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BACTERIAL POLLUTION INDICATORS AND RAINFALL-INDUCED RUNOFF, GREENBELT FARM DRAINAGE SYSTEM

ANIMAL RESEARCH INSTITUTE,
CANADA DEPARTMENT OF AGRICULTURE, 1972

by
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ABSTRACT

This report presents and summarizes data for three standard bacteriological pollution parameters applied to 1,786 water samples and 53 liquid manure samples tested during an April to November, 1972, surveillance study of land drainage systems at the Greenbelt Farm, Nepean Township, conducted in cooperation with the Animal Research Institute, Research Branch, Canada Department of Agriculture. Fecal bacterial numbers in liquid manure varied widely, and were relatively low in long-stored manure. Median counts for fecal bacteria in drainage water tended to be satisfactory in terms of recreational water quality objectives during relatively dry weather, but runoff during the unusually-wet summer of 1972 caused major increases in bacterial numbers, with density peaks closely following episodes of heavy rainfall. This occurred in the presence or absence of manuring activity in the drainage basin, and it was postulated that wild animal and bird populations constitute important sources of fecal pollution in Farm runoff. Evidence is presented that there are other significant pollution sources on the watershed of Black Rapids Creek downstream from the Greenbelt farm, but that, under dry weather conditions, the Creek outfall had no demonstrable effect on the bacteriological water quality of the Rideau River. Ninety-nine per cent of 3,049 fecal coliform cultures isolated from water and liquid manure samples were identified as *Escherichia*; 96 per cent were typical *E. coli* type I.

TABLE OF CONTENTS

TABLE OF CONTENTS (con't)

List of Tables

List of Figures

1. INTRODUCTION

In accordance with a request made in April, 1972, by Dr. R.S. Gowe, Director, Animal Research Institute, Research Branch, Canada Department of Agriculture, the Bacteriological Laboratories conducted a bacteriological monitoring study of the drainage system of the Greenbelt Farm, Nepean Township, Ontario, during the April 17 to November 23, 1972, period. Water samples were collected from 18 sampling points on Animal Research Institute and Animal Diseases Research Institute land on this Farm, and from two additional stations on Black Rapids Creek into which a part of the Farm drainage discharges, on 73 dates during the study. A total of 53 liquid manure samples were submitted during the same period. All samples were subjected to tests for three standard bacterial pollution parameters: coliforms, fecal coliforms and fecal streptococci; the data obtained are cited and summarized in this report.

A bacteriological surveillance study was required to meet three separate objectives:

1. To provide data to be used by the Animal Research Institute in the management of the 2,800 acre Farm, on which millions of gallons of liquid manure must be applied annually to the land. In a federal research facility serving the livestock and poultry industries, management procedures must be proven economically sound without contaminating the air, soil or water;

2. To provide data to be integrated with results of chemical and nutrient studies undertaken in 1972 on a small part of the A.R.I. acreage by a group of scientists in three Research Branch Institutions: the Animal Research Institute, the Soil Research Institute, and the Engineering Research Service; and

3. To provide surveillance of possible runoff pollution -rom this federal property, and to assess its impact, if any, on downstream receiving waters, in accordance with the objectives of the Federal Activities Protection Branch, Environmental Protection Service.

Accordingly, data were reported as generated to Dr. R.S. Gowe, A.R.I., and to Mr. L.J. Kamp, P. Eng., Federal Activities Protection Branch, E.P.S. The major thrust of data treatment in this report is to relate bacterial densities in Farm drainage water samples to rainfall-induced runoff, which was abnormally heavy during the summer of 1972. Integration of the bacteriological data with results obtained from the application by others of nutrient, chemical, and physical and engineering parameters, and evaluation of their relationship to manure application rates and locations, will be considered later as a part of the joint investigation cited in objective 2 (above).

2. LITERATURE REVIEW

Any examination of the impact of agricultural activities on a watershed must seriously consider pollution contributed to streams by stormwater drainage. Excellent quantitative data are now available to demonstrate the magnitude of stormwater bacterial pollution densities; at the same time, there has been a reluctance on the part of some pollution control agencies to accept the fact that urban and agricultural runoff can be a very major source of pollution index bacteria, and a potential source of enteric pathogens, in recreational and other natural waters.

