SNC·LAVALIN

Certified ISO 9001

SNC-LAVALIN INC.
Suite 200
Park Lane Terraces
5657 Spring Garden Road
Halifax, Nova Scotia
Canada, B3J 3R4

Telephone: 902-492-4544
Fax: 902-492-4540

25 February 2014

Municipality of the District of Chester
151 King Street
P.O. Box 369
Chester, Nova Scotia
B0J 1J0

Attention: Matthew Davidson, P.Eng.

Dear Mr. Davidson,

RE: Chester Business District Water Supply – Feasibility Study

The Municipality of the District of Chester (MODC) has requested that SNC-Lavalin Inc. (SLI) conduct a feasibility study of a potable water supply to serve the business district of Chester. The MODC has recognized that a number of residents and business owners in the business district of Chester are faced with high costs of providing water to patrons, employees, and residents due to low water yields in individual well supplies. The consultant team at SLI has completed this study with efforts from W.G. Shaw and Associates Ltd. (WGSL).

The feasibility study includes a description of the proposed well location and service area, the predicted well yield at the potential well location, a high level design of the system, and an opinion of probable cost for the water treatment and distribution systems. Two options will be presented pertaining to distribution system alignments.

1.0 LOCATION

A potential site for the water supply production well has been identified at Lordly Park, which is located at the intersection of Union St. and Central St. The park currently includes a gazebo that is supplied with power for lighting. Water would be pumped from the well, and treated in a building at the park. Water from this source would then be distributed to the central business district, also known as the "Village-T". Both the Village-T and gazebo (Lordly Park) locations are shown on Figure 1.



Figure 1 Location of Lordly Park and the Chester Business District (Village-T)

To date, SLI Has received the following information from MODC for use in the feasibility study.

- Nova Scotia Civic Address Finder information, displaying the property numbers and corresponding property uses along Pleasant Street and Queen Street;
- Details of each property (and usage) within the business district; and,
- Sanitary sewer system for the Village of Chester including the proposed water service alignments.

2.0 REQUIRED FLOW

The required flow for the Village-T was estimated using the Nova Scotia Civic Address Finder and information provided from the MODC pertaining to each property. Based on each occupancy and use for each property, flow estimates were computed using the Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment, and Disposal (Environment Canada, 2005) and Wastewater Engineering Treatment and Reuse (Metcalf & Eddy, 2003). A summary of the estimated flow estimates, based on each property type, are described in Table 1.

Table 1: **Flow Estimates by Water Use**

Water Use	Estimated Unit Quantity	Estimated Flow (L/d)
Residential*	340 L/person·d	29,012
Lodging Houses	270 L/room·d	810
Commercial	45 L/person·d	4,230
Restaurant	225 L/seat·d 100 L/employee·d	76,200
Theatre	25 L/seat·d	4,400
Beauty Parlours	200 L/seat·d	2,600
Other Commercial Washbasins	11 L/unit·min	3,850
Total		**121,660**

** Assuming 2.23 people per dwelling, according to 2011 Canadian census data for usually occupied residences in Chester, NS.*

3.0 WATER QUALITY AND YIELD

SLI has investigated water quality and yield in coordination with WGSL. The MODC has indicated that the motive for completing the feasibility study was due to lack of yield in existing wells that are independently owned by residents and business owners. SLI is not aware of any water quality concerns.

Existing wells within the feasibility study area for which data is available are shown in Figure 2. WGSL prepared a Well Assessment Report as part of this study, which is provided as Appendix A.

