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Windsor Utilities Commission

Windsor Water System Master Plan
EXECUTIVE SUMMARY

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1. INTRODUCTION

The WUC retained Earth Tech (AECOM) to complete the Water System Master Plan (WSMP) to 2048. The last Water System Master Plan was completed in 1988. The work to be completed included:

- the identifying water system needs from a growth and non-growth perspective to ensure the full cost of servicing was identified, and a cost recovery plan was prepared as a basis to set water rates;
- establishing the principle of "growth paying for growth" for water system expansion works to the southeast and for the Banwell Reservoir and Pump Station for Development Charge recovery;
- confirming where storage should be located and how it could best be conveyed via pumping and transmission mains to areas of need. This included confirming the need for the proposed Banwell Reservoir and Pump Station and/or locating storage at the WTP/Main PS site for flexibility of supply and maintenance purposes;
- combining the Water Rate Study and the Water Supply Master Plan outputs to develop complete financial and system-related planning into the future; and
- providing implementation planning phased in 5 and 10 year increments over the 40 year timeframe (0, 5, 10, 20, 30, 40).

Growth information was to be obtained from the latest Development Charges work and the water system modeling completed previously. The Windsor water system currently serves Windsor, areas to the south (LaSalle), and to the east (Tecumseh). The handling of growth in these areas and future connections for new or additional services was to also be reviewed.

1.1 Current Water System Condition

The WUC owns and operates an integrated water supply system that provides treated water to the City of Windsor, the Town of LaSalle and the Town of Tecumseh. Two raw water intakes in the Detroit River supply raw water to the Albert H. Weeks and the Old water treatment plants for treatment. Treated water is distributed through approximately 1000 km of watermains ranging in size from 150 to 1800 mm in diameter (6 to 72 inches), to end users via two high lift pumping stations; the A.J. Brian Pumping Station and the George Avenue Pumping Station.

The J.F. Cook Reservoir and Pumping Station located on Howard Avenue, an existing elevated water tank located on Hanna Street (5.7 ML/1.25 MIG) and an existing elevated water tower in the Town of Tecumseh (4.5 ML/1 MIGD) provide additional pumping and storage capacity. High lift pump operation at the A.J. Brian and George Avenue pumping stations is controlled based on water levels in the elevated storage tanks.

The J.F. Cook Reservoir and Pumping Station has a storage capacity of 45.4 ML (10 million gallons) and is equipped with booster pumps. The booster pumps are mainly used to supply the water system during peak demands. The pressure and flow at the reservoir and within the rest of the system is generally governed by the Hanna Street elevated tank, and high lift pump operation. Water levels in all distribution system storage tanks (J.F. Cook Reservoir, Hanna Street elevated tank, and Tecumseh elevated tank), are monitored hourly

at the WTP. In addition, a system of 15 pressure monitoring stations, recorded hourly, are used to monitor system pressures and act as a decision basis for pump operations.

The entire water supply system is operated as a single pressure zone. Flows to LaSalle and Tecumseh are sold wholesale based on flow monitoring at boundary flow meters.

1.2 Storage Implications

As part of this master planning work, an updated review of the WUC's treated water storage capacity was completed to confirm the need for additional storage capacity. The WUC currently relies primarily on storage provided by Reservoir D at the WTP, and distribution storage provided at the J.F Cook Reservoir and Pumping Station, the Hanna Street elevated storage tank and the Tecumseh elevated storage tank. To determine the level of risk associated with the existing WUC water system storage capacity, storage requirements were calculated for 2008 water system demands based on several design criteria; MOE design guidelines; 10 States Standards; and several 'self-imposed' municipal standards. For this evaluation, the "effective" storage capacity was not considered to ensure that sufficient storage capacity is available under situations where treatment capacity may not be available (i.e. raw water concerns). Table 1.1 summarizes the results of the storage requirements comparisons.

Table 1.1: Storage Requirements Comparison for Various Design Criteria

Standand[1]	***Additional Storage Requirements (2008)***
MOE Guidelines	(13.6)
City of Toronto Design Standards	79.6
Region of Peel Design Standards	(12.9)
10 States Standards with MOE Fire Flow	62.8
10 States Standards with 2 Industrial Fires	59.4
10 States Standards with 1 Industrial Fire and 1 Residential Fire	57.4
In-Plant Use Storage Projection Included in Totals Above	*9.5*

[1] All standards include plant use storage requirements, as identified in the Banwell EA Report (Stantec, 2007).

As identified by Table 1.1, the existing WUC water storage facilities have sufficient capacity (13.6 ML in excess) when using the MOE design guidelines as the design criteria; however, the total system capacity represents less than one average day of water use for the entire water system. Design criteria are typically developed based on a municipality's risk tolerance and available redundancy and/or flexibility in the system.

The WUC is considering completion of an overall storage evaluation and optimization study to confirm actual system storage requirements based on system characteristics, future demand projections, operating strategies, risk tolerance and vulnerability.

2. FUTURE NEEDS

Future needs were determined based on population growth information for Windsor, LaSalle and Tecumseh and the design criteria confirmed as part of project completion. The WUC's WaterCAD model was utilized to assess various operational and servicing strategies resulting in the selection of a preferred servicing strategy on which recommended watermain and facility works were based to meet future water demand needs.

2.1 Future Growth

Future water system demands were determined using the population and land use projection information provided by the WUC for the City of Windsor, and made available from the last water system master plans completed for LaSalle and Tecumseh respectively. The Windsor growth information was already included and allocated within the WaterCAD model provided.

Interpolation was undertaken by AECOM to determine intermediate design year demands for the purpose of this study. Two sets of growth scenarios were obtained from the above (High and Low), and were utilized to assess future infrastructure improvement requirements. This information was compared to more recent population projections (Windsor-Essex and City of Windsor Population and Housing projections 2006 – 2031 January 2008), and employment projections (City of Windsor Employment Projections, January 2008) being used for Development Charge determination purposes and were quite close to the high growth projections. Future growth information for the high and low population projections are shown by Figures 2.1 and Figure 2.2, respectively.