Weibel *et al.* (34) showed that 90 per cent of stormwater samples collected from separately sewered urban areas had coliform, fecal coliform and fecal streptococcus counts exceeding 2,900, 500 and 4,900 per 100 ml., respectively. Similarly, Burm and Vaughn (3) found that coliform numbers in separate storm sewers were approximately one-tenth of those in combined sewers which had median monthly values as high as 37,000,000 coliforms per 100 ml. The fecal coliform content of separate storm sewer systems was 7.6 per cent of the total coliform flora. Fecal streptococcal densities were about twice as great in combined sewerage as in storm water flows (500,000 vs. 200,000 per 100 ml.).

Geldreich *et al.* (13) reported that stormwater from city streets, a suburban business district storm drain, and a wooded hillside all had a bacteriological composition similar to stormwater runoff collected from cultivated farm fields. Median values for bacterial discharges in stormwater from suburban and rural areas in Ohio in autumn were:

	Median Bacterial Counts per 100 ml.		
Source	Coliform	Fecal Coliform	Fecal Strep.
Wooded Hillside	180,000	430	13,000
Street Gutters	290,000	47,000	140,000
Rural	18,000	210	2,100

Tennant et al. (29) noted that heavy rainfall on watersheds saturated by previous precipitation usually results in accelerated landwash, with a marked increase in the coliform and fecal coliform content of adjacent tidal bay and estuarine systems. While this effect was particularly significant in farming areas, runoff from virtually-uninhabited woodland was frequently grossly contaminated with these pollution index bacteria. Median coliform : fecal coliform ratios may increase or decrease during such episodes, and both indices can reach numerical levels that are indistinguishable from gross sewage pollution. Holman (15) also showed that runoff from woodland areas during periods of heavy rainfall significantly increased the fecal coliform content of water in receiving estuaries.

Morrison and Fair (24) studied a stream having no known pollution from domestic sewage, and concluded that runoff from the surrounding watershed was the most important source of bacterial contamination.

The impact of urban and agricultural runoff on water quality is discussed by Browning (2) in a recent report. Among the many and varied sources of urban pollution which finds its way into storm runoff are: street litter; material washed from surrounding lands; the many chemicals used by public agencies and private citizens for control of pests, insects, weeds and rodents, or for fertilizers and soil conditioners; animal and bird droppings; lawn and garden litter; portions of household and commercial waste; and fallout from air pollution. Browning cites high turbidities and biochemical oxygen demand in water samples taken from street gutters, as well as bacterial concentrations 16 times greater than those allowable under Florida regulations for swimming water. Pollution problems caused by animal wastes, and runoff from agricultural lands, increase in importance as large numbers of animals are crowded into feedlots.

In its Third Annual Report (31), the U.S. Council on Environmental Quality summed up the current position by stating that land runoff from farms and urban land, as distinguished from discharges from cities and factories, has a much greater impact on water pollution than has previously been realized. Point sources of organic and nutrient pollution, such as industrial and municipal discharges, appear to be overshadowed by runoff sources such as farms, feedlots and urban runoff. Even if all discharges of municipal and industrial pollution were stopped, many streams would still be polluted as a result of discharges from runoff sources.

There is no question that domestic and wild animal and bird populations constitute important reservoirs of enteric disease; the presence of enteric pathogens in animal and bird feces is well documented (21, 22, 27, 28). The degree of public health hazard associated with the entry of potentially-pathogenic fecal material from these sources into surface waters is, however, difficult to evaluate. Hooper (16) used a Moore swab technique to isolate *Salmonella dublin* from two rivers in Wales. He concluded that surface waters draining cattle pastures and barns were the probable sources of the organism in the river water; its presence could, however, not be correlated with clinical outbreaks of *S. dublin* infection in cattle.

Cherry *et al.* (4) isolated *Salmonella* from a variety of Georgia streams considered as minimally polluted or as free from domestic animal and human contamination. They postulated that *Salmonella* may exist in such locations as free living organisms capable of multiplication under natural conditions. They concluded that, regardless of their ecology, *Salmonella* and *Arizona* are potential animal pathogens, and that their widespread occurrence in surface waters cf various quality constitutes a public health problem, the magnitude of which is obscured by inadequate diagnosis and under reporting of diarrheal diseases. Comprehensive epidemiologic studies, relating disease to exposure to polluted water, are needed.

The public health significance of warm-blooded animal pollution, and the transport of microorganisms to streams has recently been exhaustively reviewed by Geldreich (12).

