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CORRODING AND FAILING SEWER LINES

HOW BIG A PROBLEM?

by Bill Terry, AICP

"Bad sewer pipes are a problem that the country can no longer ignore. And it will get worse for two simple reasons. One, most sewer pipes were built 60 years ago, and only intended to last 50 years. Two, not enough people pay attention until they break."[1]

This quote comes from an opinion article that appeared in the *Boston Globe* in 2006 about what Thomas Rooney, President and CEO of Insituform, Inc., one of the country's largest sewer line rehabilitation companies, called a very real danger to the health of the country. The quote inspired this report, which examines the problem of failing sewer lines in Tennessee and briefly analyzes the situation to determine its significance and estimate potential costs.

EXECUTIVE SUMMARY

Corroding and failing sewer lines are a major problem that many times do not get the attention that they should. Underground and out of sight, the lines are taken for granted. We assume that they will continue to carry out the function for which they were installed. However, many sewer lines are 40 to 50 years old or older and are approaching the end of their useful lives. Many sewer lines and manholes are deteriorating because of the corrosive effect of hydrogen sulfide gas, a by-product of the decomposition of human and other waste matter.

The rapid population growth that has taken place in many areas of the state has created another problem. Many sewer lines as well as treatment plants were sized and constructed before the rapid growth of the last 10 to 20 years, growth that now challenges the ability of the systems to handle the amount of waste being generated today. Treatment plants can be expanded, but lines have to be replaced, and their replacement is not only expensive but also disruptive since many sewer lines are buried under the public streets.

A smoothly functioning sewer system is essential to protect public health, the environment, and progressive economic development. As more and more sewer systems reach the end

[1] Rooney, Thomas. 2006. Corroding sewers, not Alaskan oil pipes, are the real danger. *Boston Globe*, August 24.

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of their useful lives, major programs of rehabilitation will have to be undertaken to ensure that they function properly. A preventive maintenance and rehabilitation program based on long-range analysis and detailed engineering can extend the life of existing systems, reduce operating costs, and may reduce the need for expansion.

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Out of approximately 450 waste water systems in the state, 80 are currently under an enforcement order from the Tennessee Department of Environment and Conservation (TDEC). Many systems do not have regular maintenance and rehabilitation programs and, therefore, do not address the problem until an enforcement order is issued. Without an accurate assessment of each such system, it is particularly difficult to estimate the total cost across the state.

Some specific examples reflect the magnitude of the problem.

- Since 1989, Metro Nashville has spent about $800 million to both expand treatment plants and rehab old sewer lines. The city has rehabbed about 300 miles of lines at a cost of $250 million. A recent consent decree between the Environmental Protection Agency (EPA), TDEC and Metro will require the city to spend another $300 to $400 million to correct overall system problems.
- Another consent decree from 2004 involving the Knoxville Utilities Board (KUB) required the board to spend $530 million over a ten-year period to correct its sewage overflow problems.
- The City of Lebanon and TDEC have reached an agreed order to eliminate overflows by 2010 at a cost of $6 million to rehab lines and $14 million to improve the treatment plant.

While a total cost figure may be impossible to establish, it becomes obvious that costs to rehabilitate all of the systems across the state will be enormous.

NATURE OF THE PROBLEM

In the past, the primary reason for rehabilitating a sewer was to restore the structural integrity of a line that had failed and, as a consequence, discharged raw wastewater into the environment. Today the situation is much more complex. A large number of factors contribute to the rapidly declining integrity of major portions of the wastewater collection systems throughout the country.

To begin with, many of the collection systems in use today are very old, having been installed during the growth period after World War II. Most systems were designed with a 50 to 100 year life cycle, and the materials used in their construction have lost their structural integrity because of corrosion and natural deterioration from use. Old clay pipes fail at the joints, and roots grow into them. This gradual breakdown allows greater infiltration, particularly during periods of heavy rainfall and under high groundwater conditions. The additional flows, in turn, generally produce two negative effects: (1) the surcharged sewer flows accelerate deterioration of the system and allow leakage into the environment and (2) the increased inflow/infiltration (I/I) overloads the treatment facilities to the point where they sometimes fail and discharge partially treated or untreated wastewater directly into the environment.

Many of the collection systems in use today were installed during the growth period after World War II.

