AN INTEGRATED APPROACH TO ODOUR TREATMENT

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ABSTRACT

Mangawhai is a rapidly expanding town on the east coast north of Auckland. To cope with increasing population and to improve the condition of the harbor waters the Kaipara District Council let a contract to Water Infrastructure Group (formerly Earth Tech) to design, build, transfer and operate a sewerage collection and treatment scheme for Mangawhai. Odour generation in the reticulation was recognized as a problem from the outset. This paper describes the approach taken to firstly identify sources of odour and to treat these sources to mitigate any adverse effects.

At the design stage low population densities for most of the year resulting in increased residence times in rising mains and the use of pressure sewer systems to service parts of the town were identified as posing particular problems. As a first stage odour reduction measures adopted at the design stage included close fitting covers on pump wet wells, and chemical dosing with calcium nitrate to prevent septicity developing. On commissioning some problem areas were identified where these measures were insufficient and proprietary vermiculite/hypochlorite filters were fitted to some household vent stacks. Specially developed carbon filters were fitted to two pump stations. This has proved to be a cost effective method of tackling odour problems and the end result is an essentially odour free system.

KEYWORDS

Odour, sewer, reticulation, pump stations

1 INTRODUCTION

Mangawhai is a coastal town north of Auckland. The 2001 census reported the population of the Mangawhai area as 1260 people. It has a large number of baches and attracts a large holiday population during the summer and holiday periods. In March 2002 there were some 1,216 lots. These were served largely by septic tanks. Since then subdivision has proceeded apace and by 2006 a further 875 lots were approved with another 1,100 in the pipeline.

To cope with this expansion and to preserve the quality of the harbor waters the Kaipara District Council investigated the installation of a sewerage treatment scheme to serve Mangawhai. After some years of investigation and community consultation a contract was awarded to Water Infrastructure Group (formerly Earth Tech) to design, build, transfer and operate a sewerage collection and treatment scheme for Mangawhai. Construction works started in early 1998 and the first houses were connected in June 2009.

Reticulation design was complicated by the spread out nature of Mangawhai with the town divided into two distinct areas the heads, a hilly area fronting onto the estuary and the village; a low lying flat area that traditionally acted as a service centre for the wider district. A mixture of pressure sewers and conventional gravity sewers was selected as the most economical design.

Odour discharge from pump stations was recognized as a potentially significant problem from the outset. A number of authors have proposed methods of evaluating hydrogen sulphide (the major odour component) levels in sewers. (Pomeroy 1990) The Manual for Wastewater Odour Management (Water NZ 2000) provides

information on both sources of odour and methods of treatment. These are however only of limited value in predicting just which parts of the reticulation system are likely to give rise to objectionable odours.

Issues relating to odour development and control identified at the design stage included:

- The low number of houses (around25%) occupied throughout the year leading to low flows and high residence times in rising mains. This was acerbated by spread out development and the need to service new subdivisions with relatively few houses initially.
- The use of pressure sewer systems to service the largely flat village and other pockets of housing located below main lines. (Anaerobic conditions can develop rapidly in these systems.)
- The close proximity of pump stations to residences (often in the grass verge) and the need to keep the visible footprint as small as possible.
- Cost – both operating and capital. As pump stations reduce in size odour control tends to become a larger proportion of station cost.

Rather than attempt to predict problem areas it was decided to develop a range of solutions and apply these in the field once problem areas were identified. This paper discusses the development and application of the odour control strategy employed in Mangawhai.

2 ODOUR

2.1 SOURCES

Odourous compounds, of which hydrogen sulphide is the main contributor, are generated by the action of anaerobic bacteria. (Pomeroy 1990). With gravity sewers the numerous air entry points provided by household vent stacks ensure air is dragged along the sewer by the action of the flowing water and odour is not generally noticeable. Odour problems are typically associated with long pressure mains where long residence times ensure any dissolved oxygen in the sewerage will be rapidly utilized. (Ryan)

Pressure sewer systems are a potential source of odour as oxygen in the sewage entering the pump well is largely used up between pump cycles (a typical house might pump three or four times a day); houses only occupied at weekends will have stagnant sewage in the pump wells for many days. The sealed piping system maintains anaerobic conditions until the sewage discharges at pump stations. A long rising main from the pump station, as at the village pump station exacerbates the situation.

2.2 CONTROL MEASURES

Two basic approaches to odour control are possible:

1. **Prevention** – anaerobic conditions can be prevented from developing by providing a source of oxygen for the bacterial population.
2. **Treatment** - air discharged from the pump stations and elsewhere in the reticulation system can be treated to remove odourous compounds.