Taylor and McCoy (28) concluded that, since feces from farm animals may contain pathogenic microorganisms, their disposal may be expected to disseminate these pathogens in the environment and lead to an increased incidence of human and animal infections. *Salmonella, Leptospira* and other pathogens can be found in the litter and runoff from cattle feedlots holding apparently normal animals (12, 22); such runoff must be recognized as potentially implicated with disease.

Fair and Morrison (10) showed that enteric pathogens (*Salmonella* and *Arizona* serotypes), presumably derived from the feces of wild and/or domestic animals, were present in supposedly high quality mountain stream water.

A review of water-borne disease outbreaks occurring from 1946 to 1960 (35) lists 25,984 cases in 228 known U.S. outbreaks. At least 29 outbreaks involving 9,233 cases were associated with stormwater runoff, caused either by rainfall washing human and animal feces into wells, springs, streams or reservoirs, or by widespread flooding of individual and public water systems (33, 35).

As Mitchell (23) points out, animal wastes and fertilizers are an important source of eutrophication in agricultural areas. The farm animal population in the United States in 1970 was estimated at 564 million head with a waste production equivalent to that of 2 billion people. In areas where animals are concentrated, the stream eutrophication potential is enormous. Also, in areas of intense crop production, increasing use of fertilizers has dramatically increased the rate of eutrophication of natural waters.

Rhodes and Hrubant (25) stated that until recently there has been little concern about the pollution hazard inherent in waste generated by livestock production. Changes in farm technology have concentrated animal waste in limited areas, some of which are metropolitan. Accumulations of wastes frequently have overtaxed the assimilative capacity of the environment, and runoff associated with rain wash and leaching endangers natural waters.

Townshend *et al.* (30) have pointed out that the trend to confinement feeding of animals in Ontario has increased the potential for water, air and soil pollution; they estimated that the pollution potential of some 100,000 beef cattle on Ontario feedlots in 1969, on a BOD_5 basis, was equivalent to 1.0 million people, as compared to a human population of 7.0 million. They concluded, however, that beef feedlot pollution can be controlled at reasonable cost using presently available methods and good management practices, providing sufficient land is available for waste disposal. Animal waste storage facilities should be designed to provide about six months' storage, and lot runoff storage capacity should be sized to hold winter snow melt and spring rainfall until such time as fields are dry enough for proper waste disposal.

Townshend *et al.* also point out that manure should not be applied to land that is frozen, or subject to flooding or heavy runoff; contour plowing should be practised and manure should not be spread within 50 feet of a watercourse.

In urban centres, fecal contamination in separate stormwater systems is derived initially from feces deposited by cats, dogs, rodents and birds. On occasion, urban stormwater may contain septic tank discharges because of saturated drain fields or illegal connections to storm sewers. There is thus the opportunity for the occasional occurrence of pathogens in this source of pollution; for example, Geldreich (12) reports that 4,500 *Salmonella thompson* and 450,000 fecal coliforms per 100 ml. were found in a stormwater sample from an urban business district.

Soil may contribute large numbers of bacteria to drainage water, but Geldreich and his co-workers (11, 14) found that fecal coliforms usually were absent, or present in comparatively small numbers, in unpolluted soils. They reported a marked increase in fecal coliform densities in polluted soils from feed lots, locations recently flooded with domestic wastewater, and river banks along heavily polluted streams. During periods of rainfall, coliform and coliform-like bacteria associated with vegetation and soil may enter surface waters by way of stormwater runoff. Many workers, including Evans and Owens (8), have found evidence of proliferation, sometimes characterized as after growth, of typical and atypical non-fecal coliforms in sediments and soil as a result of temperature and rainfall variations.

Such after growth may contribute to increases in coliform densities in stormwater runoff which have no direct relation to the sanitary history of the drainage area. The elevated-temperature test for fecal coliforms will yield more-specific data on the proportion of fecal pollution, and thus discriminate between pollution derived from warm-blooded animals and the myriad of other pollution sources (11). Fecal coliforms derived from animal feces transported in stormwater to streams represent recent pollution (within a 20-day interval) *since* there are many environmental factors which limit prolonged survival in soil.

