Master Plans for
Urban Water Infrastructure in
The City of Vaughan

# City-Wide Water & Wastewater Master Plan Class EA

## APPENDIX D
## Design Criteria
## Technical Memorandum

JUNE 2014

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The MUNICIPAL INFRASTRUCTURE Group Ltd.

# Technical Memorandum

File: **10010**

Date: **09 March 2012**

From: **Fabian Papa**, Fabian Papa & Partners Inc.
**Eric Tuson**, The Municipal Infrastructure Group

To: **Michael Frieri & Tony Artuso**, City of Vaughan

Re: **Design Criteria – Water & Wastewater**
**City-Wide Water & Wastewater Master Plan**

This is to set out the rationale for the design criteria applied in the hydraulic modelling of the City's water distribution and sanitary sewage collection systems for this project. In general, a review of the City's design criteria was undertaken with the intention of determining its appropriateness given the available information and experience in relation to its loadings and performance, and particularly for identifying opportunities to apply less onerous criteria on a going forward basis. The fundamental motivations for adopting appropriate and justifiably lower design loadings are as follows:

- The adopted design criteria will drive the extent of water and sanitary sewer infrastructure needs, whether new or expansions to existing plant which will, in turn, drive Development Charge requirements. Over-designing and over-building infrastructure often results in the inefficient use of capital and, furthermore, burdens economic development. Higher Development Charges result in higher home price requirements and, therefore, mitigating these increases will improve Vaughan's attractiveness and competitiveness in this respect.
- Moving towards a more sustainable City and communities therein involves the adoption of conservation efforts which are well underway in several respects. The design criteria proposed herein are consistent with this motivation and more closely reflect current realities, practices and norms.
- With respect to water systems in particular, the proposed design criteria is expected to result in smaller pipe size requirements which, from a water quality perspective, allow for higher flow velocities and hence more circulation for any given demand and, as a result, would be expected to reduce the age of the water in the system which is an indirect measure of the water's quality.

## WATER

The City's current (and historically used) criterion for average day domestic demand is 450 Lpcd which is applied to residential population as well as to an equivalent residential population for non-residential land uses. This is generally recognized as a conservative figure and there is merit in considering a more realistic figure which is justifiable and supported by field measurements. Adopting a lower, more realistic, demand aims to exploit the capacity available in the City's existing systems and to moderate the requirements for system expansions and upgrades which are often highly capital intensive. This approach is also consistent with the direction taken by the Region of York in setting design criteria for the broader water supply and transmission system to which the City's distribution network is connected.

The Region of York's Water and Wastewater Master Plan Update – Unit Rates ("Unit Rate Report", Genivar & XCG, May 2008) report establishes rates and maximum day peaking factors to be considered for the various lower-tier municipalities out to 2036. Moreover, in the case of the City of Vaughan, there are different rates for the York Water System and the Kleinburg system which is categorized as a Smaller Urban System in that report. Based on 2010 consumption data, the York Water System represents approximately 98.5% of the City while Kleinburg represents the remaining 1.5%. Accordingly, the following discussion treats these systems separately for purposes of establishing design criteria to be applied in Vaughan.

## York Water System

Average Day Demand

From the Unit Rate Report, the following unit rates are identified for 2011[1]:

- Residential 274 Lpcd
- Employment 279 Lpcd

It is noted that these rates are projected to decrease somewhat over the time horizon considered in the report on account of further implementation of the current Building Code which requires water efficient fixtures, as well as ongoing water conservation and efficiency initiatives being undertaken by the Region and local municipalities.

The current population estimates for the City are as follows[2]:

- Residential 300,557 persons
- Employment 160,000 jobs

While the Region has applied significant effort in establishing the above noted consumption rates, it is instructive to test these values specifically for the Vaughan context. Application of these rates to the current population estimates results in a projected annual consumption of 46,352,306 $m^3$. In contrast, the 2010 water consumption for the entire City, measured as the bulk supply purchase of water from the Region, was 42,132,819 $m^3$, ignoring the population and consumption information for Kleinburg given its relatively small size thereby adding some additional conservatism to the analysis. Therefore, the rates proposed by the Region appear to be somewhat conservative and provide a 10% margin of safety based on the 2010 figures.

An additional test is to employ the results from the recently completed City-Wide Water Audit for 2010 which determined the residential consumption to be 204 Lpcd. Increasing this amount by 13.7% to account for the non revenue water (NRW) results[3] in an effective consumption rate of 232 Lpcd which, when multiplied by the residential population results in a total annual consumption of 25,451,167 $m^3$. Using the City's 2010 total consumption volume noted above, the balance attributable to employment uses is 16,681,652 $m^3$ which, when accounting for the estimated employment population, results in an average day demand of 286 Lpcd, marginally above the rate adopted by the Region. This analysis suggests that the Region's figures may somewhat overestimate residential demand and underestimate employment demand, although it is noted that these differences are small.

