WATER SERVICING CONCEPT PLAN

CITY OF KINGSTON
URBAN GROWTH STRATEGY

July 2004

Submitted to:

Planning & Development Services
City of Kingston
216 Ontario Street
Kingston, Ontario
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JLR 18577
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ABBREVIATIONS

BS - Booster Station
C - pressure pipe roughness coefficient
CDA - Committed Development Area
GA - Growth Alternative
ICI - Industrial, Commercial, Institutional
L/c/d - litres per capita per day
L/ha/s - litres per hectare per second
L/s - litres per second
m - metre
mm - millimetre
ML - megalitre
ML/d - megalitres per day
m³/d - cubic metres per day
m³/ha/d - cubic metres per hectare per day
MOE - Ministry of Environment
PDS - Planning & Development Services
UGS - Urban Growth Strategy
UK - Utilities Kingston
WM - watermain
WPCP - Water Pollution Control Plant
WTP - Water Treatment Plant
1.0 INTRODUCTION

The Kingston Urban Growth Strategy (UGS) Study was an exhaustive multifaceted undertaking, the intent of which was to identify where growth should occur over the 25 year planning horizon (i.e. to 2026). "Interim Report No. 2, Evaluating the Growth Alternatives" identified several growth alternatives, presented a set of evaluation criteria, summarized the evaluation, and identified the preferred Growth Alternative 2 (GA 2) in conjunction with the Committed Development Area (CDA), as the most suitable to support the continued orderly development of the City. GA 1A scored highly, along with GA 2, however, the lands within GA 1A are owned by the Federal Government and are presently not available for development.

Appendix 2 of Interim Report No. 2 presented an evaluation of the sanitary and water infrastructure impacts associated with each of the growth alternatives. This concept plan draws from the information in that report, identifies the works required to support the preferred growth alternative, presents construction costs and scheduling estimates, and offers several recommendations.

2.0 BACKGROUND INFORMATION

Geographic Information System data files, background reports, input from the City and Utilities Kingston, and Utility Servicing Drawings from CFB Kingston were used to compile a map of the City's water distribution system. Figure W1 illustrates the water distribution system and the location of treatment plants, booster stations, and storage facilities.

R.V. Anderson Associates Limited (RVA), who completed the 2002 "Water Distribution System Computer Model Update" were members of the UGS Study Team. They used the computer model, the population and job projections, and the updated drawing information to identify the corresponding system upgrades.

The updated water model is based upon a combination of water consumption data and Ministry of Environment and City of Kingston design criteria. Key criteria include:

- Average day residential demand of 350 L/c/d;
- Maximum day peak factor of 1.8;
- Peak hour factor of 2.7; and
- Maximum fire flow requirement of 378 L/s for 6 hours.

An average day demand of 30 m³/ha/d was used to model water demand from future ICI development. This rate is greater than the average ICI water demand reported in the 2002 study, relative to the ICI development area (i.e. 26 m³/ha/d).
The development yields associated with the preferred Growth Alternative 2 plus the CDA were discussed in Interim Report No. 2 and are summarized in Table 2.1.

### TABLE 2.1 – Potential Development Yields

<table>
<thead>
<tr>
<th></th>
<th>Projected Growth</th>
<th>Committed Development Area</th>
<th>Growth Alternative 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium Projection</td>
<td>High Projection</td>
<td></td>
</tr>
<tr>
<td>Dwelling Units</td>
<td>18,856</td>
<td>24,950</td>
<td>16,405</td>
</tr>
<tr>
<td>Population</td>
<td>31,083</td>
<td>47,724</td>
<td>35,965</td>
</tr>
<tr>
<td>Jobs</td>
<td>15,000</td>
<td>25,000</td>
<td>32,849</td>
</tr>
</tbody>
</table>

The present estimated connected population is 99,934, whereas the projected connected population potential associated with the build-out of GA 2 including the CDA, is 148,549 persons. Based on several data sources, an average of 40 jobs/hectare were established for the ICI lands for UGS planning purposes. Hence, the development yield of 40,809 jobs reflected in Table 2.1 equates to the equivalent of about 1020 additional hectares of ICI land.

