Greater Lancaster Area

COMMUNAL WATER AND WASTEWATER SYSTEM

INTERIM REPORT
OCWA PROJECT NO. 50-0030-01

January 1997

totten sims hubicki associates

engineers architects and planners

GREATER LANCASTER AREA

COMMUNAL WATER AND WASTEWATER SYSTEM

INTERIM REPORT

TSH Project No. 52-20663

totten sims hubicki associates
engineers architects planners

35th ANNIVERSARY
1962 - 1997

totten sims hubicki associates

300 WATER STREET, WHITBY, ONTARIO
CANADA L1N 9J2

(905) 668-9363 FAX (905) 668-0221

January 6, 1997

Mr. M.J. Samson
Clerk-Treasurer
Township of Lancaster
North Lancaster, Ontario
K0C 1Z0

Dear Sir:

Re: Greater Lancaster Area
Communal Water and Wastewater System
Class Environmental Assessment
TSH Project No. 52-20663

We are pleased to present our Interim Report in completion of Task 1 of the above-noted project.

This report identifies the Greater Lancaster Area (study area) and describes existing conditions in terms of population and water supply and sewage disposal. It also reviews the effectiveness of water efficiency and sewage optimization in bringing municipal servicing to the whole Greater Lancaster area.

We wish to express our appreciation to the staff of the Village of Lancaster, the Township of Charlottenburgh, the Township of Lancaster, and OCWA whose cooperation and assistance enabled us to prepare this report.

Yours very truly,

totten sims hubicki associates

for. R.A. Dunn, P.Eng.
Project Manager

LEJ/wb
965432WE/R9615

GREATER LANCASTER AREA
COMMUNAL WATER AND WASTEWATER SYSTEM
INTERIM REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The purpose of the Interim Report is to determine if water efficiency programs and sewage optimization measures could be applied to the existing systems in the Greater Lancaster Area to solve the existing problems.

The Greater Lancaster Area consists of the Village of Lancaster and surrounding developments in the Township of Lancaster and the Township of Charlottenburgh. The permanent population in the Study Area is broken down as follows:

GREATER LANCASTER AREA 1996 POPULATION	
Village of Lancaster	752
Township of Lancaster	646
Township of Charlottenburgh	140
TOTAL	1,538

In addition, there are substantial seasonal populations in the Townships.

Water Supply

The Village of Lancaster is serviced with municipal water supply while residents in the Township of Lancaster and Township of Charlottenburgh draw their water supply from privately owned wells.

Numerous studies have documented the deteriorating quality of the private water supplies in the Townships.

The Village of Lancaster Water Supply System consists of two groundwater wells and is rated at 1,309 m^3/d. The water supply system has a hydraulic reserve capacity of 544 m^3/d which could service 747 residents at the current demand levels. The current maximum service capability of the system is 1,499 residents.

The wells supply poor quality water with elevated iron, colour, sodium and turbidity concentrations. It is considered that all of the quality problems with the wells can be treated; however, the economics of operating and maintaining the system may preclude this.

Existing water consumption levels are relatively low likely due to poor quality water and relatively high water costs. As a result, water efficiency measures are unlikely to have a significant effect, resulting in a maximum service population, after efficiency, of 1,502.

This is not sufficient to service the population of the Study Area so expansion of the existing plant or location of a new plant will be required.

Sewage Disposal

As with water supply, sewage disposal facilities are privately owned and operated in the Townships. The Village of Lancaster has a municipal wastewater treatment system rated at 590 m^3/d.

Studies have identified that a large percentage of the private facilities are in poor condition and are likely contributing to the poor quality of private water supplies and the St. Lawrence River.

The wastewater system in the Village nearly exceeds its hydraulic capacity. The system has experienced high extraneous flow since shortly after the system was installed. A full sewer system rehabilitation program could potentially release capacity for an additional 340 persons to be serviced, increasing the service population to 1,090. It is considered; however, that it may be extremely difficult to achieve a high level of rehabilitation without considerable sewer replacement.

The revised population capacity is still insufficient to service the needs of the Greater Lancaster Area so modifications to the treatment process will be required. The existing Certificate of Approval will have to be amended which would likely result in more stringent effluent requirements being applied at that time.

GREATER LANCASTER AREA
COMMUNAL WATER AND WASTEWATER SYSTEM
INTERIM REPORT

1. INTRODUCTION

Located 25 kilometres east of the City of Cornwall and 15 kilometres west of the Ontario-Quebec border, the Greater Lancaster area is comprised of the Village of Lancaster and adjacent developments within the Township of Lancaster and the Township of Charlottenburgh.

The study area includes all the land south of Highway 401 from the Lancaster Inn in the Township of Charlottenburgh east to Amanndale Bay in the Township of Lancaster. It also includes the Village of Lancaster and areas neighbouring the Village boundary to the north.

The Village is already serviced by municipal water and sewage systems. Both these systems have well documented deficiencies. Problems are also being experienced with private well and sewage disposal systems in the Townships and this is affecting water quality in the St. Lawrence River. This, combined with pressures arising from growth within the existing communities and planned developments are driving the need to improve water supply and sewage disposal facilities.

This report documents the existing conditions in the Greater Lancaster area and reviews the effectiveness of water efficiency and sewage optimization in resolving the problems with the existing conditions.

2. GREATER LANCASTER AREA POPULATION

2.1 Village of Lancaster

2.1.1 Permanent Population

The Village of Lancaster is located on Highway 34 north of Highway 401. It is primarily a residential community of approximately 750 people. Growth over the last 20 years is presented in Table 2.1 and Figure 2.1. As can be seen in Figure 2.1, the population increased steadily until 1988 and appears to have stabilized in recent years.

TABLE 2.1
VILLAGE OF LANCASTER POPULATION

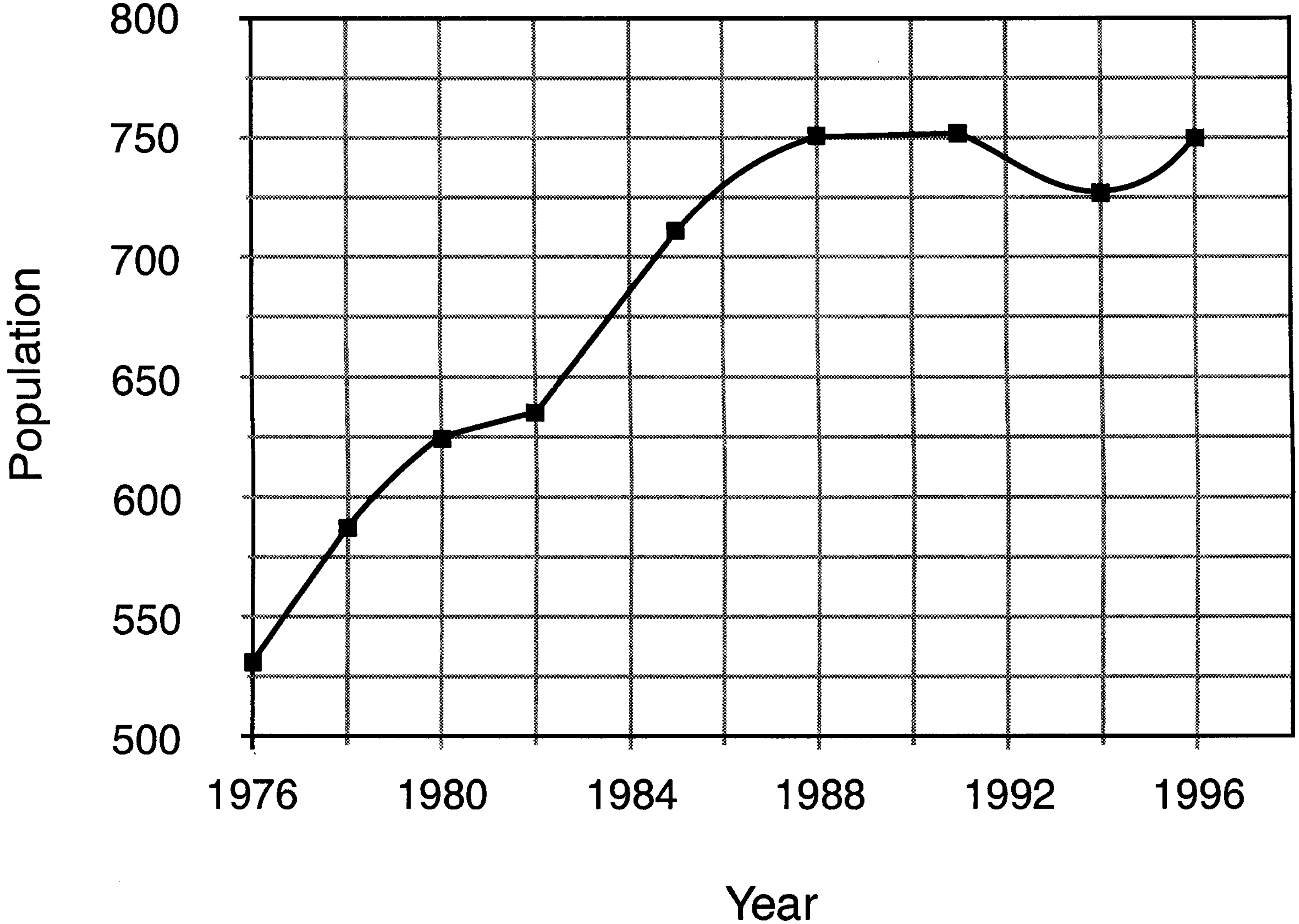
Year	Population
1976	531
1978	587
1980	624
1982	635
1985	711
1988	751
1991	752
1994	727
1996	752

