and full drawing numbering is required. Cell/Line number references are acceptable for references contained on the same drawing only.

Equipment lists shall include details, such as:

- Manufacturer;
- Supplier, including contact details;
- Model/part/catalogue number;
- Quantities;
- Equipment labelling;
- Power rating (kW/kVA/A);
- Type and size;
- Any other information that may be required by maintenance teams.

11.3.3.5 Assembly / Shop Drawings

All detailed drawings, including assembly and shop drawings, must meet the requirements of *Pr8843 – Specification for Drawing, Document and Equipment Tag Numbering* and *Pr9080 – Specification for CAD/BIM Drafting and Modelling Standards*, irrespective of the source of the drawing.

Drawings of assemblies of mechanical and electrical equipment must include, where appropriate:

- Overall dimensions and mass (including the mass of the heaviest lift for maintenance);
- Finished sizes and tolerances of all wearing parts;
- Terminal point details;
- Expansion limits;
- Lubrication points;
- Minimum clearances;
- Welding preparation and procedures;
- Coating details, including products, thicknesses, preparation, procedures, and testing;
- Where equipment is subject to pressure or temperatures higher than ambient;
    - Design pressures and temperatures;

  - Working pressures and temperatures; and
  - Test pressures and temperatures;
- Insets, where necessary, to ensure every item of the assembly is clearly shown;
- All points of support;
- All points of attachment of the equipment to piping, conduits or other items supplied by others;
- Location of holding down bolts or other points of support or anchorage; and
- Bill of materials.

11.3.4 Operation and Maintenance Manuals

A comprehensive and integrated set of operating and maintenance manuals detailing installation, operating and maintenance instructions for the asset/plant must be provided. These manuals must be in English and be clear, concise and precise and be suitable for use by tradesmen who are not familiar with the asset/plant.

For non-complex sites, information shall be collated into a single unified and indexed Operation and Maintenance Manual.

The operating and maintenance manuals must integrate existing and new assets where applicable. For the existing assets, new information must generally follow the format of the existing documents unless specified otherwise in this specification, the scope of Works or the contract.

The operating and maintenance manuals must include, but not be limited to, the content specified in Table 4 - Information included in an Operation and Maintenance manual for a single system.

Table 4 - Information included in an Operation and Maintenance manual for a single system

Category	Content	Specific Requirements
Overview Summary and Contents	A statement of the scope and contents of the manual together with alphabetical index to its contents.	The purpose and constraints of the single system.
Design of Systems	A general description of plant components, their workings and control and their relationship to other equipment.	An overview with block diagrams and may include a title page for each item of equipment or for each grouping of similar equipment, with the information, suitably arranged.

Category	Content	Specific Requirements
Design Documentation	A general description of plant components, their workings and control and their relationship to other equipment.	An overview with block diagrams and a page for each item of equipment or for each grouping of similar equipment, with the following information: • Equipment name and asset number (if applicable); • Manufacturer's name, email and web site address; • Equipment supplier's name, address, email and telephone number; • Name plate data.
	Parts list (cross referenced to assembly drawings).	The actual part installed must be stated in the instructions and alternative parts that are not supplied must be deleted.
	Equipment data sheets for all mechanical and electrical equipment, including instrumentation.	• Specific model numbers of each item installed (including all options and variants). • Details of the equipment manufacturer and supplier (including contact details). • Equipment performance specifications. • Manufacturer test data (including all works and site tests). • Performance information. • Equipment characteristic curves.
	A table detailing the technical specifications and capacity of all equipment and multiple systems (process units).	Includes hydraulic, solids, organic or nutrient capacity.
	Pump and system curves for all pumped systems.	All calculations in an editable format.
Construction Documentation	Schedules and lists of manufacturers and suppliers of equipment and components.	Contact telephone numbers, addresses and make and model numbers.
	Comprehensive equipment data schedules summarising information required for maintenance, repair, adjustment and replacement.	Items such as engines, alternators, radiators, filters, pumps, fans, motors and the like.
Shutdown Guide	Instructions to perform a safe shutdown of each system.	Recommendations to prevent deterioration during prolonged shutdown periods.

Category	Content	Specific Requirements
Operation manual	Short form operating procedures.	• Basic theory of operation of ancillary equipment not controlled by the PLC/RTU; • Function of the equipment; • Pre-start-up checks and adjustments; • Start-up procedures; • Normal shut-down procedures; • Visual checks and observations that should be made routinely to ensure equipment is operating satisfactorily.
	A list of all recommended and critical spares.	Unit prices with full details of all spares required for 2 years operation for each component where necessary.
	Fault finding guidelines described in detail with reference to associated drawings and diagrams, typical faults that may occur and how to diagnose them.	Diagnostic and trouble-shooting techniques, where applicable, to determine probable causes of operating difficulties or alarm situations.
Maintenance Information	Comprehensive preventative maintenance procedures outlying routine maintenance requirements for daily, weekly, monthly and annual intervals to maintain reasonable asset condition and process disturbance (downtime).	• Recommended lubrication protective treatment and additives, • Detailed procedures of all activities for all parts of the equipment including means and tools for access and lifting • A list of all special maintenance tools required and supplied by the Contractor.
Training Information	Illustrations showing the plant and equipment, position and types of individual components, test points and sensor locations.	Must show dismantling and reassembly drawings and instructions.
Commissioning Records	Inspection and Test Reports, i.e. complete copies of any FAT and SAT inspections, tests and commissioning reports.	Any reports or communication from the Supply Authority.
Operational Information	Emergency response plans and procedures in response to potential emergencies.	Outline fire and evacuation procedures.
	A complete description of operational parameters and optimal set points as determined throughout the Commissioning process.	A log of parameters and setpoints updated during Process Commissioning (as coordinated between the Unitywater and the Contractor and documented by the Contractor).

The information must be arranged in such a manner as to permit insertion of amendments and additional material. The instructions must be cross-referenced for ease of use in maintenance and such reference numbers must cross-referenced to all drawing numbers, item numbers, part numbers and catalogue references necessary to ensure identification and understanding of systems.

All test certificates, commissioning and test data, schedules for plant equipment and controls, must be signed, dated and witnessed and included in the operation and maintenance manuals.

11.3.5 Unit Process Guidelines UPG

Unit Process Guidelines (UPGs) must be provided for Complex Assets in all main plant areas as defined by *Pr8843 – Specification for Drawing, Document and Equipment Tag Numbering* including the PLC and SCADA system. The UPGs provide a process overview for the operations team members to effectively understand and operate that process unit. Each UPG will have a number of Standard Operating Procedures (SOPs) to support the operation of that process.

In general, a UPG shall detail:

- The objectives and function of the process unit and its relationship with the other processes;
- The components/equipment of the process unit;
- The principles of operation;
- The process control strategy;
- The key set points and limiting factors; and
- A trouble shooting guide.

The UPGs shall be prepared from the design documentation, equipment supplier information, process descriptions, functional descriptions and other reference material where required.

UPGs developed prior to process commissioning must be updated with any changes made during process commissioning, optimisation or performance testing. The ‘As Constructed’ UPGs shall be provided as part of the Handover package.

11.3.6 Standard Operating Procedure

Standard Operating Procedures (SOPs) shall be prepared for all single systems of plant. The purpose of the SOP is to provide a detailed step-by-step instruction to operate the process effectively and safely.

The SOP must contain the following descriptions.

- Summary the procedure;
- Scope of the procedure;
- Responsibilities of the operator;
- Conditions and standards to be used;
- Tasks to be carried out;
- Identification of the hazards and control measured associated with the procedure;

- Full instructions on the operation of the plant, including setting up, start up and shut down procedures, emergency and standby facilities, fault diagnosis, warning systems and recommended procedures to ensure the satisfactory performance of the plant:
    - A section must be devoted to isolation and restoration procedures to be followed when maintenance is required on the various major items of plant.
- Emergency response plans and procedures in response to potential emergencies including fire and evacuation procedures.

