

OVERVIEW: SEWER AIR FLOW & ODORS

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This document will provide a brief explanation of the dynamics within a wastewater conveyance system that can lead to air movement and foul air escape. This overview may be useful in understanding the various solutions the City of Los Angeles is studying to address odor issues stemming from its sewer system.

Sewer systems are designed to allow gravity to provide most of the force by which wastewater is caused to flow from its origin to a wastewater treatment plant. Because most of the resistance to flow occurs at the pipe wall, gravity sewers are sized so that the wastewater does not fill the pipe, resulting in a free air space that offers little flow resistance above the moving wastewater. As the wastewater flows downstream, air is dragged along with the wastewater and a low pressure can result in the sewer relative to its surroundings. When this occurs, air flows in from the surrounding atmosphere through maintenance hole covers and connecting sewers. If the flow of air is restricted due some obstruction, the foul air will be compressed and its pressure can exceed that of the sewer's surroundings. As a result, the foul air will flow out leak points in the sewer. These points can be maintenance hole lids, sewer vents, dry sink, shower or floor drain p-traps and leaking toilet seals in homes and businesses. The compressed foul air will find its way out through any path that is available.

A siphon is part of a gravity sewer that allows wastewater to flow beneath and obstruction like other buried utilities or roadways. The upstream and downstream ends of the siphon are higher than its middle that is filled completely with wastewater. As a result, air cannot flow through the siphon and it becomes the obstruction that can cause foul air to escape as described above. As an example, this is apparently the cause of odor problems originating from the North Outfall Relief Sewer (NORS) in the vicinity of the siphon inlet near the Interstate 405 freeway.

It is possible to allow air to flow around a siphon by installing a properly sized pipe commonly referred to as an air jumper. The air jumper is simply an open pipe higher in elevation than the siphon that connects the siphon's inlet to its discharge. In theory, the air that is dragged to the siphon inlet by the wastewater will flow through the jumper to the discharge where the flowing wastewater will continue to pull it down the sewer's free air space. This has been a successful strategy in relatively short siphons but in longer siphons, such as the NORS siphon, existing air jumpers have proven to be an unsuccessful strategy for allowing air to flow around its 5,367-foot length.

The ability to predict precisely and accurately how air will flow within and escape from a sewer has proven to be difficult. As the recently completed Water Environment Research Foundation (WERF) Minimization of Odors and Corrosion in Collection Systems study has shown, models can be significantly inaccurate. This is not to say they cannot be useful but modeled airflows must be considered carefully and conservatively.