While it seems that the Region's figures may be appropriate for adoption by the City, there is the risk of localized underestimation of population when designing new infrastructure going forward. This risk is mitigated through the use of relatively conservative peaking factors since Vaughan's responsibility is for distribution – that is, conveyance capacity – rather than storage which is in the Region's domain. As well, the projected decrease in unit rates over time as noted above will assist in further mitigating this concern.

It is noted that these rates would represent a significant departure from Vaughan's historical practice of applying 450 Lpcd. For purposes of this project and for establishing the City's design criteria for the next stage of the City's development, a slightly more conservative set of rates will be adopted and which can be revisited in light of additional information as it becomes available with time:

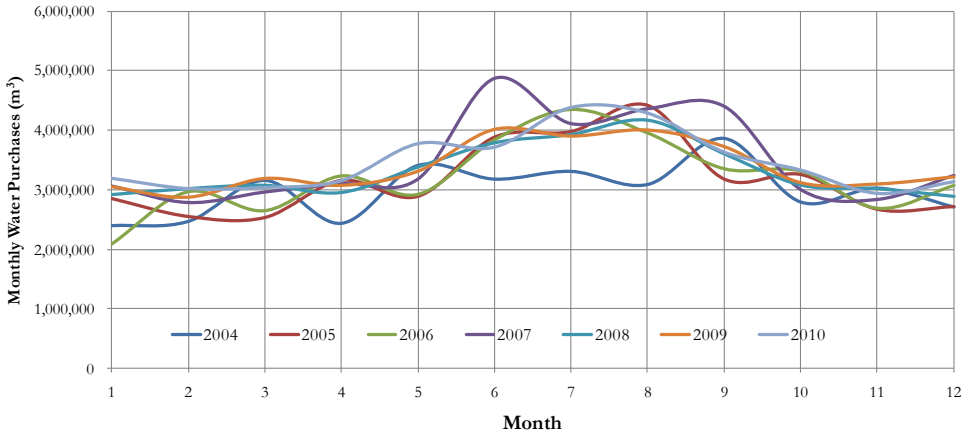
- **Residential 300 Lpcd**
- **Employment 300 Lpcd**

Based on the current population estimates, this results in an annual consumption volume of 50,431,992 which represents a 20% margin of safety based on the City's actual 2010 water consumption. Moreover, this is a 33% reduction from the historically used average demand rate of 450 Lpcd and which is expected to result in a considerable increase in the projected capacity of Vaughan's water infrastructure to facilitate future development, particularly in intensification areas.

[1] Table 2-8, Projected Water Consumption Unit Rates.
[2] From www.vaughan.ca, referencing the Region of York as at 30 June 2011.
[3] City-Wide Water Audit, Final Report, July 2011, Fabian Papa & Partners Inc.

Maximum Day Peaking Factor

The City's current (and historically used) criterion for the Maximum Day Demand peaking factor is 2.0. A review of monthly supply data for the York Water System which covers the majority of the City – approximately 98.5% by supply volume – was undertaken for the period from 2004 to 2010, the results of which are presented graphically below.




As can be expected, there is a distinct increase in consumption (purchases) during the summer months. The following table presents a statistical analysis of the same data.

| Year | Monthly Average ($m^3$) | Maximum Month ($m^3$) | Maximum/Average |
|---|---|---|---|
| 2004 | 2,981,201 | 3,863,772 | 1.30 |
| 2005 | 3,178,409 | 4,421,257 | 1.39 |
| 2006 | 3,195,805 | 4,339,037 | 1.36 |
| 2007 | 3,495,047 | 4,877,270 | 1.40 |
| 2008 | 3,314,659 | 4,171,206 | 1.26 |
| 2009 | 3,382,331 | 4,010,269 | 1.19 |
| 2010 | 3,458,386 | 4,377,111 | 1.27 |

Strictly speaking, this is a "maximum monthly average" analysis and should not be directly applied to estimate the appropriate maximum day peaking factor as these monthly figures effectively average the daily variability, however, this is a useful guide to assist in the selection of a suitable maximum day peaking factor.

The Unit Rates Report adopted a maximum day peaking factor of 1.80, confirming analyses from previous master plan studies. The Region's Long Term Water Project Master Plan Update (United Utilities, April 2004) identified that the highest and average observed maximum day peaking factor in Vaughan for the period from 1997 to 2001 were 1.68 and 1.61, respectively. In the absence of more refined monitoring data, a maximum day demand factor of **1.80** is adopted for purposes of this study and for the City's design criteria going forward, a figure which strives to strike a balance between the available measured data and conservatism, as well as maintaining consistency with the approach taken by the Region. Similarly, this figure can be revised from time to time as additional information becomes available from which further revision can be substantiated.