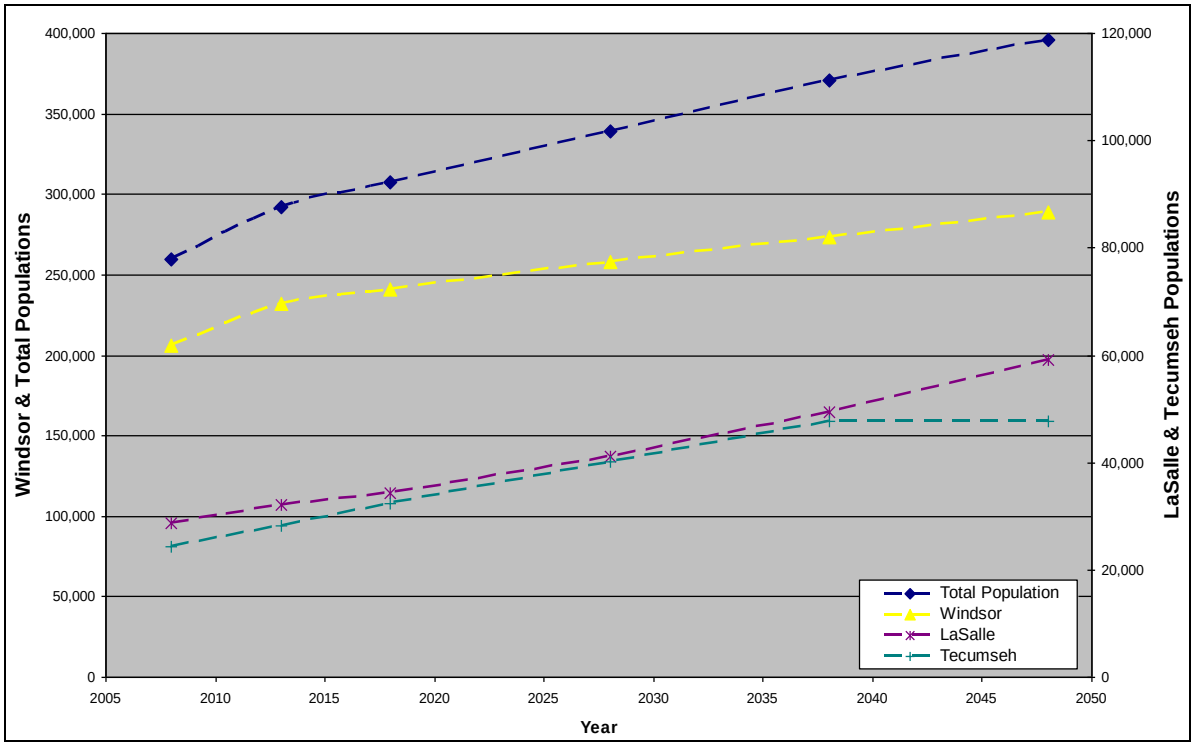

Figure 2.1: High Population Projection

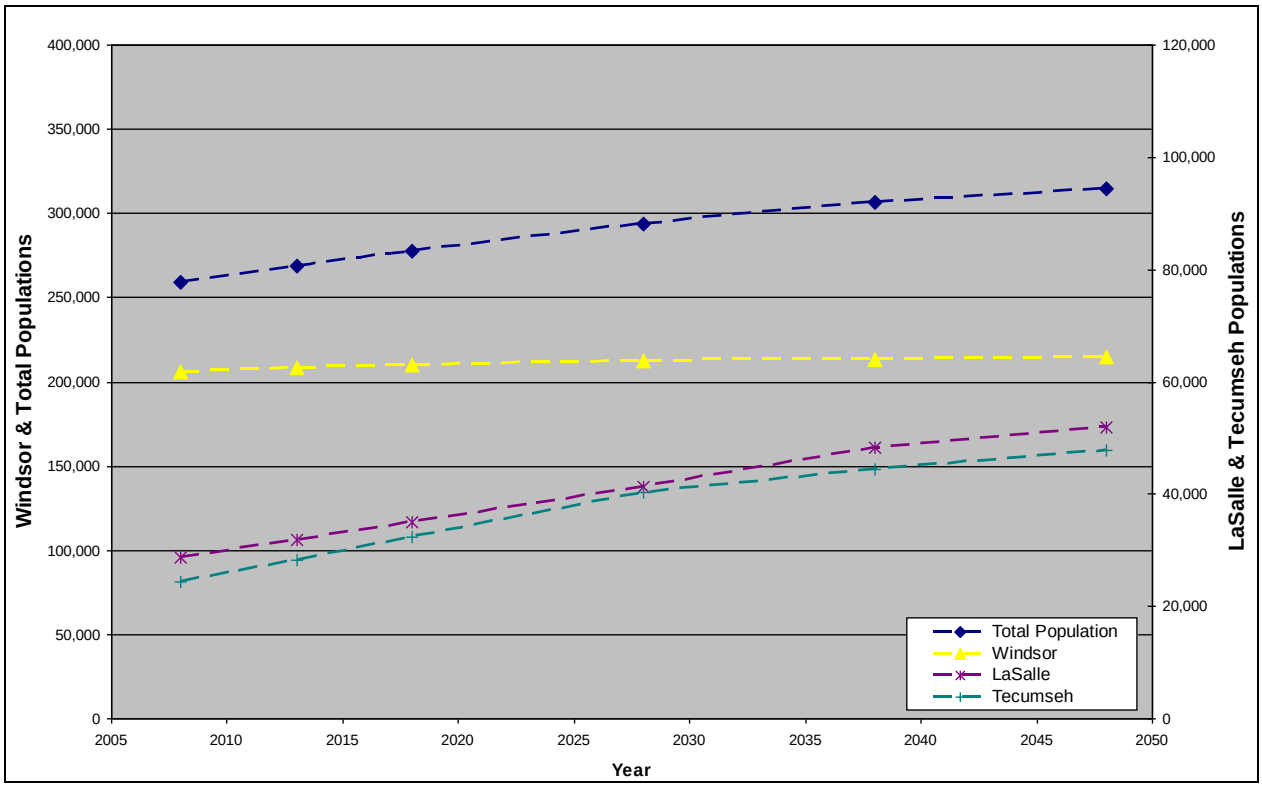

Figure 2.2: Low Population Projection

2.2 Water Demands

Water demand criteria was established by the master plan team with WUC staff members through a review of historical water consumption records, SCADA information, previous studies and MOE standards. Table 2.1 presents the key water demand criteria utilized for master planning purposes.