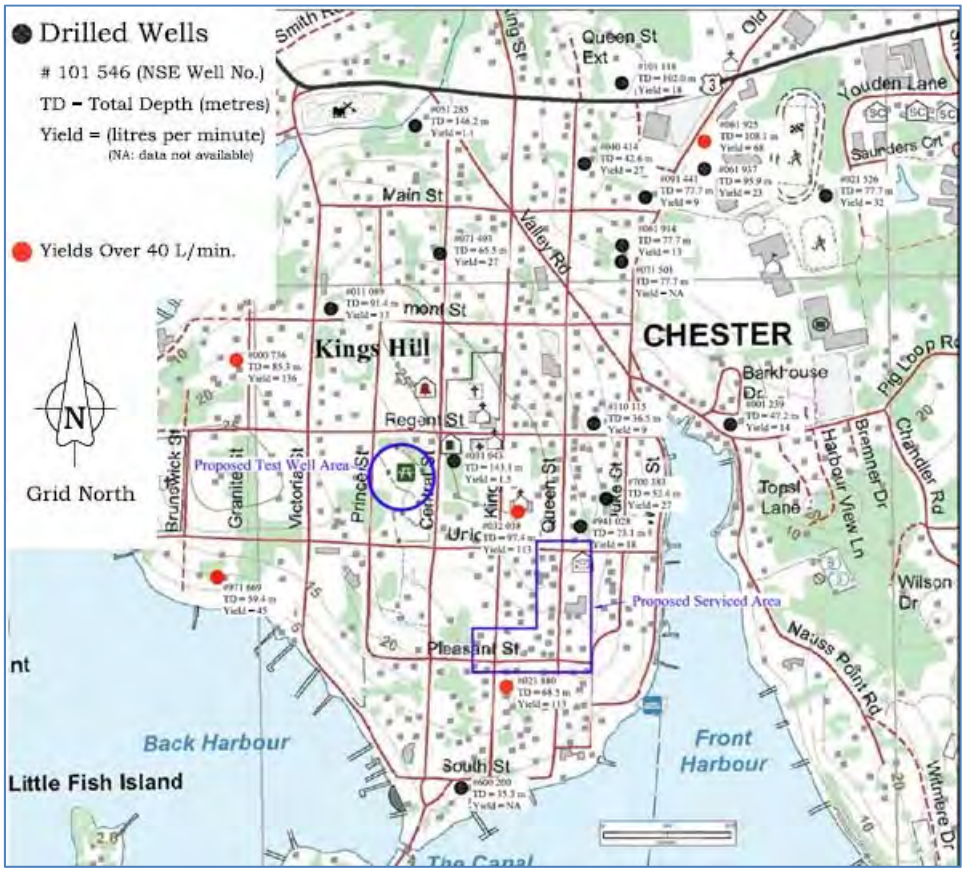


Figure 2: **Existing wells in Chester with Available Data**

From the information provided by the Nova Scotia Department of Natural Resources (DNR) Interactive Groundwater Map, the nearest well to the park for which data is available is located at 97 Central St, immediately east of Lordly Park. According to the record, the nearest well has a very low yield of 1.5 L/min. Other wells in the area show much higher yields. This very low recorded yield might mean that the well was misplaced on the map, or that incorrect information was input in to the DNR system, resulting in an incorrect record.

The producing aquifer to the drilled wells is slate bedrock. In Figure 2, all wells with yields reported over 40 litres per minute are coloured red with the remainder coloured black. With an average demand of 122,000 L/d, the source will need to consist of one well with a sustainable yield of at least 90 L/min. Another option would be a source comprised of two wells with a sustainable yield of at least 45 L/min. If two wells are required, the wells would have to be spaced at least 300 m apart to minimize interference from drawdown.

There are other wells in the area that indicate adequate yield can be supplied to the Chester Business District using one well. A well located 150 metres southeast of the proposed new well location, reports a yield of 113 L/min. Another well, 300 m northwest of the proposed new location, produces a yield of 136 L/min. With a required flow of at least 90 L/min, it is likely that a single well located in Lordly Park has potential to yield enough water to supply the Chester Business District.

4.0 DISTRIBUTION ALIGNMENT OPTIONS

Using sanitary system maps, SLI has confirmed that there are feasible routes for water distribution from the suggested well site to the Village-T. Two options for alignment of the distribution system are presented in the following sections. The outline of the two distribution system alignment options and the sanitary system in the study area are presented in Appendix B.

Alignment Option 1

Option 1 is a distribution system that services the central business district by running a water line from the well location in Lordly Park, south down Central Street, east on Pleasant Street and north on Queen Street to fully service the Village-T.

This alignment is the longer of the two at approximately 735 m but has the potential for less sanitary crossings with Central Street only having gravity server mains for half of the distance between Union Street and Pleasant Street.

Alignment Option 2

Option 2 is the shorter of the two options at approximately 660m and services the central business district by running a water line from the well location in Lordly Park, east down Union Street, south on Queen Street and both east and west on Pleasant Street to service the Village-T. Although this option is shorter, it does have the potential to cross the existing sanitary line in more locations than Option 1.

5.0 POWER REQUIREMENTS

A single-phase medium voltage distribution network owned and operated by Nova Scotia Power Inc. (NSPI) serves Lordly Park and surrounding area. A 240 V single-phase pole line runs along Union St., to the south of the park. A single-phase pole line also runs along the eastern side of the park on the northern section of Central St., including two (2) power poles near the park that likely supply power to the park's gazebo for lighting.

The pole line on the eastern side of the park may have to be extended to bring power to the well site within the park. SLI in consultation with WGSL has estimated a preliminary pump size of 5 hp. Due to the absence of a three-phase medium voltage system serving the area, the pump(s) would be connected at 240V, single-Phase.

6.0 REGULATORY REQUIREMENTS

Well Construction

Wells should be constructed in accordance with the Nova Scotia *Well Construction Regulations* Environment Act. These regulations specify the following requirements:

1. During construction or maintenance all debris should be removed from within and around the well, and the well must be disinfected using a method approved by an inspector.
2. No wells can be built in such a manner or location that surface water may enter the well or aquifer.
3. Wells must be located at minimum specified distances from potential contaminant sources as follows:
    a. 61 m from a cesspool receiving raw sewage (this applies to manure storage lagoons).
    b. 15.2 m (drilled well) or 30.5 m (dug well) from a seepage (leaching) pit, filter bed, soil adsorption field, earth pit, privy, or similar disposal unit; septic tank, concrete vault privy, sewer of tightly joined tile or equivalent material or sewer connected foundation drain.
    c. 3 m from a sewer of cast iron with leaded or approved mechanical joints, independent clear water drain or cistern.
    d. 610 mm from a pump house floor drain, cast iron with leaded joints, draining to ground surface.
    e. 1.5 m of a property boundary.
    f. 6.1 m from the outer boundary of any road or public highway unless approved by an inspector.

The Well Construction Regulations also stipulate that wells must be also maintained to ensure they do not pose a safety or environmental hazard.

Water Supply Management and Monitoring

The MODC has expressed interest in exploring registration requirements for the Village-T water supply. In Nova Scotia, there are two general types of drinking water treatment systems: municipal systems, and registered systems. The monitoring and operational requirements for each type of system vary. The following subsections contain regulatory information for the classification of drinking water systems in Nova Scotia.

