COTTAGE POLLUTION
CONTROL PROGRAM

PETERBOROUGH AND VICTORIA COUNTIES

CHANDOS LAKE
LOONCALL LAKE
HEAD LAKE

1974

Ontario
Ministry of the Environment

P. G. Cockburn, P. Eng.
Director
Central Region

COTTAGE POLLUTION CONTROL PROGRAM

1974

CHANDOS LAKE, PETERBOROUGH COUNTY
LOONCALL LAKE, PETERBOROUGH COUNTY
HEAD LAKE, VICTORIA COUNTY

The field work included in this report was completed by the staff of the Peterborough District Office, Municipal & Private Abatement Section.

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PREFACE

Ontario's thousands of beautiful inland lakes provide an abundant resource for recreational enjoyment. To protect the quality of these waters, a delicate environmental balance must be maintained.

A heavy influx of people may subject a lake and its surrounding environment to great stress. Uncontrolled development and imprudent use of our recreational lakes may cause their deterioration and destroy their natural qualities.

The Ontario Ministry of the Environment is attempting to bring some of these stress factors under control by a variety of programs; one of these, the Cottage Pollution Control Program was initiated in 1970 to study the cottage waste disposal problem, to evaluate existing waste disposal systems and to enforce repairs to those found to be unsatisfactory.

The Ministry is also carrying on research to improve the knowledge of septic tank operation and the movement of sewage effluent in shallow soils. Alternative methods of private waste disposal are also being evaluated.

SUMMARY

The Cottage Pollution Control Program was established to detect and correct faulty private sewage disposal systems of cottages located on recreational lakes. The objective of the program is to investigate and in conjunction with the owner, to undertake abatement work on those systems found to be faulty.

In 1974, a total of 1243 waste disposal systems were inspected. These were located in the Trent Waterways System - Chandos Lake and Loncall Lake in the Peterborough County and Head Lake in Victoria County.

Of these systems, 61% were found to be satisfactory or performing satisfactory at the time of inspection. However, 30% were unsatisfactory, due to improper disposal of waste water and 9% were found to be seriously substandard.

A total of 303 cottage drinking water samples were collected. Of these, 30% showed presence of coliform bacteria, which are pollution indicators. It should be stressed that these are merely individual samplings indicating only the quality at the time of sampling. It is the Ministry's recommendation that all surface water supplies used for drinking purposes should be disinfected as a precautionary measure.

Abatement work was carried out to correct sewage systems found faulty or unsatisfactory on Chandos Lake. A total of 275 inspections were made and 233 systems were corrected.

In addition, 42 letters were sent out to advise the cottage owners to have their work completed prior to using their cottages in 1975.

DESIGN OF THE SURVEY

Preparation

During the winter of 1973, a reconnaissance and mapping program was undertaken by snowmobiles on the lakes.

The snowmobile crews counted the number of establishments on the lake, photographed and described every one hundredth establishment on the shoreline, plotted the cottages on maps and located non cottage properties such as marinas, camp grounds and lodges.

Data obtained from the snowmobile work, as well as that from Cottage Owner's Association and other agencies, was used to prepare a work schedule for the student crews in the summer.

Prior to the commencement of the survey of each lake, a meeting was held with the Cottagers' Association during which members were given a brief outline of the procedures we would be following and also the information that would be required from each cottager. The co-operation of the Associations contributed greatly to the success of the program.

Detection Surveys

The crews, composed of two students, began the survey of each lake by preparing a description log in which each establishment was systematically numbered and accurately described. Thus, individual establishments can be easily located for follow-up inspection or correction.

Each establishment was then inspected with regards to: type of disposal system, size, location and design, soils type in area of all tile beds, presence of leaching pits or privies; to provide data on nature and depth of soil, source of drinking water and other related factors.

A preliminary classification of all waste disposal systems was made by the students prior to turning over the file to their supervisor for final classification.

Classification of Sewage Disposal Systems

All premises surveyed were classified into one of the following groups:

1. Satisfactory - the system meets the standards of good design, construction and location, is not polluting nor is a public health nuisance.

2. Satisfactory Performance - the system which is not up

to present day standards but appears in all other aspects a "safe" system and not likely to cause pollution.

3. Seriously Defective - a defect exists which may cause the system to malfunction in the future. The owner is advised of the defects and he is advised that some consideration should be given to up-dating the system in the near future.

4. Nuisance (Wash Water) - a system causing wash water to be exposed on the surface of the ground either directly through a waste pipe or escaping from a seepage pit or just thrown on ground surface. Such a condition is known as a Public Health Nuisance. Wash water discharged from any sanitary fixture is contaminated and creates an unhealthy environment. Phosphates and other nutrients from waste discharges encourage weed growth and affects the aesthetic quality of the lake.

5. Nuisance (Toilet and Solid Waste) - a system causing a waste containing faecal or urinary discharges to be exposed on the surface of the ground, either directly through a pipe or escaping from some part of a sewage disposal system including a privy. Also, included in this classification, is "solid waste" or garbage of a kind which can cause a "nuisance", e.g. domestic garbage containing foodstuff.

6. Direct Polluter - a system which is permitting sewage to contaminate the ground water or to reach the lake either by direct discharge through a pipe or ditch or over the ground surface; or is proven to be polluting by means of water samples or tracer tests.

7. Unclassified (temporarily) - a system which has been given a preliminary classification by the student inspector where he feels he cannot use any of the preceding classifications and has doubts about the system or part of it. These systems require further inspections by the supervisor who will attempt to make a final classification after a thorough investigation.

8. Unclassified - a system (or systems) where it is not possible at the end of the survey to make a classification at that time. Usually they amount to only a few and include abandoned or ruinous premises.

WATER SAMPLING

The Public Health Laboratories provided the necessary water sample analyses to detect total and faecal coliforms in the lake water samples. These samples were important for the tracing of sources of pollution entering the lake. They were not taken in sufficient number or frequency to investigate the overall water quality of the lakes surveyed.

A Water Quality Study has been carried out by the Ministry of the Environment on Chandos and Head Lakes. Copies of these reports are available from the Ministry of the Environment, Technical Support Section, 7th Floor, 150 Ferrand Drive, Don Mills, Ontario, M3C 3C3.

Drinking water samples were obtained when the cottager was using an untreated water supply. These samples were analysed at the Public Health Laboratory and any owner having a drinking water sample which showed unsatisfactory total or faecal coliforms was immediately informed to this effect and instructions were also sent regarding procedures for disinfecting the drinking water supply.

All lake water samples fell well within the criteria for total body contact recreational use of 1,000 total coliforms per 100 ml, and 100 faecal coliforms per 100 ml, as outlined in the Ministry of the Environment booklet "Guidelines and Criteria for Water Quality Management, July 1974".

