OTTO TOWNSHIP CONTOUR TRENCH SEWAGE SYSTEM

By H.J. Hawken, P.Eng., H. Sutcliffe Ltd

CMHC Project Officer: A. Houston/C.Ives/M.Macpherson

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1.0 ABSTRACT

This project consisted of the design, construction and monitoring of a contour trench sewage disposal system to replace failed conventional septic tank and bed systems in four CMHC homes in Northern Ontario and was the first contour trench installed in the Province of Ontario. In this instance the contour trench system consists of a single disposal pipe laid in a gravel trench constructed in imported fill which follows a single contour permitting the effluent to take advantage of lateral flow along a single gradient. The system was developed in Nova Scotia. Monitoring of system performance indicated that the chemical wastewater constituents were being effectively treated through biological and mechanical processes. A problem was experienced with the hydraulic performance of the system. Some effluent breakout was experienced in a portion of the bed, presumably due to uneven effluent distribution. Most recently this problem has diminished and the monitoring data indicates that effluent distribution has become more equalized. It is suggested that the monitoring period continue to evaluate the long term performance of the stabilized system. Future installations of this type of system could be possible in the Province of Ontario if specific engineering and effluent guidelines were developed.

2.0 EXECUTIVE SUMMARY

INTRODUCTION

Several residences constructed in 1986 and 1987 in Otto Township by Canada Mortgage and Housing Corporation experienced chronic problems with the operation of their filter bed sewage disposal systems. Several attempts at rehabilitation of these systems through conventional methods have failed. A report completed by the Ministry of the Environment in 1989 indicated that problems with effluent breakout and hydraulic overloading were still prevalent. Up until November 1992 weekly septic tank pump-outs were used to control breakout. The pump-outs represented a significant cost to CMHC.

In 1990, CMHC retained H. Sutcliffe Limited to determine the causes of bed failure and to develop solutions to the problem. A study consisting of soil and soil/water investigations, topographic surveys, homeowner investigations and mounding calculations was conducted. It was learned that the native soil was not conducive to the use of inground private disposal systems, and that the lot structure presented a constraint in terms of property availability for private systems. The primary cause of failure, appeared to be the use of an inappropriate percolation time as the basis of design for the systems. It was concluded in the H. Sutcliffe Limited report "Otto Township CMHC Homes Septic System Study" dated August 1990, that the existing beds could not be rehabilitated using conventional systems, and that alternative solutions were required.

OBJECTIVES

This project had several objectives. Firstly, and most importantly, to find a private sewage disposal solution for the failed sewage systems at the four residences eliminating the need for expensive holding tanks. Secondly, should this installation prove successful, to provide data which will illustrate, to the regulation authorities, the effectiveness of the contour trench, as a private sewage disposal system, in difficult soil and groundwater conditions. Ultimately this would lead to the inclusion of contour trench systems, for use, as a sewage disposal option in areas where conventional systems cannot be built.

Site constraints necessitated the use of an innovative system; the recommended system was a communal, four home, contour trench system. Contour trench systems have been approved for use for approximately 10 years in Nova Scotia. At the time of this report a contour trench had never been constructed in Ontario, nor in conditions such as those in Otto Township, where dense clays and harsh winter climate hinder private sewage disposal systems. The system proposed consisted of a single distribution pipe laid horizontally in a partially raised imported fill bed, fed by four forcemains. Each of the four homes required a new a pumping chamber, pump and forcemain to pump the sewage effluent to the bed. To reduce overall loading to the contour trench system low flow plumbing fixtures were installed in each home.

METHODOLOGY

H. Sutcliffe Limited undertook the design of the contour trench system using a combination of design parameters from the Nova Scotia and Ontario regulations with the result that the system was approved for construction in mid-November 1992. Implementation of this innovative system was contingent upon the recognition, by CMHC, that the Contour Trench System is a prototype system, and that system implementation involved a degree of risk. The size of the site did not permit implementation of a full length contour trench. The available length was less and two-thirds of the desired length which necessitated the extension of an imported soil buffer to compensate for the short length of trench.

2.0 EXECUTIVE SUMMARY (Continued)

Following construction of the contour trench system, seven piezometers were installed in and around the bed as the initial step in a monitoring program (see enclosed plan for location of piezometers). The monitoring program was a condition of the Certificate of Approval for the project and consisted of seasonal gathering of data (twice yearly in 1993 and 1994) with respect to hydraulic and biological performance of the system. In addition to this, system flows were recorded by measuring hours of operation on each pump.

FINDINGS

The hydraulic data indicated that the system has had no noticeable impact on local groundwater elevations, but that for most of the first two years of operation, a hydraulic gradient (flowing from south to north) existed in the trench. (The homes drilled wells are located approximately 45 m west of the contour trench). An area of effluent breakout was observed at the toe of the mantle in the northerly portion of the bed. The breakout was attributed to uneven effluent distribution in the trench because of the hydraulic gradient

Chemical data indicated that the system was operating as designed, the effluent was migrating into the sub-soil and levels of ammonia and phosphorous were reduced in down gradient monitoring points.

Low levels of E. Coli were observed in samples of the breakout, however other sources of potential contamination existed and could not be eliminated as causes of the E. Coli counts. As a precaution well water was tested, no contamination was found.

The only major problem with the system has been the effluent breakout. Recent hydraulic data has indicated that the hydraulic gradient no longer exists. It is believed that full development of the biomat in the trench has equalized trench levels and has led to more even flow distribution. This is supported by recent field observations wherein no effluent breakout was evident.

The maintenance of the system is a concern. Residents have used the bed area for recreational uses, snowmobiling, ATV's and a dog house (with dog), have all been observed on the bed. Some residents cut the grass on the bed, some do not. An educational program initiated by CMHC would assist in addressing this problem.

CONCLUSIONS

For proper system operation, no hydraulic gradient should exist. The existence of the gradient may have been due to an area of imported clay fill in the southern portion of the trench left elevated in anticipation of settlement.

Remedial work to extend the mantle to control the breakout is necessary.

Despite the difficult conditions at the site, low permeability soil, previous system failures and evidence of poor system maintenance by the owners, the system performs reasonably well.'

As a consequence of this seemingly successful application of controur trench technology to the clay belt in Northern Ontario; extending the monitoring period for one year, undertaking further contour trench installations in Ontario in less difficult circumstances and the possible development of Ontario specific design guidelines for the contour trench system are now possible.

RÉSUMÉ

INTRODUCTION

Dans le canton d'Otto, quelques résidences construites en 1986 et 1987 par la Société canadienne d'hypothèques et de logement ont connu des problèmes chroniques liés au fonctionnement de leurs dispositifs d'assainissement à lit de filtration. On a tenté à quelques reprises de réhabiliter ces installations par des méthodes traditionnelles, mais sans succès. Un rapport rédigé en 1989 par le ministère de l'Environnement indiquait que les problèmes de débordement des effluents et de surcharge hydraulique subsistaient. Jusqu'à novembre 1992, on a dû procéder à une vidange hebdomadaire des fosses septiques dans le but de contenir les débordements. Ces vidanges ont été très coûteuses pour la SCHL.

En 1990, la SCHL a engagé la firme H. Sutcliffe Limited pour déterminer les causes des défaillances des lits de filtrationet pour trouver des solutions à ce problème. La firme a étudié le sol et l'eau du sol, a procédé à des relevés topographiques, a interrogé les propriétaires-occupants et a fait des calculs relatifs à la crête de la nappe phréatique. La firme a pu ainsi déterminer que le sol indigène ne se prêtait pas à l'utilisation d'un dispositif d'assainissement autonome souterrain et que la configuration du terrain était contraignante pour les installations autonomes. La cause première de la défaillance semble être l'emploi d'un temps de percolation inapproprié lors de la conception du dispositif. Dans son rapport daté du mois d'août 1990 et intitulé «*Otto Township CMHC Homes Septic System Study*», H. Sutcliffe Limited conclut que les lits de filtration en place ne peuvent être réhabilités par des moyens traditionnels et qu'il faut trouver des solutions de rechange.

OBJECTIFS

Cette étude avait plusieurs objectifs. D'abord et avant tout, il fallait trouver une solution pour remettre en état les dispositifs d'assainissement autonomes défaillants des quatre maisons afin de ne plus devoir recourir à des bassins de rétention coûteux. Ensuite, dans le cas où l'installation de rechange s'avérerait efficace, on voulait produire des données qui illustreraient, pour les autorités réglementaires, l'efficacité de la tranchée de niveau comme dispositif d'assainissement autonome dans des conditions difficiles relativement au sol et à la nappe phréatique. Au bout du compte, on espérait que l'étude mènerait à l'inclusion de la tranchée de niveau parmi les options d'assainissement à envisager dans les secteurs où l'on ne peut aménager d'installations traditionnelles.

Les contraintes du terrain ont nécessité l'emploi d'une installation innovatrice, à savoir une tranchée de niveau commune aux quatre habitations. L'utilisation des dispositifs à tranchée de niveau est approuvée depuis environ 10 ans en Nouvelle-Écosse. Au moment de rédiger ce rapport, aucune tranchée de niveau n'avait encore été réalisée en Ontario, encore moins dans des conditions comme celles du canton d'Otto, où l'argile est dense et les hivers sont rudes, gênant considérablement le fonctionnement des dispositifs d'assainissement autonomes. L'installation proposée est constituée d'un seul tuyau de distribution couché à l'horizontale dans un tertre d'infiltration importé qu'alimentent quatre conduites de refoulement. Chacune des quatre maisons nécessitait une nouvelle chambre de pompage, une nouvelle pompe et une nouvelle conduite de refoulement afin de pomper l'effluent vers le tertre. Pour éviter une surcharge de la tranchée de niveau, chaque maison a été dotée d'appareils sanitaires à faible consommation d'eau.

MÉTHODE

H. Sutcliffe Limited a conçu le dispositif à tranchée de niveau en utilisant à la fois les paramètres de conception des règlements de l'Ontario et ceux de la Nouvelle-Écosse, de sorte que la construction du dispositif a pu être approuvée au milieu du mois de novembre 1992. La mise en oeuvre de cette installation innovatrice dépendait de la reconnaissance, par la SCHL, que cette tranchée de niveau était un prototype et que sa mise en place comportait un certain risque. Le terrain n'était pas assez grand pour accueillir une tranchée de niveau pleine longueur. La longueur possible correspondait à moins des deux tiers de la longueur requise, ce qui a nécessité l'ajout d'une couverture de terre importée afin de compenser la faible longueur de la tranchée.

Une fois la tranchée de niveau construite, sept piézomètres ont été placés à l'intérieur et autour du tertre, constituant la première phase des opérations de contrôle (voir le plan ci-joint pour connaître l'emplacement des piézomètres). Le programme de contrôle était une condition préalable à l'obtention du certificat d'approbation pour le dispositif. Il s'agissait de recueillir des données saisonnières (deux fois en 1993 et deux fois en 1994) au sujet de la performance hydraulique et biologique du dispositif. En outre, on a enregistré le débit du dispositif en mesurant les heures de fonctionnement de chaque pompe.

RÉSULTATS

Les données hydrauliques ont révélé que le dispositif n'avait eu aucune incidence notable sur le niveau phréatique local, mais que durant les deux premières années de fonctionnement, il s'était formé un gradient hydraulique (du sud vers le nord) dans la tranchée. (Les puits forés des maisons sont situés à environ 45 m de la tranchée de niveau). Une zone de débordement de l'effluent a été observée à l'extrémité de la couverture de terre, sur la partie nord du tertre. Ce débordement est attribuable à une répartition inégale de l'effluent dans la tranchée causée par le gradient hydraulique.

Les données chimiques indiquent que l'installation fonctionnait comme prévu, que l'effluent migrait dans le sous-sol et que les concentrations d'ammoniaque et de phosphore étaient réduites aux points de contrôle en aval du gradient.

De faibles concentrations de *E. coli* ont été observées dans les échantillons prélevés du débordement, mais cette contamination a pu provenir d'autres sources qui n'ont pas pu être éliminées. À titre de précaution, l'eau des puits a été testée, mais l'analyse n'a révélé aucune contamination.

Le seul problème important qu'a occasionné ce dispositif a été le débordement de l'effluent. De récentes données hydrauliques ont par ailleurs révélé que le gradient hydraulique avait disparu. On croit que la croissance complète du lit bactérien dans la tranchée a égalisé les niveaux de la tranchée et a permis une distribution plus équilibrée du débit. Cette hypothèse s'appuie sur de récentes visites du site durant lesquelles aucun débordement de l'effluent n'a pu être observé.

L'entretien du dispositif pose toutefois un problème. Les résidents touchés utilisent le tertre d'infiltration à des fins récréatives; on y a vu des motoneiges, des véhicules tout terrain et même une niche occupée par un chien. Certains résidents tondent le gazon qui pousse sur le tertre d'infiltration, d'autres non. La SCHL pourrait contribuer à régler ce problème en mettant sur pied un programme d'information.

CONCLUSIONS

Le dispositif ne peut fonctionner correctement en présence d'un gradient hydraulique. Le gradient hydraulique s'est peut-être formé parce qu'une zone du remblai d'argile importé avait été laissée relevée dans la portion sud de la tranchée en prévision d'un tassement.

Il faudra procéder à des travaux de réfection afin de prolonger la couverture de terre de manière à prévenir tout débordement.

En dépit des conditions difficiles sur le site, de la faible perméabilité du sol, des défaillances antérieures et d'un manque d'entretien manifeste par les propriétaires, le dispositif fonctionne raisonnablement bien.

