CORPORATION OF THE TOWNSHIP OF NORTH STORMONT

VILLAGE OF CRYSLER WATER SYSTEM

ENGINEERS' REPORT FOR WATER WORKS

MARCH, 2001
(Revised May 29, 2001)

Township of North Stormont
P.O. Box 99
2 Victoria Street
Berwick, ON K0C 1G0
Telephone: 613-984-2821
Fax: 613-984-2908

Report Prepared by
Kostuch Engineering Limited
Suite 214, 1725 St. Laurent Blvd.
Ottawa, ON K1G 3V4
Telephone: 613-521-7341
Fax: 613-521-0078

TABLE OF CONTENTS

1. DESCRIPTION OF SUPPLY/TREATMENT/STORAGE WORKS

1.1 General

The Village of Crysler water system is owned by the Township of North Stormont, and is operated by the Ontario Clean Water Agency under contract to the Township of North Stormont. The supply and treatment works are located on the south side of County Road 13, approximately 5 km east of the Village. An elevated water storage tank is located on the north side of County Road 13, just east of the Village limit. The Village of Crysler is located at the intersection of County Roads 12 and 13.

The water system draws water from a single production well located in Lot 20, Concession 9, formerly in the Township of Finch, now in the Township of North Stormont. A fully piped standby well is located on the same property. Both wells are equipped with submersible pumps for delivering the water at system pressure to a feeder main leading to the Village. The pumping station contains chlorination and fluoridation facilities, and continuous analysing monitoring equipment for flow, chlorine residual, turbidity and fluoride. The turbidity monitor was installed recently in order to meet the requirements of the Ontario Drinking Water Regulation for daily sampling. Turbidity is monitored through a SCADA system, with the level being recorded on a daily basis. The system is rated for delivery of 19.5 L/s (1,685 cubic metres per day) at 85 metres total dynamic head.

The water system was designed by Kostuch Engineering Ltd. of Ottawa, Ontario, and went into service in 1996.

1.2 Design Parameters

The design parameters for the water system are as follows:

Design Population:	1500
Average Consumption:	450 litres/capita/day
Average Day Demand:	674 cubic metres per day
Maximum Day Factor:	2.5
Maximum Day Demand:	1,685 cubic metres per day
Peak Hour Factor:	3.75
Peak Hour Demand:	2,530 cubic metres per day (including fire flow allowance of 79 litres/second for 2 hours)

For 1999, the following values were recorded:

Average Day Demand:	175 cubic metres per day
Maximum Day Demand:	408 cubic metres per day

1.3 Summary of Equipment

In summary the supply/treatment/storage works consist of the following equipment and all other related piping, valves, instrumentation and equipment:

Process Water System

- a 12.2 m deep drilled production well, with 250 mm diameter casing, equipped with a submersible pump rated at 19.5 L/s at 85 m TDH

- a 13.4 m deep drilled standby well, with 250 mm diameter casing, equipped with a submersible pump rated at 19.5 L/s at 85 m TDH

- a chlorination system using sodium hypochlorite solution consisting of a storage tank of approximately 100 L capacity and two chemical metering pumps (one duty and one standby) each rated at 1.89 L/h, with a third spare pump rated at 6.94 L/h

- a hydrofluosilicic acid feed system consisting of a storage tank of approximately 100 L capacity, a weigh scale, and two chemical metering pumps (one duty and one standby), each rated at 0.9 L/h.

Wastewater

- water from pump to waste operations is discharged onto a splash pad outside of the pumping station
- wastewater from the floor drain and sink is collected in a holding tank

Instrumentation and Control

- HACH 1720D turbidimeter on the treated water outlet
- Wallace and Tiernan Depolox 3 chlorine residual and fluoride analyser at the treated water outlet (with high and low level alarms)
- flow meters on the treated water line
- pressure measurement on the treated water line
- water level sensors (pressure transducers) in the two wells
- water level sensors in the elevated storage tank

External Water Storage Facilities

- a steel storage tank mounted on a concrete pedestal, located on the north side of Concession Street East (County Road 13) approximately 600 m east of Queen Street, with a storage capacity of 1238 cubic metres above Elevation 106 metres

1.4 Chemical Feed Rates

Present chemical feed rates are as follows:

Sodium hypochlorite: Target dosage is 1.15 mg/L free chlorine entering the distribution system. Based on a maximum flow rate of 19.5 L/s, maximum daily consumption of 12% solution of sodium hypochlorite is 16 L. Present average consumption is approximately 2 L/day, with the storage tank providing greater than a 30 day supply.

Hydrofluosilicic acid: Target dosage is 0.6 mg/L (range of 0.5 to 0.8 mg/L) of fluoride entering the distribution system. Based on a maximum flow rate of 19.5 L/s, maximum daily consumption of a 25% solution of hydrofluosilicic acid is 4 L. Present average consumption is approximately 2 to 2.5 kg per week.

1.5 Disinfection System

The maximum flow through the treatment plant is 1,685 cubic metres per day. Contact time is provided in the distribution system piping prior to the first consumer connection.

Ontario Drinking Water Standards require water systems supplied by ground water to provide a minimum chlorine residual, measured as free chlorine, after 15 minutes contact time determined as T_{10} at maximum flow and before the first consumer of 0.2 mg/L.

The water pumping station is located approximately 1900 metres from the first consumer service connection. The feedermain is 200 mm diameter, and provides a velocity of 37 m/minute at the maximum flow of 19.5 L/s. Contact time before the first consumer connection is therefore approximately 51 minutes.

The required contact time of 15 minutes at a minimum free chlorine residual of 0.2 mg/L is exceeded by the Crysler water system as it is presently operated. Although the present dosage exceeds the minimum residual requirements, this dosage is necessary in order to maintain the required residual of 0.2 mg/L throughout the distribution system.

1.6 Process Schematic Flow Diagram

A process schematic flow diagram has been prepared based on the existing plant operation. This diagram is provided on the following page.

2. ASSESSMENT OF THE POTENTIAL FOR MICROBIOLOGICAL CONTAMINATION

As the present treatment system has been in operation for approximately five years there is a reasonable amount of relevant data available pertaining to the effectiveness of the treatment in terms of protection against microbiological hazards.

Records of microbiological testing carried out in the last two years revealed no evidence of adverse water quality in the treatment and distribution systems.

MOE inspection reports were provided from the following dates:
November 4, 1998
November 30, 2000

The 1998 report confirmed that the overall facility was being maintained and operated to the satisfaction of the Ministry. A recommendation was made for distribution system monitoring to include all remote points. All other recommendations reflected administrative practices.

The 2000 inspection report concluded that the Crysler system was maintained and operated in compliance with Ministry requirements. No recommendations were made.

2.1 Potential Pathways for Microbiological Contamination

The water source for Crysler is ground water. The production well is contained within the treatment plant, and are therefore is not subject to surface runoff. Site grading at the standby well location, and the extension of the well casing above ground also indicate that this well is not subject to surface runoff. The location of part of the recharge zone within an agricultural area introduces the possibility of an influence from agricultural operations on the groundwater quality. During the original pump testing program for the production well, fecal and total coliforms (2 per 100 mL) were detected in one of the samples. Weekly sample results from 2000 indicated that total coliform were absent from the raw water supply except on two occasions, with 3 and OG counts per 100 ml being recorded on these occasions.

The original hydrogeology report by Water and Earth Science Associates Ltd. describes the Crysler production well site aquifer system as being recharge dominated and therefore prone to groundwater degradation due to various pollutants from the surface. Flow rates in this type of system are slow, and a considerable time lag exists between the time a contaminant would enter the ground and the time it would impact on the well. Most of the activities which are associated with water supply contamination (farming practices) are located on the flanks of the esker deposit and therefore the aquifer is isolated by the impermeable clay materials. At the time of plant

inspection, a manure pile was noted within 300 m of the well site, with surface drainage directed away from the well site. The hydrogeology report notes a concern that any discharge from these properties to the ponded waters in the adjacent sand pit may potentially impact the production well water supply.
Proposals for development of a Wellhead Protection Plan have previously been provided to the Township, and a suggested protected area has been proposed. It is recommended that the Township consider the establishment of such a plan, including ongoing groundwater monitoring, to minimize the potential for groundwater contamination, and maximize the potential for detecting any problems before the water supply is impacted.

There exists a theoretical potential for microbiological contamination of the source water in common with any ground water source. Complete source water protection cannot be fully secured, and therefore there will always be some potential for contaminants existing in the raw water supply. The history of operation of the Crysler water treatment plant indicates that the available treatment has been adequate to date for achieving microbiological water quality which meets Ontario Drinking Water Standards. The use of continuous monitoring for chlorine residual and daily monitoring of turbidity, and regular bacteriological testing also help to ensure that any gross contamination of the water supply would be detected.

3. CHARACTERIZATION OF RAW WATER SUPPLY

3.1 Characterization and Required Level of Treatment

Under Ontario Regulation 459/00 (Drinking Water Protection Regulation or DWPR), the minimum level of treatment required for a groundwater source is disinfection. The treatment works installed in Crysler meet this minimum requirement.