The SOPs shall be prepared from the design documentation, equipment supplier information, process descriptions, functional descriptions and other reference material where required.

SOPs that are developed prior to process commissioning must be updated with any changes made during process commissioning, optimisation or process performance testing. The 'As Constructed' SOPs shall be provided as part of the handover package.

11.3.7 Electrical and Control Equipment

Electrical and control operation and maintenance documentation must be divided into two sections:

1. Electrical and instrument equipment documentation for use by maintainer;
2. Control equipment and software.

The PLC and SCADA specifications provide full instructions on the operation of the SCADA system, including administration and operating instructions, operator interfaces, device interfaces, alarm and event interfaces and trending and reporting interfaces and instructions. Refer to the References section of this document for the list of control system specifications.

The electrical and instrument equipment section of the operating and maintenance manuals must contain:

- Equipment data sheets for all electrical and instrumentation equipment. This must include important equipment performance specifications, manufacturer test data (including all works and site tests), performance information and equipment characteristic curves;
- Description of the system function of each module with explanatory notes and test points to permit fault isolation;
- Explanation of the use and method of loading of diagnostic programs required to verify the correct operation of individual items of hardware;
- A list of commands required to perform first line function such as inhibit alarm, examine data, load programs, etc.;
- Settings of adjustable parameters, including settings of protective devices, such as TOL devices and protection relays;
- VSD, electronic motor protection relay and electronic shear pin parameterisation lists; and
- A schedule of recommended routine tests and inspections and instructions for adjustments which may have to be made to maintain optimum performance.

11.3.8 Control Equipment Software Documentation

All supplied software must be completely and thoroughly documented in the operating and maintenance manuals. Such documentation must include:

- A complete listing of all programmes and application software, including source code, copies of all graphical layouts, details of all communications protocols and printouts of all database or point information; and
- Address settings of cards showing switch positions on cards required to insert a card in a specific field location or office subsystem.

These items must also be stored on the engineering workstation in native format at designated locations directed by Unitywater.

11.3.9 Vendor Manuals

Vendor Manuals must be provided for all mechanical and electrical equipment supplied. The manuals shall contain an index and shall be sorted in ascending order according to the Tag number.

Manuals for major equipment and ancillary equipment shall be provided as individual files. Naming and numbering of files and folders shall be undertaken in accordance with *Pr8843 – Specification for Drawing, Document and Equipment Tag Numbering*. All documents written specifically for the project (i.e. not a generic manual) shall be provided in an editable format. All other documents shall be provided as native pdf files. Scanned documents are not acceptable.

A covering page shall be provided for all equipment, which includes all details necessary to distinguish it from others. Where the same manual is applicable to multiple tag numbers the original shall be inserted behind the cover page of the first instance. All subsequent instances can include a reference to that location. The indexed manuals shall be provided as files in an appropriate folder structure.

The information to be supplied includes, but is not limited to, the following:

- Name of supplier;
- Address and telephone numbers for service calls;
- Description – a full description of the equipment with a tabulation of specifications, dimensions and performance ratings;
- Technical data – a copy of the technical data sheet supplied by the manufacturer; reliability data (MTBF, MTTR and reliability block diagram) shall be provided for each equipment type (where applicable);
- The equipment manufacturer's operation and maintenance manual/s;
- Instrument data sheets;
- Principles of Operation – a basic working description, including novel features and any automatic control;
- Maintenance Procedures – step-by-step procedure for preventative maintenance work to be carried out at various intervals;
- Spare Parts – a list of Vendor recommended spare parts;
- Test Data and Troubleshooting – instructions to qualified tradesman for assessing and operational performance of the equipment;

- Installation and Commissioning Instructions – details of Standards and procedures for mounting or erecting, wiring and lubricating the equipment; the commissioning instructions shall include step-by-step procedures for checks before the first start, first start, and checks after starting and operational tests;
- Vendor supplied drawings.

11.3.10 Statutory Certifications

A register of Statutory Certifications shall be compiled (where applicable). The register shall contain an index page and is to be provided in as individual files in an appropriate file structure. Statutory Certifications may include:

- Dangerous goods;
- Hazardous areas;
- Pressure vessels;
- Lifting equipment;
- Environmental Relative Activity Certification (ERA63)
- RPEQ Certifications as required;
- Petroleum and GasAct Compliance;
- Building Approvals:
    - Form 15;
    - Form 16.

11.3.11 Lock Schedule

Provide a full lock schedule including a plan showing location of all locking mechanisms including a list of quantities by lock designation.

11.3.12 Asset Data Schedules

The asset data template shall be populated with the required information and the following major equipment schedules (not programs),are included as a guide for the asset register. The asset register is a deliverable as part of all works.

- Schedule of mechanical equipment; and
- Valve schedule
- Instrument schedule
- Cable Schedule
- Conduit and cable pit schedule;
- PLC equipment schedule;
- IO List; and
- Electrical equipment schedule including motors, switchboards and BOM

11.3.13 BIM

Where applicable, the design BIM must be developed to an as-built BIM status for both the Project and if applicate the Master Plan for the site.

One set of as-built documentation in electronic copy (in both AutoCad, exported from the as-built BIM, and PDF format) inclusive of all associated documents must be provided. In addition the as-built BIM must be provided in both native authoring file format and as an Industry Foundation Class (IFC) export along with a published NWF file of the federated Navisworks model.

For further information on BIM requirements see *Pr10360 - Project Information Requirements* and *Pr10382 – Digital Engineering Execution Plan* and *Pr9080 – Specification for CAD / BIM Drafting and Modelling Standards*.

11.3.14 Asset Data

Asset data on all plant infrastructure (including structures, mechanical and electrical equipment, valves, instruments and systems etc.) procured and/or installed by the Project, and all existing assets retained and/or modified by the Project, must be provided in the format required by Unitywater and suitable for uploading into the Unitywater Asset Management System (Maximo) and geographic information system (ArcGIS).

All assets that are within the SEQ Code must also hand over data as defined in *SEQ Asset Information Specification*.

F10844 - Operational Readiness Checklist must be used to compile handover deliverables for the project.

For existing assets being retained and/or modified, Unitywater will provide existing asset information for the Project to update. Asset information requires uploading into the Unitywater Asset Management System, Maximo. A bulk data load tool (asset template Excel spreadsheet) facilitates bulk load of updated information to Maximo. The template, provided by Unitywater's Asset Management Data team, contains the list of asset types requiring upload onto Maximo.

11.3.15 Asset Capitalisation

Information to be provided on each individual asset must include, but not be limited to, the following:

- Supplier costs of individual elements incurred by the Contractor;
- Adaptor, capacity, certification test/number/date, diameter, dimension, flow, frequency, head, impeller, IP rating, manufacturer, material, phases, poles, pressure, rating, size, speed, serial number, weight, winding etc.; and
- Any other information required by Unitywater from time to time.

The asset capital cost information must be provided to Unitywater for the purposes of asset capitalisation. The asset capital cost information must be in the form advised by Unitywater Project Manager to align with Unitywater's capitalisation policy.

Requests for capital cost information may coincide with completion of construction of each asset.

11.3.16 Operator Training

Training of the Operations and Maintenance personnel may be required and where required will preferably be undertaken throughout the commissioning phase.

For Sewage Treatment plants projects, Unitywater Operations personnel will work as part of the Commissioning Team. Therefore, some of the training will occur through an on-the-job approach.

For some complex assets Unitywater Operations personnel may work as part of the Commissioning Team. Therefore, some of the training may occur through an on-the-job approach. Where this does not occur, suitable other training avenues must be adopted.

Formal training (by the equipment supplier/vendor/software developer) shall be provided to the relevant Operations and Maintenance personnel including PowerPoint presentations and handouts on:

- Key equipment;
- Electrical systems;
- PLC/SCADA systems;
- Chemical handling;
- Biosolids handling;
- New equipment not previously used by Unitywater.

