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Memo

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File:	163401487	Date:	July 9, 2018

Reference: **Richmond Infill Development – Extension of King's Park Well System Potable Water Hydraulic Assessment**

OVERVIEW

Stantec Consulting Ltd. (Stantec) was retained by David Schaeffer Engineering Ltd. (DSEL) to complete a hydraulic assessment for the Richmond Infill Development Extension of King's Park Well System.

A currently vacant parcel of land located at 11 King Street, near Perth Street in Richmond Village (see **Figure 1**) is to be developed. The proposed infill development will comprise of 11 single family and 28 semi-detached homes. It is proposed to extend the existing King's Park Well System to provide the new development with potable water only.

The purpose of this analysis is to assess the capacity of the existing system and to determine the impact of extending the system to service the proposed development.

HYDRAULIC ANALYSIS

EXISTING SYSTEM

The existing King's Park system serves a subdivision in the Village (see **Figure 1**) and primarily consists of 200 mm diameter watermains, with a couple 300 mm watermains along King Street between Royal York Street and Chanonhouse Drive. The system currently has limited/no storage and in the past was considered to be less reliable than other City well systems. In recent past, the King's Park system has experienced boil water advisories. In 2012, Stantec assisted the City with electrical upgrades at King's Park which included new generators (each well now has a generator), and SCADA upgrades to increase reliability of the system.

As of 2005, the system services 151 properties (Stantec Consulting Ltd., 2011), which corresponds to approximately 500 persons at 3.4 persons per unit (PPU). The system was originally designed to provide domestic water to an ultimate population of 600 persons (approx. 175 units at 3.4 PPU).

As per the 1999 Fire Underwriters Survey (FUS), a single pump in operation provides the existing King's Park system with a limited fire flow capacity of 1,000 L/min (16.6 L/s) for 2 hours to the distribution network to meet minimum allowable fire flow for accreditation. With both pumps operating, it is possible to achieve the higher fire flow protection of 38.0 L/s for 2 hours for a population of 500 - 1,000 persons as per the MOE Design Guidelines (Ministry of the Environment, 2008).

The existing design flows are summarized in **Table 1**. For the purpose of this analysis, an average day (AVDY) per capita water demand of 450 L/cap/d was assumed for the existing residential area which is consistent with the value used in the Village's *Water & Wastewater Master Servicing Study* (MSS) (Stantec Consulting Ltd., 2011). For maximum day (MXDY) demand, AVDY was multiplied by a factor of 2.75. For peak hour (PKHR) demand, AVDY was multiplied by a factor of 4.13 for a population range of 500 - 1,000 as per the *Design*

Guidelines for Drinking Water Systems (Ministry of the Environment, 2008) as well as the City of Ottawa 2010 Water Design Guidelines (City of Ottawa, 2010).

Table 1 – Design Water Demands of Existing System

Unit Type	Units	PPU	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Singles	151	3.4	513	2.67	7.35	11.04

The system is fed by one of two (2) groundwater wells: KP1 or KP2 (see **Figure 1**). KP1 is located on King Street near Chanonhouse Drive, and KP2 is located on Chanonhouse Drive near Temple Street. Each well is equipped with a submersible pump with a Ministry of Environment, Conservation and Parks (formerly the Ministry of Environment and Climate Change, MOECC) permitted throttled withdrawal rate of 15 L/s at a TDH of 48 m (30 L/s for the total well system). According to a Jacques Whitford report entitled *Hydrogeologic Study: King's Park Subdivision, Richmond* (Jacques Whitford Limited, 1991), the long-term safe yields from KP1 and KP2 are 77 L/s and 32 L/s, both of which are well above the 15 L/s withdrawal rates. With both wells operating together, the system's total allowable pumping capacity of 30 L/s is within the safe aquifer yield of 56 L/s. Extending the King's Park system to service the proposed development is not anticipated to negatively impact the system's water source and there appears to be sufficient capacity based on historical findings in previous reports by others.

PROPOSED WATER DEMANDS

The proposed infill development will comprise of 11 single family and 28 semi-detached homes. Using a PPU density of 3.4 for single family homes and 2.7 for semi-detached homes, this equates to a residential population of approximately 76 persons. Domestic demand associated with potential connections to existing homes along the route of the extension, between King's Park and the proposed development, was also considered. Approximately 20 homes are located along this route. Applying a PPU density of 3.4, this equates to a population of approximately 68 persons.

Similar to the assumptions made for existing water demands, an AVDY per capita water demand of 450 L/cap/d was used for the proposed Richmond development and the potential connections to existing homes. Using the City of Ottawa Water Design Guideline, peak factors for MXDY and PKHR demands were taken as 2.75 and 4.13, respectively. The estimated additional design flows are summarized in **Table 2**.