The primary source of information used in completing this section was the sampling results which were provided by the operations staff.

This report was initially completed with a characterization of the source supply based on available testing data and earlier reports, most notably test results which were undertaken at the time of well construction in 1993. The revisions to the Terms of Reference for the Engineers' Reports for Water Works which were announced by the Ministry of the Environment letter dated March 2, 2001 required a more specific characterization of the water source for which additional analytical data was required. The results of this additional analysis were received in late May 2001, and have been used in this revision of the report.

The four tables of the Ontario Drinking Water Standards are provided below. A date of "March 2001" or "2001" has been indicated beside parameters that were tested in the spring of 2001.

Table 1 - Chemical/Physical Standards and Objectives (mg//L)

PARAMETER	MAC	IMAC	AO	RAW VALUE
Alachlor (March 2001)		0.005		<0.0005
Aldicarb (March 2001)	0.009			<0.005
Aldrin + Dieldrin (March 2001)	0.0007			<0.0005
Arsenic		0.025		Not detected
Atrazine+N-dealkylated metabolites (March 2001)		0.005		<0.001
Azinphos-methyl (March 2001)	0.02			<0.006
Barium	1.0			0.12
Bendiocarb (March 2001)	0.04			<0.002
Benzene (March 2001)	0.005			<0.0005
Benzo(a)pyrene (March 2001)	0.00001			<0.00001
Boron		5.0		Not detected
Bromoxynil (March 2001)		0.005		<0.001
Cadmium	0.005			Not detected
Carbaryl (March 2001)	0.09			<0.005
Carbofuran (March 2001)	0.09			<0.005
Carbon Tetrachloride (March 2001)	0.005			<0.0005
Chloramines	3.0			Not applicable
Chlordane (Total) (March 2001)	0.007			<0.0005
Chlorpyrifos (March 2001)	0.09			<0.001
Chromium	0.05			0.05
Cyanazine (March 2001)		0.01		<0.002
Cyanide	0.2			<0.01
Diazinon (March 2001)	0.02			<0.001
Dicamba (March 2001)	0.12			<0.001
1,2-Dichlorobenzene (March 2001)	0.2		0.003	<0.0004
1,4-Dichlorobenzene (March 2001)	0.005		0.001	<0.0004
Dichlorodiphenyltrichloroethane(DDT)+metabolites	0.03			<0.01 (2001)
1,2-dichloroethane (March 2001)		0.005		<0.0005

1,1-Dichloroethylene (vinylidene chloride) (March 2001)	0.014			<0.0006
Dichloromethane	0.05			Not detected

PARAMETER (TABLE 1 CONTINUED)	**MAC**	**IMAC**	**AO**	**RAW VALUE**
2-4-Dichlorophenol (March 2001)	0.9		0.0003	<0.0005
2,4-Dichlorophenoxy acetic acid (2,4-D) (March 2001)		0.1		<0.001
Diclofop-methyl (March 2001)	0.009			<0.001
Dimethoate (March 2001)		0.02		<0.005
Dinoseb (March 2001)	0.01			<0.001
Dioxin and Furan		0.0000000		Not detected
Diquat (March 2001)	0.07			<0.02
Diuron (March 2001)	0.15			<0.005
Fluoride	1.5			0.06
Glyphosate (March 2001)		0.28		<0.01
Heptachlor + Heptachlor Epoxide (March 2001)	0.003			<0.0011
Lead	0.01			Not detected
Lindane (Total) (March 2001)	0.004			<0.001
Malathion (March 2001)	0.19			<0.005
Mercury	0.001			Not detected
Methoxychlor (March 2001)	0.9			<0.001
Metolachlor (March 2001)		0.05		<0.0005
Metribuzin (March 2001)	0.08			<0.005
Monochlorobenzene	0.08		0.03	Not detected
Nitrate (as nitrogen)	10.0			0.45
Nitrite (as nitrogen)	1.0			Not detected
Nitrate + Nitrite (as nitrogen)	10.0			0.45
Nitrilotriacetic Acid (NTA)	0.4			Not detected
Nitrosodimethylamine (NDMA)		0.000009		Not detected
Paraquat (March 2001)		0.01		<0.008
Parathion (March 2001)	0.05			<0.001
Pentachlorophenol (March 2001)	0.06		0.03	<0.0005

Phorate (March 2001)		0.002		<0.001
Picloram (March 2001)		0.19		<0.005
Polychlorinated Biphenyls (PCB) (March 2001)		0.003		<0.002

PARAMETER (TABLE 1 CONTINUED)	**MAC**	**IMAC**	**AO**	**RAW VALUE**
Prometryne (March 2001)		0.001		<0.0007
Selenium	0.01			Not detected
Simazine (March 2001)		0.01		<0.002
Temephos (March 2001)		0.28		<0.2
Terbufos (March 2001)		0.001		<0.0007
Tetrachloroethylene (perchloroethylene) (March 2001)	0.030			<0.0005
2,3,4,6-Tetrachlorophenol (March 2001)	0.10		0.001	<0.0005
Triallate (March 2001)	0.23			<0.001
Trichloroethylene (March 2001)	0.05			<0.0004
2,4.6-Trichlorophenol (March 2001)	0.005		0.002	<0.0005
2,4,5-Trichlorophenoxy acetic acid (2,4,5-T) (Mar. 2001)	0.28		0.02	<0.001
Trifluralin (March 2001)		0.045		<0.001
Trihalomethanes (March 2001)	0.100			0.007
Turbidity	1.0		5.0	0.2
Uranium	0.10			Not detected
Vinyl Chloride (March 2001)	0.002			<0.0005

Table 2 - Microbiological Standards - Health Related

PARAMETER	**MAC (per 100 ml.) TREATED**	**RAW VALUE (per 100 ml)**
Total Coliform	0 (Refer to Standards)	Absent (March 2001)
Escherichia coli (EC) and/or Fecal Coliform (FC)	0 (Refer to Standards)	Absent (March 2001)
General Bacterial Population	500 (Refer to Standards)	Absent (HPC) (March 2001)

Table 3 - Radionuclide Standards - Health Related (Abbreviated List)

PARAMETER	**(Bq/L) (Raw Water)**
Cesium 137	Not detected (MAC = 10)
Iodine 131	Not detected (MAC = 6)
Strontium 90	Not detected (MAC = 5)

Tritium (March 2001)	<1000 (MAC = 7000)
Radium - 226	Not detected (MAC = 0.6)
Gross Alpha (March 2001)	<0.1
Gross Beta (March 2001)	<0.1

MAC - Maximum Acceptable Concentration NTU - Nephelometric Turbidity Unit IMAC - Interim Maximum Acceptable Concentration mg/L - milligrams per litre AO - Aesthetic Objective Value - Value for this water source

Table 4 - Chemical/Physical Objectives (mg/L) - Not Health Related

PARAMETER	OBJECTIVE (TREATED)	OBJECTIVE TYPE	RAW VALUE
Alkalinity (as CaCO3)	30 - 500	OG	139
Aluminum	0.10	OG	Not detected
Chloride	250	AO	6
Colour	5 TCU	AO	Not detected
Copper	1.0	AO	Not detected
Dissolved Organic Carbon	5.0	AO	0.4
Ethylbenzene (March 2001)	0.0024	AO	<0.0005
Hardness (as CaCO3)	80 - 100	OG	167
Iron	0.30	AO	0.04
Manganese	0.05	AO	Not detected
Methane	3 L/m3	AO	2.3
Odour	Inoffensive	AO	Inoffensive
Organic Nitrogen	0.15	OG	0.07
pH	6.5 - 8.5 (no units)	OG	7.9
Sodium	200 (Notify MOH at 20)	AO	2
Sulphate	500	AO	34
Sulphide	0.05	AO	Not detected
Taste	Inoffensive	AO	Inoffensive
Temperature	15 deg. C	AO	7 to 8 deg. C
Toluene (March 2001)	0.024	AO	<0.0005
Total Dissolved Solids	500	AO	200
Xylenes (March 2001)	0.30	AO	<0.0015
Zinc	5.0	AO	Not detected

AO - Aesthetic Objective OG - Operational Guideline TCU - True Colour Units

3.2 Microbiological Quality

The raw water supply for the Crysler plant is a ground water source, and therefore the presence of bacteria and other microbiological contaminants is expected to be lower than of a surface water source. For Crysler, raw water sampling generally reveals an absence of bacteria. As concluded in Section 2, the existing treatment and disinfection process has proven appropriate to date for the level of microbiological quality encountered in the raw water.

3.3 Volatile Organics

Based on the sampling records for raw water, volatile organics are not of concern in the source water.

3.4 Inorganics

All previous sampling for inorganic parameters indicated no reason for any concerns with the Crysler raw water.

3.5 Pesticides and PCBs

The 1993 and 2001 test results for pesticides and PCBs in the treated water indicated that the parameters tested are not of concern.

3.6 Radiological Parameters

Based on the sampling records for raw water undertaken in 1993 and 2001, radiological parameters are not of concern in the source water.