Training shall also be provided on the process and Unit Process Guidelines and Standard Operating Procedures. The UPG training shall include technical, process, specialist equipment and SCADA knowledge transfer.

The Unitywater Operational Technology team shall be trained to classify OT assets that are critical for cyber security. Training shall describe the detection and isolation of OT assets subject to cyber-attacks and steps necessary for the quick execution of an incident response plan.

Training Videos may be produced and these must be provided as part of the Training Records.

All training packages shall be prepared and supplied as part of the handover documentation to enable future training of new personnel and refresher training as required. Each package shall include all associated material including PowerPoint files, training manuals and models, etc. Attendance sheets and training competency assessments shall also be provided as part of the training packages.

12. Appendices

Refer to the following pages.

12.1. Appendix A – Definitions/Acronyms

The following definitions, abbreviations and acronyms are used throughout this specification.

Term	Meaning
CMP	Commissioning Management Plan
CMS	Commissioning Method Statement – Outlines the sequence of activities for the commissioning phase required for successful completion of the commissioning phase. The commissioning sequences are further detailed in the relevant ITP/ITC. During the commissioning phase certain sequences or setpoints may be altered to suit the particular installation to optimise the system performance and changes will be noted.
Construction Phase	A milestone and at completion of this phase the commissioning sequence may begin. Construction phase is where construction is completed and all testing and relevant punchlisting items are completed to enable the plant to commence commissioning. The end of construction phase is where equipment is ready for energisation. Prior to Energisation (pre-commissioning): Checking to establish that facilities, equipment and ancillary systems have been constructed, installed, manufactured and/or supplied as specified. This is the point where equipment is ready for energisation.
Construction Testing Report	contains all results from the tests and checks that must be completed and submitted prior to commencement of commissioning activities. Note that Passive assets do not require a Construction Testing Report.
Control Room	The Control Room is the command and control centre for operating the Unitywater water and sewer networks
Defect	An issue that impairs quality, function, or utility of equipment
Developer	Constructs and Donates assets that would be defined as Contributed Assets in Pr9253
DLP	Defects Liability Period
Dry Commissioning	First step in the commissioning process. This stage of commissioning establishes that all equipment is ready for the Wet Commissioning Phase. It covers requirements after energisation. Post Energisation: Commissioning where equipment and plant are tested to demonstrate correct operation and function, as far as possible, prior to the introduction of water.
Energisation	Where power and/or water is first provided to the system. Electrical energisation of equipment is the point at which commissioning phases/sequences may start.
FAT	Factory Acceptance Testing
Functional Description	A non-code plain English description of the process and control philosophy.
Functional Specification	Complements the Functional Description and defines the specific control system requirements for the control and automation of the Plant. Developed and used by the control system integrators to detailing all PLC/RTU and operator interface software.
Hold Point	A position in the progress of the work, beyond which further work must not proceed without the prior approval.
IO or I/O	Input/Output

Term	Meaning
ITC	Inspection and Test Checksheet. Project and system-specific checklists that are developed and used during all phases of the commissioning to verify that the Scope of Works is being achieved. Checksheets are used to check for general evaluation, testing, training, and other design and construction requirements.
ITP	Inspection and Test Plan. A written document that details the expectations, schedule, duration, and deliverables for commissioning activities.
Omission	Something from the works that has been neglected, left out, or left undone
Operational	When as asset has been fully commissioned and is in ongoing operation
PID (P&ID)	Process and Instrument Diagram
Possession of Site	See specific Contract for the works but generally means that the Contractor may commence construction works on the site and has control of the site.
Process Commissioning	Third step in the commissioning process. Process commissioning passes process fluid through the process to demonstrate, as far as possible, multiple systems working together for overall system process control and operation. i.e. multiple systems are working together for entire plant performance.
Process Performance Testing	Can also be known as Proof of Performance Testing (POPT) or Process Proving or Reliability Trial. This is the final step in the commissioning process. All Systems are working together (also known as Process Proving) This stage includes testing and monitoring to demonstrate that the plant / Process Unit conforms to the criteria specified in the Contract, including but not limited to the performance criteria and Performance Requirements. All systems are operating independently and as a whole system for overall plant process control to the requirements of the contract/SOW etc.
Punchlist	Punchlists are typically lists comprised of physical items (non-compliant, defective or omitted) and non-submitted closeout deliverables, such as O&M manuals, training, drawings, etc. Each item on the punchlist is tracked through to item resolution.
QA	Quality Assurance
Review	A review of a document or construction knowledge conducted by competent person designated by Unitywater to hold jurisdiction to determine: • whether the content of the document complies with regulations, codes, or other standards administered by the jurisdiction. • compliance with the Scope of Works, including coordination between systems being commissioned, functions, features and access (for testing and maintenance). • whether integration of knowledge into the conceptual planning, design, construction, and operation achieves project objectives efficiently and accurately at the most cost-effective levels to reduce or prevent errors, delays, and cost overruns.
SAT	Site Acceptance Testing
SCADA	Supervisory control and data acquisition system for the purpose of remote monitoring and automation of plant.
Scope of Works	A document that details the requirements of a project and the expectations for how it will be used and operated, including project goals, measurable performance criteria, cost considerations, benchmarks, interdependencies, success criteria, training requirements, documentation requirements, and supporting information.

Term	Meaning
SEQCode	The South-East Queensland Water Supply and Sewerage Design and construction Code as per the *South-East Queensland Water (Distribution and Retail Restructuring) Act 2009*.
SOP	Standard Operating Procedure
SPS	Sewer Pump Station
STP	Sewage Treatment Plant
Superintendent	For Capital Delivery projects, it is a contractual position for the delivery of projects. For projects delivered under ANC, it is the certifier.
System	A group of equipment use for a particular process purpose
UPG	Unit Process Guideline
Wet Commissioning	Wet commissioning passes water through the process to demonstrate, as far as possible, single (individual) system process control and operation. Wet commissioning also confirms capacity and performance of equipment and systems. Wet commissioning will generally be carried out using potable/recycled water or process fluid but will be dependent upon the process. This will be specified in the Contract documents.
Work Pack	Term is not used in this document and provided here only for clarity. The term “workpack” is only of relevance to large, complex projects, where the work (testing, dry commissioning, wet commissioning and process commissioning) that a contractor must complete for each item of plant / process unit as separate stages. Work is typically portioned into workpacks according to schedule, delivery milestones or contractual clauses.
WPS	Water Pump Station

12.2. Appendix B – References

General

All design, equipment and workmanship shall conform to the most recent requirements of relevant local, State and Commonwealth statutory requirements and applicable, current Australian Standards.

Where no Australian Standard exists, work shall conform to the most applicable, current IEC Standard.

Where conflict exists between different Codes, Standards or Regulations, the higher requirement shall apply.

The following legislation, related Regulation and Codes apply to this specification:

- SEQ Water Supply and Sewerage Design & Construction Code (SEQ WS&S D&C Code).