The Village is primarily zoned for Residential Development with Commercial Development permitted along both sides of Highway 34. In addition, there are areas zoned Institutional/Public for the following applications:

- 1 school
- 2 churches
- 1 nursing home
- 1 Legion hall
- 1 curling club
- 1 library
- 1 non-profit housing unit

There are currently no industrial areas zoned in the Village.

Village of Lancaster
Population Growth 1976-1996



totten sims hubicki associates
engineers architects and planners

Figure 2.1

There are currently 230 single family homes in the Village, 7 apartment buildings containing a total 47 units and the non-profit housing development has 26 units, all for a total of 303 units. The nursing home currently has an occupancy of 60 residents which results in a total residential population of 690. If it is assumed that all units are occupied, then there is an average residential density of 2.3 persons per unit (ppu) which is slightly less than the MOEE Design Guideline of 3 ppu.

2.1.2 Current Service Population

A significant portion of the students at the school in the Village do not reside in the service area. These outside students are service users but are not included in population estimates. There are 8 staff and 184 students at the school and it is estimated that 65% or 120 students reside outside the Village. The current estimate for average daily water use at elementary schools is 20 L/student/day. If this is applied for the students from outside the Village, it is equivalent to a daily consumption of 2,400 L/d. Applying the current per capita demand of 326 L/c/d, this demand is equivalent to that from a residential population of 7.

2.1.3 Future Population

Growth in the Village of Lancaster occurred at an average rate of 2.8% up until 1988 when it stabilized and has since fluctuated only slightly. This could be attributed to the downturn in the economy occurring during those years. In recent years, development has been halted due to the shortage of capacity in the wastewater treatment system.

Accurately predicting growth in a small community is difficult because of the many factors involved. It is recognized that if constraints were removed, this area could grow rapidly due to the relatively short commute to Cornwall and Montreal and the proximity of the Village to the St. Lawrence River. There is currently a Draft Approved Development being considered for the Village that could add 35 homes. Assuming the MOEE Guideline for population density, this development could add approximately 105 residents to the Village population; however, if the development proceeds at the current density of 2.3 ppu in the Village, the population would only increase by 81 persons.

2.2 Township of Lancaster

The portion of the Township of Lancaster located in the Greater Lancaster area comprises the land south of Highway 401, from Military Road (Highway 34) east to Amanndale Bay for approximately 6.2 km.

The study area includes an estimated 430 lots with areas ranging in size from 460 m^2 cottage properties to 43 hectare (433,000 m^2) properties currently being farmed.

There are approximately 646 residents living permanently in this area; however, there is a large seasonal population occupying cottages and summer homes on the river.

The area is primarily zoned as a Rural Area. There are no areas zoned for Commercial or Industrial activities. Rural areas are intended for non-urban uses and activities where the current use of land or fragmentation of ownership has resulted in long term agricultural use not being viable. Strip development within Rural areas is to be avoided. Severances of rural properties for non-farm related residential lots is permitted with consent from the Township where the lot fronts on a Public Road, can accommodate adequate private services, and does not contribute to scattered development.

The area immediately east of Highway 34 and Military Road is zoned for the Hamlet of South Lancaster. The Community is a mix of permanent residents and cottages. There are approximately 170 lots in the Hamlet, some owned by St. Andrews Presbyterian Church and leased to residents. The Official Plan currently permits growth by infilling or by subdivision only if lots are appropriately sized to permit the proper functioning of individual wells and private sewage systems. Infilling is defined as "development located between two non-farm dwellings in existence on July 7, 1993, which are located on the same side of the road and are separated by not more than 100 metres" (Township of Lancaster, Official Plan, 1994).

The policy for Hamlet development encourages the location of new homes to be such as to allow future division of the lot to increase density of development due to the provision of municipal services. The Official Plan notes that municipal servicing of the Hamlet is being considered and specific policies will be added as required.

The remaining land in the Study Area is zoned as Limited Services Residential Areas and described as "existing residential clusters consisting of a mixture of seasonal and permanent dwelling units, with access from privately owned roads with private water and sewage disposal facilities" (Township of Lancaster, Official Plan). Development is only permitted on existing vacant lots or on a new lot created by infilling and only if the lot is large enough to accommodate private services. The Plan also notes that any improvements to systems originally designed for seasonal uses will be carried out on a user pay basis.

The Township reports that there are currently no development plans being considered for this part of the Study Area.

2.3 Township of Charlottenburgh

The portion of Charlottenburgh located in the Greater Lancaster area comprises the land south of Highway 401 west to Meadow Bay and land north of Highway 401 adjacent to the Village boundary. Development is currently concentrated towards the shoreline of Lake St. Francis and consists of 37 permanent residences and 9 seasonal residences for an estimated population of 175. This is equivalent to a population density of 3.8 ppu. There are also 4 commercial establishments and an area zoned as institution.

There are three plans of subdivision being considered for the area which could vary from 70 - 170 lots depending on the degree of servicing provided.

3. WATER SUPPLY SYSTEMS

3.1 Village of Lancaster

3.1.1 Existing Water Supply Facilities

The Village of Lancaster commissioned a water supply system in 1975 to provide a "reliable and satisfactory supply of water for domestic, industrial and fire fighting purposes" (Village of Lancaster Design Report for Water Works - Wyllie and Ufnal Limited, March, 1971).

The system is supplied by two groundwater wells each rated at 1,309 m^3/d. At the time of commissioning, it was determined that the addition of chlorine and silica would be the only treatment required. Presently, only chlorine is being added for disinfection.

The wells are reported to be 25 m and 31 m deep and are housed in a brick and concrete pumphouse located in the southeast corner of the Village. The pumphouse houses two (2) Peerless vertical turbine well pumps, each 11 kW, sized to provide 15.2 L/s at a TDH of 53.3 m, two (2) chemical feed pumps rated at 1.2 L/hr and 1.6 L/hr for sodium hypochlorite addition and a Neptune Trident mechanical water meter.