3.7 Disinfection By-Products

Total trihalomethanes (TTHM) are measured for the Crysler system on a quarterly basis. The Ontario Drinking Water Standard is 100 ug/l using a running average of quarterly samples measured at the maximum residence time in the distribution system. Based on the results observed, there is only a minor potential for disinfection by-product creation, with the levels observed (maximum of 11 ug/L) being consistently below the regulatory standard. Routine monitoring for TTHM will be necessary to ensure the required level of treatment is being provided.

3.8 Chromium

The level of chromium was detected at the MAC limit of 0.05 mg/L in the 1993 well testing program. Earlier testing of the standby well in 1986 indicated that this parameter was below 0.05 mg/L.

3.9 Hardness

The raw water sampling carried out in 1993 indicated hardness (as calcium carbonate) of 167 mg/L which exceeds the operational guideline of 80 to 100 mg/L. Quarterly sampling of treated water hardness indicates that this parameter is generally in the range of 200 to 230 mg/L. The Ontario Drinking Water Standards set an operational guideline value to aid in water source selection where a choice exists. Water supplies with hardness greater than 200 mg/L are considered poor but tolerable. Hardness in excess of 500 mg/L is considered unacceptable for most domestic purposes. Given the otherwise excellent raw water quality, and the lack of an alternative source, the hardness of the Crysler water supply was accepted.

4. ASSESSMENT OF OPERATIONAL PROCEDURES

4.1 Operations Manual

The Village of Crysler Water System has an Operations Manual which was completed in 1999. In addition, OCWA staff are in the process of developing and applying a "Standard Operating Procedure" for use in all of their operations, including Crysler.

Other resources available to operations staff include original drawings and maintenance manuals for the mechanical, electrical and process control systems.

It is recommended that the "Operating Manual" be modified to include specific requirements for operation, calibration and maintenance of equipment used for flow measurement and automated analysis of water samples (chlorine residual, fluoride and turbidity).

The flow measuring devices should continue to be calibrated at regular intervals not exceeding one year to ensure their accuracy to within plus or minus 5% of actual rate of flow within the range of 10% to 100% of the full scale reading. Water quality analysers shall be recalibrated as specified by the instrument manufacturer's instructions or at minimum intervals which ensure operation during at least 95% of plant operating time within the quality control band limits indicated below (using a control chart method as set out in Ministry publication "The Principle of Control Charting" 1984, or as in "Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998" or a more recently published edition):
- free chlorine residual at point of entry to distribution system (quality control band $\pm$0.1 mg/L)
- fluoride concentration in treated water at point of entry to the distribution system (quality control band $\pm$0.1 mg/L)

- turbidity (quality control band $\pm$0.1 NTU).

4.2 General Operational Procedures

General operational procedures were reviewed. The plant is visited on a regular basis, and an operations log is completed. Critical operational parameters are monitored by the SCADA system, and supplemented by manual water quality testing. A monitoring program is carried out consistent with the requirements of the existing Certificate of Approval. Modifications to this program will be needed as required by the current Ontario Drinking Water Standards and Regulation 459/00.

The plant is operated by the Ontario Clean Water Agency, operating out of their Chesterville Hub. Alarms are in place to allow the operators to respond to potentially adverse conditions, with levels set so that time is available to respond prior to treated water of adverse quality entering the distribution system. In particular, a low chlorine residual alarm will result in lock out of the high lift pumps. The fluoride chemical pumps lock out on high fluoride level.

Operational routines are well developed, and the plant was observed to be well organized and in good operating condition.

5. ASSESSMENT OF PHYSICAL WORKS

5.1 Ability to Comply with Chlorination Procedure

The Ministry of the Environment's Procedure B13-3 "Chlorination of Potable Water Supplies in Ontario" outlines chlorination requirements for water works. The current Crysler treatment system is capable of meeting all of the requirements for ground water supplies as follows:

- capable of maintaining a minimum chlorine residual, measured as free chlorine, after 15 minutes contact time determined as T_{10} at maximum flow and before the first consumer of 0.2 mg/L in all disinfected water entering the distribution system,

- maintains a maximum chlorine residual, measured as free chlorine, of less than 4 mg/L at all times, at any location in the water distribution system,

- capable of providing a minimum free chlorine residual in the water distribution system of 0.2 mg/L, and

- provides operators and equipment for monitoring of chlorine residuals according to the Certificate of Approval requirements.

5.2 Blow-Out Disc on Elevated Water Tank

The present design of the blow-out disc on the elevated water storage tank would allow for the potential entry of foreign material into the tank in the event that the disc was activated. A proposal for an alternative vent/vacuum release has been provided by the tank manufacturer. It is recommended that the Township consider the risks associated with continued use of the present disc, and then determine if replacement is required.

5.3 Deviations from 10 State Standards

The Crysler water treatment plant was reviewed against the "Recommended Standards for Water Works", 1997, published by the Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. The following deviations are noted:

1. Sections 2.4 and 3.2.1.3 of the Standards requires dedicated standby power to permit delivery of average flow to the distribution system. The Crysler system does not provide standby power, but the elevated storage tank provides approximately two days of storage for average design flows. Portable electric generators have been used in the past when extended power outages have been encountered.

2. Section 2.10 requires that taps used for obtaining samples for bacteriological analysis shall be of the smooth-nosed type without interior or exterior threads. Not all sample taps at the Crysler plant meet this requirement. Sampling protocols are used which minimize the possibility of bacterial buildup in pipe threads influencing sample results..

3. Section 3.2.3.3 recommends that a wellhead protection plan for continued protection of the wellhead from potential sources of contamination be provided as determined by the reviewing authority. Given that a potential for aquifer contamination does exist, the completion of a wellhead protection plan for Crysler is recommended.

4. Sections 4.7.2 (k) and 5.1.2 (b) require chemical pumps to be provided with nonstandard electrical receptacles. These are not provided in the Crysler plant for any of the chemical pumps.

5. Section 4.7.4 requires that deluge showers and eye wash devices be provided at all fluosilicic acid installations. The Crysler plant provides an eye wash only, which met the requirements of the Ministry of Labour at the time of plant design.

6. Section 5.1.10 requires chemical storage tanks (including day tanks) to have a valved drain. This is not provided in Crysler due to the small size of the sodium hypochlorite and fluosilicic acid tanks.

19. Section 5.1.11 requires day tanks to hold no more than a 30 hour supply. The small quantities used in Crysler are not suitable for such a day tank.

5.4 Compliance with ODWS and the Regulation

The review indicates that the works associated with the Crysler water plant are suitable to achieve compliance with the Ontario Drinking Water Standards and Ontario Regulation 459/00.

6. MONITORING PROGRAM

In order to comply with the ODWS and the Regulation, a required monitoring program for the Crysler water treatment system has been developed, and is outlined below in the format shown in the Ministry document PIBS 4060e "Model Conditions for Certificates of Approval - Ground Water Supply With Treatment - August 2000".

Condition 2.1

The Owner shall ensure that the following monitoring program is carried out upon commencement of operation of the works:

(a) A sufficient number of flow measuring devices, calibrated at regular intervals not exceeding one year to ensure their accuracy to within plus or minus 5% of actual rate of flow within the range of 10% to 100% of the full scale reading of the measuring devices, shall be installed, maintained and operated in order to measure:

(i) the flow rate of water being conveyed to and through the water treatment plant (raw water), and

(ii) the daily quantity of treated water supplied to the distribution system.

(b) The time and duration of each event of flow rate in excess of that specified in Condition 1.4 shall be recorded along with the reasons for the occurrence.

(c) Continuous water quality analysers and indicators with alarm systems, recalibrated as specified by the instrument manufacturer's instructions or at minimum intervals which ensure operation during at least 95% of plant operating time within the quality control band limits indicated below (using a control chart method as set out in Ministry publication "The Principle of Control Charting: 1984, or as in "Standard Methods for the Examination of Water and Wastewater" 20th Edition, 1998, or a more recently published edition), shall be installed, maintained and operated to monitor the following parameters at the indicated locations:

(i) free or total chlorine residual in treated water at the point(s) of entrance to the distribution system (quality control band: $\pm$ 0.1 mg/L),

(ii) fluoride concentration in treated water at the point(s) of entrance to the distribution system (quality control band: ± 0.1 mg/L).

(d) In accordance with Regulation 459/00, Drinking Water Protection, samples of raw water and treated water shall be collected and analysed for at least the following parameters at the indicated locations and frequencies:

RAW WATER

(separate water samples taken at discharge point from each groundwater well at a location before any treatment chemical is added to the water)

Weekly

Total Coliform
Escherichia coli and/or Fecal Coliform
Heterotrophic Plate Count

TREATED WATER

(samples taken at the point of treated water entry to the distribution system unless specified otherwise)

Daily

Free Chlorine Residual
Continuous monitoring using equipment in accordance with Condition 2.1

Turbidity
One (1) grab sample per day (turbidity is monitored at the continuous analyser using the SCADA system, with level recorded on a daily basis)

Fluoride
Continuous monitoring using equipment in accordance with Condition 2.1.