Table 2.1: Key Water Demand Criteria

Category	***Water Demand Criteria***
Existing Residential Water Use*	320 Lpcd (litres per capita per day)
Future Residential Water Use(1)	300 Lpcd (litres per capita per day)
Non Residential Water Use(2)	50% of Total Water Consumption
Max. Day Factor	1.7
Peak Hour Factor	2.4

* Includes non-revenue water use

(1) Reduced non-revenue water as per WUC Water efficiency/conservation initiatives.

(2) Master Plan information used for LaSalle and Tecumseh where different.

Utilizing the projected populations for both the high and low growth scenarios and the water design criteria, water demand projections for the WUC water system were developed as shown by Tables 2.2 and 2.3.

Table 2.2: High Demand Projection (m^3/d)

Year	Win.	LaS.	Tec.	Total	Win.	LaS.	Tec.	Total	Win.	LaS.	Tec.	Total
	ADD[1] (m^3/d) – Residential				*ADD[1] (m^3/d) – ICI[2]*				*ADD[1] (m^3/d) – Total*			
2008	66,026	9,207	7,780	**83,013**	66,026	9,207	7,780	**83,013**	132,051	18,414	15,561	**166,026**
2013	73,714	10,194	8,946	**92,855**	73,714	10,194	8,946	**92,855**	147,428	20,389	17,893	**185,709**
2018	76,350	10,895	10,171	**97,416**	76,350	10,895	10,171	**97,416**	152,700	21,791	20,342	**194,832**
2028	81,423	12,946	12,561	**106,931**	81,423	12,946	12,561	**106,931**	162,847	25,892	25,123	**213,861**
2038	86,233	15,422	14,813	**116,468**	86,233	15,422	14,813	**116,468**	172,466	30,845	29,626	**232,937**
2048	90,779	18,325	14,813	**123,917**	90,779	18,325	14,813	**123,917**	181,557	36,650	29,626	**247,833**
Year	*MDD[3] (m^3/d) – Residential*				*MDD[3] (m^3/d) – ICI[2]*				*MDD[3] (m^3/d) – Total*			
2008	112,244	15,652	13,227	**141,122**	112,244	15,652	13,227	**141,122**	224,487	31,304	26,454	**282,245**
2013	125,314	17,330	15,209	**157,853**	125,314	17,330	15,209	**157,853**	250,628	34,661	30,417	**315,706**
2018	129,795	18,522	17,290	**165,607**	129,795	18,522	17,290	**165,607**	259,589	37,044	34,581	**331,214**
2028	138,420	22,008	21,354	**181,782**	138,420	22,008	21,354	**181,782**	276,840	44,016	42,708	**363,564**
2038	146,596	26,218	25,182	**197,996**	146,596	26,218	25,182	**197,996**	293,192	52,436	50,364	**395,993**
2048	154,324	31,152	25,182	**210,658**	154,324	31,152	25,182	**210,658**	308,647	62,304	50,364	**421,316**
Year	*Peak[4] (m^3/d) – Residential*				*Peak[4] (m^3/d) – ICI[2]*				*Peak[4] (m^3/d) – Total*			
2008	158,461	22,097	18,673	**199,231**	158,461	22,097	18,673	**199,231**	316,923	44,194	37,346	**398,463**
2013	176,914	24,467	21,471	**222,851**	176,914	24,467	21,471	**222,851**	353,827	48,933	42,942	**445,702**
2018	183,240	26,149	24,410	**233,798**	183,240	26,149	24,410	**233,798**	366,479	52,298	48,820	**467,597**
2028	195,416	31,070	30,147	**256,633**	195,416	31,070	30,147	**256,633**	390,832	62,140	60,294	**513,266**
2038	206,959	37,014	35,551	**279,524**	206,959	37,014	35,551	**279,524**	413,918	74,027	71,103	**559,048**
2048	217,869	43,980	35,551	**297,400**	217,869	43,980	35,551	**297,400**	435,737	87,959	71,103	**594,799**

(1) Average Day Demand
(2) Institutional/Commercial/Industrial
(3) Maximum Day Demand
(4) Peak Hour Demand

Table 2.3: Low Demand Projection (m^3/d)