This peaking factor is applied by the Region in its modelling for all lower-tier municipalities in the York Water System. For comparative purposes, the MOE[4] suggests a maximum day peaking factor of 1.50 for populations greater than 150,000 and 1.80 for populations ranging from 25,001 to 50,000.

[4] Design Guidelines for Drinking-Water Systems 2008, Ontario Ministry of the Environment

## Kleinburg System

Average Day Demand

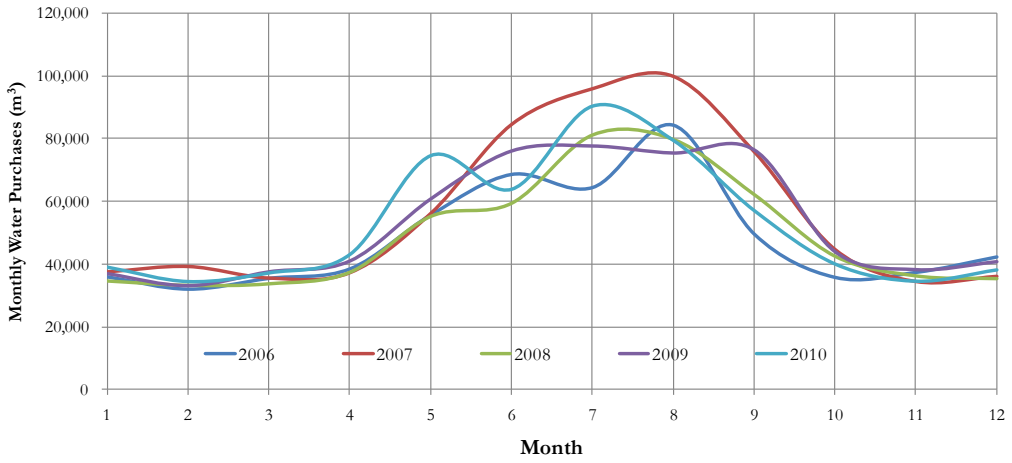
From the Unit Rate Report, the following unit rates are identified for 2011[1]:

- Residential 347 Lpcd
- Employment 317 Lpcd

Similarly, these rates are projected to decrease somewhat over time for the reasons noted above. The estimated serviced residential population is on the order of 4,525 persons and the estimated employment population is 1,567. Application of these rates results in a projected annual consumption of 754,423 $m^3$. In contrast, the 2010 water consumption for the entire City, measured as the bulk supply purchase of water from the Region, was 632,214 $m^3$. Therefore, the rates proposed by the Region appear to be somewhat conservative and provide a 19% margin of safety based on the 2010 figures. It is further noted that these unit rates are consistent with those adopted for the Kleinburg-Nashville Water and Wastewater Servicing Strategy Master Plan.

Maximum Day Peaking Factor

As noted earlier, the City's current (and historically used) criterion for the Maximum Day Demand peaking factor is 2.0. A review of monthly supply data for the Kleinburg System for the period from 2006 to 2010 is shown below followed by a statistical analysis.




| Year | Monthly Average ($m^3$) | Maximum Month ($m^3$) | Maximum/Average |
|---|---|---|---|
| 2006 | 48,213 | 84,390 | 1.75 |
| 2007 | 56,433 | 99,903 | 1.77 |
| 2008 | 49,320 | 81,229 | 1.65 |
| 2009 | 52,968 | 77,463 | 1.46 |
| 2010 | 52,685 | 90,340 | 1.71 |

As can be seen, this relatively small system exhibits a higher monthly peak consumption compared to the remainder of the City covered by the York Water System and which has been attributed by York Region to be largely due to irrigation.

In the Unit Rates Report adopted a maximum day peaking factor of 2.50 was adopted. In the absence of more refined monitoring data, a maximum day demand factor of **2.50** is adopted for purposes of this study and for the City's design criteria going forward. For comparative purposes, the MOE[4] suggests a maximum day peaking factor of 2.00 for

populations ranging from 3,001 to 10,000 persons. The historical maximum day peak factor for this system was previously determined[5] to be 2.21.

Impact on Residents

It is important to note the distinction between the use of design criteria for assessing existing or proposed infrastructure and the actual level of service experienced by the residents and businesses in any given service area. Although some modifications are proposed to reduce the design criteria to be applied, the performance of the existing system remains unaffected and any future works will be based on criteria that more closely resemble actual demand rates and, therefore, will serve to maintain service levels. No changes to operating pressures or system capacities relative to practical demand scenarios are proposed as a result of these design criteria revisions.