CORRECTION PROCEDURE

After the file is examined by the supervisor, and the original classification is confirmed, it is passed on to the Abatement Officer. The Abatement Officer then interviews the establishment owner to advise him of the findings and discuss corrective action. If the owner agrees with the findings, a corrective program is initiated and the owner signs an abatement agreement form stating the corrections which would be completed by a specific date. A final inspection is carried out upon completion of the corrective work, and the sewage disposal system is reclassified.

In the case of commercial establishments, this procedure is often more complicated requiring an engineering study and the submission of plans for approval with soil analysis reports. In these instances, unless he is a direct polluter, the owner is contacted and is instructed to submit plans for the corrective measures to be completed prior to the opening of the next commercial season. A direct polluter must take corrective action immediately to prevent pollution of the lake.

METHODS OF SEWAGE DISPOSAL

Much of the shoreline property in the Kawarthas has minimal soil cover over bedrock and thus is unsuitable, in its natural state, for sub-surface sewage disposal. This can be remedied in some areas by importing granular material over an area capable of supporting a sub-surface sewage disposal system. The use of a holding tank may provide a more

economical solution for the disposal of sewage and may be recommended if a contract for the pump-out of the tank can be secured. On some lots where there is restricted space for a sewage disposal system, the installation of a proprietary aerobic sewage treatment system may provide a viable alternative.

Recently there have been many developments in sewage disposal systems and the Ministry of the Environment is continually monitoring new systems being marketed in Ontario.

The Ministry of the Environment or the Health Unit administering the septic tank program for the Ministry in the area should be consulted and approval obtained before any sewage disposal system is installed.

CHANDOS LAKE

Chandos Lake is located in the County of Peterborough, Township of Chandos, and lies within the Pre-Cambrian Shield. The surrounding area is characterized by rolling hills, good local drainage and shallow overburden covering Pre-Cambrian bedrock. Most of the soil around the lake is comprised of 50-90 percent granite, thinly covered with a mixture of humus and sand overburden, with small deposits of deeper soil materials found in the crevices. Small areas of marsh are found in low lying areas around the lake.

The lake covers an area of approximately five square miles with the maximum depth of one hundred and fifty feet.

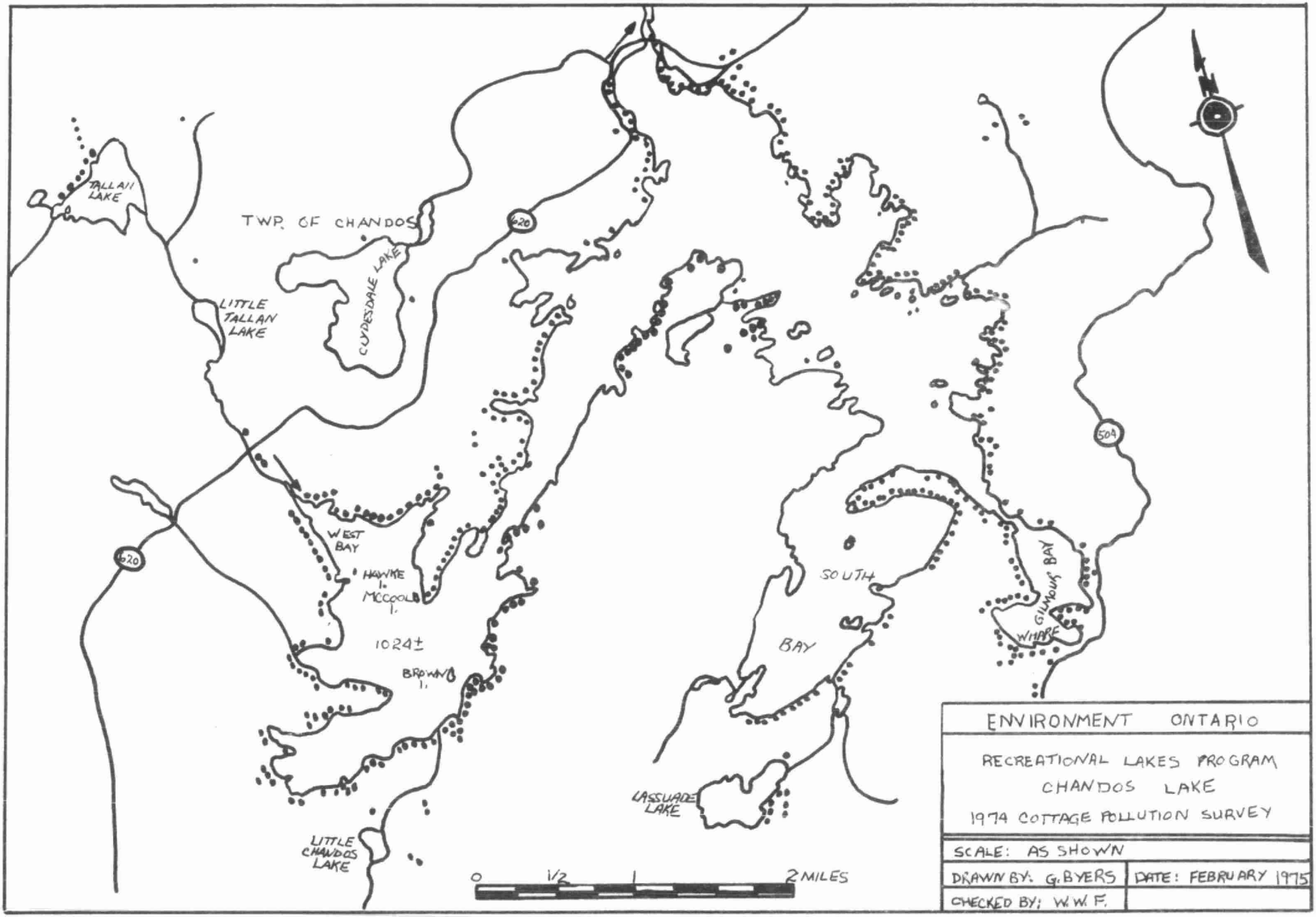
Most of the cottagers use the lake as their source of domestic water. There are no direct discharges of raw or treated wastes in Chandos Lake from municipal or communal sewage treatment facilities. The area residents are provided with six municipal solid waste disposal sites located within a mile of the lake.

The shoreline of Chandos Lake is generally well developed with the exception of the northwest shore of South Bay. There are 880 cottages, three lodges and three marinas on the lake. A public beach is located at the northeast end of the lake, and a picnic area is located at the west end of South Bay. Of the 886 sewage disposal systems on Chandos Lake, 221 or 25% of the sewage disposal systems were unsatisfactory due to improper disposal of waste water and 60,

or 7% were found to be seriously substandard.