Étant donné le succès relatif remporté par cette application de la technique de la tranchée de niveau à la ceinture d'argile du nord de l'Ontario, il est maintenant possible de prolonger la période de contrôle de une année, d'entreprendre la pose d'autres tranchées de niveau en Ontario dans des circonstances moins difficiles et de procéder à l'élaboration de directives de conception des tranchées de niveau particulières à l'Ontario.

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3.0 BACKGROUND STATEMENT

3.1 Project Location and Description

Several Rural Native Housing (RNH) residences were constructed in 1986 and 1987 for Canada Mortgage and Housing Corporation in the Geographical Township of Otto, near Kirkland Lake, Ontario, by a local General Contractor. Four homes were constructed along Highway 112 in Lot 4, Concession 6, Otto Township. Since communal water and sewer services for this area are unavailable, part of the CMHC contract called for the contractor to provide for each residence, a well, and a private sewage disposal system.

The construction of the sewage systems was undertaken, by a subcontractor, with the arrangement that the General Contractor perform the percolation tests and provide the results for use by the Subcontractor. For all residences constructed on these sites, individual septic tanks with filter type leaching beds were used. A filter type leaching bed is distinct from a conventional absorption trench bed in that the distribution pipes are laid in a continuous sand filter bed as opposed to individual trenches.

The private sewage disposal systems at the CMHC homes all failed to perform adequately. Frequent breakout of effluent occurred through the sides and tops of the beds. Corrective measures were taken; some beds were enlarged and some beds had additional fill added. The operational problems have persisted, with the result that CMHC had resorted to weekly pumpouts of the septic tanks to control bed breakout.

CMHC arranged several meetings with the Ministry of the Environment (MOE) and the Timiskaming Health Unit to evaluate solutions to the problem, culminating in a report on the septic systems by the MOE in late 1989. The report completed by the Ministry of the Environment in 1989 indicated that problems with effluent breakout and hydraulic overloading were still prevalent. Up until November 1992, weekly septic tank pumpouts were used to control breakout. The pumpouts represented a significant cost to CMHC.

In 1990, CMHC retained H. Sutcliffe Limited to determine the causes of bed failure and to develop solutions to the problem. A study consisting of soil and soil/water investigations, topographic surveys, homeowner investigations and mounding calculations was conducted. It was learned that the native soil was not conducive to the use of inground private disposal systems, and that the lot structure presented a constraint in terms of property availability for private systems. The primary cause of failure, appeared to be the use of an inappropriate percolation time as the basis of design for the systems. Over consumption of water may have contributed to the failure of the systems, however this did not appear to be a major factor, based upon flow monitoring data collected during the study.

It was concluded that the existing beds could not be rehabilitated, and that alternative solutions were required. Conventional alternatives were considered, where possible, however the site constraints necessitated the consideration of some innovative systems; the recommended system was a communal, four home, contour trench system. Contour trench systems have been approved for use for approximately 10 years in Nova Scotia. At the time of this report a contour trench system had never been constructed in Ontario, nor in conditions such as those in Otto Township, where dense clays and a harsh winter climate hinder private sewage disposal systems. The system proposed consisted of a single distribution pipe laid horizontally in a partially raised imported fill bed, fed by four forcemains. Each of the four homes required a new pumping chamber, pump and forcemain to pump the sewage effluent to the bed (see Appendix D).

H. Sutcliffe Limited undertook the design of the contour trench system using a combination of design parameters from the Nova Scotia and Ontario regulations with the result that the system was approved by the MOE (as an experimental system) for construction in the fall of 1992. The system was constructed, and placed into operation in mid-November 1992. The implementation of this innovative system was contingent upon the recognition by CMHC that the Contour Trench System is a prototype system, and that system implementation involved a degree of risk. In addition, the co-operation of the Ministry of the Environment and the Timiskaming Health Unit was fundamental to the successful implementation of the innovative system.

3.2 Need for this Project

This project was necessary to develop the design criteria and construction technique required for providing an alternative to conventional septic systems in areas where soil or physical constraints rule out the use of conventional systems. Although the contour trench sewage disposal system has been studied in a variety of settings, its suitability for use in the heavy clay soils and harsh climate of Northern Ontario has never before been examined.

3.3 Benefits of this Research

This work provides data for the Ministry of the Environment and Energy to develop design guidelines for Contour Trench Sewage Systems which could be incorporated into Provincial Regulations. If the MOEE includes the contour trench system, in Provincial Guidelines, another sewage disposal option will be available to homeowners in the Province of Ontario. This will be of benefit in areas where soils are poor and/or groundwater elevations are near surface. In addition, construction of a contour trench system will provide significant cost savings in areas where the only other option would be a mechanical treatment plant or holding tank systems. A further benefit will be that designers in other parts of Canada with similar soil types and climate can use the data collected in this study to determine if the contour trench system is suitable for use in these areas.

4.0 PROJECT OBJECTIVES

This project had several objectives. Firstly, and most importantly, to find a private sewage disposal solution for the failed sewage systems at the four residences eliminating the need for expensive holding tanks. Secondly, should this installation prove successful, to provide data which will illustrate to the regulation authorities, the effectiveness of the contour trench, as a private sewage disposal system, in difficult soil and groundwater conditions. Ultimately this would lead to the inclusion of contour trench systems for use as a sewage disposal option in areas where conventional systems cannot be built.

5.0 SYSTEM DESCRIPTION

5.1 General

The sewage disposal system selected by Sutcliffe to address the sewage contamination problem at Otto Township is the Contour Trench System. This system was developed by the Nova Scotia Department of Health and Fitness and is currently included in their guidelines as a private sewage disposal option along with conventional absorption trench and filter beds. The contour trench system consists of a pipe laid in a trench (in either natural soil or imported material) along a natural contour at a constant depth such that the pipe within the trench is perfectly horizontal. The trench itself is similar to an absorption trench in that the pipe is embedded in a gravel or stone bed.

An important consideration in the design of the contour trench system is the crossfall of the site. Since the system relies on horizontal movement of sewage effluent through the soil driven by the hydraulic gradient created by the natural slope, contour trench systems are generally used only on sites with natural slopes greater than 5%.

There are three types of contour trench systems defined in the Province of Nova Scotia Guidelines. A C1 trench is an inground system, C2 is partly raised and a C3 trench is a fully raised system. A typical section for C2 and C3 type of system are shown in Appendix B. The C2 system is used where impermeable soil is near surface, and/or insufficient space is available for a full length C1 trench. The C3 system is used where fractured bedrock is at or near surface (Pask, D.A.; 1988). Note that each of these systems has an upslope and downslope buffer of imported fill material. The buffer is equivalent to a mantle in a conventional raised absorption trench leaching bed.

The treatment of the sewage takes place as the effluent is distributed throughout the length of the bed and filters downslope through the buffer material.

5.2 Otto Township Contour Trench System

The Otto Township Contour Trench System closely resembles the C2 system as described in the Nova Scotia Guidelines. Some modifications were made to conform as much as possible to the Ontario Guidelines with respect to buffer (mantle), daily flows and separation distances. A section of the contour trench used at Otto Township is shown on Plan 90-532 (Sheet 2, Appendix D). The cross-sectional dimensions of the trench conform with the Nova Scotia Guidelines with the exception of the buffer zone and trench width. The buffer zone width was increased to 15.0 m to provide a daily sewage loading rate of approximately 5 L/day.m^2 on the buffer. This value more closely reflects the acceptable loading defined for mantles in the Ontario guidelines. Accordingly, the trench width calculation was based upon Ontario daily flow estimates, resulting in a trench width of 3.25 m. The trench width is critical in the design of the contour trench. Width is based on a trench area of 1.5 ft^2 per gallon per day. Further details on design methodology are provided in Appendix A.

The septic tank effluent, from the four homes connected to the system, is pumped through individual forcemains to the distribution pipe using effluent pumps (see plan 90-532, Sheet 2, Appendix D), providing for quite random loading patterns.

6.0 PROJECT METHODOLOGY

The project was separated into three phases. Phase I involved completion of the preliminary and final design of the contour trench system, construction of the system and installation of monitoring equipment. This phase commenced in August of 1991, with the agreement in principle by MOE to allow the installation of the Contour Trench system, and concluded in November of 1992 with the installation of the monitoring equipment.

Phase II consisted of monitoring the performance of the contour trench system. This phase of the operation commenced in the Spring of 1993 and continued until October of 1994.

Phase III of the project required that all information collected be assembled and compiled into a report for CMHC.

6.1 Phase I Methodology

1. Following receipt of a letter from the Ministry of the Environment (MOE), approving in principle the use of a contour trench system to solve the sewage disposal problems being experienced by several Rural Native Housing (RNH) residents along

Hwy. 112 in Otto Township, District of Timiskaming, this phase of the project commenced in August of 1991.

2. H. Sutcliffe Limited undertook the design of the system in consultation with D. A. Pask[2] (developer of Contour Trench System in Nova Scotia). A preliminary design submission was made to MOE in October of 1991.

3. Comments on the design were received from MOE in June of 1992. H. Sutcliffe Limited responded to the MOE comments in a report dated July 23, 1992. At a subsequent meeting held August 25, 1992, the concerns of the MOE were reviewed and an agreement on the final design configuration was reached. D. A. Pask also reviewed MOE comments and the H. Sutcliffe Limited response. Design calculation summary is provided in Appendix 'A'.

4. On September 14, 1992, the revised design was submitted to MOE for approval along with a letter from D. A. Pask confirming the suitability of the design (See Appendix B.). At the same time quotes for construction were requested from the preferred contractor (Helmer Pedersen Construction Limited).

5. During the second week of October a verbal approval was provided by MOE to proceed with construction. Quotes were approved by CMHC near the end of October and instructions to commence construction were given to the Contractor.

6. Construction commenced on November 2, 1992. The contour trench part of the bed was completed and inspected on site by D. A. Pask on November 7, 1992. Mr. Pask prepared a report discussing the design and proposed monitoring program. (See Appendix B.)

7. Construction for the 1992 season was completed November 13, with the exception of the installation of the low flow devices and topsoil and seeding. The contour trench began servicing all 4 homes in November 1992.

8. A conference call was held November 12, 1992, with MOE, wherein the monitoring program was reviewed and agreed upon. On November 17, 1992, piezometers were installed at the site to prepare for the monitoring program.

6.2 Phase II Methodology

Monitoring data collected consisted of hydraulic, chemical and bacterial information. Details on the materials and methods used are presented, as follows:

1. Piezometers - Piezometers were constructed of varying lengths of 50 mm diameter PVC tubing, capped on both ends. Water enters through 3 saw cut slots at the bottom end. The slots were covered with woven geotextile to prevent soil from entering the piezometer. Piezometers were installed by augering holes to the specified depth, inserting the piezometer and backfilling the space between the piezometer and hole wall (above the slots) with clay. A photograph of a piezometer is provided in Appendix 'C'.

Horizontal locations for the piezometers are provided on Plan 90-532, Sheet 2.

Vertical locations for the piezometers are as follows:

- Piezometer #1 rests on bedrock upstream of the bed (0.845 m below surface).
- Piezometer #2 & #3 terminate in the gravel layer of the contour trench (0.6 m below surface).
- Piezometers #4 & #7 terminate in the natural clay below the mantle (0.76 m and 0.78 m below surface respectively).
- Piezometers #5 & #6 terminate at the clay mantle interface (0.30 m and 0.325 m below surface respectively).

2. Hydraulic Monitoring - Hydraulic monitoring was undertaken at the same time as chemical sampling. Water levels were obtained in the piezometers using water

level indicators prior to pumping for chemical samples. Levels in the piezometers were related to geodetic elevations and recorded. (See Appendix 'A')

3. Chemical/Biological Monitoring - The agreed upon scheduling for chemical/biological sampling was two times per year, spring and fall for two years (1993 and 1994). Initially the procedure used for sampling was as follows:

- Separate suction tubing lines were inserted in each piezometer (after rinsing each line with distilled water).
- A peristaltic pump was used to purge each piezometer and the piezometers were allowed to refill.
- Once the piezometers were refilled, samples were obtained (using the peristaltic pump) and analyzed using standard methods for the following parameters:

- Conductivity	- Ammonium
- PH	- Nitrate
- Chloride	- BOD_5
- Phosphorous	- COD.
- Kjeldhal Nitrogen	

On several occasions, insufficient effluent volumes were obtained for a complete set of results. The procedure was then modified for the 1994 sampling run to obtain a greater effluent sampling volume. The modifications were as follows:

- A bailer was used to obtain samples. Two sets of samples were taken; one prior to purging the piezometers and the second set after allowing the piezometer to refill.
- Between piezometer samples, the bailer was rinsed with distilled water.

- Samples were collected on a random basis for bacterial basis from piezometers and surface waters and were analyzed for Total and E-Coli Coliform Bacteria at the Ministry of Health Laboratory in Timmins.

To ensure that the system was not deteriorating well water quality samples were also obtained from the wells of two of the residents and analyzed for:

- Conductivity	- Nickel
- Hardness	- Lead
- Calcium	- Zinc
- Sodium	- Iron
- Alkalinity	- Manganese
- pH	- Silver
- Fluoride	- Aluminum
- Chloride	- Arsenic
- Sulphate	- Cadmium
- Nitrates	- Nitrite
- Copper.	

4, System Flow Data

Data on contour trench system effluent flow was established by using hour meters connected to each pump. By calculating system head and using the pump head/flow relationship, the average pumpage rate was established. Hour meter readings were recorded during each sampling event to estimate flow to the bed.

6.3 Phase III Methodology

Phase III consisted of the analysis and interpretation of the collected data in order to draw conclusions as to the performance of the system. Bruce Wilson (Senior

Hydrogeologist) of International Water Consultants provided analysis of chemical, hydraulic and bacteriological data and prepared reports addressing these issues.