A public drinking water supply, as defined by Nova Scotia Environment (NSE), means a water supply system, including any source, intake, treatment, storage, transmission or distribution that is intended to provide the public with potable, piped water and that:

i. has at least fifteen (15) service connections;

ii. regularly serves twenty-five (25) or more persons per day for at least 60 days of the year; or,

iii. serves any of the following for at least 60 days of the year:

   A. a day care facility licensed in accordance with the Day Care Act;

   B. a permanent food establishment licensed in accordance with the Health Protection Act;

   C. a commercial property for the accommodation of the travelling or vacationing public comprising land used for camping or for overnight parking of recreational vehicles or containing a separate building or buildings containing at least 1 room to be used as an alternate form of accommodation in a campground; or,

   D. a commercial property for the accommodation of the travelling or vacationing public containing more than 4 rental units, including cottages or cabins.

This includes municipal, commercial, institutional, industrial, and privately owned water supplies (e.g. schools, restaurants, nursing homes, campgrounds, & parks which are on their own drinking water supply).

Water Supply Classification

There are two basic types of public drinking water supplies, transient and non-transient. A transient public drinking water supply refers to a public drinking water supply that regularly provides water in places where people are not present for long periods of time. Transient supplies do not require classification. A non-transient public drinking water supply refers to a public drinking water supply that consistently provides water to the same twenty-five (25) people for at least six (6) months of the year. This type of system is required to be

classified as per NSE standards. Since the Chester business district (Village-T) water supply is categorized as a non-transient system, classification and registration with NSE will be required.

Water Supply Registration

A Registered Water Supply means a public drinking water supply that holds a registration with NSE under the Water and Wastewater Facilities and Public Drinking Water Supplies Regulations made pursuant to Nova Scotia's Environment Act for the collection, production, treatment, storage, supply or distribution of potable, piped water to the public. Examples of registered water supplies include:

- Trailer Parks
- Apartment Buildings
- Rural Developments
- Schools
- Day Cares
- Nursing Homes
- Industrial or Commercial Buildings
- Eating Establishments
- Fixed Roof Accommodations
- Recreational Facilities
- Campgrounds

Any of the systems listed above that are not connected to municipal water works must be registered with NSE. The Chester business district water supply will require registration with NSE as a registered supply. SLI is available to aid the MODC with the application process if they intend to head the design and construction of the system prior to handing over to the end users.

A municipal drinking water supply means a public drinking water supply that has municipal water works approval issued under the Activities Designation Regulations of the Environment Act that is registered with NSE. A municipal supply permit is required for the collection, production, treatment, storage, supply or distribution of potable, piped water to the public. It is the intention of the MODC that the Chester business district water supply will not be classified as a municipal system, but will instead be a registered system maintained by the end user or a body appointed by them.

A comparison of the requirements for both registered and municipal systems is included in Table 2. We anticipate that the Chester business district water supply will be classified as a Registered System.

Table 2: Monitoring requirements for registered and municipal public drinking water systems in Nova Scotia

Chemical/Physical Parameter Monitoring Requirements	
Registered (2005)	**Municipal**
- Records should be kept for a minimum of 10 years. - Two samples should be taken (raw and treated) if treatment is used to remove a particular parameter. - NSE notified immediately of any exceedance <u>Groundwater</u> - General chemical and physical water quality once/2years <u>Surface water</u> - General chem. and physical quality annual	<u>Turbidity</u> - Daily grab or continuous samples <u>Chemical Disinfection</u> - Continuous monitoring - Dual disinfection units required - Alarms & protocols to prevent inadequately disinfected water from entering the distribution system <u>DBPs</u> - Quarterly <u>Lead/Corrosion Control</u> Annual sample (distribution system)

Microbial Sampling Requirements	
Registered (2005)	**Municipal**
<u>E.coli and Total Coliforms</u> - Quarterly (every 3 months) - Sample on start-up for seasonal systems - Maintain records for two years - NSE notified immediately of any detection	<u>E.coli and Total Coliforms</u> - Population dependent ▪ ≤ 5,000, ≤ 4 samples/month ▪ 5,000 – 90,000 , 1 sample/1,000 people ▪ ≥ 90,000, 90 + 1/10,000 people - Maintain records for two years - NSE notified immediately of any detection

7.0 OPINION OF PROBABLE COST

An opinion of probable cost for the Chester Village-T water supply is presented in Table 1.

It should be noted that alignment costs will be dependent on cost of pipe and property reinstatement from any disturbance. The cost estimate does not include the cost for connection to the Nova Scotia Power grid.

Table 3: Opinion of Probable Cost

Item No.	Description	Estimated Cost Option 1	Estimated Cost Option 2
1.0	Drilled Well	$10,000	$10,000
2.0	Well Pump*	$12,000	$12,000
3.0	Disinfection Treatment	$8,000	$8,000
4.0	Treatment Building	$70,000	$70,000
5.0	Reservoir for water storage	$30,000	$30,000
6.0	Pressure Equipment	$15,000	$15,000
7.0	Supply and Installation of Watermain	$202,125	$181,500
8.0	Service Laterals	$30,800	$30,800
SUB-TOTAL:		$377,925	$357,300
CONTINGENCY (20%):		$75,585	$71,460
TOTAL COST ESTMATE:		$453,510	$428,760

***** *Cost for connection to the electrical grid is not included, and should be determined through discussion with Nova Scotia Power.*

8.0 ASSUMPTIONS

The following assumptions were made in preparation of the water supply feasibility study.

- Lordly Park is available to the MODC for the proposed work.
- The drilled well would be approximately 100m deep with 60m of steel casing.
- One well will provide enough yield for the entire distribution system.
- The well pump will be 5 HP.
- Chlorine disinfection will be completed by a metering pump.
- The treatment building will be approximately 225 ft^2 in size and house the pressure tanks and disinfection equipment. A cost of \$300/ft^2 was assumed which includes minimal heating for the space.
- The holding tank will be approximately 27,000 L and will be installed underground, beneath the treatment building.
- Pressurization will include one pump and one pressure tank.
- The watermain is 25 mm Pex piping at a cost of \$275/m.
- Option 1 would require approximately 735m of piping (excluding laterals).