Weekly

Total Coliform
Escherichia coli and/or Fecal Coliform
Heterotrophic Plate Count

Quarterly

Nitrate as Nitrogen
Nitrite as Nitrogen

Volatile Organics

Benzene	1,1-Dichloroethylene	Toluene
Carbon Tetrachloride	Dichloromethane	Trihalomethanes

1,2-Dichlorobenzene	Ethylbenzene	Trichloroethylene
1,4-Dichlorobenzene	Monochlorobenzene	Vinyl chloride
1,2-Dichloroethane	Tetrachloroethylene	Xylene

Pesticides and PCB

Alachlor	DDT	Parathion
Aldicarb	2,4-D	Pentachlorophenol
Aldrin+Dieldrin	Diclofop-methyl	Phorate
Atrazine	Dimethoate	Picloram
Azinphos-methyl	Dinoseb	PCB
Bendiocarb	Diquat	Prometryne
Bromoxynil	Diuron	Simazine
Carbaryl	Glyphosate	Temephos
Carbofuran	Heptachlor+Heptachlor epoxide	Terbufos
Chlordane (Total)	Lindane (Total)	2,3,4,6-Tetrachlorophenol
Chlorpyrifos	Malathion	Triallate
Cyanazine	Methoxychlor	2,4.6-Trichlorophenol
Diazinon	Metolachlor	Trifluralin
Dicamba	Metribuzin	2,4,5-T
2,4-Dichlorophenol	Paraquat	

Every three years

Inorganics

Arsenic	Iron	Selenium
Barium	Lead	Uranium
Boron	Manganese	Sodium - every five years
Cadmium	Mercury	Fluoride - every five years
Chromium	Nitrite	
Copper	Nitrate	

DISTRIBUTION SYSTEM

(samples taken at locations remote from the point of treated water entry to the distribution system)

Weekly

Total Coliform
Escherichia coli and/or Fecal Coliform
Heterotrophic Plate Count
Free Chlorine Residual

The minimum number of bacteriological and chlorine residual samples to be collected from different locations within the distribution system shall be eight (8) samples taken

monthly with at least one such sample taken every week, and two (2) samples analysed for either heterotrophic plate count or background colonies on a total coliform membrane filter analysis. The bacteriological and chlorine residuals samples shall be collected together from the same locations.

Quarterly

Trihalomethanes (at a point reflecting the maximum residence time in the distribution system)

Annually

Lead (at a point reflecting the maximum residence time in the distribution system)

(e) Notwithstanding clause (c), samples of raw water and treated water should be collected and analysed for the following parameters at the indicated locations and frequencies:

RAW WATER

(samples taken at a location before any treatment chemical is added to the water taken from the raw water source)

Quarterly

pH	Hardness	Methane
Ammonia + Ammonium (N)	Total Kjeldahl Nitrogen	Colour
Nitrate as Nitrogen	Nitrite as Nitrogen	Iron
Manganese	Chloride	Conductivity
Calcium	Magnesium	Sulphate
Dissolved Organic Carbon	Chromium	

TREATED WATER

(samples taken at the point of treated water entry to the distribution system)

Quarterly

pH Hardness

(f) The sampling required by clauses (d) and (e)above shall be performed in accordance with the "Guide to the Collection and Submission of Samples for Laboratory Analysis", Ministry of the Environment, 1993, or as described in Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, or a more recently published edition.

Condition 2.2

If the Owner monitors any of the parameters required by Condition 2.1, at designated locations and in accordance with Condition 2.1, more frequently than is required by that condition, the analytical results of all such samples, both required and additional, shall be included in reporting of the values required by this certificate, and the increased frequency, or all dates of sampling, shall also be specified in the reports.

Condition 2.3

The Owner shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the monitoring activities required by this certificate.

7. SUMMARY OF EXISTING CERTIFICATES OF APPROVAL AND PERMIT TO TAKE WATER

The Certificates of Approval issued for the Village of Crysler water supply and treatment works are summarized as follows:

December 22, 1992	Certificate No. 7-0224-91-926 Approval to construct a communal water system for Crysler.
November 9, 1993	Certificate No. 7-0224-91-926 Amendment to construct a feedermain.
November 29, 1993	Certificate No. 7-0224-91-926 Amendment to construct an elevated storage tank.
August 9, 1994	Certificate No. 7-0224-91-926 Amendment to construct watermains.
May 30, 1995	Certificate No. 7-0224-91-926 Amendment to construct treatment and pumping station.
October 1, 1998	Certificate No. 7-1162-95-006 Amendment to chlorination system description.
June 1, 1999	Certificate No. 7-1162-95-006 Further amendment to chlorination system description.

Copies of these certificates are included in the Appendix to this report.

The current Permit to Take Water is numbered 93-P-4006, with renewal date of February 28, 2003, and a permitted amount of taking of 1684.8 cubic metres per day. A copy of this permit is also provided in the Appendix.

8. OWNER INFORMATION

Client Information

Client Name: Corporation of the Township of North Stormont

Client Type: Municipal Government

Client Physical Address:

Civic Address: P.O. Box 99, 2 Victoria Street
Tel: 613-984-2821 Fax: 613-984-2908

Municipality: Township of North Stormont

Client Mailing Address:

Mailing Address: As above.

Site Information:

Site Name: Crysler Water Treatment Plant

MOE District Office: Cornwall

Legal Description: N. pt. lot 20, Con. 9, Parts 1, 2 &3 of RP52R-3079
Township of North Stormont, United Counties of Stormont, Dundas & Glengarry

Civic Address: 15642 County Road 13, Crysler, ON K0A 1R0

Geo Reference: Map Datum: UTM NAD27 Zone: 18 Accuracy: 100 m ±
Geo Referencing Method: Estimation from OBM

Location	UTM Easting	UTM Northing
Treatment and Production Well	492500 mE	5008790 mN
Standby Well	492519 mE	5008770 mN
Elevated Storage	488665 mE	5007050 mN

Municipality: Township of North Stormont

Adjacent Land Use: Agriculture and Sand/Gravel Pit

Site is not located in area of development control as defined by the Niagara Escarpment Planning and Development Act.

The Operating Authority is the Ontario Clean Water Agency - Chesterville Hub, 5 Industrial Drive, Chesterville, ON, K0C 1H0, Telephone: 613-448-3098, Fax: 613-448-1616.

Client is the owner of the land.

Water Source Site Information

The raw water source is groundwater.

Project Technical Information Contact

Name: James C. Johnston

Company: Kostuch Engineering Limited

Contact Address: Suite 214, 1725 St. Laurent Blvd., Ottawa, Ont. K1G 3V4
Tel: 613-521-7341 Fax: 613-521-0078 E-mail: kostuch@travel-net.com

Public Consultation/Notification

The municipality, as owner, has knowledge of the plant, and full access to records.

9. RECOMMENDATIONS

The following recommendations arise from the investigation carried out to complete this report:

1. The Operating Manual should be amended to include specific requirements for operation, calibration and maintenance of equipment used for flow measurement and automated analysis of water samples.

   The flow measuring devices should be calibrated at regular intervals not exceeding one year to ensure their accuracy to within plus or minus 5% of actual rate of flow within the range of 10% to 100% of the full scale reading. Water quality analysers shall be recalibrated as specified by the instrument manufacturer's instructions or at minimum intervals which ensure operation during at least 95% of plant operating time within the quality control band limits indicated below (using a control chart method as set out in Ministry publication "The Principle of Control Charting" 1984, or as in "Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998" or a more recently published edition):
   - free chlorine at point of entry to distribution system (quality control band $\pm$0.1 mg/L)
   - turbidity (quality control band $\pm$0.1 NTU)
   - fluoride at point of entry to distribution system (quality control band $\pm$0.1 mg/L).

   The Operating Manual should also be updated to include current Certificates of Approval.

2. The Owner should ensure that monitoring of the water quality is carried out in accordance with the monitoring program required by the Ministry of the Environment as may be amended following Ministry review of this report..

3. The Owner should consider developing a well head protection program to monitor aquifer conditions and guide future land use planning considerations within the area of recharge of the well.

4. At the time of any future upgrading of the plant, the Owner should consider upgrades to eliminate the deviations noted from the Ten State Standards. It should be noted that none of the present deviations result in inadequate disinfection or treatment.

5. The Township should consider the risks associated with use of the present blowout disc on the elevated water storage tank, and determine if replacement is required.

In the completion of this report and the above recommendations, Kostuch Engineering Limited necessarily relied on information provided by the Owner and Operator of the Crysler Water System, and is therefore not responsible for any errors or omissions that may be present as a result of erroneous information provided by others.

10. DECLARATION OF ENGINEER

Declaration of Engineer

We, as represented by the undersigned, hereby declare that to the best of our knowledge, the information contained herein and the information in support of this submission is complete and accurate in accordance with our obligations under the Professional Engineers Act (RSO 1990) and its regulations.

We further declare that this submission has been prepared in reasonable accordance with the published terms of reference for this submission, despite any qualifications in the agreement retaining us, and acknowledge that the Director and Owner will be relying upon the accuracy of the report.

