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Pr10999 - Specification for Odour Control Unit Design and Construction (Network)

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Document Owner	Head of Asset Management
Subject Matter Expert	Senior Infrastructure Planning and Design Engineer
References	Refer to Appendix B of this document

Version Review

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A	A. O'Connell			First draft, distributed for review
1	A. O'Connell Y. Skinner	Head of Asset Management	03/06/2022	New Technical Specification for release
2	L. Bryson	N/A	N/A	24/05/2023 Minor admin amend to replace manhole terminology with maintenance hole.
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7	A. O'Connell T. Stewart Y. Skinner	Head of Asset Management	21/10/2024	Major review, summary of changes: • Reduced design air flows in Table 1. Added new methods for air valve flow rate. • Increased H2S loading rate required for biofilter assessment. • Reduced EBRT requirements for biofilters. • Changed requirements for noise limits. • Added requirement for permanent label to unit inclusive of design flows. • Expanded colour options to facilitate HDPE vessels. • Minor formatting changes.

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1. Purpose

The purpose of this specification is to define Unitywater's requirements for design, supply, construction, installation, and commissioning of odour control units within the sewer reticulation network and pumping stations.

2. Scope

This specification applies to oxidant cartridge, carbon, and biofilter odour control units installed within the sewer reticulation network and pumping stations. Consideration is provided for both naturally ventilated (or passive) units and mechanically ventilated (or fan forced).

While general design aspects of this specification may apply to Sewage Treatment Plants, the scale and complexity of odour control for Sewage Treatment Plants requires further consideration. The intent of this specification is not to limit the scope of Treatment Plant control units which may employ other technologies, however similar technologies may be employed at Sewage Treatment Plants and this specification may be used as a guide to develop the site specific requirements.

3. Planning

3.1 General

The need for odour control shall be confirmed utilising either site environmental measurements or through an odour study performed by external consultants. Installation of odour control shall be minimised where possible. Odour control shall be designed to, in general, achieve the requirements of the Environmental Protection (Air) Policy 2019, considering the typical sewer air pollutant Hydrogen Sulphide.

The OCU systems accepted by Unitywater are:

- Cartridge based units
- Activated Carbon
- Biofilter & biotrickling filters.

Details for requirements on each system is covered under Section 4 Design.

For existing assets, H_2S data should be measured to determine H_2S load. A minimum of two (2) weeks logging with an electrochemical logging unit shall be completed.

For new developments, an odour modelling study shall be completed to assess the OU requirements as described in the Guideline - Odour Impact Assessment from Developments, Section 5 (Odour impact assessment criteria). A dispersion modelling study shall also be completed by a competent person to ensure odour risks have been effectively mitigated.

4. Design

4.1 General

The odour control system shall be designed for a minimum of 20 years useful lifetime without significant overhaul of any major components.

Odour control unit structures shall be suitably reinforced, able to withstand wind loads, expected operating pressure range and any other typical forces associated with unit maintenance. Design loads to be calculated in accordance to AS 1170 Structural Design Actions.

4.2 Location

Odour control units shall be located to ensure sufficient accessibility to maintain the unit, including but not limited to removal of components and media removal and replacement via vacuum truck.

Location should, where reasonable, minimise the distance from the ventilated structure.

All odour control units shall be located such that high risk works permits are not required to access and maintain the unit. No units shall be located within confined spaces or at the top of vent poles requiring working from heights.

Units shall be located above Q100 levels to reduce risk of inundation. Where this is not achievable, Unitywater will provide guidance on suitable location during the design.

4.3 Natural Ventilation (Passive Odour Control)

Natural ventilation systems shall be limited where possible due to low effective media life compared to mechanically ventilated systems. As differential pressure increases over the media, foul air emission risk from other locations increases, prior to full consumption of the media life.

Typical natural ventilation installations consist of a cartridge only type unit, and are usually installed at air valves and discharge maintenance holes where mechanically ventilated systems are not feasible or have significant construction cost.

4.4 Mechanical Ventilation (Fan Forced Odour Control)

Where an activated carbon or biofilter unit has been specified for a pumping station site, mechanical ventilation is required.

Where possible, the fan and odour control system shall be designed to minimise the pressurised foul air segment to reduce risk of fugitive emissions.

4.5 Air Flow Rate

Required air flow rate for mechanically ventilated systems shall be determined based on the asset being ventilated. Minimum air flow rate calculation methods are detailed in Table 1 below. Air flow rate shall be the greater of all calculation methods, with the exception of air valves which can be sized based on air flow curves from manufacturers if sufficient information is available.

