HANLEY PARK NORTH DEVELOPMENT

Preliminary Watermain Design Brief

October 2021

AINLEY GRAHAM & ASSOCIATES

CONSULTING ENGINEERS AND PLANNERS
COLLINGWOOD · BARRIE · BELLEVILLE · KINGSTON · OTTAWA

File No. 18578-1

Ainley GROUP CONSULTING ENGINEERS PLANNERS

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1.0 INTRODUCTION

1.1 General

Ainley Group has been retained to undertake engineering services necessary for the completion of a watermain design brief to support the proposed Draft Plan of Subdivision application for the Hanley Park North development lands within the City of Belleville.

The proposed development is located at the eastern limits of Mercedes Meadows, east of Spruce Gardens and Tessa Boulevard. The development site is represented in **Figure 1**.

The proposal will incorporate the development of six (6) single family residential units to the immediate east of Spruce Gardens and forty (40) single family residential lots and fifty-seven (57) townhouse lots to the immediate east of Tessa Boulevard.

1.2 Criteria

This report has been prepared with consideration of the following documents and guidelines;

- Form 1 – Record of Watermains Authorized as a Future Alteration,
- Ministry of the Environment publication 'Watermain Design Criteria for Future Alterations Authorized under a Drinking Water Works Permit – June 2012',
- Ministry of the Environment publication 'Design Guidelines for Drinking Water Systems, 2008',
- Fire Underwriters Survey 'Water Supply for Public Protection (1999)', and
- The Corporation of the City of Belleville 'Manual of Standard Specifications'.

2.0 PROPOSED WATERMAIN WORKS

The proposed works will include the connection to the existing 200mm diameter PVC watermain located within Spruce Gardens and 300mm diameter PVC watermain within Tessa Boulevard. For the entirety of the proposed development (i.e. all phases), the approximate length of new 200mm diameter PVC watermain is 738m. **Figure 2** outlines the proposed watermain layout.

3.0 EXISTING CONDITIONS

Fire hydrant flow test results were provided by the City of Belleville Water Distribution and Service Department for an existing fire hydrant located at 51 Tessa Boulevard. The results indicated a static pressure of 62 psi. A copy of the test results are enclosed in **Appendix B**.

4.0 WATER DEMAND EVALUATION

4.1 Domestic Water Demand

An evaluation of the anticipated water demand has been prepared using the guidelines set out in the Ministry of the Environment publication 'Design Guidelines for Drinking Water Systems, 2008'.

Based on the proposed full development unit count and existing demands on the system from the full build-out of Mercedes Meadows, the anticipated demands are;

- Average Day – 3.04 l/s,
- Maximum Day – 8.81 l/s,
- Minimum Hour – 1.22 l/s,
- Peak Hour – 13.06 l/s.

Supporting calculations included in **Appendix C**.

4.2 Fire Flow

Fire flow requirements have been evaluated based on the Fire Underwriters Survey 'Water Supply for Public Protection (1999)'.

The resulting Fire Flow + Maximum Day requirement has been determined to be 119.34 L/s.

Supporting calculations are included in **Appendix C**.

4.3 Transient Pressure

The proposed 200 mm diameter PVC Class 235 (DR 18) pipe has been designed by the manufacturer to withstand long-term pressures up to 235 psi, and short-term pressures of 376 psi. Short-term and long-term pressures were analyzed in **Table 1** below. A water column of 0.6 m/s was used to determine the surge pressure.

Table 1: Pressure Analysis for DR18 Pressure Class 235 psi

Category	Analysis	Pressure (psi)
Long-Term Pressure Rating	Working pressure (Max. operating) =	61.63 psi
	Allowable long-term pressure = Pressure Class	235 psi
	Check:	**PC 235 psi > WP 61.63 psi**
Short-Term Pressure Rating	1 fps (0.3 m/s) = 17.4 psi Velocity change = 2 fps (0.6 m/s)	
	Occasional surge pressure = 2 x 17.4	34.8 psi
	Total pressure = 34.8 + 61.63	96.43 psi
	Allowable short-term rating (STR) = 1.6 x Pressure Class = 1.6 x 235	376 psi
	Check:	**STR 376 psi > TP 96.43 psi**

As outlined above the short-term and long-term pressures generated are less than the allowable

short-term rating of 376 psi and the long-term rating (pressure class) of 235 psi.

5.0 HYDRAULIC EVALUATION

The MOE Design Guidelines for Drinking Water Systems (2008) state that the normal operating pressures in the water distribution system should be approximately 50 to 70 psi. The maximum pressure in the system should not exceed 100 psi, and the minimum pressure in the system should be no lower than 40 psi; however, in the case of fire flows, the pressure may drop to a level no lower than 20 psi.

An EPANET model was created to model the watermain pressures for the development. The water source used in the model is based off of the hydrant testing carried out at Tessa Boulevard Drive (**Appendix B**). Inputs into the model included the hydrant pressure and flow data; pipe lengths, friction factors, and diameters; pipe junction elevations; and demand flows. The data input into the model are included in **Appendix D** along with the output generated from the model. The model nodes used to test the normal demand and peak hour demand flows were node 17, 22, and 24 within Hanley Park North Development. To test the normal demand plus fire demand flow, node 24 was used which was considered to be located in the "worst case" position, as it is located at a far distance from the source, water is connecting from one direction, and it at a high elevation.