- Option 2 would require approximately 660m of piping (excluding laterals).
- Service laterals are 25mm Pex piping at a cost of $275/m. We have assumed 28 laterals, one for each address, with an average length of 5m.
- Power availability and potential connection points will be verified by NSPI prior to any work taking place.

Please feel free to contact the undersigned with any comments or concerns related to the contents of this letter. If the undersigned is not available, please refer all comments or concerns to Tim Veinot.

Yours truly,

SNC-LAVALIN INC.



Jeffrey Theriault, P.Eng.
Civil Engineer

JT/lb

Cc Mr. Lyle Russell, P.Eng.
Mr. Jason Angel, P.Eng.
Mr. Tim Veinot, P.Eng.

509985-0041-LET-000-0001

APPENDICES: A – Well Assessment Report
B – Distribution System Alignment Options

W.G. SHAW & ASSOCIATES LTD.

Consulting Geoscientists

6 Highland Drive
Antigonish , Nova Scotia
Canada B2G 1N6
phone/fax (902) 863 - 1903
E-mail : wgshaw@eastlink.ca

Mr. Jason Angel, P.Eng.
SNC – Lavalin Inc.
Suite 200 Park Lane Terraces
5657 Spring Garden Road
Halifax, Nova Scotia
Canada

February 20, 2014

Re : Village of Chester – Assessment of Water Wells

Dear Jason,

The following is a letter report on our procedures and results of the investigation of drilled water wells within the Village of Chester.

Introduction

W.G. Shaw & Associates Ltd. (WGSL) was retained by SNC Lavalin Inc. to conduct an assessment of water wells and aquifers in the vicinity of the Village of Chester in Lunenburg County.

The objective of the study is to provide basic information and data on water supply wells within the Village of Chester as part of a feasibility study assessing the construction of a central water system to provide potable water to the downtown business district of Chester as shown on Figure #1. The number of service points is estimated to be from 25 to 30 with the following anticipated demand:

Average Daily Demand	=	125,000	litres per day
	=	86	litres per minute
Peak Daily Demand	=	250,000	litres per day
	=	172	litres per minute

Currently, all commercial and residential properties within the Village of Chester derive their potable water from dug and drilled wells.

Scope of Work

The following procedures were utilized in this study:

1) We researched and described the surficial sediments and bedrock geology in the vicinity of the Village of Chester from published documents.

2) We researched and compiled information on private water wells located within Village of Chester from the NSE Water Well Database.

3) We researched and compiled information on pump tests of wells located within Village of Chester from the NSE Water Well Database.

4) Using the phone, we discussed the character of water wells in the area with two well drillers: 1) Mr. Peter Johnson of Chappel Well Drilling Ltd., and 2) Mr. Andy Veinotte of L.E. Veinotte Well Drilling Ltd.