Table 1: Design Air Flow Rate by Ventilated Asset Type (Greatest value of all methods)

Asset Type	Method 1	Method 2	Method 3
SPS	1.25 x PDWF	1.25 x Maximum upstream pump flowrate	6 Air Changes Per Hour (1)
Air Valve	1.0 x Maximum upstream single pump flowrate	Air release rate at orifice sonic velocity from manufacturer specifications, pipeline fully pressurised (3)	Air release rate at 0.35bar differential pressure, pipeline filling
Discharge maintenance hole	1.2 x Maximum upstream pump flowrate		
Drop Structure / Barometric Loop	10 x ADWF	2 x Maximum Upstream Pump Flowrate	
Upstream of Siphon	5 x ADWF	1.2 x Maximum upstream pump flowrate	

(1) Air Changes per hour shall be calculated as the volume between the duty start level and roof of the pumping station wet well.

4.6 H_2S Load and Media Lifetime

Media life shall in general be designed to achieve >18 months between media replacements. Lower media lifetimes are acceptable if it is shown to result in a lower lifetime cost for the asset.

For determining media lifetime, the H_2S loading rate shall be calculated as follows:

$$\mathrm{H_2S\ Loading\ Rate\ (g/s)} = \frac{\mathrm{Avg.\ H_2S\ (ppm_v)}}{1 * 10^6} * \frac{34.1 \frac{\mathrm{g}}{\mathrm{mol}}\ (\mathrm{H_2S})}{24.46 \frac{\mathrm{L}}{\mathrm{mol}}} * \mathrm{Average\ Air\ Flow\ Rate\ (L/s)}$$

Molar volume assuming ideal gas at atmospheric pressure (101.3kPa) and 25°C.

For H_2S loading rates greater than 400kg/year, a comparison of biofilter and activated carbon technologies should be completed to evaluate the lowest lifetime cost solution. When these calculations have been completed, Unitywater will make the final decision as to the technology to use.

Average air flow rate shall reflect the typical air conditions in the sewer. Typically, average air flow rate shall be calculated by asset type as follows:

Table 2: Average Air Flow Rate for Determining H_2S Loading Rate by Asset Type

Asset Type	Average Air Flow Rate Calculation Method
SPS	ADWF
Air Valve (Typical High Point)	2% of sewer volume from upstream to downstream low points * pump starts per day
Air Valve (Draining Rising Main)	Drained air volume * pump starts per day
Discharge Maintenance hole	Upstream Station ADWF
Drop Structure / Barometric Loop	2 x ADWF
Upstream of Siphon	ADWF
Existing mechanically ventilated assets	Existing fan flow rate

4.7 Empty Bed Residence Time

Empty Bed Residence Time (EBRT) shall be sufficient to achieve the removal efficiency requirements outlined in Section 4.8.

The following minimum EBRT values by unit type shall be used:

Table 3: Minimum Empty Bed Residence Times by Odour Control Unit Type

Odour Control Unit Type	Minimum EBRT
Cartridge Only Units	2 seconds
Activated Carbon Units	4 seconds
Biofilter Unit (Biomedia Bed)	30 seconds
Biofilter Unit (Carbon Polisher)	2 seconds

4.8 H_2S Removal Efficiency and Outlet Concentrations

H_2S removal efficiency shall be > 99% measured at the outlet of the odour control system.

H_2S removal efficiency shall be determined by the following formula:

$$\text{Removal Efficiency } (\%) = \frac{\text{Inlet } H_2S\ (\text{ppm}_v) - \text{Outlet } H_2S\ (\text{ppm}_v)}{\text{Inlet } H_2S\ (\text{ppm}_v)} * 100$$

Biofilter units shall achieve >95% removal efficiency over the bio component of the odour control system, with a total of >99% removal efficiency at the outlet of the system.

The odour control system shall be designed to ensure H_2S levels are less than 5 ppb at the nearest sensitive environment in peak H_2S conditions, in line with the requirements of the *Environmental Protection (Air) Policy 2019 Schedule 1*.

4.9 Cartridge Only Units

Cartridge only units are generally not preferred for mechanically ventilated systems due to their lower adsorption capacity.

Cartridge only units shall not be H_2S monitored due to their low capital cost with respect to monitoring and replacement.

4.10 Activated Carbon Units

Activated carbon systems shall typically consist of the following equipment:

- Inlet Isolation Valve
- Pre-Filter Unit (Mechanically Ventilated Systems Only)
- Fan
- Adsorption unit isolation and air flow control valve
- Adsorption Unit
- Control Panel
- Monitoring equipment where specified.

H_2S monitoring is required on all activated carbon units located within pumping station boundaries with a carbon bed greater than or equal to 2m3 volume (i.e. McBerns ZC3000, Aarcon SC1800 etc). Monitoring shall meet the requirements of Section 5.12 of this specification and shall consist of:

- Inlet H_2S (ppm)
- Outlet H_2S (ppb).

Monitoring may be specified on locations other than pumping stations and units smaller than nominated in above at the discretion of Unitywater.