Other factors that contribute significantly to the deterioration of collection systems in some areas include rapid system expansion to keep pace with population growth. Total capacity is a different problem. Sewer lines as well as treatment plants were sized and installed at a time before the rapid growth of the last 10 to 20 years. Treatment plants can be expanded, but lines cannot, at least not without replacing them. Not only can expansion challenge the entire system, but it may also result in a diversion of effort and attention away from the long-term preservation of existing facilities. Another effect of population growth is the stress that is created by vibrations from construction and the laying of roadways and other utilities over sewer systems. Sewer systems also are failing because of unstable foundation soils or improper pipe bedding material.

A smoothly functioning sewer system is a service the public has come to take for granted. Because the system is largely out of sight, there is little awareness of its importance or of the serious consequences that result from continued neglect. As more and more large municipal systems reach the end of their useful lives, major programs of systematic rehabilitation will have to be undertaken. An ongoing program of long-range analysis and rehabilitation could greatly extend the serviceability of existing systems, reduce operating costs, reduce the need to expand the system, and protect the environment from the consequences of a major collection system failure.

The effective operation of a conventional gravity sewerage system begins with proper design and construction. Serious problems may develop without an effective preventative maintenance program

and, occasionally, factors beyond the control of the maintenance crews can cause problems. Potential problems include

- explosions or severe corrosion caused by discharge of uncontrolled industrial wastes,
- odors,
- corrosion of sewer lines and manholes caused by generation of hydrogen sulfide gas,
- collapse of the sewer line because of overburden or corrosion,
- poor construction, workmanship or earth shifts causing pipes to break, joints to separate, and manhole walls to crack, resulting in excessive infiltration/exfiltration,
- protruding taps in the sewer lines caused by improper workmanship (known as plumber taps or hammer taps) that can substantially reduce line capacity and contribute to frequent blockages,
- excessive settling of solids in the manholes and lines, which can lead to obstruction, blockage or generation of undesired gases,
- reduction of the diameter of the sewer line by accumulation of slime, grease, and viscous materials on the pipe walls, leading to blockage of the line, and
- faulty, loose or improperly fitting manhole covers leading to inflow.

The problem of failing sewer lines will affect every wastewater system in Tennessee.

EXTENT OF THE PROBLEM

According to the TDEC, there are approximately 450 sewerage or wastewater systems within the state. Each of these will potentially face the problem of failing sewer lines at some point in their operation. A total of 80 of those systems are currently under an enforcement order from TDEC. It is safe to state that the problem is enormous; however, it is very difficult to estimate any kind of total cost without a comprehensive survey of each such system.

Some systems in Tennessee have a maintenance and rehabilitation program in place. This program is known as a "CMOM", the acronym for capacity, maintenance, operations and management. Such a program involves the preparation of a detailed engineering study of the system and provides an excellent source of information about the sewerage system and analysis of system problems and

solutions. A key problem in many systems is that the cities or utility districts are not proactive in addressing the maintenance issues and react only when a TDEC enforcement order is issued.

A recent news article in the *Tennessean* illustrates how three systems are addressing the problem. All of these systems are under some type of enforcement order.

- The City of Lebanon is doing a major overhaul of some older parts of its sewerage system brought about by major I/I that has resulted in the capacity of the pipes being exceeded. The agreed order between the city and TDEC will eliminate overflows by 2010, and the city will spend $6 million to rehab the lines and another $14 million to improve the sewage treatment plant.
- The City of Hendersonville is served by the Hendersonville Utility District and has a number of sewer lines that are failing. The district has recently completed a $3 million sewer line rehab project, and another such project will likely take place in 2008 and 2009.
- The City of Smyrna is also engaged in a rehab project and has budgeted $650,000 for spot rehabs next year.[2]

In another situation, the KUB signed a consent decree with the EPA in 2004 while paying an initial $167,000 fine for sewage overflows. It will face additional fines for any future overflows. The signing of the decree followed a state order issued in 2003 that required KUB to spend $530 million over a 10-year period to remediate its sewage overflow problems.[3]

In yet another example of the enormity of the problem, the Harpeth Valley Utility District has had to deal with some significant failures in recent years. The district experienced a catastrophic failure of its Overall Creek Interceptor that was caused by hydrogen sulfide degradation. The entire line had to be replaced at a total cost of $3.4 million. The district is currently in the process of spending another $22 million to replace the remainder of that interceptor line. Another failure caused by hydrogen sulfide resulted in the replacement of 2,000 feet of a force main. The district's annual

A key problem in many systems is that the cities or utility districts are not proactive in addressing maintenance issues and react only when a TDEC enforcement order is issued.