The water model was revised to reflect works which Utilities Kingston had scheduled in their 2003 and 2004 construction program. These projects, some of which have been constructed and others which are still pending, included:

- 400 mm WM on Henderson Boulevard, constructed in 2003, from Days Road to Glen Cairn;
- 500 mm WM on Bath Road, from Gardiners Road to Vista Drive (pending 2004);
- 400 mm WM on Railway Street, constructed in 2003, from Patrick Street to Division Street;
- 500 mm WM on Division Street, from Railway Street to Kirkpatrick Street (pending 2004);
- 500 mm WM from Division & Railway to Alfred & Carleton (pending 2004); and
- 450 mm WM across the Great Cataraqui River, from Cataraqui Street to James Street (pending 2004).

The purpose of the modelling exercise was to identify reasonable alternatives for meeting the identified servicing needs. Other servicing options are possible. For example, an elevated tower could possibly be used in lieu of or in conjunction with ground level storage. Also, there may be more than one trunk watermain route available to service any particular alternative. Notwithstanding the fact that other alternatives may exist, those scenarios identified formed a reasonable basis for assessing the relative merits of the growth alternatives.
The works identified to support growth include work on the existing infrastructure plus those additional facilities required to provide service at the "front door" of the particular growth area. The approximate size and location of internal trunk watermains are indicated, however, the costs for internal works were not identified since they would largely be the responsibility of the developer.

3.0 PROPOSED WORKS

The proposed trunk watermains, booster stations, and storage facilities required to support the future growth of the City are illustrated in Figure W2, along with the existing treatment plants, towers, booster stations, and reservoirs. Those existing facilities that require upgrades are also noted. The identified works include those that Utilities Kingston had originally identified for construction in 2003 and 2004. The system upgrades, excluding those noted in Section 2.0 above, are listed below.

Watermains

.1 The 400 mm easterly leg of the Creekford Road watermain which is scheduled for 2004 will connect the proposed tower to the trunk main on Gardiners Road;

.2 The Creekford Road trunk immediately west of the tower will interconnect with development within the CDA;

.3 A 400 mm trunk watermain along King Street and Front Road is one of several proposed interconnections between the Central and West water systems. These interconnections will result in operational efficiencies including shared plant capacity and water storage;

.4 The Bath Road trunk watermain provides a possible linkage between the Kingston West and Central systems. The interconnection, which was originally installed as a temporary measure, includes a normally-closed valve which isolates the two systems. Any necessary system modifications should be implemented and the valve opened to permit interconnection;

.5 The 400 mm Counter Street trunk main should be constructed in conjunction with the road reconstruction project. This main will provide another link between the two water systems;

.6 A fourth link between the water systems is proposed on Princess Street in the vicinity of the railway overpass;

.7 The Gore-Elliott 400 mm trunk watermain is required to support continued growth within the Rideau Community. The main could be installed in conjunction with the proposed transportation crossing or it could be undertaken as a separate project;
8. The 400 mm Centennial Drive watermain should be constructed in conjunction with the road extension and the railway grade separation;

9. The westerly leg of the Creekford Road watermain will have to be extended further west to provide an interconnection between the Creekford tower and the GA 2 lands.

Water Booster Stations & Water Storage

1. A booster station and storage reservoir are proposed for O'Connor Drive to support continued growth within the northwesterly area of Kingston West;

2. The Gore-Elliott booster station and storage reservoir are proposed in conjunction with the trunk watermain to support continued growth in the Rideau Community;

3. The Gardiners Road BS will require upgrading to supply sufficient water to service the new Creekford tower and continued development in Pressure Zone 2 in Kingston West. Both the BS upgrades and the tower are scheduled for 2004 construction.

Water Treatment Plant

1. The Kingston West WTP will require upgrading to support continued growth within the westerly portion of the City. The timing and magnitude of the upgrades will depend upon several factors mentioned elsewhere in this report.