The model shows that during Maximum Day Flows (normal demand conditions), the minimum pressure in the system will be 61.63 psi (43.34 m head), whereas during the Maximum Day + Fire Flow demand, the minimum pressure in the system will be 33.46 psi (23.53 m head). Peak hour flow was modeled and the pressure in the system will be 61.03 psi (42.92 m head). Two other flows were analyzed for quality control / confidence checks: 1) at 100 l/s, the pressure at the fire flow node will be 43.20 psi (30.38 m head), and 2) the flow that will cause 20 psi pressure (14.06 m head) at the fire flow demand node was determined to be 148.08 l/s. Supporting calculations are included in **Appendix D**. As such, the EPANET model shows that the watermain pressures conform to the guidelines for normal operating pressures and fire flow pressures.

6.0 DESIGN CONSIDERATIONS

Notwithstanding the following the Guidelines outlined in The Corporation of the City of Belleville 'Manual of Standard Specifications' shall apply. The following outlines the design considerations to be applied for the hydraulic evaluation and design layout;

Pipe Diameters
The distribution system shall require fire flow throughout; therefore, the minimum pipe diameter shall be 150mm.

Friction Factors
For all watermain 200mm in diameter – 120
For all watermain 300mm in diameter – 130

Pipe Material
All watermain pipe 100mm to 300mm in diameter shall be PVC DR18 (or lower) and be manufactured in accordance with AWWA C900 and certified to NSF/ANSI 61 and to CSA B137.3.

The pressure class of all pipes shall be a minimum of 235psi.

System Pressure

Normal pressures in the distribution system should not go above 100 psi or below 40 psi during normal demand periods. In the case of fire flows, it may be acceptable to allow the pressure in the system to drop to a level no lower than 20 psi.

Service Pipe
Service piping shall be a minimum diameter of 19mm and of copper or polyethylene.

Copper services shall be type K soft copper with an internal working pressure of 175psi and conform to ASTM B88 and be certified to NSF/ANSI 61.

Polyethylene services shall have a standard DR of 11.0 or lower with a pressure class of 160psi or greater and shall conform to AWWA C901 and be certified to NSF/ANSI 61.

Fire Hydrants
Hydrants should be installed at locations agreed to through consultation with the Municipality during the review process.

Hydrants shall conform to AWWA Standard C502: Dry Barrel Fire Hydrants.

Fire hydrant drain holes are anticipated to be at least 1.0 m above the water table at all proposed hydrant locations.

Valves
Valves shall be installed at each intersection (2 at a ‘T’, 3 at a ‘cross’) and at minimum separations as requested by the Municipality during detailed design.

All valves shall conform to AWWA standards.

Chambers
There are no chambers proposed in this development.

Depth
All watermain shall be a minimum of 1.8m in depth.

Dead Ends
All locations where a watermain terminates (temporary or permanent) a plug and blow off shall be installed.

Restraints
All joints (at fittings, hydrants, valves and bends greater than 11.25º) shall be mechanically restrained

Separation Distances
- Horizontal – 2.5m clear,
- Vertical – 0.5m clear.

Utility Crossings
When a watermain crosses over or under a utility (other than sanitary or storm) a separation of 0.3m shall be provided.

Permeation by Organic Compounds
There are no know soil contamination concerns on the subject lands, accordingly no consideration for permeation has been considered.

Pipe Encasement
There are no encasement requirements in this phase of the development.

7.0 CONCLUSIONS

- The proposed watermain works are anticipated to meet the minimum required 20 psi under maximum day demand plus fire flow.
- Under normal demand conditions, the proposed watermain works are anticipated to meet the minimum required 40 psi. The proposed works are not anticipated to exceed the maximum 100 psi.
- The design layout should conform to the criteria outlined in section 6 of this brief.

We trust that the above meets your guidelines and ask that you contact the undersigned, should you have any queries.