Name: James C. Johnston, P.Eng., for Kostuch Engineering Limited

Signature:

Date: May 29, 2001

APPENDIX A

CERTIFICATES OF APPROVAL AND PERMIT TO TAKE WATER

CORPORATION OF THE TOWNSHIP OF NORTH STORMONT

VILLAGE OF CRYSLER WATER SYSTEM

ENGINEERS' REPORT FOR WATER WORKS

MARCH, 2001
(Revised May 29, 2001)

Township of North Stormont
P.O. Box 99
2 Victoria Street
Berwick, ON K0C 1G0
Telephone: 613-984-2821
Fax: 613-984-2908

Report Prepared by
Kostuch Engineering Limited
Suite 214, 1725 St. Laurent Blvd.
Ottawa, ON K1G 3V4
Telephone: 613-521-7341
Fax: 613-521-0078

TABLE OF CONTENTS

1. DESCRIPTION OF SUPPLY/TREATMENT/STORAGE WORKS

1.1 General

The Village of Crysler water system is owned by the Township of North Stormont, and is operated by the Ontario Clean Water Agency under contract to the Township of North Stormont. The supply and treatment works are located on the south side of County Road 13, approximately 5 km east of the Village. An elevated water storage tank is located on the north side of County Road 13, just east of the Village limit. The Village of Crysler is located at the intersection of County Roads 12 and 13.

The water system draws water from a single production well located in Lot 20, Concession 9, formerly in the Township of Finch, now in the Township of North Stormont. A fully piped standby well is located on the same property. Both wells are equipped with submersible pumps for delivering the water at system pressure to a feeder main leading to the Village. The pumping station contains chlorination and fluoridation facilities, and continuous analysing monitoring equipment for flow, chlorine residual, turbidity and fluoride. The turbidity monitor was installed recently in order to meet the requirements of the Ontario Drinking Water Regulation for daily sampling. Turbidity is monitored through a SCADA system, with the level being recorded on a daily basis. The system is rated for delivery of 19.5 L/s (1,685 cubic metres per day) at 85 metres total dynamic head.

The water system was designed by Kostuch Engineering Ltd. of Ottawa, Ontario, and went into service in 1996.

1.2 Design Parameters

The design parameters for the water system are as follows:

Design Population:	1500
Average Consumption:	450 litres/capita/day
Average Day Demand:	674 cubic metres per day
Maximum Day Factor:	2.5
Maximum Day Demand:	1,685 cubic metres per day
Peak Hour Factor:	3.75
Peak Hour Demand:	2,530 cubic metres per day (including fire flow allowance of 79 litres/second for 2 hours)

For 1999, the following values were recorded:

Average Day Demand:	175 cubic metres per day
Maximum Day Demand:	408 cubic metres per day

1.3 Summary of Equipment

In summary the supply/treatment/storage works consist of the following equipment and all other related piping, valves, instrumentation and equipment:

Process Water System

- a 12.2 m deep drilled production well, with 250 mm diameter casing, equipped with a submersible pump rated at 19.5 L/s at 85 m TDH

- a 13.4 m deep drilled standby well, with 250 mm diameter casing, equipped with a submersible pump rated at 19.5 L/s at 85 m TDH

- a chlorination system using sodium hypochlorite solution consisting of a storage tank of approximately 100 L capacity and two chemical metering pumps (one duty and one standby) each rated at 1.89 L/h, with a third spare pump rated at 6.94 L/h

- a hydrofluosilicic acid feed system consisting of a storage tank of approximately 100 L capacity, a weigh scale, and two chemical metering pumps (one duty and one standby), each rated at 0.9 L/h.

Wastewater

- water from pump to waste operations is discharged onto a splash pad outside of the pumping station
- wastewater from the floor drain and sink is collected in a holding tank

Instrumentation and Control

- HACH 1720D turbidimeter on the treated water outlet
- Wallace and Tiernan Depolox 3 chlorine residual and fluoride analyser at the treated water outlet (with high and low level alarms)
- flow meters on the treated water line
- pressure measurement on the treated water line
- water level sensors (pressure transducers) in the two wells
- water level sensors in the elevated storage tank

External Water Storage Facilities

- a steel storage tank mounted on a concrete pedestal, located on the north side of Concession Street East (County Road 13) approximately 600 m east of Queen Street, with a storage capacity of 1238 cubic metres above Elevation 106 metres

1.4 Chemical Feed Rates

Present chemical feed rates are as follows:

Sodium hypochlorite: Target dosage is 1.15 mg/L free chlorine entering the distribution system. Based on a maximum flow rate of 19.5 L/s, maximum daily consumption of 12% solution of sodium hypochlorite is 16 L. Present average consumption is approximately 2 L/day, with the storage tank providing greater than a 30 day supply.

Hydrofluosilicic acid: Target dosage is 0.6 mg/L (range of 0.5 to 0.8 mg/L) of fluoride entering the distribution system. Based on a maximum flow rate of 19.5 L/s, maximum daily consumption of a 25% solution of hydrofluosilicic acid is 4 L. Present average consumption is approximately 2 to 2.5 kg per week.

1.5 Disinfection System

The maximum flow through the treatment plant is 1,685 cubic metres per day. Contact time is provided in the distribution system piping prior to the first consumer connection.

Ontario Drinking Water Standards require water systems supplied by ground water to provide a minimum chlorine residual, measured as free chlorine, after 15 minutes contact time determined as T_{10} at maximum flow and before the first consumer of 0.2 mg/L.

The water pumping station is located approximately 1900 metres from the first consumer service connection. The feedermain is 200 mm diameter, and provides a velocity of 37 m/minute at the maximum flow of 19.5 L/s. Contact time before the first consumer connection is therefore approximately 51 minutes.

The required contact time of 15 minutes at a minimum free chlorine residual of 0.2 mg/L is exceeded by the Crysler water system as it is presently operated. Although the present dosage exceeds the minimum residual requirements, this dosage is necessary in order to maintain the required residual of 0.2 mg/L throughout the distribution system.

1.6 Process Schematic Flow Diagram

A process schematic flow diagram has been prepared based on the existing plant operation. This diagram is provided on the following page.

2. ASSESSMENT OF THE POTENTIAL FOR MICROBIOLOGICAL CONTAMINATION

As the present treatment system has been in operation for approximately five years there is a reasonable amount of relevant data available pertaining to the effectiveness of the treatment in terms of protection against microbiological hazards.

Records of microbiological testing carried out in the last two years revealed no evidence of adverse water quality in the treatment and distribution systems.

MOE inspection reports were provided from the following dates:
November 4, 1998
November 30, 2000

The 1998 report confirmed that the overall facility was being maintained and operated to the satisfaction of the Ministry. A recommendation was made for distribution system monitoring to include all remote points. All other recommendations reflected administrative practices.

The 2000 inspection report concluded that the Crysler system was maintained and operated in compliance with Ministry requirements. No recommendations were made.

2.1 Potential Pathways for Microbiological Contamination

The water source for Crysler is ground water. The production well is contained within the treatment plant, and are therefore is not subject to surface runoff. Site grading at the standby well location, and the extension of the well casing above ground also indicate that this well is not subject to surface runoff. The location of part of the recharge zone within an agricultural area introduces the possibility of an influence from agricultural operations on the groundwater quality. During the original pump testing program for the production well, fecal and total coliforms (2 per 100 mL) were detected in one of the samples. Weekly sample results from 2000 indicated that total coliform were absent from the raw water supply except on two occasions, with 3 and OG counts per 100 ml being recorded on these occasions.

The original hydrogeology report by Water and Earth Science Associates Ltd. describes the Crysler production well site aquifer system as being recharge dominated and therefore prone to groundwater degradation due to various pollutants from the surface. Flow rates in this type of system are slow, and a considerable time lag exists between the time a contaminant would enter the ground and the time it would impact on the well. Most of the activities which are associated with water supply contamination (farming practices) are located on the flanks of the esker deposit and therefore the aquifer is isolated by the impermeable clay materials. At the time of plant

inspection, a manure pile was noted within 300 m of the well site, with surface drainage directed away from the well site. The hydrogeology report notes a concern that any discharge from these properties to the ponded waters in the adjacent sand pit may potentially impact the production well water supply.
Proposals for development of a Wellhead Protection Plan have previously been provided to the Township, and a suggested protected area has been proposed. It is recommended that the Township consider the establishment of such a plan, including ongoing groundwater monitoring, to minimize the potential for groundwater contamination, and maximize the potential for detecting any problems before the water supply is impacted.

There exists a theoretical potential for microbiological contamination of the source water in common with any ground water source. Complete source water protection cannot be fully secured, and therefore there will always be some potential for contaminants existing in the raw water supply. The history of operation of the Crysler water treatment plant indicates that the available treatment has been adequate to date for achieving microbiological water quality which meets Ontario Drinking Water Standards. The use of continuous monitoring for chlorine residual and daily monitoring of turbidity, and regular bacteriological testing also help to ensure that any gross contamination of the water supply would be detected.

3. CHARACTERIZATION OF RAW WATER SUPPLY

3.1 Characterization and Required Level of Treatment

Under Ontario Regulation 459/00 (Drinking Water Protection Regulation or DWPR), the minimum level of treatment required for a groundwater source is disinfection. The treatment works installed in Crysler meet this minimum requirement.