This information together with a review of previous literature on contour trenches (including research reports, Nova Scotia guidelines, conference proceedings and media articles) provided the base of information on which this final report has been prepared. Site photographs were reviewed to record visible changes in the performance of the system over time. Information such as odour complaints and site wetness received from occupants of the homes connected to the system was also taken into account in assessing the performance of the system.

A comparison between the contour trench system and conventional systems was undertaken by comparing analytical results (obtained from samples of contour trench effluent) with previous MOEE published[18] research undertaken on effluent characteristics on conventional septic systems.

The MOEE was contacted to establish the conditions under which future use of the contour trench may be permitted. All of this information has been assembled and is now presented, together with related appendices.

7.0 DATA ANALYSIS AND RESULTS

7.1 Background Information

Much of the background information relevant to this study was obtained from the 1990 report of H. Sutcliffe Limited entitled "Otto Township CMHC Homes Septic System Study". Following is an excerpt from that study which describes soil types, percolation rates, groundwater elevations and soil contamination.

"The site is located along Hwy. 112 on the boundary between a clay plain and a ground moraine. East of the site, and up gradient there is a bedrock ridge and ground moraine landform consisting primarily of glacial till. Part of this area (approximately

200 ha) drains toward the study area. The residences are located on a glaciolacustrine plain which consists of mixed wet and dry clay and silty clay soils. Percolation rates for this type of soil are generally in the vicinity of 50 minutes per cm (0.02 cm/min.) with permeability in the 10^{-8} to 10^{-7} cm/sec range. The percolation and permeability tests conducted on the native soil of the site support the expected findings in that the measured percolation times were all in excess of 50 min/cm and the measured permeability rates were less than 1×10^{-8} cm/sec. In most cases it was not possible to complete the standard percolation and permeability tests since water was either stationary, or infiltrating into the test holes.

Groundwater levels at the site ranged from 1.77 m below surface to 0.4 m below surface. Complete groundwater monitoring results can be found in Appendix A.

A review of the MOE report on the existing systems indicates that the septic systems for the site were constructed on the basis of measured percolation rates of 5 to 20 min/cm, and that three of the systems were enlarged subsequent to the original installation."

7.2 System Construction

The system was constructed in the Fall of 1992, following receipt of approval from the Ministry of Environment and Energy [Mr. Ray Banach] to proceed with construction. On November 2, 1992, construction began. Work was completed for the season on November 13th, 1992 with the outstanding work consisting of the installation of the low flow devices in each home, parging of the pump chambers and the topsoil and seeding of the contour trench bed. The remaining work was completed by May of 1993.

1. Scope of Work

The system was constructed by Pedersen Construction Inc. of New Liskeard, Ontario, at a total cost for the four residences of $44,001.61. This cost breaks down to approximately $11,000.00 per bed which is comparable to the cost of a conventional raised absorption trench bed in this area. The scope of the work for the project was as follows:

- Clearing and grubbing of bed and mantle (buffer) area.
- Excavation for base of contour trench, cutoff ditch and French Drain.
- Construction of contour trench bed including pipe, stone, geotextile, imported fill bed and mantle, french drain, topsoil and seeding.
- Supply and install four pump chambers, effluent pumps, alarm system, floats, wiring, discharge piping and mechanical appurtenances.
- Supply and install each residence with a low flow (1.6 gal. per flush) toilet, low flow showerhead and faucet aerator.

Dimensions for the bed are shown on the construction drawings in Appendix 'D'.

2. Installation Procedure

The procedure followed in constructing the bed was as follows:

- Excavate cutoff ditch to drain water away from bed area.
- Construct French Drain upstream of bed.
- Excavate bottom of trench (horizontal) at prescribed contour elevation.
- Install sand, stone and pipe for distribution bed, enveloped in non-woven geotextile.
- Install pump forcemains from pump chamber location to distribution pipe.
- Haul in and spread imported fill for raised portion of bed and mantle

- Grade imported fill and moderately compact with machinery used for spreading.
- Install pump chambers, pumps, floats, alarm, valves and fittings, make electrical connections and connect pump chamber to existing septic tank.
- Install low flow devices in each household.
- Under appropriate weather conditions, topsoil and seed bed and mantle areas.

3. Construction Challenges

The construction of the system went according to plan with two exceptions. During construction of the cutoff ditch upstream of the bed, a bedrock outcrop was encountered, and the ditch was rerouted around the outcrop. This modification did not affect construction of any other portion of the bed.

The second problem which occurred was the discovery (when the trees were removed) of the remnants of a small gully in the southern portion of the bed area. This presented a problem in that it was necessary to import material to maintain a horizontal base for the bed. The gully was approximately 10 m N. of the S. end of the bed.

To overcome this problem, imported clay was hauled in to build up the base of the bed to the correct elevation. Although the clay fill was compacted as it was placed, there was concern about the clay settling. For this reason, the clay fill in this area was elevated approximately 25 mm to provide for future settlement. The fill material has functioned well, however the area has not settled to the degree expected. It is estimated that the clay material has settled over the course of the past two years since water elevations in the trench have equalized.

7.3 Wastewater Flows

Wastewater flows to the system were estimated by determining the flow rate of the pump under the head conditions on the system and recording the actual operating hours of the pump. Hourly readings were taken shortly after system startup in December 1992 and continued throughout 1993, ending with a reading in November of 1994.

The results of the monitoring are presented in Table I (Appendix A). It was noted that the flows for the period December 1992 to May 1993 were extraordinarily high (13,000 to 15,000 L/day per household). This can be explained by the fact that the pump chambers were not parged (due to late completion of construction in 1992) and groundwater entered the tanks. The tanks were sealed in May of 1993 and pumpage rates have decreased dramatically. Discarding the data from December 1992 to May 1993, the average daily pumpage rate was 725 L/day per household.

The water consumption rate prior to installation of the system was measured for a two week period and average 885 L/day per household. The difference in consumption can in part be attributed to the low flow shower heads, toilets and faucet aerators which were installed as part of the contour trench project. The design values for daily flows were 1600 L/day, per household (Ontario values) and 908 L/day per household (Nova Scotia values).

7.4 Hydraulic Performance

The analysis of the groundwater elevation data indicates that the bed has had little effect on the elevation of the local groundwater system. As noted in the groundwater analysis report (see Appendix A) the elevations observed in the distribution trench (piezometers 2 and 3) have risen approximately 25 centimetres in the two year period from May 1993 to May 1995. It is also important to note that there was a hydraulic gradient within the bed in May of 1993 since the elevation in the northerly piezometer (No. 3) was 50 mm lower than the water level measured in piezometer No. 2. Since that time, elevations of the water level in both piezometers have risen, however the rate of rise in piezometer 3 has been more rapid such, that by May of 1995, the elevation of the water in piezometer 3 is slightly higher than piezometer 2.

The explanation for the equalization of water levels in piezometer 2 and 3 is possibly due to the gradual settling action of the clay fill near piezometer 2. As the clay settled, the effluent gradually became more evenly distributed throughout the bed. This fact is critical to the performance of the contour trench, as even distribution of effluent throughout the length of the trench is required for proper treatment of the effluent.

The effect of the uneven distribution of effluent is evidenced by the earlier surface breakout of effluent at the toe of the mantle in the northerly section of the bed (near piezometers 4 & 5) while the southerly portion of the mantle has remained dry. (See photos - Appendix 'C'.) In the initial operation of the system, a greater proportion of the effluent was flowing to the northerly section of the bed (due to the hydraulic gradient) resulting in overloading and breakout at the toe of the mantle as the effluent moved horizontally down the slope. Samples of the breakout were collected and analyzed (see Section 7.5).

Most recently (June 1995), it would appear that the effluent may be now more equally distributed throughout the mantle since the effluent is no longer breaking out at the toe of the mantle....Further observation of the bed will be necessary to determine if this situation is temporary (due to seasonal effects).

Another possible explanation for the equalization of the flow in the bed may be the development of the biomat in the trench. As the biomat develops, a certain amount of clogging occurs. It is not uncommon for the biomat to take up to two years to completely develop, and the related clogging may have caused the effluent to become more evenly distributed throughout the trench.

It is noted that a similar problem occurred at the Takla Landing Contour Trench system in Northern British Columbia. The breakout in this system was attributed to uneven distribution of flow in the trench due to overexcavation, fill and post-construction settlement (CMHC Report, Reference No. 5).

7.5 Chemical/Biological Data

The results of the chemical monitoring data indicate that the system is effectively reducing concentrations of ammonia and phosphorus in the mantle of the bed. As indicated in the Review of Chemical Data (see Appendix 'A') the concentration of ammonia and phosphorus in the downgradient soils (native material) is greater than in the mantle, indicating that the effluent is entering the natural soil.

In summary, from a chemical perspective, the system appears to be functioning as expected. Effluent is entering the native soil, and reductions in ammonia and phosphorus are occurring as the effluent migrates downslope.

As noted in the Review of Chemical Data, there is a concern with respect to the breakout of effluent which has occurred at the toe of the mantle in the north section of the bed. The presence of E-Coli bacteria has been detected in the swale downslope of this area. Although the levels of E-Coli detected are not high enough to exclude other possible sources of contamination, the report recommends measures which can be taken to control the breakout. For instance, the presence of animal waste and rotting carcasses in the area could be a potential source of E.Coli bacteria.

As a precautionary measure, well samples were taken in 1994 to determine if any noticeable impact from the sewage system could be detected in the well water. From the results in Appendix 'A', it is evident that all parameters tested meet the Ontario Drinking Water Objectives.

The complete Review of Chemical Data and related chemical results are available in Appendix 'A'.

8.0 Discussion of System Performance

8.1 Design Considerations

The preliminary study for this project suggested that the contour trench for this site be designed for three homes only. Because no other septic tank effluent disposal option was available for the fourth home, the decision was made to include this home in the system.

As noted in the design calculations, the length of available trench to service four homes was less than two-thirds of the theoretical length specified in the Nova Scotia guidelines. This determination was made using daily flows as recommended in the Nova Scotia guidelines which are approximately 60% of the values used in Ontario. With the conditions at the site, low permeability soil, previous system failures and evidence of poor system maintenance by owners, it would have been preferable to limit the loading on the contour trench such that the theoretical trench length could have been used.

To compensate for the lack of contour length available for the four homes, the buffer zone (mantle) width was increased in accordance with Province of Nova Scotia Guidelines. The Nova Scotia guidelines call for the width of the buffer zone to be doubled when the actual length of available contour is less than two-thirds of the theoretical length. In the case of Otto Township, this required increasing the buffer zone width from 6 m to 12 m. It was decided during the design process to increase the buffer zone (mantle) width to 15 m to comply with Province of Ontario regulations and to reduce loading rates to less than 5 L/m^2.day in accordance with Ontario Guidelines. This increased system cost, but was necessary to obtain MOEE approval.

A second design variance was undertaken with respect to establishing the trench width. Trench width is calculated by using the actual trench length and a loading rate of 1.5 ft^2 per gallon per day (0.03 m^2/L per day) based upon design flows. Instead of using Nova Scotia design flows for this calculation, the higher Ontario flows were used which resulted in a minimum acceptable trench width of approximately 3 m (10'). All other design features followed the Nova Scotia guidelines (See Design Summary Appendix A).

For future installations of contour trench systems in Ontario, differences between Ontario design flow rates and the Nova Scotia rates should be resolved.

8.2 System Hydraulic Performance

1. Water Consumption

The water consumption rates for the residences connected to the contour trench system appear quite reasonable. The rates as determined by pump operating hours tend to support the design flows as established by the Nova Scotia guidelines, however the factor of safety in this Ontario situation is approaching one.

A further consideration on the point of water use as it affects trench loading, is that some of these residences are rental units with occupants having a somewhat transient lifestyle. There were periods during the study period where some residences were unoccupied while others have had additional occupants from time to time.

With respect to the low flow devices installed, they appear to have decreased water consumption on average by approximately 18%. These installations utilized toilets with a 6 L/flush flow rate, showerheads with a 8 L/min. flow rate and faucet aerators with a 5.7 L per minute flow rate. The results indicate that the use of these devices is beneficial and that they should be specified in all new Rural Native Housing construction and in situations where failed sewage systems are being replaced.

2. Pump System

As shown on Plan 90-532, Sheet 2, individual effluent pumps mounted in pump chambers were used to pump the septic tank effluent to the contour trench distribution pipe. Each pump is equipped with an on/off float, an alarm float and an alarm panel. The pump chambers discharge-volumes were set at different values by changing float levels. This was done to try and spread the flow to the bed over a longer span of time during each 24 hour period. Each pump discharges to the distribution pipe by an individual forcemain which is self-draining. Each home was equipped with its own forcemain for "administrative" rather than technical reasons; as there is a possibility that these homes could become privately owned in the future and the intent was to have as much of the sewage treatment system as possible maintained by each homeowner.

There have been no problems with the pumping system, and no complaints have been received regarding the pumps.

3. Contour Trench Performance

The contour trench system has performed reasonably well. The monitoring data has indicated that harmful concentrations of ammonia and phosphorus are being reduced, and that effluent is being transmitted into the underlying soil.

The project cannot be considered a complete success because of the breakout which has occurred at the toe of the northern portion of the bed. Several possible causes for this occurrence have been considered. The differential in the water levels between the south and north portions in the bed indicates that a hydraulic gradient existed and that a greater portion of the flow was being directed to the north end of the bed. The gradient may have existed because of the clay fill added beneath the south section of the fill and elevated in anticipation of the fill settling.

