WELL FIELD PROTECTION PROGRAM

Village of Moose Creek
Municipal Wells

Prepared for:

TOWNSHIP OF NORTH STORMONT
2 Berwick Victoria Street
P.O. Box 99
Berwick, Ontario
K0C 1G0

Prepared by:

Water and Earth Science Associates Ltd.
Box 430, 3108 Carp Road
Carp, Ontario, K0A 1L0

March 2004

Project No. CB2500

Ref:B2500 March-04 FinalReport..doc

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

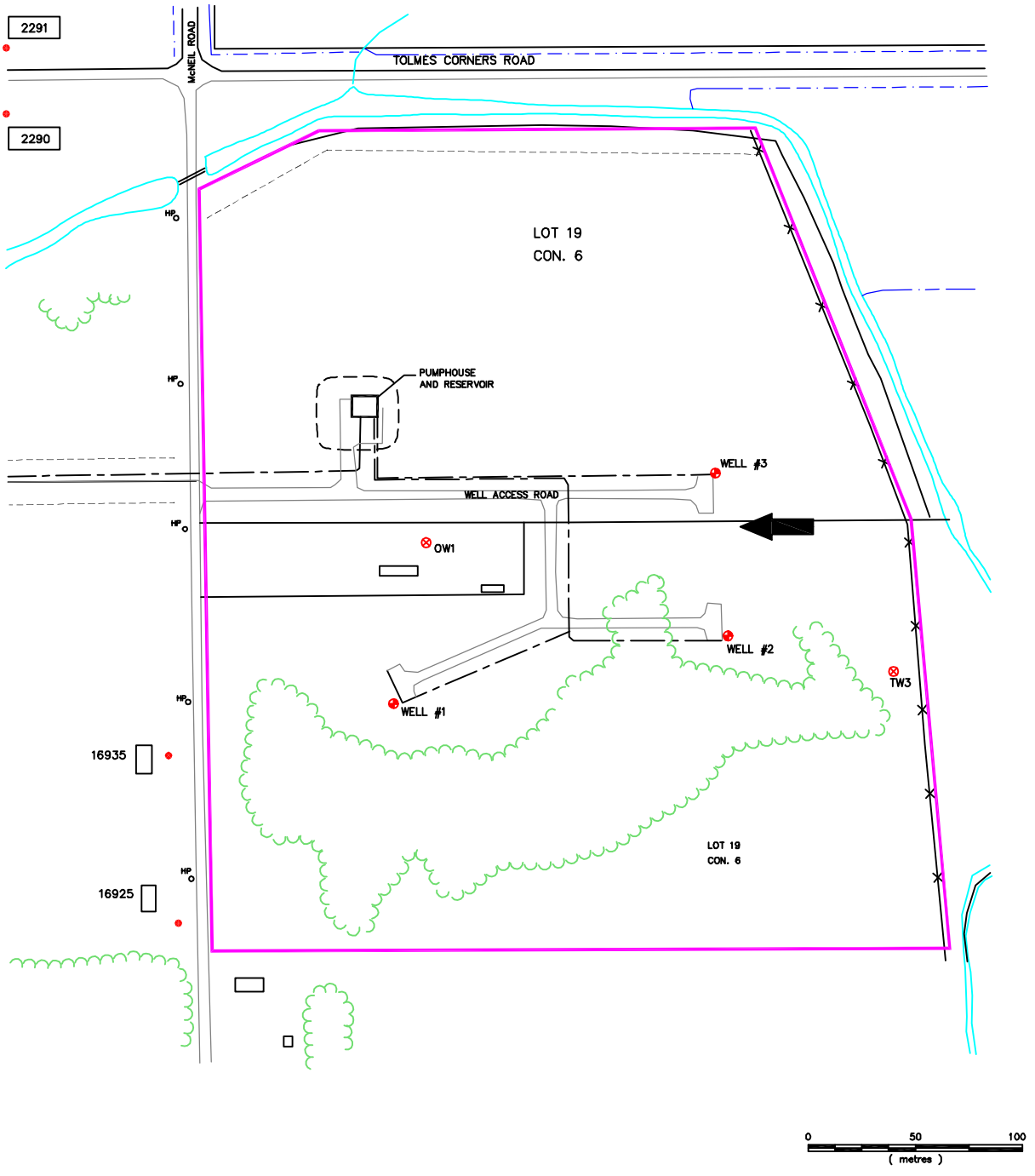
1.0 INTRODUCTION

The following provides a recommended Well Field Protection Program (WFPP) for the Village of Moose Creek Municipal wells. The purpose of this program is to implement measures at the Municipal well 'Site' that will safe guard the quality and quantity of the groundwater resource. A plan showing well locations and property boundaries to the Site is provided as Figure 1. The WFPP should be implemented as part of an overall wellhead protection strategy to protect the area of recharge of the wells from potential adverse impacts due to existing and future land use.