Abatement work was carried out to correct sewage systems found faulty or unsatisfactory. Work was completed on 233 sewage disposal systems and these cottage establishments were re-classified to a "satisfactory" or "satisfactory performance" category. The remaining number of cottage establishment owners were advised by letter what corrections were necessary and if their systems were seriously substandard, they were advised to consider updating them to meet present day requirements. Abatement work will be continuing in 1975 to correct those systems not completed in 1974.

A total of 257 cottage drinking water samples were collected. Of these, 30% showed the presence of coliform bacteria, which are pollution indicators. It should be stressed that these are merely individual samplings indicating only the quality at the time of sampling. It is the Ministry's recommendation that all surface water supplies used for drinking purposes should be disinfected as a precautionary measure. The cottage establishment owners were notified by letter of the results of the drinking water sample obtained from their premises.


TALLAN LAKE
TWP. OF CHANDOS
520
CLYDESDALE LAKE
LITTLE TALLAN LAKE
WEST BAY
HAWKE I.
MCCOOL I.
1024±
BROWN I.
LITTLE CHANDOS LAKE
SOUTH BAY
GILMOUR BAY
WHARF
504
LASSUADE LAKE
0 1/2 1 2 MILES
ENVIRONMENT ONTARIO
RECREATIONAL LAKES PROGRAM
CHANDOS LAKE
1974 COTTAGE POLLUTION SURVEY
SCALE: AS SHOWN
DRAWN BY: G. BYERS
DATE: FEBRUARY 1975
CHECKED BY: W.W.F.

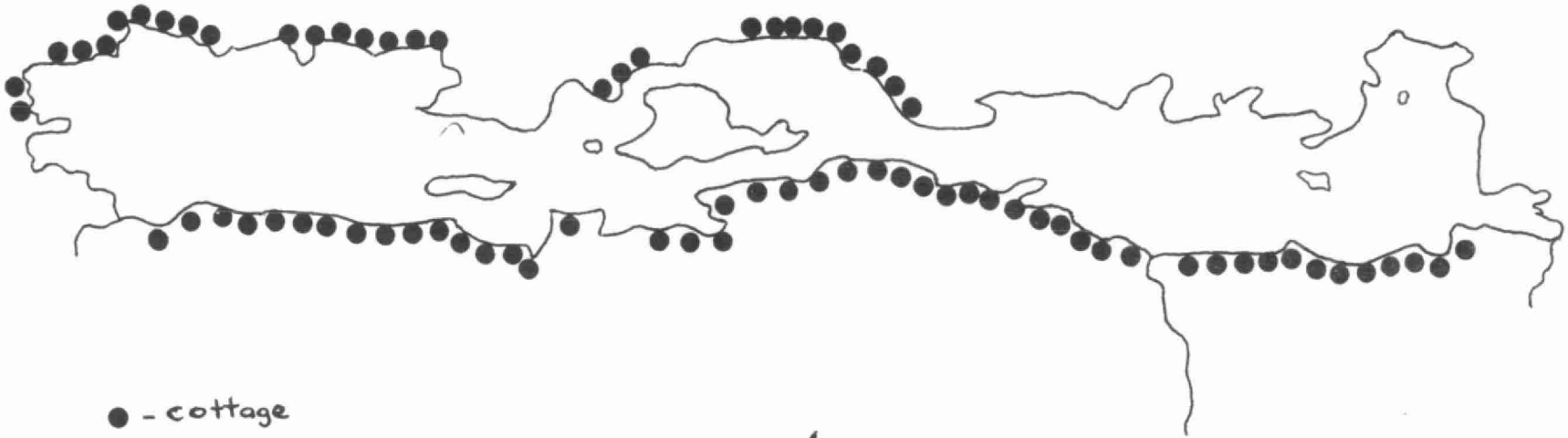
LOONCALL LAKE

Looncall Lake is located in the Township of Anstruther, Peterborough County and is approximately 3 miles south west of the community of Apsley.

The land surrounding the lake is generally a moderately forested hilly area. Most of the soil around the lake belongs to the Rockland series. This is comprised of 50 to 90 percent granite, thinly covered with a mixture of humus and sand with small deposits of deeper soil materials in the crevices. Small areas of marsh are found in the low lying areas around the lake.

Of the 81 cottages on the lake, 44, or 54% were found to have sewage disposal systems that were unsatisfactory due to improper disposal of waste water, and 22, or 8% were found to be seriously substandard. No abatement was carried out on these systems but the cottage establishment owners will be interviewed during the winter months to discuss their problem and have an agreement signed to do the necessary corrective work.

LOON CALL LAKE



● - cottage

ENVIRONMENT ONTARIO	
COTTAGE POLLUTION PROGRAM LOON CALL LAKE 1974 SURVEY	
Scale: As Shown	
Drawn by: C. Muisiner	Date: Dec. 1974
Checked by: BF	

HEAD LAKE

Head Lake is located in the Townships of Laxton and Digby in Victoria County, approximately 30 miles north-west of Lindsay.

The area surrounding the lake is generally comprised of moderately undulating hills. The shoreline is made up of two types of soils; Dummer Loam Shallow Phase and Rockland. The shallow phase loam has a thin cover of stony glacial till over the limestone.

The shoreline is dominated by steep slopes on the west and east sides of the lakes, whereas to the north and south ends of the lake has lesser slopes with greater soil cover. The lake has a water surface area of 3.4 square miles and is shallow with a maximum depth of 21 feet.

There are 276 cottages and 2 resorts on the lake. One marina is situated on the east side of the lake. The lower east side and the middle half of the west side of the lake is fully developed, as well as the northern shore extending from the outlet of the Head River to the marsh at the north east sector. At the southern end of the lake is a small park with picnic tables, 2 outhouses and a beach. Development is scarce along the upper quarter on the west side as well on the north east corner due to marshy condition.

Of the 276 cottages and resorts on the lake, 78, or 28% were found to have sewage disposal systems that were

unsatisfactory due to improper disposal of waste water and 22, or 8% were found to be seriously substandard. No abatement was carried out on these systems but the cottage establishment owners will be interviewed during the winter months to discuss their problems and have an agreement signed to do the necessary corrective work.