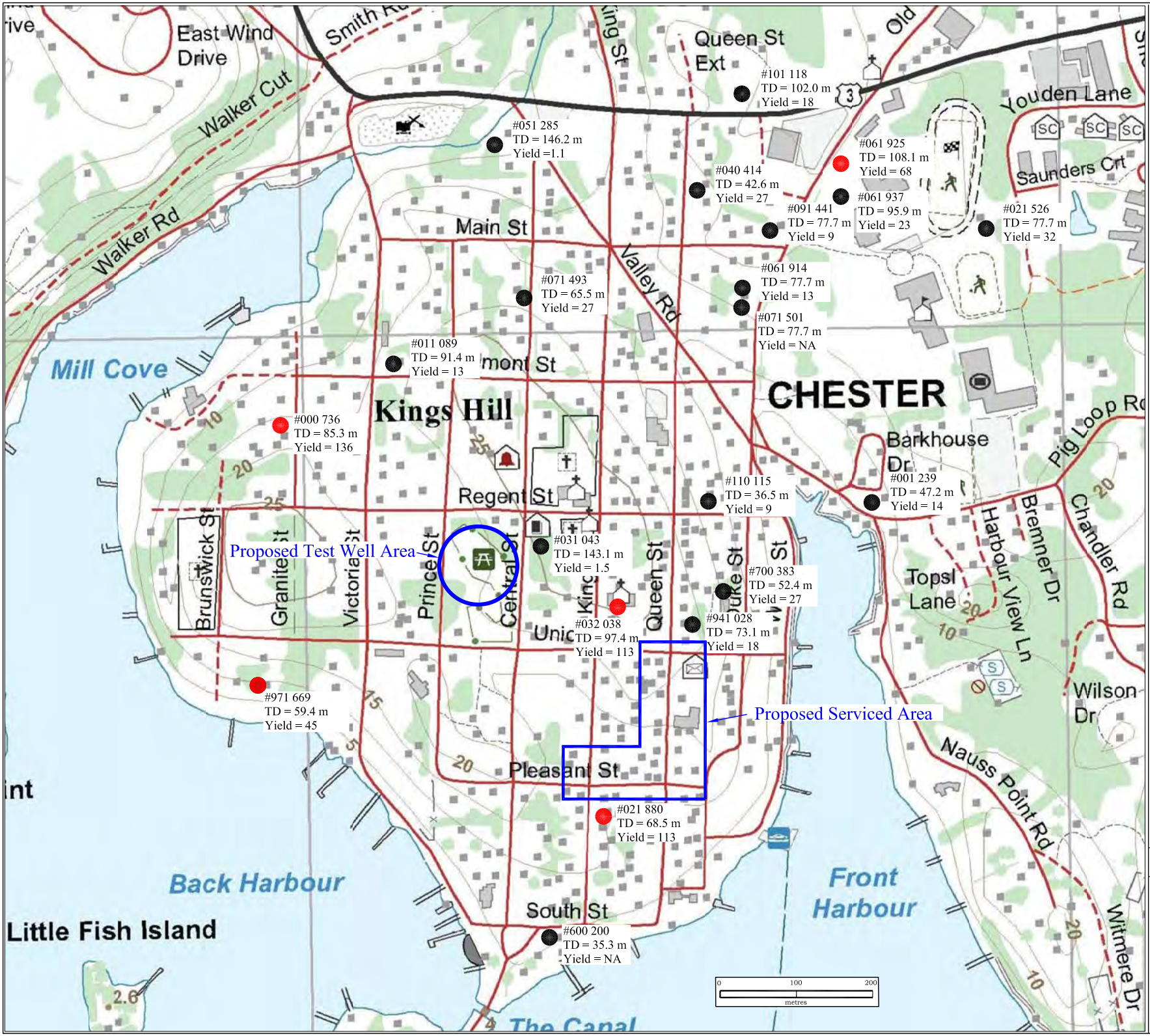
Summary of Geologic Units and Aquifers

Surficial Sediments (Soils)

The surficial sediments within the Village of Chester consists of gravely clay and silt with boulders. The thickness of these sediments varies from 3 to 60 metres and varies widely over short horizontal distances.

Bedrock

The Village of Chester is underlain by bedrock that consists of dark gray coloured slate which is part of the regionally extensive Halifax Formation.



Explanation

Grid North

● Drilled Wells

101 546 (NSE Well No.)

TD = Total Depth (metres)

Yield = (litres per minute)

(NA: data not available)

● Yields Over 40 L/min.

Preliminary Map

SCN Lavalin Inc.

Village of Chester

Lunenburg County, Nova Scotia

Figure #1

February, 2014

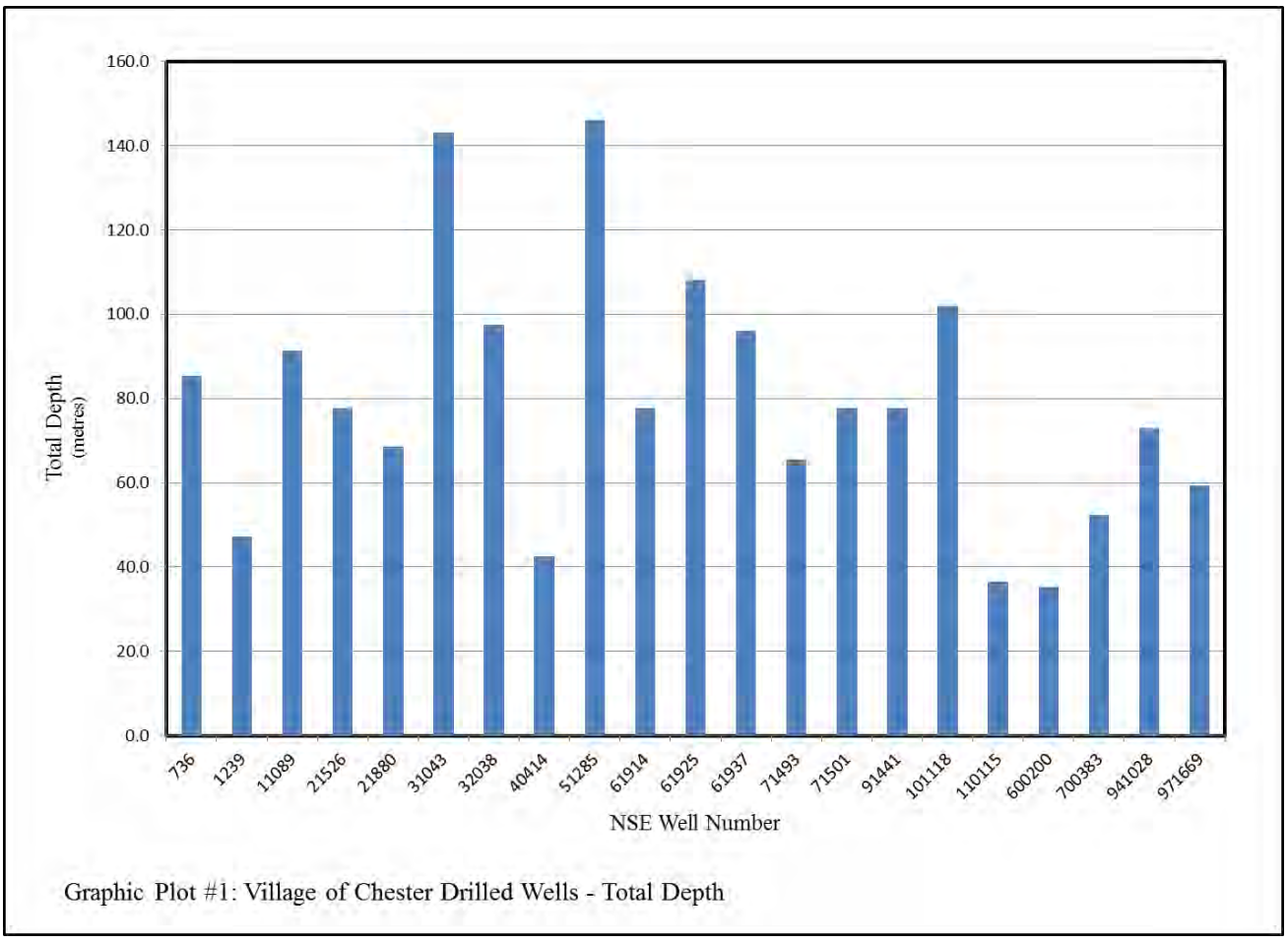
W.G. Shaw & Assoc. Ltd.