The primary source of information used in completing this section was the sampling results which were provided by the operations staff.

This report was initially completed with a characterization of the source supply based on available testing data and earlier reports, most notably test results which were undertaken at the time of well construction in 1993. The revisions to the Terms of Reference for the Engineers' Reports for Water Works which were announced by the Ministry of the Environment letter dated March 2, 2001 required a more specific characterization of the water source for which additional analytical data was required. The results of this additional analysis were received in late May 2001, and have been used in this revision of the report.

The four tables of the Ontario Drinking Water Standards are provided below. A date of "March 2001" or "2001" has been indicated beside parameters that were tested in the spring of 2001.

Table 1 - Chemical/Physical Standards and Objectives (mg//L)

PARAMETER	MAC	IMAC	AO	RAW VALUE
Alachlor (March 2001)		0.005		<0.0005
Aldicarb (March 2001)	0.009			<0.005
Aldrin + Dieldrin (March 2001)	0.0007			<0.0005
Arsenic		0.025		Not detected
Atrazine+N-dealkylated metabolites (March 2001)		0.005		<0.001
Azinphos-methyl (March 2001)	0.02			<0.006
Barium	1.0			0.12
Bendiocarb (March 2001)	0.04			<0.002
Benzene (March 2001)	0.005			<0.0005
Benzo(a)pyrene (March 2001)	0.00001			<0.00001
Boron		5.0		Not detected
Bromoxynil (March 2001)		0.005		<0.001
Cadmium	0.005			Not detected
Carbaryl (March 2001)	0.09			<0.005
Carbofuran (March 2001)	0.09			<0.005
Carbon Tetrachloride (March 2001)	0.005			<0.0005
Chloramines	3.0			Not applicable
Chlordane (Total) (March 2001)	0.007			<0.0005
Chlorpyrifos (March 2001)	0.09			<0.001
Chromium	0.05			0.05
Cyanazine (March 2001)		0.01		<0.002
Cyanide	0.2			<0.01
Diazinon (March 2001)	0.02			<0.001
Dicamba (March 2001)	0.12			<0.001
1,2-Dichlorobenzene (March 2001)	0.2		0.003	<0.0004
1,4-Dichlorobenzene (March 2001)	0.005		0.001	<0.0004
Dichlorodiphenyltrichloroethane(DDT)+metabolites	0.03			<0.01 (2001)
1,2-dichloroethane (March 2001)		0.005		<0.0005

1,1-Dichloroethylene (vinylidene chloride) (March 2001)	0.014			<0.0006
Dichloromethane	0.05			Not detected

PARAMETER (TABLE 1 CONTINUED)	MAC	IMAC	AO	RAW VALUE
2-4-Dichlorophenol (March 2001)	0.9		0.0003	<0.0005
2,4-Dichlorophenoxy acetic acid (2,4-D) (March 2001)		0.1		<0.001
Diclofop-methyl (March 2001)	0.009			<0.001
Dimethoate (March 2001)		0.02		<0.005
Dinoseb (March 2001)	0.01			<0.001
Dioxin and Furan		0.0000000		Not detected
Diquat (March 2001)	0.07			<0.02
Diuron (March 2001)	0.15			<0.005
Fluoride	1.5			0.06
Glyphosate (March 2001)		0.28		<0.01
Heptachlor + Heptachlor Epoxide (March 2001)	0.003			<0.0011
Lead	0.01			Not detected
Lindane (Total) (March 2001)	0.004			<0.001
Malathion (March 2001)	0.19			<0.005
Mercury	0.001			Not detected
Methoxychlor (March 2001)	0.9			<0.001
Metolachlor (March 2001)		0.05		<0.0005
Metribuzin (March 2001)	0.08			<0.005
Monochlorobenzene	0.08		0.03	Not detected
Nitrate (as nitrogen)	10.0			0.45
Nitrite (as nitrogen)	1.0			Not detected
Nitrate + Nitrite (as nitrogen)	10.0			0.45
Nitrilotriacetic Acid (NTA)	0.4			Not detected
Nitrosodimethylamine (NDMA)		0.000009		Not detected
Paraquat (March 2001)		0.01		<0.008
Parathion (March 2001)	0.05			<0.001
Pentachlorophenol (March 2001)	0.06		0.03	<0.0005

Phorate (March 2001)		0.002		<0.001
Picloram (March 2001)		0.19		<0.005
Polychlorinated Biphenyls (PCB) (March 2001)		0.003		<0.002

PARAMETER (TABLE 1 CONTINUED)	MAC	IMAC	AO	RAW VALUE
Prometryne (March 2001)		0.001		<0.0007
Selenium	0.01			Not detected
Simazine (March 2001)		0.01		<0.002
Temephos (March 2001)		0.28		<0.2
Terbufos (March 2001)		0.001		<0.0007
Tetrachloroethylene (perchloroethylene) (March 2001)	0.030			<0.0005
2,3,4,6-Tetrachlorophenol (March 2001)	0.10		0.001	<0.0005
Triallate (March 2001)	0.23			<0.001
Trichloroethylene (March 2001)	0.05			<0.0004
2,4.6-Trichlorophenol (March 2001)	0.005		0.002	<0.0005
2,4,5-Trichlorophenoxy acetic acid (2,4,5-T) (Mar. 2001)	0.28		0.02	<0.001
Trifluralin (March 2001)		0.045		<0.001
Trihalomethanes (March 2001)	0.100			0.007
Turbidity	1.0		5.0	0.2
Uranium	0.10			Not detected
Vinyl Chloride (March 2001)	0.002			<0.0005

Table 2 - Microbiological Standards - Health Related

PARAMETER	MAC (per 100 ml.) TREATED	RAW VALUE (per 100 ml)
Total Coliform	0 (Refer to Standards)	Absent (March 2001)
Escherichia coli (EC) and/or Fecal Coliform (FC)	0 (Refer to Standards)	Absent (March 2001)
General Bacterial Population	500 (Refer to Standards)	Absent (HPC) (March 2001)

Table 3 - Radionuclide Standards - Health Related (Abbreviated List)

PARAMETER	(Bq/L) (Raw Water)
Cesium 137	Not detected (MAC = 10)
Iodine 131	Not detected (MAC = 6)
Strontium 90	Not detected (MAC = 5)

Tritium (March 2001)	<1000 (MAC = 7000)
Radium - 226	Not detected (MAC = 0.6)
Gross Alpha (March 2001)	<0.1
Gross Beta (March 2001)	<0.1

MAC - Maximum Acceptable Concentration NTU - Nephelometric Turbidity Unit IMAC - Interim Maximum Acceptable Concentration mg/L - milligrams per litre AO - Aesthetic Objective Value - Value for this water source

Table 4 - Chemical/Physical Objectives (mg/L) - Not Health Related

PARAMETER	OBJECTIVE (TREATED)	OBJECTIVE TYPE	RAW VALUE
Alkalinity (as CaCO3)	30 - 500	OG	139
Aluminum	0.10	OG	Not detected
Chloride	250	AO	6
Colour	5 TCU	AO	Not detected
Copper	1.0	AO	Not detected
Dissolved Organic Carbon	5.0	AO	0.4
Ethylbenzene (March 2001)	0.0024	AO	<0.0005
Hardness (as CaCO3)	80 - 100	OG	167
Iron	0.30	AO	0.04
Manganese	0.05	AO	Not detected
Methane	3 L/m3	AO	2.3
Odour	Inoffensive	AO	Inoffensive
Organic Nitrogen	0.15	OG	0.07
pH	6.5 - 8.5 (no units)	OG	7.9
Sodium	200 (Notify MOH at 20)	AO	2
Sulphate	500	AO	34
Sulphide	0.05	AO	Not detected
Taste	Inoffensive	AO	Inoffensive
Temperature	15 deg. C	AO	7 to 8 deg. C
Toluene (March 2001)	0.024	AO	<0.0005
Total Dissolved Solids	500	AO	200
Xylenes (March 2001)	0.30	AO	<0.0015
Zinc	5.0	AO	Not detected

AO - Aesthetic Objective OG - Operational Guideline TCU - True Colour Units

3.2 Microbiological Quality

The raw water supply for the Crysler plant is a ground water source, and therefore the presence of bacteria and other microbiological contaminants is expected to be lower than of a surface water source. For Crysler, raw water sampling generally reveals an absence of bacteria. As concluded in Section 2, the existing treatment and disinfection process has proven appropriate to date for the level of microbiological quality encountered in the raw water.

3.3 Volatile Organics

Based on the sampling records for raw water, volatile organics are not of concern in the source water.

3.4 Inorganics

All previous sampling for inorganic parameters indicated no reason for any concerns with the Crysler raw water.

3.5 Pesticides and PCBs

The 1993 and 2001 test results for pesticides and PCBs in the treated water indicated that the parameters tested are not of concern.

3.6 Radiological Parameters

Based on the sampling records for raw water undertaken in 1993 and 2001, radiological parameters are not of concern in the source water.

