Littleton, Massachusetts Smart Sewering Strategy

Sustainable Wastewater Treatment Infrastructure: Engineering Concept Report

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Long Lake, Prouty Woods – Effect applied to photo by Adam Hemingway

Charles River Watershed Association
Natural System Utilities
Don E. Zizzi, Economic Advisor

Executive Summary

The Town of Littleton, Massachusetts (MA) would like to promote economic development and more amenities in its village center while at the same time discouraging suburban sprawl elsewhere. To obtain greater density at its center, the town must introduce a sewer system; lacking sewers, greater density there is impossible. Recognizing the need for change, Littleton adopted new multi-use zoning, allowing for greater density in two adjacent districts at the commercial center of the town, and charged the Littleton Common Sewer Feasibility Committee (LCSFC) with the responsibility of coming up with a sewer plan that would encourage economic growth and discourage suburban sprawl. Working with its consultants (the Consultant Team), Charles River Watershed Association, Natural Systems Utilities, and economist Don Zizzi, an affordable plan for limited sewering has been developed. The plan also provides for significant social and environmental benefits. Called "smart sewering", the plan illustrates the possibilities for phasing of a limited town sewer system over time. A range of possible scenarios demonstrate how upfront capital investment can be reduced, and how added sewer capacity can be delivered as growth occurs. It also shows how the risks of the investment can be reduced where projected growth occurs slower than anticipated, or not at all. Further, the report illustrates how a public/private partnership to design, build, and operate the plant can allow for broad options in acquiring necessary construction capital. Finally, the report illustrates an integrated infrastructure scenario where wastewater, septage, and food waste are utilized to generate energy, treated wastewater effluent is recharged back to the ground in the "sub-watershed" where it was originally pumped for drinking water supply and/or direct reuse of nonpotable water is generated for toilet flushing, cooling and irrigation. In this scenario, the sale of produced energy and the sale of produced nonpotable water improve overall operating efficiency and help reduce the long term operating cost of the plant. The recharge of treated effluent back to the general area from which it was pumped helps to protect the town in the face of significant drought. This report shows that a Smart Sewering approach represents a paradigm shift from conventional sewering, and achieves affordable limited sewer districts with additional economic, environmental, and social benefits[1].

Conventional sewering solutions have typically been more affordable at large-scales. The inability to cost-effectively implement conventional sewer systems at the scale of small town commercial centers can inhibit desirable economic growth. Extending the sewer district to the wider town may make the system more affordable but this strategy is often met with resistance by those who do not wish to incur the cost associated with adopting a town-wide sewer for the benfit of the commercial center. The Smart Sewering approach involves several novel aspects that are dissimilar to conventional sewering strategies and enable cost-effective sewering to be achieved at small-scale:

1. <u>Community Values Assessment</u> – Raises awareness and identifies priorities and concerns around sewering so that these can be adequately addressed by the smart sewering design. In the case of

[1] It should be noted that this study discusses hypothetical scenarios to demonstrate the range of possibilities for sewer feasibility in the Town of Littleton and should be used for planning purposes only. Implementation of any of the scenarios presented would require more detailed studies. All costs provided in this report should be considered approximate to +/-30%.

Littleton the community emphasized the importance that sewering should not cause a townwide increase in taxes.

2. Consideration of Wider Environmental Issues – Current energy, water, land and biodiversity management practices are evaluated to identify opportunities for improvement through smart sewering design. In the case of Littleton, this consideration involved helping to maintain natural watershed streamflows in the Merrimack and Concord watersheds by recharging treated wastewater to the watershed from which it was extracted.
3. Achieving Phasing Strategies – Using alternative technologies that are affordable at a small scale to allow wastewater installation as growth requires. The result is a more economically viable adoption schedule for capital costs that reduces user rates. An economic feasibility analysis illustrated that it was possible for Littleton to absorb wastewater capacity across five phases by using: a) a small diameter low-pressure sewer that is compatible with existing septic tanks; b) subsurface flow treatment wetlands with module sizes between 30,000 and 60,000 gallons per day (gpd) which can be installed for $20/gpd across this range of capacity.
4. Integration with Other Infrastructure – Potential to subsidize new sewer service is evaluated by integrating with existing and new water, wastewater, and energy assets. In the case of Littleton, the sewer service is subsidized with an anaerobic digester used to produce biogas from local wastewater solids, septage, and food waste. Subsidies are derived from tipping fees for these waste flows, the sale of electricity produced from biogas and the potential sale of Renewable Energy Certificates (RECs). For Littleton, an anaerobic digester receiving 4,100 gallons per day (gpd) of septage and 2.74 tons per day of food waste yielded $216,145 of subsidy annually. In addition, water reuse for non-potable applications in place of potable supply could yield an additional subsidy of $55,000, based on a consistent demand of 87,500 gpd created by new development.