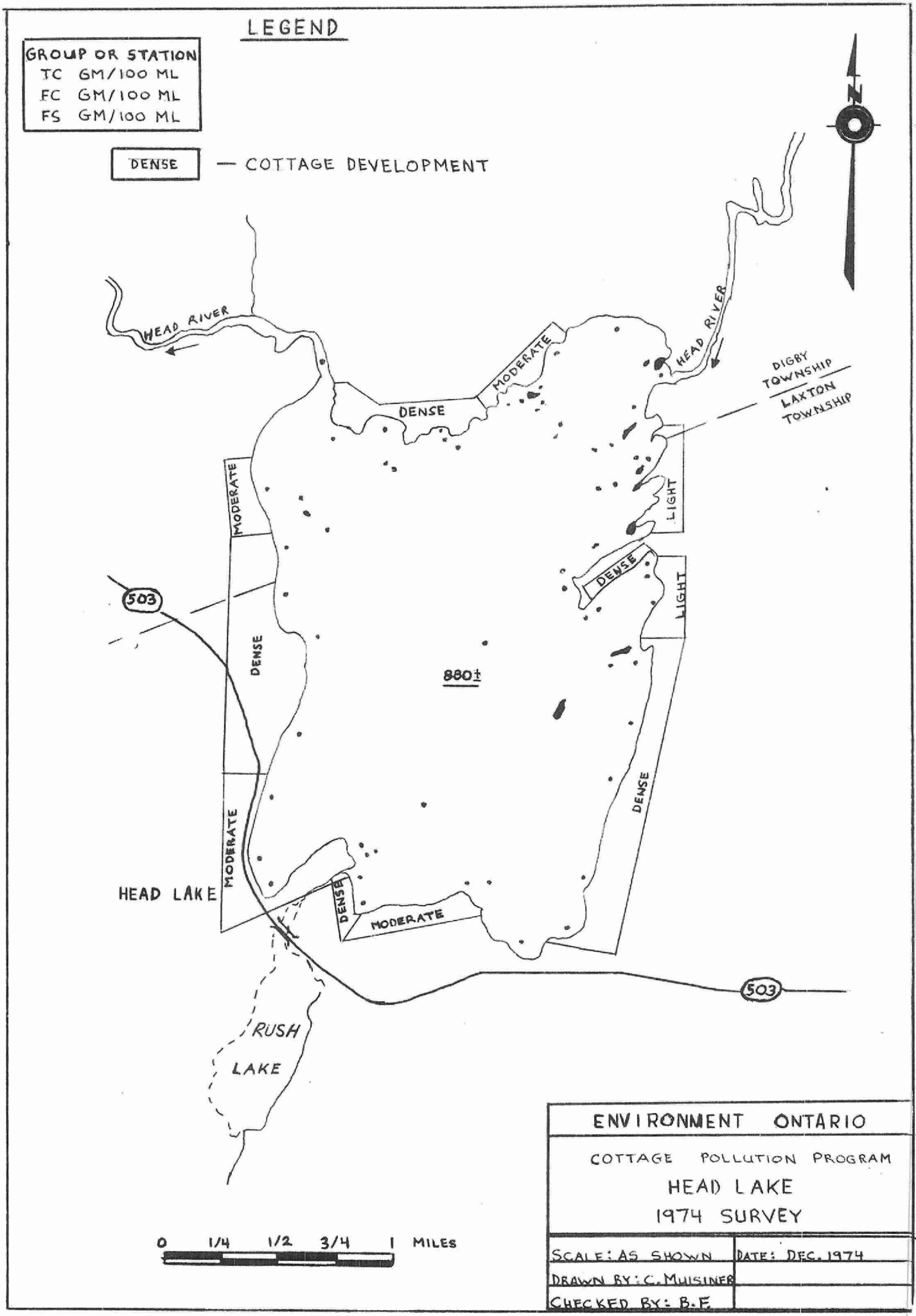

LEGEND
GROUP OR STATION
TC GM/100 ML
FC GM/100 ML
FS GM/100 ML
DENSE — COTTAGE DEVELOPMENT
N
HEAD RIVER
HEAD RIVER
DENSE
MODERATE
DIGBY TOWNSHIP
LAXTON TOWNSHIP
MODERATE
LIGHT
DENSE
LIGHT
503
DENSE
880±
DENSE
MODERATE
HEAD LAKE
MODERATE
DENSE
DENSE
503
RUSH LAKE
0 1/4 1/2 3/4 1 MILES
ENVIRONMENT ONTARIO
COTTAGE POLLUTION PROGRAM
HEAD LAKE
1974 SURVEY
SCALE: AS SHOWN
DATE: DEC. 1974
DRAWN BY: C. MUISNER
CHECKED BY: B.E.

TABLE I

PRELIMINARY CLASSIFICATION OF SYSTEMS INSPECTED

PETERBOROUGH DISTRICT

1974

BODY OF WATER	NUMBER OF SYSTEMS INSPECTED	CLASSIFICATION OF SYSTEMS															
		SATISFACTORY		SATISFACTORY PERFORMANCE		SERIOUSLY SUBSTANDARD		NUISANCE (WASH WATER)		NUISANCE (SOLID WASTE)		DIRECT POLLUTER		UNCLASSIFIED TEMPORARILY		UNCLASSIFIED	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
CHANDOS LAKE	886	71	8	481	54	60	7	190	21	26	3	5	7	53	6	0	0
LOONCALL LAKE	81	4	5	29	36	4	5	36	44	7	9	1	1				
HEAD LAKE	276	28	10	148	54	22	8	65	24	12	4	1	0				
	1243	103	8	658	53	86	7	291	23	45	4	7	1	53	4	0	0

TABLE II

DRINKING WATER SAMPLES
1974
COLIFORMS PER 100 ML. M.F.

BODY OF WATER	TOTAL SAMPLES	SATISFACTORY		UNSATISFACTORY
		TOTAL 0 FAECAL 0	TOTAL 1-4 FAECAL 0	TOTAL 5-80+ FAECAL 0-80+
Chandos Lake	251	177	0	74
Looncall Lake	7	5	0	2
Head Lake	45	30	0	15
TOTAL	303	212	0	91
Percent of Total Samples		69.96%	0%	30.03%
TOTAL		212		91
Percent of Total Samples		69.96%		30.03%

NOTE:
1. Owners of establishments where laboratory analysis of drinking water samples was unsatisfactory were notified to that effect by mail.
2. The designations "Satisfactory" and "Unsatisfactory" are in accordance with the drinking water sample interpretation chart pamphlet "Understanding the Bacteriological Report on your Drinking Water", produced by the Ontario Ministry of Health.
3. No drinking water sample was taken if drinking water was being treated.

INFORMATION OF GENERAL INTEREST TO COTTAGERS

MICROBIOLOGY OF WATER

For the sake of simplicity, the micro-organisms in water can be divided into two groups: the bacteria that thrive in the lake environment and make up the natural bacterial flora; and the disease causing micro-organisms, called pathogens, that have acquired the capacity to infect human tissues.

