I&I study reveals several issues with Sudbury's wastewater collection system

By Robert G. Langlois

The City of Greater Sudbury in Ontario is reviewing options to increase the operation efficiency of the various wastewater treatment plants within its area. One facet of the wastewater treatment system that has come under greater scrutiny is the collection system. The City is concerned that a significant amount of water is entering the sewers from outside sources (e.g., rainwater and groundwater), all of which flows to the City's 10 wastewater treatment plants.

In addition, capacity constraints in the collection network at times overwhelm the system and cause localized flooding and the need to discharge to the environment.

The City engaged R.V. Anderson Associates Ltd. (RVA) to complete an inflow and infiltration (I&I) study on the wastewater collection system in Lo-Ellen Park, which is a primarily residential area in the city's south end. This is an area of Sudbury that municipal engineers were particularly concerned about, given the age of the system (servicing began in 1960), the number of lift stations and force mains due to the rolling topography of the area, and the proximity of Nepahwin Lake.

Sigma flow monitors and Telog recording telemetry units during study.

Probe and band in sewer.

The scope of the I&I study included obtaining an understanding of the collection system, monitoring of sewage flows, performing an assessment and analysis of the collection system, and developing a plan for remediation of the sewers. The study began in the spring of 2009 with rainfall and sewer flow monitoring. Reporting was completed by the end of 2011.

At the onset of the study, the Lo-Ellen Park Area sanitary sewage system consisted of four sewage lift stations and associated force mains, 13 km of sanitary sewers and 243 maintenance holes. RVA prepared mapping of the collection system in the study area, complete with tributary areas for each lift station, population and demand information, and routing of each sewer.

In the summer of 2009, the City completed a trunk sewage rock tunnel in this area, which allowed for the decommissioning of two lift stations. However, the sources of I&I in the collection system were not alleviated by the trunk sewer, so the principal driver behind the study remained.

Assessment and analysis

Six Hach Sigma 910 portable flow monitors and submerged area/velocity sensors were used to monitor sewage flows. The monitors were installed in March 2009 and removed from service in early February 2010. During the course of the study, the City commissioned a permanent flow meter, hence one of the portable meters was relocated in order to measure flows in another region of the study area. Also, a portable American Sigma data-logging rain gauge was set up in a central location to collect rainfall data for the study area. Flow monitor and rain gauge data was recorded at 15-minute intervals.

Flow monitors were equipped with remote communications by means of Telog RU-33 recording telemetry units. These units were directly connected to the Sigma flow monitors, and logged data as it was being collected. The telemetry units would call the Internet service provider at regular 12-hour intervals, via mobile telephone service, and report the data recorded.

The website would then update the records of the data channel for that instrument. Essentially, this equipment allowed staff to verify the various data channels (e.g., flow depth, velocity, battery life, etc.) from their office, rather than making site visits. Field visits were made to each site roughly once per month to download data manually, to perform a visual check on the installation, and to change batteries if required.

Raw data was collected from the flow monitors and rain gauge and processed once the study period was complete. Generally, flow was observed to increase in the sanitary sewers when rain occurred. Typically, peak flows in the sewers occurred roughly two hours after peak rainfall, but not all monitors reported observable increases for every rain event. However, the observed increases in sewage flow were typical of infiltration.

In addition to the flow and rain monitoring, smoke testing was carried out on roughly 20 km of sewer and service laterals of the Lo-Ellen Park area. This testing involves forcing vaporized liquid smoke into the sanitary sewer system with a portable high-powered fan. The objective of this portion of the investigation was to confirm sewer configuration and identify I&I sources, as flow monitoring alone does not provide a complete picture.

Typically, smoke is visible as it emits from all openings into the sanitary sewer system, such as roof vents and maintenance holes. However, occasionally smoke is visible coming from points where the sanitary system should not be connected — such as roof downspouts or storm sewer catch basins.

A media release was first issued to residents advising them of the planned work, and a public open house was hosted by the City to answer questions. Testing was carried out over a five-day period in October 2009. In general, results of the smoke testing indicated there were no combined sewer, roof leader or foundation drain connections. The testing did provide information on one possible "indirect" connection, open cleanouts in lawns and possible sags in the sewer system. Five maintenance holes were identified as possible heavy water inflow sources.

As part of the investigation, the City provided footage of the closed-circuit television (CCTV) inspection performed on all the sewers in the Lo-Ellen Park area. RVA completed a review of the videos provided by the City's pre-selected service provider. CCTV was not completed in areas immediately upstream of lift stations, at inaccessible maintenance holes, or where monitoring devices were installed.

The CCTV investigation provided qualitative information pertaining to the sewers in the area, which are composed of vitrified clay (VC), asbestos cement (AC) transite pipe, concrete and polyvinyl chloride (PVC) pipe. In general, the older sections of pipe are in the worst shape. Many of the segments of VC and concrete pipe are beyond their useful life. VC joints have separated and infiltration is apparent, or some gaskets have slipped off the concrete pipes. For the remainder of the pipes there are many dented segments, sags or pipes "out of round," but pipe integrity is generally good.

Plan for remediation

RVA's investigation of the sanitary system in the Lo-Ellen Park area revealed that the system does not experience high dry-weather infiltration, but does exhibit higher than average flow during storm events. Normally, high response to storm events is due to inflow,

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Smoke testing was carried out on roughly 20 km of sewer and service laterals of the Lo-Ellen Park area.

Smoke machine.

which is not generally occurring in the Lo-Ellen area. Accordingly, infiltration observed in the sanitary sewer is likely from groundwater from sources such as pipe joints and cracks, or at older brick maintenance holes.

Other sources are weeping tile connections to the sanitary service laterals, which could also be contributing through joints and cracks. While the smoke testing did not reveal direct weeping tile connections, homeowners have noted anecdotally that their weeping tiles run to the sanitary system during rain events and spring runoff.

The study made the following additional recommendations.

- Disconnect water "blowoffs" (i.e., direct connections to sanitary sewers)
- Educate the public about lot grading
- Remove VC piping where replacement is warranted
- Seal all brick and block maintenance holes
- Add inserts to structures in road low points
- Implement open-grate storm maintenance-hole covers at road low points to help alleviate flooding of roads caused by catch basins frozen in under snow banks.

The CCTV videos showed pipes with an accumulation/buildup of grease in the area of the 10 restaurants and two schools in the study area. RVA recommended the grease should be cleaned from the pipes and sources addressed.

In addition, RVA recommended that the City educate residents of low-lying areas about its new Preventative Plumbing Subsidy Program and encourage them to implement this disconnection program. For homes that do not have weeping tile connections to the sanitary laterals, RVA recommended the City encourage residents to place the sump discharge outside the home to grade and not to laundry tubs or other sanitary sewer connections.

Robert G. Langlois, P.Eng., is with R.V. Anderson Associates.
E-mail: rlanglois@rvanderson.com