The carbon media bed shall consist of:

- Extruded steam activated carbon made from peat coconut shell or high grade coal.
- Potassium Hydroxide (KOH) impregnated carbon, minimum specifications per Table 4.
- For systems where other odorous compounds are potentially an issue (volatile sulphur compounds like methyl mercaptan, aldehydes etc.) virgin carbon may be used as a component of the media, minimum specifications per Table 5.
- Other proprietary media that predominantly consists of activated carbon and has been demonstrated to provide similar odour removal efficiencies to virgin or KOH impregnated carbon.

Table 4: Minimum Requirements – Potassium Hydroxide Impregnated Activated Carbon

Parameter	Requirement	Test Method
Potassium Hydroxide Content	< 10%	
Apparent Density	0.50-0.65 g/mL	ASTM D2854
Hardness	> 95%	ASTM D3802
Particle Diameter	4mm	ASTM D2862
Particle Length	6mm	ASTM D2862
H_2S Adsorption Capacity	> 0.14g(H_2S)/cm^3(Carbon)	ASTM D6646

Table 5: Minimum Requirements – Virgin Activated Carbon

Parameter	Requirement	Test Method
Apparent Density	0.50-0.65 g/mL	ASTM D2854
Hardness	> 95%	ASTM D3802
Particle Diameter	4mm	ASTM D2862
Particle Length	6mm	ASTM D2862
H_2S Adsorption Capacity	> 0.04g(H_2S)/cm^3(Carbon)	ASTM D6646

4.11 Biofilter Units

Biofilter systems shall typically consist of the following equipment:

- Inlet Isolation Valve
- Biofilter Unit with Irrigation System
- Fan
- Carbon polishing unit
- Control Panel
- Monitoring equipment.

Biofilter media design lifetime shall be >3 years.

The biofilter bed shall consist of a rice husk/perlite blend, or other proprietary media blend which has demonstrated ability to achieve >95% removal efficiency per Section 4.8.

The carbon polishing unit shall be filled with carbon consistent with Section 4.10 above.

The carbon polishing unit should be sized to have an equivalent lifetime to the biofilter bed, assuming the H_2S loading rate calculated in Section 4.6 above has been treated to 95% removal efficiency.

Irrigation systems are to be electrical solenoid controlled, with control setpoints available to be adjusted by SCADA.

All biofilter units are to be H_2S monitored by units consistent with Section 5.12 of this document. The following H_2S monitoring is required:

- Inlet H_2S (ppm)
- Biofilter Outlet H_2S (ppm)
- Polisher Outlet H_2S (ppb).

4.12 Condensate Drainage

All low points within the odour control system that are susceptible to water accumulation shall be connected to a condensate drainage system.

The condensate drainage system shall return condensate to the nearest suitable sewer asset.

Condensate drains shall be water trapped, with sufficient height to avoid blow out of the trap due to fan pressure. For example, an odour control unit with a design maximum pressure drop of 2kPa should have a minimum water trap height of 200mm.

Requirements for condensate drainage on the treated air segment of the odour control system should be minimised or eliminated to reduce risk of foul air breaking through to the treated air system.

The water trap shall have a gas tight inspection port to check trap height and refill if required.

4.13 Noise

Targeted noise levels from odour control infrastructure are described in Table 6. These levels are intended to give guidance for achieving the requirements outlined by Environmental Protection (Noise) Policy 2019, but there may be instances where increased noise management above Table 6 are required to achieve the goals of the policy.

Table 6: Targeted Sound Pressure Levels

Odour Control Location	Design Sound Measurement Location	Targeted Sound Level
SPS	Boundary fenceline at nearest sensitive receptor, minimum distance from odour control system.	Less than or equal to 3dB(A) above background levels.
Reserves and public spaces	Nearest likely sensitive receptor location (i.e. walkway, barbeque area).	Less than or equal to 5dB(A) above background levels.
	Nearby property boundary (if located within 20m of unit).	Less than or equal to 3dB(A) above background levels.

Assessment of noise generation shall include:

- fan equipment noise generation
- flow generated noise from the outlet duct or vent
- flow generated noise from partially throttled butterfly valves, closed greater than 30 degrees.

5. Construction and Materials

5.1 General

Materials used for construction shall in general be resistant to sulphuric acid or coated to minimise impact from sulphuric acid exposure to ensure the design life of 20 years is met. All bolts, nuts and washers shall be constructed from 316 Stainless Steel unless otherwise indicated.

5.2 Foundation

The odour control unit shall in general be located on a concrete slab, suitably designed to carry the full load of the odour control unit and any potential vehicle loads pending slab location and size.

Where odour control units require elevation to meet Q100 requirements, the unit shall be located on an elevated aluminium platform designed to AS 1657.

Foundation civil works shall comply with the requirements of Unitywater's Pr9902 - Specification for Civil and Earthworks.

Structural components such as elevated platforms shall comply with the requirements of Pr9903 - Specification for Building and Structural Works.