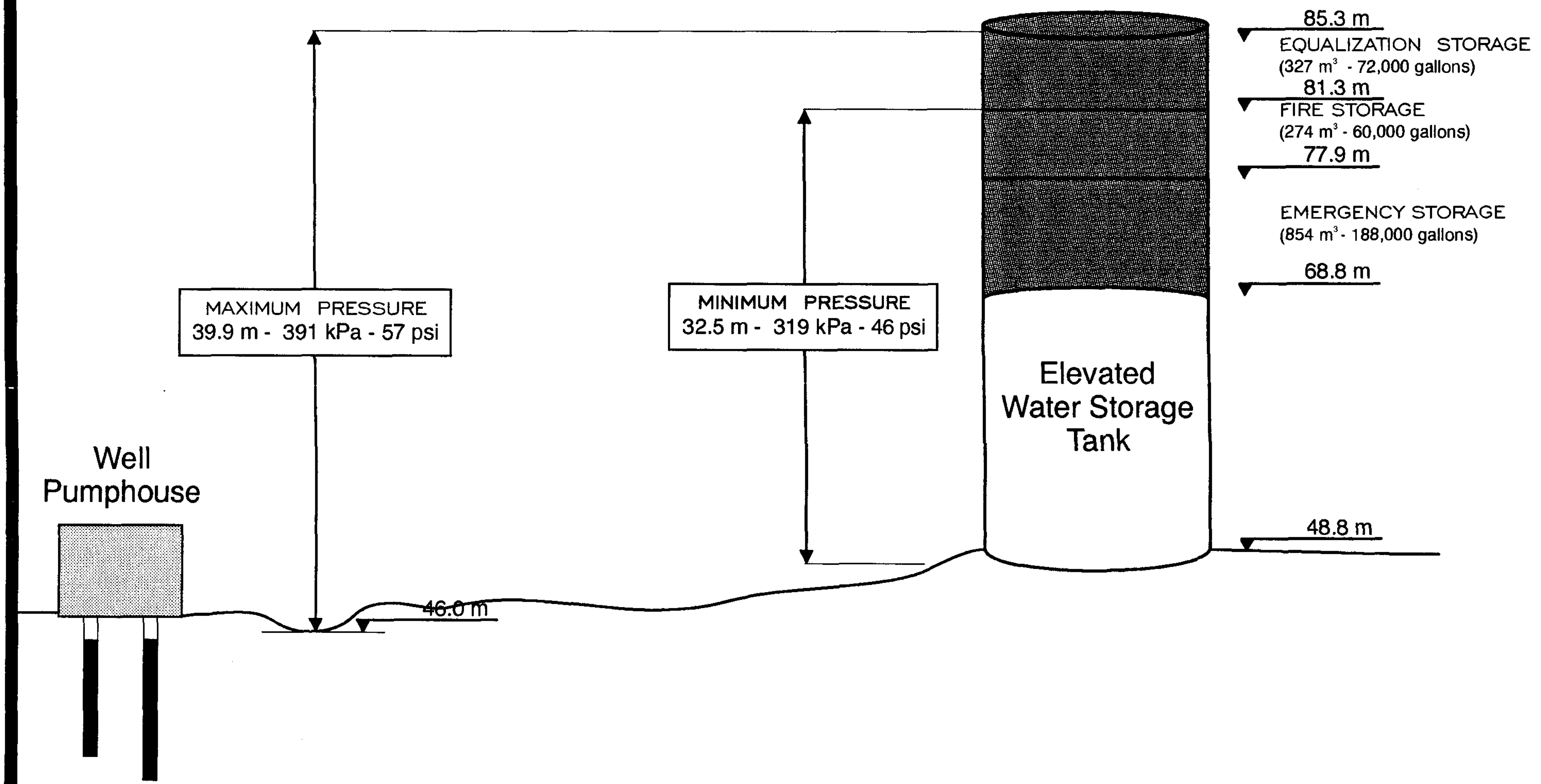
The wells pump to a 1,455 m^3 standpipe type elevated water storage tank located in the northwest corner of the Village.

The MOEE Guidelines for Sizing Water Storage Facilities proportion storage volumes into components for equalization, fire protection and emergency storage.

Equalization storage is equivalent to 25% of the maximum day demand. Based on the rated system capacity of 1,309 m^3/d, 327 m^3 of the storage volume is required for equalization. The recommended fire storage volume for a community the size of Lancaster is equivalent to 38 L/s for 2 hours or 274 m^3. The emergency storage component is equivalent to 25% of the equalization and fire storage volumes combined, for a total volume of 156 m^3. The total storage volume required for the Village of Lancaster is 757 m^3 which is considerably less than the existing volume.

The Top Water Level in the storage tank is 85.3 m. Based on a volume of 327 m^3, the bottom of equalization storage will be 81.3 m. The MOEE recommend that distribution system pressures range between 350 - 550 kPa (50 - 80 psi) under maximum day conditions. As can be seen from Figure 3.1, pressures range between 319 and 391 kPa (46 - 57 psi) under static conditions. During a fire flow condition, the MOEE recommend that system pressures do not fall below 140 kPa. The bottom of the fire storage component in the Lancaster tank is 77.9 m. If the water level in the tank drops to the bottom of the fire storage, then system pressure would range between 285 kPa and 319 kPa which is sufficient. These figures are approximate only as they do not take into account pressure losses in the distribution system piping.

Village of Lancaster
Distribution System Hydraulic Profile



totten sims hubicki associates
engineers architects and planners

Figure 3.1

There is approximately 7,024 m of watermain installed in the Village. Distribution system as-builts indicate that the watermains are generally Class 160 PVC ranging in diameter from 150 mm to 300 mm.

3.1.2 Water Demand

Water demand in the Village of Lancaster is monitored by a turbine type flowmeter at the pumphouse. The following table presents a summary of flow rates over the last five years.

TABLE 3.1
VILLAGE OF LANCASTER
WATER DEMAND 1991 - 1996

Year	Total Flow (ML)	Average Day Flow (ML/d)	Maximum Day Flow (ML/d)	Peaking Factor
1991	91.6	0.251	0.359	1.43
1992	86.0	0.235	0.493	2.10
1993	101.7	0.282	0.610	2.16
1994	88.5	0.247	0.731	2.96
1995	80.6	0.222	0.561	2.53
1996 (to August)	51.9	0.243	0.580	2.39
Average	89.7	0.247	0.551	2.24
Per Capita Consumption (L/c/d)		314	700	

The MOEE recommended peaking factor for a community the size of the Village of Lancaster is 2.75. The recorded peaking factors are slightly less than this with the exception of 1994. The maximum day flow of 731 m^3/d recorded in November was considerably higher than other recorded figures. This large demand was required to refill the water storage tank after it was drained due to low chlorine residuals that resulted in "boil water orders" being implemented. If this abnormal peaking factor is ignored, then the average peaking factor over the last five years is 2.06.

The average per capita consumption over the last five years averages 314 L/c/d. The MOEE Guidelines recommend that water supply systems be sized to supply domestic demands between 270 - 450 L/c/d plus the demands of institutional, commercial and industrial (ICI) establishments.

It is assumed that ICI demands make up only a small component of the water demand as the Village is primarily residential.

Per capita consumption in the Village of Lancaster is quite low, compared to other communities in Ontario. The following table presents a range of water consumptions reported in different communities in the last two years.

TABLE 3.2
WATER CONSUMPTION IN ONTARIO COMMUNITIES

Community	Per Capita Consumption (L/c/d)	Serviced Population
Community of Sutton	324	4,381
Town of Fort Erie	327	22,503
Regional Municipality of Waterloo	429	296,000
Town of Aurora	458	28,250
Village of Stirling	510	1,970
Village of Fenelon Falls	653	1,631
Town of Campbellford	656	3,528
Town of Cobourg	688	16,331
Community of Matheson	837	896
Village of Havelock	1,052	1,361
Village of Iroquois	1,848	1,255

To determine the uncommitted hydraulic reserve capacity of the water supply facilities the following formula from the MOEE Guidelines is used:

$$Cu = Cr - \frac{L \times F \times P}{H}, \text{ where}$$

Cu = uncommitted hydraulic reserve capacity
Cr = hydraulic reserve capacity
L = number of unconnected approved lots
F = average per capita flow
P = existing connected population
H = number of connected households

These variables are calculated for the Lancaster Water Supply System as follows:

i) Hydraulic Reserve Capacity (Cr)

The hydraulic reserve capacity is calculated by multiplying the average daily water use over the past three (3) years by the peaking factor, and subtracting this result from the approved capacity of the municipal system.

Based on the records presented in Table 3.1, water use in the Village averaged approximately 247 m^3/d from 1993 through 1995, and the maximum peaking factor over this three (3) year period was 2.96. The approved capacity of the municipal well system is 1,309 m^3/d, therefore, the current hydraulic reserve capacity is calculated as follows:

$$Cr = 1{,}309 - (2.96 \times 247)$$

$$= 578 \ m^3/d$$

Therefore, the municipal system has a hydraulic reserve capacity (Cr) of 578 m^3/d.

ii) Unconnected Approved Lots (L)

The Village indicates that there is currently a draft approved plan of subdivision that would add 35 lots to the water supply system (L).

iii) Average Per Capita Flow (F)

The equivalent population serviced by the Lancaster water system from 1993 through 1995 averaged approximately 760 persons. Therefore, based on the average daily water use of 247 m^3/d over this period, the average per capita water use (F) in the Village is approximately .325 $m^3/c/d$.

iv) Existing Connected Population (P)

The Lancaster water system currently services an existing connected population (P) of approximately 750 permanent residents.

v) Number of Connected Households (H)

Billing records indicate that the current number of households connected to the Lancaster water distribution system (H) is approximately 252 units.