Summary of Water Well Information

Most private water supply wells within Village of Chester are dug wells for which there is very little documented information. However, these dug wells would be expected to have depths of from 5 to 10 metres.

Within the Village of Chester, we were able to find 21 records for drilled wells in the Nova Scotia Department of Environment Drilled Well Database (Figure #1 and Table #1).

The total depth of these wells varies from 35.6 to 146.2 metres (116 - 479 feet; Graphic Plot #1).



Graphic Plot #1: Village of Chester Drilled Wells - Total Depth

The depth of top of bedrock in these drilled wells varies from 6.1 to 63.6 metres (Graphic Plot #2).

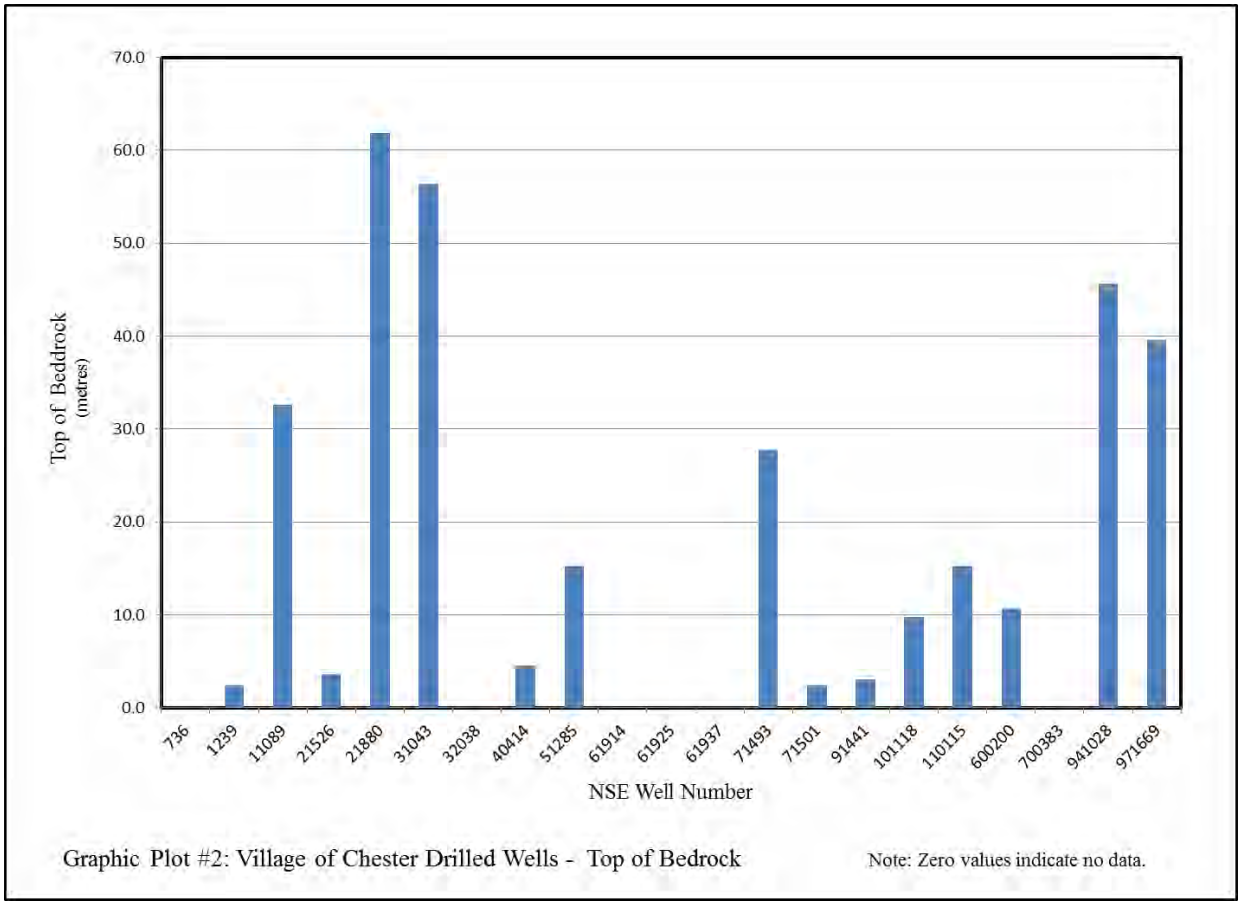
Table #1

Village of Chester

Drilled Wells

Preliminary Results

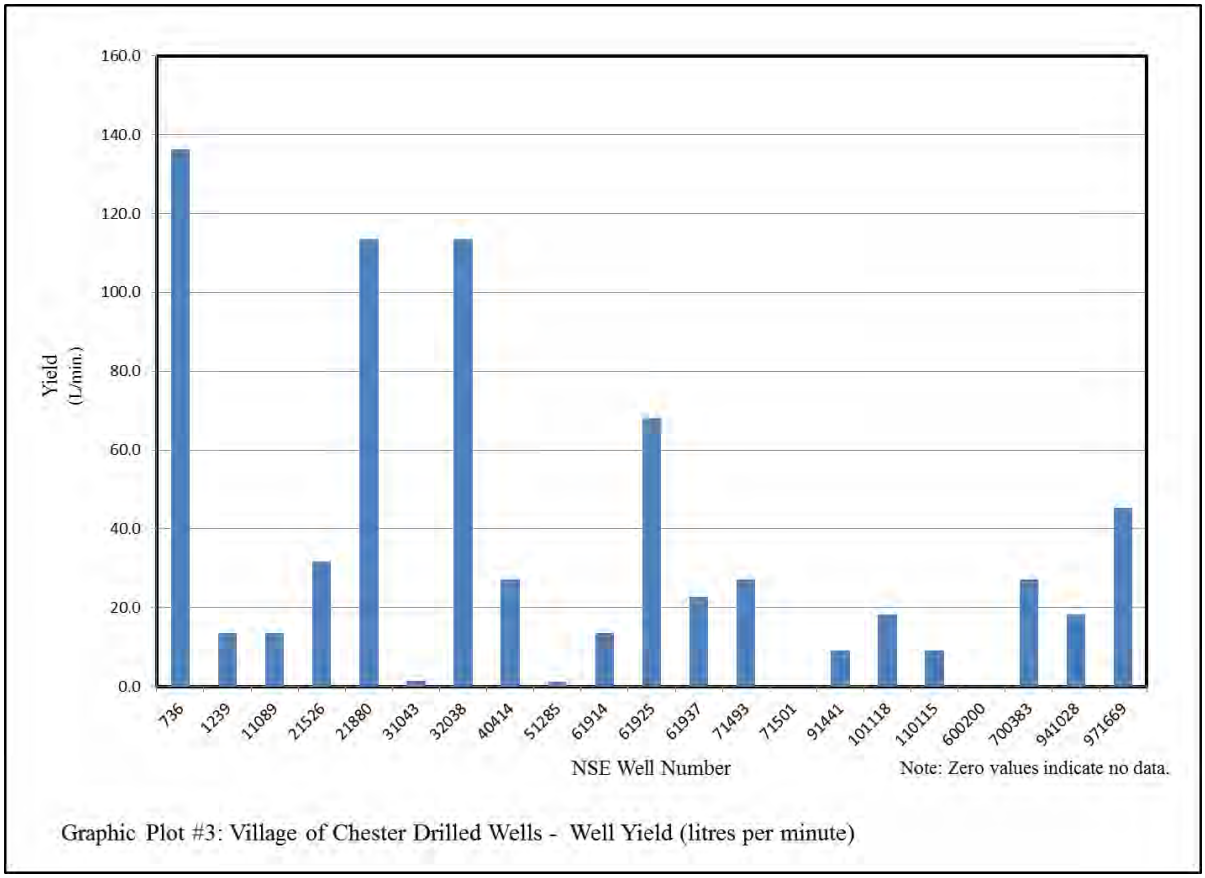
Well Number		Total Depth metres	Casing Depth metres	Top of Bedrock mertres	Static Water Level metres	Yield (Lpm)	Notes
736	75 Granite Street	85.3	62.4			136.2	
1239	232 Pig Loop Road	47.2	6.1	2.4	0.9	13.6	
11089	94 Tremont Street	91.4	35.3	32.6	12.2	13.6	
21526		77.7	12.2	3.7	3.4	31.8	Location is Questionable.
21880	30 King Street	68.5	63.6	61.8		113.5	
31043	P.O. Box 369	143.1	60.9	56.3		1.5	Chester Library
32038	84 King Street	97.4	60.9		24.4	113.5	
40414	188 Queen Street	42.6	6.1	4.6	6.1	27.2	
51285	Larder Lane	146.2	16.4	15.2		1.5	Location is Questionable.
61914	169 Duke Street	77.7				13.6	
61925	204 Duke Street	108.1			7.6	68.1	