Relevant Unitywater documents that relate to this specification

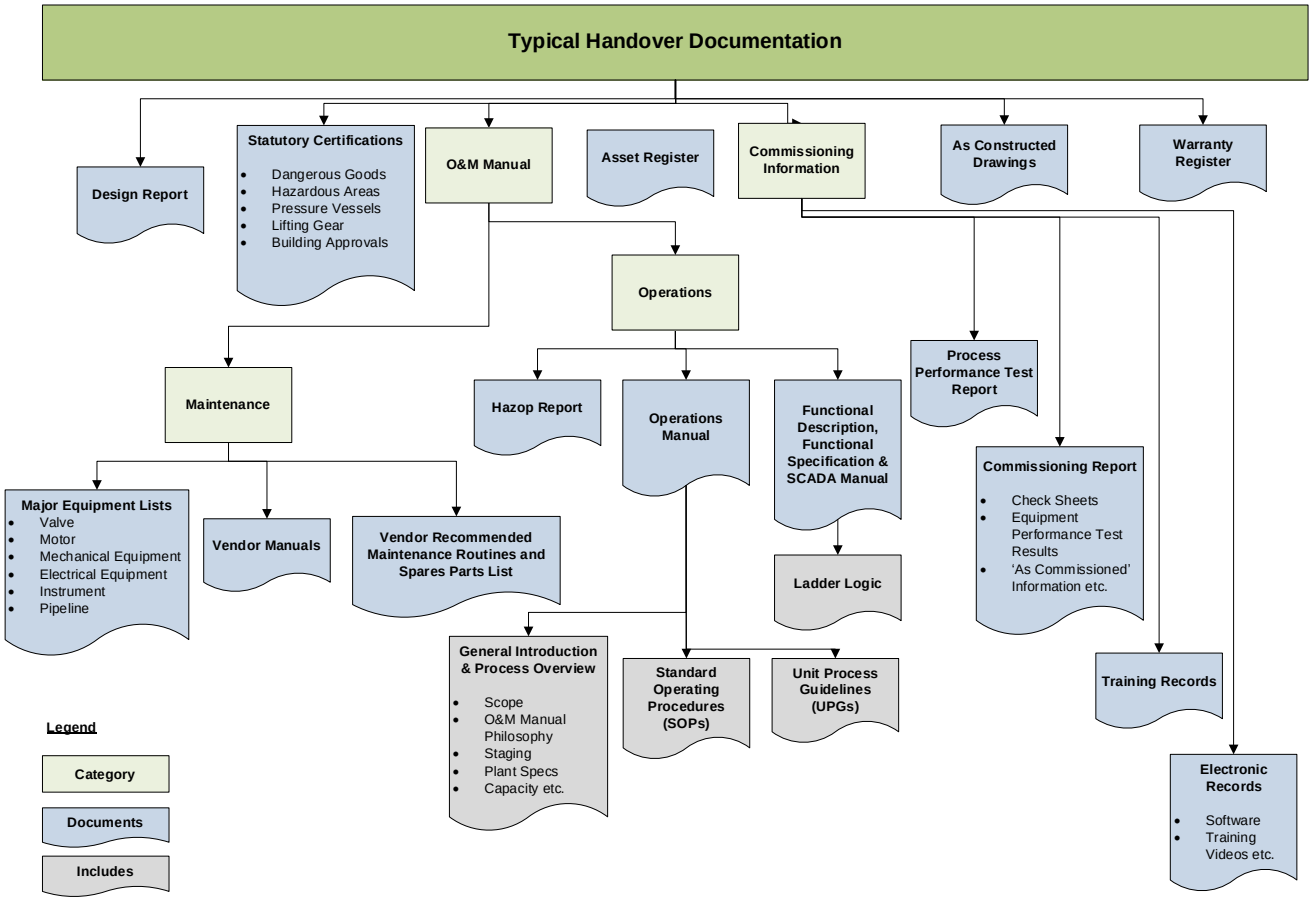
Document No.	Title
Asset information and handover	
Pr8843	Specification for Drawing, Document and Equipment Tag Numbering
Pr10360	Project Information Requirements
Pr10382	Digital Engineering Execution Plan
Pr9080	Specification for CAD / BIM Drafting and Modelling Standards
Pr8701	Specification for Asset Information
SEQ AIS	SEQ Asset Information Specification
Connections Approvals and Handover	
BP9256	Connections Policy
Pr9253	Connections Administration Manual
Technical information related to Commissioning	
Pr9693	Specification for Mechanical Specification
Pr9032	Procedure for Managing Water Quality During Mains Commissioning
Pr9087	Pressure Testing of Water Mains Work Instruction
Pr9770	Specification for Sewer CCTV Inspection and Laser Profiling
SEQ Code	SEQ Water Supply and Sewerage Design & construction Code (SEQ WS&S D&C Code)
Pr9821	Specification for Reservoir Design and Construction
In Development	Specification for Reservoir Refurbishment
In Development	Roof Flooding Tests
Pr10635	Dewatering Work Instruction
Commissioning forms	
A7923139	Template - Commissioning Management Plan (for Unitywater use)
F10045	Water Quality Mains Commissioning Form
F8927	Worksheet WPSs
F8941	Check Sheet Template PRVs
F8940	Check Sheet Template Overflow and Emergency Storage

Document No.	Title
F8941	Check Sheet Template PRVs
F8943	Check Sheet Template SPSs
F8917	Commissioning Worksheet – Overflow and Emergency Storage
F8922	Commissioning Worksheet – PRVs
F8934	Handover Planning Workshop Template
F10844	Operational Readiness Checklist
F8924	Worksheet – SPSs
F10435	Project Deliverables Checklist - Design Documentation
Control Systems	
Pr9833	Specification for SCADA and PLC Architecture
Pr9834	Specification for SCADA
Pr9844	Specification for SCADA and PLC Device Type - Siemens
Pr10699	Specification for SCADA and PLC Device Type - Schneider
Pr10434	Specification for SCADA and PLC Device Type Siemens OPC - PID Controller
Pr9845	Specification for SCADA and PLC Implementation
Pr9846	Specification for SCADA and PLC Historian and Reporting

International and Australian Standards referenced within this specification

Standard No.	Title
WSA-05 2020	Conduit Inspection Reporting Code of Australia

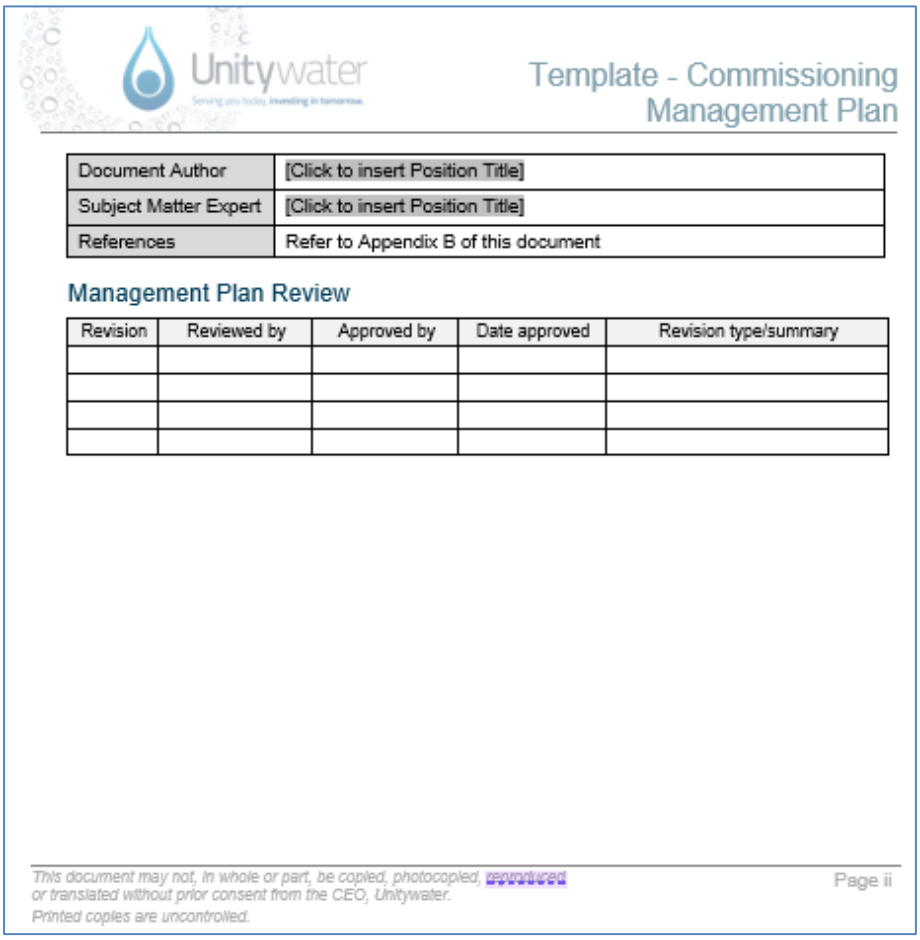
12.3. Appendix C – Typical Handover Documentation Structure



Note all sections will apply to all assets.