Year	Win.	LaS.	Tec.	Total	Win.	LaS.	Tec.	Total	Win.	LaS.	Tec.	Total
	ADD[1] (m^3/d) – Residential				*ADD[1] (m^3/d) – ICI[2]*				*ADD[1] (m^3/d) – Total*			
2008	66,026	9,207	7,780	**83,013**	66,026	9,207	7,780	**83,013**	132,051	18,414	15,561	**166,026**
2013	66,677	10,134	8,946	**85,757**	66,677	10,134	8,946	**85,757**	133,353	20,269	17,893	**171,514**
2018	67,187	11,062	10,171	**88,419**	67,187	11,062	10,171	**88,419**	134,373	22,123	20,342	**176,838**
2028	67,847	12,946	12,561	**93,354**	67,847	12,946	12,561	**93,354**	135,693	25,892	25,123	**186,708**
2038	68,207	15,035	13,821	**97,063**	68,207	15,035	13,821	**97,063**	136,413	30,071	27,643	**194,127**
2048	68,573	16,175	14,813	**99,561**	68,573	16,175	14,813	**99,561**	137,145	32,351	29,626	**199,122**
Year	*MDD[3] (m^3/d) – Residential*				*MDD[3] (m^3/d) – ICI[2]*				*MDD[3] (m^3/d) – Total*			
2008	112,244	15,652	13,227	**141,122**	112,244	15,652	13,227	**141,122**	224,487	31,304	26,454	**282,245**
2013	113,350	17,228	15,209	**145,787**	113,350	17,228	15,209	**145,787**	226,700	34,457	30,417	**291,575**
2018	114,217	18,805	17,290	**150,313**	114,217	18,805	17,290	**150,313**	228,434	37,610	34,581	**300,625**
2028	115,339	22,008	21,354	**158,701**	115,339	22,008	21,354	**158,701**	230,678	44,016	42,708	**317,403**
2038	115,951	25,560	23,496	**165,008**	115,951	25,560	23,496	**165,008**	231,902	51,120	46,992	**330,015**
2048	116,573	27,498	25,182	**169,254**	116,573	27,498	25,182	**169,254**	233,147	54,996	50,364	**338,508**
Year	*Peak[4] (m^3/d) – Residential*				*Peak[4] (m^3/d) – ICI[2]*				*Peak[4] (m^3/d) – Total*			
2008	158,461	22,097	18,673	**199,231**	158,461	22,097	18,673	**199,231**	316,923	44,194	37,346	**398,463**
2013	160,024	24,322	21,471	**205,817**	160,024	24,322	21,471	**205,817**	320,048	48,645	42,942	**411,635**
2018	161,248	26,548	24,410	**212,206**	161,248	26,548	24,410	**212,206**	322,496	53,096	48,820	**424,412**
2028	162,832	31,070	30,147	**224,049**	162,832	31,070	30,147	**224,049**	325,664	62,141	60,294	**448,098**
2038	163,696	36,085	33,171	**232,952**	163,696	36,085	33,171	**232,952**	327,392	72,170	66,342	**465,904**
2048	164,574	38,821	35,551	**238,947**	164,574	38,821	35,551	**238,947**	329,148	77,642	71,103	**477,893**

(1) Average Day Demand
(2) Institutional/Commercial/Industrial
(3) Maximum Day Demand
(4) Peak Hour Demand

2.3 Model Assessment Outputs

The modeling completed for project purposes and the resulting outputs are as follows.

2.3.1 Modeling Overview

The WUC's existing WaterCAD hydraulic model was provided to the master plan team and used for water system modeling purposes. The existing model is a skeletonized model of the existing integrated water system within Windsor, LaSalle and Tecumseh which includes all major transmission mains (>300 mm).

The hydraulic model was utilized to assess system performance under both high and low future growth scenarios for each design year, and identify all necessary improvement works while maximizing the utilization of existing infrastructure. The design years assessed included 2008 (existing), 2013, 2018, 2028, 2038 and 2048. The hydraulic model was set up for the following conditions under these design years for both the high and low future growth scenarios.

- Maximum Day Demand Conditions (Extended Period Simulation)
- Maximum Day Demand Conditions plus Fire Flow

The hydraulic analysis included the following evaluation of each operation scenario:

- Each simulation was assessed to ensure maximum and minimum pressure criteria were maintained;
- Existing and proposed mains were assessed to ensure maximum headloss gradient and velocities were within design criteria;
- Storage balancing and filling was assessed to ensure adequate operation;
- Pump operation was assessed to ensure pumps operated within a reasonable range of flow and Total Dynamic Head (TDH).

Based on the model results, new mains were added within Windsor to either upsize (or twin) existing watermains, to provide looping, to add or upgrade facilities, or to service new growth areas. Water system upgrades within Tecumseh and LaSalle were included according to their respective approved Master Plans. System analysis was completed for each of the above scenarios as follows.

- An analysis was initially completed for the year 2048 water demands. Required works were then identified to satisfy design constraints, and for input to the model;
- The water supply scheme was than evaluated based on the existing and proposed supply points to Tecumseh and LaSalle. Additional modelling was conducted to ensure the net supply to each municipality fulfilled existing water servicing agreements; and
- Assessed works were then staged for the 30 year period up to 2038 by assessing the scenarios in the order identified above and defining the timing of each required work.

The evaluation of alternate operating strategies (e.g. pump operation) were also completed as part of the modelling analysis to determine the most efficient and cost-effective operating strategy to maintain sustainability of the WUC water system. The first principle in evaluating the best operating strategy was to

maximize the use of existing infrastructure. The following operational strategies were evaluated as part of the master plan study:

- Re-allocation of existing storage amongst Windsor and possibly LaSalle and Tecumseh facilities;
- Evaluation of alternate storage replenishment schedules;
- Implementation of new pressure districts;
- Rationalization of inlet/outlet controls for each floating storage.

2.3.2 Existing System Needs

Table 2.4 summarizes the existing and potential challenges in operating the existing water system and the mitigation measures recommended to overcome these challenges.

Table 2.4: Existing Distribution System Operating Challenges and Mitigation Measures

Operational Challenge	*Short Term Mitigation Measure*	*Disadvantage of the Mitigation Measure*	*Long Term Solution*
➢ Replenishing Cook Reservoir – the system pressure for the areas near Cook Reservoir reduce significantly.	➢ Avoid filling Cook Reservoir during day time; only filling the reservoir from midnight to 4:00am to minimize the low pressure impact to the water consumers.	➢ Pumping from Cook Pumping Station is limited in order to maintain balanced reservoir levels. ➢ Cook Reservoir & Pumping Station is not being fully utilized.	➢ Increase pumping from A.J. Brian / George pumping station when filling Cook Reservoir ➢ Increase transmission main capacity by implementing additional watermains from A.J. Brian/George pumping station to Cook Res.
➢ Potential overflow of Hanna Tower could occur when pumping is increased at A.J. Brian and George pumping station for increasing the system pressure at the southern part of the system.	➢ Throttle the inlet/outlet valve to control in/out flow	➢ Energy inefficient ➢ Reduces functionality moderating the system pressure	➢ Relocate Hanna Tower
➢ Replenishing Tecumseh Tower. When water demand increases in the Town of Tecumseh, the collective headloss of the existing feedermain could increase the difficulty in maintaining tank levels	➢ Increase pumping from A.J. Brian / George pumping station and throttle the inlet valve to prevent overflowing at Hanna Tower	➢ Energy inefficient ➢ Potential over-pressuring the areas near A.J. Brian / George pumping station	➢ Increase transmission main capacity by implementing additional watermains from A.J. Brian/George pumping station to Tecumseh Tower

