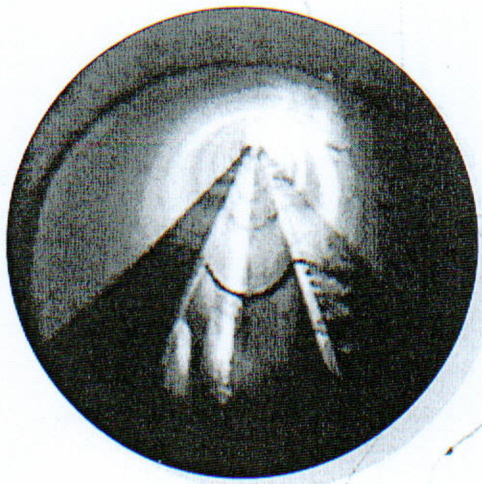
Greater Vancouver Regional District

Policy and Planning Department

Feasibility Study of Using GVRD Sewers as Heat Sources and Sinks



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Sandwell

2 EXECUTIVE SUMMARY

As part of the Sustainable Region Initiative (SRI) the Greater Vancouver Regional District (GRVD) Policy and Planning Department has commissioned this study to investigate the use of district sewers as heat sources or heat sinks. This conceptual study examines the technology available for sewer heat transfer, and provides a mathematical and physical model of a heat transfer system, in order to ascertain the feasibility, ecological benefits, and cost effectiveness of such a system.

Possible sites for implementing a sewer heat transfer system within the GVRD are also considered, with particular attention given to the Sapperton forcemain and the Trout Lake Trunk.

A thorough literature search revealed two practical, proven methods for heat transfer in raw sewage mains: a mechanically intensive system in place in Japanese cities, and a less obtrusive system with heat transfer panels in the sewer invert (termed "Rabtherm") in use in Zurich, Switzerland. The latter was selected as being most applicable in GVRD sewers and was studied further.

Other methods of heat recovery in use were "GFX" heat exchangers, for use in recovering heat at a residential level, and heat recovery systems in place on treated sewer flows or at industrial sites; these were not examined further.

District sewers over 1200 mm diameter can supply or dissipate significant heat energy, and are good candidates for installation of a heat recovery system. A 36 m length of sewer main lined with heat transfer plates will result in a net reduction of energy consumed of 106 kW; this displaces electricity or natural gas, and will reduce greenhouse gas emissions by 29 or 282 tonne/yr respectively. Greater or lesser amounts of energy can be recovered from the sewers with additional or fewer plates installed. The Rabtherm system can also be used for cooling, but with less efficiency.

The installation cost of a heat recovery system varies with its size. For a 106 kW system (36 m section of sewer), the cost is in the order of $300,000. At this cost, the payback time for a system displacing electrical load is 5 years (at $0.06 / kWh). The payback time for a system displacing natural gas is 17 years (at current gas rates), which may need further financial incentives to promote implementation. Such incentives may be prudent if based on objectives such as community sustainability and reduced greenhouse gas emissions, and in light of the Kyoto Agreement.

Numerous sites of all scales may be candidates for implanting a sewer heat recovery system, including townhouse complexes, high rise apartments, hotels, institutions such as hospitals, and industrial facilities. Further study of potential sites is required to confirm local sewer flows, particular site costs, and system size and integration.

The moderate density residential developments around the Trout Lake Trunk are suitable for a small scale system.

The Sapperton forcemain has (or will have in future) a number of high-density residential complexes as well as institutional complexes nearby, and is suitable for a mid-scale system.

Recovering heat from GVRD sewer lines is feasible and will reduce overall power consumption and greenhouse gas emissions. Potential trial or show case sites may be selected and should be examined further prior to implementing a system and realizing the energy and emission savings.

8 CONCLUSIONS

The GVRD sanitary sewer network operates at conditions ideal for recovering heat energy, and thus can contribute to reducing energy demand, reducing greenhouse gas emissions, improving air quality in the GVRD, creating a sustainable community and meeting Kyoto Agreement targets. Combined sewers are also suitable, but provide less benefit.

Technologies exist and are in use to recover sewer heat, particularly in Japan and Europe. One system, using Rabtherm panels, is best suited to be installed in GVRD sewer lines, and can recover energy ranging from 4 kW up.

Models based on a Rabtherm system indicate that a mid sized heat recovery facility displaces 106 kW of energy, either electrical or natural gas, and reduces greenhouse gas emissions by 282 t/yr based on displaced natural gas and 29 t/yr based on displaced electrical power.

The installation cost for a mid sized facility, if sewer heat transfer plates are installed in conjunction with planned replacement work, is roughly $300,000 and may be recovered in 17 years based on current natural gas savings, or 5 years based on current electrical savings. As energy costs increase, heat recovery facilities will have greater and greater financial impetus. Currently, financial incentives may be required to reduce the capital cost and thus to obtain the reduction in emissions when natural gas systems are replaced. The cost and benefits associated with any proposed installation must be examined in more depth prior to implementation, to account for the particular details of that installation.

Many sites throughout the GVRD have potential for using a heat recovery system.

The Sapperton forcemain offers some potential for recovery of energy. There are currently high demand users relatively close to the sewer and the municipal plans include development of high density residential complexes near the sewer. However, a new heat transfer device will be required for installation on the forcemain, as its construction differs from a gravity flow sewer.

The Trout Lake Trunk is a candidate for implementing small heat recovery systems, because of the low density development around it; the Trout Lake community center may be a potential site.

Other sites include townhouse complexes, high rise apartments, institutions such as universities, sports complexes or hospitals, or industries such as breweries, which are relatively close to sewer mains. New subdivisions may be able to combine sewer heat recovery with a district heating system.

The GVRD may be required to take a leading role in co-ordinating and promoting the use of sewer heat recovery.

Recovering heat from GVRD sewer lines is feasible and will reduce overall power consumption and greenhouse gas emissions. Potential trial or show case sites should be selected and examined further with the aim of implementing a pilot system to show the energy and emission savings.