

**NORS Siphon Air Line Feasibility Study
Comments by Independent Odor Expert – Dirk Apgar**

Introduction

This paper is intended to provide a constructive critique of the work produced by the HDR/Malcolm Pirnie team for the City of Los Angeles Bureau of Sanitation entitled North Outfall Relief Sewer (NORS) Siphon Air Line Feasibility Study (Study). The stated purpose of the Study was to examine the feasibility of improving sewer air movement at the NORS siphon. It is believed that airflow within the NORS is blocked at the siphon inlet causing foul air from the sewer to escape and cause odor impacts in the surrounding community.

Alternatives Critique

The Study describes the basic characteristics of the NORS siphon and examines five possible alternative methods to reduce foul air from escaping from the sewer and impacting the community. The five alternatives examined are:

1. Installation of a new, single air jumper line
2. Installation of fan(s) to force air through the existing air jumper lines
3. Construction of a new air treatment facility (ATF) near the siphon inlet
4. Connection of the NORS and the North Central Outfall Sewer (NCOS) air spaces
5. Management of the wastewater flows and upsizing existing sewer ATFs

Each alternative will be examined based on its potential ability to relieve the community of nuisance odors. Other aspects of the alternatives, such as constructability or costs, will not be addressed in this current paper. Verification of the Study authors' calculations has not been conducted but the reasonableness of those values has been assessed based on the experience of the independent odor expert (IOE). Information will be provided to explain why each alternative could decrease odor impacts in the community, why each could fall short of that goal and, in some cases, could result in increased nuisance to the neighbors.

Alternative 1: New Single Air Jumper Line

The single air jumper alternative would replace the four existing small diameter jumpers and connect the inlet and outlet of the NORS siphon with a 36-inch diameter ribbed high-density polyethylene (HDPE) pipe. The Study indicates that the air jumper would need to convey 20,000 CFM of foul air from the inlet to the discharge of the siphon where it could, but may not necessarily, travel to the Hyperion Treatment Plant where it could be treated in the plant's ATFs. It is not clear how the 20,000 CFM value was determined but it is not an unreasonable flow rate given the size of the NORS sewer. Because the differential pressure between the inlet and outlet of the siphon is not sufficient to force this volume of air through the 5,367 feet length of the air jumper, the Study rightly concludes that a fan would have to be provided to induce the airflow. The resistance to airflow could be reduced if a smoother pipe design was selected but a fan would almost certainly still be required.

There are several negative aspects to this alternative that make it unattractive. First, the Study states that it is "expected" that the sewer downstream of the siphon would be able to accept the 20,000 CFM of foul air. Without actually testing this hypothesis under many wastewater flow

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conditions this cannot be guaranteed. Forcing this volume of air into the sewer could result in forcing foul air out into neighborhoods that currently do not experience nuisance odors thus creating new problems while solving others.

Alternative 2 – Place Fan in Existing Air Jumper Lines

The current NORS siphon includes four 18-inch diameter air jumpers that were installed in its original construction. These PVC pipes have not proven effective in relieving the positive air pressure at the siphon inlet. As discussed above with the single air jumper described in Alternative 1, the differential pressure between the inlet and outlet of the siphon is not sufficient to force the 20,000 CFM of air through the 5,367 feet length of the four air jumper lines. This problem is more severe than with the single air jumper option because the smaller diameter pipes would provide more resistance to airflow than the single air jumper of Alternative 1. The Study again rightly concludes that a fan would have to be provided to induce the airflow.

As with the single air jumper alternative, there are several negative aspects to this alternative that make it unattractive. Again, the Study states that it is “expected” that the sewer downstream of the siphon would be able to accept the 20,000 CFM of foul air. Without testing this hypothesis under many wastewater flow conditions success cannot be guaranteed. Forcing this volume of air into the downstream sewer could result in forcing foul air out into neighborhoods that currently do not experience nuisance odors thus creating new problems while solving others.

Alternative 3 – Place Air Treatment Facility at Siphon Inlet

This alternative would extract 20,000 CFM of foul air from the siphon inlet to relieve the high pressure in the sewer upstream of the siphon thereby preventing odor impacts. The extracted air would be treated first in a biotrickling filter to remove hydrogen sulfide and then in an activated carbon scrubber to remove residual odors. Finally, the treated air would be released into the neighborhood through an elevated stack. This combination of technologies can provide very good odor control if properly designed and operated. In addition to the two odor control devices, the Study describes the other basic devices necessary to complete the system design.

The ATF would extract the sewer air and convey it to the ATF that could be located somewhat remotely from the siphon inlet. This flexibility could allow the selection of an exhaust stack location that provides sufficient height to allow further dilution by atmospheric dispersion of any odors that pass through the odor control system.

The Study describes a system that would include multiple parallel biotrickling filters and parallel carbon scrubbers. This would allow part of the system to be taken off-line for maintenance without eliminating all odor control or allow part of the system to be operated while the other parts were in standby providing operating flexibility depending on odor control needs.

Maintenance of the system described would be crucial to ensure adequate odor control. Biotrickling filters and carbon scrubbers are low maintenance devices compared to equipment like wet chemical scrubbers. However, they are not maintenance free. If system upsets occur it is

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conceivable that the 20,000 CFM of foul air could be emitted to the neighborhood virtually untreated and cause significant odor impacts.

Alternative 4 – Install Interceptor Connection (NORS & NCOS) Air Line

The Study explains that the NCOS typically experiences internal air pressure that is below that of the surrounding atmosphere while the air within the NORS is above atmospheric pressure in the vicinity of their respective siphons. It is reasoned that the air space of each sewer could be joined by an air duct allowing the high pressure NORS to be relieved by allowing air to be drawn downstream into the low pressure NCOS.