The "pathogens" are generally introduced to the aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. The presence of these bacteria does not change the appearance of the water but poses an immediate public health hazard if the water is used for drinking or swimming. The health hazard does not necessarily mean that the water user will contract serious waterborn infections such as typhoid fever, polio or hepatitis, but he may catch less serious infections of gastro-enteritis (sometimes called stomach flu), dysentery or diarrhea. Included in these minor afflictions are eye, ear and throat infections that swimmers encounter every year and the more insidious but seldom diagnosed, subclinical infections usually associated with several waterborn viruses. These viral infections leave a person not feeling well enough to enjoy holidaying although not bedridden. This type of microbial pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satisfactory conditions within a relatively short time (approximately 1 year) since disease causing bacteria usually do not thrive in an aquatic environment.

The rest of the bacteria live and thrive within the lake environment. These organisms are the instruments of biodegradation. Any organic matter in the lake will be used as food by these organisms and will give rise, in turn to subsequent increases in their numbers. Natural organic matter as well as that from sewage, kitchen wastes, oil and gasoline are readily attached by these lake bacteria. Unfortunately, biodegradation of the organic wastes by organisms uses correspondingly large amounts of the dissolved oxygen. If the organic matter content of the lake gets high enough, these bacteria will deplete the dissolved oxygen supply in the bottom waters and threaten the survival of many deep water fish species.

RAINFALL AND BACTERIA

The "Rainfall Effect" relates to a phenomena that has been documented in previous surveys of the Recreational Lakes. Heavy precipitation has been shown to flush the land area around the lake and the subsequent runoff will carry available contaminants including sewage organisms as well as natural soil bacteria with it into the water.

Total coliforms, faecal coliforms and faecal streptococci, as well as other bacteria and viruses which inhabit human waste disposal systems, can be washed into the lake. In Pre-Cambrian areas where there is inadequate soil cover and in fractured limestone areas where fissures in the rocks provide access to the lake, this phenomenon is

particularly evident.

Melting snow provides the same transporation function for bacteria, especially in an agricultural area where manure spreading is carried out in the winter on top of the snow.

Previous data from sampling points situated 50 to 100 feet from shore indicate that contamination from shore generally shows up within 12 to 48 hours after a heavy rainfall.

WATER TREATMENT

Lake and river water is open to contamination by man, animals and birds (all of which can be carriers of disease); consequently, NO SURFACE WATER MAY BE CONSIDERED SAFE FOR HUMAN CONSUMPTION without prior treatment, including disinfection. Disinfection is especially critical if coliforms have been shown to be present.

Disinfection can be achieved by:

a) Boiling

Boil the water for a minimum of five minutes to destroy the disease causing organisms.

b) Chlorination Using a Household Bleach Containing 4 to 5.1/4% Available Chlorine

b) Chlorination (cont'd)

Eight drops of a household bleach solution should be mixed with one gallon of water and allowed to stand for 15 minutes before drinking.

c) Continuous Chlorination

For continuous water disinfection, a small domestic hypochlorinator (sometime coupled with activated charcoal filters) can be obtained from a local plumber or water equipment supplier.

d) Well Water Treatment

Well water can be disinfected using a household bleach (assuming strength at 5% available chlorine) if the depth of water and diameter of the well are known.

CHLORINE BLEACH
per 10 ft. depth of water

Diameter of Well Casing In Inches	One to Ten Coliforms	More than Ten Coliforms
4	.5 oz.	1 oz.
6	1 oz.	2 oz.
8	2 oz.	4 oz.
12	4 oz.	8 oz.
16	7 oz.	14 oz.
20	11 oz.	22 oz.
24	16 oz.	31 oz.
30	25 oz.	49 oz.
36	35 oz.	70 oz.

Allow about six hours of contact time before using the water.

Another bacteriological sample should be taken after

one week of use.

Water sources (spring, lake, well, etc.) should be inspected for possible contamination routes (surface soil, runoff following rain and seepage from domestic waste disposal sites). Attempts at disinfecting the water alone without removing the source of contamination will not supply bacteriologically safe water on a continuing basis.

There are several types of low cost filters (ceramic, paper, carbon, diatomaceous earth sometimes impregnated with silver, etc.) that can be easily installed on taps or in water lines. These may be useful to remove particles if water is periodically turbid and are usually very successful. Filters, however, do not disinfect water but may reduce bacterial numbers. For safety, chlorination of filtered water is recommended.

SEPTIC TANK INSTALLATIONS

In Ontario, provincial law requires under Part 7 of the Environmental Protection Act that before you extend, alter, enlarge or establish any building where a sewage system will be used, a Certificate of Approval must be obtained from the Ministry of the Environment or its representatives. The local municipality or Health Unit may be delegated the authority to issue the Certificate of Approval. Any other pertinent information such as size, types and location of septic tanks and tile fields can also be obtained from the same authority.

(1) General Guidelines

A septic tank should not be closer than:

- 50 feet to any well, lake, stream, pond, spring, river or reservoir.
- 5 feet to any building.
- 10 feet to any property boundary.

The tile field should not be closer than:

- 100 feet to the nearest dug well.
- 50 feet to a drilled well which has a casing to 25 feet below ground.
- 25 feet to a building with a basement that has a floor below the level of the tile in the tile bed.
- 10 feet to any other building.
- 10 feet to a property boundary.
- 50 feet to any lake, stream, pond, spring, river or reservoir.

The ideal location for a tile field is in a well-drained, sandy loam soil remote from any wells or other drinking water sources. For the tile field to work satisfactorily, there should be at least 3 feet of soil between the bottom of the weeping tile trenches and the top of the ground water table or bedrock.

Recognizing that private sewage systems are relatively inefficient where shallow and inappropriate soil conditions are present (e.g. Pre-Cambrian areas) the Ministry of the Environment is conducting research into alternate methods of private sewage disposal in un-severed areas; into the improvement of existing equipment and methods of design and operation for these systems; and into the development of better surveillance methods such as by the use of chemical, biological and radioactive tracers to detect the movement of pollutants through the soil mantle.

DYE TESTING OF SEPTIC TANK SYSTEMS

There is considerable interest among cottage owners to dye test their sewage systems, however, several problems are associated with dye testing. Dye would not be visible to the eye from a system that has a fairly direct connection to the lake. Thus, if a cottager dye-tested his system and no dye was visible in the lake, he would assume that his system is satisfactory, which might not be the case. A low concentration of dye is not visible and therefore expensive equipment such as a fluorometer is required. Only qualified people with adequate equipment are capable of assessing a sewage system by using dye. In any case, it is likely that some of the water from a septic tank will eventually reach the lake. The important question is whether all contaminants including nutrients have been removed before it reaches the lake. To answer this question special knowledge of the system, soil depth and composition, underground geology of the region and the shape and flow of the shifting water table are required. Therefore, we recommend that this type of study should be performed only by qualified professionals.

