Vent Shaft Guideline

Sydney Water

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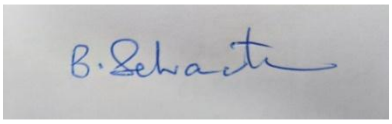	Name: Bala Selvananthan Position Title: Program Lead Integrated Planning East	11/12/2024
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Acronyms and Abbreviations

Abbreviation	Definition
ACPH	Air Change Per Hour
AQAM	Air Quality and Ambient Monitoring
CCTV	Closed Circuit Television
CI	Cast Iron
DPG	Differential Pressure Gauges
EPL	Environment Protection License
GIS	Geographic Information System
GRP	Glass Reinforced Plastic
H_2S	Hydrogen Sulphide
ICODSS	Integrated Corrosion and Odour Decision Support System
NSOOS	Northern Suburbs Ocean Outfall Sewer
OIA	Odour Impact Assessment
OU	Odour Unit
PID	Photoionisation Detector
VIA	Visual Impact Assessment
WSAA	Water Services Association of Australia
WSA 02	Gravity Sewerage Code of Australia - Sydney Water Edition - Version 4 - 2017

1 Introduction and Scope

1.1 Background

Adequate ventilation of the sewer is required for pressure correction in the network as well as to mitigate the build-up of humidity, odorous and corrosive gases (e.g., hydrogen sulphide), and prevent the subsequent corrosion of sewer assets.

Natural ventilation of reticulation sewers is typically achieved via house vents as part of property connections on reticulation sewers. Branch and trunk sewers typically have dedicated vent shafts. As Sydney expanded, the ventilation strategy changed over time. Some parts of Sydney's developments now have boundary traps, complete with water seals, which hinder the ability of reticulation sewers from being ventilated from property vents. Other parts, without boundary traps, typically vent the reticulation sewer via property vents.

Although the importance of having vent shafts in the sewerage system is well understood, Sydney Water is receiving an increasing number of applications from developers requesting to relocate or remove some existing vent shafts. The reasons behind the inclusion of some vent shafts have also been removed (i.e. due to industry in a particular area where there is no longer industry) and as vent shafts reach the end of their service life, Sydney Water is determining whether they should be removed, replaced with like for like, or another option. This guideline aims to provide a standardised assessment procedure to inform both Sydney Water and external developers on how to investigate and assess sewer vent shaft modifications.

1.2 Purpose of the Guidelines

The purpose of this guidance document is to cover the following three aspects:

- Provide required information and clear instructions for developers to undertake relevant investigations and provide sufficient information to Sydney Water to facilitate the assessment of the application.
- Provide streamlined process and basis of assessment to enable Sydney Water to be consistent with decision-making and ensure that any modifications to vent shafts are conducted in a manner that maintains system integrity, odour risk, visual impact and public health standards.
- Establish guidance to Sydney Water to rationalise the vent shafts in Sydney Water's network, ensuring they are effectively managed and optimised.

By establishing a clear and consistent framework for vent shaft modifications, Sydney Water aims to facilitate urban redevelopment while maintaining the integrity and effectiveness of the wastewater system.

1.3 Scope of the Guidelines

This document covers the following sections:

- Section 1: Introduction and scope of the guidelines – This section introduces the background and the purpose of the guideline development.
- Section 2: The purpose of ventilation – This section states the purpose of the ventilation and the typical ventilation systems adopted in Sydney Water's wastewater systems.
- Section 3: Relevant types of vents – This section introduces the types of vents and cowls used by Sydney Water.
- Section 4: Relevant types of studies – This section summarises the types of studies that can be undertaken for assessing the necessity of the vent shaft.
- Section 5: Acceptable relocating or removal of vent shaft – This section lists out the scenarios / circumstances under which the relocating or removal of the vent shaft is normally acceptable.
- Section 6: Acceptable alternatives – This section provides some alternative options for vent shaft removal.
- Section 7: Decision framework – This section presents the decision framework to facilitate the assessment and the decision-making process.

2 Purpose of Ventilation

2.1 Purpose of Ventilation

According to the Gravity Sewerage Code of Australia - Sydney Water Edition - Version 4 - 2017 (WSA 02), the objective of ventilation is to:

a) release sewer gases to atmosphere in a controlled manner and to introduce fresh air into the system.
b) reduce septicity of raw sewage.
c) control sulphide-initiated corrosion.
d) reduce hazards to maintenance personnel.

Due to the nature of the sewerage system, i.e., conveyancing wastewater that is rich in nutrients and microorganisms, the dissolved oxygen in the liquid phase tends to be exhausted rapidly resulting in septic sewage that is favourable for anaerobic reactions to occur. As a consequence, some typical gases such as hydrogen sulphide (H_2S) and methane can be generated from microbial activities in the sewer. A proportion of the formed gases in the liquid phase is released into the headspace of the sewer and the transfer of substances from the liquid to the gas phase is highly dependent on the turbulence of the wastewater flow and the air stream. The release of H_2S and other odorous volatile organic compounds (VOCs) into the ambient environment has long been recognized as the major contributor to odour complaints in relation to the sewer network operations. The methane produced and released has the potential to accumulate in the sewers contributing to the formation of explosive atmosphere posing safety risks to maintenance personnel.

Some of the released H_2S can travel to the sewer wall in the headspace and is converted into sulphuric acid biogenically when the humidity level is suitable. This is deemed as the primary cause of concrete corrosion in sewer networks.

A well designed and operated ventilation system could provide the following benefits:

- Replenish the dissolved oxygen in the sewage by introducing fresh air to reduce the septicity of the sewage. This reduces the potential of H_2S and methane forming.
- Reduce the humidity of the air in the headspace to mitigate the formation of biogenic sulphuric acid on the sewer wall and subsequently slows down the sulphide induced corrosion of the assets.
- Introduces fresh air into the sewer thereby diluting the foul air in the sewer headspaces and reduce safety risks and the risk of accumulation of foul air in higher concentrations.
- Release the foul air in a controlled manner to the atmosphere to minimise odour risks.

The ventilation of the sewers can be achieved via forced ventilation (i.e., fan forced ventilation) or natural ventilation (i.e., property connections and vent shafts). Forced ventilation is generally very reliable as the operation of the fans is controllable. Conversely, natural ventilation is less reliable and can be readily affected by the following factors:

- Sewer air condition such as air temperature and humidity in the headspace: This causes changes in sewer air density and the differential density between sewer and outside air could potentially result in an uplift force pushing the air out of sewer vents.
- Sewage flow: The sewage flow has two separate effects. The frictional drag by the sewage

flow continuously encourages air induction into the sewer. Additionally, the volume of headspace varies as the wastewater depth changes with the diurnal flow. As flows increase the air space is compressed forcing air out of the vents whilst and when flows decrease a vacuum is created that naturally draws air in.

- Gradient of the sewer pipes: at locations where the sewer changes gradient suddenly (from steep to flat or from flat to steep), the surface velocity of wastewater changes rapidly resulting in changes in wastewater depth that draws air in or forces air out accordingly. When going from flat to steep gradients, air is predominantly drawn into the sewer. When going from steep to flat gradients, air is predominantly forced out of the sewer.
- Meteorological conditions such as the wind direction and wind speed over the ventilation shafts. The wind blowing on top of the vent shafts causes changes in ambient pressure which creates a venturi effect that draws air out of the vent shaft. For reticulation sewers in particular that see low or intermittent flows, this effect can be the one which occurs most frequently.

Based on the sewer alignment and configuration (e.g., water traps / water seals), there are three typical types of natural ventilation systems:

- Educt only ventilation: These systems normally utilise the vents on property connections for drawing fresh air in and use educt vents on the sewers for foul air release. This is suitable for reticulation sewers where there are no boundary traps on property connections. In areas with boundary traps, the educt vents operate as both induct and educt. This is the predominant ventilation configuration in reticulation sewers.
- Uncontrolled natural ventilation: These systems consist of alternating induct and educt vents designed to maximise the effect of wind flow and air relative density effects. The issue with this system is that in sections where air and wastewater flow are opposed, the effectiveness of the natural ventilation can be comprised. This is the predominant ventilation configuration in branch and trunk sewers.
- Controlled natural ventilation: These systems ensure the air only flows in the direction of the wastewater flow using flexible bulkheads or air curtains to partition sections of sewers. This is only done in some trunk sewer.

2.2 Ventilation of Typical Sewer Infrastructure

As a means of wastewater collection and conveyancing, the sewerage system typically consists of the following key infrastructure that is ventilated:

- Property connection sewer - A short sewer, owned and operated by the Water Agency, which connects the main sewer and the customer sanitary drain. It includes a junction on the main sewer and a section of straight pipe extending to the property boundary to ensure the property connection arrangement is within the lot to be serviced.
- Reticulation sewer – A sewer operated by Sydney Water, generally between DN 100 and DN 300, for the collection of wastewater from individual properties and conveyance to branch and trunk sewers or to a point of treatment.
- Main sewer – Principal reticulation sewers excluding the last upstream section of end-of-line sewers and property connection sewers.
- Branch sewer – A network of pipes nominally between DN 375 and DN600 that connect reticulation sewers.
- Trunk sewer – Principal sewer of a catchment system that drains to the point of treatment.

- Sewage pumping stations – These are typically located at low points of sewer catchments and pump sewage, via a pressure main, to another gravity catchment, sewer pumping station or treatment plant.
- Pressure main discharge maintenance holes – These are maintenance holes where pressure mains discharge.
- Air valve – Along pressure mains, there are occasionally high points that can act as accumulation points for sewer gases. The accumulated gas is vented (either manually or automatically) through an air valve.
- Syphon – This type of sewer allows wastewater to cross areas that cannot readily be sewered such as waterways, other infrastructure or poor ground conditions.

The ventilation of these typical sewerage system infrastructure is discussed in the following sections.

2.2.1 Property Connection Sewers

The property connection sewers are normally ventilated on the property side of the sewer via property vents.