A program to implement wellhead protection strategies for the United Counties of Stormont Dundas and Glengarry, the United Counties of Prescott & Russell, and the City of Ottawa is being carried out by the Eastern Ontario Water Resources Committee (EOWRC). The definition of Wellhead Protection Areas (WHPAs) for the Village of Moose Creek Municipal wells and recommended measures for a wellhead protection strategy for the defined areas are provided in *Municipal Groundwater Study, Township of North Stormont. Prepared for the Eastern Ontario Water Resources Committee. October 2003*. The WHPAs and Aquifer Intrinsic Susceptibility for the Moose Creek Municipal Wells as determined in the *Municipal Groundwater Study* is provided in Appendix A for reference. Input data used in the modeling and delineation of the WHPAs was not available for review during preparation of the WFPP.

2.0 SITE DESCRIPTION

The Village of Moose Creek well site is located on the outskirts of the south side of the village. The Site is approximately 30 acres in area and is bordered by Moose Creek to the south and to the east, by McNeil Road to the north, and by private land to the west. Neighbouring land use consists of low density residential (on private services) to the north and agriculture to the east, west and south. Access to the Site is via a laneway from McNeil Road. No fencing or gate entrance is present to control access to the Site. The three Municipal wells are accessible via a constructed gravel roadway. The well caps for each Municipal well are secured with bolts and with padlocks. Two observation wells, TW3 and OW1, are also located on the property. Observation well TW3 is a 150 mm diameter steel cased well located to the south of Well #2. OW1 is a former 150 mm diameter domestic well that has been instrumented with two PVC multi-level monitoring wells. OW1 is located between Well #1 and the Pumphouse. All Municipal well and observation well locations are shown on Figure 1.



LEGEND:

- ⊗ DENOTES OBSERVATION WELL
- DENOTES PRODUCTION WELL
- DENOTES DOMESTIC WELL
- DENOTES WELL FIELD PROPERTY LINE
- DENOTES INFERRED REGIONAL GROUNDWATER FLOW DIRECTION

PLAN REFERENCE: McNEELY ENGINEERING CONSULTANTS LTD. /MARCH 1994

PROJECT NUMBER:	B2500	DRAWN BY: C.M.R.	DESIGNED BY: R.H.
DATE:	16 MARCH 2004	CHECKED BY:	R.H.
SCALE:	AS SHOWN	CAD FILE NO.:	B2500-SP

FIGURE: 1

SITE PLAN

MOOSE CREEK WATER SUPPLY SYSTEM
TOWNSHIP OF ROXBOROUGH

WESA
A Better Environment For Business

2.1 SITE HYDROGEOLOGY

The geology of the Site consists of 3.5 to 5.5 metres of sand and silty sand overlying silty clay that extends to the bedrock surface at between 12.0 and 14.0 metres depth. Site bedrock consists of limestone of the lower member, Lindsay Formation. The thin-bedded nodular limestone at the Site is characterized by frequent shaley partings that are present between beds.

During the construction of test wells and the Site Municipal wells in 1990 and 1991, two water-bearing zones were observed within the bedrock at less than 32 metres depth. Due to aquifer turbidity issues (attributed to loose materials present within the shaley partings), a 406 mm (16 inch) x 203 mm (8 inch) gravel pack well design was used in the construction of the Municipal wells. Each Municipal well has two 1.5 metre (5 feet) well screens installed within a gravel pack and adjacent to the observed bedrock water-bearing zones. A significant reduction in the specific yield of Well #1 has been observed since its construction and testing in 1991. Efforts to rehabilitate this well have been unsuccessful, indicating inefficient well screen location relative to the water-bearing zones. Well #1 is scheduled to be replaced in 2004. A well construction summary for the site wells is provided in Table 1 below.