The 90 per cent reduction times for bacteria in drain discharges from manured soil calculated by Evans and Owens (8) were 57 days for *Escherichia coli* and 96 days for fecal streptococci; these are more than four times longer than those (13 and 21 days) estimated by Van Donsel *et al.* (33) for *E. coli* and *Streptococcus faecalis* var. *liquefaciens* inoculated into soil plots. Survival varied with season. The 90 per cent reduction times ranged from 3.3 days in summer to 13.4 days in autumn for *E. coli*, and from 2.7 days in summer to 20.1 days in winter for *S. faecalis*. Van Donsel *et al.* concluded that in summer, fecal coliforms survived slightly longer than fecal streptococci; in autumn, survival periods for the two index bacteria were quite similar, while in spring and winter, fecal streptococci survived much longer than fecal coliforms. Both organisms could be isolated from stormwater runoff collected below the soil sampling site when counts were sufficiently high in the soil. Isolation was more frequent during prolonged rains, lasting up to 10 days, than during short rain storms.

Fecal streptococci constitute a sensitive pollution index parameter and, when taken in conjunction with fecal coliform densities, may provide useful inferences concerning the human or animal origin of pollution in surface waters. Geldreich *et al.* (13) found that, in both animal feces and in stormwater runoff samples, the ratios of fecal coliforms to fecal streptococci were generally less than 0.7. In contrast, the fecal coliform to fecal streptococcus ratio for man was 4.4, and, for various domestic sewages, was above 4.0.

Kunkle (18) compared coliforms and fecal coliforms in storm runoff from an "uncontaminated" hayfield and from grazed pasture land on the same watershed. He concluded that soil and vegetation serve as reservoirs for large numbers of non-fecal coliforms, and that high counts of "background" coliforms during storms are not necessarily due to farm pollutants. While there were some fecal coliforms, in the "background" flora, probably derived from wildlife, fewer fecal coliforms *were* present in the hayfield runoff; Kunkle concluded that the fecal coliform group was clearly the better index for pollution surveillance. He calculated that the number of fecal coliforms yielded in 2 hours of storm runoff from the hayfield could be supplied by only 5 grams of bird or rodent feces.

In a second study, Kunkle (19) found that microbial densities in streams are not as dependent on the amount or type of land use activity on a watershed as on the exact location of the pollutants in reference to the stream channel. Only a minor fraction of the total available live bovine fecal bacteria on uplands pastures were even actually washed into the stream.

On the other band, barn drains, rural sewer outfalls, manure piles by streams and other "point source" pollution produced very high bacterial concentrations, particularly during warm weather periods of low flows (hence low dilution). Storm overland runoff came from the stream channel areas plus adjoining "seepy" sectors, while upland portions of the catchments apparently yielded little or nothing to storm runoff.

Kunkle concluded that storm runoff transports surface pollutants only from those portions of the watershed that yield overland flow, not the entire watershed.

In a study of the bacteriological quality of irrigation and subsurface drainage waters in Idaho, Smith *et al.* (26) found that bacterial loadings in irrigation water were generally low (a mean coliform count of only 3,300 per 100 ml.). Approximately 50 per cent of the irrigation water infiltrated the soil and emerged from subsurface drains. Filtration through soil greatly decreased the microorganism populations studied, and in many cases decreased the indicator bacteria to levels acceptable for domestic use of the water.

The consensus that soil is a reasonably efficient bacterial filter medium, and that storm landwash pollution is primarily a surface transport phenomenon has recently been seriously challenged by a study by Evans and Owens (8), who demonstrated that fecal bacteria from pig excrement applied to land as a semi-liquid slurry can pass through soil into subsurface tile drains within a few hours. The spraying of pig excrement slurry resulted in a 30- to 90-fold increase in the numbers for fecal bacteria in the drain discharge within 2 hours of the start of spraying. Concentrations of fecal bacteria returned to their normal levels within a period of 2 to 3 days.

The data suggest that if manure containing pathogenic bacteria were spread on land the concentrations of such bacteria in water could reach levels likely to constitute a health hazard to animals or humans drinking that water. They concluded that the disposal of animal feces on the land as slurries may lead to a significant increase in the level of microbial pollution of the environment.

While fecal bacterial numbers in drainage water showed large increases during the 36 hours following slurry application, biochemical oxygen demand increased only slightly, and no increases in the concentration of suspended solids were detected. This was attributed (8) to the combined effects of filtration and of adsorption of solid material to soil particles, and the relative insensitivity of tests for BOD and SS in comparison with methods for determining viable bacterial counts.

It should be stressed that bacteriological pollution parameters are extremely sensitive indices, and that even very marked fluctuations in bacterial numbers in drainage water may not be parallelled by comparable changes in chemical parameter concentrations.