5.3 Ductwork

Ductwork shall be constructed of corrosion resistant materials, typically PVC-U SWJ (SN6 or SN8). Refer to the Civil IPAM for approved material and manufacturers.

Ductwork shall where practical grade down towards the sewer or asset being ventilated to reduce condensate draining requirements.

Ductwork shall be sized to minimise pressure drop, and should be no smaller than the inlet to the adsorption or biofilter unit. Ductwork shall have sufficient dismantling capability to replace major odour control components or damaged ductwork.

Above ground ductwork shall be supported at regular intervals per the maximum spacing requirements of AS 2032 (PVC) or other relevant AS. Supports where not specifically designed shall be "Unistrut" components or equivalent.

Flanged connections shall utilise a full faced flange, stub flanges are not accepted.

Ductwork shall incorporate flexible connections where vibration and thermal expansion cycles are expected. Expansion joints shall be consistent with Pr9693 - Specification for Mechanical Installations.

5.4 Fans

For mechanically ventilated systems, a single fan with control panel and upstream isolation valve will be supplied. Unitywater preference is that the fan be directly wired to the site switchboard where possible. Where this is not possible a separate control panel design is required.

Where fan flowrates require limiting to achieve empty bed residence times, either a smaller fan should be utilised (preferred), or a VSD should be installed to control fan speed. On smaller motors where a VSD is not appropriate, throttling of airflow can be completed using the inlet valve to the adsorption unit.

Fan shall be of the centrifugal type with single inlet and outlet.

Fan impeller and volute shall be constructed of materials to withstand sulphuric acid exposure. Plastics (such as Polypropylene) or 316 Stainless Steel are common materials utilised to achieve this.

Fans are to be fitted with a weatherproof shroud, constructed from 3mm marine grade aluminium, powder coated as per the requirements of Section 5.13 of this specification. Alternatively for HDPE adsorption units, a HDPE weatherproof shroud can be utilised to maintain visual consistency.

Where required, fans shall be fitted with inlet, discharge silencers and/or an acoustic enclosure to achieve the noise requirements in Section 4.13 of this document.

5.5 Valves (Ductwork)

An odour control system shall incorporate at least one isolation valve, installed upstream of the prefilter, fan (for mechanically ventilated systems) or odour control unit, in order of preference.

Valves should be a dual flange butterfly valve, or lugged butterfly valve with sufficient downstream dismantling ability to remove components while the valve is closed.

Butterfly valves should be quarter turn to close (hand lever), with position indicator and lockable handle to reduce risk of inadvertent valve closure/opening.

Valves shall utilise an EPDM, NBR or SBR sealing surface, and should provide a gas tight seal in the closed position.

Due to the low-pressure and corrosive nature of odour control systems, PVC-U butterfly valves are acceptable (e.g. PAAS Lugged Butterfly Valve Type 578 or equivalent).

5.6 Pre-Filter

Pre-filters shall be installed upstream of fans and activated carbon/biomedia odour units to ensure the risk of foul air emissions from the maintenance/inspection area are minimised.

Pre-filters shall be of sufficient size to ensure cleaning events are in line with the civil maintenance program for the pumping station (typically 1-3 months)

Spares for filters shall be available as an off-the-shelf item, or available within the Unitywater Stores.

The pre-filter shall be designed to flow condensate back towards the sewer asset, or connect to the condensate drainage system for the odour control unit.

Materials of construction of the pre-filter body shall be as per the materials requirements of Section 5.7.

5.7 Carbon Adsorption Units (Including Polishers)

Adsorption units shall be constructed from the following materials to minimise the risk of corrosion:

a) 316 Stainless Steel. Internal surfaces exposed to H_2S shall be electropolished per System 22 of Pr9693 - Specification for Mechanical Installations. Alternatively, internal surfaces shall be epoxy coated per either System 10, 13 or 14 of Pr9693 - Specification for Mechanical Installations.

b) Polyethylene.

c) Glass Reinforced Plastic (Fibreglass), Consisting of an internal corrosion barrier, structural lay and outer surface layer consistent with BS EN13121.

d) Other material as approved by the Superintendent that is of equivalent strength and durability.

Removable components of the adsorption unit to replace the carbon bed shall be located on the treated air side of the carbon bed to reduce the risk of foul air emissions.

For monitored sites, the adsorber unit shall have sample ports installed on the inlet and outlet side of the filter. Sample ports shall be installed prior to any coating systems to avoid damage of the corrosion protection.

Adsorption units shall have a permanently affixed stainless steel if located outdoors, or traffolyte label if the system is located indoors, with the following minimum information:

- Unit model number
- Unit serial number
- Unit construction date
- Design air flow rate
- Design outlet air velocity.