Therefore, the uncommitted hydraulic reserve capacity of the Lancaster municipal well system is calculated as follows:

$$Cu = Cr - \frac{L \times F \times P}{H}$$

$$= 578 - \frac{35 \times 0.325 \times 750}{252}$$

$$= 544 \text{ m}^3/\text{d}$$

Therefore, the municipal system has an uncommitted hydraulic reserve capacity (Cu) of 544 m^3/d.

3.1.3 Water Quality

The 1996 Compliance Inspection Report on the water supply system prepared by the MOEE indicated that "the water supply system does not have acceptable treatment processes to ensure that the appropriate limits for drinking water are met". Table 3.3 presents a summary of water quality data over the last five years.

TABLE 3.3
VILLAGE OF LANCASTER
TREATED WATER QUALITY (1991-1996)

Parameter	Average	Range	ODWO
Turbidity (FTU)	1.61	0.5 - 3.6	1
Colour (TCU)	20.35	2 - 42	5
Iron (mg/L)	1.16	0.04 - 2.5	0.3
Sodium (mg/L)	108.52	1.41 - 134	200
Nitrate (mg/L)	0.48	0 - 1.2	10

The parameters frequently exceed the ODWO established.

ODWO for colour, iron and sodium are classified as aesthetic objectives by the MOEE. These parameters, if present in a water supply, do not effect the safety but could make it unsuitable for domestic use. Complaints of unpleasant tastes and odours in the water and staining of fixtures and laundry are a result of failure to meeting aesthetic objectives.

High iron levels may stain laundry, produce a bitter taste in water and beverages and can promote the growth of iron bacteria in plumbing. Precipitation of iron in the distribution system results in consumer complaints and significant solids accumulation in the watermains and storage tank that necessitate regular flushing of the system. Currently the system is flushed twice a year in May and October.

Natural or synthetic organic parameters and metallic ions such as iron, manganese and copper can create a colour in the water supply. Colour levels in excess of 5 TCU may become noticeable.

The intake of sodium from drinking water represents a small fraction of that consumed in a normal diet; however, if sodium concentrations in the water supply exceed 20 mg/L then it is recommended that the Medial Officer of Health be notified so that this information can be passed on to local doctors treating patients with sodium restricted diets.

Turbidity and nitrates are considered health-related concerns. Elevated turbidity can provide a source of nutrients for microorganisms and interfere with the disinfection process.

Nitrates are present in groundwater due to the presence in decaying plant or animal material, agricultural fertilizers, domestic sewage or geological formations. Nitrates are reduced to nitrites during digestion and nitrites have been linked to the incidents of methaemoglobinaemia (blue baby syndrome) in infants.

Elevated bacterial levels were detected once in the last five years; however, this was attributed to poor disinfection chemicals.

A pilot study was carried out in September, 1994 by MacLellan Water Technology Limited to evaluate iron, colour and turbidity treatment systems.

The study was a bench scale test that looked at the process of aeration followed by filtration. Three different media were evaluated including manganous dioxide, mixed sand/aggregate and greensand. The study concluded that a detention time of 30 minutes prior to the use of greensand removed 86% of the iron present in the raw water supply. The sand/aggregate filter was reported to be relatively ineffective at iron removal. While the manganous oxide performed slightly better than sand it was not as effective as greensand. The relatively high cost of the media eliminated it from further evaluation.

Further testing was carried out to determine the effectiveness of aeration and the study concluded that aeration did "not impair treatment but [did] not add a quantifiable advantage". As a result, the study recommended the following treatment procedure:

- Continue in-line chlorination.
- Provide a retention tank/chamber sized to provide a minimum 30 minute contact time.

- Install a dual filtration system consisting of a dual media sand/aggregate filter followed by a greensand filter. The study indicated that much of the colour and turbidity would be removed in the sand bed which would reduce the load on the greensand filter allowing it to deal solely with iron removal. It was felt that this would prolong the life of the greensand filter.

The study pointed out that the high iron levels would likely necessitate frequent backwashing of the filters and flushing of the retention tank.

The treatability study did not consider treatment methods for the elevated sodium concentrations. Generally, excess sodium is removed through the process of reverse osmosis where the water supply is pressurized and forced against a semipermeable membrane. Pure water is forced through the membrane and the salts are left behind to be disposed of. The pressure requirements of reverse osmosis units result in relatively high power costs compared to other treatment systems.

3.2 Township of Lancaster

3.2.1 General

All residents in the Township of Lancaster portion of the Study Area are serviced by privately owned water supplies. These are primarily drilled or dug groundwater wells but some draw their supply from Lake St. Francis. As indicated previously, a large percentage of the homes are seasonal residences; however, more are being converted to year round use. Studies have been carried out in two areas in the Township to identify problems with the water supply.

3.2.2 Hamlet of South Lancaster

Numerous sampling programs have been undertaken on water supplies in the Hamlet of South Lancaster.

In 1990, 23 well water samples were collected and analyzed by the Cornwall District Office of the MOEE. Five of twenty-three supplies sampled (22%) were considered unsafe or poor due to high bacteria levels. Eight of the samples (35%) exceeded the ODWO for iron.

Four samples were collected of surface water in drainage ditches in the Hamlet and analyzed for faecal coliform and faecal streptococci. Three of the samples exceeded the Provincial Water Quality Objective for coliform. If the ratio of coliform to streptococci concentrations are greater than 4, this generally serves as an indication that contamination is likely to be human in origin. None of the four samples showed this.

During a study of private sewage disposal systems in 1991/92, M.S. Thompson and Associates also surveyed residents and sampled 73 private well supplies. Their report indicated that 30% of surveyed residents were dissatisfied with their water supplies and regularly purchased bottled water. Table 3.4 summarizes the results of the analysis.

TABLE 3.4 HAMLET OF SOUTH LANCASTER 1992 WELL WATER QUALITY			
Parameter	ODWO (mg/L)	Range	% Exceeding ODWO
Iron	0.3	0 - 34	51
Chloride	250	11.3 - 464	67
Nitrite	0.1	0 - 6.8	1.4
Nitrate	10	0 - 40.7	8.2
Nitrite + Nitrate	10	0 - 40.7	8.2

Of the 73 samples taken, 20.5% had coliform levels in excess of 5 counts/100 mL which classifies the water supply as unsafe. Five (5) more homes produced poor quality water with counts grater than 1 but less than 5.

In 1994, OCWA completed another survey to be used in support of funding applications. Tables 3.5 and 3.6 summarize the results of the 1994 survey.

TABLE 3.5 HAMLET OF SOUTH LANCASTER WELL CHARACTERISTICS					
Type	% of Samples	Age	% Samples	Depth	% Samples
Dug	14	<10 yrs	20	<10 ft	0
Drilled	67	10-20 yrs	17	10-20 ft	5
Other/Unknown	19	21-40 yrs	17	21-40 ft	7
		>41 yrs	7	41-60 ft	17
		Unknown	35	>60 ft	19
		No Well	3	Unknown	48
				No Well	3

Water samples were collected from 43 homes and analyzed for iron, chloride, nitrite, nitrate. The results of the analyses are reported in Table 3.6.

TABLE 3.6 HAMLET OF SOUTH LANCASTER - 1994 WELL WATER QUALITY			
Parameter	ODWO (mg/L)	Range	% Exceeding ODWO
Iron	0.3	0 - 4.6	11
Chloride	250	7.9 - 449.2	6
Nitrite	1	0 - 5.8	1
Nitrate	10	0 - 12.3	1
Nitrite + Nitrate	10	0 - 12.4	1

Justifications for the ODWO for these parameters has been described previously. Chloride, in reasonable concentrations, is not harmful to humans; however, concentrations above the ODWO may impart an undesirable taste to the water supply.

Ninety-seven (97) wells were tested for the presence of coliform bacteria. 70% of samples showed no evidence of bacteria and are considered safe for consumption and 9% of samples had total coliforms present but in concentrations less than 5 counts/100 mL. These sources are considered poor. Any sample with coliforms in excess of 5 counts/100 mL was considered unsafe and 22% of the samples showed in excess of this level of contamination.

In both surveys, samples were measured for ammonia and conductivity for which there currently is no ODWO. Ammonia concentrations ranged from 0 - 0.64 mg/L and conductivity levels ranged from 119 - 1,950 units.