2.2.2 Reticulation Sewers

The ventilation of reticulation sewers is different between boundary trap areas and those areas not designated as requiring boundary traps.

A boundary trap is defined as an inverted syphon trap installed in a customer sanitary drain to prevent sewer gas passing and entering the building through the drain. A boundary trap area is defined as an area within which properties connected to a sewer are potentially at risk of back-vented gases and where boundary traps are usually required to be installed as a preventive measure.

In the 1890s, Sydney's sewers carried combined industrial and domestic wastewater as well as stormwater; however, the sewers were rarely extended directly to a household. Sewer workers noted unsafe conditions and, as households began to be connected directly to the sewer, foul air was noted as coming back up from the sewer into households. In response to this, Sydney Water's precursor (the Metropolitan Water, Sewerage and Drainage Board of Sydney, also known as the Board) began installing vent shafts on sewers. Households also began installing boundary traps to prevent sewer gases from entering their homes. Additionally, bends on toilets, showers, kitchen sinks, and other fixtures were recognized for their role in providing a water seal that blocks foul odours. Certain areas that were known to contain either poor ventilation or a large amount of trade waste were designated as boundary trap areas, where all sewer connections would need boundary traps. The Board installed sewer vent shafts in reticulation areas with boundary traps to ensure that the sewer was still ventilated, even if this could not be done through the households.

In the 1940s, the common practice evolved such that sewers would have fresh air provided from household connections without boundary traps, and sewers would then educt in branch or trunk mains. Since 1953 the practice of requiring boundary traps in reticulation areas generally ceased except with minor extensions in areas that already contained boundary traps (known as boundary trap areas), with minor extensions serving 10 or more properties in a boundary trap area, in well-defined industrial areas, in house connections directly to submains or in areas where it was unsure whether a boundary trap was needed.

In today's Sydney, there are many areas designated as boundary trap areas where there is a preponderance of vent shafts in reticulation sewers. These areas were often originally listed as boundary trap areas due to the presence of trade waste or the lack of ventilation, both of which are no longer issues. There is an opportunity for new developments within these boundary trap areas to provide property connection ventilation without any boundary traps as a means of removing Sydney Water owned ventilation shafts.

Reticulation sewers in areas of no boundary traps are ventilated through property vents located on household connections. There is normally no need for additional vent shafts in the reticulation sewer.

Reticulation sewers in boundary trap areas require additional vent shafts to ensure the sewer maintains ventilation. In the absence of other guidance, it has become common practice to install vent shafts approximately every 400 m in reticulation areas with a view to achieve between 1 and 4 air change per hour (ACPH).

It should be noted that vent shafts can be located on a reticulation sewer however they actually ventilate a branch or a trunk sewer when they are located very close to them. If unsure, clarify with Sydney Water's Networks and Planning team.

2.2.3 Branch and Trunk Sewers

The ventilation of trunk sewers is most typically through a series of passive vent shafts provided approximately every 400 m as nominated by WSA 02. There is a drawing, SEW-1407 of WSA 02, which notes a 300 m spacing for educt vent shafts with an induct vent located between subsequent educt vents; however, this drawing is no longer used in the Sydney Water version of WSA 02. As such, the text within WSA 02 is often used, which stipulates a maximum of 400 m between vent shafts (unless agreed by Sydney Water).

Whilst it is intended that subsequent vent shafts operate as alternating educt and then induct, often each passive vent shaft acts as both an induct and an educt at different times of the day. The intent with this arrangement is to provide ventilation of approximately 1 to 4 ACPH. As the height of the vent shaft increases, wind velocity also rises, leading to a greater inducement of air from the educt vent shaft. Taller vent shafts located at the tops of hills tend to have the highest ventilation rates. Shorter vent shafts located at lower points do not induce much ventilation but can act as air inducts or educts from gradient or flow changes within the sewer.

There are some cases where air curtains were used to control natural ventilation in a manner that forced educting at some locations and inducting at others. Nearly all of Sydney Water's air curtains in sewer networks (particularly to control natural ventilation) have since been removed. As of July 2024, only six air curtains remain in use - five of which are in the Malabar network, and one in the Northern Suburbs Ocean Outfall Sewer (NSOOS).

There are some cases where mechanically assisted ventilation is provided. In this case, Sydney Water will model the system using its Integrated Corrosion and Odour Decision Support System (ICODSS) to determine the ventilation rate that is required to achieve suitable negative pressure along the sewer. In this case, it is common practice to close some vent shafts along a trunk sewer to ensure the mechanically assisted ventilation has as large an impact as possible and that pressure is not lost through passive vent shafts.

Vent shaft diameters are listed in WSA 02 as being the same size as the sewer, up to DN 300.

2.2.4 Sewage Pumping Stations

At sewer pumping stations, air that is dragged from upstream sewers terminates at the pumping station wet well and needs to be ventilated. This is predominantly through one or more vent shafts that are connected to the wet well of the pumping station. Some sewage pumping stations also have odour control units (OCUs) to treat foul air prior to being discharged. In these cases, there is often a fan to mechanically assist the ventilation. The sizing of mechanically assisted OCUs is governed by Sydney Water's technical specification for OCUs, ACP0004. This is normally to provide 6 ACPH plus a velocity of 1 m/s through the largest of the incoming sewers, or otherwise as determined by Sydney Water's modelling system.

Whilst the vent shaft at sew pumping stations is most commonly attached to the wet well, there can be other vent shafts also located at sewer pumping stations. These are typically connected to emergency storage systems, inlet maintenance holes, dry wells or even some other maintenance holes.

2.2.5 Pressure Main Discharge Maintenance Holes

Vent shafts attached to pressure main discharge maintenance holes are often passive and intend to allow fresh air into the sewer to enable free flow of wastewater downhill. However, when upstream sewer pump stations start pumping, they can briefly act as air educts (unless hindered). In some circumstances, where there is a sudden significant increase in wastewater flow, the water level in the maintenance hole can rise to such an extent that the downstream sewer is briefly inundated. In this case, the vent shaft also acts as an educt to prevent maintenance hole lids from rattling and lifting. When there have been odour complaints, an induct type cowl is often fitted to prevent foul air release or a passive activated carbon type OCU is installed to treat the foul air prior to being discharged.

2.2.6 Air Valves

The air released from an air valve used in wastewater applications, is intermittent and can sometimes be odorous. In these cases, the released air is often dispersed through vent shafts, treated with OCUs, or managed with a combination of both. For wastewater applications there is a requirement for the air valve release to be directly connected to a vent line (and not to discharge into the air valve chamber) which is then connected to an OCU or vent shaft (or both). This is to ensure the air valve chamber does not fill with foul air which could lead to corrosion.

Air valves used in recycled water or potable water systems can sometimes discharge into a chamber with chamber grills to allow inducting and educting. These typically are not equipped with vent shafts. This type of venting arrangement is not allowed for wastewater applications.

2.2.7 Syphon

Air that is dragged by the wastewater terminates at the upstream end of the syphon and needs to be ventilated through a vent shaft. As such, the vent shaft on the upstream end of a sewer predominantly acts as an educt. On the downstream end of a syphon, fresh air is required to enter the sewer to allow wastewater to flow downstream. The vent shaft on the downstream end of a sewer predominantly acts as an induct.

3 Types of Vents and Cowls

This section covers the types of vents and cowls that are currently used, and were historically used, by Sydney Water. Based on the functionality of the vents, they are categorised into two types, namely induct vent and educt vent.

The induct vents are designed to only allow fresh air to enter the sewer system. There are two sub-types of induct vents:

- Ground level induct vent with non-return flap (referred to as induct pipe with mica flap in Sydney Water's Hydra system).
- Elevated vent fitted with an induct or forced induct cowl or a gas-check valve.

The educt vents instead are designed to allow foul air to exit the sewer system.

Despite the definitions of induct and educt vent, in practice, when not fitted with specific fittings (e.g., non-return flaps, specific induct cowls or check valve), most vents are naturally ventilated with no method to control which direction the air flows and operate as either an induct or an educt depending on the sewer flows and meteorological conditions.

Sydney Water maintains a series of Deemed to Comply (DTC) drawings that can be used. DTC drawings are available in the Standards and Specifications' section of Sydney Water's website. Any use of DTC drawings must be in accordance with Sydney Water's DTC terms of use. Older designs may be used as a guideline where the design and construction are in accordance with Sydney Water's Engineering Competency Standard and Technical Specification - Civil.

The current DTC drawings available (May 2025) for vent shafts are summarised below.

- DTC 2300 - VENTILATION SHAFT - STAINLESS STEEL 9 - 18m HEIGHT - DN150 - DN300 SHEET 1 OF 2
- DTC 2301 - VENTILATION SHAFT - STAINLESS STEEL 9 - 18m HEIGHT - DN150 - DN300 SHEET 2 OF 2
- DTC 2302 - VENTILATION SHAFT REPLACEMENT - STAINLESS STEEL 9 - 18m HEIGHT - DN150 - DN300
- DTC 6048 – SEWAGE PUMPING STATION – INDUCT VENT - DETAILS

3.1 Types of Vent Shafts

Sydney Water has a number of distinctive types of ventilation shaft that are in service. For new vent shafts the types of vents, their description and an example image for each type of vent is shown in

Table 3-1. For historically used vent shafts, some of which are still in service, the same information is provided in Appendix A.

Table 3-1: Types of vents

Type	Description	Image
Currently accepted for new installations by Sydney Water		
Post Type	Free-standing structure. This is the type of vent that is compliant with the DTC drawings. Sizes are DN 150, 225, and 300. Heights range from 9 to 18 meters in DTC drawings, however shorter ones have been provided that are not DTC compliant.	
Post Type	Free-standing structure. This is the type of vent that is broadly compliant with the DTC drawings; however, it should be noted that the bracing shown in the example image is no longer used on DTC drawings. May be installed **only** where the catchment being vented is less than 80 - 100 houses. Unsuitable in vicinity of multi-story buildings (wall mounted vent preferred in such situations). Sizes are DN 150, 225, and 300. Heights are 9 m only.	