5.8 Biofilter Units

Biofilter units shall be constructed from the following materials to minimise the risk of corrosion:

a) 316 Stainless Steel. Internal surfaces exposed to H_2S shall be electropolished per System 22 of Pr9693 - Specification for Mechanical Installations. Alternatively, internal surfaces shall be epoxy coated per either System 10, 13 or 14 of Pr9693 - Specification for Mechanical Installations.

b) Polyethylene.

c) Glass Reinforced Plastic (Fibreglass), Consisting of an internal corrosion barrier, structural lay and outer surface layer consistent with BS EN13121.

d) Other material as approved by Unitywater that is of equivalent strength and durability.

Removable components of the biofilter unit to replace the media bed shall be located on the treated air side of the bed to reduce the risk of foul air emissions.

For monitored sites, the biofilter unit shall have sample ports installed on the inlet and outlet side of the biofilter, as well as the outlet of the carbon polisher. Sample ports shall be installed prior to any coating systems to avoid damage of the corrosion protection.

Biofilter units shall incorporate an ability to bypass the biofilter bed and direct flows to the carbon polisher to allow continued operation of the odour control unit while servicing the biofilter bed.

Irrigation sprays and pipework shall be constructed from 316 Stainless Steel, or PE-100 nominal bore sized to suit the flow required to the bed.

Irrigation systems shall be connected downstream of the pumping station RPZ. If no RPZ is installed at the station, a new assembly per SEQ-SPS-1308-1 shall be provided.

Irrigation systems shall be controlled by an electrical solenoid, energise to open. See Unitywater F10678 - Accepted Electrical Equipment List for approved solenoids.

Biofilter units shall have a permanently affixed stainless steel if located outdoors, or traffolyte label if located indoors, with the following minimum information:

- Unit model number
- Unit serial number
- Unit construction date
- Design air flow rate
- Design outlet air velocity.

5.9 Condensate Drainage

Condensate drains shall be constructed of minimum size DN25 and out of Sch80 PVC-U or PE-100 SDR17.

Above ground drainage shall be supported at regular intervals per the maximum spacing requirements of AS 2032 (PVC) or AS 2033 (PE). Supports where not specifically designed shall be "Unistrut" components or equivalent.

Above ground PE condensate drains shall be carbon black or white to prolong lifetime when exposed to solar radiation.

As per Section 4.12 above, condensate drains shall incorporate a water trap of minimum height by maximum design pressure before discharging back to sewer.

5.10 Outlets and Vent Stacks

Outlets where possible shall be directed either vertically or horizontally such that the outlet is directed away from the nearest sensitive customer.

Structural vent poles should not be utilised unless indicated it is required by an odour control study to achieve odour levels at the nearest sensitive environment.

5.11 Control Panel and Wiring

Where possible, controls shall be incorporated to the main switchboard of the pumping station. Control panels and wiring for odour control units shall comply with Pr9380 - Electrical Installations at Network Sites, and components shall be per the Unitywater F10678 - Accepted Electrical Equipment List.

5.12 H_2S Monitoring System

H_2S analysers shall be of the pumped electrochemical cell type. Current approved analysers are the Acrulog IPX PPM and PPB analysers.

Analysers shall be installed in a switchboard panel, complying with Pr9380 - Electrical Installations at Network Sites.

Analysers at pumping stations shall have a 24VDC input and 4-20mA output signal, and outputs shall be connected to the pumping station RTU.

Analysers installed remotely shall include a 4G LTE or NB-IoT modem and lithium batteries.

Sample lines shall be constructed from PTFE or other low gas permeability tubing that is resistant to sulphuric acid.

Sample lines shall not exceed the maximum length as nominated by the manufacturer of the H_2S analyser.

Sample lines shall continuously rise to the analyser to avoid condensate build up in the line. If this is not achievable, the sample line shall have a sample dryer head to reduce the sample air humidity and risk of condensate build up. Alternatively, a water trap or drain point shall be installed to avoid blockage of the sample line due to condensate.

Sampling lines shall include return lines from the analyser to return the foul air sample back to the odour control system, or alternatively discharge to a small external filter where required.

5.13 Colours

Acceptable colours for odour control units and ancillary equipment is described in Table 7, along with the recommended painting system as described in Pr9693 - Specification for Mechanical Installations. Colours shall be as described by AS 2700 Colour Standards for General Purposes. Colours outside of those described in Table 7 may be accepted at the discretion of the superintendent.

Table 7: Accepted Equipment Colours

Equipment	Location	Preferred Colour	Alternate Colour	Painting System
Adsorption Unit, Biofilter Unit, Fan Covers and Switchboards	SPS(1)	G54 Mist Green	N54 Basalt / N64 Dark Grey	System 6 (Steel/Stainless Steel) System 18 (Steel / Stainless Steel /Aluminium) Manufacturers Recommendation (Fibreglass)
	Reserves and public spaces(1)	G54 Mist Green	N/A	
Ductwork & Condensate Drainage (PVC)	SPS	G54 Mist Green	N54 Basalt / N64 Dark Grey	System 19
	Reserves and public spaces	G54 Mist Green	N/A	
HDPE Equipment(2)	All	N61 Black	N/A	N/A

(1) For high exposure locations, such as parks, an external vinyl wrap or similar is approved for use to improve aesthetic amenity and reduce risk of vandalism. Wrap should be suitable for exposure to direct sunlight.