The conductivity of a sample is related to the concentration of dissolved solids like inorganic salts, small amounts of organic matter and dissolved materials. The principle salts dissolved in water include carbonates, sulphates, nitrates, sodium, potassium, calcium and magnesium. Generally, as conductivity and dissolved solids increase, the corrosivity also increases. There is an ODWO established for TDS of 500 mg/L. Above this level, many consumers find the water unpalatable. The relationship been conductivity and dissolved solids in dilute solutions (i.e. conductivity $<2,000$ μhmo/cm) is TDS = 0.5 conductivity so it follows that conductivity in excess of 1,000 μhmo/cm would be considered unacceptable. In the 1992 survey, 67% had conductivity levels in excess of 1,000 μhmo/cm and in the 1994 survey, 40% had excess conductivity levels.

3.2.3 Westley's Point

In 1994, the Raisin Region Conservation Authority (RRCA) conducted a study of conditions in Westley's Point located approximately 6 km east of the Hamlet. The area was developed as a cottage community consisting of 74 residences serviced by drilled wells (some shared between homes). The RRCA indicated in their review that approximately 38 have been converted to permanent residences.

Analysis of groundwater indicated that high iron and sulphur were a concern in three of the wells.

Sampling was carried out on the 51 wells twice over a four week period to determine the level of bacterial contamination. Eleven samples showed coliform levels ranging from 1 - 7,000 counts/100 mL representing 22% of the area. Three of these samples continued to show contamination during the second sampling with an additional two wells reporting contamination.

All of the wells had acceptable clearances from septic systems; however, three were closer than the required 15 m separation to holding tanks.

4. SEWAGE DISPOSAL SYSTEMS

4.1 Village of Lancaster

4.1.1 Existing Wastewater Treatment System

The Village of Lancaster Wastewater Treatment System was installed in 1974 and has a rated capacity of 590 m^3/d. The system consists of approximately 6.15 km of sewer pipe that drains by gravity to a sewage pumping station located on South Beech Street in the south west corner of the Village. The sewage pumping station is equipped with two submersible sewage pumps each rated at 2,592 m^3/d at 18.3 m TDH. The pumps operate in a duty/standby arrangement in response to the level in the wet well. A magnetic flowmeter on the station discharge monitors flow to two waste stabilization lagoons located approximately 400 m east of the Village limits, north of the CN railway.

A 1.5 km 250 mm diameter forcemain delivers sewage to the lagoons. The lagoons have a design volume of 77,600 m^3 and 40,400 m^3 and a total area of 6 Ha. Each lagoon discharges to Finney Creek for 14 days in the spring and fall through separate 400 mm diameter discharge pipes. Effluent requirements for the lagoon discharge are currently 30 mg/L for Biochemical Oxygen Demand (BOD) and 40 mg/L for Suspended Solids based on the annual average. A review of effluent quality data over the last five years is presented in Table 4.1 which indicates compliance with this objective. Both ponds are extensively covered in bulrushes; however, neither effluent quality of lagoon storage capacity appears to have been effected by their presence.

**TABLE 4.1
VILLAGE OF LANCASTER
WASTE STABILIZATION LAGOON EFFLUENT QUALITY
(1990-1996)**

Parameter	Average	Range
BOD	7.46	1.3 - 18.5
Suspended Solids	14.74	4.33 - 31.7
Phosphorous	1.63	0.18 - 3.65

4.1.2 Wastewater Treatment System Flows

Table 4.2 presents average and maximum day flows to the sewage lagoons over the last five years.

TABLE 4.2 VILLAGE OF LANCASTER WASTEWATER TREATMENT SYSTEM FLOWS (1991 - 1996)			
Year	Total Flow (ML)	Average Day Flow (ML/d)	Maximum Day Flow (ML/d)
1991	237.9	0.653	1.131
1992	212.6	0.584	1.520
1993	216.1	0.593	1.761
1994	198.0	0.543	1.150
1995	167.1	0.458	0.890
1996 (to August)	128.0	0.606	2.110
Average		0.566	1.086

Based on the current population of 752, the average per capita sewage flows are 753 L/c/d. This is very high compared to the MOEE Design Guideline for domestic sewage flow of 225 - 450 L/c/d even allowing an additional 90 L/c/d for infiltration. A comparison of other communities in Ontario shows it to be in the mid to upper range of recently reported per capita flows as presented in Table 4.3.

TABLE 4.3 WASTEWATER PER CAPITA FLOW IN ONTARIO COMMUNITIES		
Community	Average Day Flow (L/c/d)	Population Serviced
Village of Stirling	400	2,050
Village of Havelock	561	1,361
Village of Fenelon Falls	753	1,577
Township of Matheson	914	896
Town of Cobourg	1,023	14,617
Village of Iroquois	2,298	1,248

In accordance with MOEE guidelines, the uncommitted hydraulic reserve capacity of the wastewater treatment facilities is calculated using the following formula:

$$Cu = Cr - \frac{L \times F \times P}{H}, \text{ where}$$

Cu = uncommitted hydraulic reserve capacity
Cr = hydraulic reserve capacity
L = number of unconnected approved lots
F = average per capita flow
P = existing connected population
H = number of connected households

These variables are calculated for the Lancaster wastewater treatment facilities as follows:

i) Hydraulic Reserve Capacity (Cr)

The hydraulic reserve capacity is calculated by subtracting the average daily sewage flow over the past three (3) years from the design capacity of the wastewater treatment facilities.

Based on the records presented in Table 4.1, sewage flows in the Village averaged approximately 528 m^3/d from 1993 through 1995. The design capacity of the wastewater treatment facilities is 590 m^3/d, therefore, the current hydraulic reserve capacity is calculated as follows:

$$Cr = 590 - 528$$

$$= 62 \text{ m}^3/\text{d}$$

Therefore, the wastewater treatment facilities has a hydraulic reserve capacity (Cr) of 62 m^3/d.

ii) Unconnected Approved Lots (L)

The draft approved plan of subdivision will create a servicing commitment (L) of 35 lots.

iii) Average Per Capita Flow (F)

The equivalent population serviced by the Lancaster wastewater system from 1993 through 1995 averaged approximately 760 persons. Therefore, based on the average daily sewage flow of 528 m^3/d over this period, the average per capita sewage flow (F) in the Village is approximately 0.753 $m^3/c/d$.

iv) Existing Connected Population (P)

The Lancaster wastewater system currently services an existing connected population (P) of approximately 752 permanent residents.

v) Number of Connected Households (H)

Billing records indicate that the total number of households connected to the Lancaster wastewater collection system (H) is currently 252 units.

Therefore, the uncommitted hydraulic reserve capacity of the Lancaster wastewater treatment facilities is calculated as follows:

$$Cu = Cr - \frac{L \times F \times P}{H}$$

$$= 62 - \frac{35 \times 0.753 \times 752}{252}$$

$$= -16.6 \ m^3/d$$

Therefore, the Lancaster wastewater treatment facilities have very little uncommitted hydraulic reserve capacity (Cu), and the facilities are over committed by a sewage flow of approximately 17 m^3/d.

A Sanitary Sewer Needs Study prepared in September, 1988 by McNeely Engineering concluded that infiltration was the most significant factor contributing to abnormally high sewage flows. Infiltration was occurring at manholes and sewer pipes caused by open joints, cracked concrete walls, sump and foundation drains from households. It is reported that infiltration has been an issue since shortly after the construction of the sewers.

The Needs Study identified that from 1985 - 1987, monthly volumes of wastewater pumped to the lagoons were generally 1.5 to 3.5 times the production of potable water. Figure 4.1 shows that this situation continues with sewage flows reaching more than 4 times the volume of potable water flows.

4.1.3 Sewage Collection System

At the time of Needs Study preparation, the sewage collection system was operated by MOEE from the Hawkesbury Office and they did routine inspections 2 to 3 times/week of the system. During an emergency situation the roads superintendent was called until MOEE staff arrived. Currently the system is operated by the Ontario Clean Water Agency (OCWA).

Limited maintenance records were kept by the Village prior to the 1988 Needs Study. Village staff have indicated that two repairs per year are representative and records show no major expenses from 1985 to 1988.

The collection system consists of 78 manholes (1200 mm precast concrete) and approximately 6.15 km of sewer pipe. The sewer is typically 200 mm to 250 mm Asbestos Cement or PVC pipe. The pipe slopes are typically between 0.3% - 0.6%, which represents a capacity of 20 to 40 L/s.

Based on flow monitoring data gathered in November and December of 1989 on Victoria Street, an average flow of 4 L/s for a population of 370 (including the northwest and southwest quadrants) represents per capita wastewater production of 930 L/c/d. This is considerably higher than the provincial design standard of 450 L/c/d. These excessive flows have reportedly been experienced since the construction of the collection system in the mid-seventies.

