PRACTICAL METHODS FOR ESTIMATING ODOUR AND H_2S EMISSIONS FROM WASTEWATER TRANSPORT INFRASTRUCTURE

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Agenda

1. Introduction
2. Background - wastewater transport infrastructure
3. Key challenges in estimation of odour and H_2S emissions
4. Odour and H_2S concentration estimation hierarchy
5. Contemporaneous odour and H_2S measurements
6. Estimating ventilation air flow rates
7. Summary of emission estimation procedure

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Introduction

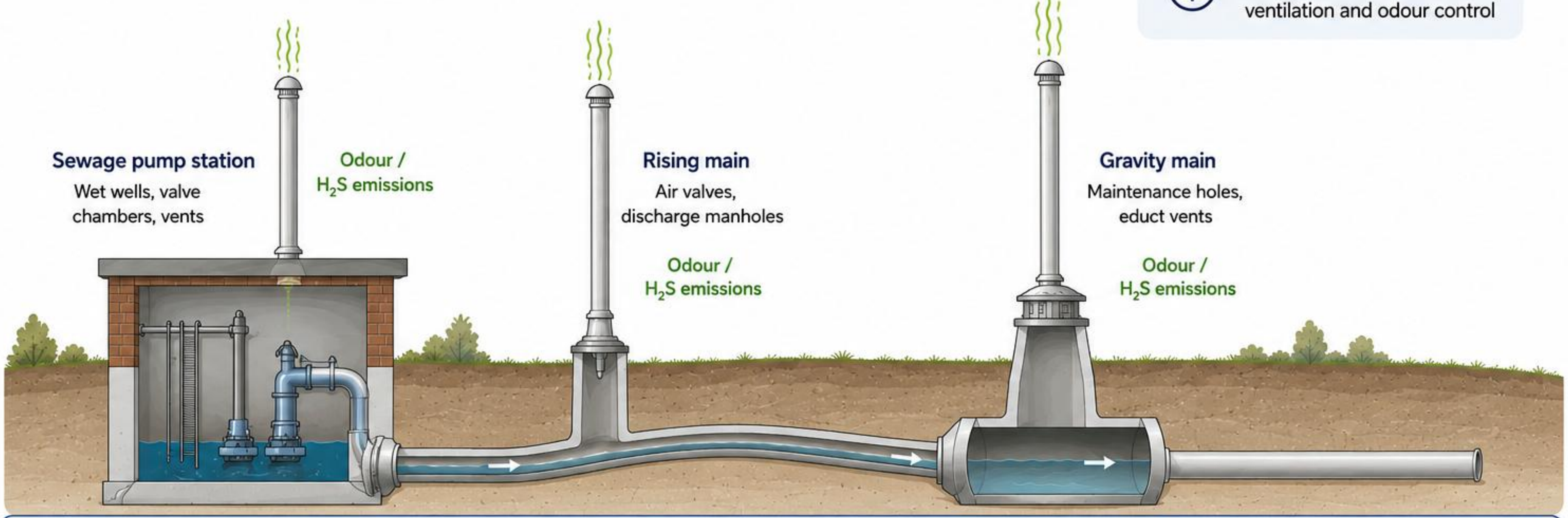
- Population growth increasing pressure on aging WWTI
- Significant infrastructure upgrades required to accommodate growth
- Odour impact assessments required to inform design decisions and support approvals in early design phases
- Key challenges include rapid delivery schedules and limited data availability for key inputs (pollutant concentrations, air flow rates and odour control efficiency)
- Paper explores these challenges and discusses methods used to develop robust emissions estimates

Odour and H_2S emissions from wastewater transport infrastructure

- H_2S is typically the dominant odorous compound
- Generated under anaerobic conditions in wastewater and sewer biofilms
- Dissolved sulfide can transfer to the gas phase due to pH, turbulence and ventilation
- Wastewater odour is a complex mixture of H_2S and other compounds *(e.g. mercaptans, amines, volatile fatty acids)*
- Emissions can occur from multiple WWTI sources

Why it matters

- Community amenity and complaints
- Regulatory approvals and compliance
- Design decisions for ventilation and odour control



Key factors influencing emissions

- Wastewater characteristics
- System configuration
- Operational conditions
- Environmental conditions
- Ventilation conditions

Key message: *Odour emissions are highly variable and depend on both wastewater conditions and how the infrastructure is ventilated.*

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Key challenges

Data availability

- Targeted odour monitoring is costly and rarely undertaken during early project phases
- H_2S data is more commonly available, but may be spatially or temporally limited
- Greenfield projects require emission estimates without site-specific measurements
- Early phases of design mean some important information not available

→ **Requires alternative data sources**

Temporal and spatial variability

- H_2S and odour concentrations have fluctuating diurnal pattern
- Peak concentrations generally coincide with periods of peak system load
- Localised hotspots can occur at specific infrastructure

→ **Difficult to represent with simplified models – requires different model scenarios to reflect variability**

Odour–H_2S relationships

- H_2S is often used as a surrogate for odour
- The relationship is highly variable and site-specific
- Simple conversion factors can misrepresent actual odour

→ **Requires representative measurements or assumptions**

The challenge is not eliminating uncertainty, but developing a transparent and defensible approach to managing it.