(2) HDPE equipment should be avoided in reserves and public spaces due to colour constraints. If no alternative is available, obscuring fencing may be requested by the superintendent on advice from Council to achieve visual amenity requirements.

6. Control System Requirements

6.1 General

Where located within a sewer pumping station, odour control units shall be connected to the site RTU to provide basic monitoring and control where applicable.

Connections to the RTU shall comply with Pr9380 - Electrical Installations at Network Sites.

All inputs and outputs to the odour control system shall be able to be trended within SCADA.

6.2 Fan

Where a mechanically ventilated system is installed, fan running state and a fan fault relay shall be provided as digital inputs to the RTU.

Running state shall be alarmed to provide indication when the fan has stopped running.

6.3 Irrigation Systems (Biofilter)

Where a biofilter is installed, the irrigation solenoid shall be connected to a digital output of the RTU.

The SCADA mimic shall provide a “Irrigation Spray Duty Cycle” that provides a specific period of on-time in percentage for the irrigation solenoid that is adjustable to suit site specific requirements.

“Irrigation Spray Duty Cycle” shall be specified by the Biofilter manufacturer. In lieu of this information, the setpoint shall be set at 1% (approx. 36 seconds / hour).

6.4 H_2S Monitors

H_2S monitored systems shall have provision to connect each analysers 4-20mA output to an analog input on the site RTU.

The pumping station mimic shall be configured to calculate odour unit removal efficiency as outlined in Section 4.8.

For biofilter units, there shall be two removal efficiencies calculated, “Biofilter Removal Efficiency” using inlet H_2S and biofilter outlet H_2S, and “Carbon Polisher Removal Efficiency” using biofilter outlet H_2S and polisher outlet H_2S.

Low alarms shall be provided for removal efficiency with preliminary setpoints of 99% for activated carbon units and 95% for biofilter units.

7. Commissioning

7.1 General

A Commissioning Management Plan shall be developed in accordance with Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets and must be submitted to Unitywater prior to commencing any commissioning activities and no commissioning activities may commence until the Plan has been accepted.

Any works on or in proximity of existing assets will require operational notification. Details and timelines are shown Pr8996 - Network Permit to Work Procedure. Longer timelines may be stipulated in contracts or scope of works documents.

Any works on or in proximity of existing assets will require operational notification with a minimum of 21 days notice. Notification to be provided to Unitywater, or the contractor may directly submit a request for a permit to work as advised through Pr8996 - Network Permit to Work Procedure.

7.2 Factory Acceptance Tests

Factory acceptance testing for mechanical assets (i.e. units, fans, valves) shall be per the requirements of Pr9693 - Specification for Mechanical Installations.

Factory acceptance testing for electrical assets (i.e. local control panels, monitoring panels) shall be per the requirements of Pr9380 - Electrical Installations at Network Sites and Pr11211- Specification for Commissioning and Handover of Active and Passive Assets.

Calibration of all H_2S analysers shall be completed by the manufacturer with calibration certificates provided.

7.3 Site Commissioning and Site Acceptance Tests

Site acceptance testing for electrical assets shall be per the requirements of Pr9380 - Electrical Installations at Network Sites and Pr11211- Specification for Commissioning and Handover of Active and Passive Assets.

In addition to electrical asset SATs, the following minimum tests are to be completed:

- Confirm operation of all isolation valves and ensure valves are in their normal positions.
- Soap test / smoke test all solvent welded and electrofusion joints at design flow to ensure joints are gas tight.
- Confirm fan flow rate is as per design using a hot wire anemometer, adjust fan speed or valving to achieve design fan flow rate.
- Confirm empty bed residence time is as per design using fan flow rate measurements.
- Confirm noise at design fan flow rate does not exceed requirements of Section 4.13 of this document.
- Confirm all condensate water traps are full.

7.4 Proof of Performance and Reliability Testing

Following site commissioning a 14 day performance and reliability period shall apply.

The intention of this period is to confirm odour unit performance with respect to design requirements and ensure there are no major faults that occur.