12.4. Appendix D – Template Example Commissioning Management Plan

Below is an example of a Commissioning Management Plan template. Unitywater team members may use Template - Commissioning Management Plan (A7923139).



Unitywater

Template - Commissioning Management Plan

Document Author	[Click to insert Position Title]
Subject Matter Expert	[Click to insert Position Title]
References	Refer to Appendix B of this document

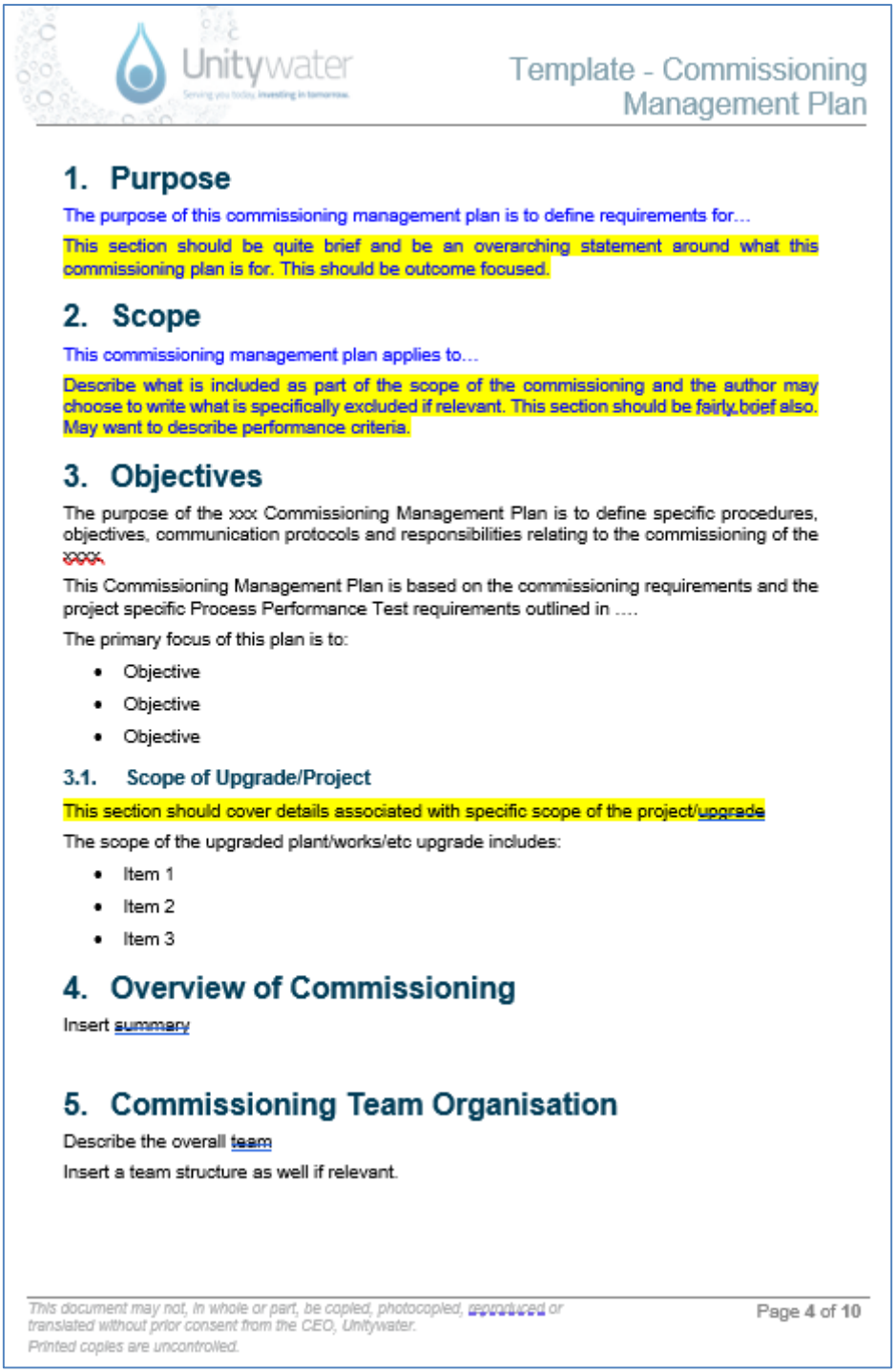
Management Plan Review

Revision	Reviewed by	Approved by	Date approved	Revision type/summary

Contents

List of Tables

List of Figures



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Template - Commissioning Management Plan

1. Purpose

The purpose of this commissioning management plan is to define requirements for…

This section should be quite brief and be an overarching statement around what this commissioning plan is for. This should be outcome focused.

2. Scope

This commissioning management plan applies to…

Describe what is included as part of the scope of the commissioning and the author may choose to write what is specifically excluded if relevant. This section should be fairly brief also. May want to describe performance criteria.

3. Objectives

The purpose of the xxx Commissioning Management Plan is to define specific procedures, objectives, communication protocols and responsibilities relating to the commissioning of the xxxx.

This Commissioning Management Plan is based on the commissioning requirements and the project specific Process Performance Test requirements outlined in ….

The primary focus of this plan is to:

- Objective
- Objective
- Objective

3.1. Scope of Upgrade/Project

This section should cover details associated with specific scope of the project/upgrade

The scope of the upgraded plant/works/etc upgrade includes:

- Item 1
- Item 2
- Item 3

4. Overview of Commissioning

Insert summary

5. Commissioning Team Organisation

Describe the overall team

Insert a team structure as well if relevant.

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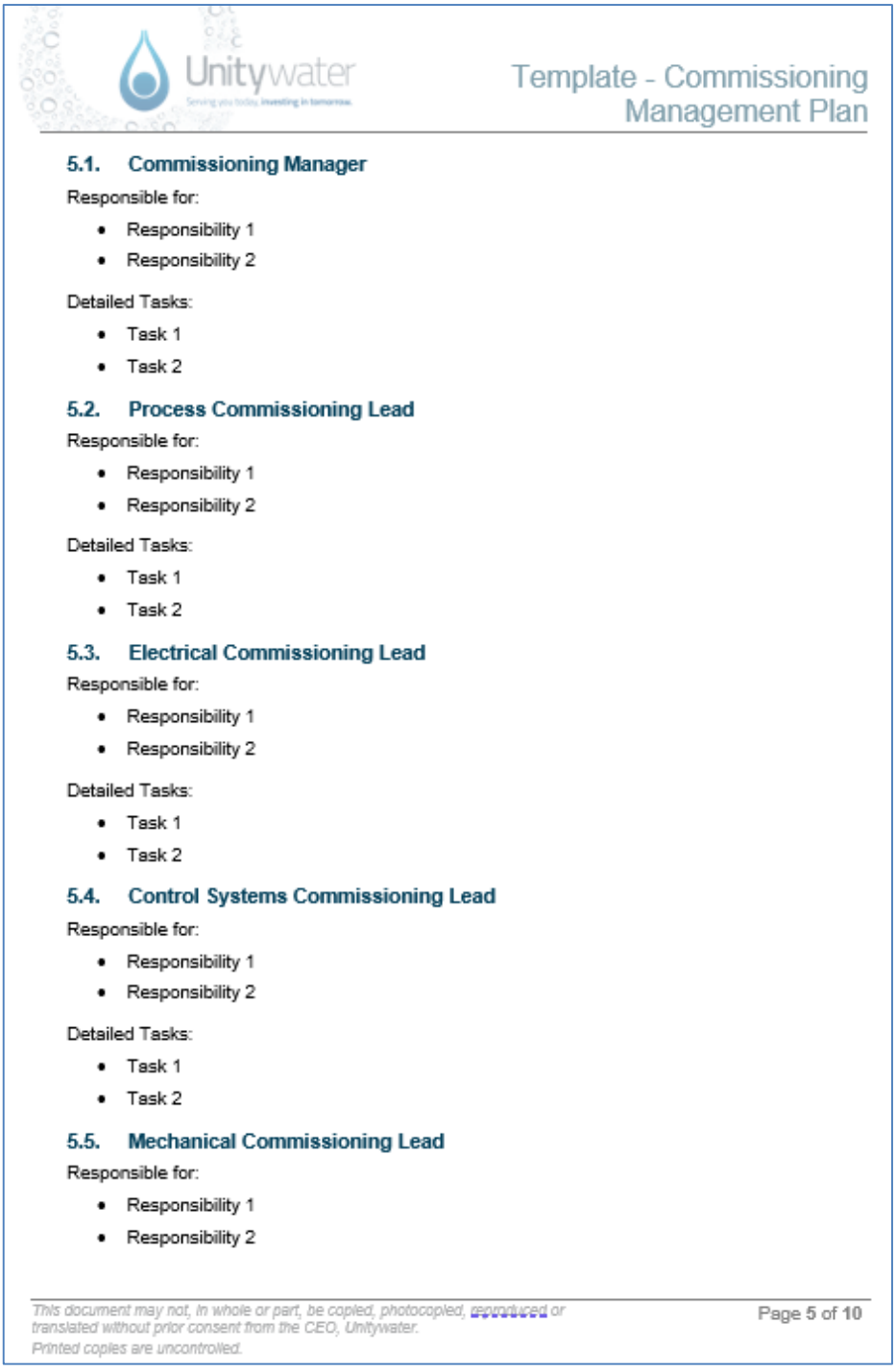