Closed circuit television (CCTV) inspections were undertaken for the 1988 Needs Study on 1,650 metres of sewer on Victoria Street South from North Beech to South Terrace, west to Maple Street, south to South Beech Street, east to Military Road (Hwy 34), and north to the intersection of South Terrace.

Minor inflow at 15 building connections were observed and a recommendation was made to confirm illegal connections using smoke testing. This recommendation was not undertaken due to a lack of funding.

The study further determined that 9% of the inspected sewer system had a sag condition which prevented filming of the joints in these areas because the camera was submerged.

The video inspection also revealed that 52 open, cracked and misaligned joints existed in the pipe sections. The joints were open on average 1 cm; however, there were some detected with openings as large as 10 cm. Overall the video inspection showed that approximately 10% of all joints were open. These are a major contributor of extraneous flow. The Needs Study noted that this figure was likely an underestimation of the number of open joints as there was a high probability that sewers with a sag condition also had open joints.

The Village has storm sewers only on Military Road (Hwy 34). The 1988 Needs Study indicated that no cross connections to the sanitary sewer were found.

Manholes

The Needs Study identified infiltration through the manholes as a problem. Minor leaks were found at 12 manholes and more significant infiltration was occurring at 14 manholes. The infiltration was located at joints between precast segments, at incoming pipes and at cracks in walls.

Four installations of rubber gaskets were done during 1988 and 1989. Two of the four rubber gaskets were reported to have performed well. Further recommendation was made to parge the outside of the manholes in the spring of 1990, however, this was not completed. In the summer of 1991 the Village undertook a manhole rehabilitation program. The details on the rehabilitation of ten manholes is presented in Table 4.4.

TABLE 4.4
SUMMARY OF MANHOLES REPAIR JUNE - AUGUST 1991

MH 14	Victoria & Monk Street (June 24, 1991)	• Brick chimney was replaced with concrete spacers. • Gaskets were installed beneath the taper cone. • Frost straps installed. • Backfilled with gravel.
MH 29	Front Street @ Main Street (June 25, 1991)	• Section beneath taper cone replaced with 24" from 30". • New gaskets beneath taper cone & first section. • Ladder rung leak repaired.
MH 21	John Street & Wood Street (July 4, 1991)	• Brick chimney replaced with concrete spacers. • New gaskets installed beneath taper cone. • Leak in ladder rungs repaired. • Backfilled with gravel.
MH 18	Thomas Street (July 16, 1991)	• Brick chimney replaced with concrete spacers. • Installed gaskets beneath taper cone and first concrete section. • Leak repaired at pipe connection. • Backfill with gravel.
MH 22	Broad Street (July 17, 1991)	• Brick chimney replaced with concrete spacers. • Gasket installed beneath taper cone. • Leak repaired at pipe connection. • Backfilled with gravel.
MH 27	Queen Street (July 18, 1991)	• Brick chimney replaced with concrete spacers. • New gaskets installed beneath taper cone. • Installed frost straps. • Backfilled with gravel.
MH 68	South Beech (July 24, 1991)	• Installed gaskets beneath taper cone and first section. • Installed frost straps. • Backfilled with gravel.

TABLE 4.4 SUMMARY OF MANHOLES REPAIR JUNE - AUGUST 1991		
MH 39	Molan Street (July 25, 1991)	• Replaced gaskets beneath taper cone. • Replaced leak at pipe connection. • Backfilled with gravel.
MH 36	Head Street (August 7, 1991)	• Replaced gasket beneath taper cone. • Adjusted height with new concrete riser rings. • Installed frost straps.
MH 67	South Beech Street (August 13, 1991)	• Gasket installed beneath taper cone, first, second sections. • Frost straps installed. • New concrete riser ring. • Backfill with gravel.

During a Lifelines Meeting, held on February 19, 1992, it was determined that at least one of the 10 manholes which had undergone remediation in the summer of 1991 was still leaking. The reconstruction was not successful because of manhole design and replacement should have been considered. A spring review of the 10 rehabilitated manholes was recommended, but it was not completed, again because of funding.

Illegal Connections

A house-to-house survey was conducted during the 1988 Needs Study. The survey revealed that 23 residences had improper connections into the sanitary sewer and the 45 had the potential for improper connections. A letter was sent to these residents identified in the 1988 Needs Study during the summer of 1989 advising them that they should disconnect from the sanitary sewer.

In November 1989, a second house-to-house survey identified the following:

Out of the 23 previously identified illegal hookups:
- 9 residents disconnected,
- 4 residents remained connected,
- from the 10 remaining, no sump pump was found at 4 and no entry was possible at the remaining 6.

Out of the 45 homes which had the potential for improper hookups:
- 17 residents disconnected,
- 4 still have improper hookups,
- from the 24 remaining, no sump pump was found at 16 and no entry was possible at the remaining 8.

In addition, roof leaders of each home were inspected during the house to house survey for possible connection to the sanitary sewer. Twenty-one homes had no visible surface outlet, however, no confirmed connections to the sanitary were found.

An update to the Needs Study was completed in January, 1990. At that time, it was recommended that a second notice to those residents which had not disconnected be issued and that further inspections be conducted. The Village decided to issue every resident a letter in regards to disconnection.

Sewer use is regulated by Bylaw 11-76. The sewer Bylaw was revised to incorporate stiffer fines for illegal connections in 1990.

4.2 Township of Lancaster

4.2.1 General

There are no communal sewage disposal facilities in the Township portion of the Greater Lancaster Area. Residents use a variety of private sewage disposal systems including privies, tile beds and holding tanks. Concern for the public health and the quality of the St. Lawrence River initiated studies of the private systems in the Hamlet of South Lancaster and the Community of Westley's Point.

4.2.2 Hamlet of South Lancaster

Under the terms of the St. Lawrence Remedial Action Plan, M.S. Thompson and Associates investigated 100 residences in the Hamlet in December, 1991 and January, 1992. The investigation included a door to door survey to collect responses to a questionnaire on the characteristics of sewage disposal facilities and visual inspections of the individual systems.

The survey found that forty-nine (49) of the systems surveyed were considered to be seriously substandard. The classification was applied if the homeowner did not use a Class IV septic tank and tile bed system but used a privy, leaching pit, cesspool or holding tank for sewage disposal. Some Class IV systems were considered seriously substandard if the tank volume was less than 2,273 L, if the tile bed lengths were less than 30 m, if there was improper separation from water supplies or if the septic tank age was greater than 25 years for concrete tanks and 15 years for steel tanks.

Satisfactory systems were found at 50 of the residences surveyed; however, some of these systems, even though appearing to function properly, did not comply with all of the current regulations pertaining to private sewage disposal.

The sewage disposal systems at two of the homes surveyed were considered to pose a hazard to public health and water quality, as both homes reported foul smelling ponding on their lots in the springtime. This likely indicates a failure of the septic system resulting in breakthrough of untreated sewage to the surface.

The M.S. Thompson report indicated that these results likely underestimated the number of faulty septic systems as visual inspection was difficult due to snow cover. The results also depended on the degree of accuracy of answers provided by the homeowner. The report also noted that the contamination of water supplies described earlier could be a result of the release of contaminants from faulty septic systems into the shallow aquifer that many of the wells draw their water supply from. The report noted that the hydrogeology of the area would not prevent the contaminated aquifer or surface drainage from discharging to the St. Lawrence River.

4.2.3 Westley's Point

Flooding and drainage problems are of major concern in this area. The R.R.C.A. concluded that the altered surface drainage patterns were resulting in seasonal inundation of septic systems. The review of sewage disposal in Westley's Point identified that 36 of the residents had Class IV system installed while the remaining 32 homes were serviced by holding tanks. R.R.C.A. noted that the soil characteristics and high water table in the area require that new septic systems be built with raised tile beds. Their survey noted that only 10 of the existing septic systems were of this design. The review also included analysis of surface water samples taken throughout the area. Samples taken at three different locations in Macintosh Creek five times throughout the summer of 1994 showed consistent elevated Phosphorous concentrations. E.coli counts were exceeded at each location at least once during the sampling programme. Both could be an indication that faulty septic systems are contributing to the degradation of the quality of the St. Lawrence River.

5. WATER EFFICIENCY AND WATER CONSERVATION

5.1 Water Use Breakdown

Overall water use can be broken down into the following three (3) general categories:

- Domestic Water Use
- Industrial, Commercial and Institutional (ICI) Water Use
- Unaccounted for Water

Although all consumers are metered, the Village does not maintain records on the consumption of individual users. For the purpose of this study, estimates will be made based on MOEE Guidelines to estimate water usage by the institutional and commercial sectors of the Village. There are currently no industrial customers serviced by the Village.