As part of the performance and reliability period, the following equipment shall be installed:

- An electrochemical cell PPB logger consistent with Section 5.12 above shall be installed at the nearest sensitive environment (for pumping stations, typically the fenceline of the nearest property adjacent to the pumping station).
- For sites that are not permanently monitored, 1 x ppm logger shall be installed at the inlet location and 1 x ppb logger shall be installed in the outlet location of the odour unit. If outlet gas readings are expected to be greater than 1ppm, and for passive ventilation sites, 1 x ppm logger may be utilised in lieu of the ppb logger. Loggers to be per Section 5.12 above.
- Installed loggers for the performance and reliability period shall have been calibrated within the last 6 months, with calibration certificates to be provided.
- Unitywater will not provide any logging equipment.

At the end of the performance and reliability period, the logging data shall be assessed to confirm:

- Average removal efficiency does not fall below the design requirements per Section 4.8 of this document.
- Minimum removal efficiency does not fall below the design requirements per Section 4.8 above for greater than 2% of the performance and reliability period.
- Maximum H_2S measured at the nearest sensitive environment does not exceed 5ppb for a period of 30 minutes, and not greater than 2% of the performance and reliability period.

Evidence that the above requirements are met shall be provided as part of the Commissioning and Handover documentation.

In the event that the requirements of Section 7.4 of this document are not achieved, additional adjustments must be performed to achieve these requirements. Typical adjustments may include increasing empty bed residence time by reducing fan speed or replacing the media bed with a KOH impregnated carbon and virgin carbon media blend.

After adjustment of the odour control system, another 14 day performance and reliability period shall apply.

After the second performance and reliability period, the removal efficiency requirements of Section 7.4 may be removed at the discretion of Unitywater, provided it will not impact employee or community health and safety, and that the environmental H_2S requirement of < 5ppb is still met.

8. Handover Documents

The Contractor shall provide commissioning documentation and information in accordance with:

- Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets
- Electrical test certificate.

8.1 Project Closure

Provide final project cost and confirmation that all identified works have been completed.

A completed Unitywater Asset Template of all active and decommissioned assets on site shall be returned to Unitywater.

All relevant QA documentation to be provided through Objective Connect.

8.2 As Constructed Information

The As Constructed drawings shall be prepared and supplied in accordance with the Asset information data and Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets and shall be recorded on the 'As-Constructed Asset Record for Water Supply Assets' spreadsheet will be provided by Unitywater. This asset data shall include full asset details including installed value of all items.

8.3 Asset Manuals

Asset manuals shall be prepared and provided in accordance with the SEQ WS&S D&C Code Asset Information Specification and Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets.

Table 8 describes the required documentation on handover to Unitywater based on odour control unit type. Note that Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets may have further requirements, and these must also be provided.

Table 8: Documentation Requirements by Odour Control Unit Type

Document	Odour Control Unit Type		
	Cartridge Only Unit	Activated Carbon Unit	Biofilter System
O & M Manual	Yes	Yes	Yes
Civil As Constructed Drawings	No	Yes	Yes
Electrical As Constructed Drawings	No	Yes (Mechanically Ventilated Only)	Yes
P & ID Diagram	No	No	Yes
Asset Data Template	Yes	Yes	Yes
Performance and Reliability Period H_2S Data	Yes	Yes	Yes
H_2S Analyser Calibration Certificates	No	Yes (H_2S monitored sites only)	Yes

8.4 Operating and maintenance manual

A draft Operating and Maintenance (O&M) Manual for the OCU must be prepared and submitted prior to process commissioning. It must be finalised and re-submitted after successful commissioning of the unit and incorporate any learnings or changes required during commissioning and proof of performance.

The Operations and Maintenance (O&M) Manual shall be provided in PDF format and include the minimum following information:

- Unitywater site at which odour control unit has been installed and the date of installation.
- General description of odour control unit provided with photographs.
- Design assumptions and requirements for the odour control unit as detailed in Section 8.3 above.
- Instructions for operation of the odour control unit, such as normal valve positions, any valves that are to be partially closed for EBRT requirements, detail of control setpoints, instructions for any alternate arrangements (e.g. biofilter bypass).
- Maintenance schedule, including recommended maintenance events and intervals.
- Maintenance instruction, including type and weight/volume of media required, process for media replacement, and any specialist tools required.
- Troubleshooting guidelines for when unit is operating outside of design parameters.

The asset data template shall be provided to the contractor by Unitywater, with the contractor to complete and return to the Superintendent.

9. Appendices

Refer to following pages.