Rural stormwater pollution may become a more serious problem in some areas as small individual farm operations are phased out and animals are concentrated in feedlots (20, 21). Geldreich (12) points out that accumulations of manure may present a serious solid waste disposal problem. Animal wastes have been characterized as solid material containing large quantities of feed residue and undigested matter; domestic sewage treatment technology is generally not successful in animal waste treatment. Disposal to farm fields may not always be practical since haulage costs may exceed the cost of commercial fertilizers. Manure accumulations, in landfill operations may serve as fly breeding areas and produce noxious odours and dust problems; during storm periods manure piles may serve as point sources of pollution to dramatically degrade adjacent stream water quality.

The density and frequency of fecal contamination on soil that is related to wild animals would be more limited than that expected from farm animals because of the smaller fecal output per day and the wider area of disposal (12, 33).

It must be concluded that rural runoff is a major factor in stream pollution which must be considered in any evaluation of receiving water quality. Unfortunately, abatement action will pose difficult problems. Stormwater runoff from rural areas represents one source of water pollution which is not susceptible to the usual abatement measures (36).

Very few authors have proposed definitive remedial action or policies. Weidner *et al.* (36) showed that "improved farming practices", including contour cultivation and careful crop selection, were of value in reducing the impact of runoff pollution. They showed that, despite an increase in the amount of manure applied under improved practices, there was a marked decrease in the amount of pollutional load that *came* from the watersheds, as contrasted to the load from water sheds using prevailing farming practice.

Since stormwater can be a major source of intermittent pollution to bathing beaches and other natural recreational waters, Geldreich *et al.* (13) have advocated certain control measures. Cats and dogs should be prohibited from public beach areas, and adequate garbage control plans instituted to discourage rodent habitation.

Diverting storm drains and land drainage away from beaches can be an important engineering consideration; in areas where such drainage cannot economically be diverted, treatment methods must be developed to handle the large volumes of irregular discharges that characterize stormwater.

We consider it probable that periodic short-term closure of some sensitive beach areas may be necessary during periods of rainfall-accelerated landwash; beaches could be reopened for public use as soon as bacteriological monitoring tests conclusively show that conditions have returned to normal.

Policies to control agricultural runoff were recently announced by the U.S. Environmental Protection Agency (32); their report included guidelines, the voluntary use of which should be "strongly encouraged" through educational programs and technical assistance.

Key points were:

(1) Programs to manage agricultural nutrients should be planned and implemented for a complete drainage basin;

(2) Development of fertilizer application management plans will require complete evaluation of nutrients present and retention capability of the soil types. Compliance with fertilizer application guidelines should be considered in determining eligibility for selected forms of government assistance;

(3) Programs should be developed to retain manure and incorporate it into the soil;

(4) Because animal wastes should not be applied to farm lands under unfavourable conditions, methods should be developed to store wastes until the right time;

(5) Watering and feeding points should be established away from waterways. Where animals are highly concentrated, streams should be fenced off to prevent pollution by animal wastes.

3. DATA COLLECTION

3.1 Water Sampling Program

A total of 19 sampling stations were selected by Dr. R.S. Gowe, Dr. L.J. Fisher and Mr. V. McNeely of A.R.I. before the study began. Locations of these sampling points are shown on a map (Figure 1). Station 1 had flows only during snow melt conditions and at peak storm runoff periods, and could be sampled only on April 17 and 20, on August 8 after more than 2 inches of rain, and on November 9 after more than an inch of rain. Station 18 proved to consist only of snow melt ponding, and was deleted.