Table 2 – Additional Design Water Demands

Unit Type	Units	PPU	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Proposed Development						
Singles	11	3.4	37	0.19	0.54	0.80
Semi-detached	28	2.7	76	0.39	1.08	1.63
Sub-Total	*39*		*113*	*0.58*	*1.62*	*2.43*
Potential Connections to Existing Homes						
Singles	20	3.4	68	0.35	0.97	1.46
Total	***59***		***181***	***0.93***	***2.59***	***3.89***

Under PKHR demands, derived using the conservative design values, one pump would provide sufficient capacity for domestic demand from the existing system (11 L/s), the proposed infill development (2.4 L/s), and the potential connections to existing homes located along the route of the extension (1.5 L/s), or 14.9 L/s total.

RESULTS

Applying the Hazen-Williams equation, the head loss between each of the two supply sources and the proposed connection point of the service extension was estimated. As per the MSS, the preliminary water distribution system piping for the Village considered looped 300 mm diameter watermains from the pumping station around the lands west of the Jock River and crossing of the Jock River into the lands east of the river, plus a network of 200 mm diameter watermains throughout the major growth areas and the existing developed areas. The following three (3) watermain sizes were assessed for the extension: 150 mm (sizing optimized for capital cost savings), 200 mm (preliminary sizing suggested for the majority of the system), and 300 mm (preliminary sizing suggested for watermains crossing the Jock River). The parameters and calculated values are summarized in **Table 3**, **Table 4**, and **Table 5**.

Head loss with the additional demand was estimated to be minimal (< 1 psi) for all watermain sizes considered. Water age of the total demand in the system, including the additional demand, ranged from approximately 0.4 days for the 150mm diameter watermain up to 1.2 days for the 300 mm diameter watermain (see **Table 6**), which is below the maximum residence time of 8 days for water quality requirements.

Table 3 – Head Loss with Additional Demand via 150 mm dia. Watermain

Parameter	Units	150 mm dia.					
		KP1 to Development			KP2 to Development		
		AVDY	MXDY	PKHR	AVDY	MXDY	PKHR
Hazen-Williams Coefficient, C	-	100	100	100	100	100	100
Pipe Length, L	m	740	740	740	1150	1150	1150
Pipe Diameter, D	m	0.150	0.150	0.150	0.150	0.150	0.150
Discharge, Q	m^3/s	0.00094	0.00259	0.00389	0.00094	0.00259	0.00389
Velocity, V	m/s	0.053	0.147	0.220	0.053	0.147	0.220
Head Loss, H	m	0.04	0.26	0.56	0.06	0.41	0.86
	psi	0.06	0.37	0.79	0.09	0.58	1.22

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Table 4 – Head Loss with Additional Demand via 200 mm dia. Watermain

Parameter	Units	200 mm dia.					
		KP1 to Development			KP2 to Development		
		AVDY	MXDY	PKHR	AVDY	MXDY	PKHR
Hazen-Williams Coefficient, C	-	110	110	110	110	110	110
Pipe Length, L	m	740	740	740	1150	1150	1150
Pipe Diameter, D	m	0.200	0.200	0.200	0.200	0.200	0.200
Discharge, Q	m^3/s	0.00094	0.00259	0.00389	0.00094	0.00259	0.00389
Velocity, V	m/s	0.030	0.083	0.124	0.030	0.083	0.124
Head Loss, H	m	0.01	0.05	0.11	0.01	0.08	0.18
	psi	0.01	0.08	0.16	0.02	0.12	0.25

Table 5 – Head Loss with Additional Demand via 300 mm dia. Watermain

Parameter	Units	300 mm dia.					
		KP1 to Development			KP2 to Development		
		AVDY	MXDY	PKHR	AVDY	MXDY	PKHR
Hazen-Williams Coefficient, C	-	120	120	120	120	120	120
Pipe Length, L	m	740	740	740	1150	1150	1150
Pipe Diameter, D	m	0.300	0.300	0.300	0.300	0.300	0.300
Discharge, Q	m^3/s	0.00094	0.00259	0.00389	0.00094	0.00259	0.00389
Velocity, V	m/s	0.013	0.037	0.055	0.013	0.037	0.055
Head Loss, H	m	0.00	0.01	0.01	0.00	0.01	0.02
	psi	0	0.01	0.02	0	0.01	0.03

Table 6 – Estimated Water Age Under AVDY Demand

	Units	Watermain Segment			
		Existing (Between KP2 and KP1)	Potential Connections to Existing Homes	Proposed Development	Total
AVDY Demand	L/s	2.67	0.35	0.58	*3.62*
150 mm dia. Extension					
Diameter	mm	200	150	150	*N/A*
Length	m	516	317	317	*1,150*
Total Available Volume	m^3	16.2	5.6	5.6	*27*
Water Age	d	0.07	0.18	0.11	*0.36*
200 mm dia. Extension					
Diameter	mm	200	200	200	*N/A*
Length	m	516	317	317	*1,150*
Total Available Volume	m^3	16.2	10.0	10.0	*36*
Water Age	d	0.07	0.33	0.20	*0.59*
300 mm dia. Extension					
Diameter	mm	200	300	300	*N/A*
Length	m	516	317	317	*1,150*
Total Available Volume	m^3	16.2	22.4	22.4	*61*
Water Age	d	0.07	0.73	0.44	*1.24*

CONCLUSIONS

Based on the results of this analysis, the King's Park Well System has adequate capacity to service the proposed Richmond infill development with domestic water supply. The King's Park Well System provides limited fire protection to existing services and would therefore provide limited fire protection to any new services connected to the system. Head loss under PKHR demands was found to have minimal impact to pressure across the system. The current operational capacity of the pumps at KP1 and KP2, as well as the safe yields of their aquifers, have sufficient capacity to accommodate the demands of the proposed development including the potential connections to existing homes along the proposed extension.