Type	Description	Image
Wall Mounted Type - External	A tube vent that is supported by being attached to a solid wall. They can sometimes be confused with private house drainage vents. Sydney Water wall mounts are normally round but can be square or rectangular and will generally have an inspection door. Vent tube **should not** be enclosed inside a wall cavity. Sizes are DN 150, 225 and 300.	
Special Derrick Type (with or without guy-wire support)	Any vent larger than DN 300 is considered a special vent and requires separate design consideration. Structural support may have a derrick alone, a derrick with supporting guy wire, or other approved designs.	 Derrick supported vent

Type	Description	Image
		 Vent with support via derrick and guy wire

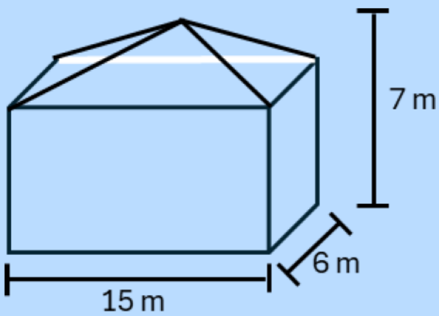
3.2 General Vent Shafts Requirements

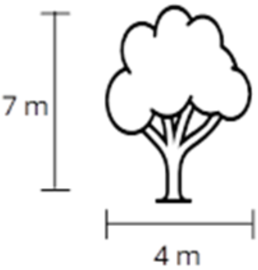
3.2.1 Height

In general, a sewer vent shaft should be 2 m taller than any adjacent nearby or planned buildings, structures or trees.

A building, structure or tree can be considered 'adjacent' if it within a distance of 5 times a factor 'L' where 'L' is the lesser of the height or width of the building, structure or tree. Refer to Table 3-2 below for worked examples.

Table 3-2: Adjacent building and tree examples

Example	Explanation
	In this case, the shortest dimension of the building is 6m. This becomes 'L'. If the vent shaft in within 5xL (i.e. 30m) of the outer dimension of the building, the building is considered adjacent to the vent shaft.

Example	Explanation
	In this case, the shortest tree dimension is the diameter of the canopy which is 4m. This becomes 'L'. If the vent shaft is within 5xL (i.e. 20m) of the tree canopy perimeter, the tree is considered adjacent to the vent shaft.

3.2.2 Distance from Buildings

DTC 2300 notes that new vent shafts should be located 2 m clear from any nearby structure. This requirement is from an access and maintenance perspective but is not from an odour impact perspective. For wall mounted vent shafts, this is unachievable.

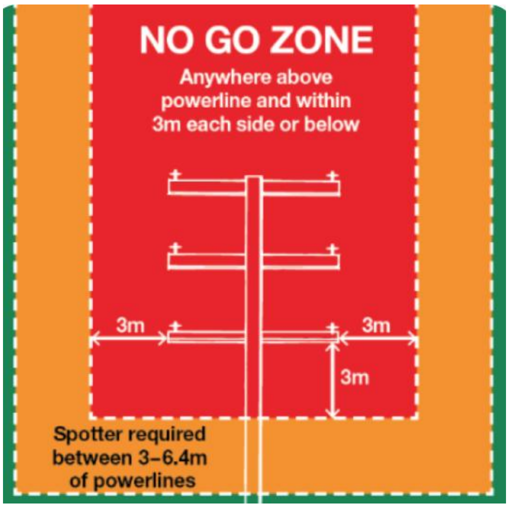
It is important to ensure that the anemometer door located in a vent shaft has 2 m of clearance around it. Additionally, the anemometer door should not be obstructed by any supporting legs or bands on the vent.

3.2.3 Proximity to Power Lines

Vent shafts should be located at least 3 m away from power lines however they may need to be further away if the voltage of the power lines is high resulting in potential for arc flash. This sometimes means providing vent shafts across the road from the sewer location. Positioning vent shafts greater than 6.4m from powerlines is desired to eliminate the mandatory requirement of a spotter, refer to Figure 3-1 below.

Note that if the vent shaft is made from a non-conducting material (such as Glass Reinforced Plastic (GRP)) the vent shaft should still be located at least 3 m away from power lines to allow access to the top of the vent shaft for cowl maintenance and replacement.

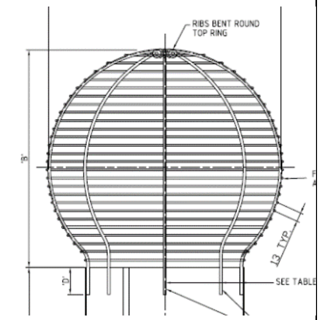
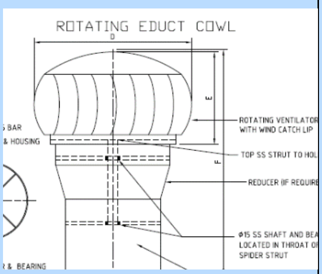
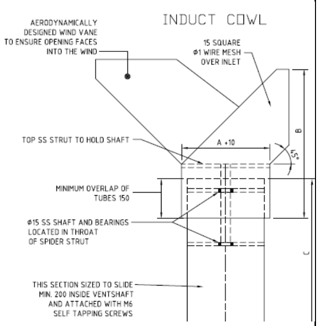
Figure 3-1 Power line no go zone

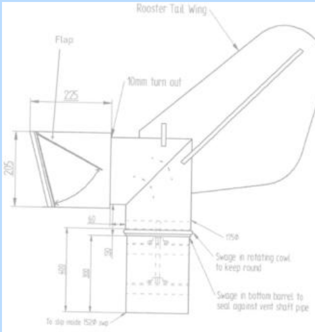


3.3 Types of Cowls

There are currently four types of cowls used by Sydney Water. For new cowls, the types of cowls, their description and an example image for each type is summarised in Table 3-3. For historically used cowls, some of which are still in service, the same information is provided in Appendix A.

Table 3-3: Types of cowls

Type	Description	Drawing	Image
Currently accepted for new installations by Sydney Water			
Wire	A wire ball that is also known as a bird cowl. It is non-directional and used on both induct and educt vents. It is the most common and preferred cowl option.		
Rotating	Used on educt vents (similar in principle to a "whirly-bird" house vent).		
Forced Induct	Wind-vane. The cowl rotates so that the front is always pointing into the wind to force air into the vent.		

Type	Description	Drawing	Image
Forced Induct (with flap)	Similar to the Forced Induct cowl but contains a flap to ensure foul air is not released when there are no winds. The cowl rotates so that the front is always pointing into the wind to force air into the vent.		

4 Types of studies

This section covers the potential studies that can be undertaken to obtain additional information / evidence as supporting material for the applications. This provides consistency in methodologies for developers and for Sydney Water to use.

Prior to any measurements conducted on any vent shafts, the vent shaft and vent line should be inspected by Closed Circuit Television (CCTV), endoscope or similar to ensure that they are not blocked with evidence provided along with any monitoring report.

4.1 Vent Shaft Pressure and Airflow Monitoring

The primary purpose of differential pressure monitoring in the vent shafts is to identify / verify the functionality of the vent (i.e., induct, educt or both). Continuous differential pressure monitoring over a course of four weeks is recommended to gain sufficient data to reflect variation within the sewer. When undertaking measurements from vent shafts connected to pressure main discharge maintenance holes, a trial should be undertaken when the upstream sewer pumps are running at full speed for a short period of time to ascertain the pressure within the vent shaft during this time.

The main difference between pressure and airflow monitoring is that a pitot tube is often attached to the vent shaft. The Differential Pressure Gauge (DPG) is then attached to the pitot tube rather than directly to the vent shaft.

For unobstructed vent shafts, Sydney Water accepts the use of DPG and the use of the equation below to infer the vent airflow rate:

Equation 1 – Inference of air flow from differential pressure (adapted from Bernoulli's Law)

$$Q = 1000 \times \frac{\pi d^2}{4} \times \frac{\sqrt{2 \times |dP|}}{1000}$$

Where:
Q = Flowrate (L/s)
dP = Measured differential pressure (Pa)
d = Vent shaft diameter (m)

A DPG that can readily record data and be installed in the field can be rented from Acrulog™ along with solar shades. Acrulog is the only provider currently available in the market that rents appropriate units (as of June 2024).

Figure 4-1: Acrulog™ pressure logger (left), solar shade (centre) and application (right)

The DPG is to be deployed at the anemometer door of a vent shaft with a false anemometer door (complete with tapping points) replacing the existing anemometer door for the duration of the assessment.

When the vent shaft does not have an anemometer door, the following alternatives are acceptable:

- Affix one of the tapping points from the DPG to the outlet of the vent shaft. Note that this would likely require an elevated work platform or similar.
- Provide a new anemometer door. Note that this would require a structural inspection of the vent shaft and a structural assessment of the design and installation of the new anemometer door. The structural assessor would need to meet Sydney Water's Engineering Competency Standards.
- Construct an inspection port on the vent line between the maintenance hole and the vent shaft. Monitoring can be undertaken from this inspection port.

4.2 Ventilation Assessment

Ventilation assessments can be undertaken to identify whether a particular vent shaft can be removed. It is most commonly conducted in boundary trap areas, however, can also be undertaken on branch or trunk sewers.