61937	204 Duke Street	95.9			3.7	22.7	
71493	187 Central Street	65.5	35.6	27.7	24.4	27.2	
71501	165 Duke Street	77.7	12.2	2.4	6.1		
91441	2 Main Street	77.7	12.2	3.0	6.1	9.1	
101118	3880 Highway #3 (North Street)	102.0	24.4	9.7	6.1	18.2	
110115	20 Regent Street	36.5	18.3	15.2		9.1	
600200		35.3		10.7			Location is Questionable.
700383	14 Union Street	52.4	48.1		13.4	27.2	Royal Canadian Legion
941028	78 Queen Street	73.1	51.8	45.7	18.3	18.2	
971669	127 Union Street	59.4	56.3	39.6	18.3	45.4	



Graphic Plot #2: Village of Chester Drilled Wells - Top of Bedrock

Note: Zero values indicate no data.

The reported yields of these 21 wells range from 1.5 to 136.2 litres per minute (Graphic Plot #3). All wells with yields reported over 40 litres per minute are coloured red on Figure #1; the others are coloured black.



Graphic Plot #3: Village of Chester Drilled Wells - Well Yield (litres per minute)

Conclusions

If the average demand of the proposed, central water system will be 125,000 litres per day, we will need one well with a sustainable yield of at least 90 litres per minute or two with sustainable yields of 45 litre per minute each. If two wells are required, the wells should be spaced at least 300 metres apart to minimize interference.

Although the yields of the drilled wells in the Village of Chester illustrate considerable variation over short horizontal distances, there is the potential of supplying the proposed, central water system with one or two wells.