BOATING REGULATION

In order to help protect the lakes and rivers of Ontario from pollution, it is required by law that sewage (including garbage) from all pleasure craft, including house-boats must be retained in equipment of a type approved by the Ministry of the Environment. Equipment which will be approved by the Ministry of the Environment includes (1) retention devices

with or without circulation which retain all toilet wastes for disposal ashore, and (2) incinerating devices which reduce all sewage to ash.

To be approved, equipment shall:

1. be non-portable
2. be constructed of structurally sound material,
3. have adequate capacity for expected use
4. be properly installed,
5. in the case of storage devices, be equipped with the necessary pipes and fittings conveniently located for pump-out by shore-based facilities (although not specified, a pump-out deck fitting with 1.1/2 inch National Pipe Thread is commonly used).

An Ontario regulation requires that marinas and yacht clubs provide or arrange pump-out service for the customers and members who have toilet-equipped boats. In addition, all marinas and yacht clubs must provide litter containers that can be conveniently used by occupants of pleasure boats.

The following "Tips" may be of assistance to you in regards to boating:

1. Motors should be in good mechanical condition and properly tuned.

2. When a tank for outboard motor testing is used, the contents should not be emptied into the water.

3. If the bilge is cleaned, the waste material must not be dumped into the water.

4. Fuel tanks must not be overfilled and space must be left for expansion if the fuel warms up.

5. Vent pipes should not be obstructed and fuel needs to be dispensed at a correct rate to prevent "blow-back".

6. Empty oil cans must be deposited in a leak-proof receptacle, and

7. Slow down and save fuel.

EUTROPHICATION OR EXCESSIVE FERTILIZATION AND LAKE PROCESSES

In recent years, cottagers have become aware of the problems associated with nutrient enrichment of recreational lakes and have learned to recognize many of the symptoms characterizing nutrient enriched (etrophic) lakes. It is important to realize that small to moderate amounts of aquatic plants and algae are necessary to maintain a balanced aquatic environment. They provide food and a suitable environment for the growth of aquatic invertebrate organisms which serve as food for fish. Shade from large aquatic plants helps to keep the lower water cool, which is essential to certain species of fish and also provides protection for young game and forage fish. Numerous aquatic plants are utilized for food and/or protection by many species of waterfowl. However, too much growth creates an imbalance in the natural plant and animal community particularly with respect to oxygen conditions, and some desireable forms of life such as sport fish are eliminated and unsightly algae scums can form. The lake will not be "dead" but rather abound with life which unfortunately is not considered aesthetically pleasing. This change to poor water quality becomes apparent after a period of years during which extra nutrients are added to the lake and return to the natural state may also take a number of years after the nutrient inputs are stopped.

Changes in water quality with depth are a very important characteristic of a lake. Water temperatures are uniform throughout the lake in the early spring and winds generally keep the entire volume well mixed.

Shallow lakes may remain well mixed all summer so that water quality will be the same throughout. On the other hand, in deep lakes, the surface waters warm up during late spring and early summer and float on the cooler more dense water below. The difference in density offers a resistance to mixing by wind action and many lakes do not become fully mixed again until the surface waters cool down in the fall. The bottom water receives no oxygen from the atmosphere during this unmixed period and the dissolved oxygen supply may be all used up by bacteria as they decompose organic matter. Cold water fish, such as trout, will have to move to the warm surface waters to get oxygen and because of the high water temperatures they will not thrive, so that the species will probably die out. (see Figure next page).

Low oxygen conditions in the bottom waters are not necessarily an indication of pollution but excessive aquatic plant and algae growth and subsequent decomposition in the bottom waters can aggravate the condition and in some cases result in zero oxygen levels in lakes which had previously held some oxygen in the bottom waters all summer. Although plant nutrients normally accumulate in the bottom waters of lakes, they do so to a much greater extent if there is no oxygen present. These nutrients become available for algae in the surface waters when the lake mixes in the fall and dense algae growths can result. Consequently, lakes which have no oxygen in the bottom water during the summer are more prone to having algae problems and are more vulnerable to nutrient inputs than lakes which retain some oxygen.