To undertake a ventilation assessment on a particular vent shaft, the following steps should be undertaken:

1. Identify vent shafts on sewer under investigation – For reticulation sewers, this most often means the subject vent shaft as well as all vent shafts on the sewer leg that the vent shaft is connected to. This is typically 2 vent shafts upstream and 2 vent shafts downstream of the subject vent shaft (which may be on downstream main sewers). For branch or trunk sewers, this often means all vent shafts along the trunk sewer.
2. Calculate the air volume during peak dry weather flow from the linear span of sewer under investigation, i.e., the sewer from the connection to the most upstream vent shaft (or the upper reaches of a reticulation sewer if the vent shaft is intended to ventilate the entire upper section of a reticulation sewer, whichever is larger) to the connection to the most downstream vent shaft. This can be assumed to be 80% of the total volume of the sewer.
3. Measure differential pressure in each of the sewer vent shafts for a period of four weeks and calculate the velocity as per Section 4.1. Convert this to a volumetric flowrate (i.e., in m^3/h) by multiplying the velocity by the cross-sectional area of the vent shaft. Calculate the average flowrate for each vent shaft.
4. Sum all the average volumetric flowrates from all the vent shafts. Divide this by the sewer air volume at peak dry weather flow. This is the rate of ventilation in air changes per hour.

4.3 Contaminant Monitoring

4.3.1 Gas Phase H_2S Monitoring

Gas phase H_2S monitoring is of particular importance when the removal of an educt vent is deemed unacceptable and an alternative solution is to be sought, as H_2S is the primary sewer foul gas that is responsible for odour nuisance in communities. Should there be a reason to believe that there are other main odorants in the sewer headspace (e.g., from a high proportion of trade waste in the catchment), monitoring using a photoionisation detector (PID) is recommended in addition to H_2S monitoring.

Continuous gas phase H_2S monitoring over a minimum of four weeks of dry weather days is recommended to estimate the odour release.

As of June 2024, the most common H_2S analysers that are suitable for use in sewer environments are OdaLog™ or Acrulog™ instruments (shown in Figure 4-2). Generally, a range of 0-50 ppm or 0-200 ppm are used with data captured every 30 seconds. These units can readily be rented through a variety of instrument rental companies.

Regardless of the monitoring undertaken, the monitoring devices are to be calibrated before deployment and response tested following the deployment. The post deployment response test is to confirm that the data collected is accurate. Calibration and response test details for any monitoring should be provided as part of standard reporting.

Gas phase H_2S monitoring shall be subject to the following restrictions:

- Sampling shall only be conducted a minimum of two weeks after a rain event. A rain event is considered an event when rainfall of greater than 10 mm has occurred. A rain event can be considered finished when no rain greater than 5 mm per day has occurred for a minimum of 5 days, or 0 mm within last 24 hours. In the event that rain is forecast during the sampling period, the sampler is to raise the issue with Sydney Water to determine if sampling shall proceed or be delayed.
- The monitoring campaign cannot occur over school holidays.
- The monitoring campaign cannot occur over gazetted public holidays where there is more than one consecutive day of public holiday.
- The monitoring cannot occur during the winter months of May, June or July.
- When sampling occurs in Autumn or Spring, the results should be temperature corrected to summer temperatures using the following conversion:

Equation 2 – Temperature correction for H_2S from gas-liquid equilibrium (Henry's Law) and biological activity (Arrhenius' Law)

$$[H_2S]_2 = [H_2S]_1 \frac{1.07^{(T2-293.15)} \times e^{-2100\times\left(\frac{1}{T2}-\frac{1}{298.15}\right)}}{1.07^{(T1-293.15)} \times e^{-2100\times\left(\frac{1}{T1}-\frac{1}{298.15}\right)}}$$

Where

$[H_2S]_2$ = Temperature corrected H_2S concentration (ppm)
$[H_2S]_1$ = Measured H_2S concentration (ppm)
T_1 = Measured averaged temperature of the period (K)
T_2 = Summer average headspace temperature (if no other information is provided, use 298.15 K)

Figure 4-2: OdaLog™ (left) and H_2S Acrulog™ (right)

4.3.2 Gas Phase Volatile Organic Compounds Monitoring

Where there is a high proportion of trade waste that can contribute to odour, hydrogen sulphide monitoring can be supplemented with PID monitoring which measures the level of total volatile organic compounds in the sewer headspace. This is normally conducted to determine the size of OCUs.

Continuous gas phase PID monitoring over a minimum of four weeks of dry weather days is recommended to estimate the odour release.

The most common PID analysers that are suitable for use in sewer environments are Acrulog™ instruments (shown in Figure 4-3). However, at time of writing, these are available for purchase but not for rental. If used, these units should be placed within a solar shade as shown in Figure 4-1. Sydney Water's Air Quality and Ambient Monitoring (AQAM) group has some of these units and can be contacted for their use or rental. Other PID monitors are available for rental; however, these typically require a dedicated power source (which is often not available in the field), a secure environment (which is also often unavailable in the field) and continuous replacements of water traps.

Gas phase PID monitoring shall be subject to the following restrictions:

- Sampling shall only be conducted a minimum of two weeks after a rain event. A rain event is considered an event when rainfall of greater than 15 mm has occurred. A rain event can be considered finished when no rain greater than 5 mm per day has occurred for a minimum of 5 days since the event when greater than 15 mm rainfall was recorded. In the event that rain is forecast during the sampling period, the sampler is to raise the issue with Sydney Water to determine if sampling shall proceed or be delayed.
- The monitoring campaign cannot occur over school holidays.
- The monitoring campaign cannot occur over gazetted public holidays where there is more than one consecutive day of public holiday.
- PID sampling should be undertaken in conjunction with H_2S monitoring.

Figure 4-3: Acrulog™ PID VOC monitor

4.3.3 Monitoring location

The contaminant monitoring is to be undertaken within the vent shaft using the anemometer door of a vent shaft. If the monitoring equipment has an in-built pump and requires to be mounted outside the vent shaft, a forced anemometer door (complete with tapping points) must be used to replace the existing anemometer door for the duration of the assessment.

When the vent shaft does not have an anemometer door, the following alternatives are acceptable:

- Insert the logger into the vent shaft from the top of the vent shaft. Alternatively, if the monitoring equipment has an in-built pump and requires to be mounted outside the vent shaft, affix one of the tapping points from the monitoring equipment to the outlet of the vent shaft. Note that this would likely require an elevated work platform or similar.
- For insertion type equipment, the logger can be placed into the maintenance hole that the vent shaft attaches to.
- Provide a new anemometer door. Note that this would require a structural inspection of the vent shaft and a structural assessment of the design and installation of the new anemometer door. The structural assessor would need to meet Sydney Water's Engineering Competency Standards.
- Construct an inspection port on the vent line between the maintenance hole and the vent shaft. Monitoring can be undertaken from this inspection port.

4.4 Odour Impact Assessment

The process for odour impact assessment can be found in Sydney Water's "Procedure for Odour Dispersion Modelling for Sydney Water Projects" (October 2024). When applying odour impact assessments to sewer network projects, the following is required:

- Dispersion modelling is not required for passive vent shafts connected to sewers conveying predominantly domestic sewage (i.e. trade waste impacts are likely to be minor) and the 95th percentile of measured H_2S is less than 5 ppm.
- The vent shaft shall be assumed to be discharging continuously at the 95th percentile of the air flow rate measured on site.
- For sites where the sewer is conveying predominantly domestic sewage (i.e., trade waste impacts on odour are likely to be minor), the odour release can be based off the H_2S measurements assuming 1 ppb of H_2S = 1 odour unit (ou).
- The odour level shall be assumed to be constantly discharging at the 80th percentile of that measured on site.
- Flagpole receptors shall be included in the model to show areas where sensitive receptors could be located at height. Flagpole receptors should be included in the model at the location of nearby balconies, windows, outdoor garden, barbecue or other recreational areas or any area that could be considered to be used by occupants (or others) of the development in a manner that the air release from the vent could affect that area.
- For new developments in mid to high rise buildings, an assessment criterion of 2 ou should be used as per the NSW EPA document "Approved methods for the Modelling and Assessment of Air Pollutants in New South Wales".

4.5 Visual Impact Assessment

A visual impact assessment (VIA) may be required when the proposed modification to the existing vent shaft is likely to result in visual impact on the surrounding communities (e.g., significantly increased footprint to include an OCU or relocation of the vent shaft to a new area). The VIA procedure follows the best practice principles as shown in the "Guideline for landscape character and visual impact assessment" published by Transport for NSW (2023). This guideline outlines best practices and standards for assessing visual impacts in environmental assessments. The VIA rating matrix is extracted from this guideline and is shown in Table 4-1.

The VIA is based on the sensitivity of the visual receptors to proposed changes of vent shaft at each viewpoint, and the magnitude of impact. The sensitivity of receptors and magnitude of impact both contain four rating levels: high, moderate, low and negligible. A rating matrix is established considering the two aspects of the assessment, as is shown in Table 4-1, to determine an overall 'significance of visual effects' rating. If further guidance is needed to complete the VIA, it's recommended to review the "Guideline for landscape character and visual impact assessment" published by Transport for NSW (2023).

Table 4-1: Significance of visual impacts rating matrix

		Magnitude of Impact			
		High	Moderate	Low	Negligible
Sensitivity of Receptors	High	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Some guidance on using the VIA rating matrix is given below:

- Magnitude of impact
  - Moving from a wall-mounted vent shaft to a free-standing vent shaft should be considered as having a moderate or high magnitude of impact.
  - Increasing the height of an existing vent shaft would be considered a low to medium magnitude of impact depending on the additional height
  - Relocating a wall mounted vent shaft to another location (but keeping it as a wall mounted vent shaft) would have a low magnitude of impact
  - Replacing a vent shaft with a like for like replacement would have a negligible magnitude of impact
- Sensitivity of receptors
  - The sensitivity of receptors should only be considered low or negligible if there are no receptors who would view the change on a daily basis.
  - A moderate sensitivity of receptors would be 1-5 households impacted
  - A high sensitivity of receptors would be >5 households impacted

If the significance level of visual impact is negligible or low, the proposed modification is more likely to be approved by Sydney Water so long as it meets other performance criteria. Otherwise, the application is deemed to have moderate to high level of visual impact to the local community, which increases the risk of receiving community complaints. An alternative to the proposed modification should be sought to reduce the visual impact. A community consultation (with signed and witnessed statements) may be considered to obtain feedback from the local community on proposed modification if the visual impact is considered moderate to high.