As noted previously, there are approximately 196 staff and students at the school in the Village. If it is assumed that water is consumed at a rate of 20 L/student/day, the school accounts for approximately 4.0 m^3/d of water demand. There are 60 residents in the nursing home. At a rate of 450 L/c/d, the nursing home water demand is approximately 27 m^3/d. The curling club is estimated to have a water demand of 10 m^3. There are currently 27 commercial or business units in the Village which are reported to be low water users. These consumers would typically consume 1,000 L/d for a total of 27 m^3/d. The fire hall, library and legion are also assumed to be low users adding 3 m^3/d to demand.

These demands are summarized in Table 5.1.

TABLE 5.1
VILLAGE OF LANCASTER
INSTITUTIONAL AND COMMERCIAL WATER USE

Water User	Average Water Use (m^3/d)
School	4
Nursing Home	27
Curling Club	10
Low Water Users	30
Total	71

Unaccounted for water is the difference between the total volume of water supplied to the distribution system and the total volume of water measured at the service connections. Common reasons for unaccounted for water are water system leaks, watermain flushing and fire fighting. A comparison between OCWA records and the Town metering records should be carried out to define this factor.

In the absence of this, an allowance of 10% will be assumed for fire fighting and biannual watermain flushing.

The MOEE consider losses greater than 15% of overall water use to be excessive. It is considered that the relatively recent installation of the distribution system and low consumption rates indicates a sound system with few leaks.

Based on the current average flow of 247 m^3/d, the water demand breakdown is assumed to be as follows:

TABLE 5.2
VILLAGE OF LANCASTER
AVERAGE DAILY WATER USE BREAKDOWN

Institutional/Commercial	71
Unaccounted For	24.7
Domestic	151.3
Average Day Demand	247 m^3/d

Based on the residential population of 690, the domestic average per capita water demand is 220 L/c/d. This is very low relative to other communities.

The Village reports that water use is charged at a rate of $1.10/$m^3$ and each homeowner is billed for a minimum annual demand of 117 m^3 plus consumption in excess of this.

A comparison of this rate to other similar sized communities shows it to be relatively high. The Ontario Water Works Association publishes a comparison of water rates for many communities throughout Ontario. In 1995, their report indicated that for 13 communities servicing less than 1,000 accounts, water rates ranged from $0.29 m^3 - $2.66 m^3.

It is considered that the relatively high water rate in combination with the problems with water quality is likely the reason for low water consumption.

5.2 Water Efficiency Strategies

Although water consumption is relatively low, some reductions in domestic water use may be realized by implementing the following demand management initiatives.

5.2.1 Public Awareness Campaign

The first step would be to develop and implement a public awareness campaign that educates consumers on how a water supply system works, why water conservation is important and how to use water more efficiently. The campaign would include publicizing the campaign through distribution of information flyers and through local media and the development of an information display to be presented at community events. An initial cost of $1500 would be required to develop the campaign and an annual cost of $750 would be required to maintain it. This strategy is estimated to reduce per capita water use by 5 L/c/d.

5.2.2 Faucet Retrofitting

The next step would be to distribute retrofit kits containing 2 toilet dams, 1 kitchen faucet aerator, 1 bathroom faucet aerator, 1 low flow showerhead, toilet leak detection dye tablets and installation instructions. These kits cost $10/kit and a cost of $5/kit has been assigned for labour required to distribute them for a total cost of $4,500. It would be the homeowners responsibility to install the kits and it is estimated that a 15 L/c/d reduction could be realized.

5.2.3 Additional Initiatives

Other communities with high water consumption have considered lawn watering restrictions and changes to the water rate structures as means to further reduce demand. A review of water demand in the Village does not show peaks that are indicative of high lawn watering. The peaks observed correspond with biannual flushing of the distribution system. Lawn watering restrictions are not expected to have a measurable effect on water demand.

Implementing an increasing block rate structure where the cost per unit of water increases as consumption increases has proved a successful means of demand reduction in many communities. It is not considered to be effective for the Village as rates are already relatively high and high demand is not currently a concern.

5.2.4 Impact of Water Demand Reduction

If the Public Awareness Campaign is implemented and retrofit kits are installed, then a total reduction in water demand of 20 L/c/d could be realized reducing domestic consumption to 200 L/c/d and the average day demand to 138 m^3/d.

These initiatives would not significantly impact Institutional and Commercial Demand or losses so the daily water use breakdown presented in Table 5.3 would be revised as follows:

TABLE 5.3 VILLAGE OF LANCASTER AVERAGE DAILY WATER USE BREAKDOWN WITH EFFICIENCY	
Institutional/Commercial	71
Unaccounted For	24.7
Domestic	138
Average Day Demand	234 m^3/d

If hydraulic reserve calculation are recalculated based on this reduction, then the system would have an uncommitted reserve capacity of 583 m^3/d.

At the revised demand of 311 L/c/d and a peaking factor of 2.5, this would allow the addition of 750 people to the service population.

6. SEWAGE OPTIMIZATION

6.1 Sewage Collection System

As indicated in Chapter 4, average per capita sewage flow in the Village of Lancaster is relatively high. While a reduction in water demand will have some effect on reducing sewage flows, it will not be significant. As indicated by Figure 4.1, and the discussion on the condition of the sanitary sewers, the major source of flow in the sewers since construction is infiltration through poorly sealed sewers and manholes. Reduction of sewage flows from these sources will be an essential component of any long term solution for Village servicing.

The 1988 Needs Study identified deficiencies and categorized priorities for the rehabilitation of the collection system. The tasks associated with the priorities all address the reduction of extraneous flow. The tasks included:

- priority one - grout open joints
- priority two - disconnect illegal connections
- priority three - seal leaking manholes
- priority four - repair leaky connections.

To date, emphasis has been placed on the sealing of leaking manholes and the removal of illegal connections.

Based on the problems identified in the investigations, a complete sewer sealing and rehabilitation program is necessary to effectively reduce extraneous flows.

The Needs Study carried out a camera inspection in areas in the west part of the Village where infiltration was considered to be highest. It is recommended that a complete inspection program be initiated to enable the Village to more fully identify the extent of repairs required. At an estimated cost of $3.50/m of sewer length, a CCTV inspection would cost approximately $21,525. Based on the results of the inspection, a rehabilitation program could be developed. A phased program, starting in the northwest quadrant, would allow the Village to monitor the success of the project through reduced sewage flows. The program would include several rehabilitation programs.

Chemical grouting of sewers can be considered to seal leaking joints and small cracks. The Needs Study identified 52 open or failed joints in the 1,650 m of sewer line inspected. They further noted that at least 9% of the system was submerged which may have concealed additional failed joints. If the percentage of open joints in the inspected portion is applied to the entire system it can be assumed that there are approximately 193 open or failed joint in the entire system that require repair. An additional factor of 10% should be applied to account for open joints in submerged lines resulting in a total of 213 joints to be grouted at an estimated cost of $350/joint for a total of $74,550.

In addition, the remaining joints should be tested for water tightness and any small cracks identified should be grouted. The cost for testing and sealing each joint is $30 per test and $40 per seal or approximately $35 per metre of sewer length. Based on 6,150 m of sewer pipe, the estimated value of a sewer sealing program would be $215,250.

The grouting procedures can be considered to seal leaking joints and small cracks to stop infiltration; however, it will not improve the structural strength of the pipe. In areas where the pipe is determined to be structurally unsound, a dig and replacement program will be required. The Needs Study indicated that the sewers were generally sound so for budget purposes, it will be assumed that 5% of the system is unsound and requires replacement at an estimated cost of $600/m for a total of $184,500. The sewers in a sag condition would only be required to be repaired if they were found to be responsible for measurable blockage of the system.

Lateral connections to the main line sewer have also been identified as sources of extraneous flow. In situations where the extraneous flow is not due to an illegal connection but rather an offset joint or crack, the lateral can be chemically sealed at a cost of approximately $700.00 each. It is estimated that approximately one third (72) of the homes in the Village will require lateral sealing. This represents a cost of $50,400.00.

Manholes can also be chemically sealed, however, the rehabilitation program undertaken in the summer of 1990 has revealed that many of the manholes were constructed without gaskets and are insufficiently designed. Manholes can be chemically sealed at a cost of $1,000.00/each. Manholes with damaged sections would be dug up and the sections replaced and regasketed. Including the cost of pavement restoration, this work would be estimated to cost $3,000.00 per manhole. Out of the 78 existing manholes 14 have been rehabilitated recently. The remaining 64 manholes will require rehabilitation. It is estimated that approximately half (32) could be chemically sealed and the other half will require reconstruction due to the presence of damaged sections.