More recent measurements in the trench have indicated that the water levels have equalized in the north and south ends of the bed. This may indicate that the clay has settled, or that the clogging of the biomat in the trench has compensated for the gradient and stabilized the water levels. During a site visit on June 27, 1995, it was noted that no breakout or seepage was evident in any portion of the bed. Continued observation of the bed is required to determine if the breakout problem will reoccur during the high rainfall season.

With respect to the bacterial quality of the breakout, there has been evidence of the trace of E-Coli but not to levels which could specifically be attributed to the bed as a source and not such that a health concern exists. A remedial work program has been proposed to address the breakout. The work consists of extending the mantle approximately 3 m downgradient to the swale at the toe and thickening the mantle by 100 to 150 mm in areas where breakout is evident. The mantle extension is to be completed for approximately the northerly two-thirds of the bed. The extended mantle area is to be covered with topsoil and seeded following installation.

4. System Maintenance

The operation and maintenance of the system is becoming a concern. At various times during site visits there has been evidence of activities on the bed which could shorten the system life and impair performance. During winter months, snowmobiles have been driven across the bed while in the summer all terrain vehicle and motorcycle tracks have appeared on the bed. On other occasions metal stakes have been driven into the bed and for a period of time a dog was tied on the bed. The dog dug holes and wore away the vegetative cover in the bed area where it was tied.

In addition, some of the residents cut the grass on their portion of the bed, while others do not. When the breakout in the toe of the mantle was prevalent, it was too wet to cut the grass in this area, however this is not the current situation. It would be very helpful to the operation of the system if CMHC would educate the users in the proper care of a private sewage disposal system.

With respect to the septic tank and pump chamber, the septic tank should be pumped once every three years to ensure that solids are properly removed. The pump chamber should be checked annually by a competent person to ensure that the floats are operating properly, that no solids are accumulating in the tank and that the pump is functioning correctly.

5. Position of the MOEE Regarding Contour Trench Systems

[The MOEE has not formally indicated their position on this system to date.]

9.0 MONITORING PROGRAM

The monitoring program for this system was established by MOEE. Samples were collected by H. Sutcliffe Limited and MOEE and were analyzed by the MOEE Laboratory. The monitoring program was completed on a very small budget and was therefore of limited scope.

Many times during the monitoring process, sufficient sample volumes were not available to complete analysis for all requested parameters. This problem could have been solved by sampling visits on consecutive days, however budget restrictions made this impossible.

The Review of Chemical Data report suggested continuing the monitoring period for at least one more year, and that samples be collected on consecutive days to ensure sufficient volumes are collected. This recommendation may lead to the gathering of valuable data since it would appear that the system began to reach equilibrium between the Fall of 1994 and Spring of 1995. This program would be most beneficial if it was carried out by MOEE to assist in determining future use of this system.

The data collected during monitoring was sufficient to allow some conclusions to be drawn regarding the performance of the bed, however more information is needed to determine changes in performance or general trends. The bacterial data collected, particularly with respect to surface water samples was complicated by several factors. Competing sources of bacteria were sometimes present adjacent to collection sites. A dog tied on the bed, decaying animal flesh in the yard of one of the residents and garbage strewn around the site were potential sources of bacterial contamination not related to the performance of the sewage system.

In some instances, bacterial samples were diluted in the lab, allowing only reporting of E-Coli levels of less than 10^3 which means that there were 0 counts in a sample diluted to 1:1000. Future bacterial monitoring should be for actual counts in samples such as effluent breakout or downgradient piezometers.

10.0 CONCLUSIONS

Firm conclusions cannot be drawn about the performance of the contour trench system, in this instance, because of numerous external factors which complicated the analysis. The limited monitoring data which is available, poor housekeeping, and the apparent recent change in operating characteristics of the bed, limit the conclusions which can be drawn..

Statements which can be made about the system are as follows:

- \- This installation cannot be considered 100% successful because of the breakout which has occurred in the North portion of the bed.
- \- The monitoring program should be extended to determine if the recent trend towards system stabilization is an anomaly or a permanent change. This will also help to determine the effectiveness of extending the mantle.
- \- More work needs to be done to establish guidelines for the future use of contour trench systems in the Province of Ontario.
- \- With the support of the MOEE, a future installation of a contour trench should be permitted (under less challenging circumstances) to evaluate the performance of this type of system in an environment other than replacing a failed conventional system.
- \- CMHC should educate the system users on the proper care and operation of a private sewage disposal system. A program to ensure regular septic tank pumpouts should also be implemented.
- \-

Future installations of <u>any</u> type of remedial system to replace a failed system should include installation of low flow toilets, aerators and showerheads as part of the work.

Otto Township Contour Trench System

Appendix A

OTTO TOWNSHIP CONTOUR TRENCH
SUMMARY OF DESIGN PARAMETERS
Four Home Contour Trench System
System to Service 3 x 3 Bedroom Homes
1 x 4 Bedroom Homes

1. Ontario Guidelines

Daily flow would be (3 x 1600) + (1 x 2000) = 6800 L.Day

2. Nova Scotia Guidelines

- Bases theoretical trench length on single family home (200 gal/day) or (3 x 200) + (4/3 x 200) = 867 gal. (3936 L) using 1.0 ft of imported fill as effective depth, ground slope of 7% and permeability of silty sand 1.6 x 10^{-5} m/sec, theoretical length is 90' for a 3 bedroom home and 4/3 x 90 = 120 ft. for a 4 bedroom home (page 3-06 nomogram 3.1.1; N.S. Guidelines).

Total theoretical trench length required (3 x 90) + (1 x 120) = 390 ft.

Available length is 223 = 57.1% → less than 2/3 of theoretical length.
∴ use C2 type 'b' system (page 3-10) and refer to Table 3.2.2 for minimum lengths.

- Minimum length for 1' of silty sand at 7% is 50 ft. (3 bedroom home).
∴ overall min. length is (3 x 50') + (4/3 x 50) = 217 ft.

- We have 223' available; require buffer zone (200%)

2 x 20' = 40' wide (see Table 3.2.4) - at request of MOE buffer zone was expanded to 50' wide to meet loading rate of 5 L/m².day.

3. Loading Rates (1.5 ft²/gal.day; page 3-07; Nova Scotia Guidelines)

Using *Ontario* daily flows for trench width calculation

6800 L/d = 1496 gallons/day.

Trench area - 1298 (gal/day) x 1.5 ft² (gal/day) - 2247 ft²

∴ width = 2247 ft² ÷ 223 ft. = 10.08' (3.07 m).

fn: ottosumm

INTERNATIONAL WATER CONSULTANTS LTD.

Ground Water Engineering
BARRIE BELOEIL, P.Q. SASKATOON
342 Bayview Dr., Post Office Box 340
Barrie, Ontario, Canada L4M 4T5
Tel 705-733-0111 • 905-889-3639 • Fax 705-721-0138

June 8, 1995

H. Sutcliffe Limited
P.O. Box 1208
New Liskeard, Ontario
POJ 1PO

Attention: **Mr. H.J. Hawken, P. Eng.**

Reference: **Otto Township Contour Trench Disposal System**

Dear Sir:

International Water Consultants Ltd. has carried out a review of available groundwater elevations for the period of December 1992 to May 1995 for the Otto Township contour trench septic waste disposal system. Groundwater elevations are summarized in Table 1 and are plotted in Figure 1.

The available data show that the groundwater elevations at the locations of piezometers 2 and 3, which are located within the distribution trench, have increased from May 1993 to May 1995. The May 1995 groundwater elevations of piezometers 2 and 3 are about 20 to 25 centimetres higher than the May 1993 levels.

The upgradient groundwater elevation measured at piezometer 1 showed an increase from May 1993 to October 1993 and then a decrease from October 1993 to May 1995. The May 1995 elevation is lower than the May 1993 elevation. The groundwater elevations at piezometers 4 and 7, installed in native clay below the mantle, and piezometer 6, installed at the mantle/native clay interface, show trends similar to the groundwater elevation at piezometer 1.

Based on the available data, the only impact on groundwater elevations that can be attributed to the operation of the sewage disposal system are the increases in elevation observed at piezometers 2 and 3. The remaining piezometers show trends that are likely related to normal seasonal fluctuations in groundwater elevations.

We trust that this letter is sufficient for your present requirements. If you have any questions, please do not hesitate to contact this office.

Yours truly,

INTERNATIONAL WATER CONSULTANTS LTD.

B.A. WILSON, P. Eng.
BAW/ti

TABLE 1

OTTO TOWNSHIP CONTOUR TRENCH
Groundwater Elevations

Piezo #	Dec 17, 1992	May 19, 1993	Oct 18, 1993	May 9, 1995
1	<288.27	288.49	288.55	288.45
2	287.47	287.44	287.51	287.64
3	DM	287.39	287.48	287.66
4	286.46	286.49	286.72	286.50
5	<286.65	<286.65	286.78	<286.65
6	286.75	286.52	286.61	286.53
7	286.64	286.34	286.40	286.30

NOTES: DM Data Missing

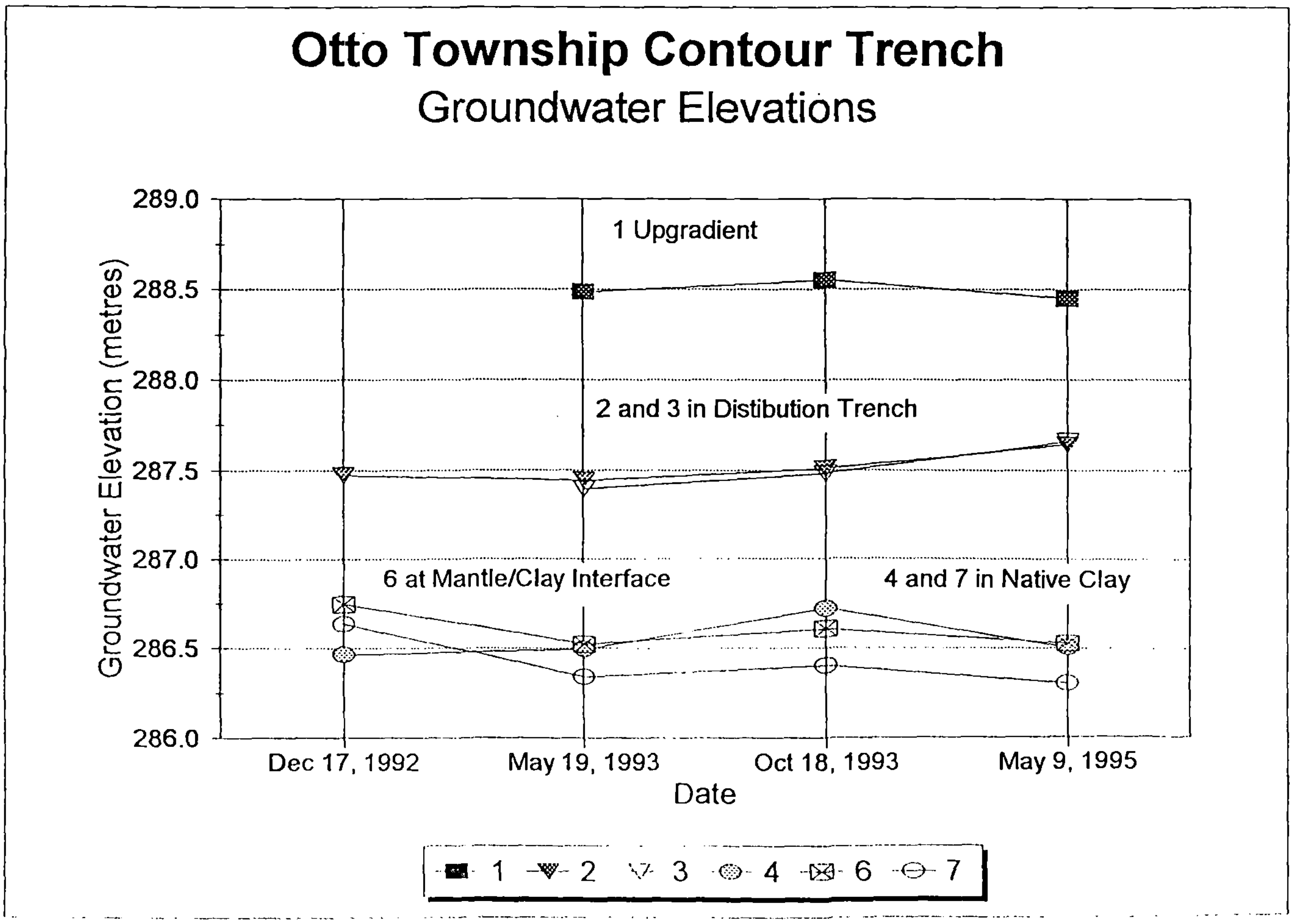


FIGURE 1

INTERNATIONAL WATER CONSULTANTS LTD.

Ground Water Engineering
BARRIE BELOEIL, P.Q. SASKATOON
342 Bayview Dr., Post Office Box 310
Barrie, Ontario, Canada L4M 4T5
Tel. 705 733 0111 • 416-889 3639 • Fax 705 721 0138

August 29, 1990

H. Sutcliffe Ltd.,
Box 1208,
9 Wellington Street,
New Liskeard, Ontario
P0J 1P0

Attention: Mr. J. Hawken, P.Eng.

Reference: OTTO TOWNSHIP
CMHC HOMES
MOUNDING ASSESSMENT

Dear Sir;

This report assesses the potential mounding beneath in-ground sewage disposal systems at two Canada Mortgage and Housing sites in Otto Township. The assessment is based on information provided by H. Sutcliffe Ltd. including;

(a) Site topographic maps with sewage system locations.