2.2.1 PREVENTION

This is the preferred solution if it can be delivered at an economic cost. Oxygen can be provided directly in the form of aeration with oxygen gas. This is cost effective only in the largest systems and was not considered for Mangawhai.

Anaerobic bacteria can also utilize oxygen from nitrate. (Mathioudakis et al. 2006) Dosing with nitrate solution can prevent anaerobic conditions developing. Both Calcium and ammonium nitrate are readily available from fertilizer suppliers and present no particular handling problems. Mathioudakis (2006) notes further that, if dosed

into septic wastes, nitrate will promote the conversion of sulphide to sulphate thus reducing hydrogen sulphide levels

2.2.2 TREATMENT

Four main air treatment systems have been applied to treat sewer odours from pumping stations.

Biofilters –Well proven in NZ these use a bark bed which, when kept moist, develops a microbial flora that breaks down pollutants to CO_2 and water. In Mangawhai problems of keeping the bed moist (Mangawhai does not have a reticulated water supply) and the need for a fan to push air through the bed counted against the use of biofilters. Space was also a consideration at several sites.

Chemical Scrubbers. Size and complexity made these unattractive and they were not investigated further

Vermiculite/chlorine Filters. An Australian company McBurns Pty. Ltd. manufactures small (50- 300 dia) odour filters that had proved effective in Australian projects. They are available fitted with wind powered extract fans and are cost effective for smaller installations.

Activated Carbon. Activated carbon has been proven in many installations. Typically a fan and an air inlet heater to control humidity are needed.

3 OUR APPROACH

3.1 PREVENTION

It was decided that in the first instance that we would target prevention rather than treatment. A 200 litre chemical tank was mounted adjacent to the pump station. This was fitted with a solenoid valve and a 6mm discharge line was run down the vent line and into the pump well. (All pump wet wells had vent lines installed during construction so odour treatment equipment could be installed without needing to enter the pump station.) The solenoid valve was controlled by a timer which allowed a slug of solution to flow in at the end of each pump cycle thus giving approximately proportional dosing. Photograph one shows the dosing system installed at Wintle St.

Photograph 1 Nitrate dosing system

Two systems were installed, one at the village where septic waste was expected from the pressure sewer lines and one at Wintle Street. The latter discharged via a chain of four pump stations before reaching the main pump station. Tests at pump stations downstream from Wintle Street showed that nitrate remained in solution through three stations in the chain.

At the village pump station high levels of hydrogen sulphide were present in the incoming sewers. Dosing here therefore could only reduce odour at the downstream pump station rather than at the pump station itself.

This approach is similar to that adopted by Hunter Valley (Ryan) It was recognized that further treatment of pump station vents might be required and the pump station electrical cabinets included provision to power an extract fan if found necessary.

4 OPERATIONAL ISSUES

4.1 HOUSES

Houses were connected progressively area by area. The first reports of odour came from a householder at the top of a rising main where it discharged into a gravity sewer before passing to the next pump station. This rising main had chemical dosing installed however odour from the house vent stacks was noticeable. This house was fitted with a McBern ventilator on the main stack and a non return valve (Hunter valve) on a second stack. (see photo). Neighboring houses were monitored in case the problem simply migrated next door but no further odour was noticed in the area.

Photograph 2 McBern ventilator and non return valve

As the reticulation system was progressively commissioned the same problem appeared at other high points. These were treated in the same way so we now have six stacks fitted with filters and five with Hunter valves.

Since completing this work there has been no household complaints. A small stock of filters and replacement filter elements together with adaptors to fit most vent stacks are held at the plant which allows rapid response if any one reports odour problems. At this stage the first filters have been in service for six months without odour breakthrough.

4.2 PUMP STATIONS

There were no odour issues at the majority of pump stations. All pump stations are fitted with aluminium lids that largely seal the wet well; the well was vented by an induct valve. Odour was however an issue at two of the thirteen pump stations. These were the village, which receives sewage from pressure sewers and the main pump station delivering to the treatment plant. After discussion with several suppliers it was decided to install a large, low air velocity, carbon filter without a fan or any air pre-conditioning. The first unit was installed at the main pump station and immediately following on a second was installed at the village pump station. These have proven very effective and there have been no further odour apparent since these were installed. (These units are described in more detail in another conference paper.)

5 CONCLUSIONS

There are a number of potential sources of odour in sewerage reticulation systems. It is difficult at the design stage to predict just where odour from the system will become a nuisance. At Mangawhai it was decided to initially fit chemical dosing to restrict odour generation and follow this up by tackling the individual sources of odour with adsorption filters once problem areas were identified. It has proved possible to develop simple solutions not reliant on powered extract systems or elaborate control devices that have effectively eliminated odour.

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