Relocation of vent shafts (even within the same property) are sensitive and may require more VIA investigation to be carried out. If a vent shaft relocation is instigated by a developer, this will need to be conducted by the water service coordinator (WSC). Sydney Water may flag at the Notice of Requirements (NOR) or design stage to include consultation with adjoining landholders.

4.6 Heritage study

Some vent shafts are either considered heritage listed items or are located within heritage conservation areas. If modifications are proposed for a particular vent shaft, the heritage listing of the particular vent shaft should be checked at the following locations.

- Sydney Water's Heritage Register (accessible from the Sydney Water's website)
- NSW State Heritage Inventory
- Australian Heritage Database

The location of the vent shaft should also be assessed against the local environment plan of the council where the vent shaft is located within.

If the vent shaft is identified on any of the following listings, of if the vent shaft is located within a local council heritage conservation area, a Heritage Consultant should be engaged to determine if there are any implications on modification to the vent shaft due to its heritage status or its location within a heritage conservation area. In lieu of engagement of a Heritage Consultant, a like for like replacement would normally satisfy heritage requirements. This applies to both vent shafts and cowls.

If the vent shaft is not on any of the heritage registers and is not located within a local heritage conservation area, no further heritage associated investigations are required.

5 Acceptable relocating or removal of vent shafts

This section describes under what conditions vent shaft can be relocated or removed. This section is divided into vent shafts that are found ventilating different types of sewer infrastructure.

It should be noted that when relocating vent shafts, the length of any vent from the maintenance hole to the top of the vent shaft shall not exceed 25 m, or 35 m if the vent shaft and vent line diameter is increased by one (1) nominal size.

Taller vent shafts may be approved by Sydney Water when adjacent to high rise developments, however these would typically require mechanical ventilation.

5.1 Reticulation Sewer

In areas where there are no boundary traps, and the following conditions are met, the sewer vent can be removed. In this case, ventilation is achieved via the property vents.

- There must be no privately operated pump to sewer discharges upstream of the location.
- There must be no low-pressure sewer schemes discharging upstream of the vent location.
- There must be no significant sewer gradient changes around the area.
- There must be no trade waste discharges upstream of the location.

In some boundary trap areas where medium rise (4 to 8 storeys) or high rise (9+ storeys) developments are planned, the sewer vent can be removed in lieu of property vents so long as the boundary trap is also removed. In such a case, the property vent should follow the requirements of AS/NZS 3500. If this change is instigated by a developer, it would be at the developer's expense. Note that an application to Sydney Water must be made to remove the boundary trap and will only be accepted in the following scenarios:

- There must be no privately operated pump to sewer discharges upstream of the location.
- There must be no low-pressure sewer schemes discharging upstream of the vent location.
- There must be no significant sewer gradient changes around the area.
- There must be no trade waste discharges upstream of the location.

There may be further requirements to ensure that the connection line from the development to the sewer is made larger to allow for air from the property vent to adequately ventilate the sewer.

For vent shafts in reticulation sewers in areas where there are boundary traps, ventilation assessment as described in Section 4.2 needs to be undertaken to determine the likely impact on ventilation if the vent shaft is removed. H_2S is also required to be monitored at the subject vent shaft. If the number of air changes is maintained above a certain threshold without the subject vent shaft (threshold level is based on the measured H_2S levels, refer to Section 7 for details), then the vent shaft can be removed.

If the ventilation assessment identifies that the vent shaft cannot be removed, relocation can be considered. When relocating vent shafts, the following requirements apply:

- As ventilation is heavily dependent on wind speed at the top of the vent, it can only be relocated in a manner that ensures the top of the relocated vent shaft is at or taller than the top of the existing vent shaft. This must take into account any changes in relative level between the existing and the relocated vent shaft. For instance, if a 14m tall vent shaft is relocated 50m away in a location that is 2 m downhill from the existing vent shaft, the relocated vent shaft must be a minimum of 16m tall.
- Dispersion modelling shall be conducted to show impact of moved vent on existing (and potential future) receptors (see dispersion modelling requirements listed out in Section 4.3.3). Note that H_2S monitoring (or other contaminant monitoring where there is a high proportion of trade waste) as well as pressure monitoring would be required to determine the odour concentration and foul air flow rate to use in modelling.
- VIA on new location must show a low or negligible impact (see Section 4.5 for visual impact assessment requirements).

5.2 Branch and Trunk Sewer

5.2.1 Mechanical Ventilation

For trunk sewers that are mechanically ventilated (i.e., there is a fan associated with the discharge), it is rare that the vent shaft associated with the mechanical ventilation can be removed. This is because it provides ventilation across a large stretch of sewer line. Other forms of ventilation on the trunk sewer have often been removed in lieu of providing mechanical ventilation.

In rare circumstances, the mechanical ventilation can be relocated to another location. The identification of a suitable location to relocate mechanical ventilation involves a dedicated study. This study would need to investigate the following:

- Odour impact assessment using dispersion modelling
- VIA
- Ventilation modelling using Sydney Water's ICODSS to determine expected pressure requirements for the fan
- Access investigation
- Odour control requirements
- Background noise investigations
- Before You Dig Australia investigation
- Contaminated land investigation
- Flood investigation

If this change is instigated by a developer, it would be at the developer's expense.

5.2.2 Passive Ventilation

If with the removal of the subject vent shaft, there will still be one vent shaft on either side of the removed vent shaft within 400 m of each other on the trunk sewer, the vent shaft can be removed.

Alternatively, the vent shaft can be relocated to within 100 m of its location so long as it is not less than 200 m from another vent shaft that is in use. If relocating a vent shaft, the following requirements apply:

- Dispersion modelling to show impact of moved vent on existing (and potential future) receptors (see dispersion modelling requirements listed out in Section 4.3.3). Note that H_2S or odour monitoring as well as pressure monitoring would be required to determine the odour concentration and foul air flow rate to use in modelling.
- VIA on new location must show a low or negligible impact (see Section 4.5 for visual impact assessment requirements).

If this change is instigated by a developer, it would be at the developer's expense. The application to remove or relocate a passive vent should be submitted to Sydney Water for approval prior to the removal or relocation of the vent shaft.

5.3 Sewer Pumping Station

The removal and relocation of a vent shaft from a sewer pumping station is rare as they are normally required for the proper operation of a pumping station.

In rare instances, the vent shaft can be relocated to another location within the pumping station boundary. If this change is instigated by a developer, it would be at the developer's expense.

5.4 Pressure Main Discharge Maintenance Hole

5.4.1 Single Lot Discharge

Vent shafts that are on discharge maintenance holes where there is only a single pumped residential lot connection can be removed so long as the purpose of the vent shaft is predominantly for venting air associated with the pumped discharge.

5.4.2 Multiple Lot Development Discharge

It is rare that a vent shaft can be removed from a pressure main discharge associated with a multiple lot development; however, there are occasions when it can be replaced with an air inlet (see Section 7).

The vent shaft cannot be relocated to another location.

5.4.3 Catchment Discharge

It is rare that a vent shaft can be removed from a pressure main discharge associated with a catchment; however, there are occasions when it can be replaced with an air inlet (see Section 7).

The vent shaft cannot be relocated to another location.

5.5 Air Valve

The air valve itself cannot be removed or relocated.

Under certain circumstances, when measured and temperature corrected H_2S is below certain limits (see section 7), the vent shaft downstream of an OCU associated with an air valve can be removed.

Vent shafts associated with air valves can be relocated under the following conditions:

- VIA on new location must show a low or negligible impact (see Section 4.5 for VIA requirements).
- Suitable drainage of vent line between air valve and vent shaft is provided.
- Note that the length limits from the top of the vent (cowl) to the air valve shall not exceed 300 m.
- The air valve discharge is directly piped to the vent line (i.e. it does not vent to the chamber which then exhausts through a vent line)

5.6 Syphon

Vent shafts on syphons typically cannot be removed or relocated. These are required for the proper operation of the syphon.

6 Acceptable alternatives

This section proposes a list of acceptable alternatives to developers and Sydney Water for consideration when removal or relocation of a vent shaft is deemed unacceptable.

Under certain conditions, different alternatives to vent shaft removal are available. For all these alternatives, if change is instigated by a developer, it would be at the developer's expense. The alternatives should be approved by Sydney Water.

6.1 Reticulation Sewers

Where it is identified that a vent shaft in a reticulation sewer cannot be removed or relocated, an alternative is to increase the height of vent shafts (with appropriate base modifications to account for loading from the taller vent shaft). This can be undertaken when a new development is planned adjacent to an existing vent shaft such that the existing sewer vent shaft is no longer 2 m taller than the adjacent development. There may be cases where the air line from multiple catchments can be connected and vented through the same vent shaft. Applications of this nature should be made to Sydney Water for assessment.

If this cannot be undertaken, a contaminant monitoring campaign should be performed. Depending on the results of the contaminant monitoring campaign, the following could be viable options as shown in Section 7.

- New development should be constructed such that no openings, air intakes or communal areas be located within a certain distance from the vent shaft outlet. For distances (H_2S level dependant) see Section 7.
    - If this cannot be undertaken, a passive OCU can be installed to reduce the odour release from the vent shaft. The passive OCU would need to have the following features:
        - Flow rate based on the 95th percentile of pressure monitoring
        - Minimum of 2 seconds of contact time
        - Maximum of 50 Pa pressure loss across the unit at maximum flow rates
        - Minimum of 24 months between carbon replacements based on the measured flow rate and contaminant concentration
        - Be provided with an isolation valve
        - Be easily accessible and not located at the top of the vent shaft
        - Have access locations to install gas phase H_2S monitors upstream and downstream
        - Have access locations to install differential pressure monitors across OCU and from outlet to ambient.
        - Must be installed completely above ground(for ease of access when replacing media)
        - Include free draining of condensate back into the maintenance hole (with associated water trap on drain lines)
        - Where appropriate, be provided with a visual amenity shroud
        - Upon commissioning, be provided with new asset details in line with Sydney Water's D0001440 – *Technical Specification for Commissioning*

(Transitioning Assets into Operation) to ensure asset is included in Sydney Water's asset management systems and GIS.
    - When this is developer driven, the developer would need to provide a contribution to Sydney Water for two years of maintenance as well as the cost of media replacement.
- If H_2S levels and odour are low enough (see Section 7), the vent shaft can be entirely replaced with a passive OCU.