(b) On-site borehole monitoring data.

(c) Well records for each residence.

(d) Estimated soil permeability from field testing. ($\leq 9 \times 10^{-6}$ cm/sec.)

The attached sections A and B illustrate the conditions at each site. The waste disposal systems are reported to be small sand filter type beds constructed in the native soils. The surficial soils consist of brown clay about 1 to 3 m thick with an estimated permeability of 9×10^{-6} cm/sec. or less. This is underlain by grey clay which ranges in thickness from about 15 m(50ft.) at Site 1 to about 21 m(70ft.) at Site 2. One exception is the Lingenfelter residence at Site 1 where the well record indicates that bedrock underlies the brown clay.

Based on borehole monitoring during July the water table within the tile bed areas was about 1 m below ground surface. This likely represents near average conditions, with lower levels expected near the end of summer and higher levels in the spring and fall.

The potential mounding has been assessed using the method developed by the M.O.E. For the purpose of the mounding estimate, it is considered that the brown clay layer is the main transmitting unit, and that the underlying grey clay is a low permeability lacustrine clay unit which forms the base of the shallow flow system. Using this model the mounding predictions are as follows;

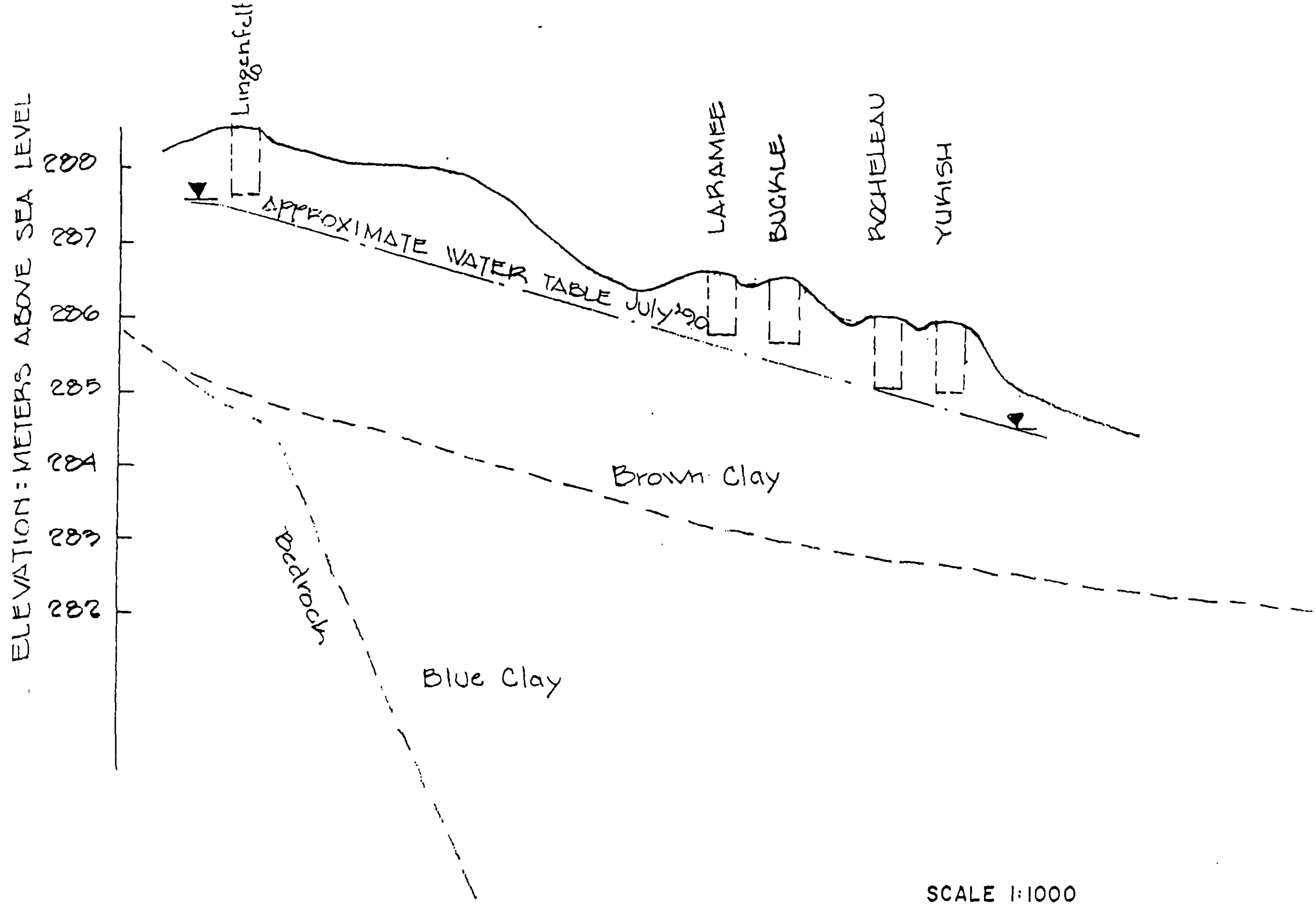
	SITE 1	SITE 2
Sewage Inflow	1 m^3/day	1 m^3/day
Soil Permeability	$9x10^{-6}$cm/sec	$9x10^{-6}$cm/sec
Effective Thickness	2.5 m	1.5 m
Predicted Maximum Mounding	8 m	14 m
Available Mounding	1 m	1 m

Based on this assessment, failure of the sewage systems is predicted. Effluent within the tile bed areas would mound up to ground surface, and break-out at the surface.

It is expected that adequate sewage treatment will require importing of suitable sand fill for construction of leaching beds with mantle areas to provide adequate treatment of effluent before discharging to the surface.

Yours truly,

GARY A. KUEHL,
SENIOR HYDROGEOLOGIST
GAK/lp



SCALE 1:1000

NO.	WAS	BY	DATE

OTTO TOWNSHIP

C.M.H.C. SITE I
SECTION A

International Water Consultants Ltd.
SASKATOON · BARRIE · MONTREAL

DRN: j.wall
CKD:

DRAWING NO.
A 90258

SUMMARY OF HOMEOWNER INFORMATION

NAME: Charette & Yukich   LOT DESCRIPTION: Site 1 Part 17

NO. OF BEDROOMS: 3   NO. OF RESIDENTS: 5

SIZE OF EXISTING SEPTIC TANK: 4500 L

SIZE OF ORIGINAL FILTER BED: 22 m^2 MANTLE PRESENT? No

SIZE OF EXISTING FILTER BED: 22 m^2 MANTLE PRESENT? No

DATE FILTER BED ENLARGED: n/a   ORIG. PERC. TIME: 5 min/cm

DATE OF ORIGINAL USE PERMIT: Oct. 1987

1990 STUDY DATA

NATIVE SOIL PERCOLATION RATE: >50 min/cm

NATIVE SOIL PERMEABILITY: $< 1x10^{-6}$ cm/sec

ACTUAL AVERAGE WATER CONSUMPTION: 677 L/day (recorded by meter).

OBSERVED NATIVE SOIL TYPE: Clay

LIFESTYLE COMMENTS:

-No. of loads of wash done per day: 1

-Septic tank is pumped out: Weekly

-Home contains 1 washing machine and 1 bathroom

-No landscaping over existing bed.

SUMMARY OF HOMEOWNER INFORMATION

NAME: Rocheleau LOT DESCRIPTION: Site 1 Part 14

NO. OF BEDROOMS: 3 NO. OF RESIDENTS: 3

SIZE OF EXISTING SEPTIC TANK: 4500 L

SIZE OF ORIGINAL FILTER BED: 22 m^2 MANTLE PRESENT? No

SIZE OF EXISTING FILTER BED: 22 m^2 MANTLE PRESENT? No

DATE FILTER BED ENLARGED: n/a ORIG. PERC. TIME: 5 min/cm

DATE OF ORIGINAL USE PERMIT: Oct. 1987

1990 STUDY DATA

NATIVE SOIL PERCOLATION RATE: >50 min/cm

NATIVE SOIL PERMEABILITY: $<1 \times 10^{-6}$ cm/sec

ACTUAL AVERAGE WATER CONSUMPTION: Home vacant during study

OBSERVED NATIVE SOIL TYPE: Clay

LIFESTYLE COMMENTS:

-No. of loads of wash done per day: 3

-Septic tank is pumped out: Weekly

-Home contains one bathroom and one washing machine

-Storage shed and trailer are located in vicinity of bed.

SUMMARY OF HOMEOWNER INFORMATION

NAME: Backle   LOT DESCRIPTION: Site 1 Part 13

NO. OF BEDROOMS: 3   NO. OF RESIDENTS: 5

SIZE OF EXISTING SEPTIC TANK: 4500 L

SIZE OF ORIGINAL FILTER BED: 22 m^2 MANTLE PRESENT? No

SIZE OF EXISTING FILTER BED: 22 m^2 MANTLE PRESENT? No

DATE FILTER BED ENLARGED: n/a   ORIG. PERC. TIME: 5 min/cm

DATE OF ORIGINAL USE PERMIT: Oct. 87

1990 STUDY DATA

NATIVE SOIL PERCOLATION RATE: >50 min/cm

NATIVE SOIL PERMEABILITY: $<1 \times 10^{-6}$ cm/sec

ACTUAL AVERAGE WATER CONSUMPTION: 833 L/day (recorded by meter)

OBSERVED NATIVE SOIL TYPE: Clay

LIFESTYLE COMMENTS:

-No. of loads of wash done per day: 1

-Septic tank is pumped out: Weekly

-Home contains 1 bathroom and 1 washing machine

-Vehicle parked in bed area. Bed area is not landscaped.

SUMMARY OF HOMEOWNER INFORMATION

NAME: Axwell(formerly Laramee) LOT DESCRIPTION: Site 1 Part 10

NO. OF BEDROOMS: 4 NO. OF RESIDENTS: 5

SIZE OF EXISTING SEPTIC TANK: 4500 L

SIZE OF ORIGINAL FILTER BED: 22 m^2 MANTLE PRESENT? No

SIZE OF EXISTING DISPOSAL BED: 22 m^2 MANTLE PRESENT? No

DATE FILTER BED ENLARGED: n/a ORIG. PERC. TIME: 8 min/cm

DATE OF ORIGINAL USE PERMIT: Oct. 1987

1990 STUDY DATA

NATIVE SOIL PERCOLATION RATE: $>$ 50 min/cm

NATIVE SOIL PERMEABILITY: $<1\times10^{-6}$ cm/sec

ACTUAL AVERAGE WATER CONSUMPTION: 1145 L/day (recorded by meter)

OBSERVED NATIVE SOIL TYPE: Clay

LIFESTYLE COMMENTS:

-No. of loads of wash done per day: N/A

-Septic tank is pumped out: Weekly.

-Home recently changed owners and some data is unavailable.

-To date septic bed area has not been properly landscaped.

INTERNATIONAL WATER CONSULTANTS LTD.

Ground Water Engineering
BARRIE BELOEIL, P.Q. SASKATOON
342 Bayview Dr., Post Office Box 310
Barrie, Ontario, Canada L4M 4T5
Tel. 705-733-0111 • 905-889-3639 • Fax 705-721-0138

May 2, 1995

H. Sutcliffe Limited
29 Whitewood Avenue
P.O. Box 1208
New Liskeard, Ontario
POJ 1PO

Attention: **Mr. H.J. Hawken, P. Eng.**

Reference: **Review of Chemical Data**
Otto Township Contour Trench

Dear Sirs:

International Water Consultants Ltd. has carried out a review of chemical data collected as part of the monitoring of a contour trench septic waste disposal system in Otto Township.

The results of chemical analyses on water samples collected between May 1993 and November 1994 are summarized in Table 1.

The results of the chemical analyses suggest that the concentrations of the parameters analyzed have increased, but the lack of data for some parameters on some dates makes it difficult to determine trends.

The results of the chemical analyses show that the downgradient concentrations in the native soils beneath the mantle are higher than those in the mantle suggesting a downward migration of the effluent. The concentrations of phosphorous and ammonium decrease in the downgradient direction as shown in Table 2. The downgradient concentration of phosphorous in the northern portion of the bed (piezometers 4 and 5) show decreases to 3 per cent to less than 1 per cent of the concentrations reported for the trench (piezometer 3). The concentrations of ammonia showed decreases to 50 per cent to 10 per cent of the trench concentration. Similar decreases were noted in the southern portion of the bed (piezometers 2, 7 and 6). The concentration of nitrate in the downgradient piezometers tends to be greater than the upgradient concentrations in the northern portion of the bed. In the souther portion of the bed, there appears to be little change in nitrate concentrations despite the reduction in ammonia concentration.

The results of November 1994 bacteriological analyses on two samples, one collected from an area of seepage at the toe of the mantle and one collected from the drainage swale between Part 13 and Part 14, indicate that there is impact by effluent from the bed on the water. The presence of E. Coli at a count of 10 in both samples indicates that the samples show recent fecal pollution. In July 1993, a sample from the drainage swale had a E. Coli count of $<10^3$. E. Coli is present in fecal matter and prevalent in sewage and therefore is a good indication of fecal pollution. The Ontario Ministry of Environment and Energy has set a limit of 0 counts of E. Coli in drinking water. Because the E. Coli bacteria have been detected in surface water samples at the site, there is exposure of the public to potentially harmful water.

The presence of a seepage area along the toe of the mantle indicates that the mantle has failed. Additional material should be added to the mantle to contain the breakout. The addition to the mantle may also reduce the E. Coli count in the surface runoff.