4.0 CONSTRUCTION COSTS & SCHEDULING

Construction cost estimates were developed for the required works based upon a variety of data sources including recent project costs, local knowledge, and consultation with industry estimators. The following assumptions were applied:

1. The depth of watermain cover is 1.7 metres;

2. Trench width was assumed to equal pipe diameter plus 0.9 metres;

3. Fire hydrants were spaced at 150 metre intervals;

4. Valves were spaced at 150 metre intervals on straight pipe sections, and a valve was assumed on each leg of all intersections;

5. Rock was assumed to exist at 1.0 metre below existing ground surface in all but the valley lands. Hoe-ram rock removal was assumed;

6. Surface restoration was based upon existing site conditions (i.e. green field, light, or heavy duty asphalt);
.7 No specific allowance was made for unusual site conditions such as poor soil conditions, environmentally sensitive lands, traffic control, contaminated soils, or unusual construction conditions. The contingency allowance should cover the majority of such unforeseen conditions;

.8 Costs are based on 2003 dollars; and

.9 The cost estimates include a 25% contingency allowance and a 15% engineering allowance.

The construction cost estimates for booster stations, water storage facilities, and water treatment plants were based on the projected capacity upgrades, assumptions about the expected work, and construction costs for similar work. The existing facilities have not been subject to detailed condition and/or performance evaluations, and hence the construction cost estimates are approximate. No field or geotechnical surveys have been conducted along the route of any proposed pipe works. Notwithstanding the foregoing, the cost estimates present a reasonable opinion of probable cost for these works. Table 4.1 summarizes the construction cost estimates for the proposed works.

In order to evaluate the various growth alternatives, it was essential to estimate the construction timing of individual works. The timing reported in Interim Report No. 2 is reflected in Table 4.1.

The timeline for the proposed works recognizes the potential influence of factors such as market demand for housing and/or employment lands, the interest of landowners within the development community, and the City’s ability to pay for supporting infrastructure. The works associated with the CDA are assumed to occur within the 1-5 or 6-10 year period. The Gore-Elliott watermain crossing and related works are anticipated in the 11-15 year period.

The infrastructure impact appendix in Interim Report No. 2 indicated that the Kingston West WTP has approximately 7 years of remaining capacity, based upon the historical growth rate for Kingston West. However, if the Central and West water systems are interconnected in the near future, and water efficiency strategies and leak reduction initiatives are successful, the plant expansion could be postponed. Close monitoring of community growth and water usage will be critical in establishing when planning and detailed design for the plant should commence.

Secondary plans and supporting studies will be required before the lands in GA 2 may be developed. Such studies and the subsequent subdivision approval process may take 5 or more years to complete. Hence, a 6 to 10 year period is assumed for the associated works.
### TABLE 4.1 – Construction Cost Estimates