REFERENCES

City of Ottawa. (2010). *Ottawa Design Guidelines - Water Distribution.* Ottawa.

Jacques Whitford Limited. (1991). *Hydrogeological Study King's Park Subdivision, Richmond.*

Ministry of the Environment. (2008). *Design Guidelines for Drinking Water.*

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Stantec Consulting Ltd. (2011). *Village of Richmond: Water & Wastewater Master Servicing Study.*

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Attachment: Figure 1 – King's Park Well System

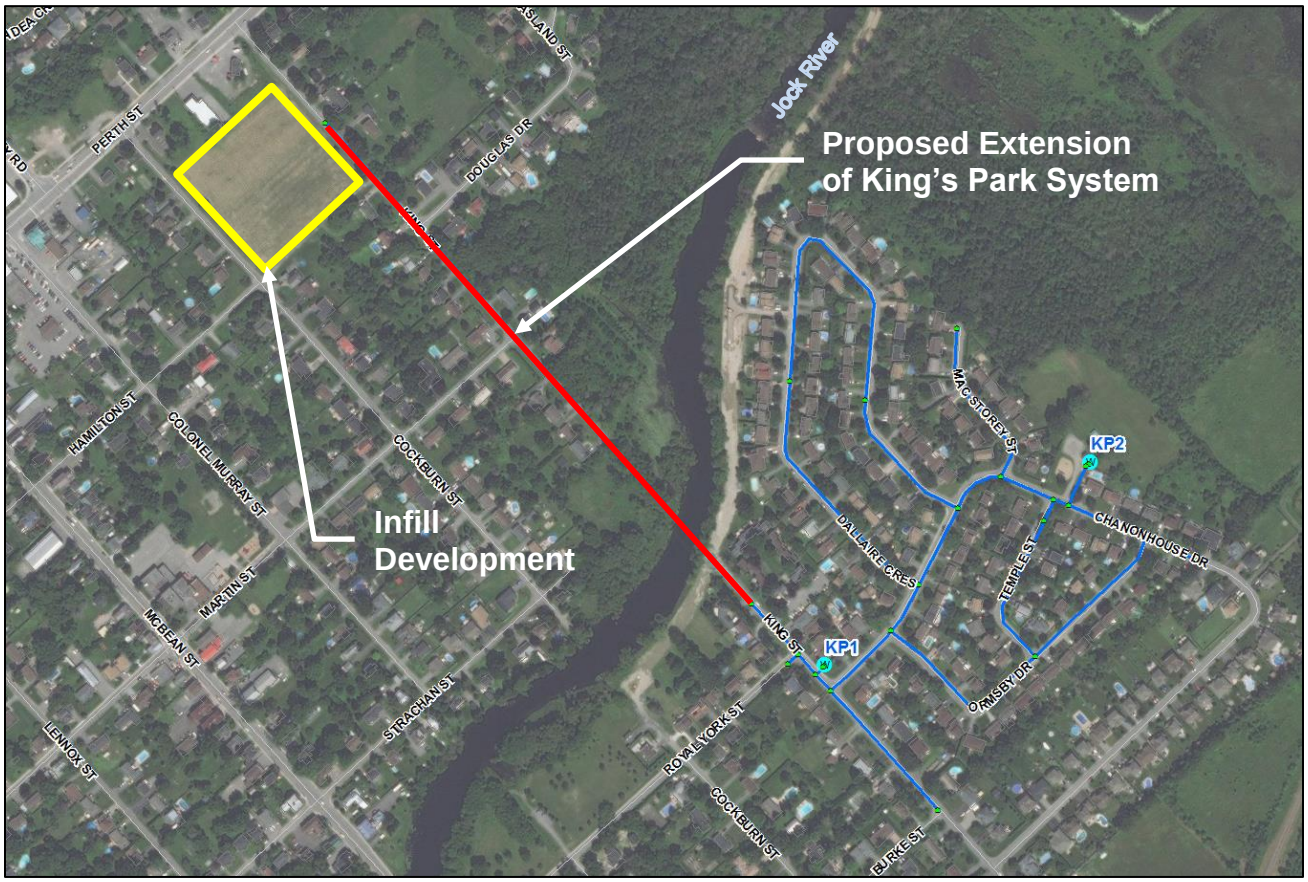

Figure 1 – King's Park Well System