FUTURE MONITORING

The monitoring of the bed's performance should be continued for at least one more year. In particular, the concentration of E. Coli in the surface water should be closely watched. If possible, sufficient samples volumes should be collected to allow for analyses of the following parameters: chloride, phosphorous, TKN, ammonia, nitrate, BOD, COD, bacteria. If adequate sample volumes cannot be obtained at one time, the piezometers should be sampled on two consecutive days. Field measurements of temperature, conductivity and pH should be made at the time of sample collection.

SUMMARY

The system is reducing the concentrations of ammonia and phosphorous within the mantle of the bed. At the present time, there is contamination of surface water by E. Coli bacteria indicating that the bacteriological component of the effluent is not being treated properly in the mantle. The seepage noted at the toe of the mantle in the northern portion of the bed indicates that the mantle has failed that area. The mantle should be extended to prevent seepage from the toe. The failure may be the result of uneven effluent distribution in the trench. Monitoring of the system should continue especially to monitor bacterial levels.

Yours truly,

INTERNATIONAL WATER CONSULTANTS LTD.

B.A. WILSON, P. Eng.
SENIOR HYDROGEOLOGIST
BAW/ti

TABLE 1 SUMMARY OF CHEMICAL ANALYSES

Location	Date	Conductivity ms/cm	pH	Chloride	Phosphorous	TKN	Ammonia	Nitrate	BOD	COD
P1	May 19/93	170	7.4	4.3	0.7	1.75	0.15	<0.01	-	195
P1	Oct.18/93	86	6.6	2.3	0.3	0.8	0.2	0.03	-	125
P2	May 19/93	2790	7.3	650	3.63	62.5	57	<0.01	26	175
P2	Oct.18/93	-	-	-	1.85	6.0	0.12	5.8	-	-
P2	Nov.4/94	-	-	-	8.2	-	52.2	0.1	57	-
P3	May 19/93	2650	7.6	550	-	-	65.5	<0.01	-	410
P3	Oct.18/93	-	-	-	8.35	42	26.9	0.08	-	-
P3	Nov.4/94	-	7.3	-	11	69	44.5	-	-	-
P3B	Jul 20/94	-	-	-	7.25	-	49	0.05	100	-
P3B	Nov.4/94	-	7.1	-	10	74	42	-	-	-
P4	May 19/93	-	-	-	7.25	-	48.2	0.25	75	-
P4	Oct.18/93	2520	6.6	690	0.047	33.8	7.3	9.6	5.3	60
P4	Nov.4/94	-	-	-	0.24	-	4.95	5.33	11	-
P4B	Nov.4/94	-	-	-	0.45	-	4.09	6.15	11	-
P5	Oct.18/93	1790	7.2	350	0.091	4.5	1.91	12.5	-	45
P5	Jul 20/94	-	7.3	-	9.5	61.5	53.7	-	60	-
P5B	Jul 20/94	-	7.1	-	8	55	44.6	-	-	-
P6	Oct.18/93	1930	7.1	470	0.025	0.29	0.1	<0.01	-	40
P7	May 19/93	1020	6.3	87	0.062	0.92	<0.01	<0.01	79	445
P7	Oct.18/93	2160	6.7	570	0.017	1.15	0.79	<0.01	-	55
P7	Jul 20/94	-	7.1	-	2.6	8	4.29	-	12	-
P7	Nov.4/94	-	-	-	0.11	-	1.73	0.1	4.3	-
P7B	Jul 20/94	-	6.7	-	0.65	6.1	4.06	-	-	-
P7B	Nov.4/94	-	-	-	0.31	-	1.5	0.16	11	-

All values are mg/L unless otherwise noted.

TABLE 2

STIBUTION OF SELECTED PARAMETI

	NORTH SECTION			SOUTH SECTION		
	P3 (T)	P4 (N)	P5 (M)	P2 (T)	P7 (N)	P6 (M)
OCT 18/93						
Cond.	---	2520	1790	---	2160	1930
Cl	---	690	350	---	570	470
P	8.35	0.017	0.091	1.85	0.017	0.025
TKN	42	33.8	4.5	6.0	1.15	0.29
NH_3	26.9	7.3	1.91	0.12	0.79	0.1
NO_3	0.08	9.6	12.5	5.8	<0.01	<0.01
COD	---	60	45	---	55	40
MAY 19/39	P3 (T)	P4 (N)	P5 (M)	P2 (T)	P7 (N)	P6 (M)
Cond	2650	1390	NS	2790	1020	NS
Cl	550	92	NS	650	87	NS
P	---	0.12	NS	3.63	0.062	NS
TKN	---	10.3	NS	62.5	0.92	NS
NH_3	65.5	32.8	NS	57	<0.01	NS
NO_3	<0.01	<0.01	NS	<0.01	<0.01	NS
COD	410	180	NS	175	445	NS
NOV 4/94	P3 (T)	P4 (N)	P5 (M)	P2 (T)	P7 (N)	P6 (M)
Cond	---	---	NS	---	---	NS
Cl	---	---	NS	---	---	NS
P	7.25	0.24	NS	8.2	0.11	NS
TKN	---	---	NS	---	---	NS
NH_3	49	4.95	NS	52.2	1.73	NS
NO_3	0.5	5.33	NS	0.1	0.1	NS
COD	---	---	NS	---	-	NS

NOTES:

T	piezometer installed in trench
N	piezometer installed in native material under mantle
M	piezometer installed in mantle at mantle/native interface
---	parameter not analyzed for due to insufficient sample volume
NS	not sampled
	all results are in mg/L except Conductivity (μS/cm)

ANALYSIS RESULTS

PRIVATE WELL

Name: Graham   Date: July 20, 1994

Parameters	Concentrations (in mg/l)	Ontario Drinking Water Objectives (in mg/l)
Conductivity umho/cm at 25°C	680	No set limit
Hardness as $CaCO_3$	< 1	200.0
Calcium	0.002	No set limit
Sodium	180	200.0
Alkalinity	370	30 - 500
pH	7.4	6.5 - 8.5
Fluoride	0.15	2.4
Chloride	6	250.0
Sulphate		500.0
Nitrates	0.1	10.0
Nitrite	0.01	1.0
Copper	0.028	1.0
Nickel	< 0.005	No set limit
Lead	< 0.02	0.01
Zinc	0.033	5.0
Iron	0.55	0.3
Manganese	< 0.002	0.05
Silver	0.00	0.05
Aluminum	< 0.05	0.1
Arsenic	0.0009	0.025
Cadmium	0.003	0.005

Note: * above Ontario Water Drinking Objectives

ANALYSIS RESULTS

PRIVATE WELL

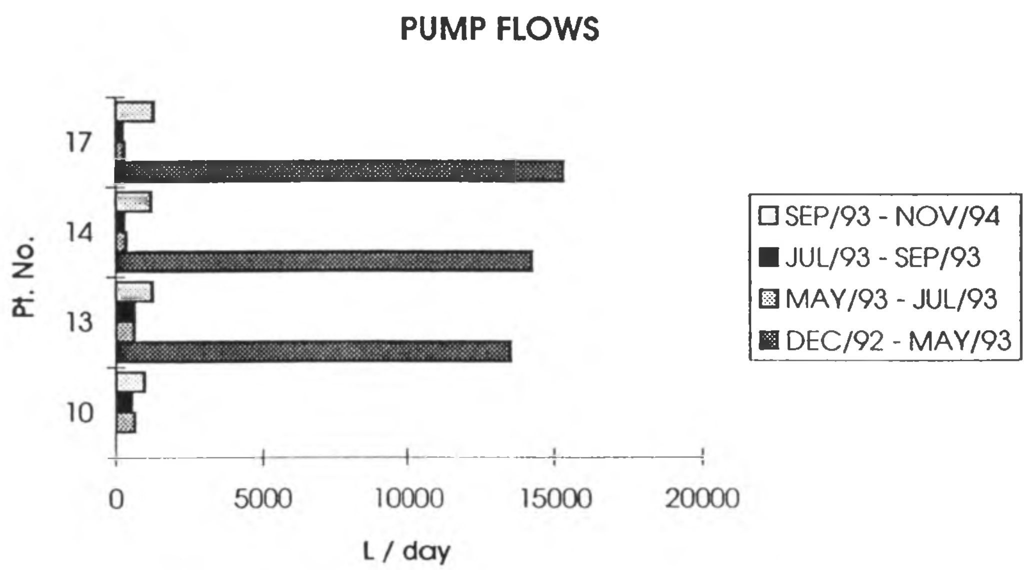
Name: SHACKLE **Date:** July 20, 1994

Parameters	Concentrations (in mg/l)	Ontario Drinking Water Objectives (in mg/l)
Conductivity umho/cm at 25°C	594	No set limit
Hardness as $CaCO_3$	< 1	200.0
Calcium	< 0.05	No set limit
Sodium	160	200.0
Alkalinity	310	30 - 500
pH	7.5	6.5 - 8.5
Fluoride	0.21	2.4
Chloride	13	250.0
Sulphate		500.0
Nitrates	0.1	10.0
Nitrite	0.01	1.0
Copper	0.064	1.0
Nickel	< 0.005	No set limit
Lead	< 0.02	0.01
Zinc	< 0.01	5.0
Iron	0.09	0.3
Manganese	< 0.002	0.05
Silver	< 0.005	0.05
Aluminum	0.11	0.1
Arsenic	0.0007	0.025
Cadmium	< 0.002	0.005

Note: * above Ontario Water Drinking Objectives

TABLE 1

CMHC PROJECT - OTTO TOWNSHIP SUMMARY OF FLOWS				
PT No.	DEC/92 - MAY/93	MAY/93 - JUL/93	JUL/93 - SEP/93	SEP/93 - NOV/94
10	0	687	565	996
13	13532	655.8	676.6	1249
14	14272	395	333	1212
17	15323	333	296	1298



Sutcliffe Est. 1906 Engineers & Surveyors

H. Sutcliffe Limited

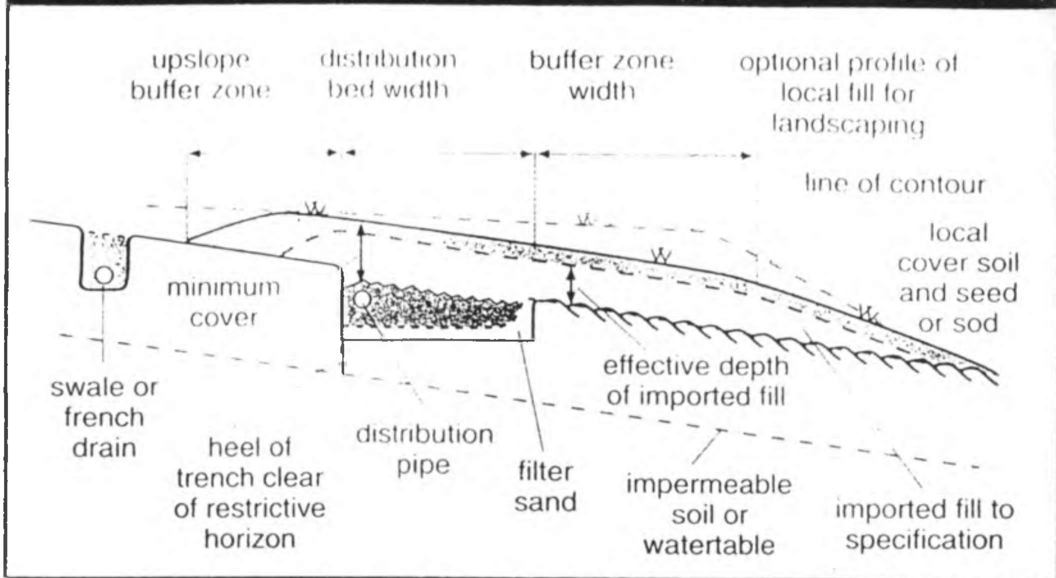
H. Sutcliffe Surveying Ltd.

9 Wellington Street Box 1208 New Liskeard, Ontario, Canada P0J 1P0 Tel: 705-647-4311 Toll Free: 1-800-461-4584 Fax: 705-647-3111

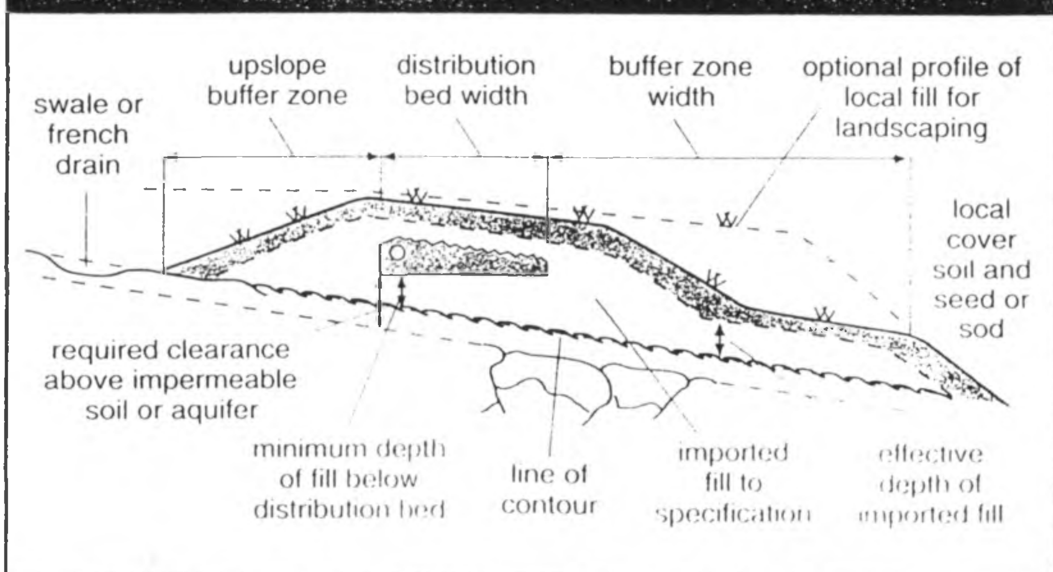
Otto Township Contour Trench System

Appendix B

Imported Fill Disposal Fields (Type C2)



Type C3 - Section



Source: Small Flows Vol. 9, No. 2, Spring 95

National Drinking Water Clearinghouse
West Virginia University
A Program of the National Research Center for Coal and Energy

H. J. Hawken, P.Eng.
H. Sutcliffe Ltd.
29 A Whitewood Avenue
Box 1208
New Liskeard
Ontario POJ 1PO

92 09 11

Dear James,

RE: CMHC - Otto Township - C2 System

I refer to our telephone conversation yesterday and confirm that I have reviewed your drawings marked 90-532, sheets 1&2, taking into account the alterations described verbally.