2.3.3 Servicing Strategies

Once relative system constraints and opportunities were identified, a number of servicing strategies were developed and operating strategies tested to best meet these needs. The five strategies reviewed were as follows:

Option No. 1 – Zone Isolation (High Demand Projection)

- New pressure zone for southern part of system/LaSalle and dedicating Cook Reservoir and PS for supply of the new pressure zone.
- Pro - continuous supply of water to the system without dropping pressure.
- Con – major upgrades at Cook PS (possibly a new PS by 2038), and significant zone isolation works.
- Other concerns – water quality and transient impacts are unknown and subject to further work.

Option No. 2 – Pumping and New Storage at WTP (High Demand Projection)/
Option No. 3 – Pumping and New Storage at WTP (Low Projection)

- Pump from existing facilities and construct new storage at the water treatment plant.
- Pro – less upgrades than Option No. 1 and best utilizes existing infrastructure.
- Con – infrastructure near the WTP could be over-stressed.
- Other concerns – cycling Hanna ET may be difficult.

Option No. 4 – New Pumping and Storage in Distribution System (High Demand Projection)

- Same as Option No. 2, but reduce the storage constructed at the WTP and construct new reservoir and PS in the distribution system (i.e., Banwell Reservoir & PS).
- Pro – pumping/storage located in the system (near Tecumseh).
- Con – dropping pressure when reservoirs are filled.
- Other concerns – difficult to balance two in-ground reservoirs and two elevated tanks in the system.

Option No.5 – New Pumping & Storage in the Distribution System (High Demand Projection)

- Construct the full Banwell Reservoir (45 ML in distribution system) and do not provide additional storage at the WTP;
- Pro - pumping/storage located in the system (Tecumseh);
- Con - dropping pressure when reservoirs are filled;
- Con - increased operating cost of additional large facility (labour & pumping);
- Con - does not facilitate splitting/rehabilitation of Reservoir D for risk mitigation;
- Other concerns - difficult to balance two in-ground reservoirs and two elevated tanks in the system.

2.3.4 Preferred Servicing Strategy

Through consultation with the WUC, Servicing Strategy Option No.2 was selected as the preferred servicing strategy for further review and optimization. This selection was based on the following:

- Servicing Strategy Option No.2 has reduced capital infrastructure works in comparison to Servicing Strategy No.1. Separating the existing single zone system into two separate (high and low) pressure zones (per Servicing Strategy Option No.1) would require the identification and installation of numerous zone separation chambers throughout the distribution system. Capital costs for these chambers were not identified and would need to be confirmed through a full-pipe model or detailed review of the entire water distribution system. Costs associated with these zone separation chambers would further separate the capital cost difference of strategies 1 and 2.
- The population growth projections used for Servicing Strategy Option No.2 are indicative of projected growth forecasts. The low scenario (Option No. 3) was used to determine the sensitivity of growth

on infrastructure requirements. With the exception of the water treatment plant expansion and one watermain work, the remaining infrastructure requirements to 2048 were not significantly different than those projected for the high population model (Option 2) suggesting that the sensitivity of the growth projection is quite low for linear infrastructure. While this strategy significantly delayed the need for additional treatment capacity, it was not considered prudent to proceed based on the low growth projections given the desire for economic growth and development.

- While the intent of Servicing Strategy Option No.4 was to provide system storage and pumping to eliminate costly linear infrastructure identified in Servicing Strategy Option No.2, the estimated costs suggested that the infrastructure requirements nearly offset one another. As confirmed through the National Benchmarking Initiative, of which the WUC is a participant, pumping and labour costs are typically the most significant annual operating costs for municipal water facilities. As such, eliminating ongoing operating and maintenance costs related to a new distribution system pumping facility by the construction of additional linear infrastructure was considered favourable.
- System operation and storage balancing is difficult under existing conditions and the addition of a new in-ground reservoir (Servicing Strategies No. 4 and 5) would further complicate operations. The modelling results for Option No. 4 suggested that cycling of the two existing elevated storage facilities and a new in-ground storage facility located in the distribution system would be difficult and could lead to water quality concerns. This would apply also to storage recommended in LaSalle as per the previous Water System Master Plan 1988.

2.4 Recommended Watermain and Facility Works

Building on the servicing analyses and the preferred servicing strategy selected (Servicing Strategy Option No.2); Table 2.5 outlines the infrastructure works required for existing deficiency rectification and to accommodate future growth to 2048. Prioritization was forecasted based on the results of separate modelling for 5 and 10 year demand projections. Prioritization was determined based on the year for which additional capacity was first required through the numerous model runs. The infrastructure was then sized to provide sufficient capacity to 2048.

The pipe related waterworks required to service population and employment growth to 2048 were determined based on the water system demands and modeling outputs. Although future system requirements were the focus of this work, any existing water system works required to service growth, or failing to meet the design criteria, were also identified.

Table 2.5 identifies the infrastructure requirements as the serviced population and water system demands grow to 2048. It includes:

- watermain location (Component ID, street and from/to), and applicable details (diameter [mm]; length [m]), for each watermain;
- project implementation requirements in 5 year increments;
- estimated cost information (incl. pipe, construction, road restoration, engineering, contingency);

The required works are shown by Figure 2.3.