## Maximum Hour Peaking Factor

The City's current (and historically used) criterion for the Peak Hour Demand peaking factor is 4.5. For populations greater than 150,000, the MOE guidelines indicate a factor of 2.25. Previous work by the Region of York[6] suggests a peaking factor of 3.0. For purposes of this study and for the City's design criteria going forward, the following maximum hour peaking factors are adopted:

- York Water System: **3.0**
- Kleinburg System[14]: **4.0**

These values may be revisited from time to time with the support of field monitoring data, if available.

## Minimum Hour Peaking Factor

The City's does not currently specify a minimum hour demand factor in its design criteria, and such a criterion is typically required where excessive pressures can result when demands are lowest (e.g., at night), particularly in low lying areas where pressures are highest. For populations greater than 150,000, the MOE guidelines indicate a factor of 0.80. Previous work by the Region of York[6] suggests a peaking factor of **0.85** which is adopted herein for purposes of this study and for the City's design criteria going forward. Similarly, this value may be revisited from time to time with the support of field monitoring data, if available.

## Fire Flows

The current City criteria for fire flows are adopted for this study, as follows:

- Single Family/Semi Detached 7,000 L/min (117 L/s)
- Townhouses 9,000 L/min (150 L/s)
- Institutional 15,000 L/min (250 L/s)
- Industrial/Commercial 25,000 L/min (417 L/s)

[5] Environmental Study Report, Class Environmental Assessment, Water Supply and Storage Capacity For Kleinburg-Nashville, KMK Consultants Limited, May 2007.
[6] York Long Term Water Project, Modelling and Optimisation, Final Report, Consumers Utilities, February 1998.

# WASTEWATER

## Generation Rates

Analysis undertaken in York Region's Unit Rate study to compare measured water consumption volumes with wastewater volumes measured at the Region's treatment plants showed that, while there is seasonal variation, the volumes are generally similar on an annual basis. Accordingly, wastewater generation rates were derived based on the water rates plus an allowance of 90 Lpcd to account for average infiltration. For 2011, the following rates were adopted by the Region[7]:

| System | Residential | Employment |
|---|---|---|
| YDSS & Duffins Creek WPCP | 364 Lpcd | 369 Lpcd |
| Kleinburg WWTP | 437 Lpcd | 407 Lpcd |

The City is currently in the process of entering into an arrangement which will target the reduction of inflow and infiltration (I/I) which is expected to significantly reduce flows entering the sanitary sewer system. Previous sanitary flow monitoring studies have yielded the following results:

- Residential flow generation for the Woodbridge Expansion Area[8] of 238 Lpcd and an average infiltration rate of 0.08 L/s/ha which translates to 114 Lpcd[9] for a total of 352 Lpcd.
- Residential dry weather flow for various locations thoughout the City ranging from 304 Lpcd to 400 Lpcd in areas that are predominantly (>90%) residential, after adjusting for I/I[10].
- Flows to Kleinburg WPCP[11]:
    - 2001 – 283 Lpcd
    - 2002 – 330 Lpcd
    - 2003 – 411 Lpcd
    - 2004 – 338 Lpcd

YDSS & Duffins Creek WPCP

Based on the foregoing, it would appear that the figures adopted by the Region of York for the York-Durham Sanitary Sewer (YDSS) and Duffins Creek WPCP are appropriate for use in Vaughan for purposes of this study and for use by the City as design criteria for new infrastructure going forward. That is, **364 Lpcd** and **369 Lpcd** for residential and employment uses, respectively. This represents a ±19% reduction from the currently employed value of 450 Lpcd and is therefore expected to provide a substantial increase in the projected capacity of the City's existing systems that have been designed using this historical figure.

Kleinburg WPCP

The recently completed Kleinburg-Nashville Water and Wastewater Servicing Strategy Master Plan employed a generation rate of 450 Lpcd which is somewhat higher than the figures adopted by the Region. Given the relatively small size of this area, the relatively small difference between these figures, a value of **450 Lpcd** is adopted for purposes of this study and for the City's design criteria going forward.

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[7] Table 3-8, YDSS and Duffin Creek WPCP Future Wastewater Generation Unit Rates & Table 3-9, Smaller Urban System Facilities – Future Wastewater Generation Unit Rates. (Includes dry weather infiltration allowance of 90 Lpcd.)
[8] Sanitary Flow Monitoring of the Clarence Street Trunk Sewer, Greenland International Consulting Inc., October 2001.
[9] Based on a monitored service area of 197 ha and estimated population of 11,947 persons.
[10] City of Vaughan Sanitary Sewage Flow Monitoring, 1998 Program Final Report & 1999-2000 Amendment to Final Report, C.C. Tatham & Associates Ltd.
[11] Environmental Study Report, Class Environmental Assessment, Wastewater Servicing Capacity for Kleinburg-Nashville, KMK Consultants Limited, May 2007.