In general, the layout and detailing appear to conform with the "Nova Scotia Guidelines". I would recommend that the top of the distribution pipe be drilled (12mm) adjacent to the force main tees to discourage back-siphoning. The other suggestion is that the imported fill material be marked as "Imported sand fill to specification" so that there is no misconception on the part of the contractor.

The imported fill is critical to this design and I would suggest that a source be located prior to letting the contract. Potential sources should be tested using the falling head permeameter (Appendix C in the guidelines) to ensure that the permeability lies well within the acceptable range. If the contours shown on your plan are at 1m intervals. the system will have a slope of approximately 12% minimum.and I estimate that the system would have a total capacity of approximately 4 cu.m./day (480gal.) using sand with a permeability of 2E-5m/sec which is the lowest acceptable permeability. I suggest that a sand be found with a higher permeablity, in the "good" range shown on the chart. I would also suggest that you do not select the sand on the basis of sieve analysis.

304 293-4191 FAX 304 293-3161 P.O. Box 6064 Morgantown, WV 26506-6064

On the question of supervision of the construction, it would be difficult for me to visit the site at any other time than a week-end, but perhaps not impossible. I would need to see the trench after excavation, not necessarily before the gravel and pipe are installed.and I would also wish to see a representive sample of the imported fill for examination and test. I would also need to have a general discussion of construction details with the contractor. This would be adequate to satisfy my requirements for supervision, although you would obviously require continuing local supervision.

I will comment further when I receive a copy of your latest drawings.

Yours truly,

David. A Pask

David A. Pask, P.Eng.

David A. Pask, P.Eng.
805 Des Moines Avenue,
P.O. Box 643,
MORGANTOWN, WV 26507
U.S.A.
Tel (304) 292 5162

H.J. Hawken, P.Eng.
H. Sutcliffe Ltd.
29A Whitewood Avenue
P.O. Box 1208
New Liskeard
Ontario POJ 1PO
~~U.S.A.~~ /

22 November 1992

Dear Sirs,

RE: CMHC - Otto Township - C2 System
Inspection of Site 7 November 1992

I refer to our meeting and visit to the above site on 7 November 1992.

I am pleased to confirm the following observations made during our visit.

1. The site appeared to be in conformity with your Drawings Nos. E90023/1 & 90023/2. The subsoil consisted of a sandy silty clay of low permeability.
2. The distribution bed had been constructed to the stage of the geo-textile cover. The sand under-bed, the crushed rock or gravel, the pressure distribution pipework and geo-textile all were in conformity with the specification.
3. It was noted that the layout of the system had been amended in order to accomodate a natural drainage channel found on the site. The channel had been diverted to flow around the east end of the disposal field. The original channel had been properly filled in and compacted using local clay.
4. The sample at the site of imported sand fill appeared to meet the specification.
5. The Surface Water Interceptor Drain upslope from the disposal field had been installed and was draining to the diverted drainage channel.
6. It was suggested that the ground surface downslope from the disposal field should be regraded to eliminate any potential ponding areas.
7. The location of the pumping chambers (not yet installed) was discussed and positions suggested that would allow the delivery pipes to drain back to the chamber without excessive depth of bury.

In general design and construction standards to the date of my visit were found to be entirely sound and I anticipate that on completion of construction the system should perform satisfactorily with no detriment to the local environment.

Yours truly,

David A. Pask, P.Eng.

REFERENCES

1. Ministry of the Environment, "Manual of Policy Procedures and Guidelines for Private Sewage Disposal Systems"; 1982.

2. Nova Scotia Department of Health & Fitness; "On Site Sewage Disposal System Technical Guidelines"; February 1988.

3. Pask, D.A.; "On Site Sewage Disposal in Nova Scotia, the Contour Disposal Field and Related Techniques"; Proceedings of 1st Conference on Innovate Technology-Water and Sewage Systems for Northern Ontario; September 1988.

4. Charles G.M., Waller D.H.; "On Site Wastewater Research Program"; Final Report; 1987-1990; Centre for Water Resources Studies, Technical University of Nova Scotia.

5. Canada Mortgage and Housing Corporation; "Assessment of the Takla Landing Contour Trench Wastewater Disposal System". Novatec Consultants Inc.; May 1989.

6. Canada Mortgage and Housing Corporation; "Otto Township CMHC Homes Septic System Study; H. Sutcliffe Limited; August 1990.

7. Pask, D.A., "Lateral Thinking in Groundwater Flow: Introducing Contour Disposal Fields"; Small Flows, Winter 1994; National Small Flows Clearing House, West Virginia University.

8. Chowdry, N.A.; "Domestic Waste Water Disposal and Nutrient Removal by Septic Tank - Sand Filter System, MOE, 1979.

fn: ottocvr

Otto Township Contour Trench System

Appendix C

Contour Trench
Distribution Pipe, Imported Sand And Stone Layer.
Nov.92

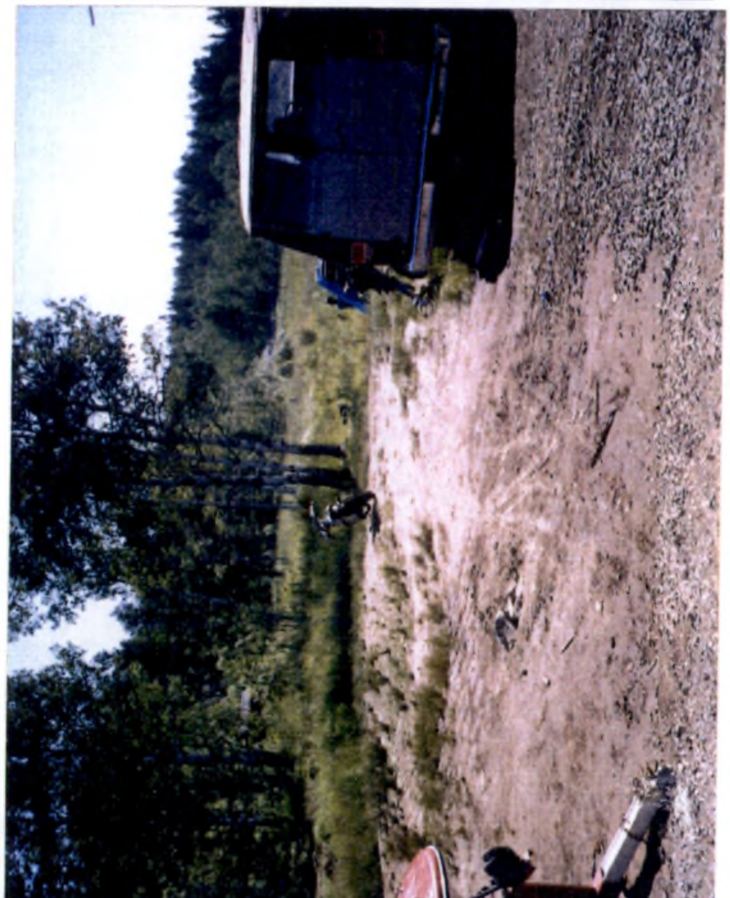
Excavation For Contour Trench
November 1992

Cutoff Ditch And French Drain Upslope From Contour Trench
Nov.92

Spreading Imported Fill On Buffer Area.
Nov.92

Breakout Area At Toe of Buffer June '93

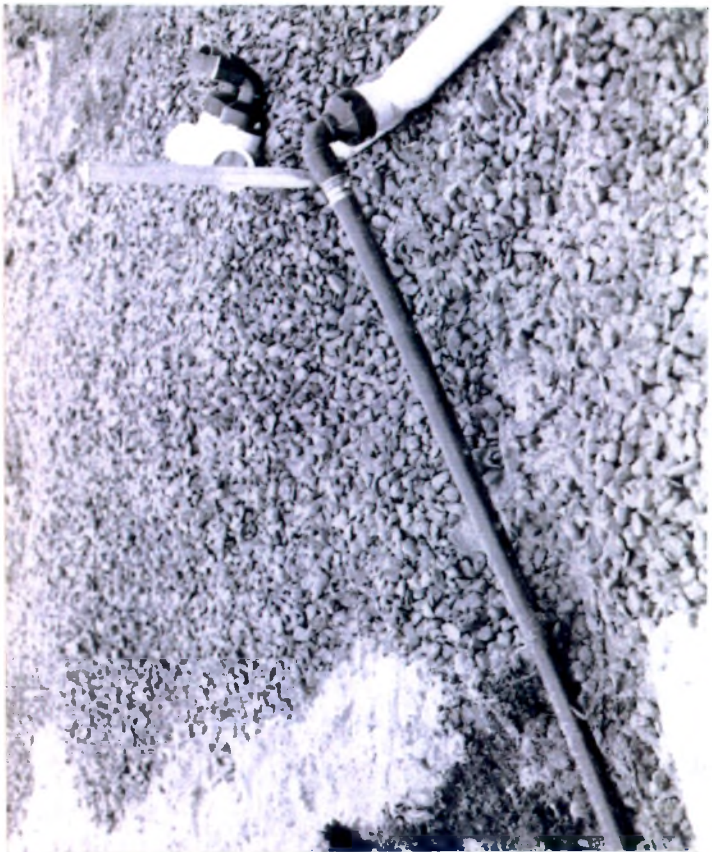
Dry Breakout Area at Toe of Buffer June '95



Bed Area - Prior to Construction of Contour Trench July 1990

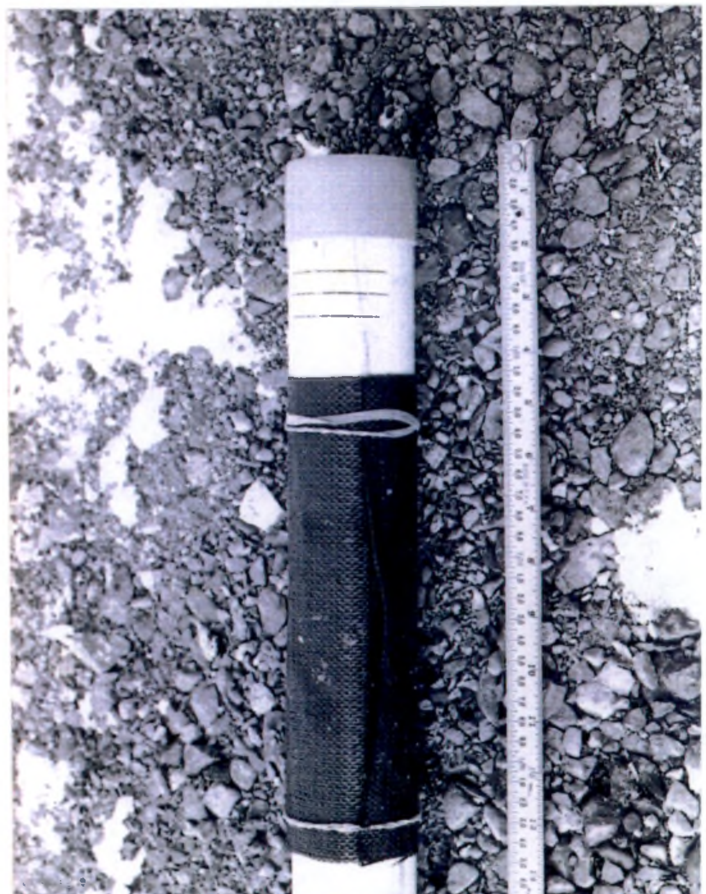
Bed Area - After Two Years of Contour Trench Operation June '95