Table 2.5: Infrastructure Works to 2048

Year	Project	Replacement / Upgrade / New Works Details	Servicing	Size/Diameter	Units	Length	Unit Cost[1]	Cost Estimate[2]
2013	WM1	AJ Brian to Cook Pumping Station						
		- Wyandotte St to Seminole St. on Laurendeau Ave.	W/T/L	1350	mm	1263	$2,387	$3,015,000
		- Laurendeau Ave. to Turner Road on Seminole St.	W/T/L	1350	mm	1065	$2,387	$2,542,000
		- Seminole St. to Grand Marais Rd E on Turner Rd	W/T/L	1350	mm	2471	$2,387	$5,898,000
		- Grand Marais Rd E to Country Rd 42 on Turner Rd	W/T/L	1200	mm	3348	$2,157	$7,223,000
		- Turner Rd. to Howard PL on Cabana Rd E	W/T/L	900	mm	2134	$1,632	$3,483,000
2013	WM5	Country Rd 42						
		- Turner Rd to 9th Road	W/T	900	mm	2975	$1,632	$4,855,000
		- 9th Road to MCT-6	W/T	750	mm	1925	$1,431	$2,755,000
		- County Road 42 (MTC-6 to Odessa Drive)	T	600	mm	1770	$1,259	$2,229,000
2013	S1	New Reservoir at WTP	W/T/L	45	ML		-	$20,000,000
2018	S2	WTP Expansion/Upgrade	W/T/L	72	MLD		-	$80,000,000
2028	WM8	Howard Ave						
		- Cabana Rd E to 6th Concession Rd on Howard Ave	W/T/L	600	mm	2972	$1,259	$3,743,000
2038	WM4	Banwell Road						
		- Mulberry Dr. to the North of existing Railway	W/T	750	mm	2000	$1,431	$2,862,000
		- Odessa Drive (County Road 42 to Intersection Road)	T	600	mm	1643	$1,259	$2,069,000
2038	WM2	Brian Tecumseh feedermain						
		- George Ave. to Lauzon Road on South National St.[3]	W/T	1050	mm	4776	$1,918	$6,230,000
		- Lauzon Road to Forest Glade Dr. on South National St. [3]	W/T	900	mm	1781	$1,632	$1,977,000
2038	WM6	LaSalle Feedermain						
		- Howard Ave to Huron Church Rd on 6th Concession Rd	L	600	mm	2100	$1,259	$2,645,000
		- Huron Church Rd to Malden Rd on Bouffard Rd	L	500	mm	2440	$1,088	$2,654,000
2048	WM11	Walker Road						
		- County Rd 42 to MCT-10 (Provincial Rd.)	W/T	600	mm	1535	$1,259	$1,933,000
		- MCT-10 (Provincial Rd.) to Talbot Road	T	600	mm	2488	$1,259	$3,134,000
2048	WM12	Talbot Road						
		- on Talbot Road, from Walker Road to Howard Ave	T	400	mm	2847	$859	$2,445,000
							TOTAL:	***$161,692,000***

NOTES:
(1) - All transmission unit replacement costs in 2008$ including engineering fees (10%) and contingency allowances (15%).
(2) - Cost estimates rounded to '000.
(3) - Watermain costs along Rail Easement are based on 68% of unit costs (i.e. excl. half road restoration).