<table>
<thead>
<tr>
<th>Proposed Works</th>
<th>Length/ Capacity</th>
<th>Cost</th>
<th>Timing (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.0 Trunk Watermains</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.1 Creekford Road</td>
<td>475 (m)</td>
<td>$400,000</td>
<td>1</td>
</tr>
<tr>
<td>.2 Creekford Road Tower to Growth Area 1</td>
<td>475</td>
<td>$385,000</td>
<td>6-10</td>
</tr>
<tr>
<td>.3 King Street-Front Road</td>
<td>1,780</td>
<td>$1,450,000</td>
<td>1-5</td>
</tr>
<tr>
<td>.4 Bath Road</td>
<td>50</td>
<td>$50,000</td>
<td>1-5</td>
</tr>
<tr>
<td>.5 Counter Street</td>
<td>800</td>
<td>$660,000</td>
<td>1-5</td>
</tr>
<tr>
<td>.6 Princess Street</td>
<td>690</td>
<td>$560,000</td>
<td>1-5</td>
</tr>
<tr>
<td>.7 Gore-Elliot</td>
<td>1,440</td>
<td>$1,500,000</td>
<td>11-15</td>
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<tr>
<td>.8 Centennial Drive</td>
<td>1,295</td>
<td>$1,050,000</td>
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<td>.9 Creekford Road Tower to Growth Area 2</td>
<td>950</td>
<td>$650,000</td>
<td>6-10</td>
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<tr>
<td><strong>Sub-Total</strong></td>
<td></td>
<td>$6,705,000</td>
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<tr>
<td><strong>2.0 Water Booster Stations</strong></td>
<td></td>
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<tr>
<td>.1 O’Connor Drive</td>
<td>68.6 (ML/d)</td>
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<tr>
<td>.2 Gore-Elliott</td>
<td>11.2</td>
<td>$1,630,000</td>
<td>11-15</td>
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<tr>
<td>.3 Gardiners Road</td>
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<td><strong>Sub-Total</strong></td>
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<td><strong>3.0 Water Storage</strong></td>
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<td>.1 Creekford Road</td>
<td>4500 (m³)</td>
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<td>.2 O’Connor Drive</td>
<td>15,400</td>
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<td>.3 Gore-Elliot</td>
<td>4,500</td>
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<td><strong>Sub-Total</strong></td>
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<td><strong>4.0 Water Treatment Plant</strong></td>
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<td>.1 Kingston West</td>
<td>57 (ML/d)</td>
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<td><strong>Sub-Total</strong></td>
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<tr>
<td><strong>Total Estimated Cost</strong></td>
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5.0 RECOMMENDATIONS

.1 Coordinated Management Review

It is essential that UK and Planning & Development Services (PDS) continue to work closely to manage development within the City in accordance with the Urban Growth Strategy. Monitoring of water demand, system performance, and growth rates including development approvals, will be essential to planning and implementing system upgrades. This will be particularly important during the next few years, while the Ravensview WPCP capacity issues are addressed.

The management review program should involve regular reporting between UK and PDS, including:

• Quarterly reports by PDS to UK indicating the status of new and pending subdivision and site plan approvals, building permits issued, etc.;

• Semi-annual reports by UK indicating the remaining capacity of key facilities, based upon PDS and performance data. A reporting format could be adopted which facilitates the use of available data and is compatible with acceptable or recognized protocols. For example, remaining plant capacity should be based upon MOE Procedure D-5-1; and

• Circulation of semi-annual reports to PDS and others as required.

The semi-annual reports should highlight any particular concerns or initiatives taken or pending, which might impact on system capacity and the ability to service continued growth. A threshold of at least 5 years should be established as a trigger to initiate any Environmental Assessment and design studies required to upgrade key facilities.

.2 Water Efficiency Plan

A water efficiency plan should be developed and adopted by the City with the intent being to reduce water use, including water loss, in the most cost-effective way. The plan, which would also result in reduced sewage flows, should incorporate a number of principles, including:

• Watering restrictions throughout the City during peak demand periods. Restrictions may vary from watering gardens every other day to complete bans, depending upon weather conditions and system demands;

• Since 1996, the Ontario Building Code has required water efficient toilets and showerheads in all new construction. A by-law should be implemented extending these requirements to all renovation projects;

• Water audits by ICI and residential customers should be promoted. Some ICI customers with large cooling or process demands could possibly reduce water usage through the use of cooling towers, water reuse, etc. The City and Utilities Kingston should lead by example by undertaking audits on their own properties;
Applications for building or site plan approval should require submission of a water management plan for review and comment by the City;

An incentive program should be considered to encourage the replacement of fixtures and appliances such as toilets and possibly clothes washers with low volume, high efficiency units in both the residential and ICI sectors;

A public education program should be initiated to heighten public awareness about the importance of conservation. The direct relationship between water consumption and the water and sewer rates will help convey the financial benefit of conservation to some consumers.

3 Water Loss Reduction Program

The Totten Sims Hubicki Associates 1997 "Water Needs Study" for the former Township of Kingston, indicated there was significant water loss (35% ±) associated with the distribution network. Losses were attributed to unmetered uses such as street cleaning, sewer and watermain flushing, non-metered accounts, and line leakage. The estimated water loss was valued at approximately $95,000 for the year 1995, with the majority (97% ±) of this associated with system leakage.