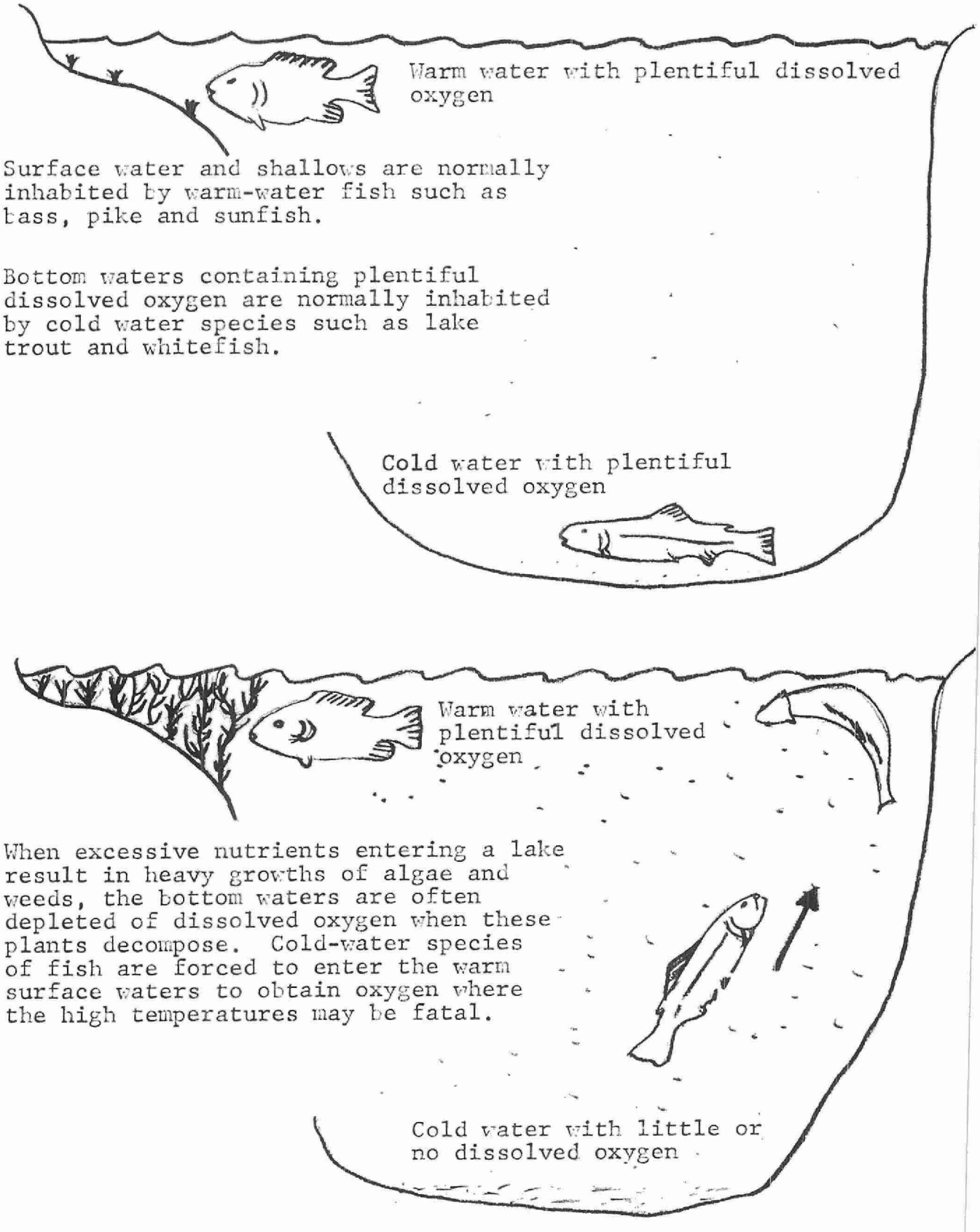


FIGURE A-1: DECOMPOSITION OF PLANT MATTER AT THE LAKE BOTTOM CAN LEAD TO DEATH OF DEEP-WATER FISH SPECIES.

Like humans, aquatic plants and algae require a balanced "diet" for growth. Other special requirements including those for light and temperature are specific for certain algae and plants. Chemical elements such as nitrogen, phosphorus, carbon, and several others are required and must be in forms which are available for uptake by plants and algae. Growth of algae can be limited by a scarcity of any single "critical" nutrient. Nitrogen and phosphorus are usually considered "critical" nutrients because they are most often in scarce supply in natural waters, particularly in lakes in the Pre-Cambrian area of the province. Phosphorus, especially is necessary for the processes of photosynthesis and cell division. Nitrogen and phosphorus are generally required in the nitrate-N (or amonia-N) and phosphate forms and are present in natural land runoff and precipitation. Human and livestock wastes are a very significant source of these and other nutrients for lakes in urban and agricultural areas. It is extremely important that cottage waste disposal systems function so that seepage of nutrients to the lake does not occur since the changes in water quality brought about by excessive inputs of nutrients to lakes are usually evidenced by excessive growths of algae and aquatic plants.

The large amounts of suspended algae which materialize from excessive inputs of nutrients, result in turbid water of poor clarity or transparency. On the other hand, lakes with only small, natural inputs of nutrients and correspondingly low nutrient concentrations (characteristically large and deep lakes) most often support very small amounts of suspended

The figure below indicates the previously mentioned relationship.

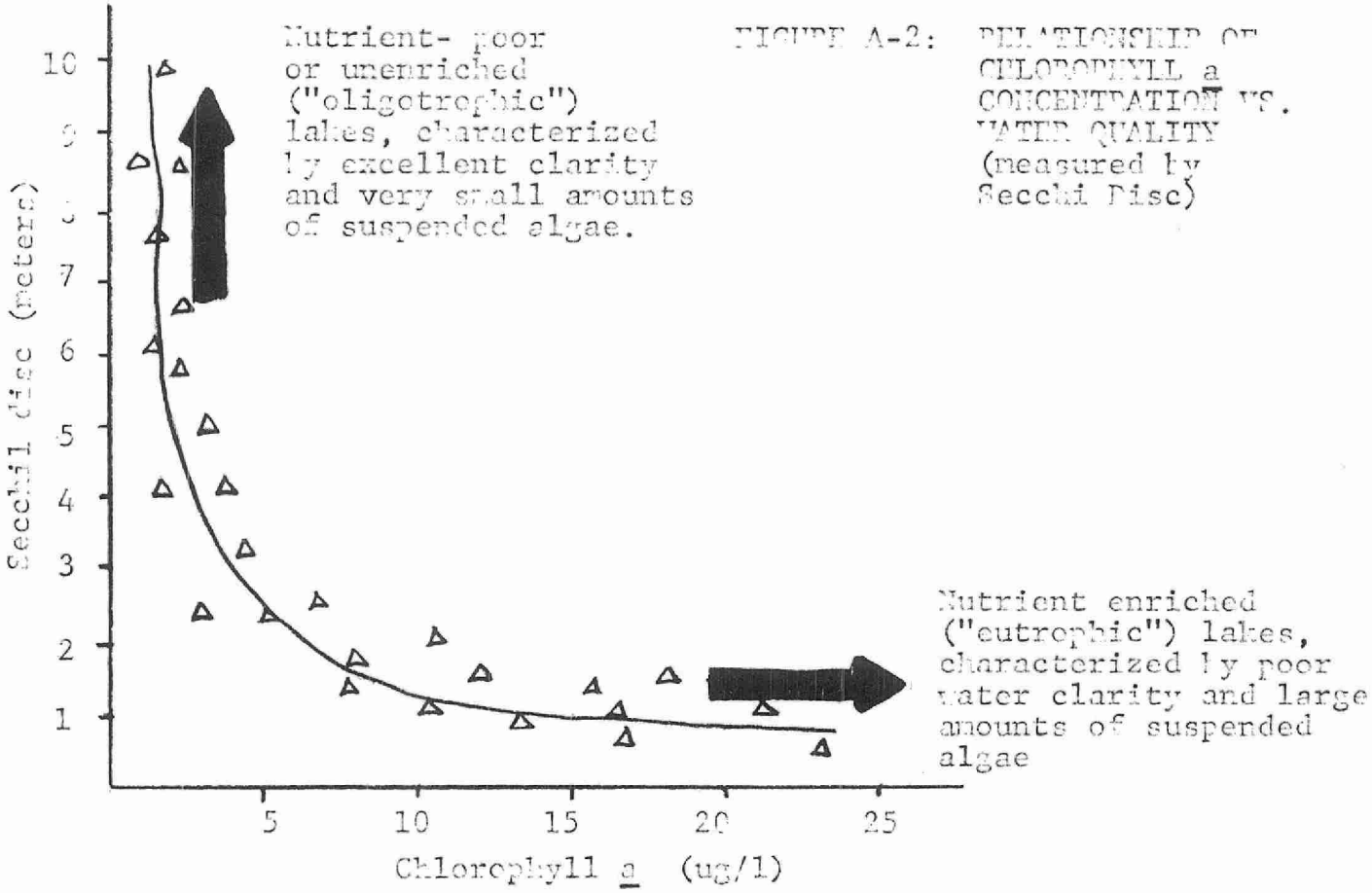


FIGURE A-2: RELATIONSHIP OF CHLOROPHYLL a CONCENTRATION VS. WATER QUALITY (measured by Secchi Disc)

algae and consequently are clear-water lakes. An indication of the degree of enrichment of lakes can therefore be gained by measuring the density of suspended algae (as indicated by the chlorophyll a concentration - the green pigment in most plants and algae) and water clarity (measured with a Secchi disc). In this regard, staff of the Ministry of the Environment have been collecting chlorophyll a and water clarity data from several lakes in Ontario and have developed a graphical relationship between these parameters which is being used by cottagers to further their understanding of the processes and consequences of nutrient enrichment of Pre-Cambrian Lakes.