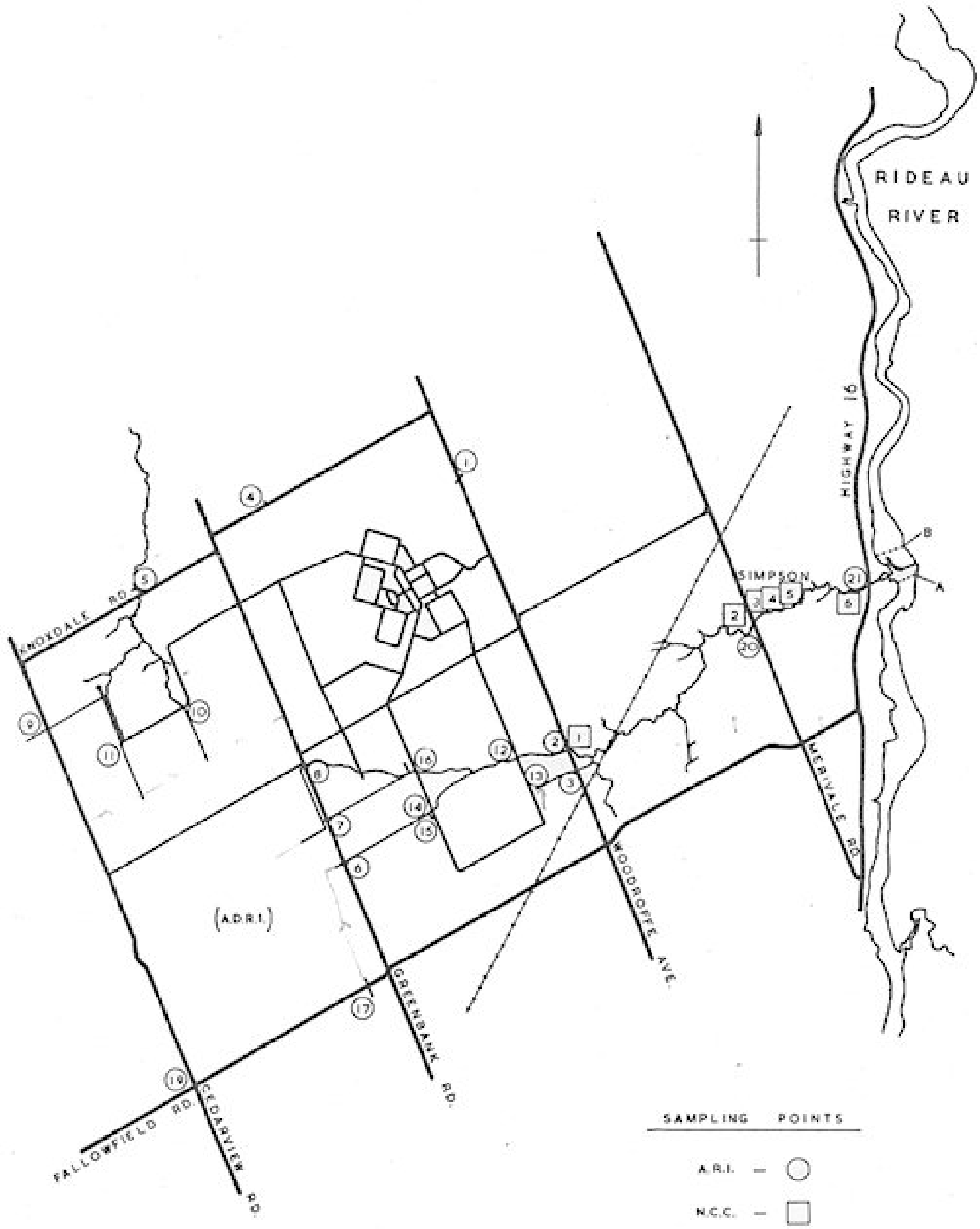

Figure 1: Sampling Points, Greenbelt Farm Study, 1972

Stations 17 and 19 represented input flows to A.D.R.I. land, while Stations 6, 7 and 8 represented input to A.R.I. land from A.D.R.I. property. Station 9 represented input to A.R.I. land from N.C.C. property. Stations 12, 13, 14, 15 and 16 were located on internal A.R.I. drainage systems which ultimately drain to Black Rapids Creek. Stations 2 and 3 represented discharge flows from A.R.I. property to Black Rapids Creek, while Stations 1, 4, 5, 10 and 11 represented discharge flows from A.R.I. land to the Baker Creek system.

Station 20 (at the Merivale Road) and Station 21 (at Highway 16) were also established on Black Rapids Creek downstream from A.R.I. property. In this sector the Creek is subject to a number of known or potential pollution sources, including private farming operations on N.C.C. land along the Creek, and storm drainage from the Simpson Housing Development.

Samples were collected from these Stations by Laboratories staff in 73 dates during the April 17 to November 23 study period. Normally collection trips were made between 0800 and 1100 hours. Occasionally more than one set of samples were collected during a single day (2 collection trips on June 21, 22, 23, 26, and on August 3 and 9; 3 collection trips on June 9 and July 10; and 5 collection trips on May 17). In addition, water samples were collected from Stations 2, 3, 20 and 21 at the beginning and end of most sampling trips, so that two sets of data per sampling date, 1 to 1.5 hours apart, are available For these Stations. All samples were delivered immediately to the Laboratories, and were subjected to bacterial density determinations within 2 to 4 hours of collection.

