Agenda Item # Page #

TO:	**CHAIR AND MEMBERS CIVIC WORKS COMMITTEE MEETING ON MONDAY, SEPTEMBER 22, 2014**
FROM:	**JOHN LUCAS, P.ENG DIRECTOR-WATER AND WASTEWATER**
SUBJECT:	**OPTIMIZATION OF LONDON WASTEWATER TREATMENT PLANTS A STRATEGY AND ROADMAP**

RECOMMENDATION

That, on the recommendation of the Director - Water and Wastewater, the development of an optimization strategy and roadmap for the Adelaide, Oxford, Pottersburg and Vauxhall Wastewater Treatment Plants plan **BE ENDORSED.**

PREVIOUS REPORTS PERTINENT TO THIS MATTER

"Timeline for Major Environmental Reports", Civic works Committee, April 7, 2014.

BACKGROUND

Purpose:

This report outlines a strategy to comprehensively evaluate various sewage treatment present and 20 year needs, and to articulate a roadmap for the optimal financial and technical coordination of future work at the Adelaide, Oxford, Pottersburg and Vauxhall Wastewater Treatment Plants (WWTP's). This strategic approach has already been completed for Greenway WWTP which serves 60% of the City.

Context:

At its meeting on April 7, 2014, the Civic Works Committee received a preview of major reports to be delivered in 2014 by EESD, including "An Approach to Wastewater Treatment". This report delivers on that objective.

Summary:

This report recommends an approach to reducing long term costs for wastewater treatment plants, while effectively planning to meet more stringent effluent criteria. The goal is to leverage the performance of existing facilities to coordinate improvements with life cycle requirements over the next twenty years, while also giving consideration to the location of future needs and technological upgrades. The future challenges of tighter effluent criteria, Combined Sewer Overflow treatment (and mitigation requirements), the Industrial Land Development Strategy and the effects of climate change will also be planned for.

Operational savings are possible through reduced energy consumption coupled with increased efficiency and recovery in both growth and lifecycle project designs, and by deferring capital expansions. These are critical in a goal to limit future Wastewater Rate increases to inflation rates.

The 2014 Wastewater Budget highlighted financial risks associated with future unknowns; such unknowns need to be managed with a more robust reserve fund balance. The proposed

strategy and roadmap are intended to significantly reduce the level of these unknowns, thereby increasing the accuracy of capital and operating forecasts.

The plan will embrace new technologies, and involve technical staff and outside expertise within a phased process that recognizes successful pilot projects that are in progress, and envisions the benefits of automation and innovation into the future. This approach will leverage the work of London's International Water Centre of Excellence, our academic and business partners, and add the implementation of new technologies to our leadership in research role.

A preliminary capacity/optimization study for Adelaide, Oxford, Pottersburg and Vauxhall plants was undertaken in 2013. It reviewed possible optimization of the existing sewage treatment processes. The next steps will confirm the findings of this study and will focus on the wet weather flows at these plants. It is possible to increase the average daily flow capacity available by reducing the peaking factors. Further steps include integration of performance results with other plant needs into a roadmap for future capital expenditures.

The strategy, in compact form, includes these key features:

- Identify performance enhancement opportunities (done)
- Plant testing and modeling to quantify the opportunity (next step)
- Wet weather performance (next step)
- Integrate other plant needs for flood proofing, asset management (physical infrastructure), future effluent criteria and energy efficiency (future step)
- Develop a roadmap for capital and operating budget forecasts (future step)

DISCUSSION

WWTP expansion projects have historically driven plant improvement projects – the primary motivation. However, some of the WWTPs in London are not slated for expansion in the next 20 years; growth needs are being accommodated by reduced water demands. Notwithstanding this, plant capacity performance is still an issue for other reasons:

- For wet weather / CSO treatment
- To allow for significant asset reconstruction due to age and condition
- To meet more stringent effluent criteria in the future

Keeping in mind that excessive capacity can negatively affect operating and long term asset management costs, a balance needs to be struck for optimal financial performance.

An optimizing approach was undertaken to find the most efficient and effective way to improve Greenway WWTP for growth and wet weather performance. This project is now in the design phase. Another example is the review of sludge management for the City, the result of which produced substantial capital ($33M) and operating ($700,000 /per year) cost savings. The future capital and operating plans for Adelaide, Pottersburg, Oxford and Vauxhall WWTPs can significantly benefit from a similar optimization exercise.

<u>Plant Performance – Opportunities to Optimize</u>

Building new wastewater treatment capacity is expensive and speculative given the difficulty of projecting future flows and the effects of water conservation across the system; a cost guideline for new treatment capacity is in the range of $2.6-$3.3 million/MLD based on the present Greenway expansion. Building capacity too far in advance can lead to unused or partially used processes which do not contribute to the quality or efficiency of treatment. Underutilized capacity carries additional operating costs while the life cycle of the asset diminishes; life cycle begins with construction regardless of the degree of utilization.