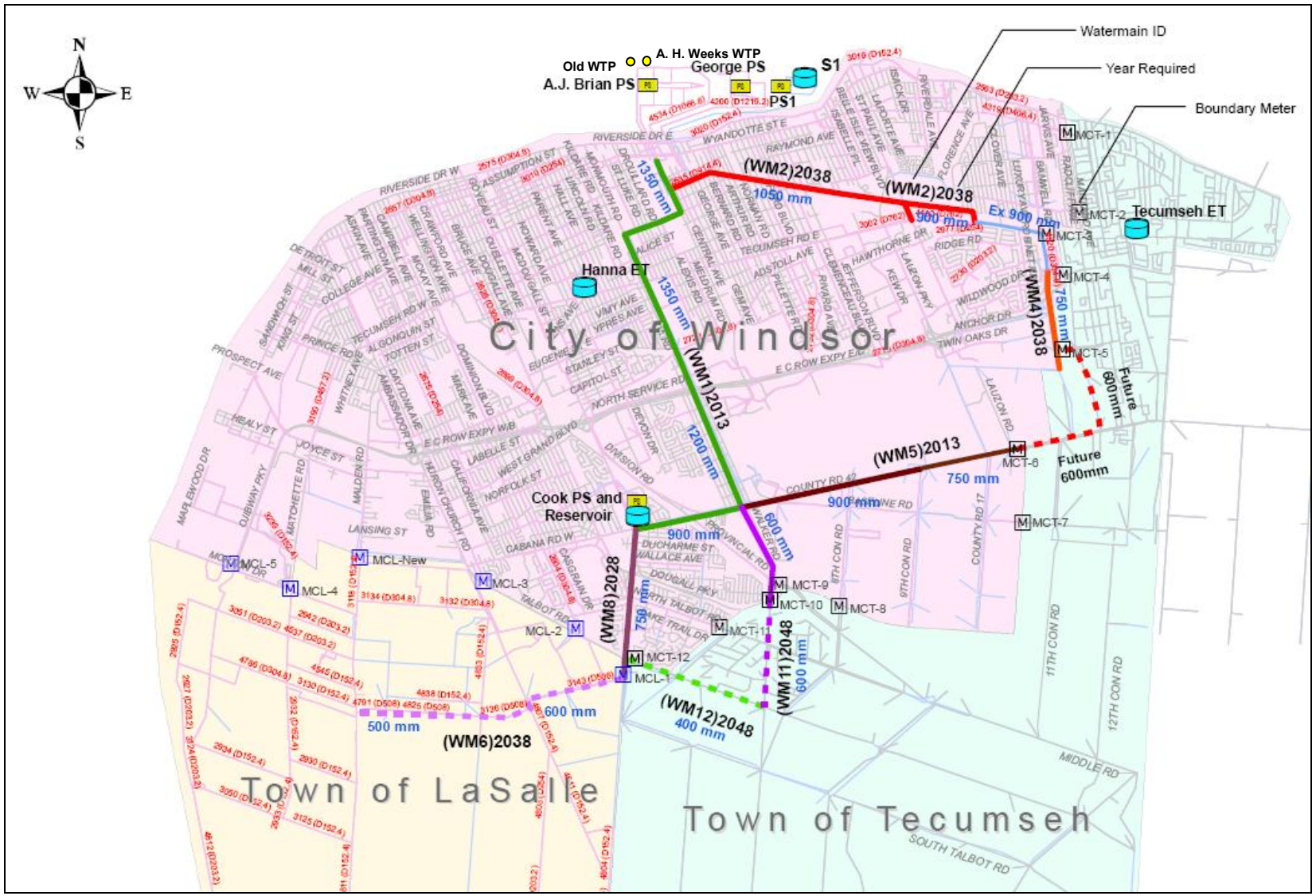

Figure 2.3: Infrastructure Works to 2048

In addition to the watermain related works, facility related works are also required for the WUC water system for servicing to 2048. Table 2.5 identifies the facility related works required. Identified is the facility by name; approximate implementation year as per our work and modelling outputs; new/expansion capacity information; and estimated costs.

2.5 Regionalization

To ensure the works recommended could service the full build-out of Tecumseh and LaSalle, and potentially provide servicing further to the east of Tecumseh or south of LaSalle, additional analysis was completed resulting in the following:

- Recommended works (with revisions outlined below), can generally service to the east limit of Tecumseh and the south limit of LaSalle under full build-out conditions.
  - Increase WM 8 size from 750 mm dia. to 900 mm dia.
  - Increase WM 6 size from 500 mm dia. to 750 mm dia. and from 600 mm dia. to 900 mm dia.
  - Provide additional pumping at the George Street PS in the amount of 490 L/s.
- If servicing is to be provided east of Tecumseh or south of LaSalle, separate storage and pumping systems would have to be implemented to address Max Day plus Fire Flow and Peak Flow conditions, along with additional pumping at the George Street PS by a further 1,000 L/s. Additional pumping at George Street could be offset by additional storage being provided as part of pumping station and storage components east of Tecumseh and south of LaSalle. In addition the following watermains would have to be upsized further.
  - WM 1, 900 mm dia. to 1050 mm (on Cabana Road West)
  - WM 6, 500 mm dia. to 900 mm dia. and 600 mm dia. to 1050 mm dia.
  - WM 8, 750 mm dia. to 1050 mm dia.

Given both regionalization and/or full build-out conditions are well beyond the 40 year growth period, upsizing of the watermains identified would be best accomplished via twinning rather than upsizing as part of the recommended works. Pump station upsizing and/or additions should be considered as part of reservoir implementation at the WTP campus to facilitate in the future, but not implement until needed well beyond 40 years.

3. FINANCIAL IMPLICATIONS

Once required works and estimated costs were confirmed, financial analysis was undertaken by AECOM and Watson & Associates Economists to:

1. Determine growth/non-growth related components in general.
2. Confirm growth/non-growth related components for Windsor, LaSalle and Tecumseh based on growth needs.
3. Further breaking down growth related components for each municipality from a Residential/Non-Residential perspective.

4. Determine Development Charge related impacts for Windsor with and without Development Charge credits being taken into consideration.
5. Completing a cash flow and debt analysis for those works within the City of Windsor intended to service, Windsor and in part or in whole, LaSalle and Tecumseh, as per current service agreements with each.
6. Determine Windsor Water Rate Impacts.
7. Review of the existing water service agreements with LaSalle and Tecumseh and determine current and future Windsor water rate impacts for those growth servicing works intended to service in part or in whole LaSalle and Tecumseh through the lives of each agreement.

Table 3.1 summarizes the rate impact outputs of the above work activities. Based on Watson's analysis of the first 4 items, the growth/non-growth and Res/Non-Res impacts for Windsor from a Development Charge perspective (without credits), and presuming cash flow arrangements would even be possible for the implementation of those works in part or in whole driven by LaSalle and Tecumseh, represents the best case alternative for the WUC. However, given the reality that the City of Windsor has various Development Charge credits (which would bring growth related costs back onto tax or rate components); and the existence of servicing agreements in current form (LaSalle's is currently being renewed, Tecumseh's is long-term (50 years or until 2054) with the next opportunity to adjust Tecumseh rates beyond normal CPI adjustments in 10 years); the outputs of the analysis reflected by Table 3.1 represents the financial reality the WUC will have to deal with in the short-term.

Notwithstanding these impacts, these were considered and factored in as part of the Asset Management Financial Plan completed by Earth Tech/AECOM and Watson in 2007 which addressed these fully. No further negative rate impacts are envisioned, with some potential for positive rate reductions possible.