Samples were obtained at Stations 3 and 5 on all 73 sampling dates. Stations 2, 9, 12, 13, 16, 20 and 21 were each sampled on all but one or two dates; in each case, the sampling point could not be reached on either April 17 or 18 because of snow melt conditions, or no sample could be collected on November 23 because freeze-up had occurred. At all other Stations there were sampling periods when there was no flow, or when samples could not be obtained for other reasons:

Station 4: April 17, 18; June 19; July 10; and September 14 to 28 (5 dates);

Station 6: April 18; May 31; August 29, 31; and September 6 and 7;

Station 7: April 18; May 29; June 7, 12, 14, 19; July 4, 7, August 29 to September 28 (10 dates); November 23;

Station 8: April 17, 18; May 29, 31; June 7, 12, 14, 19, 21; July 4, 7; September 7, and September 14 to 28 (5 dates); November 20 and 23;

Station 10: April 17 to 26 (access road flooded);

Station 11: April 17 to 26 (5 dates; access road flooded); May 23 to June 21 (12 dates); July 4 to 12 (4 dates); August 1; and August 29 to September 28 (10 dates); November 23;

Station 14: April 17; May 29;

Station 15: April 17 and 18; May 23 to June 21 (12 dates); July 4, 7 and 10; and August 29 to October 23 (17 dates) ;

Station 17: April 18; May 25 and 31; June 5 to 12 (4 dates); July 4; on August 10 the ditch flow was blocked, and subsequently reversed because of ditch reconstruction by the Township; flow into A.R.I. property was restored only briefly (on September 18 to 21) and samples were not collected from the Station again except on those dates;

Station 19: April 18; May 25, 29 and 31; June 5 to 21 (7 dates); July 4, 7, 12, and 27; August 1 and 4; August 29 to September 28 (10 dates); November 23.

In addition to the A.R.I. Greenbelt Farm water sampling program described above, water samples were collected on 11 dates from six Black Rapids Creek sampling points by National Capital Commission personnel under the direction of Mr. L.A. Bower, Operational Services Section, Construction and Services Division, Development Branch (Table 1).

A number of other water samples were selected from some of these stations, and from two ranges on the Rideau River above and below the Black Rapids Creek outfall, by Mr. L.B. Killoran, Federal Activities Control Branch, EPS. All of these samples were delivered to the Bacteriological Laboratories on the day of collection.

Table 1. Location of NCC Sampling Points, Black Rapids Creek, 1972

NCC No.	Equivalent ART No.	Location
BR-1	2	Woodroffe Avenue (Boyce Farm)
BR-2	20	Merivale Road (Behind Church)
BR-3	--	20 ft. Upstream from Culvert, East of Merivale Road (G. Craig Farm)
BR-4	--	Culvert East of Merivale Road; Drains Simpson Housing Development
BR-5	--	20 ft. Downstream from Culvert, East of Merivale Rd.(G. Craig Farm)
BR-6	21	Highway 16 (below highway)

3.2 Liquid Manure Sampling

Samples of liquid manure were collected by A.R.I. staff under the supervision of Dr. L.J. Fisher when the manure was pumped from tanks or storage pits to tank trucks for disposal by the plow down technique. All samples were collected in sterile glass 8-ounce bottles for delivery to the Laboratories; they were subjected to bacteriological analysis on the day of collection, or were refrigerated for test on the following day.

3.3 Bacteriological Procedures, Water Samples

All water samples were subjected to A.P.H.A. Standard Methods (1) Membrane Filter (MF) procedures for the estimation of coliform, fecal coliform and fecal streptococcus densities.

3.3.1 Coliform density determinations

The medium used was m-Endo Agar LES*. Membrane filtrations were made for three or more appropriate volumes of each water sample. Incubation was at 35°C for 20 ± 2 hours in an atmosphere of saturated humidity. The development of dark colonies with a golden metallic-appearing surface luster (sheen) was interpreted as direct evidence of the presence of coliform organisms. The number of sheened colonies appearing on the MF preparations was determined from the appropriate sample volumes.

Counts were calculated and recorded in terms of coliforms per 100 ml. of water. Where 50 ml. was the largest volume filtered, negative results were expressed as less than 2 (<2) per 100 ml.