Based on a 20-year build out analysis it is estimated that 182,000 gpd of new wastewater capacity will be required to service the Study Area. This study recommends that this capacity be achieved using the following phasing strategy:

Phase	1	2	3	4	5
Year	0	5	10	15	20
Flow (gpd)	30,000	38,000	61,000	23,500	29,500
Anticipated Connections	100	127	203	78	98
Capital Cost ($)	$ 4,300,000	$ 3,800,000	$ 7,100,000	$ 3,200,000	$ 4,600,000
Sewer Length Required (LF)	18,200	6,333	10,167	3,917	4,917
Treatment Area Required (acres)	1.67	2.11	3.39	1.31	1.64

Based on the information above, 10.1 acres of land are required for full build out. This study identified 72 acres of land available within the Study Area on parcels owned by private landowners, corporate landowners such as Wells/IBM and Park & Co., and the MA Department of Transportation. The opportunity to incorporate treatment capacity on these sites should be developed in tandem with the development plans of these landowners.

Options exist to finance the various phases, including municipal financing, private financing, and public/private partnership (P3). Private financing will substantially increase monthly user rates, but removes all risk to Littleton tax base associated with not achieving projected sewer revenue. A blend of private and public financing would be appropriate if it is desired to achieve a balance between risk and affordability. It appears that special state legislation would be required for a municipality to procure a design-build-operate type contract in MA. The table below summarizes how risk can be transferred away from the Town by using private resources to implement the project.

Comparison of Risk Allocation-Traditional Approach vs. DBOF

		Design-Bid-Build Conventional Approach (implementation through public financing)	**Design-Build-Operate-Finance (DBOF) (implementation through private financing)**
Design Build	Design Build Cost	Town	Private Entity
	Schedule Completion	Town	Private Entity
	Construction Warranty	Town	Private Entity
Asset Mgmt	Compliance Guarantee	Town	Private Entity
	Capital Replacement	Town	Private Entity
	O&M Cost	Town	Private Entity
	Residual Disposal Cost	Town	Private Entity
	Life Cycle Cost	Town	Private Entity
Finance	Long-Term Financing	Town	Private Entity
	Interest Rate Risk	Town	Private Entity

The recommended Smart Sewering Strategy depends on whether private, public or blended financing is obtained. All recommended strategies are based solely on revenues collected from the Study Area and do not require subsidy from the tax-base, i.e. construction and operation of the Smart Sewer project would result in no costs for Littleton residents outside of The Study Area. Under all scenarios it is recommended that treatment capacity is installed in phases.

The recommended municipally financed scenario (based on a 5% discount factor) is given in Scenario 17 of Section 5.3 and encourages integration of water reuse and digester infrastructure to provide subsidy to the sewer system in the case of revenue shortfall (i.e. to prevent the tax base from having to compensate). Incorporating a 2 dry ton ton per day anaerobic digester would increase capital costs for the first phase by $3.2M. Incorporating an 85,000 gpd water reuse system would increase capital costs for the second phase by $2.7M. Under this strategy, (which assumes a $2 million contribution from private investment for the first phase of treatment), the resulting user-rate would be 37 $/month. This is 27 $/month less than the average Massachusetts user rate for sewer service of 64 $/month.