Major expansions and upgrades typically require significant front end work including approvals and engineering, which must be initiated well in advance of the actual need. Optimization of existing works may allow smaller and more targeted works, which can add capacity in smaller increments. These projects can be planned and budgeted accordingly. Some optimizations

may be as simple as applying for re-rating of existing facilities while others will involve removal of bottlenecks and smaller capital projects. Once the potential capacity has been identified it can be used to coordinate other works including those involving common processes allowing an integrated design for all anticipated works.

Capacity Rating Potential

The current Ministry of Environment and Climate change (MOECC) design guidelines for Wastewater Treatment plants are conservative, often resulting in the ability for a plant to treat flows above its rated capacity. This “latent” capacity can be determined through modeling and stress testing at much lower costs than building new infrastructure. High wet weather flows or peaking factors can also limit the rated capacity of a plant with expensive secondary treatment capacity reserved for intermittent wet weather events. Plant optimization will evaluate the most effective method to treat wet weather flows.

XCG Consulting has completed a desktop analysis to determine the extra capacity potentially available at the Adelaide, Oxford, Pottersburg and Vauxhall plants. They have also identified the testing measures needed to substantiate an application for re-rating to the MOECC. Table 1 summarizes the current rated and the maximum potential rated capacity of these plants as determined through the desktop analysis. The actual capacity will fall between these values.

Table 1. Current and Maximum Potential Rated Capacity Summary

Plant	Current Rated Capacity (MLD)	Maximum Potential Capacity (MLD)
Adelaide	36.4	57.0
Oxford	17.2	40.0
Pottersburg	39.1	54.0
Vauxhall	20.9	47.0

Asset Management Perspective

The 2013 State of the Infrastructure Report indicated that improved information on the condition rating of sewage treatment plants as being important to future asset condition. Significant asset renewal projects will require capacity flexibility within a plant or between plants.

Once the optimized plant capacity has been determined it can be used to coordinate other projects through a roadmap for all anticipated works, including renewals aimed at extending the service life of the assets. Asset reconstruction will reduce treatment capacity while the repairs are underway, and can only be done if sufficient capacity remains available. A robust and flexible treatment system with the ability to transfer flows between plants will help provide the capacity needed to complete these repairs with significant savings in comparison to new construction.

The Optimization Strategy -- Determining Plant Performance as the First Step

Wastewater Treatment Plants in Ontario have typically been designed to conservative standards with additional capacity potentially available at less cost than building new. The MOECC will allow the use of more aggressive design criteria in treatment plant design; however, the City will have to demonstrate the ability of the plant to meet the effluent criteria at the proposed flow rates. The Federation of Canadian Municipalities (FCM) and the MOECC promote the optimization of wastewater treatment plants as a sustainable method of maintaining these systems. More aggressive design criteria will be supported through:

Stress Testing

Treatment capacity can be determined by removing a portion of the plant from service to simulate higher flows, and involves multiple samples from several treatment processes over several weeks. Data obtained from the sampling can then be used to model the treatment plant to refine potential treatment capacity and identify system constraints.

Hydraulic Modeling

The ability of a plant to handle higher flows needs to be evaluated with computational tools. Hydraulic bottlenecks can limit treatment plant capacity irrespective of actual process capacity.

Aeration System Capacity Testing

The main wastewater treatment process is biological and requires the maintenance of sufficient dissolved oxygen in the system. The ability of existing systems to treat higher flows will need to be confirmed.

Ultraviolet (UV) Transmittance Testing

Ultraviolet disinfection is the last treatment process and must provide adequate disinfection at higher rated flows.

Wet Weather Treatment Facilities

Wet weather flows not only impact treatment efficiency but also affect the capacity rating of the plant through allocation of expensive secondary treatment capacity for intermittent wet weather flows. Reducing the wet weather peaking factor at the Pottersburg treatment plant from 3 times to 2 times could increase the rated capacity of the plant by 20 MLD (worth up to $50 million) while providing improved wet weather treatment. Staff are currently completing a pilot study at the Pottersburg plant to examine the effect of wet weather flows on overall plant capacity and the possibility of creating stand-alone wet weather treatment processes. The Pottersburg study will form the basis for similar studies at the remaining plants.

The level of modeling and testing required for each facility will depend on the aggressiveness of the design in relation to the MOECC guidelines. While time consuming, this work is high value and low cost in comparison to building additional capacity to current design standards.