Unitywater

Template - Commissioning Management Plan

5.1. Commissioning Manager

Responsible for:

- Responsibility 1
- Responsibility 2

Detailed Tasks:

- Task 1
- Task 2

5.2. Process Commissioning Lead

Responsible for:

- Responsibility 1
- Responsibility 2

Detailed Tasks:

- Task 1
- Task 2

5.3. Electrical Commissioning Lead

Responsible for:

- Responsibility 1
- Responsibility 2

Detailed Tasks:

- Task 1
- Task 2

5.4. Control Systems Commissioning Lead

Responsible for:

- Responsibility 1
- Responsibility 2

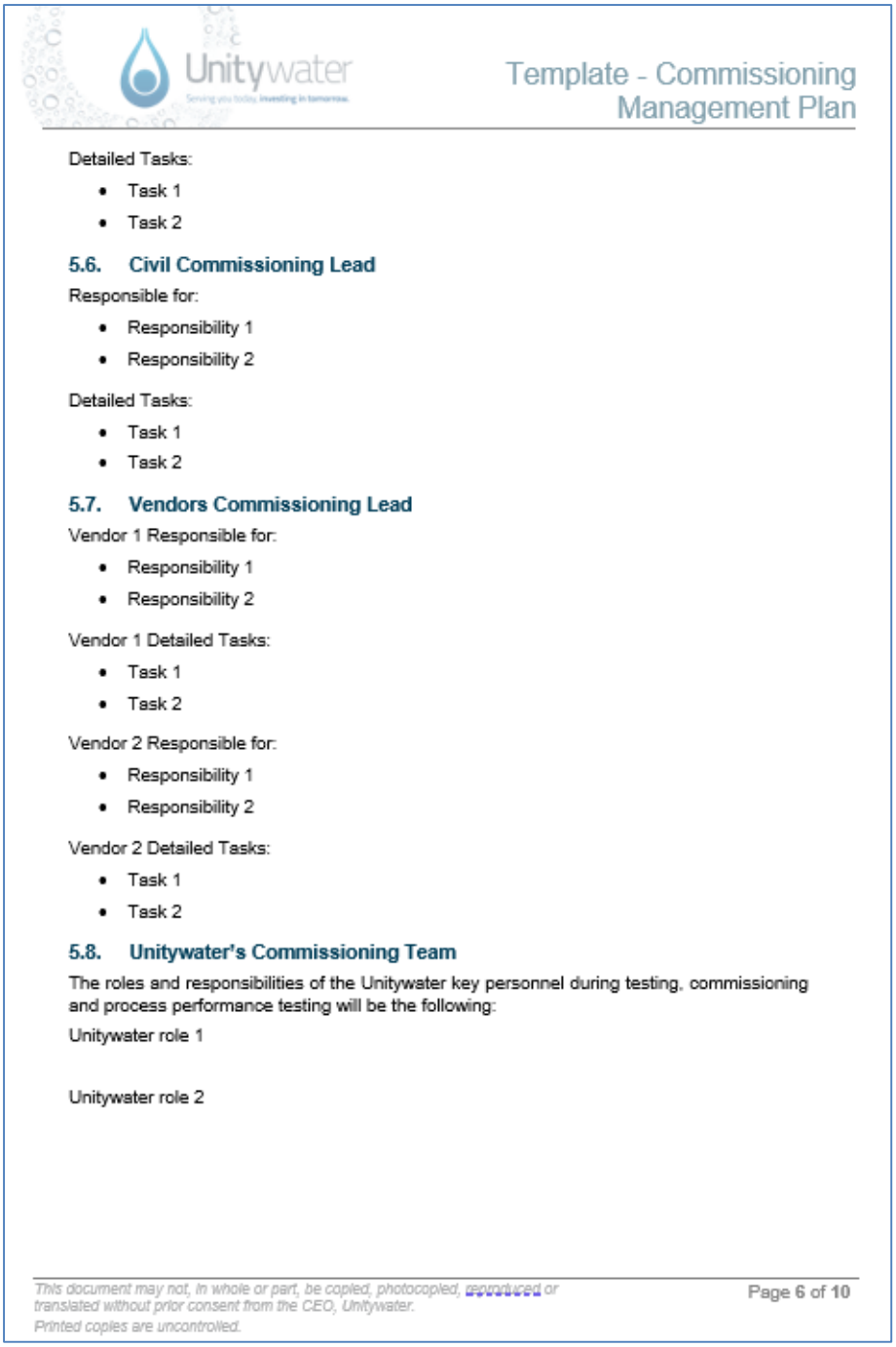
Detailed Tasks:

- Task 1
- Task 2

5.5. Mechanical Commissioning Lead

Responsible for:

- Responsibility 1
- Responsibility 2



Detailed Tasks:

- Task 1
- Task 2

5.6. Civil Commissioning Lead

Responsible for:

- Responsibility 1
- Responsibility 2

Detailed Tasks:

- Task 1
- Task 2

5.7. Vendors Commissioning Lead

Vendor 1 Responsible for:

- Responsibility 1
- Responsibility 2

Vendor 1 Detailed Tasks:

- Task 1
- Task 2

Vendor 2 Responsible for:

- Responsibility 1
- Responsibility 2

Vendor 2 Detailed Tasks:

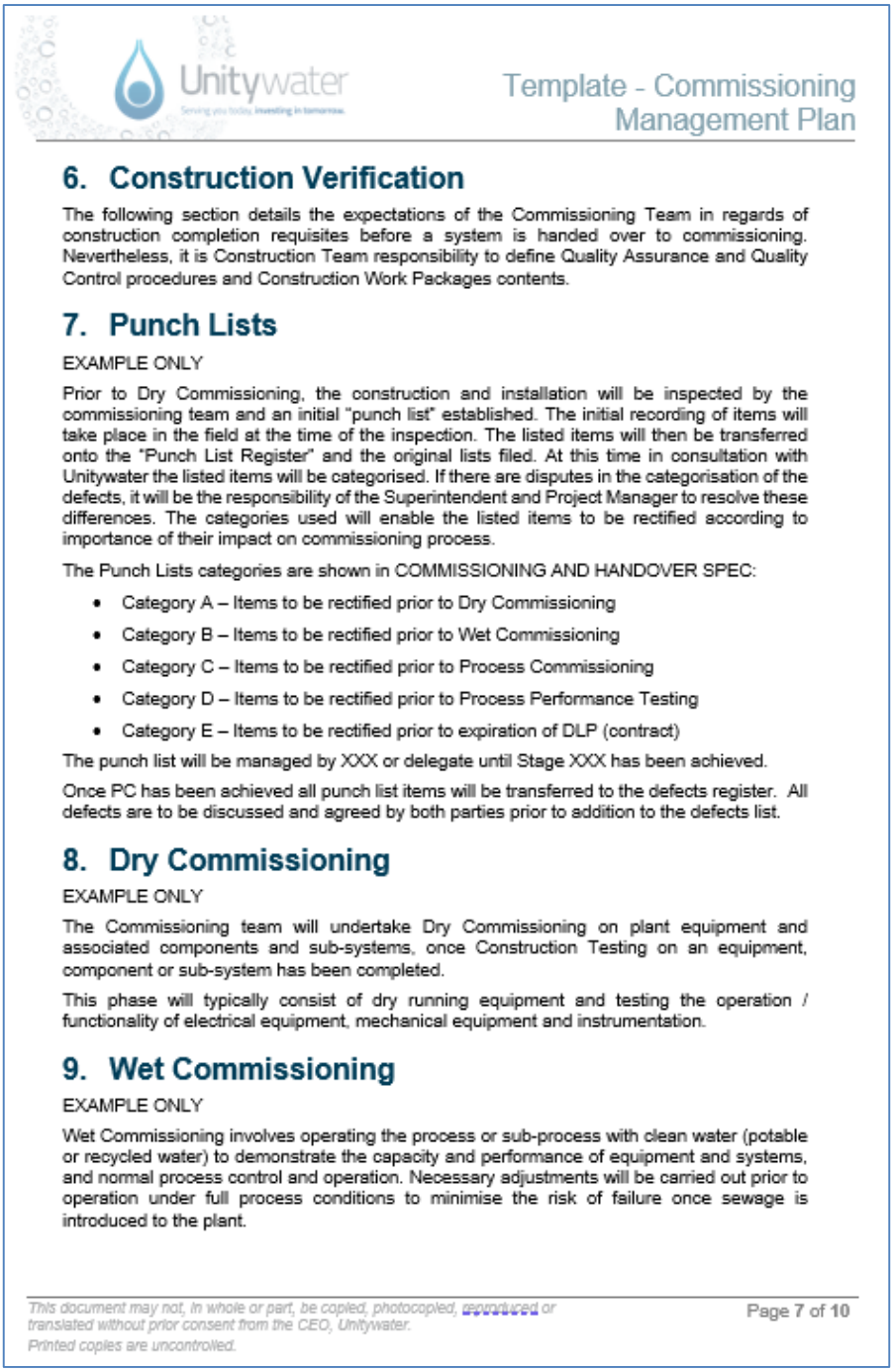
- Task 1
- Task 2

5.8. Unitywater's Commissioning Team

The roles and responsibilities of the Unitywater key personnel during testing, commissioning and process performance testing will be the following:

Unitywater role 1

Unitywater role 2



6. Construction Verification

The following section details the expectations of the Commissioning Team in regards of construction completion requisites before a system is handed over to commissioning. Nevertheless, it is Construction Team responsibility to define Quality Assurance and Quality Control procedures and Construction Work Packages contents.

7. Punch Lists

EXAMPLE ONLY

Prior to Dry Commissioning, the construction and installation will be inspected by the commissioning team and an initial "punch list" established. The initial recording of items will take place in the field at the time of the inspection. The listed items will then be transferred onto the "Punch List Register" and the original lists filed. At this time in consultation with Unitywater the listed items will be categorised. If there are disputes in the categorisation of the defects, it will be the responsibility of the Superintendent and Project Manager to resolve these differences. The categories used will enable the listed items to be rectified according to importance of their impact on commissioning process.

The Punch Lists categories are shown in COMMISSIONING AND HANDOVER SPEC:

- Category A – Items to be rectified prior to Dry Commissioning
- Category B – Items to be rectified prior to Wet Commissioning
- Category C – Items to be rectified prior to Process Commissioning
- Category D – Items to be rectified prior to Process Performance Testing
- Category E – Items to be rectified prior to expiration of DLP (contract)

The punch list will be managed by XXX or delegate until Stage XXX has been achieved.

Once PC has been achieved all punch list items will be transferred to the defects register. All defects are to be discussed and agreed by both parties prior to addition to the defects list.

8. Dry Commissioning

EXAMPLE ONLY

The Commissioning team will undertake Dry Commissioning on plant equipment and associated components and sub-systems, once Construction Testing on an equipment, component or sub-system has been completed.

This phase will typically consist of dry running equipment and testing the operation / functionality of electrical equipment, mechanical equipment and instrumentation.

9. Wet Commissioning

EXAMPLE ONLY

Wet Commissioning involves operating the process or sub-process with clean water (potable or recycled water) to demonstrate the capacity and performance of equipment and systems, and normal process control and operation. Necessary adjustments will be carried out prior to operation under full process conditions to minimise the risk of failure once sewage is introduced to the plant.

Facilities may be broken down into sub-systems composed of interrelated equipment and other components for which functional testing has been completed, referred to as Commissioning Work Packs. Each sub-system will then be tested to demonstrate that it operates in the manner designed. Individual commissioning ITP's complemented with ITC's and, if necessary, CMS's, will be developed for each Commissioning Work Pack that is to be tested and signed off.

The prerequisites prior to begin wet-commissioning are the following:

- Requirement 1
- Requirement 2

10. Process Commissioning

EXAMPLE ONLY

This is the phase of commissioning when the augmented plant is brought on-line with raw sewage. This phase of the project will require an increased focus and a conscious effort from all parties to communicate the risks, priorities and hazards associated with meeting the sites environmental licence requirements.

10.1. System 1

Details of any particular system that needs further development

10.2. System 2

Details of any particular system that needs further development

11. Process Performance Testing

EXAMPLE ONLY

Process Performance Testing will commence after Process Commissioning has been completed and optimisation and stabilisation of the processes have been achieved.