6.2 Branch and Trunk Sewers

6.2.1 Mechanical Ventilation

An alternative to removal of vent shafts on trunk sewers that are mechanically ventilated is to increase the height of vent shafts. This can be undertaken when a new development is planned adjacent to a trunk sewer forced ventilation vent shaft such that the existing sewer vent shaft is no longer 2 m taller than the adjacent development.

If this cannot be undertaken, a contaminant monitoring campaign should be performed. Depending on the results of the contaminant monitoring campaign, the new development should be constructed such that no openings, air intakes or communal areas be located within a certain distance from the vent shaft outlet. For distances (H_2S level dependent) see Section 7.

6.2.2 Passive Ventilation

If pressure investigations identify that negative pressures are maintained within the vent for 80% or more of the monitoring period, then the vent shaft can be replaced with a ground mounted air inlet valve. The air inlet valve would need to have the following features:

- Not create a trip hazard
- Not create a hazard for vehicles
- Be accessible and easy to maintain safely
- Be enclosed within a shroud that prevents vandalism of the air inlet
- Upon commissioning, be provided with new asset details in line with Sydney Water's D0001440 – *Technical Specification for Commissioning (Transitioning Assets into Operation)* to ensure asset is included in Sydney Water's asset management systems and GIS.

In the event that the above requirements cannot be met for an air inlet, a shorter vent (minimum 5 m tall) can be provided with an air induct cowl.

If pressure monitoring identifies that the vent shaft is not acting predominantly as an air inlet, a contaminant monitoring campaign can be undertaken. Depending on the results of the contaminant monitoring campaign, the new development should be constructed such that no openings, air intakes or communal areas be located within a certain distance from the vent shaft outlet. For distances (H_2S level dependent) see Section 7.

Passive OCUs are not normally appropriate for individual vent shafts on trunk sewers due to the size of the passive OCU required and/or the impact it has on ventilation throughout the trunk sewer and subsequent need to address all other vent shafts along the trunk sewer. Any application for passive OCUs on trunk sewer vent shafts should be discussed first with Sydney Water.

6.3 Sewage Pumping Stations

An alternative to vent shaft removal at sewage pumping stations is to increase the height of vent shafts. This can be undertaken when a new development is planned adjacent to a sewer pumping station such that the existing sewer vent shaft is no longer 2 m taller than the adjacent development.

If this cannot be undertaken, a contaminant monitoring campaign can be performed. Depending on the results of the contaminant monitoring campaign, the new development should be constructed such that no openings, air intakes or communal areas be located within a certain distance from the vent shaft outlet. For distances (H_2S level dependent) see Section 7.

6.4 Pressure Main Discharge Maintenance Holes

If pressure investigations identify that negative pressures are maintained within the vent for 80% or more of the monitoring period, and that no measurements greater than a certain amount are recorded (particularly when the upstream sewer pumps are running at full speed), then the vent shaft can be replaced with a shorter vent (minimum 5 m tall) when fitted with a forced induct cowl.

If the above cannot be met, or if pressure monitoring does not allow air inlets, an alternative to vent shaft removal at pressure main discharge maintenance holes is to increase the height of vent shafts. This can be undertaken when a new development is planned adjacent to a sewer pumping station such that the existing sewer vent shaft is no longer 2 m taller than the adjacent development.

If this cannot be undertaken, a contaminant monitoring campaign can be performed. Depending on the results of the contaminant monitoring campaign, the new development should be constructed such that no openings, air intakes or communal areas be located within a certain distance from the vent shaft outlet. For distances (H_2S level dependent) see Section 7.

If this cannot be undertaken, a passive OCU can be installed to reduce the odour release from the vent shaft. Passive OCUs would need to have the following features:

- Flow rate based on the 95th percentile of pressure monitoring
- Minimum of 2 seconds of contact time
- Maximum of 50 Pa pressure loss across the unit at maximum flow rates
- Minimum of 24 months between carbon replacements based on the measured flow rate and contaminant concentration
- Be provided with an isolation valve
- Be easily accessible and not located at the top of the vent shaft
- Have access locations to install gas phase H_2S monitors upstream and downstream
- Have access locations to install differential pressure monitors across OCU and from outlet to ambient.
- Must be installed completely above ground (for ease of access when replacing media)
- Include free draining of condensate back into the maintenance hole (with associated water trap on drain lines)
- Where appropriate, be provided with a secure visual amenity shroud

- Upon commissioning, be provided with new asset details in line with Sydney Water's D0001440 – *Technical Specification for Commissioning (Transitioning Assets into Operation)* to ensure asset is included in Sydney Water's maintenance systems and GIS.
- When this is developer driven, the developer would need to provide a contribution to Sydney Water for two years of maintenance as well as the cost of media replacement.

6.5 Air Valves

An alternative to vent shaft removal on vent shafts downstream of air valves is to increase the height of vent shafts. This can be undertaken when a new development is planned adjacent to a vent shaft connected to an air valve such that the existing sewer vent shaft is no longer 2 m taller than the adjacent development.

If this cannot be undertaken, a contaminant monitoring campaign can be performed. Depending on the results of the contaminant monitoring campaign (note that the 99th percentile is used in setting limits from air valves due to the infrequency of air valve operation), the new development should be constructed such that no openings, air intakes or communal areas be located within a certain distance from the vent shaft outlet. For distances (H_2S level dependent) see Section 7.

If this cannot be undertaken, a passive OCU can be installed to reduce the odour release from the vent shaft.

If measured and temperature corrected H_2S levels and odour are low enough (see Section 7 for limits), the entire vent shaft can be replaced with a passive OCU.

The passive OCU would need to have the following features:

- Flow rate based on the 95th percentile of pressure monitoring
- Minimum of 2 seconds of contact time
- Minimum of 24 months between carbon replacements based on the measured flow rate and contaminant concentration
- Be provided with an isolation valve
- Be easily accessible and not located at the top of the vent shaft
- Have access locations to install gas phase H_2S monitors upstream and downstream
- Have access locations to install differential pressure monitors across OCU and from outlet to ambient.
- Must be installed completely above ground (for ease of access when replacing media)
- Include free draining of condensate back through an appropriately sized water trap (size to be determined by air valve release pressure) into an appropriate location (to be agreed with Sydney Water)
- Where appropriate, be provided with a secure visual amenity shroud
- Upon commissioning, be provided with new asset details in line with Sydney Water's D0001440 – *Technical Specification for Commissioning (Transitioning Assets into Operation)* to ensure asset is included in Sydney Water's maintenance systems and GIS.
- When this is developer driven, the developer would need to provide a contribution to Sydney Water for two years of maintenance as well as the cost of media replacement.

6.6 Syphons

An alternative to vent shaft removal at syphons is to increase the height of vent shafts. This can be undertaken when a new development is planned adjacent to a syphon vent shaft such that the existing sewer vent shaft is no longer 2 m taller than the adjacent development.

If this cannot be undertaken, a contaminant monitoring campaign can be performed. Depending on the results from the contaminant monitoring campaign, the new development should be constructed such that no openings, air intakes or communal areas be located within a certain distance from the vent shaft outlet. For distances (H_2S level dependent) see Section 7.

If this cannot be undertaken, a passive OCU can be installed to reduce the odour release from the vent shaft. Passive OCUs would need to have the following features:

- Flow rate based on the 95th percentile of pressure monitoring
- Minimum of 2 seconds of contact time
- Maximum of 50 Pa pressure loss across the unit at maximum flow rates
- Minimum of 24 months between carbon replacements based on the measured flow rate and contaminant concentration
- Be provided with an isolation valve
- Be easily accessible and not located at the top of the vent shaft
- Have access locations to install gas phase H_2S monitors upstream and downstream
- Have access locations to install differential pressure monitors across OCU and from outlet to ambient.
- Must be installed completely above ground (for ease of access when replacing media)
- Include free draining of condensate back into the maintenance hole (with associated water trap on drain lines)
- Where appropriate, be provided with a secure visual amenity shroud
- Upon commissioning, be provided with new asset details in line with Sydney Water's D0001440 – *Technical Specification for Commissioning (Transitioning Assets into Operation)* to ensure asset is included in Sydney Water's maintenance systems and GIS.

7 Decision framework

The decision framework for modifications to existing vent shafts has been developed for each type of infrastructure being ventilated.