3.7 Disinfection By-Products

Total trihalomethanes (TTHM) are measured for the Crysler system on a quarterly basis. The Ontario Drinking Water Standard is 100 ug/l using a running average of quarterly samples measured at the maximum residence time in the distribution system. Based on the results observed, there is only a minor potential for disinfection by-product creation, with the levels observed (maximum of 11 ug/L) being consistently below the regulatory standard. Routine monitoring for TTHM will be necessary to ensure the required level of treatment is being provided.

3.8 Chromium

The level of chromium was detected at the MAC limit of 0.05 mg/L in the 1993 well testing program. Earlier testing of the standby well in 1986 indicated that this parameter was below 0.05 mg/L.

3.9 Hardness

The raw water sampling carried out in 1993 indicated hardness (as calcium carbonate) of 167 mg/L which exceeds the operational guideline of 80 to 100 mg/L. Quarterly sampling of treated water hardness indicates that this parameter is generally in the range of 200 to 230 mg/L. The Ontario Drinking Water Standards set an operational guideline value to aid in water source selection where a choice exists. Water supplies with hardness greater than 200 mg/L are considered poor but tolerable. Hardness in excess of 500 mg/L is considered unacceptable for most domestic purposes. Given the otherwise excellent raw water quality, and the lack of an alternative source, the hardness of the Crysler water supply was accepted.

4. ASSESSMENT OF OPERATIONAL PROCEDURES

4.1 Operations Manual

The Village of Crysler Water System has an Operations Manual which was completed in 1999. In addition, OCWA staff are in the process of developing and applying a "Standard Operating Procedure" for use in all of their operations, including Crysler.

Other resources available to operations staff include original drawings and maintenance manuals for the mechanical, electrical and process control systems.

It is recommended that the "Operating Manual" be modified to include specific requirements for operation, calibration and maintenance of equipment used for flow measurement and automated analysis of water samples (chlorine residual, fluoride and turbidity).

The flow measuring devices should continue to be calibrated at regular intervals not exceeding one year to ensure their accuracy to within plus or minus 5% of actual rate of flow within the range of 10% to 100% of the full scale reading. Water quality analysers shall be recalibrated as specified by the instrument manufacturer's instructions or at minimum intervals which ensure operation during at least 95% of plant operating time within the quality control band limits indicated below (using a control chart method as set out in Ministry publication "The Principle of Control Charting" 1984, or as in "Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998" or a more recently published edition):
- free chlorine residual at point of entry to distribution system (quality control band $\pm$0.1 mg/L)
- fluoride concentration in treated water at point of entry to the distribution system (quality control band $\pm$0.1 mg/L)

- turbidity (quality control band $\pm$0.1 NTU).

4.2 General Operational Procedures

General operational procedures were reviewed. The plant is visited on a regular basis, and an operations log is completed. Critical operational parameters are monitored by the SCADA system, and supplemented by manual water quality testing. A monitoring program is carried out consistent with the requirements of the existing Certificate of Approval. Modifications to this program will be needed as required by the current Ontario Drinking Water Standards and Regulation 459/00.

The plant is operated by the Ontario Clean Water Agency, operating out of their Chesterville Hub. Alarms are in place to allow the operators to respond to potentially adverse conditions, with levels set so that time is available to respond prior to treated water of adverse quality entering the distribution system. In particular, a low chlorine residual alarm will result in lock out of the high lift pumps. The fluoride chemical pumps lock out on high fluoride level.

Operational routines are well developed, and the plant was observed to be well organized and in good operating condition.

5. ASSESSMENT OF PHYSICAL WORKS

5.1 Ability to Comply with Chlorination Procedure

The Ministry of the Environment's Procedure B13-3 "Chlorination of Potable Water Supplies in Ontario" outlines chlorination requirements for water works. The current Crysler treatment system is capable of meeting all of the requirements for ground water supplies as follows:

- capable of maintaining a minimum chlorine residual, measured as free chlorine, after 15 minutes contact time determined as T_{10} at maximum flow and before the first consumer of 0.2 mg/L in all disinfected water entering the distribution system,

- maintains a maximum chlorine residual, measured as free chlorine, of less than 4 mg/L at all times, at any location in the water distribution system,

- capable of providing a minimum free chlorine residual in the water distribution system of 0.2 mg/L, and

- provides operators and equipment for monitoring of chlorine residuals according to the Certificate of Approval requirements.

5.2 Blow-Out Disc on Elevated Water Tank

The present design of the blow-out disc on the elevated water storage tank would allow for the potential entry of foreign material into the tank in the event that the disc was activated. A proposal for an alternative vent/vacuum release has been provided by the tank manufacturer. It is recommended that the Township consider the risks associated with continued use of the present disc, and then determine if replacement is required.

5.3 Deviations from 10 State Standards

The Crysler water treatment plant was reviewed against the "Recommended Standards for Water Works", 1997, published by the Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. The following deviations are noted:

1. Sections 2.4 and 3.2.1.3 of the Standards requires dedicated standby power to permit delivery of average flow to the distribution system. The Crysler system does not provide standby power, but the elevated storage tank provides approximately two days of storage for average design flows. Portable electric generators have been used in the past when extended power outages have been encountered.

2. Section 2.10 requires that taps used for obtaining samples for bacteriological analysis shall be of the smooth-nosed type without interior or exterior threads. Not all sample taps at the Crysler plant meet this requirement. Sampling protocols are used which minimize the possibility of bacterial buildup in pipe threads influencing sample results..

3. Section 3.2.3.3 recommends that a wellhead protection plan for continued protection of the wellhead from potential sources of contamination be provided as determined by the reviewing authority. Given that a potential for aquifer contamination does exist, the completion of a wellhead protection plan for Crysler is recommended.

4. Sections 4.7.2 (k) and 5.1.2 (b) require chemical pumps to be provided with nonstandard electrical receptacles. These are not provided in the Crysler plant for any of the chemical pumps.

5. Section 4.7.4 requires that deluge showers and eye wash devices be provided at all fluosilicic acid installations. The Crysler plant provides an eye wash only, which met the requirements of the Ministry of Labour at the time of plant design.

6. Section 5.1.10 requires chemical storage tanks (including day tanks) to have a valved drain. This is not provided in Crysler due to the small size of the sodium hypochlorite and fluosilicic acid tanks.

19. Section 5.1.11 requires day tanks to hold no more than a 30 hour supply. The small quantities used in Crysler are not suitable for such a day tank.

5.4 Compliance with ODWS and the Regulation

The review indicates that the works associated with the Crysler water plant are suitable to achieve compliance with the Ontario Drinking Water Standards and Ontario Regulation 459/00.

6. MONITORING PROGRAM

In order to comply with the ODWS and the Regulation, a required monitoring program for the Crysler water treatment system has been developed, and is outlined below in the format shown in the Ministry document PIBS 4060e "Model Conditions for Certificates of Approval - Ground Water Supply With Treatment - August 2000".

Condition 2.1

The Owner shall ensure that the following monitoring program is carried out upon commencement of operation of the works:

(a) A sufficient number of flow measuring devices, calibrated at regular intervals not exceeding one year to ensure their accuracy to within plus or minus 5% of actual rate of flow within the range of 10% to 100% of the full scale reading of the measuring devices, shall be installed, maintained and operated in order to measure:

(i) the flow rate of water being conveyed to and through the water treatment plant (raw water), and

(ii) the daily quantity of treated water supplied to the distribution system.

(b) The time and duration of each event of flow rate in excess of that specified in Condition 1.4 shall be recorded along with the reasons for the occurrence.

(c) Continuous water quality analysers and indicators with alarm systems, recalibrated as specified by the instrument manufacturer's instructions or at minimum intervals which ensure operation during at least 95% of plant operating time within the quality control band limits indicated below (using a control chart method as set out in Ministry publication "The Principle of Control Charting: 1984, or as in "Standard Methods for the Examination of Water and Wastewater" 20th Edition, 1998, or a more recently published edition), shall be installed, maintained and operated to monitor the following parameters at the indicated locations:

(i) free or total chlorine residual in treated water at the point(s) of entrance to the distribution system (quality control band: $\pm$ 0.1 mg/L),

(ii) fluoride concentration in treated water at the point(s) of entrance to the distribution system (quality control band: $\pm$ 0.1 mg/L).

(d) In accordance with Regulation 459/00, Drinking Water Protection, samples of raw water and treated water shall be collected and analysed for at least the following parameters at the indicated locations and frequencies:

RAW WATER

(separate water samples taken at discharge point from each groundwater well at a location before any treatment chemical is added to the water)

Weekly

Total Coliform
Escherichia coli and/or Fecal Coliform
Heterotrophic Plate Count

TREATED WATER

(samples taken at the point of treated water entry to the distribution system unless specified otherwise)

Daily

Free Chlorine Residual
Continuous monitoring using equipment in accordance with Condition 2.1
Turbidity
One (1) grab sample per day (turbidity is monitored at the continuous analyser using the SCADA system, with level recorded on a daily basis)
Fluoride
Continuous monitoring using equipment in accordance with Condition 2.1.