11.1. System 1

Details of any particular system that needs further development

11.2. System 2

Details of any particular system that needs further development

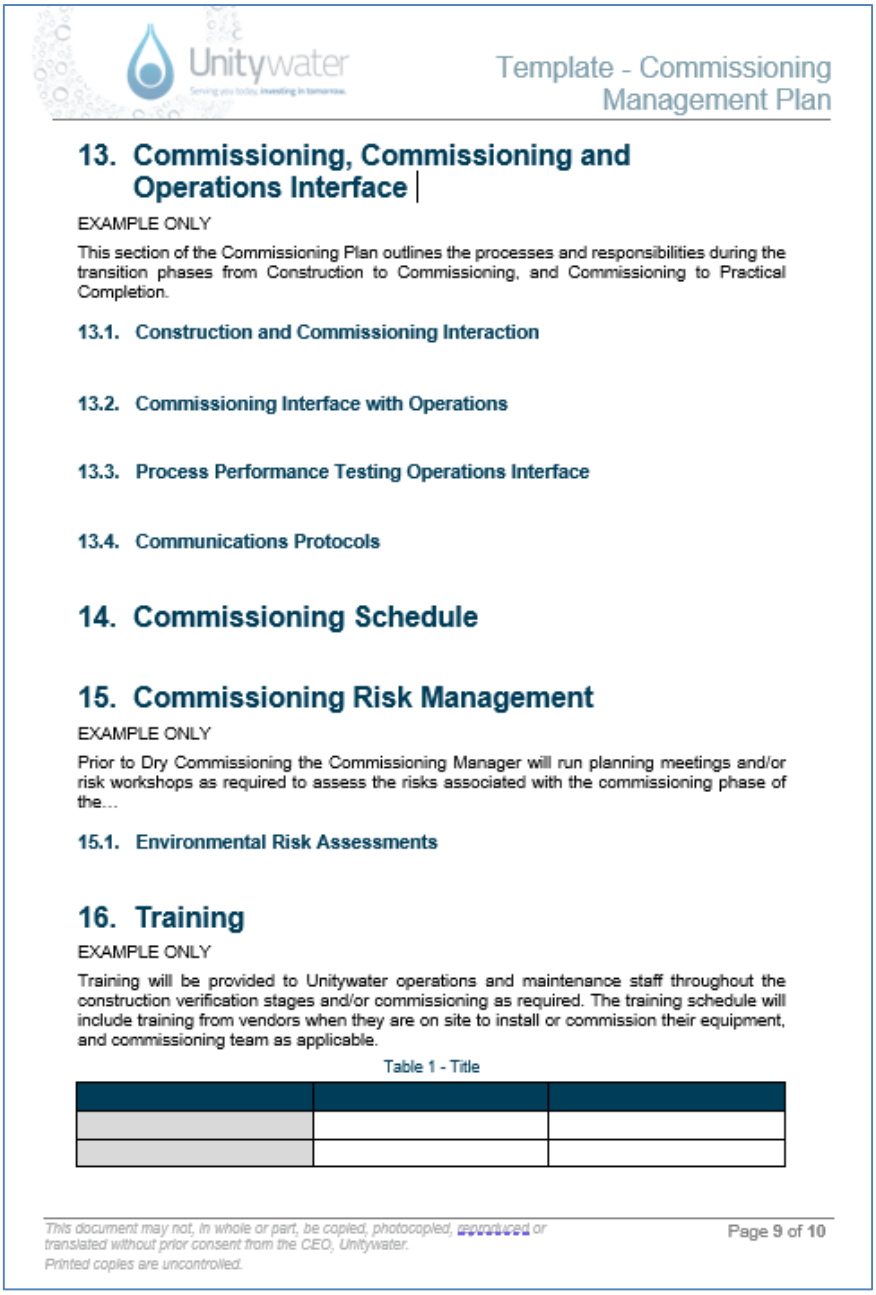
12. Commissioning Documentation

Commissioning documentation will consist of the following:

- Document 1
- Document 2

12.1. Commissioning Work Packs

Insert detail



Unitywater

Template - Commissioning Management Plan

13. Commissioning, Commissioning and Operations Interface

EXAMPLE ONLY

This section of the Commissioning Plan outlines the processes and responsibilities during the transition phases from Construction to Commissioning, and Commissioning to Practical Completion.

13.1. Construction and Commissioning Interaction

13.2. Commissioning Interface with Operations

13.3. Process Performance Testing Operations Interface

13.4. Communications Protocols

14. Commissioning Schedule

15. Commissioning Risk Management

EXAMPLE ONLY

Prior to Dry Commissioning the Commissioning Manager will run planning meetings and/or risk workshops as required to assess the risks associated with the commissioning phase of the…

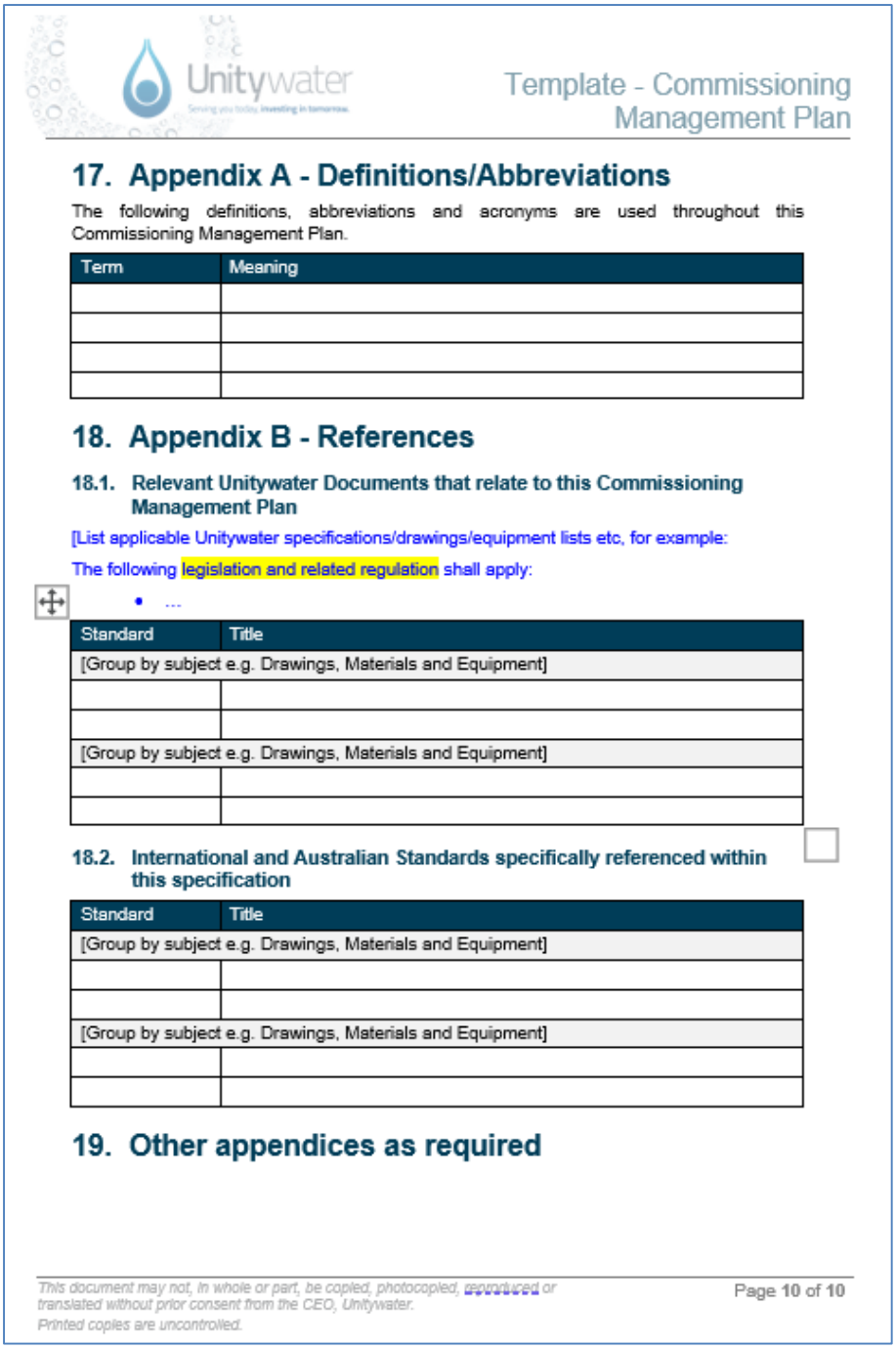
15.1. Environmental Risk Assessments

16. Training

EXAMPLE ONLY

Training will be provided to Unitywater operations and maintenance staff throughout the construction verification stages and/or commissioning as required. The training schedule will include training from vendors when they are on site to install or commission their equipment, and commissioning team as applicable.

Table 1 - Title



Unitywater

Template - Commissioning Management Plan

17. Appendix A - Definitions/Abbreviations

The following definitions, abbreviations and acronyms are used throughout this Commissioning Management Plan.

Term	Meaning

18. Appendix B - References

18.1. Relevant Unitywater Documents that relate to this Commissioning Management Plan

[List applicable Unitywater specifications/drawings/equipment lists etc, for example:

The following legislation and related regulation shall apply:

- ...

Standard	Title
[Group by subject e.g. Drawings, Materials and Equipment]	
[Group by subject e.g. Drawings, Materials and Equipment]	

18.2. International and Australian Standards specifically referenced within this specification

Standard	Title
[Group by subject e.g. Drawings, Materials and Equipment]	
[Group by subject e.g. Drawings, Materials and Equipment]	

19. Other appendices as required