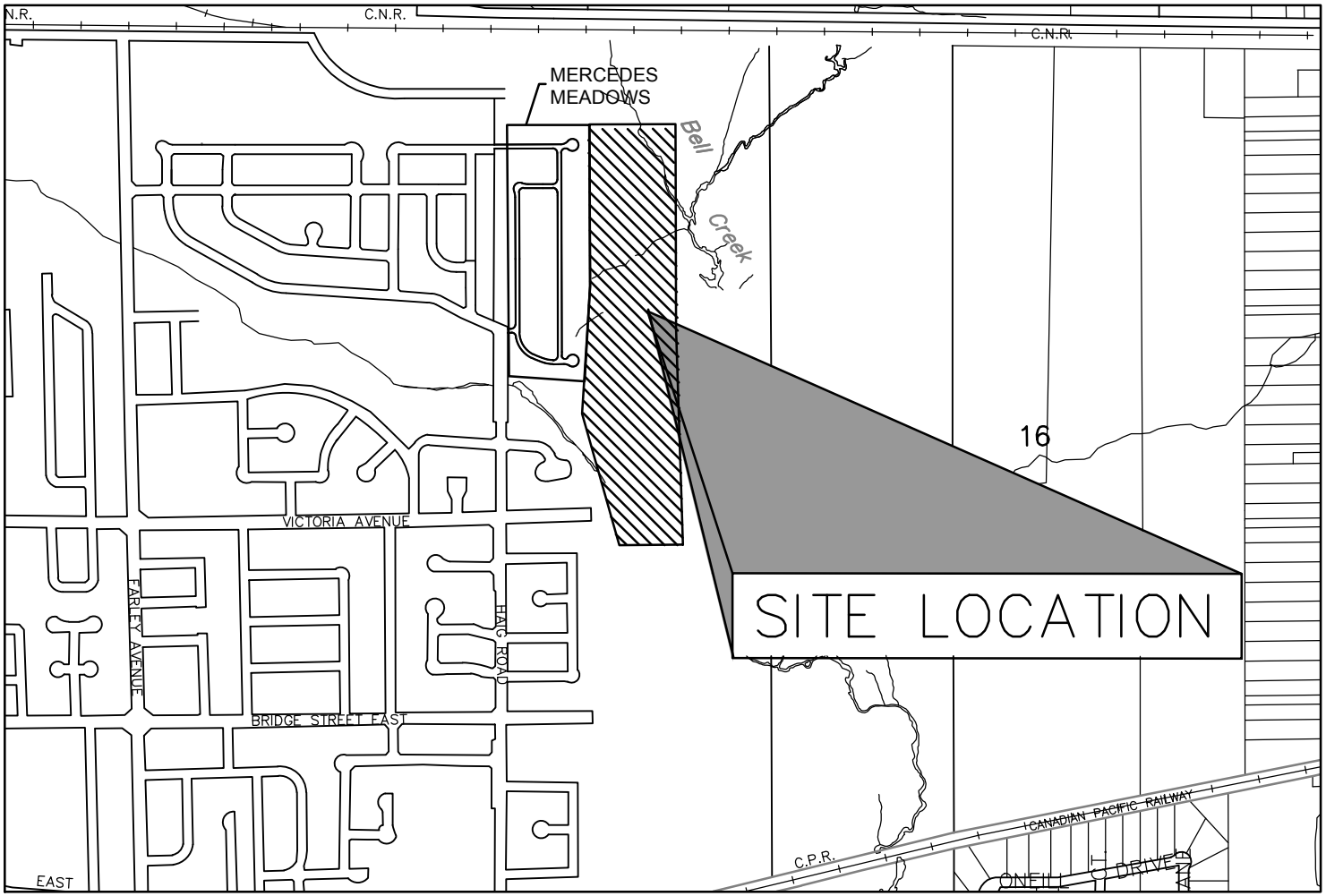
Sincerely,
AINLEY GRAHAM & ASSOCIATES LIMITED