In the absence of excessive coloured matter (e.g. drainage from marsh-lands), lakes which are very low in nutrients are generally characterized by small amounts of

suspended algae (i.e. chlorophyll a) and are clear-water lakes with high Secchi disc values. Such lakes, with chlorophyll a and Secchi disc values lying in the upper left-hand area of the graph are unenriched or nutrient-poor ("oligotrophic") in status and do not suffer from the problems associated with excessive inputs of nutrients. In contrast, lakes with high chlorophyll a concentrations and poor clarity are positioned in the lower right-hand area of the graph and are enriched ("eutrophic"). These lakes usually exhibit symptoms of excessive nutrient enrichment including water turbidity owing to large amounts of suspended algae which may float to the surface and accumulate in sheltered areas around docks and bays.

Measurements of suspended algae density (chlorophyll a) and water clarity are especially valuable if carried out over several years. Year to year positional changes on the graph can then be assessed to determine whether or not changes in lake water quality are materializing so that remedial measures can be implemented before conditions become critical. (See Figure A-2)

CONTROL OF AQUATIC PLANTS AND ALGAE

Usually aquatic weed growths are heaviest in shallow shoreline areas where adequate light and nutrient conditions prevail.

Extensive aquatic plant and algae growths sometimes interfere with boating and swimming and ultimately diminish shoreline property values.

Control of aquatic plants may be achieved by either

chemical or mechanical means. Chemical methods of control are currently the most practical, considering the ease with which they are applied. However, the herbicides and algicides currently available generally provide control for only a single season. It is important to ensure that an algicide or herbicide which kills the plants causing the nuisance, does not affect fish or other aquatic life and should be reasonable in cost. At the present time, there is no one chemical which will adequately control all species of algae and other aquatic plants. Chemical control in the province is regulated by the Ministry of the Environment and a permit must be granted prior to any operation. Simple raking and chain dragging operations to control submergent species have been successfully employed in a number of situations; however, the plants soon re-establish themselves. Removal of weeds by underwater mowing techniques is certainly the most attractive method of control and is currently being evaluated in Chemong Lake near Peterborough. Guidelines and summaries of control methods, and applications for permits are available from the District Pesticides Specialist, Ministry of the Environment, 139 George Street North, Peterborough, Ontario, K9J 3G6.

PHOSPHORUS AND DETERGENTS

Scientists have recognized that phosphorus is the key nutrient in stimulating algae and plant growth in lakes and streams.

Phosphorus and Detergents (cont'd)

In the past year, approximately 50% of the phosphorus contributed by municipal sewage was added by detergents. Federal regulations reduced the phosphate content of P_2O_5 in laundry detergents from approximately 50% to 20% on August 1, 1970 and to 5% on January 1, 1973.

It should be recognized that automatic dishwashing compounds were not subject to the government regulations and that surprisingly high numbers of automatic dishwashers are present in resort areas (a questionnaire indicated that about 30 percent of the cottages in the Muskoka lakes have automatic dishwashers). Cottagers utilizing such conveniences may be contributing significant amounts of phosphorus to recreational lakes because automatic dishwashing compounds are characteristically high in phosphorus. Indeed, in most of Ontario's vacation land, the source of domestic water is soft enough to allow the exclusive use of liquid dishwashing compounds, soap and soap-flakes which are, in general, relatively low in phosphorus.

ONTARIO'S PHOSPHORUS REMOVAL PROGRAMME

By 1975, the Government of Ontario expects to have controls in operation at more than 200 municipal wastewater treatment plants across the province serving some 4.7 million persons. This represents about 90 percent of the population serviced by sewers. The programme is in response to the International Joint Commission recommendations as embodied in the Great Lakes Water

Quality Agreement and studies carried out by the Ministry of the Environment on inland recreational waters which showed phosphorus to be a major factor influencing eutrophication. Specifically, the programme makes provision for nutrient control in the Upper and Lower Great Lakes, the Ottawa River system and in prime recreational waters where the need is demonstrated or where emphasis is placed upon prevention of localized, accelerated eutrophication.

Phosphorus removal facilities became operational at waste-water treatment plants on December 31, 1973, in the most critically affected areas of the province, including all the plants in the Lake Erie drainage basin and the inland recreational areas. The operational date for plants for discharging to waters deemed to be in less critical condition, which includes plants larger than one million gallons per day (1 mgd) discharging to Lake Ontario and to the Ottawa River system, is December 31, 1975. The 1973 phase of the programme involved 113 plants, of which 48 are in prime recreational areas. An additional 53 new plants, each with phosphorus removal, are now under development, 23 of which are located in recreational areas. The capacities of these plants range from 0.04 to 24.0 mgd, serving an estimated population of 1,600,000 persons.

The 1975 phase will bring into operation another 54 plants ranging in size from 0.3 to 180 mgd serving an additional 3,100,000 persons. Treatment facilities utilizing the Lower Great Lakes must meet effluent guide-

lines of less than 1.0 milligram per litre of total phosphorus in their final effluent. Facilities utilizing the Upper Great Lakes, the Ottawa River Basin and certain areas of Georgian Bay where needs have been demonstrated must remove at least 80 percent of the phosphorus reaching their sewage treatment plant.

CONTROL OF BITING INSECTS

Mosquitoes and blackflies often interfere with the enjoyment of recreational facilities at the lakeside vacation property. Pesticidal spraying or fogging in the vicinity of cottages produces extremely temporary benefits and usually do not justify the hazard involved in contaminating the nearby water. Eradication of biting fly populations is not possible under any circumstances and significant control is rarely achieved in the absence of large-scale abatement programmes involving substantial funds and trained personnel. Limited use of approved larvicides in small areas of swamp or in rain pools close to residences on private property may be undertaken by individual landowners, but permits are necessary wherever treated waters may contaminate adjacent streams or lakes. The use of repellents and light traps is encouraged as are attempts to reduce mosquito larvae habitat by improving land drainage. Applications for permits to apply insecticides as well as technical advice can be obtained from the District Pesticides Specialist, Ministry of the Environment, 139 George Street North, Peterborough, Ontario, K9J 3G6.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