[2] Carey, Clay. 2007. Communities scramble to fix aging sewer lines. *Tennessean*, April 4.
[3] Harless, Bill. 2007. Metro, EPA negotiate consent decree for fixing sewer system. *City Paper*, June 18.

expenditures for maintenance and repair generally exceed $200,000.[4]

SPECIFIC EXAMPLES

Listed below are some more specific examples of rehabilitation activities that have been or are being undertaken by two cities, one large and one small.

METRO NASHVILLE

The Department of Water Services of Nashville has been engaged in major efforts to expand and rehabilitate its system since 1986 in order to meet the requirements of the Clean Water Act, as well as respond to a moratorium on new sewer connections that was issued by TDEC in 1989. Through this year, the department has spent about $800 million, which has been paid by ratepayers through the monthly water/sewer bills. Part of this amount was spent on expanding treatment plants in order to handle the combined sanitary-storm-sewer system in the older parts of the city. However, the city also has a major commitment to rehabilitating old sewer lines.

The Department of Water Services of Nashville has been engaged in major efforts to expand and rehabilitate its system since 1986 in order to meet the requirements of the Clean Water Act, as well as respond to a moratorium on new sewer connections that was issued by TDEC in 1989.

The system in Nashville includes more than 2,600 miles of sewer lines. Since the program was started, the city has rehabbed 300 miles of sewer lines at a cost of $250 million or $700,000 per mile. This figure translates into $132 per foot. The program now is known as the Nashville Overflow Abatement Program (NOAP) and is considered a model in sewer line rehabilitation across the country. An engineering analysis of 94 miles of rehabbed sewer lines or about 12% of the total system revealed that I/I was cut in half and 123 overflows were eliminated.[5]

Even though Metro Nashville had developed a model program for eliminating overflows, the system still had many problems and continued to experience overflows. The city, EPA, and TDEC have been in negotiations for a solution to the problems. On October 24, 2007, the EPA announced that an agreement between Metro Nashville and the EPA had been reached. The basic agreement is that Metro, at a cost of between $300 million and

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[4] Jack Lyle, e-mail message to author and personal communication, October 23, 2007.
[5] Kurz, George E. 2007. Presentation at the Sewer Rehabilitation Strategy Workshop, February 8, in Franklin, Tennessee.

$400 million, will make extensive improvements to its sewer systems to eliminate unauthorized overflows of untreated raw sewage and to control overflows of combined sewage and storm water.

The consent decree filed on October 24, 2007, in the U.S. District Court for the Middle District of Tennessee requires Metro to comply with four specific corrective action plans:

- Metro must propose and implement specific corrective actions to bring combined sewer overflows (CSO), which are overflows of a combination of untreated sewage and storm water from permitted outfall locations, into compliance with water quality standards.
- It must create and carry out specific corrective action plans to eliminate unauthorized sanitary sewer overflows (SSO) of untreated sewage. The worst of such overflows, about 50% of the total, must be addressed within the next two years.
- It must improve its sewer systems management operation and maintenance (MOM) programs to prevent future overflows.
- Metro must also respond to overflows attentively when they occur.

Metro is also required by the consent decree to pay a civil penalty in the amount of $282,019 and perform supplemental environmental projects.

Metro Nashville must spend between $300 and $400 million to comply with the consent decree and pay a civil penalty of $282,019.

GOODLETTSVILLE

The City of Goodlettsville's wastewater collection system dates back to 1967. The system of sewer lines and pumping stations is owned by the city, but the effluent is pumped to Metro Nashville's Dry Creek Sewage Treatment Plant for treatment. When Nashville was issued the moratorium on new connections as noted above, Goodlettsville was also placed under the moratorium as a result of excessive I/I during rainfall.

The first steps taken by Goodlettsville to correct its problems began in 1994 with construction of a larger capacity pump station, a large interceptor gravity line, and a force main to take the sewage to the treatment plant. The total cost of this project was $8 million. Starting in 1997, the city began a four-phase program of sewer line and manhole rehabilitation. To date, three phases have been completed at a total cost of $2,188,089. Phase 4 is currently in progress with a budgeted cost of $1,193,770. Since the 1989 enforcement order

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and moratorium, Goodlettsville has spent $11,381,859. The cost to rehab sewer lines in Goodlettsville is approximately $60 per foot or $316,800 per mile. There are approximately 105 miles of sewer lines in the system.[6]

TOTAL COSTS

The task of attempting to assign a total cost amount for the rehabilitation of sewer systems on a statewide basis would appear to be impossible because of a lack of detailed data and engineering studies. Each individual system would have to be analyzed through an engineering study. Needless to say, the cost would be monumental. The total amount of money that has been or will be spent by just the wastewater systems mentioned in the above report totals $1.2 billion. This figure does not include any amount for the construction or expansion of treatment plants.