TABLE 6.1
VILLAGE OF LANCASTER
SEWAGE COLLECTION SYSTEM REHABILITATION COSTS

Item	Quantity	Unit Cost	Total
CCTV Inspection	6,150	$3.50/m	$ 21,525
Joint Repair	213	$350/joint	$ 74,550
Sewer Testing and Sealing	6,150	$35/m	$215,250
Lateral Sealing	72	$700 each	$ 50,400
Manhole Sealing	32	$1,000 each	$ 32,000
Manhole Reconstruction	32	$3,000 each	$ 96,000
Sewer Replacement	308 m	$600/m	$184,500
Engineering and Contingencies			$ 90,000
Total			$764,225

6.2 Waste Stabilization Lagoons

The design of stabilization lagoons considers both biological and hydraulic loading from the incoming sewage.

The Wyllie & Ufnal Ltd design brief indicates that the lagoons were originally sized for a BOD loading of 20 lb/acre/day (22 kg/ha/day). The Lancaster lagoons have an area of 6 Ha which would permit a loading of 132 kg/day of BOD.

Based on raw sewage influent data, BOD loading to the plant has averaged 72.9 kg/day over the last three years which is 55% of the design loading. This indicates that the lagoons, while nearing hydraulic overload, have sufficient biological loading capacity to accept additional services. The BOD loading over the last three years is equivalent to 107 g/person/day. At this rate, an additional 552 persons could be added to the sewage system without biological overloading of the facility.

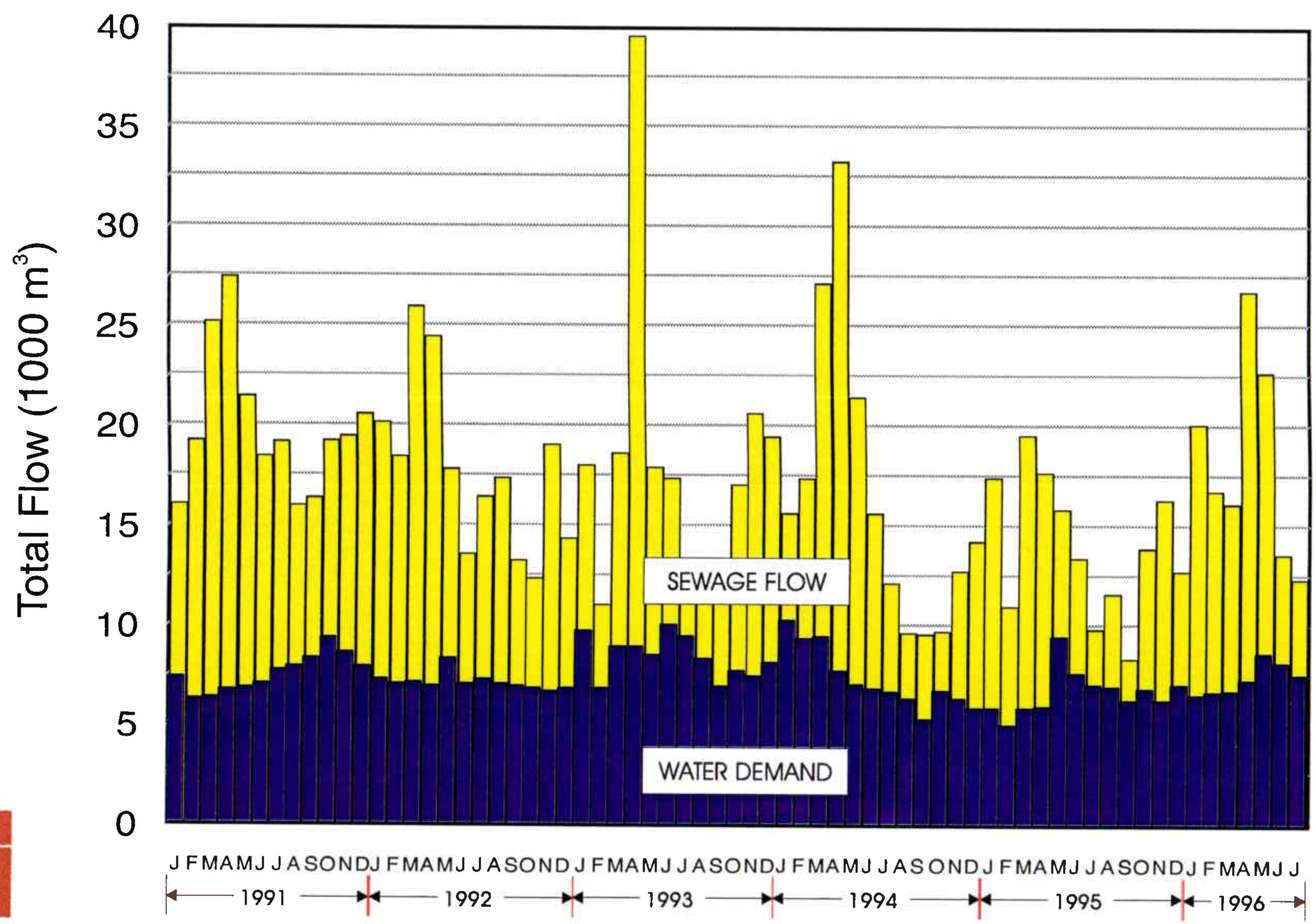
The sewage lagoons have a total volume of 118,000 m^3. Residence times for sewage flows of 590 m^3/d are 159 days.

As noted previously, MOEE recommend that sewage collection systems be designed for average per capita flows of 450 L/c/d plus an allowance of 90 L/c/d. At this rate, the Lancaster wastewater treatment system should be able to service a population of 1,090: however, the existing average day flow is 753 L/c/d which reduces the service population significantly.

If infiltration can be reduced, then water demand reductions brought about by water efficiency could release sufficient capacity to service an additional 28 people for a total of 1,118. If additional capacity is required to service a larger population, then the lagoons themselves may have to be modified.

The existing C of A does not establish effluent limits for discharge to Finney Creek from the lagoons. The MOEE currently apply the guidelines of MOEE Procedure F-5-1 requiring BOD concentration of 30 mg/L and suspended solids concentration of 40 mg/L. If this project results in any changes to the C of A, the MOEE will likely require an assimilative study on Finney Creek. A study conducted by the Raisin Region Conservation Authority found elevated phosphorous levels in Finney Creek. As such, the Creek has no assimilative capacity for additional phosphorous loading and phosphorous removal would likely be required. If it is found that BOD and SS have no critical impact on the creek, then effluent criteria would likely be set at 25 mg/L for BOD and 25 mg/L for SS. If the study shows that the effluent does have an impact on the creek, then considerably more stringent requirements may be imposed.

Village of Lancaster
Monthly Water and Sewage Flows



totten sims hubicki associates
engineers architects and planners

Figure 4.1

7. CONCLUSION AND RECOMMENDATIONS

7.1 Water Supply

- The capacity of the existing Village wells system is 1,309 m^3/d.

- It is considered that all of the quality problems with the municipal wells can be treated; however, the long term economics of operating and maintaining the system must be considered in the evaluation.

- Since water consumption levels are already low to moderate, water efficiency measures are unlikely to have a great effect.

- Based on this interim study, the existing water system service area population limit, taking into account all viable water efficiency measures, is 1,502 persons. This is not sufficient to supply the permanent population of the Greater Lancaster area and expansion or an alternative water supply will be required if municipal services are provided for the Greater Lancaster Area.

7.2 Sewage Disposal

- The existing sewage system capacity is 590 m^3/d.

- The lagoons are almost at hydraulic capacity.

- The system experiences high extraneous flow into the sewers. These flows have been experienced since shortly after the system was installed. It is recommended that a sewer rehabilitation program be undertaken to correct these deficiencies.

- A full sewer system rehabilitation program could potentially release capacity for 340 persons to service up to a total of 1,090 persons; however, it may be extremely difficult to achieve this high level of rehabilitation without considerable capital cost.

- The revised service population is not sufficient to service the total population of the Greater Lancaster Area. As a result, modifications to the treatment process would be required if the Greater Lancaster Area is provided with municipal services. This will require an amendment to the existing Certificate of Approval and likely result in more stringent effluent criteria being applied at that time.