## Peaking Factor

The City has, similar to the vast majority of jurisdictions across Canada and North America, traditionally employed the Harmon peaking factor to compute peak wastewater flows. This has been shown in flow monitoring studies to be rather conservative[12] and allows for some margin of safety in relation to the generation rates adopted. The Region of York's Unit Rate Study suggests the use of the diurnal patterns in their InfoWorks model to determine peak dry weather flows in the YDSS system. For purposes of this study and for the City's design criteria going forward, the **Harmon formula** will continue to be adopted, subject to a minimum of 2.0 and a maximum of 4.0, in accordance with the guidelines set by the Ministry of the Environment. This approach has also been adopted in the Kleinburg-Nashville Water and Wastewater Servicing Strategy Master Plan.

## Peak Inflow/Infiltration Allowance

Although an allowance of 90 Lpcd is made in the wastewater generation rates noted above, these do not account for peak infiltration. The Region of York's Unit Rates Study adopts the following rates which are similarly adopted for purposes of this study and for the City's design criteria going forward:

- YDSS & Duffins Creek WPCP System[13]: **0.26 L/s/ha**
- Kleinburg System[14]: **0.23 L/s/ha**

[12] The observed peaking factor during the monitoring of the Clarence Street Trunk Sewer servicing the Woodbridge Expansion Area (Greenland International Consulting Inc., 2001) was 51% of that predicted using the Harmon formula.
[13] This rate is higher than that currently and historically used by the City (0.23 L/s/ha) and "is representative of an achievable target rate for infiltration and inflow for new development areas" in this system.
[14] Consistent with the Kleinburg-Nashville Water and Wastewater Servicing Strategy Master Plan.

## SUMMARY

### York Water System

- Average Day Demand: 300 Lpcd (residential & employment)
- Maximum Day Peaking Factor: 1.8
- Maximum Hour Peaking Factor: 3.0
- Minimum Hour Peaking Factor: 0.85

### Kleinburg Water System

- Average Day Demand: 347 Lpcd (residential); 317 Lpcd (employment)
- Maximum Day Peaking Factor: 2.5
- Maximum Hour Peaking Factor: 4.0
- Minimum Hour Peaking Factor: 0.85

### YDSS & Duffins Creek WPCP Wastewater Systems

- Generation Rate: 364 Lpcd (residential); 369 Lpcd (employment)
- Peaking Factor: Harmon, subject to a minimum of 2.0 and a maximum of 4.0
- Infiltration Allowance: 0.26 L/s/ha (based on gross area)

### Kleinburg WPCP Wastewater System

- Generation Rate: 450 Lpcd (residential & employment)
- Peaking Factor: Harmon, subject to a minimum of 2.0 and a maximum of 4.0
- Infiltration Allowance: 0.23 L/s/ha (based on gross area)

## ATTACHMENT

Annotated excerpts from the Region of York's Unit Rates report from its May 2008 Water and Wastewater Master Plan Update is attached for reference.

Regional Municipality of York

# Unit Rates
# Water and Wastewater
# Master Plan Update

**May 2008**


GENIVAR XCG

## 2.3 Projected Water Consumption

### 2.3.1 Consumption Rates

The Projected Water Consumption Rates have been determined for each service area/community and presented in Table 2-8.

The maximum day peaking factors for each community/service area were based on the historical data. Where the data was unreliable due to water restrictions or major changes proposed in the community population, the peaking factor was chosen based on similar communities. Separate unit rates for residential and employment have been determined for all communities based on actual data available from Markham, Vaughan, Newmarket, Georgina and Aurora.

The maximum day factors for each community are shown in Table 2-8 and discussed in Section 2.3.1.

The projected rates are lower than shown in the 1997 and 2004 water master plans, considering a decrease in water consumption due to implementing water use reduction programs, such as Water for Tomorrow, which are assumed to be continued in the future
The presented data will be used for planning of the proposed and new infrastructure facilities. They are not used for allocation purposes as the allocation is a function of the capacity of the existing infrastructure facilities. Please note that the reduction in water consumption reduction is contingent upon the implementation of Water Efficiency program.