The recommended privately financed scenario is given in Scenario 18 of Section 5.3, and recommends against integrated water reuse and digester infrastructure due to the inability to achieve capital recovery from operating revenues, assuming a 12% discount factor. The resulting user-rate would be 172 $/month, but would completely remove risk from the tax base.

Under the recommended blended financing arrangement (Scenario 19 of Section 5.3), the integration of water reuse and digester infrastructure is ecomomically feasible (based on a discount factor of 8%). The resulting user-rate is 96 $/month, which in the view of the Consultant Team provides a good balance between affordable user-rates and risk to the tax base. For this reason, it is recommended that the Town investigate the feasibility of financing the Smart Sewering Strategy through a P3, an example of which would be private financing combined with a municipally secured loan from the State Revolving Fund.

The study has illustrated how to feasibly finance a Smart Sewering Strategy for The Study Area, under various financing arrangements and without requiring funding from the tax-base. Notably, provision of sewer to The Study Area would enable over 2 million $/year of additional property tax revenue through development over the next 20 years.

Additional benefits of the smart sewering solution can be categorized into Economic, Environmental, and Social benefits as follows:

Economic

- Phase 1 capital cost for wastewater infrastructure is $4.2 million providing 30,000 gpd of waste treatment. This cost is $7.1 million less than the conventional approach of providing 183,000 gpd at Phase 1. The economic impact of incurring carrying costs for underutilized assets, such as oversized pipes and treatment systems, is much lower under the Smart Sewering Strategy.
- An anaerobic digester scheme would provide multiple benefits to the town beyond an economic subsidy of the sewer project, including lowering cost of municipal solid waste disposal, pumping septic tanks, and electric supply.
- The solution could help enhance Littleton's important agricultural sector. Residual stabilized solids from the anaerobic digestion process and recycled water with higher nutrient levels than potable water could be beneficially reused for landscaping and agricultural purposes.

Environment

- Based on the proposed facility location, the Merrimack watershed is recharged with high quality treated effluent. This will help maintain natural streamflows between the Merrimack and Concord watersheds. Without smart sewering, those parcels located in the Concord watershed with onsite septic systems would transfer water from the Merrimack to Concord watersheds and would exacerbate the deviation from natural watershed streamflows.
- The recommended use of an anaerobic digester would reduce Littleton's carbon footprint by reducing emissions associated with food waste and septage degradation, and by producing electricity from a

renewable energy source. The solution prevents the annual transfer from Littleton of 1,000 tons of food waste and 1.5 million gallons of septage. Approximately 2,000 kilowatt hours (kWh) of electricity would be provided daily which would avoid 2,600 lbs per day of carbon dioxide being released via combustion of non-renewable resources. This is the same quantity of carbon dioxide removed by a 245-acre forest.

- A realistic level of water reuse would reduce potable demand of the sewer district by 87,500 gallons per day under full build-out. Reuse would also reduce nutrient discharge to groundwater.
- Subsurface flow treatment wetlands can promote biodiversity and are often planted with indigenous plant populations. They do not increase impervious cover and would not contribute to storm runoff.

Society

- Enabling a limited sewer district provides a way to control growth, but the use of modular treatment technology and low-cost small diameter sewer means that subsequent expansions to the network are straightforward and affordable and built to accommodate only the growth that is desired, as it is needed.
- Subsurface flow treatment wetlands can be designed to blend into the natural environment and provide robust year-round operation in cold climates. These systems are odor free, produce no noise, and become aesthetic amenities. Conventional wastewater treatment structures are often above ground, and unless contained in buildings and carefully controlled, are sometimes considered unattractive and a nuisance.
- The proposed recharge zone is designated a "Zone 3," which meets all Massachusetts Department of Environmental Protection requirements for sufficient travel time to ensure protection of drinking water supplies.
- A limited sewer district minimizes the population that will be affected by an interruption to service. A conventional sewer system would require a larger singular district to achieve the same affordability, and a larger population would be impacted by any interruption to service.
- The use of groundwater recharge instead of surface water discharge ensures that recreational waters for fishing, swimming, and sailing are protected.
- The anaerobic digester provides a way for the wider town to benefit from the sewer plans by providing local treatment for septage and food waste.