The Study describes an actual field test that joined the two sewers' air spaces with an above ground duct and the resulting pressure changes in each. The pressure was measured in the two sewers for approximately one week prior to and one week after the duct installation. This does represent a good effort by the City of Los Angeles and the HDR team but it did not include data from much of the year when the pressures may differ significantly due to seasonally changing wastewater flows. If flows do not change significantly throughout the year the collected data may be sufficient. If the wastewater flows do change significantly additional data collection and analysis could be warranted or more conservative design assumptions may be prudent.

The average air pressure in the NORS was apparently decreased by about 30% as a result of the air duct installation according to the information in the Study. However, the pressure is still well within the positive range at 0.14 inches of water column. While this decrease in average pressure could provide a decrease in the amount of sewer out-gassing and odor impacts it would be difficult to estimate by how much.

The attractive aspect of this alternative is its simplicity. The Study indicates that it would cost approximately \$200,000 to install. Because it is simple it could likely be installed more quickly than the other alternatives discussed and provide some relief to the community. However, it is unlikely to provide total relief from nuisance odors to the community because the remaining positive pressure in the NORS.

Alternative 5 – Flow Management & Upsize Existing ATFs

The Study apparently examined this alternative to determine how the existing ATFs in the system affect the air pressure values in the NORS and NCOS. Although it is not explicitly stated in the Study, it is assumed that the purpose of the investigation was to determine if increasing the airflows through the ATFs would decrease those pressure values and subsequent escape of odor impacts from the sewers.

The description of the investigation includes a discussion of the interconnections between the NORS and NCOS with the temporary air duct, the East Central Interceptor Sewer (ECIS) and several other contributing sewers. Air pressure data loggers were placed in the sewers and air pressure measurements were made before and after the installation of the air duct connecting the NORS and NCOS. After the duct was installed, airflow through the duct and further sewer air pressure measurements were made while the fans at the existing NORS/ECIS junction structure

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ATF and the Jefferson Siphon ATF were turned off and on. The Study states that the data revealed the air duct installation had a significant impact on pressure differential between the NORS and NCOS. However, it was stated earlier in the Study that the average pressure in the NORS was still 0.14 inches of water column. This is still quite high and, as stated earlier in this paper, could result in odor emissions from the sewer.

The Study also states that active ventilation did not have a desirable effect on the air pressures in the NORS or the NCOS and that the pressure in the NCOS increased to greater than 1.0 inches of water column. This is a very high value for sewer air pressure and would likely lead to significant odor impact in the neighborhood surrounding that sewer in the vicinity of the area where air is forced into the sewer.

The Study concludes that the existing NORS/ECIS and Jefferson Siphon Scrubber (ATF) operations had a more significant impact on air pressure reduction in the NCOS than in the NORS. It also speculates (not unreasonably) that this may be due to the interconnection of the air spaces of the two sewers and that upsizing of the ATFs and closing off some of the interconnections may lead to better air pressure control in each sewer.

Discussion

The NORS Siphon Air Line Feasibility Study examined five possible alternatives for reducing odor impacts caused by high air pressure conditions resulting from the airflow blockage caused by the siphon. While other or more alternatives could have been selected for examination those selected are reasonable.

The installation of a single (large) air jumper line or the use of the existing small air jumpers with an added fan could relieve the high air pressure in the NORS upstream of the siphon. However, moving the air to the downstream side of the siphon could cause odor emissions to be moved from one location to the other. For this reason alone these alternatives are unattractive and should probably not be considered for implementation.

Installation of a new ATF facility to remove foul air at (or near) the siphon inlet could provide the most certain relief of high air pressures upstream of the NORS siphon. Properly sized, designed and maintained, the new ATF could significantly reduce the frequency, intensity and duration of odor impacts on the surrounding neighborhood. Odor impacts could be reduced to non-nuisance levels by implementing this alternative.

The Study concludes that connecting the NORS and NCOS with an air line (Alternative 4) coupled with managing flows and upsizing the ATFs (Alternative 5) should be considered by the City of Los Angeles because they lower the pressure upstream of the NORS siphon and, therefore, lower the probability of odor emissions from the sewer. Due to their simplicity and relative low cost these alternatives could provide some relief to the neighboring communities. The Study further recommends that the City continue with a redesign of the ATF to relieve pressures upstream of the NORS siphon (Alternative 3). The IOE concurs with these conclusions and recommendations, as it is likely that a combination of these three alternatives will be necessary to adequately control odor impacts in the community.

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Conclusion

The NORS Siphon Air Line Feasibility Study discussed a reasonable set of alternative solutions to the problem of odor problems caused by the high pressures in the sewer air space resulting from blockage of air movement caused by the siphon. While a myriad of different alternatives could have been selected for analysis, those selected, particularly the first three and the fifth, would have been quickly identified by the IOE as reasonable and prudent in the exercise of good engineering judgment and due diligence. The consideration of the fourth alternative (air duct connection of the NORS and NCOS) shows creative thinking. It alone is not likely to completely solve the NORS siphon odor problems but the proximity of the two sewers and the potential for a low cost partial solution made it worthy of consideration.

The Study's conclusion is reasonable. It will likely require a combination of air extraction from the NORS siphon inlet with air treatment in a new ATF and some degree of flow management and increased capacity in the existing ATFs in the sewer system. This combination of alternatives should be further examined in a formal predesign effort during which they can be investigated further. This would be a prudent course of action given the complexity and difficulty in assessing sewer airflow, odor emissions and the high cost of constructing air treatment facilities.