**Table 2-8 Projected Water Consumption Unit Rates (L/ca/d)**

| Water System | Service Area | Rate Type | Base | 2011 | 2016 | 2021 | 2026 | 2031 | 2036 | Maximum Day Factor |
|---|---|---|---|---|---|---|---|---|---|---|
| York Water System | Aurora | Res | 241 | 237 | 229 | 224 | 224 | 224 | 224 | 1.8 |
| | | Emp | 252 | 248 | 239 | 234 | 234 | 234 | 234 | |
| | Holland Landing | Res | 229 | 229 | 229 | 229 | 229 | 229 | 229 | 1.8 |
| | | Emp | 198 | 198 | 198 | 198 | 198 | 198 | 198 | |
| | Queensville | Res | 229 | 229 | 229 | 229 | 229 | 229 | 229 | 1.8 |
| | | Emp | 198 | 198 | 198 | 198 | 198 | 198 | 198 | |
| | Sharon | Res | 229 | 229 | 229 | 229 | 229 | 229 | 229 | 1.8 |
| | | Emp | 198 | 198 | 198 | 198 | 198 | 198 | 198 | |
| | Markham | Res | 240 | 236 | 228 | 223 | 223 | 223 | 223 | 1.8 |
| | | Emp | 214 | 211 | 204 | 199 | 199 | 199 | 199 | |
| | Newmarket | Res | 229 | 236 | 217 | 213 | 213 | 213 | 213 | 1.8 |
| | | Emp | 198 | 195 | 188 | 184 | 184 | 184 | 184 | |
| | Richmond Hill | Res | 256 | 252 | 243 | 238 | 238 | 238 | 238 | 1.8 |
| | | Emp | 246 | 242 | 234 | 229 | 229 | 229 | 229 | |
| | Vaughan | Res | 278 | 274 | 264 | 259 | 259 | 259 | 259 | 1.8 |
| | | Emp | 283 | 279 | 269 | 263 | 263 | 263 | 263 | |

**Table 2-8 Projected Water Consumption Unit Rates (L/ca/d)**

| Water System | Service Area | Rate Type | Base | 2011 | 2016 | 2021 | 2026 | 2031 | 2036 | Maximum Day Factor |
|---|---|---|---|---|---|---|---|---|---|---|
| Georgina Water System | Keswick | Res | 290 | 286 | 276 | 270 | 270 | 270 | 270 | 2.1 |
| | | Emp | 252 | 248 | 239 | 234 | 234 | 234 | 234 | |
| | Sutton | Res | 256 | 252 | 243 | 238 | 238 | 238 | 238 | 2.1 |
| | | Emp | 276 | 272 | 262 | 257 | 257 | 257 | 257 | |
| Smaller Urban System | Ballantrae | Res | 223 | 219 | 212 | 207 | 207 | 207 | 207 | 2.9 |
| | | Emp | 208 | 205 | 198 | 193 | 193 | 193 | 193 | |
| | King City | Res | 256 | 252 | 243 | 238 | 238 | 238 | 238 | 2.4 |
| | | Emp | 246 | 242 | 234 | 229 | 229 | 229 | 229 | |
| | Kleinburg | Res | 352 | 347 | 335 | 327 | 327 | 327 | 327 | 2.5 |
| | | Emp | 322 | 317 | 306 | 300 | 300 | 300 | 300 | |
| | Mount Albert | Res | 214 | 211 | 203 | 199 | 199 | 199 | 199 | 2.8 |
| | | Emp | 198 | 195 | 188 | 184 | 184 | 184 | 184 | |
| | Nobleton | Res | 264 | 260 | 251 | 245 | 245 | 245 | 245 | 2.5 |
| | | Emp | 220 | 217 | 209 | 205 | 205 | 205 | 205 | |
| | Schomberg | Res | 276 | 272 | 262 | 257 | 257 | 257 | 257 | 2.1 |
| | | Emp | 401 | 395 | 381 | 373 | 373 | 373 | 373 | |
| | Stouffville | Res | 266 | 262 | 252 | 235 | 235 | 235 | 235 | 2.0 |
| | | Emp | 232 | 228 | 220 | 205 | 205 | 205 | 205 | |

A discussion of each community follows.

#### 2.3.1.1 Aurora

The 'Base' rates for Aurora are 241 and 252 L/ca/d for residential and employment, respectively. These values represent the average value for the past five years during which there has not been a significant deviation. The maximum day peaking factor has ranged from 1.4 to 1.7. It is recognized that Aurora has been subject to water restrictions (Stage 1) and water bans (Stage 2) at times throughout the summers of 2001 to 2006. It is believed the maximum day factor has been impacted by the water restriction in Aurora as in Newmarket. A maximum day factor of 1.8, which would be consistent with larger urban areas like Markham and Vaughan, is recommended. Also, it is recognized that in 2008 there will be additional water supply available in Aurora and York Region may not need to impose water restrictions. Without the restrictions the question remains whether the unit rates and/or the maximum day factor would increase.