Victoria Chapman, EIT
Engineering Intern

Adam Wilson, P. Eng.
Senior Engineer

APPENDIX A

Figures



HANLEY PARK NORTH
CITY OF BELLEVILLE

FIGURE 1
KEY MAP

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EXISTING 300mm DIA, WM

EXISTING 200mm DIA. WM

PROPOSED 200mm DIA. WM

FIGURE 2

HANLEY PARK NORTH DEVELOPMENT

APPENDIX B

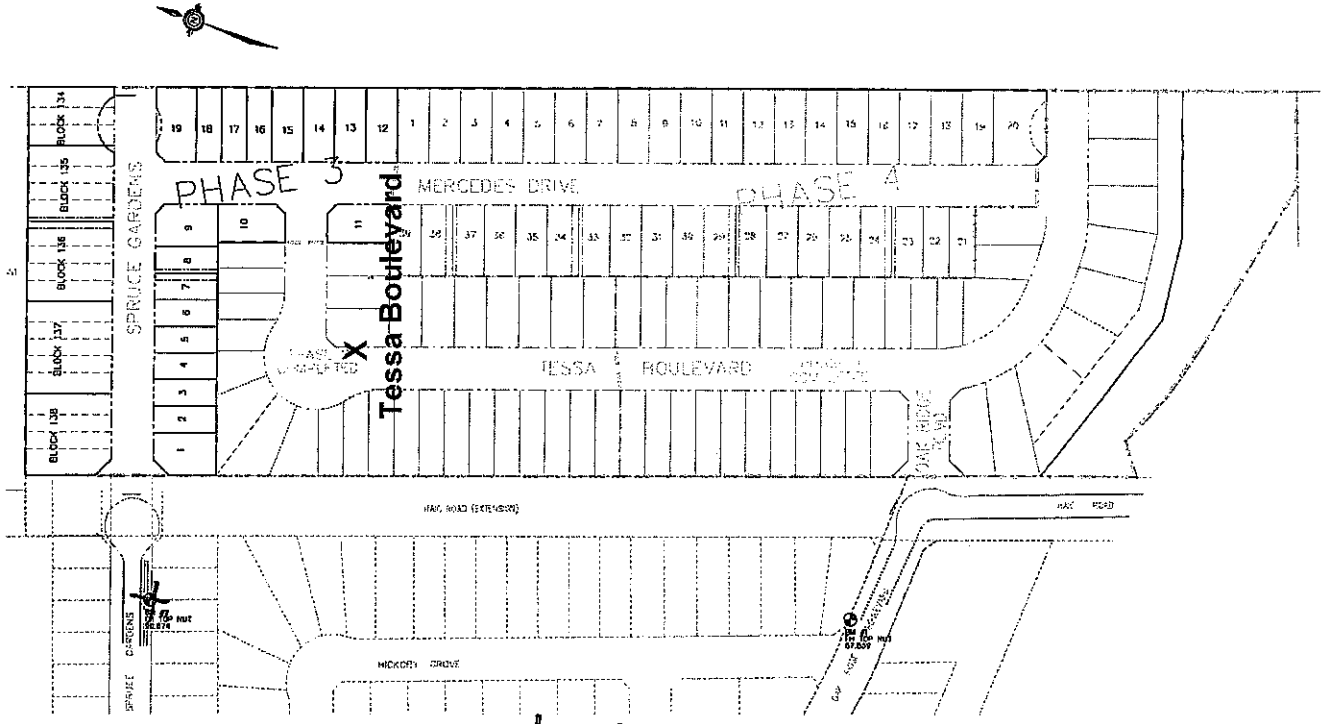
Fire Hydrant Flow Test Data

CITY OF BELLEVILLE

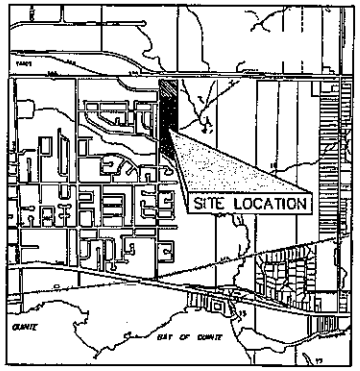
MERCEDES MEADOWS
HAIG ROAD SUBDIVISION

PHASE 3

PROJECT No. 14526-2



65 Spruce Gardens



KEY MAP

GEODETIC BENCHMARKS:
BM #1 – LOCATED ON THE TOP NUT OF THE FIRE HYDRANT LOCATED AT THE N.E. CORNER OF MOSSEY DRIVE AND OAK RIDGE BLVD. GEODETIC ELEVATION = 87.569

BM #2 – LOCATED ON THE TOP NUT OF THE FIRE HYDRANT LOCATED ON THE SOUTH SIDE OF SPRUCE GARDENS. GEODETIC ELEVATION = 90.574

INDEX

SUBMITTED: JULY 12/2016, JULY 29/2016, AUG 2/2016

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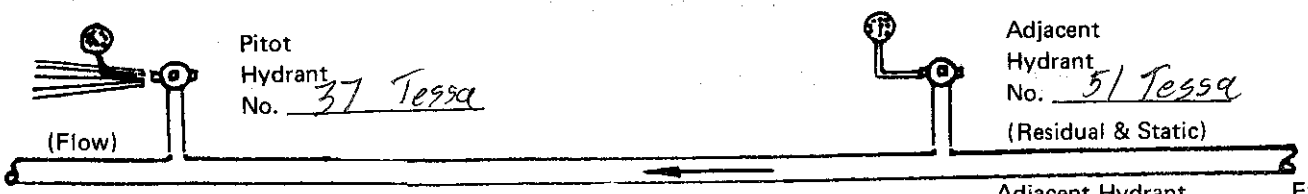
Routing

White - 1. Op. Mgr. 2. Draft. 3. FF bk.
Pink - File 842
Canary - Originator

Belleville Utilities Commission
459 SIDNEY STREET
P.O. BOX 939
BELLEVILLE, ONT., K8N 5B6
(613) 966-3651

Date: Sept 12, 16
Time: 118
Performed by QP CEM
File: 842

FIRE HYDRANT FLOW TEST



Pitot Hydrant No. 37 Tessa
(Flow)

Adjacent Hydrant No. 51 Tessa
(Residual & Static)

Adjacent Hydrant _____ Ft.
Above or Below Pitot Hydrant

Street Name Tessa Blvd
Location on St.
or name of Bldg. _____

Provide Four Pressure Readings:
Select outlets to give 10 psi drop at adjacent hydrant if possible

		OUTLETS					
		one - 1"	one - 1 1/8"	one - 1½"	one - 2½"	two - 2½"	
Step One -	Adjacent Hydrant				62	62	psi (static)
Step Two -	Pitot Hydrant				55	40	psi (flow)
Step Three -	Adjacent Hydrant				60	57	psi (residual)
Step Four -	Adjacent Hydrant				62	62	psi (static check)

low with 20 psi residual at adjacent hydrant
= measured flow $\left(\frac{\text{available drop}}{\text{test drop}}\right)^{.54}$