<u>The Roadmap for Works Coordination – Bringing it All Together</u>

A number of projects have already been identified for the four plants, and their alignment with optimization efforts offers efficiencies in design, sizing and construction. Projects to coordinate with performance optimizations include:

Flood Proofing

Flood proofing includes barriers between the river and treatment plant, effluent pumping to ensure flows entering the plant can be discharged and may also include engineering controls to help prevent the collateral flooding of buildings connected through underground pipe galleries. The Adelaide, Greenway and Vauxhall plant buildings are at risk from flooding in a 100 year storm. There is a direct relationship between operating capacity and the river levels, and money to be saved by coordinating projects with other purposes.

Condition Assessment and Renewal

Many plants have infrastructure dating to the 1950’s and 60’s and will require renewal over the coming years. The 2013 State of the Infrastructure Report indicated that improved information on the condition rating of sewage treatment plants as being important to future asset condition. Condition assessments to be undertaken as part of optimization efforts will allow coordination of renewal efforts and equipment replacement

with other projects, and will also complement the City's Capital Asset Management (CAM) and the Tangible Capital Asset (TCA) efforts. Significant asset renewal projects will require capacity flexibility within a plant or between plants.

Future Effluent Criteria

Effluent from the City's WWTP's consistently meets the effluent criteria as defined in the individual Environmental Compliance Approvals (ECA's). The strategy will account for anticipated changes in effluent criteria and how to incorporate any enhancements needed to meet these criteria. Current discussions on new effluent criteria center on implementation of nitrate limits (will require denitrification), lowered phosphate limits and toxicity testing of plant effluent. Wet weather flow treatment also continues to be a high profile topic.

Energy Efficiency

Manufacturers are developing more efficient equipment and processes. Incorporating these new technologies with performance and renewal projects while capitalizing on available incentives will help maintain our low operating costs of the system. The goal for future operating costs is to maintain wastewater rate increases to below a blended inflation rate of 3%.

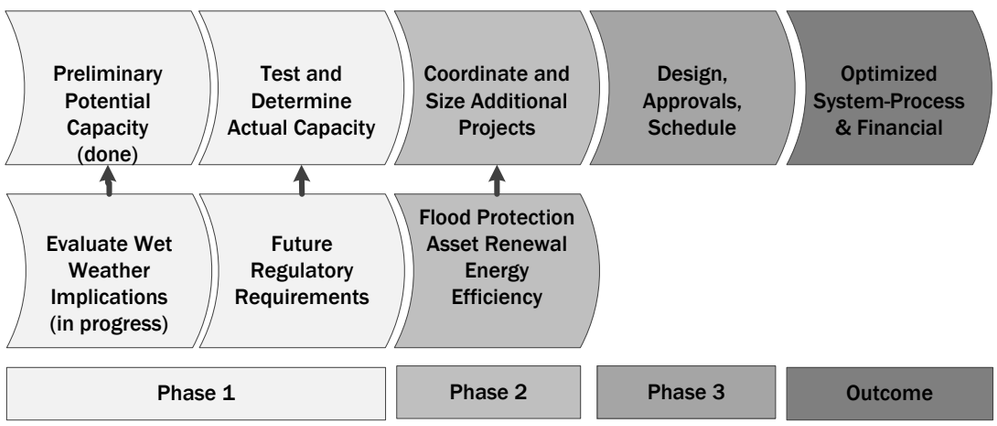
Vauxhall and Pottersburg Interconnection

An interconnecting forcemain between the Vauxhall and Pottersburg WWTP's was identified in the 2014 Wastewater Treatment Budget (ES3097) forecast. This project will allow flows to be transferred between the plants and will be valuable for capacity optimization and treatment flexibility during asset renewal.

An example of combining the optimization and roadmapping exercises is incorporating concrete renewal, aeration upgrades, wet weather process enhancements and optimized capacity in the design capacity of the effluent pumping station at Vauxhall. Any of these works done in isolation could restrict the potential capacity rating of the plant.

The Road Map

The nature of this optimization initiative lends itself well to the use of a roadmap to illustrate the anticipated phases of the project. Each phase of work, from the completed optimization opportunities study through to construction, takes its form from the phase before it, as illustrated in the figure below:



Financial Impacts

The 2014 Budget indicates that unknown future expenditures are to be managed with a healthier Wastewater Reserve Fund balance. These include outputs from the Pollution Prevention and Control Plan (in progress), Industrial Land Development Plan servicing, and

upfront costs for energy efficiency and optimization projects. The proposed strategy draws the needs of all of these, as they relate to wastewater treatment plants, into a comprehensive solution and road map to achieve the least long term cost.