#### 2.3.1.2 Holland Landing / Queensville / Sharon

These three communities are planned to grow into a large urban area, larger than Newmarket to the south. Current water consumption rates are, therefore, not considered to be representative of the future. The 'Base' rates are recommended as 229 L/ca/d and 198 L/ca/d for residential and employment, respectively. These rates are generally representative of the large urban areas like Newmarket and Markham. Reduction of these rates is not recommended as noted in Section 2.2.3.

for treatment plant and major pumping station design in the MOE Design Guidelines. As was noted in the water unit rate discussion in Section 2.2.3, these proposed wastewater generation rates recognize the impact of the York Region's Water for Tomorrow program over time. Table 3-8 presents the recommended wastewater generation rates by community for the period up to 2036 for the YDSS and Duffin Creek WPCP. Note that the presented rates include a dry weather inflow and infiltration allowance of 90 L/ca/d.

**Table 3-8 YDSS and Duffin Creek WPCP Future Wastewater Generation Unit Rates (L/ca/d) (Including dry weather infiltration allowance 90 L/ca/d)**

| Wastewater System | Service Area | Rate Type | 2001-2005 Average | 2011 | 2016 | 2021 | 2026 | 2031 | 2036 |
|---|---|---|---|---|---|---|---|---|---|
| **YDSS** | Aurora | Res | 331 | 327 | 319 | 314 | 314 | 314 | 314 |
| | | Emp | 342 | 338 | 329 | 324 | 324 | 324 | 324 |
| | East Gwillimbury | Res | 319 | 319 | 319 | 319 | 319 | 319 | 319 |
| | | Emp | 288 | 288 | 288 | 288 | 288 | 288 | 288 |
| | Markham | Res | 330 | 326 | 318 | 313 | 313 | 313 | 313 |
| | | Emp | 304 | 301 | 294 | 289 | 289 | 289 | 289 |
| | Newmarket | Res | 319 | 326 | 307 | 303 | 303 | 303 | 303 |
| | | Emp | 288 | 285 | 278 | 274 | 274 | 274 | 274 |
| | Richmond Hill | Res | 346 | 342 | 333 | 328 | 328 | 328 | 328 |
| | | Emp | 336 | 332 | 324 | 319 | 319 | 319 | 319 |
| | Vaughan | Res | 368 | 364 | 354 | 349 | 349 | 349 | 349 |
| | | Emp | 373 | 369 | 359 | 353 | 353 | 353 | 353 |
| | King City | Res | 346 | 342 | 333 | 328 | 328 | 328 | 328 |
| | | Emp | 336 | 332 | 324 | 319 | 319 | 319 | 319 |
| | Stouffville | Res | 356 | 352 | 342 | 325 | 325 | 325 | 325 |
| | | Emp | 322 | 318 | 310 | 295 | 295 | 295 | 295 |

Average residential wastewater generation rates for the YDSS and Duffin Creek WPCP system by 2036 range from 303 L/ca/d for Newmarket to 349 L/ca/d for Vaughan. Average employment wastewater generation rates for the YDSS and Duffin Creek WPCP system range from 274 L/ca/d for Newmarket to 353 L/ca/d for Vaughan. It is important to note that these rates include an allowance for average infiltration. The previous 2003 Master Plan utilized a residential wastewater generation rate of 265 L/ca/d and an employment wastewater generation rate of 160 L/e/d along with an infiltration allowance of 1,000 L/ha/d. The wastewater generation rates recommended for this Master Plan Update are higher for some communities than those utilized in the 2003 Master Plan. However, the recommended rates recognize the specific nature of these communities.

### 3.3.2 Peak Dry Weather Flows

Peak dry weather flows in the YDSS will be calculated based on the average flow and calculated peaking factors. For the YDSS, the InfoWorks model is populated with diurnal patterns that allow the model to replicate the actual diurnal flow patterns observed within the YDSS. These patterns were derived based on the actual measured flows. For future growth scenarios, it is

recommended that the existing diurnal patterns found in the InfoWorks model be applied to the future growth.

### 3.3.3 Peak Inflow/infiltration Allowance

Inflow and infiltration have been identified as important component of the flow within the YDSS system. York Region has invested significant effort into developing modelling tools to achieve a better understanding of how existing inflow and infiltration contributes to the performance of the YDSS.

It is important to note that inflow and infiltration into existing wastewater conveyance systems within York Region occurs due to the age, condition and nature of existing infrastructure. Any new infrastructure will be designed and constructed in accordance with current municipal standards.

An average infiltration and inflow allowance has been included in the average wastewater generation rates presented in Table 3-8. However, these rates do not account for peak infiltration and inflow that can enter the YDSS.