Table 3.1: Water Rate Implications

Year	Project	Replacement / Upgrade / New Work Details	Cost Estimate	Windsor Non-Growth $	Windsor Growth $ Res (50%)	Windsor Growth $ Non-Res (50%)	LaSalle Growth Rate Impact	Tecumseh Growth Rate Impact	LaSalle Growth $[2] Res (50%)	LaSalle Growth $[2] Non-Res (50%)	Tecumseh Growth $[3] Res (50%)	Tecumseh Growth $[3] Non-Res (50%)
2013	WM1	AJ Brian to Cook Pumping Station										
		- Wyandotte St to Seminole St. on Laurendeau Ave.	$3,015,000	$0	$919,575	$919,575	$663,300	$512,550	$0	$0	$0	$0
		- Laurendeau Ave. to Turner Road on Seminole St.	$2,542,000	$0	$775,310	$775,310	$559,240	$432,140	$0	$0	$0	$0
		- Seminole St. to Grand Marais Rd E on Turner Rd	$5,898,000	$0	$1,798,890	$1,798,890	$1,297,560	$1,002,660	$0	$0	$0	$0
		- Grand Marais Rd E to Country Rd 42 on Turner Rd	$7,223,000	$0	$2,203,015	$2,203,015	$1,589,060	$1,227,910	$0	$0	$0	$0
		- Turner Rd. to Howard PL on Cabana Rd E	$3,483,000	$0	$1,062,315	$1,062,315	$766,260	$592,110	$0	$0	$0	$0
2013	WM5	Country Rd 42										
		- Turner Rd to 9th Road	$4,855,000	$0	$1,893,450	$1,893,450	$0	$1,068,100	$0	$0	$0	$0
		- 9th Road to MCT-6	$2,755,000	$0	$1,074,450	$1,074,450	$0	$606,100	$0	$0	$0	$0
		- County Road 42 (MTC-6 to Odessa Drive)	$2,229,000	$0	$0	$0	$0	$0	$0	$0	$1,114,500	$1,114,500
2013	S1	New Reservoir at WTP[1]	$20,000,000	$5,000,000	$4,575,000	$4,575,000	$3,300,000	$2,550,000	$0	$0	$0	$0
2018	S2	WTP Expansion/Upgrade	$80,000,000	$20,000,000	$18,300,000	$18,300,000	$13,200,000	$10,200,000	$0	$0	$0	$0
2028	WM8	Howard Ave										
		- Cabana Rd E to 6th Concession Rd on Howard Ave	$3,743,000	$0	$1,141,615	$1,141,615	$823,460	$636,310	$0	$0	$0	$0
2038	WM4	Banwell Road										
		- Mulberry Dr. to the North of existing Railway	$2,862,000	$0	$1,116,180	$1,116,180	$0	$629,640	$0	$0	$0	$0
		- Odessa Drive (County Road 42 to Intersection Road)	$2,069,000	$0	$0	$0	$0	$0	$0	$0	$1,034,500	$1,034,500
2038	WM2	Brian Tecumseh feedermain										
		- George Ave. to Lauzon Road on South National St.	$6,230,000	$0	$2,429,700	$2,429,700	$0	$1,370,600	$0	$0	$0	$0
		- Lauzon Road to Forest Glade Dr. on South National St.	$1,977,000	$0	$771,030	$771,030	$0	$434,940	$0	$0	$0	$0
2038	WM6	LaSalle Feedermain										
		- Howard Ave to Huron Church Rd on 6th Consession Rd	$2,645,000	$0	$0	$0	$0	$0	$1,322,500	$1,322,500	$0	$0
		- Huron Church Rd to Malden Rd on Bouffard Rd	$2,654,000	$0	$0	$0	$0	$0	$1,327,000	$1,327,000	$0	$0
2048	WM11	Walker Road										
		- County Rd 42 to MCT-10 (Provincial Rd.)	$1,933,000	$0	$753,870	$753,870	$0	$425,260	$0	$0	$0	$0
		- MCT-10 (Provincial Rd.) to Talbot Road	$3,134,000	$0	$0	$0	$0	$0	$0	$0	$1,567,000	$1,567,000
2048	WM12	Talbot Road										
		- on Talbot Road, from Walker Road to Howard Ave	$2,445,000	$0	$0	$0	$0	$0	$0	$0	$1,222,500	$1,222,500
		Subtotal:	-	***$25,000,000***	***$38,814,400***	***$38,814,400***	***$22,198,880***	***$21,688,320***	***$2,649,500***	***$2,649,500***	***$4,938,500***	***$4,938,500***
		TOTAL:	***$161,692,000***	***$146,516,000***					***$5,299,000***		***$9,877,000***	

NOTES:
All transmission unit replacement costs in 2008$ including engineering fees (10%) and contingency allowances (15%).
(1) – Tecumseh future fire storage requirements included as part of reservoir expansion (system wide calculation).
(2) – As per the WUC/LaSalle servicing agreement.
(3) – As per the WUC/Tecumseh servicing agreement.

4. KEY CONCLUSIONS AND RECOMMENDATIONS

The following key conclusions and related recommendations have been made as a result of the work completed for the Water System Master Plan.

- The works shown by Table 2.5 be implemented in the timeframes identified. The budget amounts identified in 2008 dollars should be inflated accordingly on an annual basis. The extent of works required was confirmed via the transient analysis completed in September 2009.
- The works outlined in Table 3.1 be utilized for future Development Charge and ongoing rate implementation activities.
- Although the current storage capacity of the Windsor Water System is within MOE guidelines, the total storage capacity represents slightly less than one average day of storage. It is recommended that a risk and vulnerability assessment be completed to determine if the current storage capacity meets emergency needs at this time, or if additional storage capacity is required. Normally 1 to 2 days is recommended subject to Average and Maximum Day conditions.
- An opportunity to combine the current function of the Hanna Water elevated tank as part of a future Oldcastle elevated tank in Tecumseh be looked at to see if one facility could service the needs of both in the future.
- Any additional storage required due to growth (35 ML) be implemented adjacent to the WTP campus given the operational efficiencies identified. This work may have to be expedited to facilitate maintenance and upgrade work at the Reservoir D facility at A.H. Weeks as per the outputs of additional work activities authorized by the WUC completed by AECOM. As a result the Banwell Reservoir and PS would not be required.
- Fire storage requirements for Tecumseh be incorporated as part of the above storage requirements with cost sharing confirmed for this component as per the current Water Servicing agreement in place.
- The WUC consider a full system-wide model implementation for all watermains and facilities comprising the water system including adding the LaSalle and Tecumseh water systems, and any further afield, as part of a regional water model for the area. If to function on an operational level, extensive calibration and field programs would have to be implemented complete with inventory updating and WUC operation training and staffing to maintain. This should include a review of modeling software to confirm needs are met.
- WUC initiate a Schedule B Class EA for all 10 (possibly 20) year watermain works to confirm routes, land/easement requirements and railway, major roadway or water crossing details for implementation on a phased basis as part of City and/or WUC initiated works.
- The build-out and regionalization impacts identified will be facilitated as part of the recommended works and should not be implemented until well into the future via watermain twinning and/or additional pumping capacity.