French Drain Wrapped in Filter Cloth (Geotextile) Nov. 92



Forcemain Connection to Distribution Pipe Nov. 92

Preparing Bed For Topsoil And Seeding Operation June 93



Piezometer Prior to Installation Dec. 92

Installation of Low
Flow Toilet Dec. 92

Otto Township Contour Trench System

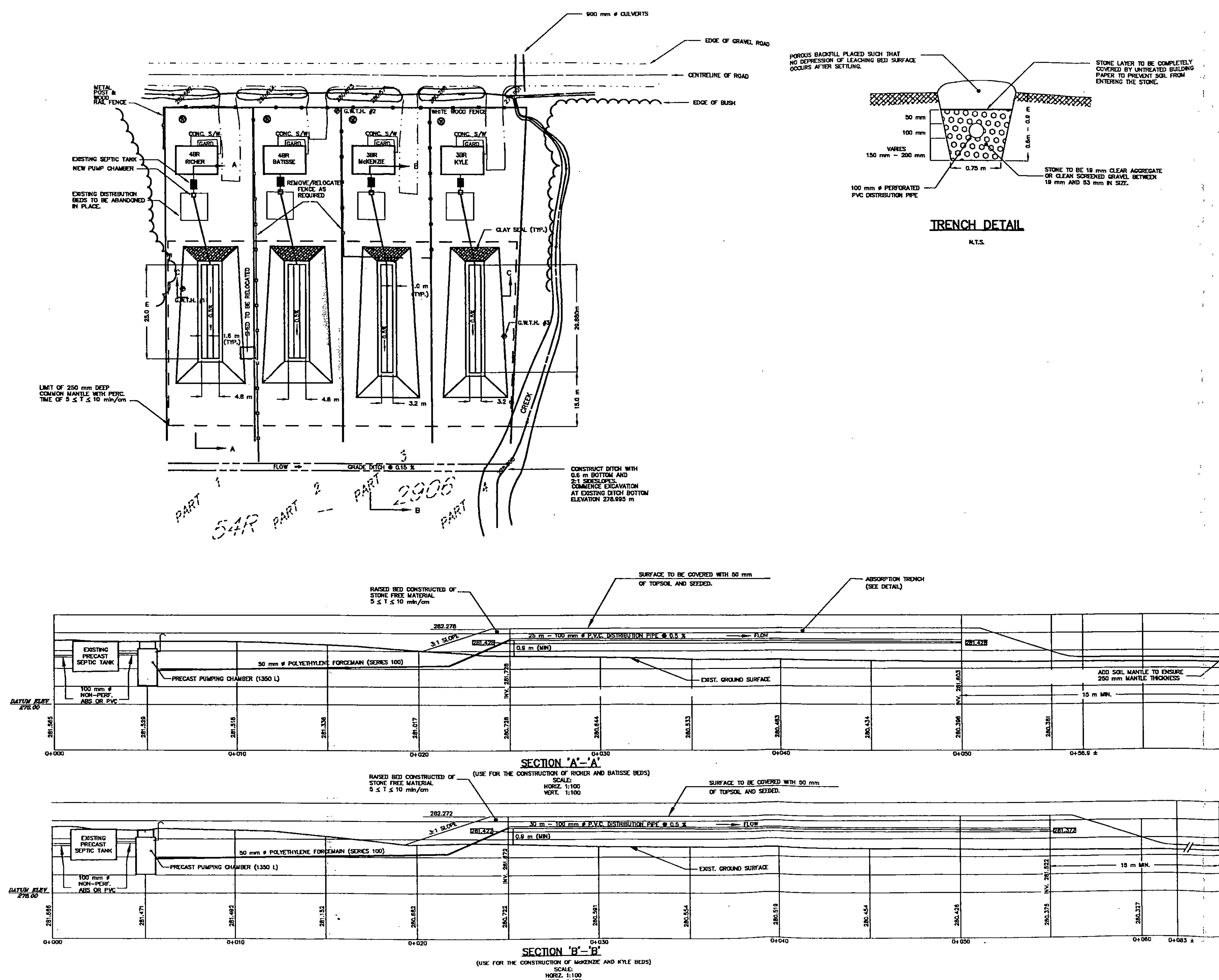
Appendix D

DRAWING TITLE
DETAIL DRAWINGS FOR RAISED ABSORPTION BEDS

SHEET Nº. 1

ORIENTATION

N



LEGEND

- DENOTES WELL CASING
- DENOTES LOCATION OF SEPTIC TANK
- DENOTES POPLAR TREE
- DENOTES ROCK OUTCROP/BOULDER
- DENOTES GROUND WATER TEST HOLE (G.W.T.H. #)

CONSTRUCTION NOTES:

1. EXISTING SEPTIC BEDS TO BE ABANDONED IN PLACE.
2. NEW SEPTIC SYSTEM CONSTRUCTION TO TO COMPLY WITH O. REG. 374/81.
3. RAISED BED TO BE CONSTRUCTED OF STONE FREE SANDY LOAM WITH PERCOLATION TIME OF 5< T < 10 min/cm. MATERIAL TO BE PLACED IN 150 mm LAYERS AND COMPACTED BY REPEATED PASSES OF SPREADING EQUIPMENT.
4. McKENZIE AND KYLE SEPTIC SYSTEMS TO CONSIST OF 3 RUNS OF 100 mm ø PVC DISTRIBUTION PIPE (30m LONG EACH). DISTRIBUTION PIPES TO BE INTERCONNECTED AT EACH END WITH 100 mm ø PVC NON-PERFORATED PIPE.
5. RICHER AND BATISSE SEPTIC SYSTEMS TO CONSIST OF 4 RUNS OF 100 mm ø PVC DISTRIBUTION PIPE (25 m LONG EACH). DISTRIBUTION PIPES TO BE INTERCONNECTED AT EACH END WITH 100 mm ø PVC NON-PERFORATED PIPE.
6. CONTRACTOR TO PERFORM ALL NECESSARY ELECTRICAL AND MECHANICAL WORK (AND OBTAIN PERMITS) TO MAKE THE ALARM AND PUMP SYSTEMS OPERATIONAL.

Nº	DATE	REVISION	BY

CANADA MORTGAGE AND HOUSING CORPORATION

OTTO TOWNSHIP CMHC HOMES SEPTIC SYSTEM DESIGN

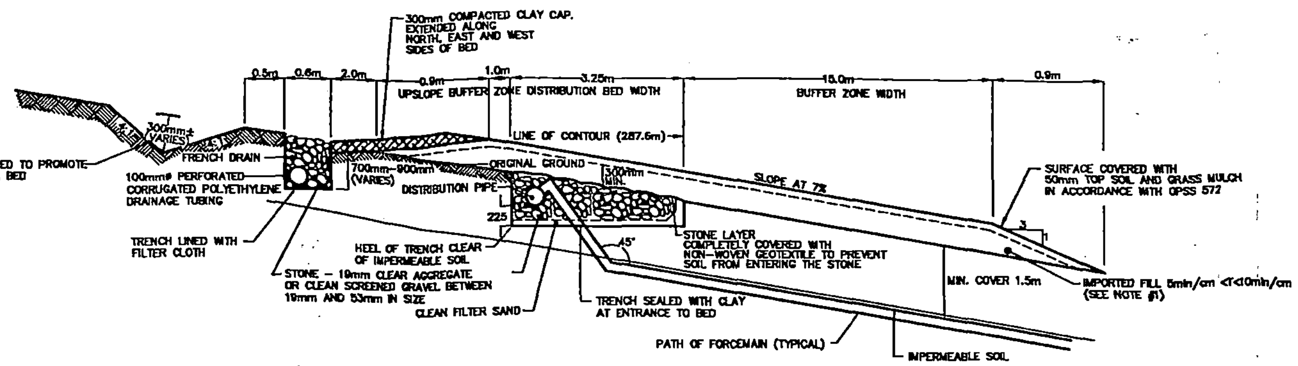
PROJECT Nº. E90023

DRAWING TITLE

PLAN–PROFILE AND DETAIL DRAWINGS FOR RAISED ABSORPTION BEDS

DRAWN B.R.P./CAD	SCALES HORIZ. 1:500
CHECKED H.J.H.	PLAN Nº. 90–532
NOTES E90023*.GRE	SHEET Nº. 1
DATE OCT. 22/90.	REVISION

H SUTCLIFFE LIMITED
CONSULTING ENGINEERS
NEW LISKEARD, ONTARIO P.O. BOX 1208
TELEPHONE (705) 647-4311, FAX (705) 647-3111



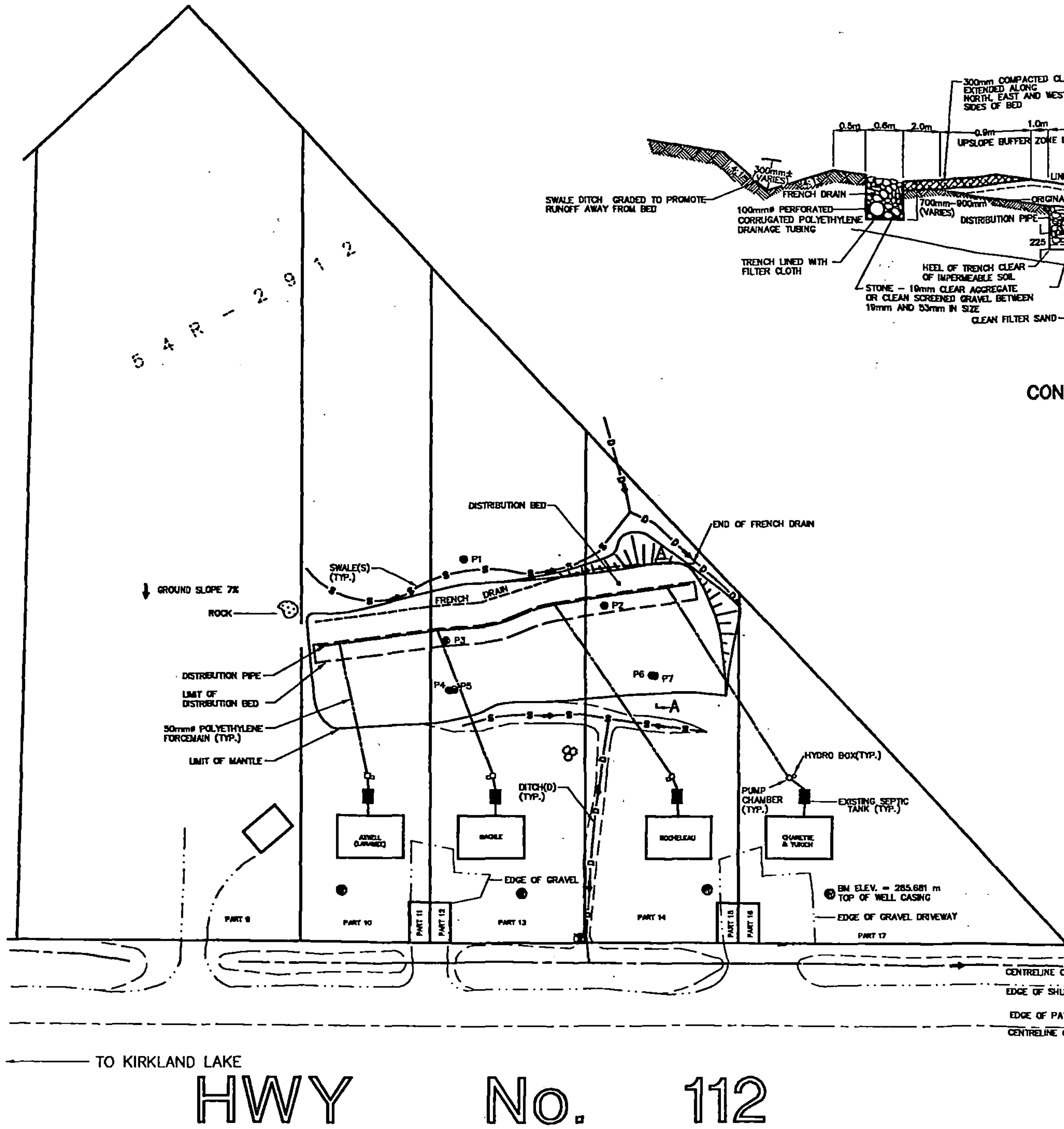
CONTOUR TRENCH CROSS-SECTION SECTION A-A

NOT TO SCALE

NOTES:

1. RAISED PORTION OF BED TO BE CONSTRUCTED OF STONE FREE SANDY LOAM WITH PERCOLATION TIME OF 5 TO 10 min/cm. MATERIAL PLACED IN 150mm LIFTS AND COMPACTED BY REPEATED PASSES OF SPREADING EQUIPMENT. CONTRACTOR SUBMITTED SAMPLE OF LOAM MATERIAL FOR APPROVAL PRIOR TO CONSTRUCTION.

2. EACH RESIDENCE WAS SUPPLIED AND INSTALLED WITH
   1 LOW FLOW TOILET (KOHLER #K3421-PB)
   1 TELEDYNE WATER PIK SHOWER HEAD (2.1 LPM WATER SAVER)
   1 EATON FAUCET FLOW REGULATOR (MODEL FMB)



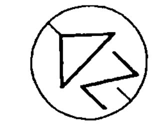
SITE PLAN

SCALE 1:500

PIEZOMETER Nº.	TOP ELEV.	GRD. ELEV.
P1	289.950	288.766
P2	288.641	287.941
P3	288.606	287.946
P4	287.824	286.986
P5	287.505	286.949
P6	287.267	286.717
P7	287.622	286.740

DRAWING TITLE: AS CONSTRUCTED | SHEET Nº. 2

ORIENTATION



Nº	DATE	REVISION	BY
2	07/93	AS CONSTRUCTED	BRP
1	09/92	DESIGN REVISION REQUESTED BY MOE	HJH

CANADA MORTGAGE AND HOUSING CORPORATION

OTTO TOWNSHIP CMHC HOMES
CONTOUR TRENCH SEPTIC SYSTEM
LOT 4 CON 6 OTTO TWP

PROJECT Nº. E91083

DRAWING TITLE

AS CONSTRUCTED

DRAWN AMD/CAD BRP/CAD	SCALES AS NOTED
CHECKED H.J.H.	PLAN Nº. 90-532
NOTES E90023+.GRE	SHEET Nº. 2
DATE SEPT. 1992	DWG. FILE E91083AC.DWG

Sutcliffe
CONSULTING ENGINEERS est. 1906 ONTARIO LAND SURVEYORS
H. SUTCLIFFE LIMITED
H. SUTCLIFFE SURVEYING LTD.
P.O. BOX 1206, NEW LISKEARD, ONTARIO, P0J 1P0
TELEPHONE (705) 647-4311, FAX (705) 647-3111