Table 1: Well Construction Summary

	Well #1	Well #2	Well #3	TW3	OW1
Construction Details					
• Depth to bedrock	12.2 m (40')	13.1 m (43')	12.5 m (41')	14.0 m (46')	Not avail.
• Total Depth	30.5 m (100')	31.4 m (103')	32 m (105')	31.4 m (103')	Not avail.
• Well Screen Depth Interval	19.9 to 21.4 m 27 to 28.5 m	20.9 to 22.4 m 23.8 to 25.3 m	25 to 26.5 m 30.5 to 32 m	No screen	Not avail.
• Well Screen slot size	80-slot	100-slot	100-slot	No screen	PVC
• Top of Casing Elevation (masl)	87.493	86.512	86.958	84.988	86.684
Current Operational Status	**Replacement Well to be constructed in 2004**	**On Line**	**On Line**		

A hydrogeological assessment completed as part of the *Municipal Groundwater Study* indicates that the regional groundwater flow direction within the bedrock aquifers is towards the north. However, local groundwater flow direction within the Site overburden is likely influenced by the seasonal conditions (i.e. the water level) of Moose Creek.

WHPAs that have been modeled for the Moose Creek Municipal wells are depicted on the Figure provided in Appendix A. This assessment indicates that the 50-day groundwater time of travel (TOT) area for each Municipal well is situated within the boundaries of the Site. The 2-year TOT area extends approximately 750 metres beyond the boundaries of the Site, on to agricultural land to the south-southeast. The 10-year and 25-year TOT areas extend several kilometers to the southeast. The aquifer intrinsic susceptibility index for the Site, the 2-year, and the 10-year TOT areas range from 'medium' to 'low' due to the presence of an abundance of fine textured overburden materials (i.e. clay) within the WHPAs.

3.0 RECOMMENDED PROGRAM

The components of a recommended WFPP are presented below. The rationale for specifying each component is also provided.

3.1 ADDITIONAL SITE CONTROLS

- Installation of site entrance gate with padlock

Rationale: The 50-day WHPA and a portion of the 2-year WHPA are located within the boundaries of the Village of Moose Creek Well Site (see Appendix A). The 50-day WHPA represents the area of greatest concern for wellhead protection due to the high potential for an adverse impact to the water supply from surface spills and microbial contaminants introduced within this WHPA. Without controlled site access the risk exists for onsite dumping/spillage of solid and liquid wastes. A risk for vandalism/damage to the Municipal wells due to unauthorized vehicle access is also present. Consequently, the installation of an entrance gate with controlled site access provides a highly beneficial measure of 'risk avoidance' for the 50-day WHPA.

3.2 GROUNDWATER QUALITY MONITORING PROGRAM

- Quarterly 'raw water' sampling program for Municipal wells

1. Raw water chemistry analysis for all three Municipal wells on a quarterly basis. Chemistry data to be tabulated and maintained within a suitable database for assessment of long term water quality trends. List of parameters to be analyzed to include:

- Iron
- Manganese
- Hardness
- Alkalinity
- pH
- Conductivity
- Sodium
- Nitrate
- Nitrite
- Ammonia
- Chloride
- Turbidity
- Colour
- Calcium
- Magnesium
- Total Kjeldahl Nitrogen
- Total Organic Carbon
- Dissolved Organic Carbon
- Sulphate
- Total Dissolved Solids

2. Manual collection of static water levels from the three Municipal wells and the two observation well locations (OW1 and TW3 on Figure 1) in conjunction with the quarterly sampling event. To be representative of static aquifer conditions the data must be collected a minimum of 24 hours after the last operation of any site wells.

Rationale: Given the rural Site location, the absence of commercial/industrial land use, and the'medium' to 'low' aquifer intrinsic susceptibility index, the greatest potential sources of groundwater quality degradation are agricultural land use impacts derived from lands to the south and potential impacts from the over-pumping of the bedrock aquifer during periods of low aquifer recharge. A long term monitoring program would serve to assess the seasonal variations and long term water quality trends due to neighbouring agricultural land use (i.e. from the application of nitrogen based fertilizers) and from over-pumping (i.e. from the potential up-welling of poor groundwater quality at depth).

Quarterly sampling for a list of water quality parameters similar to the list provided above was carried out between 2000 and 2003 and was recently discontinued in 2004. A preliminary analysis of the existing data indicates significant seasonal variations in raw groundwater quality at the Site. The existing baseline data provides a starting point for the development of a water quality database that can be used in the assessment of future monitoring results.