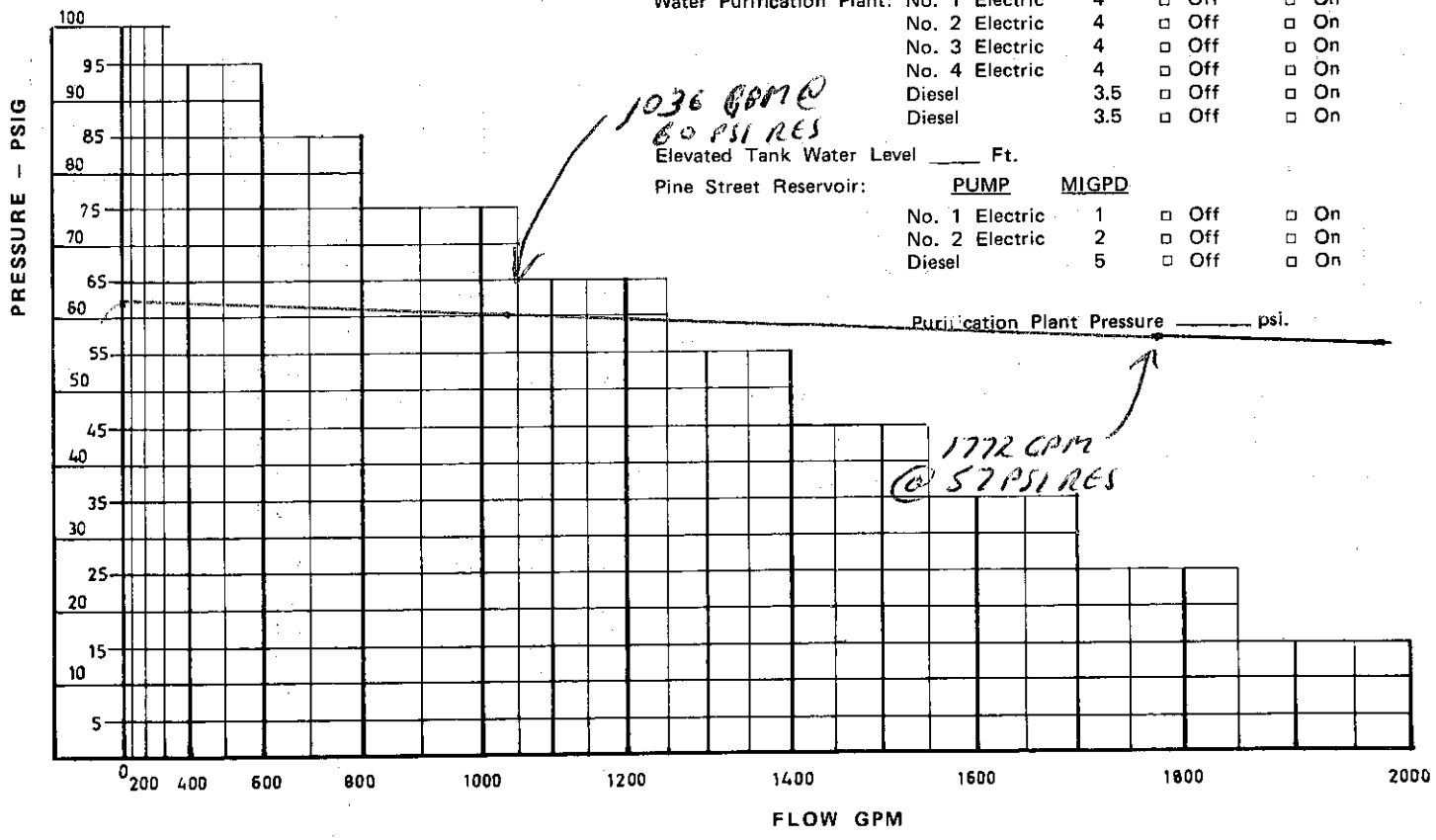
Available drop is static less 20
Test drop is static less residual

Information below can be obtained at a later date from records at Water Purification Plant.

		PUMP	MIGPD		
Water Purification Plant:	No. 1 Electric		4	☐ Off	☐ On
	No. 2 Electric		4	☐ Off	☐ On
	No. 3 Electric		4	☐ Off	☐ On
	No. 4 Electric		4	☐ Off	☐ On
	Diesel		3.5	☐ Off	☐ On
	Diesel		3.5	☐ Off	☐ On

Elevated Tank Water Level ____ Ft.

		PUMP	MIGPD		
Pine Street Reservoir:	No. 1 Electric		1	☐ Off	☐ On
	No. 2 Electric		2	☐ Off	☐ On
	Diesel		5	☐ Off	☐ On



Fm. 109A

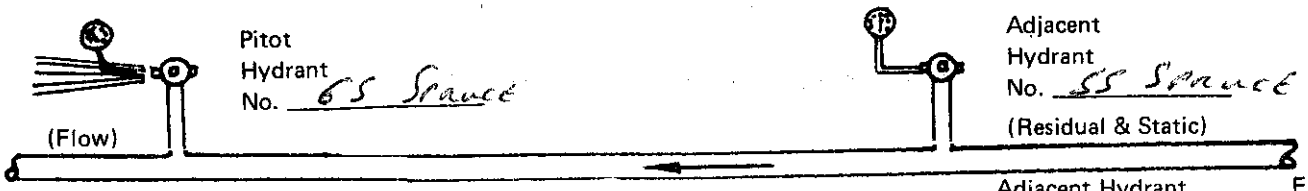
Routing

White - 1. Op. Mgr. 2. Draft. 3. FF bk.
Pink - File 842
Canary - Originator

Belleville Utilities Commission
459 SIDNEY STREET
P.O. BOX 939
BELLEVILLE, ONT., K8N 5B6
(613) 966-3651

Date: Sept. 12/16
Time: 11:55
Performed by QP, CM
File: 842

FIRE HYDRANT FLOW TEST



Pitot Hydrant No. 65 Spruce

Adjacent Hydrant No. 55 Spruce (Residual & Static)

Adjacent Hydrant _____ Ft. Above or Below Pitot Hydrant

Street Name Spruce Cons

Location on St. or name of Bldg. _____

Provide Four Pressure Readings:
Select outlets to give 10 psi drop at adjacent hydrant if possible

		OUTLETS					
		one - 1"	one - 1 1/8"	one - 1½"	one - 2½"	two - 2½"	
Step One -	Adjacent Hydrant				62	62	psi (static)
Step Two -	Pitot Hydrant				60	45	psi (flow)
Step Three -	Adjacent Hydrant				60	58	psi (residual)
Step Four -	Adjacent Hydrant				62	62	psi (static check)

low with 20 psi residual at adjacent hydrant

$$= \text{measured flow} \left(\frac{\text{available drop}}{\text{test drop}} \right)^{.54}$$