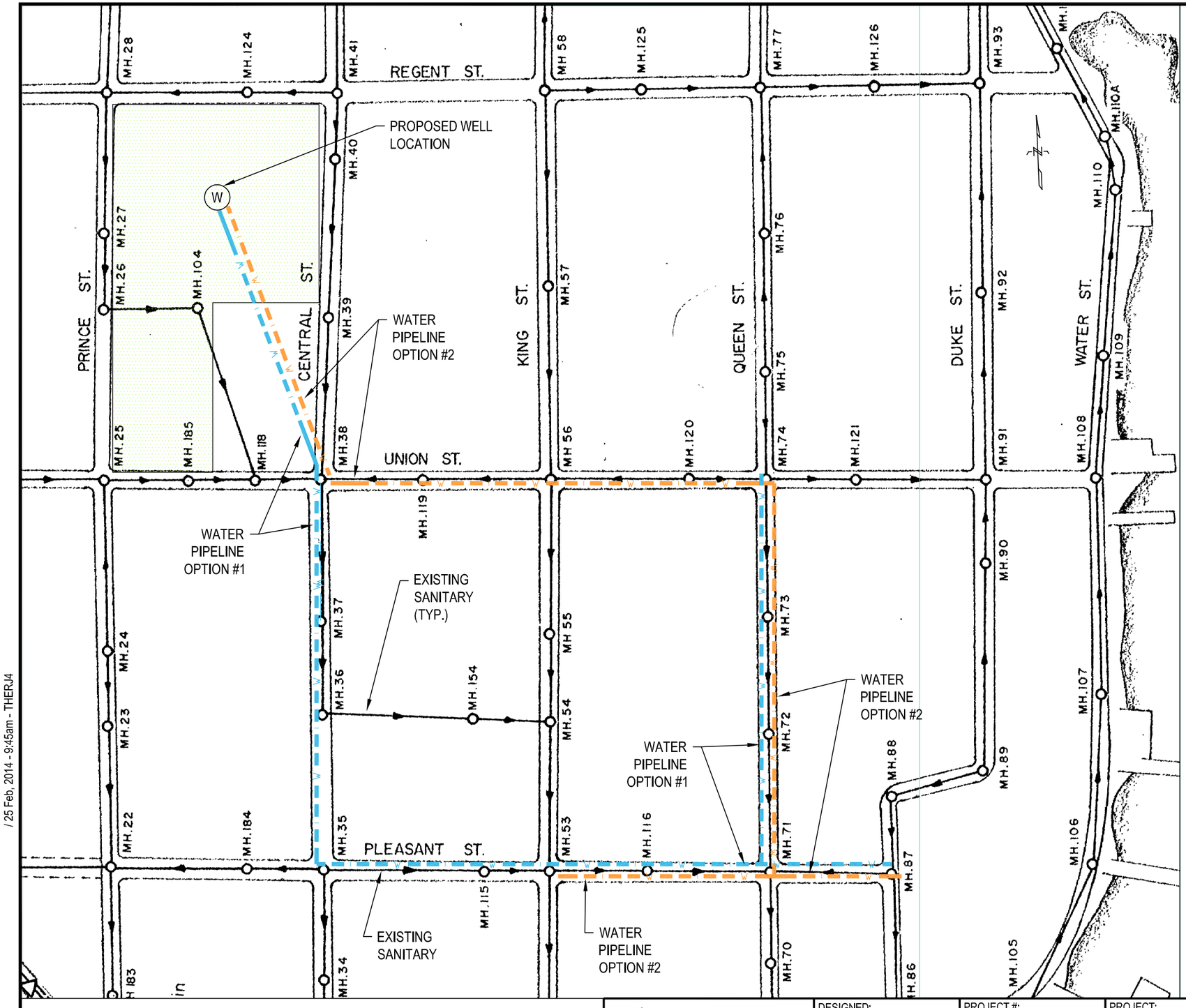
Recommendations

In order to confirm the locations of some of the wells in the NSE Database and to add to our current body of data on drilled wells in the area, we recommend conducting a day or two of field work in the Village of Chester. The results of the field work will refine the recommended location of the test well recommended in the following paragraph.

In order to better determine the capability of one, or two, water wells to provide the necessary raw water supply to the conceived system, we recommend constructing a drilled well in the general area of the park illustrated with a blue circle in Figure #1. The well should be constructed to 100 to 140 metres total depth with a diameter of 152 mm (6"). After well construction, an estimate of the yield of the well should be determined using air-lift pumping techniques. If the well shows the potential to yield over 40 litres per minute, the well should be pump-tested for a period of 72 hours. Water quality should be monitored at regular intervals during the pump test using a combination of hand-held instruments and laboratory analyses. The results of the pump test should be utilized to determine a sustainable yield of the well and expected water quality.

With best regards,

William G. Shaw, *P.Geo.*
President





ALIGNMENT OPTION #1

ALIGNMENT OPTION #2

EXISTING SANITARY

PROPOSED WELL (W)

/ 25 Feb, 2014 - 9:45am - THERJ4

DCC#

SNC•LAVALIN

SNC•LAVALIN Inc.
Halifax, Nova Scotia, Canada
Telephone: (902) 492-4544
Fax: (902) 492-4540
Member of the SNC•LAVALIN Group

Certified ISO 9001

DESIGNED:	PROJECT #: 509985-0041	PROJECT: VILLAGE OF CHESTER WATER SUPPLY	APPENDIX B
DRAWN: S.R	SCALE: N.T.S.	DRAWING TITLE: ALIGNMENT OPTIONS	
CHECKED:	DATE: 2014-02-18		