The 2002 R.V. Anderson Associates Limited "Water Distribution System Computer Model Update" report estimated water loss for the entire City to be approximately 38%. The MOE design guideline suggests that unaccounted for water loss of 15% or more is excessive.

The City has already initiated a number of leak detection studies and completed rehabilitation works to address water loss. One such project included relining an extensive portion of watermain in Westbrook in 2003, which resulted in improved watermain hydraulics and reduced leakage. A leak detection team and a repair crew have spent the last 8 months locating and repairing leaks with noted success. In addition, UK has also curtailed the use of hydrants by anyone other than UK staff and firefighters to reduce unaccounted for usage. Such initiatives are important elements in the ongoing management of the water system.

The potential value of an aggressive leak detection, repair, and rehabilitation program to reduce water loss is very significant. The need for the $8.0 Million Kingston West WTP expansion could be delayed or reduced in magnitude depending upon successful leak reduction. A reduction in overall flows would also reduce future storage requirements and pumping requirements, which are in part, based on water usage.

The TSH Report identified areas within Kingston West which historically have experienced frequent breaks. They also report there are over 35,000 m of unlined cast iron pipe in Kingston West. These mains are generally older, and because they are unlined, are subject to accelerated corrosion, a corresponding reduction in flow capacity, and failure. UK staff report that approximately 90% of watermain breaks occur on cast iron pipe.
It is recommended that the leak detection and repair program initially focus on those areas of Kingston West with a high frequency of watermain breaks and on those areas with cast iron pipe. Efforts should subsequently focus on the balance of Kingston West to minimize water loss and postpone the future expansion of the WTP. Eventually the program should extend into Kingston Centre and East, with the priorities again being areas with frequent breaks and/or cast iron watermains. The water loss reduction program should be an ongoing component of the water system maintenance program.

.4 Water Metering

It is essential the City be able to meter the water produced at the plants as well as the volume consumed by customers. The variance represents a combination of unmetered water usage and water loss or leakage.

Previously, portions of Kingston West relied on a flat rate billing system as opposed to metered consumption. A recent initiative has resulted in meter installation in the majority of these properties and the balance of installations is scheduled for this year.

Another initiative involved meter inspections at all major customers to confirm meter size, operation, and installation details. A number of meters were changed and installations modified to improve meter accuracy and reliability.

A meter replacement program has been initiated to change-out the older meters in the system. Initial focus will be on the larger meters, however, the intent is to eventually replace all meters, over time, as part of a regular maintenance program.

Meter maintenance and calibration are important tools in the water management strategy to track water production versus water consumption, and to minimize water loss.

.5 Update Distribution System Database

The water distribution network drawings and the infrastructure GIS database should be updated regularly to record changes in the system. Data on pipe and fitting age, type, size, repair and maintenance history, etc. will serve as a valuable system management tool as well as facilitate periodic record updates.

.6 Update Computer Model

Utilities Kingston intends to update the computer model in the coming months. This program should include conducting flow tests on the system to determine pipe C values, monitoring system pressures under various flow conditions, updating the network drawings to reflect as-constructed data, reassessment of the design criteria, and calibration of the model. Regular use of the updated model may then be used to predict the potential impact of various development scenarios and the benefit of the water loss reduction program, and to assess the design alternatives and priority of the more significant system upgrades.
.7 Implementation of the Proposed Works

The initiatives, data, and outcome associated with the previous recommendations will facilitate the future planning, prioritization, and detailed design of the works identified in Section 3.0. Some of the works, such as the Creekford Road watermains, are relatively straightforward. Others will require further study to confirm design and operating details. The interconnection of the Kingston West and Centre water systems and the O'Connor Drive BS and reservoir, for example, will have operational impacts which must be thoroughly assessed and integrated into the detailed design of the system upgrades.