- Bi-annual Assessment and Reporting of Raw Water Quality Trends

1. Every 2 years a brief letter report should be prepared by a qualified hydrogeologist assessing any apparent changes/trends in raw water quality and well static water level elevations. The assessment should evaluate both the quarterly groundwater quality data outlined above and the weekly microbiological quality data collected by the Operator.

Rationale: To be of value, the raw water quality data must be assessed for trends on a regular basis in order to identify any existing or potential future concerns. The 'Engineer's Report' that is completed every five years will not be able to identify/mitigate groundwater quality issues in a prompt enough manner.

3.3 WELL INSPECTION PROGRAM

- Semi-Annual General Inspection of Municipal Wells

The following inspections and tasks should be undertaken at each well on a semi-annual basis at approximately the same dates each year, preferably in the spring and fall:

1. Inspect site to ensure ground slopes away from well. Note any ground subsidence, evidence of leakage into or out of the well, or nearby ponding of water.

2. Ensure well cap or well seal are securely fastened/locked to prevent tampering and the potential entry of foreign material.

3. Ensure the MOE identification tag is securely attached to the well casing or cap.

4. Ensure the Site access gate is secure to prevent unauthorized vehicle access. Inspect for evidence of any unauthorized access via other possible routes on to the Site.

5. Inspect the well vent to ensure that it is not blocked, that the screen is secure, and that the opening is shielded.

6. Visually inspect casing wall, cap and cover for cracks or other damage.

7. Visually inspect casing for signs of any movement.

8. Review the water level and compare with previous measurements. Observe levels after pumps have been off for a minimum period of one hour.

9. Review the flow and pressure readings as an indication of pump operation, and compare with previous measurements.

10. Clear vegetation overgrowth from around the well casing.

11. Review the well field protection plan for any changes or modifications to the local site condition.

12. Ensure that the well record and Permit to Take Water are valid and available for inspection.

- Every five years re-assess well and pump performance

1. A step-drawdown test should be conducted for each well in a manner that may be repeated in the future for evaluation and comparison of well specific capacity (yield/increment of drawdown) and pump performance (amperage draw and pumping capacity). The program will use existing flow meters, pumps, and pressure gauges and will <u>not</u> involve pump shut down or well recovery between steps.

- Every ten years remove and inspect the pumps and assess the condition of the well screen

    1. Remove well pump and inspect/repair pump, casing, screen and pitless adaptor.

    2. Undertake a camera inspection of the well screen and assess the need for well screen cleaning (i.e. acid treatment) and/or well re-development.

    Rationale: The well inspection program is necessary to ensure that the site wells are maintained in optimum condition to prevent the potential entry of microbial contamination at the well casing annulus and/or the direct entry of foreign material. Due to the observed reduction in well specific yield over time, it is essential to monitor well performance to ensure an adequate supply is maintained to meet water supply demand.

APPENDIX A

Wellhead Protection Areas and Aquifer Intrinsic Susceptibility

Figure 2
Wellhead Protection Area
Aquifer Intrinsic Susceptibility
Moose Creek Municipal Wells

Périmetre de Protection de Tête de Puits
Sensibilité Intrinsèque D'eau Souterraine

Legend/Légende

- Municipal Water Well / Puits Municipal
- Water Use Permit / Permis de Puiser de l'Eau
- 50 Day — Wellhead Protection Area Groundwater Time of Travel / Périmetre de Protection de Tête de Puits Temps de Migration de l'Eau Souterraine
- Esker Deposits / Dépôt D'Esker
- Buried Esker Deposits / Dépôt D'Esker Enterré
- Pits and Quarries / Sablières et Carrières
- Point Contaminant Source / Pollutant de Source Ponctuelle

Zoning/Zonage

WD	Waste Disposal/Dépôtoir
WY	Wrecking Yard/Aire de Démolition
M	Industrial/Industriel
MX	Mineral Extraction/Sources Extractives
CH	Highway Commercial/Commerciale Routier

Intrinsic Susceptibility Index/Index de Sensibilité Intrinsèque

- High/Elévé
- Medium/Moyen
- Low/Bas

WELL FIELD PROPERTY LINE

Scale 1:20,000 Échelle

0.25 0 0.25 0.5 0.75 1

Kilometers/Kilomètres

RAISIN REGION CONSERVATION AUTHORITY
OFFICE DE PROTECTION DE LA NATURE DE LA RÉGION DE RAISIN

Prescott Russell | United Counties Stormont Dundas Glengarry | Ottawa

AQUAFOR BEECH LIMITED | Robinson Consultants | Horsley & Witten Inc.