Weekly

Total Coliform
Escherichia coli and/or Fecal Coliform
Heterotrophic Plate Count

Quarterly

Nitrate as Nitrogen
Nitrite as Nitrogen

Volatile Organics

Benzene	1,1-Dichloroethylene	Toluene
Carbon Tetrachloride	Dichloromethane	Trihalomethanes

1,2-Dichlorobenzene	Ethylbenzene	Trichloroethylene
1,4-Dichlorobenzene	Monochlorobenzene	Vinyl chloride
1,2-Dichloroethane	Tetrachloroethylene	Xylene

Pesticides and PCB

Alachlor	DDT	Parathion
Aldicarb	2,4-D	Pentachlorophenol
Aldrin+Dieldrin	Diclofop-methyl	Phorate
Atrazine	Dimethoate	Picloram
Azinphos-methyl	Dinoseb	PCB
Bendiocarb	Diquat	Prometryne
Bromoxynil	Diuron	Simazine
Carbaryl	Glyphosate	Temephos
Carbofuran	Heptachlor+Heptachlor epoxide	Terbufos
Chlordane (Total)	Lindane (Total)	2,3,4,6-Tetrachlorophenol
Chlorpyrifos	Malathion	Triallate
Cyanazine	Methoxychlor	2,4.6-Trichlorophenol
Diazinon	Metolachlor	Trifluralin
Dicamba	Metribuzin	2,4,5-T
2,4-Dichlorophenol	Paraquat	

Every three years

Inorganics

Arsenic	Iron	Selenium
Barium	Lead	Uranium
Boron	Manganese	Sodium - every five years
Cadmium	Mercury	Fluoride - every five years
Chromium	Nitrite	
Copper	Nitrate	

DISTRIBUTION SYSTEM

(samples taken at locations remote from the point of treated water entry to the distribution system)

Weekly

Total Coliform
Escherichia coli and/or Fecal Coliform
Heterotrophic Plate Count
Free Chlorine Residual

The minimum number of bacteriological and chlorine residual samples to be collected from different locations within the distribution system shall be eight (8) samples taken

monthly with at least one such sample taken every week, and two (2) samples analysed for either heterotrophic plate count or background colonies on a total coliform membrane filter analysis. The bacteriological and chlorine residuals samples shall be collected together from the same locations.

Quarterly

Trihalomethanes (at a point reflecting the maximum residence time in the distribution system)

Annually

Lead (at a point reflecting the maximum residence time in the distribution system)

(e) Notwithstanding clause (c), samples of raw water and treated water should be collected and analysed for the following parameters at the indicated locations and frequencies:

RAW WATER

(samples taken at a location before any treatment chemical is added to the water taken from the raw water source)

Quarterly

pH	Hardness	Methane
Ammonia + Ammonium (N)	Total Kjeldahl Nitrogen	Colour
Nitrate as Nitrogen	Nitrite as Nitrogen	Iron
Manganese	Chloride	Conductivity
Calcium	Magnesium	Sulphate
Dissolved Organic Carbon	Chromium	

TREATED WATER

(samples taken at the point of treated water entry to the distribution system)

Quarterly

pH Hardness

(f) The sampling required by clauses (d) and (e)above shall be performed in accordance with the "Guide to the Collection and Submission of Samples for Laboratory Analysis", Ministry of the Environment, 1993, or as described in Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, or a more recently published edition.

Condition 2.2

If the Owner monitors any of the parameters required by Condition 2.1, at designated locations and in accordance with Condition 2.1, more frequently than is required by that condition, the analytical results of all such samples, both required and additional, shall be included in reporting of the values required by this certificate, and the increased frequency, or all dates of sampling, shall also be specified in the reports.

Condition 2.3

The Owner shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the monitoring activities required by this certificate.

7. SUMMARY OF EXISTING CERTIFICATES OF APPROVAL AND PERMIT TO TAKE WATER

The Certificates of Approval issued for the Village of Crysler water supply and treatment works are summarized as follows:

December 22, 1992	Certificate No. 7-0224-91-926 Approval to construct a communal water system for Crysler.
November 9, 1993	Certificate No. 7-0224-91-926 Amendment to construct a feedermain.
November 29, 1993	Certificate No. 7-0224-91-926 Amendment to construct an elevated storage tank.
August 9, 1994	Certificate No. 7-0224-91-926 Amendment to construct watermains.
May 30, 1995	Certificate No. 7-0224-91-926 Amendment to construct treatment and pumping station.
October 1, 1998	Certificate No. 7-1162-95-006 Amendment to chlorination system description.
June 1, 1999	Certificate No. 7-1162-95-006 Further amendment to chlorination system description.

Copies of these certificates are included in the Appendix to this report.

The current Permit to Take Water is numbered 93-P-4006, with renewal date of February 28, 2003, and a permitted amount of taking of 1684.8 cubic metres per day. A copy of this permit is also provided in the Appendix.

8. OWNER INFORMATION

Client Information

Client Name: Corporation of the Township of North Stormont

Client Type: Municipal Government

Client Physical Address:

Civic Address: P.O. Box 99, 2 Victoria Street
Tel: 613-984-2821 Fax: 613-984-2908

Municipality: Township of North Stormont

Client Mailing Address:

Mailing Address: As above.

Site Information:

Site Name: Crysler Water Treatment Plant

MOE District Office: Cornwall

Legal Description: N. pt. lot 20, Con. 9, Parts 1, 2 &3 of RP52R-3079
Township of North Stormont, United Counties of Stormont, Dundas & Glengarry

Civic Address: 15642 County Road 13, Crysler, ON K0A 1R0

Geo Reference: Map Datum: UTM NAD27 Zone: 18 Accuracy: 100 m ±
Geo Referencing Method: Estimation from OBM

Location	UTM Easting	UTM Northing
Treatment and Production Well	492500 mE	5008790 mN
Standby Well	492519 mE	5008770 mN
Elevated Storage	488665 mE	5007050 mN

Municipality: Township of North Stormont

Adjacent Land Use: Agriculture and Sand/Gravel Pit

Site is not located in area of development control as defined by the Niagara Escarpment Planning and Development Act.

The Operating Authority is the Ontario Clean Water Agency - Chesterville Hub, 5 Industrial Drive, Chesterville, ON, K0C 1H0, Telephone: 613-448-3098, Fax: 613-448-1616.

Client is the owner of the land.

Water Source Site Information

The raw water source is groundwater.

Project Technical Information Contact

Name: James C. Johnston

Company: Kostuch Engineering Limited

Contact Address: Suite 214, 1725 St. Laurent Blvd., Ottawa, Ont. K1G 3V4
Tel: 613-521-7341 Fax: 613-521-0078 E-mail: kostuch@travel-net.com

Public Consultation/Notification

The municipality, as owner, has knowledge of the plant, and full access to records.

9. RECOMMENDATIONS

The following recommendations arise from the investigation carried out to complete this report:

1. The Operating Manual should be amended to include specific requirements for operation, calibration and maintenance of equipment used for flow measurement and automated analysis of water samples.

   The flow measuring devices should be calibrated at regular intervals not exceeding one year to ensure their accuracy to within plus or minus 5% of actual rate of flow within the range of 10% to 100% of the full scale reading. Water quality analysers shall be recalibrated as specified by the instrument manufacturer's instructions or at minimum intervals which ensure operation during at least 95% of plant operating time within the quality control band limits indicated below (using a control chart method as set out in Ministry publication "The Principle of Control Charting" 1984, or as in "Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998" or a more recently published edition):
   - free chlorine at point of entry to distribution system (quality control band $\pm$0.1 mg/L)
   - turbidity (quality control band $\pm$0.1 NTU)
   - fluoride at point of entry to distribution system (quality control band $\pm$0.1 mg/L).

   The Operating Manual should also be updated to include current Certificates of Approval.

2. The Owner should ensure that monitoring of the water quality is carried out in accordance with the monitoring program required by the Ministry of the Environment as may be amended following Ministry review of this report..

3. The Owner should consider developing a well head protection program to monitor aquifer conditions and guide future land use planning considerations within the area of recharge of the well.

4. At the time of any future upgrading of the plant, the Owner should consider upgrades to eliminate the deviations noted from the Ten State Standards. It should be noted that none of the present deviations result in inadequate disinfection or treatment.

5. The Township should consider the risks associated with use of the present blowout disc on the elevated water storage tank, and determine if replacement is required.

In the completion of this report and the above recommendations, Kostuch Engineering Limited necessarily relied on information provided by the Owner and Operator of the Crysler Water System, and is therefore not responsible for any errors or omissions that may be present as a result of erroneous information provided by others.

10. DECLARATION OF ENGINEER

Declaration of Engineer

We, as represented by the undersigned, hereby declare that to the best of our knowledge, the information contained herein and the information in support of this submission is complete and accurate in accordance with our obligations under the Professional Engineers Act (RSO 1990) and its regulations.

We further declare that this submission has been prepared in reasonable accordance with the published terms of reference for this submission, despite any qualifications in the agreement retaining us, and acknowledge that the Director and Owner will be relying upon the accuracy of the report.

Name: James C. Johnston, P.Eng., for Kostuch Engineering Limited

Signature:

Date: May 29, 2001

APPENDIX A

CERTIFICATES OF APPROVAL AND PERMIT TO TAKE WATER