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The latest infrastructure report by the Tennessee Advisory Commission on Intergovernmental Relations (TACIR) indicates that the total amount of water and wastewater projects needed in all counties will cost nearly $3.2 billion.[7] Of this amount, $370 million is identified for wastewater projects that either are all rehabilitation or include rehabilitation. The costs for projects that were identified as just rehabilitation amount to $268 million. It is not clear whether all of the costs for sewer rehabilitation are included in that report. It would appear that those cities or utility districts that are aware of their problems and have a plan in place to address them would have submitted their cost estimates for the report. Those cities or districts that have not had an engineering analysis of their systems might not submit cost estimates. Of course, any kind of sudden sewer line failure is impossible to project. It is, therefore, likely that more costs can be anticipated, though not projected.

METHODS OF FINANCING IMPROVEMENTS

Another problem facing Tennessee communities is the manner in which system improvements are financed. Because rehabilitation projects fall under the heading of maintenance, they generally must be financed from the revenues generated from the ratepayers. Some

[6] City of Goodlettsville. 2006. EPA CMOM Self-Assessment.
[7] Roehrich-Patrick, Lynnisse, David W. Lewis, Catherine Corley, and Daniel Merchant. 2007. Building Tennessee's tomorrow, anticipating the state's infrastructure needs. Nashville: Tennessee Advisory Commission on Intergovernmental Relations.

assistance is available in the form of low interest loans from the Clean Water State Revolving Fund (SRF). These loans are available for the planning, design, and construction phases of wastewater facilities. The funds may be used for all three phases in any combination. Eligible projects include new construction or the upgrading or expansion of existing facilities and may encompass wastewater treatment plants, pump stations, force mains, collector sewers, interceptors, elimination of combined sewer overflows, and/or non-point source pollution remedies. The loans must be repaid from the general revenues of the system and usually require a rate increase to cover the loan.

Since the loan program involves federal funds, there are extensive requirements to qualify for the program. Each project requires a financial review, the development of a facilities plan, an environmental review, opportunities for minority- and women-owned business participation, a state-approved sewer use ordinance, a state-approved plan of operation, and interim and final construction inspections to be conducted by the SRF loan program's technical staff. A municipality or utility district must also be listed on the state's priority ranking list, and this list forms one basis for funding eligibility and the allocation of funds.

The revolving fund itself has also been reduced dramatically over the last several years. The $3.3 billion loan fund has been reduced by $800 million per year. The amount reserved for Tennessee has been reduced from $19.5 million in FY 2004 to an estimated $15 million for FY 2007.

Actual grants for sewer line construction or repair are very limited. The Community Development Block Grant (CDBG) program as administered by the Tennessee Department of Economic and Community Development can provide outright grants for many activities, including water and sewer improvements. While CDBG dollars may be used to replace lines, they cannot be used to repair them. In practice, most of the funds go for projects that create jobs (grants for industrial infrastructure and loans for industrial buildings and equipment) and for projects where system failure has resulted in health and safety issues.

BENEFITS OF SEWER LINE REHABILITATION

Sewer line rehabilitation is expensive, however, the benefits are also great.

There are lower costs

- for pumping, treatment and disposal,
- from clean-up, and
- from fines.

There is less risk

- of regulatory action,
- of legal action, and
- of spreading disease.

There is enhanced reputation

- for proper operation and maintenance,
- professional management of the system, and
- for quality customer service.

Tennessee Advisory Commission on Intergovernmental Relations (TACIR)

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- Monitor the operation of federal-state-local relations,
- Analyze allocation of state and local fiscal resources,
- Analyze the functions of local governments and their fiscal powers,
- Analyze the pattern of local governmental structure and its viability,
- Analyze laws relating to the assessment and taxation of property,
- Publish reports, findings and recommendations, and draft legislation needed to address a particular public policy issue, and
- Provide a neutral forum for discussion and education about critical and sensitive public policy issues.

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