7.1 Reticulation Sewer

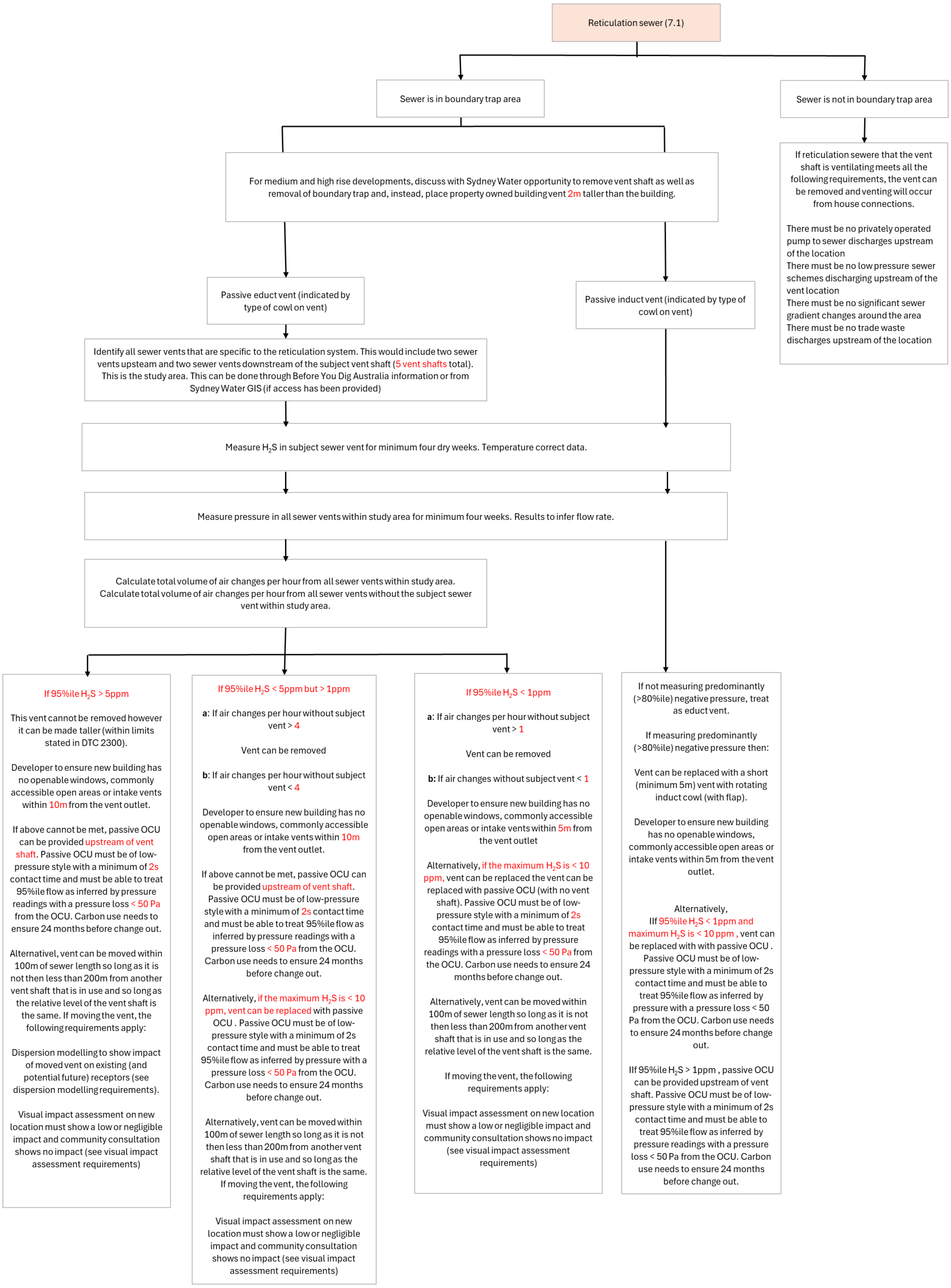


Figure 7-1: Decision framework for reticulation sewer vent shafts

7.2 Branch and Trunk Sewer

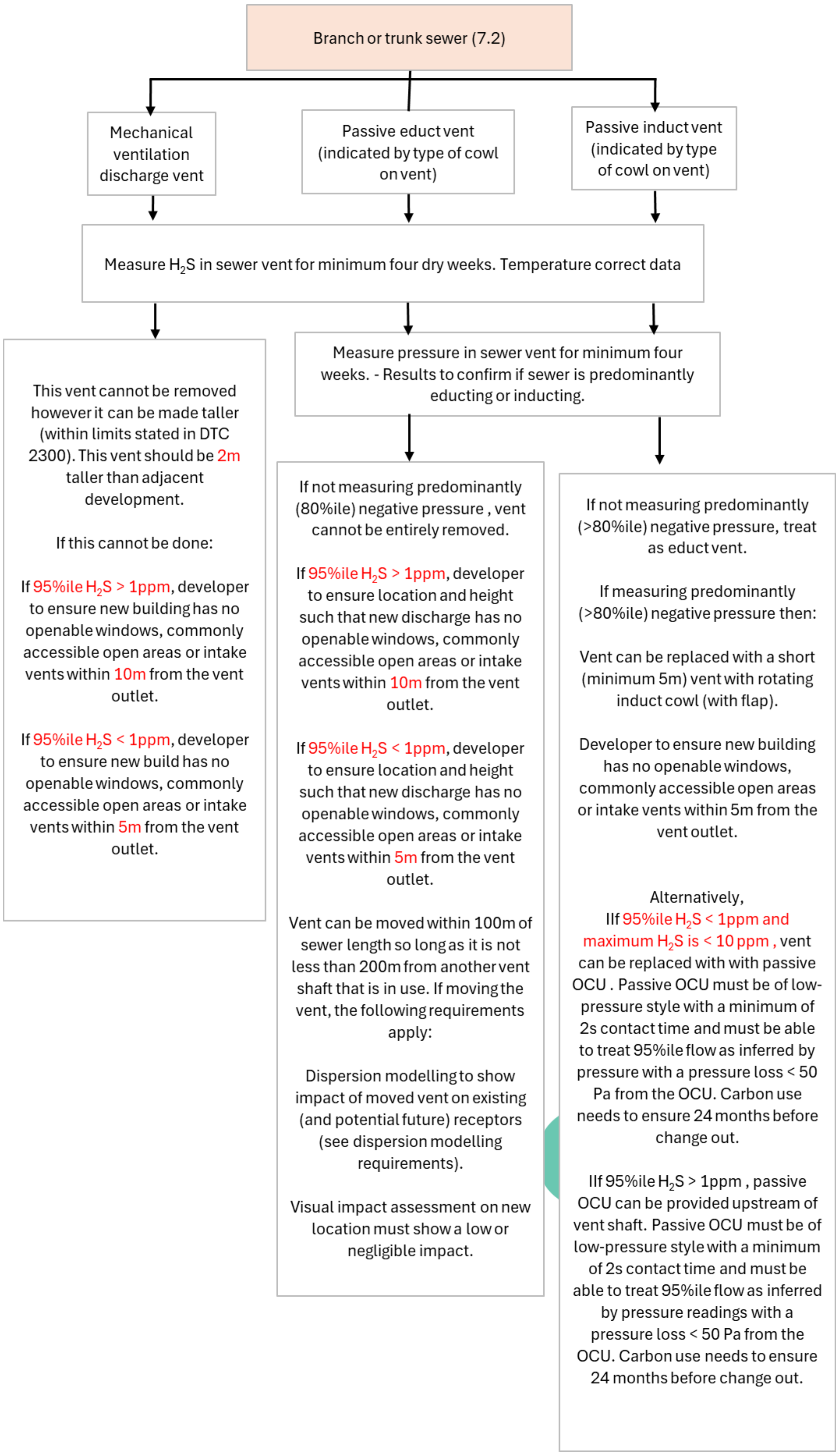


Figure 7-1: Decision framework for branch and trunk sewer vent shafts

7.3 Sewer Pumping Station

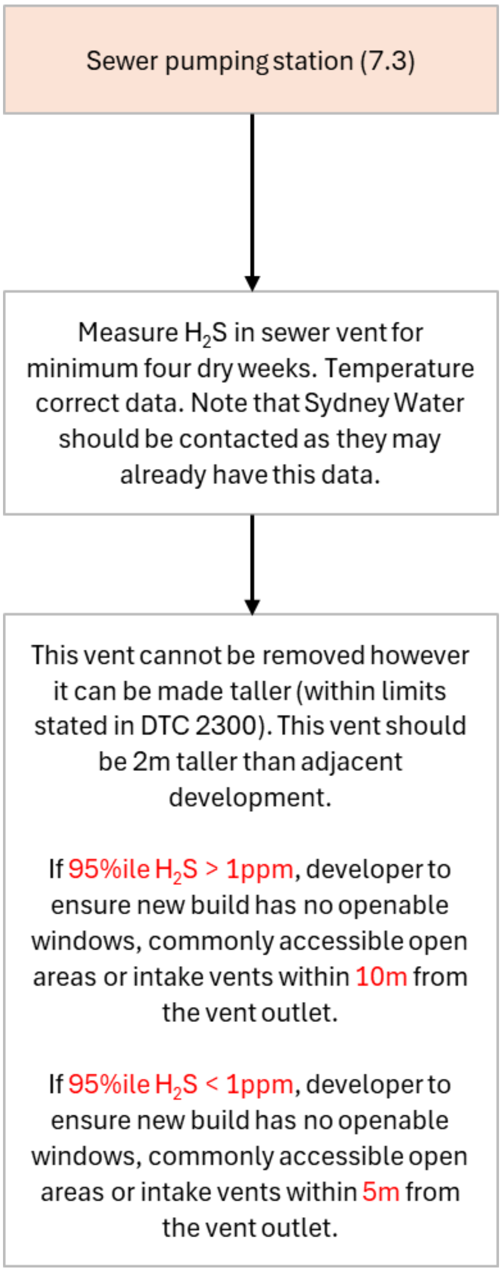


Figure 7-3 Decision framework for sewer pumping station vent shafts

7.4 Pressure Main Discharge Maintenance Hole

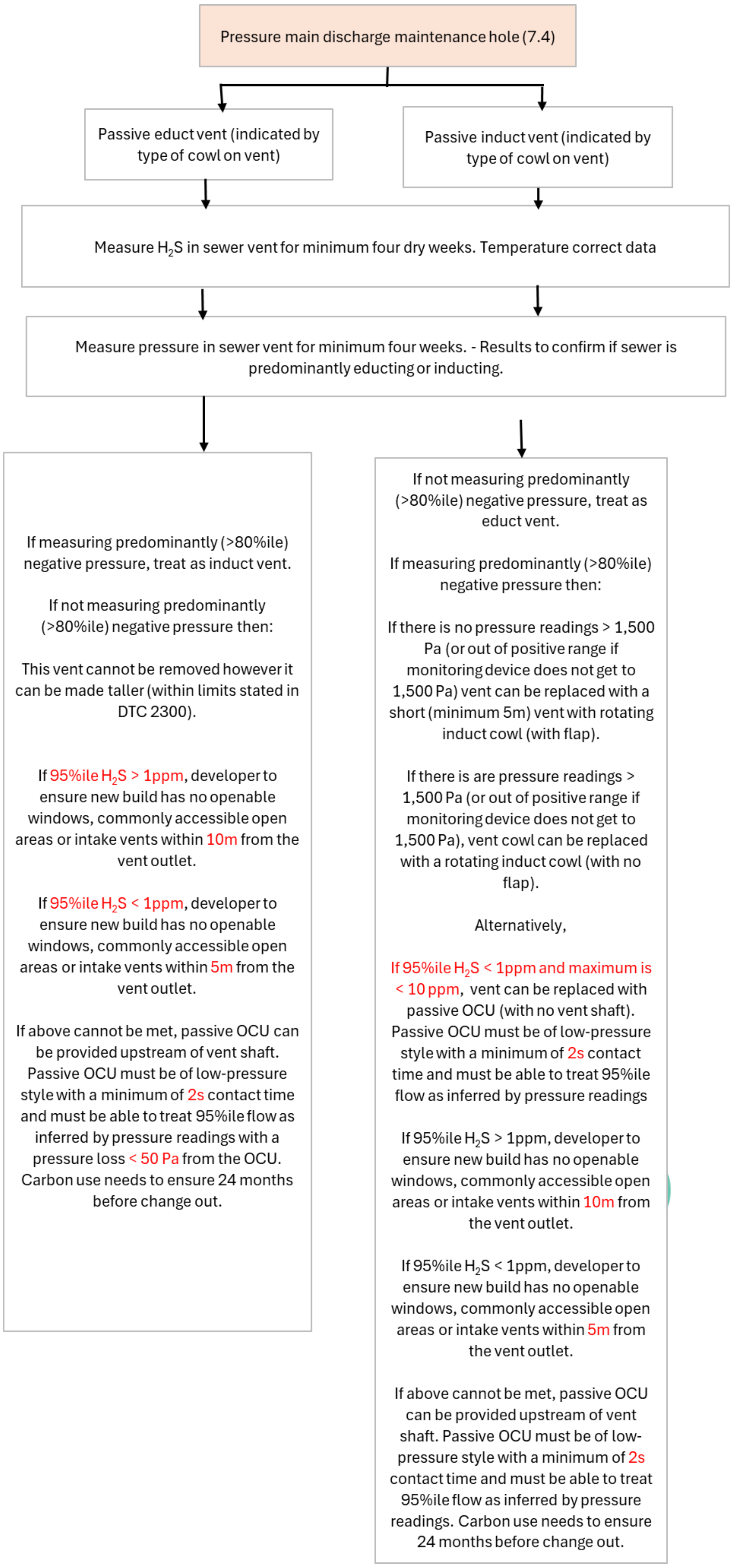


Figure 7-4: Decision framework for pressure main discharge maintenance hole vent shafts

7.5 Air Valves

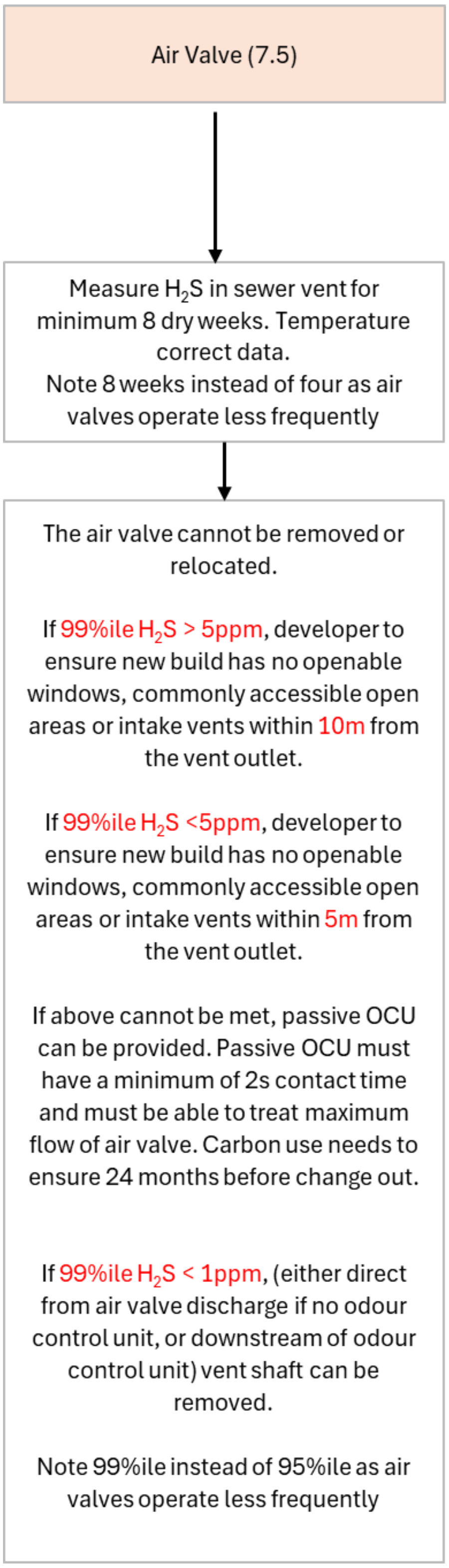


Figure 7-2: Decision framework for air valve vent shafts

7.6 Syphon

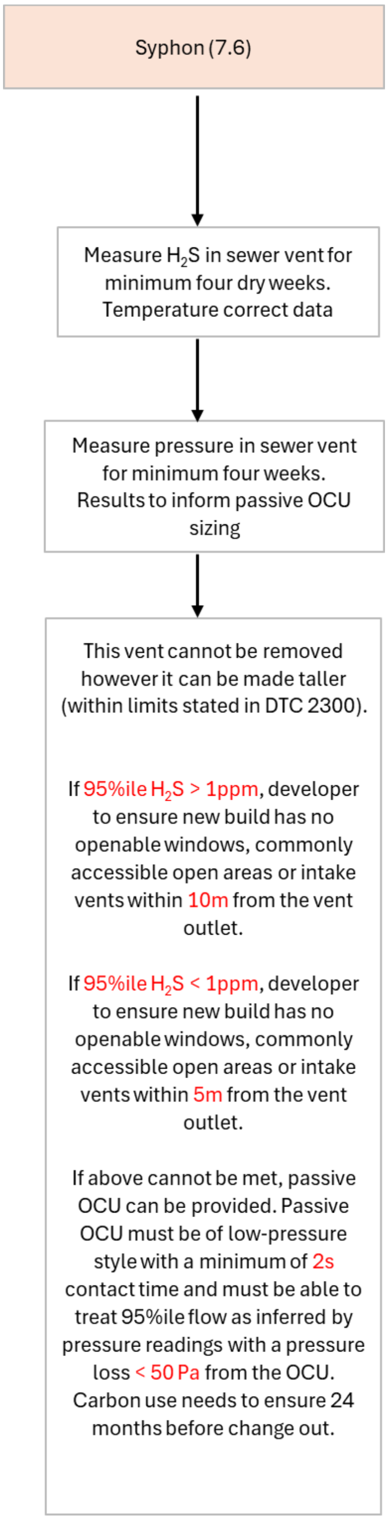


Figure 7-3: Decision framework for syphon vent shafts

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Appendix A: Historically used vent shafts and cowls

This appendix provides information on historically used vent shafts and cowls.

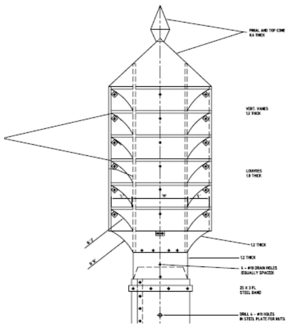
Table A-1: Historically used types of vent shafts

Type	Description	Image
No longer used for new installations by Sydney Water		
Cast Iron (CI) Column	Free-standing type of vent with a decorative cast iron base. For safety reasons the current policy is to paint the base white when in road or parking lane. CI column vents are no longer being installed but are maintained in heritage areas by the use of an adaptor plate to use a stainless steel tube (DTC for this adaptor plate is currently being developed as of June 2024).	