For the YDSS, it is recommended that the InfoWorks model continue to be used to generate existing peak infiltration and inflows. Details of wet weather flows generated within existing developed areas will be documented within the InfoWorks Model Development Technical Memorandum. For new development areas, it is recommended that the YDSS target infiltration and inflow allowance of 0.26 L/s/ha be adopted. This rate of 0.26 L/s/ha has been adopted as part of the South East Collector IEA and is representative of an achievable target rate for infiltration and inflow for new development areas.

York Region has recently initiated an Inflow and Infiltration Reduction Program, in coordination with the South East Collector IEA, that will focus on understanding, communication, cooperation and investment to ensure that inflow and infiltration is managed to a level currently achievable through industry best practices.

## 3.4 Smaller Urban System Facilities

The following sections present the recommended average flow and average infiltration and inflow unit rates for the smaller urban system facilities.

### 3.4.1 Average Day Flow

Similar to the YDSS, average unit wastewater generation rates for the smaller urban systems were calculated on a community basis. For residential development, an average infiltration and inflow allowance of 90 L/ca/d was added to the community based residential water demand rates to calculate the wastewater generation rates. The community based water demand rates, shown in Table 2-8, consider the impact of the York Region's Water for Tomorrow program over time. Table 3-9 presents the proposed wastewater generation rates for the smaller urban system facilities by community for the period up to 2036.

**Table 3-9 Smaller Urban System Facilities – Future Wastewater Generation Unit Rates (includes dry weather infiltration allowance 90 L/ca/d) (L/ca/d)**

| Wastewater System | Service Area | Rate Type | Base | 2011 | 2016 | 2021 | 2026 | 2031 | 2036 |
|---|---|---|---|---|---|---|---|---|---|
| Keswick WWTP | Keswick | Res | 380 | 376 | 366 | 360 | 360 | 360 | 360 |
| | | Emp | 342 | 338 | 329 | 324 | 324 | 324 | 324 |
| Sutton WWTP | Sutton | Res | 346 | 342 | 333 | 328 | 328 | 328 | 328 |
| | | Emp | 366 | 362 | 352 | 347 | 347 | 347 | 347 |
| Kleinburg WWTP | Kleinburg | Res | 442 | 437 | 425 | 417 | 417 | 417 | 417 |
| | | Emp | 412 | 407 | 396 | 390 | 390 | 390 | 390 |
| Mount Albert WWTP | Mount Albert | Res | 304 | 301 | 293 | 289 | 289 | 289 | 289 |
| | | Emp | 288 | 285 | 278 | 274 | 274 | 274 | 274 |
| Nobleton WWTP | Nobleton | Res | 354 | 350 | 341 | 335 | 335 | 335 | 335 |
| | | Emp | 310 | 307 | 299 | 295 | 295 | 295 | 295 |
| Schomberg WWTP | Schomberg | Res | 366 | 362 | 352 | 347 | 347 | 347 | 347 |
| | | Emp | 491 | 485 | 471 | 463 | 463 | 463 | 463 |

Average residential wastewater generation rates for the smaller urban systems in 2036 range from 289 L/ca/d for Mount Albert to 417 L/ca/d for Kleinburg. Average employment wastewater generation rates for the smaller urban systems range from 274 L/ca/d for Mount Albert to 390 L/ca/d for Kleinburg. For Schomberg, the Region has previously utilized industry specific unit rates to generate average flows from employment lands to reflect high water use industries. Unit rates shown in Table 3-9 should not be used alone without consideration of specific industry types and land areas.

### 3.4.2 Inflow/infiltration

For the calculation of average day treatment requirements at treatment facilities, it is customary to adopt an infiltration allowance that represents average flow conditions. The MOE recommends that an infiltration allowance of 90 L/ca/d be utilized to develop average flow projections. This infiltration and inflow allowance has been included in the unit wastewater generation rates presented in Table 3-9.

For peak wet weather infiltration and inflows, the local municipality infiltration and inflow rates were adopted. Table 3-10 presents the recommended peak infiltration and inflow rates. These rates will be used for any new regional trunk sewer infrastructure located within these communities. These rates have been selected to ensure that adequate downstream trunk sewer capacity is provided.

**Table 3-10 Smaller Urban Systems Peak Infiltration and Inflow Rates**

| Smaller Urban System | Peak Infiltration and Inflow Rate (L/s/ha) |
|---|---|
| Keswick WWTP Sewershed Area | 0.21 |
| Sutton WWTP Sewershed Area | 0.21 |
| Kleinburg WWTP Sewershed Area | 0.23 |
| Mount Albert WWTP Sewershed Area | 0.26 |
| Nobleton WWTP Sewershed Area | 0.20 |