Appendix A – Definitions/Acronyms

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

Term	Meaning
ADWF	Average Dry Weather Flow. Typically determined by reviewing pumping station trends, or through population estimates
AS	Australian Standard
Biofilter	Odour control units which utilise a media suitable for biological growth to consume hydrogen sulphide, typically supplemented by a water irrigation system. Not to be confused with Biotrickling Filters, which utilise a nutrient irrigation system, and are typically employed at waste water treatment plants
BS	British Standard
Cartridge Unit	Any odour control unit employing a cartridge only system, rather than raw media. An example is the McBerns GM series of odour control units.
DN	Nominal Diameter
EBRT	Empty Bed Residence Time. The contact time of air travelling over the media bed, assuming there was no media in place.
EF	Electrofusion
EPDM	Ethylene Propylene Diene Monomer
H_2S	Hydrogen Sulphide
ITP	Inspection and Test Plan
KOH	Potassium Hydroxide. An alkali typically impregnated in carbon to improve its H_2S adsorption capacity.
NBR	Nitrile Butadiene Rubber
O&M	Operations and Maintenance
OCU	Odour Control Unit
OU	Odour Units
Perlite	A volcanic glass, typically expanded by heat to increase its surface area allowing a large bacterial biome to form
PE	Polyethylene
ppm	Parts per million (by volume unless otherwise stated)
ppb	Parts per billion (by volume unless otherwise stated)
PTFE	Poly Tetra Fluro Ethylene (Teflon-DuPont)
PVC-U	Un-plasticised Poly Vinyl Chloride
Q100	Flood level at which there is 1% annual exceedance probability, or a 100-year average recurrence interval
RPZ	Reduced Pressure Zone device
SBR	Styrene Butadiene Rubber
SCADA	Supervisory Control and Data Acquisition
SS	Stainless Steel
SWJ	Solvent Welded Joint
Virgin Carbon	Carbon that has not been impregnated with any additives
VSD	Variable Speed / Frequency Drive

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.

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

- *Work Health and Safety Act 2011* (Qld)
- *Work Health and Safety Regulation 2011* (Qld)
- *Water Supply (Safety and Reliability) Act 2008* (Qld)
- *Environmental Protection Act 1994* (Qld):
  - *Environmental Protection (Air) Policy 2019* *(Subordinate Legislation No.153)*
  - *Environmental Protection (Noise) Policy 2019* *(Subordinate Legislation No.154)*
- Managing Noise and Preventing Hearing Loss at Work 2021, WorkSafe Qld
- SEQ Water Supply and Sewerage Design and Construction Code (SEQ WS & S D & C Code)
- Guideline - Odour Impact Assessment from Developments, Department of Environment, Science and Innovation.

Relevant Unitywater documents that relate to this specification

Document No	Title
Pr8843	Specification for Drawing, Document and Equipment Tag Numbering
Pr8996	Network Permit to Work Procedure
Pr9380	Specification for Electrical Installations at Network Sites
Pr9693	Specification for Mechanical Installations
Pr9875	Specification for Non-Pressure Pipe Construction
Pr9902	Specification for Civil and Earth Works
Pr9903	Specification for Building and Structural Works
Pr10618	Specification for Power System Analysis and Arc Flash Studies
Pr11211	Specification for Commissioning and Handover of Active and Passive Assets

International and Australian Standards referenced within this specification

Standard	Title
Quality Systems	
AS 2990	Quality Systems for Engineering and Construction Projects
AS 3901	Quality Systems for Design/Development, Production, Installation and Servicing
AS 3902	Quality Systems for Production and Installation
AS 3903	Quality Systems for Final Inspection and Test

Standard	Title
Drawings	
AS 1100	Technical Drawings
AS 1101	Graphical Symbols for General Engineering
AS 1102	Graphical Symbols for Electrotechnology
Materials and Workmanship	
AS 1055	Acoustics – Description and Measurement of Environmental Noise
AS 1170	Structural Design Actions
AS 1111	ISO metric hexagon commercial bolts and screws
AS 1112	ISO metric hexagon nuts, including thin nuts, slotted nuts and castle nuts
AS 1260	PVC Pipes and Fittings for Drain Waste and Vent Applications
AS 1319	Safety signs for the occupational environment
AS 1345	Identification of the contents of pipes, conduits and ducts
AS 1359	Rotating electrical machines – General requirements
AS 1554	Structural steel welding
AS 1627	Metal finishing – Preparation and pre-treatment of surfaces – Method selection guide
AS 1654	ISO system of limits and fits
AS 1657	Fixed platforms, walkways, stairways and ladders – Design, construction and installation
AS 2032	Installation of PVC pipe systems
AS 2033	Installation of Polyethylene Pipe Systems
AS 2312	Guide to the protection of iron and steel against exterior atmospheric corrosion
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 2566	Buried flexible pipelines
AS 2700	Colour standards for general purposes
AS 2887	Plastics Waste Fittings
AS/NZS 3000	Electrical Installations
AS 3500	Plumbing Code of Australia
AS 4024	Safeguarding of Machinery
Media Testing	
ASTM D2854	Standard Test Method for Apparent Density of Activated Carbon
ASTM D2862	Standard Test Method for Particle Size Distribution of Granular Activated Carbon
ASTM D3802	Standard Test Method for Ball-Pan Hardness of Activated Carbon
ASTM D6646	Standard Test Method for Determination of Accelerated Hydrogen Sulfide Breakthrough Capacity of Granular and Pelletized Activated Carbon