Step 1: Estimation of odour and H_2S concentrations

Odour concentration

H_2S concentration

Direct measurement most reliable but often not available

H_2S + odour measurements from nearby infrastructure preferably contemporaneous

Published odour databases – lower level of certainty means selection of conservative concentrations important (e.g. 70th percentile)

Process modelling / mass balance
↓
Measurements from comparable infrastructure in different catchments / literature review

Average & peak odour and H_2S concentrations

Key principle
Prioritise representative, site-specific data where available, while using comparable data and conservative assumptions where it is not.

Contemporaneous H_2S + odour measurements

Obtain local contemporaneous H_2S + odour measurements (e.g. nearby ventilation points)

Derive OU:H_2S ratio

Apply to design H_2S concentration

$$R = \frac{OU_M}{HS_m}$$

Where:
R = ou per part per million (ppm) H_2S.
OU_m = measured odour concentration (ou)
HS_m = measured H_2S concentration (ppm).

$$EOC = EHC \times R$$

Where:
EOC = estimated odour concentration
EHC = estimated H_2S concentration
R = ou per ppm H_2S.

Worked example:
2,000 ou ÷ 5 ppm = 400 ou: 1 ppm
7.5 ppm × 400 = 3,000 ou

Estimating ventilation airflow

Passive/natural vents = Hydraulic flows (e.g. ADWF, PDWF, PWWF)
Active mechanical vent = Industry standards calculations for minimum mechanical ventilation rates

Sewage pump stations	• Air flow rates relatively consistent, particularly for mechanically ventilated systems • Airflow can be calculated using industry standard minimum ventilation requirements (e.g. 6 air changes per hour)
Sewer rising main	• Large variability in air flow rates with potential for high flows/pulses associated with upstream pump cycles • Average scenario flows = ADWF • Peak scenario flows = maximum single pump flow or PWWF
Sewer gravity main	• SGM educt vent flows typically less variable than SRMs – not influenced by pump cycles • Average scenario flows = ADWF • Peak scenario flows = PDWF

The challenge is not eliminating uncertainty, but developing a transparent and defensible approach to managing it.

Air flow rate estimation methods for mechanically ventilated assets commonly used in industry

Asset type	Air flow rate estimation method
Pump station	1.25 × PDWF
	1.25 × maximum upstream pump flowrate
	6 air changes per hour
Rising main air valve	1.0 × maximum upstream single pump flowrate
Rising main discharge manhole	1.2 × maximum upstream pump flowrate

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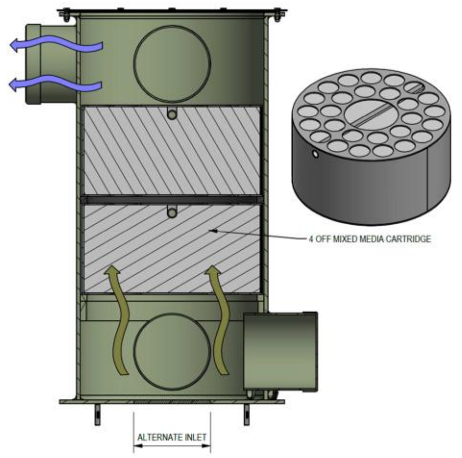
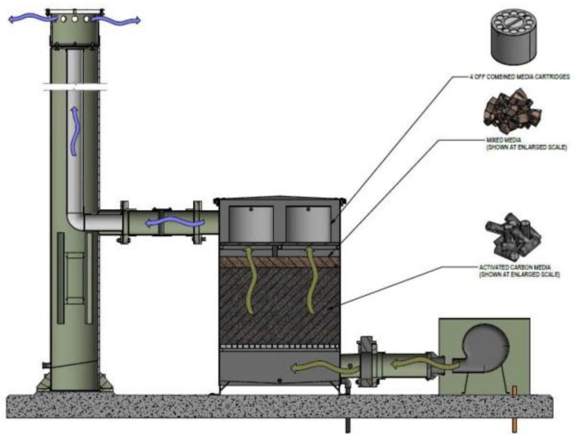
Odour control filtration: Key considerations

- **Filtration reduces emissions, but does not eliminate them**
- **Typical performance:** Caustic-impregnated activated carbon can achieve **>95% removal efficiency** (Le-Minh et al., 2014).
- **Performance degrades over time:** Filter media effectiveness decreases as media becomes exhausted
- **Conservative modelling:** Adopt **realistic/conservative removal efficiencies** to account for potential degradation and maintenance delays.
- **Risk communication:** Clearly identify assumptions and limitations associated with odour control efficiency and highlight the **increased nuisance risk from inadequate maintenance**.
- **Demonstrate the risk:** Where practical, model both:
  - **Controlled scenario** – filtration operating effectively
  - **Uncontrolled/degraded scenario** – reduced or no filtration efficiency

Key message: *Odour control should be treated as a risk-reduction measure, not a complete elimination of emissions.*





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Odour and H_2S emissions estimation procedure

Step 1: Estimate odour and H_2S concentration
Direct measurement, process modelling, mass balance, monitoring, measured odour–H_2S relationship or published datasets

Step 2: Estimate ventilation rate

Hydraulic modelling (ADWF, PDWF, PWWF), maximum single pump capacity or industry standard calculation methods

Step 3: Determine odour control efficient
Nominate odour control efficiency which considered odour control technology and accounts for filter degradation

Step 4: Calculate odour and H_2S emission rates
Concentration × airflow - odour control factor

Determine concentrations for average and peak scenarios

Thank you

Questions?