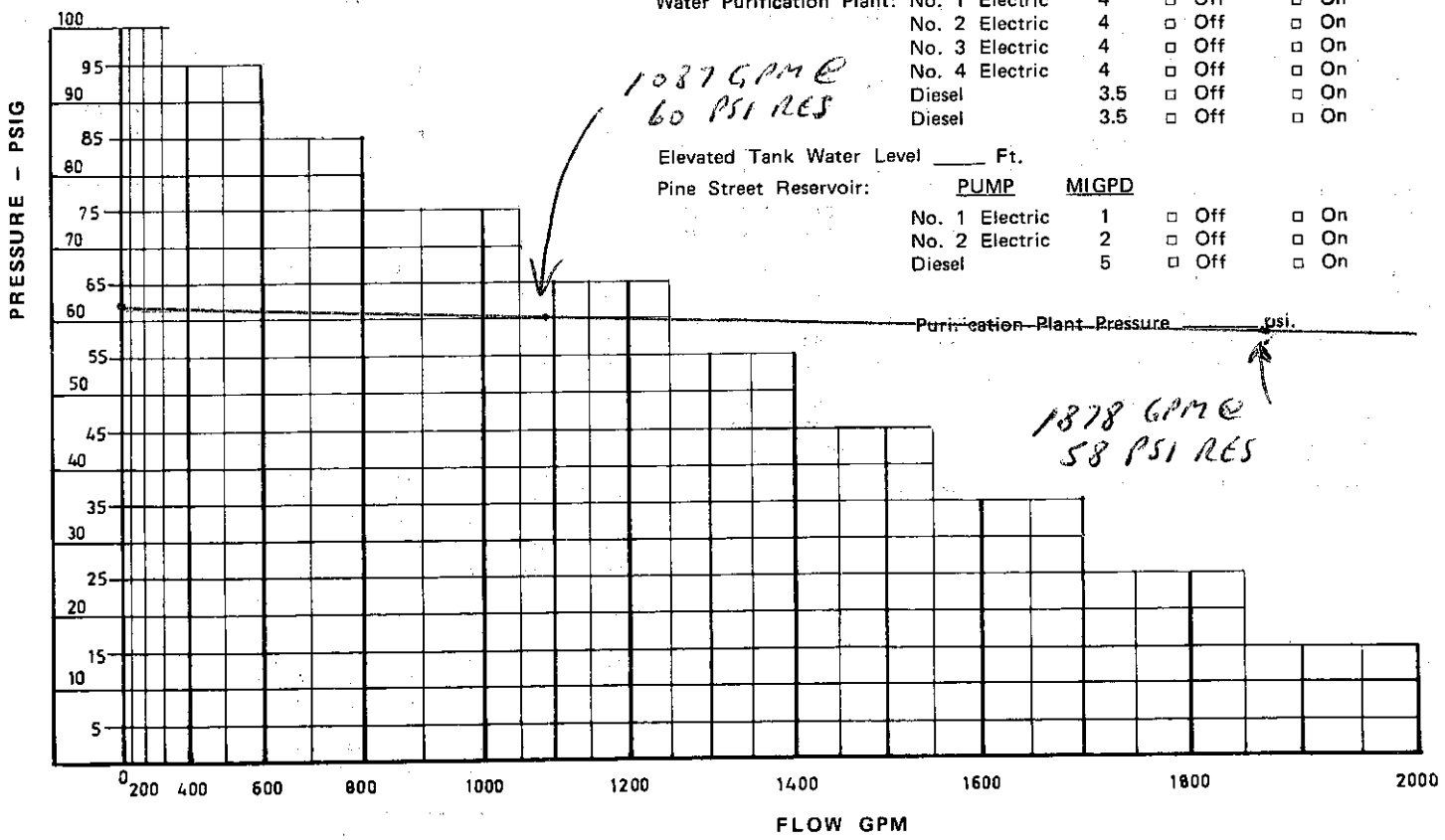
Available drop is static less 20
Test drop is static less residual

Information below can be obtained at a later date from records at Water Purification Plant.

Water Purification Plant:	PUMP	MIGPD		
	No. 1 Electric	4	☐ Off	☐ On
	No. 2 Electric	4	☐ Off	☐ On
	No. 3 Electric	4	☐ Off	☐ On
	No. 4 Electric	4	☐ Off	☐ On
	Diesel	3.5	☐ Off	☐ On
	Diesel	3.5	☐ Off	☐ On

Elevated Tank Water Level ____ Ft.

Pine Street Reservoir:	PUMP	MIGPD		
	No. 1 Electric	1	☐ Off	☐ On
	No. 2 Electric	2	☐ Off	☐ On
	Diesel	5	☐ Off	☐ On



Fm. 109A

APPENDIX C

Water Demand Calculations

Hanley Park North
Evaluation of Water Demand

Population

#units	250	
pop/unit	3	assumed
# people	750	

Average Day Flow

L/cap*d	350	assumed
ADF	262500	l/d
	3.04	l/s

Maximum Day Flow

factor	2.9	MOE Table 3.3
L/cap*d	350	
MDF	761250	l/d
	8.81	l/s

Minimum Hour

factor	0.4	MOE Table 3.3
ADF	3.04	l/d
	1.22	l/s

Peak Hour

factor	4.3	MOE Table 3.3
ADF	3.04	l/d
	13.06	l/s

Fire Flow - Single Family Units

*Water Supply for Public Fire protection - Guide for Determination of Reguired Fire flow - Fire Underwriters Survey (1999)