Guy Wire	The most common type in use. Consist of supporting legs and bands on the lower half with spreaders and guy wires. Sizes are DN 150, 225, and 300 and heights range from 12 to 18 m.	

Type	Description	Image
Free Standing Taper - Mild Steel	Vent consists of a tapered (conical) tube with no above ground support. These are fairly common but are no longer in the standards and are being replaced with other types of vent. When a rust hole appears it is deemed unsafe.	
Free Standing Tube	Vent consists of a tube with no above ground support. This type of vent is constructed from fibreglass and used in aggressive conditions e.g., coastal areas. Sizes range from DN 150 to DN 400 and heights range from 13 to 16 m.	
Free Standing Taper - Concrete Type	Concrete vents are normally inherited from Council sewerage schemes. They are prone to concrete cancer and are not maintained but are preplaced when required with either a post or guy wire vent. They are becoming less common in Sydney Water.	 Segmented taper

Type	**Description**	**Image**
		 Single taper

Table A-2: Historically used types of cowls

Type	**Description**	**Drawing**	**Image**
No longer used for new installations by Sydney Water			
Induct	Static vanes pointing down. Whilst no longer installed, existing induct cowls are maintained and replaced where they have heritage value.		

Type	Description	Drawing	Image
Cone Top Cowl	Whilst no longer installed, existing induct cowls are maintained and replaced where they have heritage value.