Plant optimization and roadmapping offers substantial savings for wastewater treatment projects. Following the recommended road map to optimize future plant capital projects and operating methods will allow savings for wastewater treatment to be quantified, and fill capital program gaps. While some of this work can be completed under the existing replacement equipment program, the reserve fund will also be needed to complete additional projects while maintaining wastewater rate increases below inflation.

London is pursuing an Industrial Land Development Strategy (ILDS) which involves a potential for significant land areas to be serviced. While the initial optimization analysis has identified up to 41 MLD of combined latent capacity at the Pottersburg and Vauxhall plants, realizing even 10 MLD of this capacity through optimization will service 400 acres of industrial land at a cost well below the $26 million required to build new capacity. Determining the available capacity in advance also positions the City to accommodate potential new high water users.

It should also be noted that although there may be up to 27 MLD** or $70M of latent capacity available at the Vauxhall plant, this sewershed is essentially built out and unlikely to supply this much additional flow to the plant. The ability to utilize this capacity to meet demands at the Pottersburg plant through the proposed interconnection represents a unique, low cost opportunity to reduce growth related demands on the system. Ensuring the most efficient use of the existing Pottersburg and Vauxhall plants will also help minimize costs associated with regulatory upgrades at these plants especially if additional tanks are required. Regulatory upgrades are not currently budgeted in the 20 Year Plan.

Operational savings resulting from these projects, in particular those related to energy savings, will help offset new capital expenditure pressures on rates and the reserve fund. For example, the blowers recently purchased for the Adelaide, Oxford and Vauxhall plants are expected to save $170,000 annually, increasing to $252,000 annually if hydro rates increase by 42% over the next five years as anticipated. The dewatering upgrades at Greenway saved $70,000 above the expected $400,000 in annual savings due a spike in natural gas prices this past winter.

Next Step (Phase 1)

Optimization and Project Coordination:

Given the scope and technical nature of the works, a Request for Proposals (RFP) will be issued to Engineering firms asking them to highlight their experience and expertise related to the proposed projects. The firm providing the best fit for each facility will then be selected following the Procurement of Goods and Services Policy. Each firm assigned a project will then complete the assessment and provide a list of potential upgrades and increases in capacity for each facility.

Vauxhall and Pottersburg Environmental Assessment:

An Environmental Assessment Master Plan (EAMP) will be initiated covering optimized plant capacity and the transfer of flows between the Pottersburg and Vauxhall treatment plants and the associated pumping stations. The EAMP will be completed in parallel with the initial engineering work and will provide the planning foundation for the combined sewershed. Key details for this EAMP will result from the assessment of Pottersburg and Vauxhall PCPs.

Funding up to $500,000 for these Engineering assignments will be through the existing ES5084 – Replacement WWTP Equipment account given the implications of the optimization and roadmapping on the long term management of the wastewater system.

Conclusions

Historically, growth driven plant expansions have been the spearhead for non-growth projects. In the absence of growth driven expansions for the next 20-30 years, a new approach is needed to manage plant upgrades while maintaining flexibility and a vision for the future. Notwithstanding this, capacity for the ILDS must be planned for.

There are existing and future needs of the plants to be quantified and brought together for efficient expenditure forecasts: flood proofing, asset management (physical infrastructure), future effluent criteria and energy efficiency. Some are tied to the performance and capacity of Adelaide, Pottersburg, Oxford and Vauxhall WWTPs.

A desktop analysis has determined a significant amount of latent capacity may exist at these plants, which can be realized through smaller, more focused works, in comparison to traditional large plant expansions. Determining the actual capacity available through an optimization strategy will not only allow deferral of large capital upgrades, but will also allow coordination between the optimization works and the other needed projects through a road mapping exercise that is also recommended herein.

The 2013 State of the Infrastructure Report indicated that improved information on the condition rating of sewage treatment plants as being important to future asset condition. Significant asset renewal projects will require capacity flexibility within a plant or between plants.

Developing a roadmap covering all plant needs will help reduce both operating and capital costs, contributing to the long term sustainability of the wastewater system as a whole and the goal to maintain Wastewater rate increases to a blended cost of living level.

The cost of developing the optimization strategy and roadmap can generally be considered as high value and low cost in comparison to proceeding without optimization and coordination between the various projects. The first steps can be funded from available sources.

PREPARED BY:	**RECOMMENDED BY:**
GEORDIE GAULD **DIVISION MANAGER** **WASTEWATER TREATMENT** **OPERATIONS**	**JOHN LUCAS, P.ENG.** **DIRECTOR-WATER AND WASTEWATER**

REVIEWED & CONCURRED BY:
JOHN BRAAM, P.ENG. **MANAGING DIRECTOR OF** **ENVIRONMENTAL & ENGINEERING** **SERVICES & CITY ENGINEER**