Note J - Single Family Dwellings - short Method Applicable

Step

A	Construction type	Wood Frame			
B	Floor Area	130 m^2			
C	Height	2 storey max typ.			
			C	1.5	
			A	260	
D	F=220CsqrtA		F	5321.09	l/min
E	Hazard Adjustment	low (-25%)		-1330.27	l/min
		adjusted		3990.82	
F	Sprinkler Adjustment			NA	
G	Exposure Adjustment***	75%		2993.11	l/min
H	Total			**6983.93**	l/min
				116.40	l/s

****(sides = 2x25%, front = 10% and rear = 15%)*

Fire Flow - Townhouse Units

*Water Supply for Public Fire protection - Guide for Determination of Reguired Fire flow - Fire Underwriters Survey (1999)

Step

A	Construction type	Wood Frame			
B	Floor Area	130 m^2			
C	Height	1 storey			
			C	1.5	
			A	150	
D	F=220CsqrtA		F	4041.66	l/min
E	Hazard Adjustment	low (-25%)		-1010.41	l/min
		adjusted		3031.24	
F	Sprinkler Adjustment			NA	
G	Exposure Adjustment***	75%		2273.43	l/min
H	Total			**5304.68**	l/min
				88.41	l/s

****(sides = 2x25%, front = 10% and rear = 15%)*

Fire Flow - Two-Storey Townhouse Units

*Water Supply for Public Fire protection - Guide for Determination of Reguired Fire flow - Fire Underwriters Survey (1999)

Step

A	Construction type	Wood Frame			
B	Floor Area	100 m^2			
C	Height	2 storey			
			C	1.5	
			A	200	

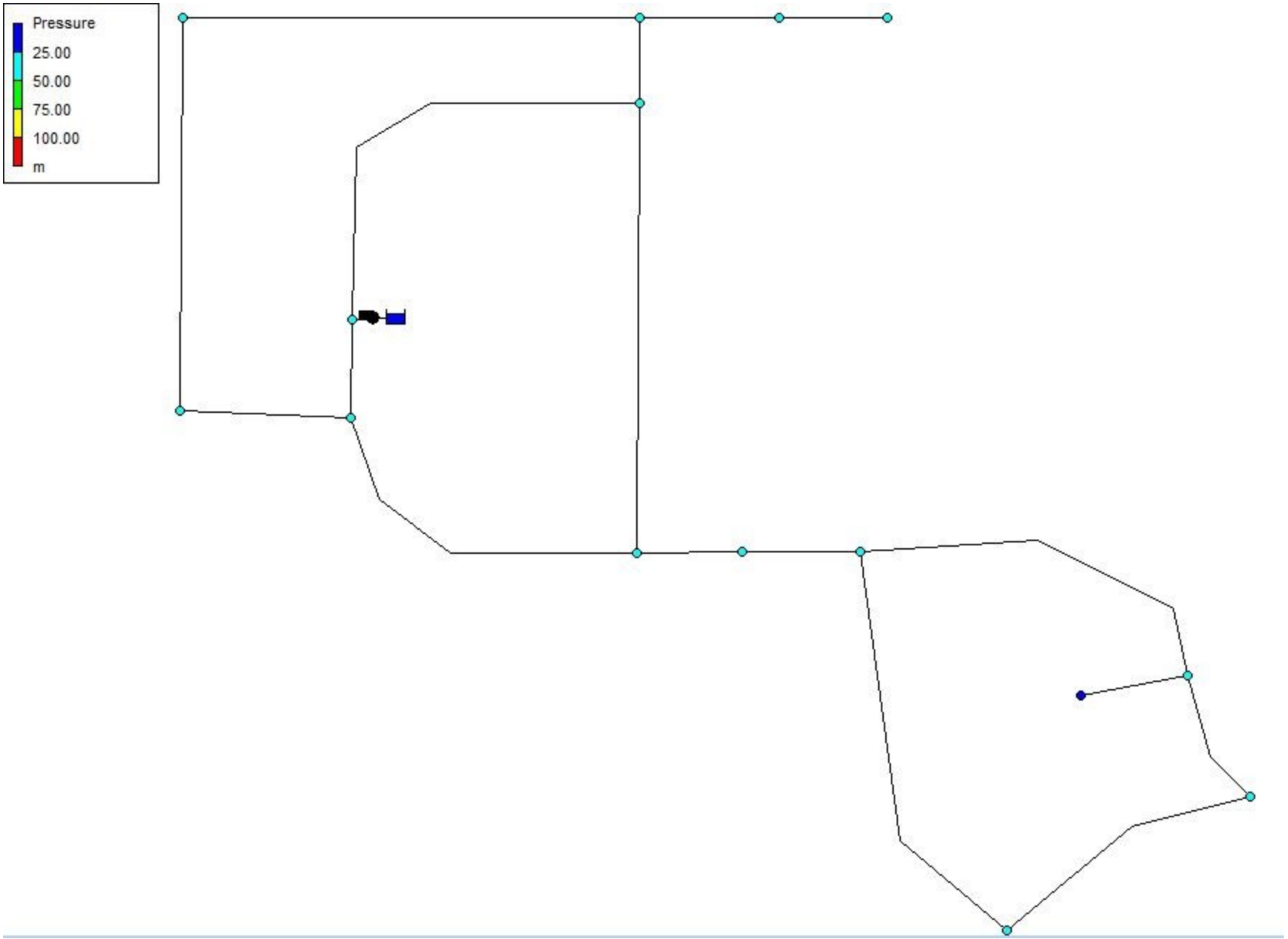
D	F=220CsqrtA		F	4666.90	l/min
E	Hazard Adjustment	low (-25%)		-1166.73	l/min
		adjusted		3500.18	
F	Sprinkler Adjustment			NA	
G	Exposure Adjustment***	75%		2625.13	l/min
H	Total			**6125.31**	l/min
				102.09	l/s

****(sides = 2x25%, front = 10% and rear = 15%)*

Max Day + Fire Flow **125.21** l/s

APPENDIX D

Hydraulic Calculations


Pressure
25.00
50.00
75.00
100.00
m

Pump Curve - Tessa Boulevard (Elevation 88.8m)

Flow (L/s)	Head (m)
0	43.6
78.5	42.19
134.26	40.1

Equation: Head = 43.60-0.000818(Flow)^1.71

Note: Curve Flow (L/s) and Head (m) values taken from Hydrant Testing and Converted from IGPM and PSI (Appendix B)

Links

Network Table - Links

Link ID	Length m	Diameter mm	Roughness
Pipe 1	40	200	120
Pipe 3	120.524	300	130
Pipe 4	44.4	300	130
Pipe 5	54.674	300	130
Pipe 6	339.295	200	120
Pipe 7	358.463	200	120
Pipe 8	81.371	200	120
Pipe 9	41.95	200	120
Pipe 10	141.178	200	120
Pipe 11	370.955	300	130
Pipe 12	73.6	200	120
Pipe 13	243.9	200	120
Pipe 15	101.3	200	120
Pipe 17	62.4	200	120
Pipe 18	76.1	200	120
Pipe 21	180.6	200	120
Pipe 22	23	200	120
Pump 2	#N/A	#N/A	#N/A

Max. Day

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	88.216	0	44.23
Junc 2	87.81	0	44.62
Junc 4	87.211	0	45.22
Junc 6	87.403	0	45.02
Junc 8	86.828	0	45.60
Junc 10	88.500	0	43.93
Junc 13	88.78	0	43.65
Junc 15	88.966	0	43.46
Junc 17	89.086	2.94	43.34
Junc 19	89.460	0	42.97
Junc 20	87.203	0	45.20
Junc 21	86.503	0	45.88
Junc 22	86.153	2.94	46.23
Junc 24	86.603	2.94	45.78
Junc 25	85.953	0	46.44
Resvr 3	88.88	#N/A	0.00

Peak Hr

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	88.216	0	44.20
Junc 2	87.81	0	44.58
Junc 4	87.211	0	45.17
Junc 6	87.403	0	44.97
Junc 8	86.828	0	45.56
Junc 10	88.500	0	43.88
Junc 13	88.78	0	43.60
Junc 15	88.966	0	43.41
Junc 17	89.086	4.35	43.28
Junc 19	89.460	0	42.92
Junc 20	87.203	0	45.13
Junc 21	86.503	0	45.79
Junc 22	86.153	4.35	46.14
Junc 24	86.603	4.35	45.68
Junc 25	85.953	0	46.35
Resvr 3	88.88	#N/A	0.00

Max. Day + Fire Flow

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	88.216	0	41.16
Junc 2	87.81	0	39.57
Junc 4	87.211	0	39.36
Junc 6	87.403	0	38.75
Junc 8	86.828	0	40.56
Junc 10	88.500	0	39.01
Junc 13	88.78	0	38.67
Junc 15	88.966	0	38.48
Junc 17	89.086	2.94	38.36
Junc 19	89.460	0	37.94
Junc 20	87.203	0	33.21
Junc 21	86.503	0	28.28
Junc 22	86.153	2.94	29.55
Junc 24	86.603	119.34	23.53
Junc 25	85.953	0	31.14
Resvr 3	88.88	#N/A	0.00

100 LPS Confidence Check

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	88.216	0	42.15
Junc 2	87.81	0	41.24
Junc 4	87.211	0	41.28
Junc 6	87.403	0	40.80
Junc 8	86.828	0	42.22
Junc 10	88.500	0	40.65
Junc 13	88.78	0	40.34
Junc 15	88.966	0	40.15
Junc 17	89.086	0	40.03
Junc 19	89.460	0	39.60
Junc 20	87.203	0	37.05
Junc 21	86.503	0	33.83
Junc 22	86.153	0	34.89
Junc 24	86.603	100	30.38
Junc 25	85.953	0	36.03
Resvr 3	88.88	#N/A	0.00

20 PSI Confidence Check

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	88.216	0	40.13
Junc 2	87.81	0	37.81
Junc 4	87.211	0	37.25
Junc 6	87.403	0	36.47
Junc 8	86.828	0	38.79
Junc 10	88.500	0	37.33
Junc 13	88.78	0	36.99
Junc 15	88.966	0	36.80
Junc 17	89.086	0	36.68
Junc 19	89.460	0	36.20
Junc 20	87.203	0	28.49
Junc 21	86.503	0	21.10
Junc 22	86.153	0	22.91
Junc 24	86.603	148.08	14.06
Junc 25	85.953	0	25.05
Resvr 3	88.88	#N/A	0.00