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* All test media used were Bacto Brand supplied by Difco Laboratories, Detroit, Michigan.

3.3.2 Fecal Coliform density determinations

The medium used was m-FC Agar, with rosolic acid. Incubation was for 20 ± 2 hours in sealed plastic bags immersed in a water bath equipped with a circulation device and controlled at 44.5°C. Membrane filtrations were made for two or more appropriate volumes of each water sample, and the development of typical blue colonies was interpreted as evidence of the presence of fecal coliforms. Counts were recorded in terms of fecal coliforms per 100 ml. of water.

3.3.3 Fecal Streptococcus density determinations

The medium used was m-Enterococcus Agar. Membrane filtrations were made for two or more appropriate volumes of each water sample, with incubation at 35°C. for 48 hours in an atmosphere of saturated humidity. The development of colonies, normally dark red to pink in colour, was interpreted as evidence of fecal streptococci. Counts were determined from the most appropriate dilution and recorded in terms of fecal streptococci per 100 ml.

3.4 Bacteriological Procedures, Liquid Manure Samples

Liquid manure samples were shaken thoroughly by hand. Twenty-gram aliquots were weighed aseptically into sterile, tared beakers. The material was then transferred aseptically to a standard, sterile Waring Blender jar with 180 grams of sterile standard phosphate buffer solution (1). The mixture was blended for two minutes, and serial decimal dilutions to 10^{-6} were prepared (10 ml. in sterile APHA dilution blanks containing 90 ml. phosphate buffer). One ml. aliquots of each 10^{-2} to 10^{-6} decimal dilution were suspended in 30 ml. of sterile phosphate buffer prior to membrane filter tests to determine coliform, fecal coliform and fecal streptococcus densities as for water samples (3.3.1, 3.3.2 and 3.3.3, above). Results were recorded as MF counts per gram of liquid manure sample, on a wet weight basis. MF counts can be expressed on a dry weight basis, if desired, by the application of the dry weight factor reported for each sample.

Twenty-gram aliquots of each sample were weighed to tared aluminum weighing dishes. Each was dried to constant weight at 105°C. (ca. 24 hours). The net weight loss was calculated, and expressed in terms of a dry weight factor for each sample. To calculate bacterial MF counts on a dry weight basis, multiply the reported MF count by the appropriate factor, and round the number off to two significant figures.

3.5 Pure Culture Study, Fecal Coliform MF Cultures

Periodically during the 1972 study, all typical fecal coliform colonies from selected membranes from MF Count determinations (water and liquid manure samples) were isolated in pure culture for identification by genus or species. All cultures were replated on Levine's EMB Agar, and discrete colonies were isolated in pure culture to TGE Agar slopes. All typical and atypical cultures were then subject to the following biochemical classification tests (6, 9):

Lactose Broth fermentation (35°C., 30 days); EC Broth fermentation (44.5°C., 48 hours); Indol Test (35°C., 48 hrs.); Methyl Red Test (30°C., 5 days); Voges-Proskauer Test (30°C., 48 hrs.); and Citrate utilization (Simmon's Citrate

Agar, 35°C., 72 hours) .

All cultures, other than typical *Escherichia coli* type I (IMViC ++--, Lactose +, EC (44.5°C.) +), were subjected to a further battery of biochemical classification tests (6, 9):

Cytochrome Oxidase Test (TGE Agar, 35°C., 24 hrs.); H_2S production (TS I Aga, 35°C., 7 days) ; Motility (Motility Agar plate test, 35°C., 3 days, and 22°C., 5 days); and Ornithine Decarboxylase Test (35°C., 4 days);

Tentative identification of *Klebsiella* strains was based solely on a demonstrated absence of motility at 35° and 22°C., and negative ornithine decarboxylase and H_2S (TSI Agar) tests, since IMViC tests do not provide a firm basis for identification of this genus. After replating on Levine's FMB Agar, *Klebsiella* cultures were subjected to a third battery of tests:

Lysine decarboxylase test (35°C., 4 days); Dulcitol and Glucose fermentation tests (35°C., 14 days); ONPG test (35°C., 4 hrs.); and Urea utilization test, (35°C., 5 days).

All *Klebsiella* isolates were subjected to slide agglutination tests, using 18 Difco *K. pneumoniae* antisera pools, according to the procedure of Edwards and Ewing (6). Strains showing positive slide agglutination reactions with one or more of the serum pools were tested for capsular swelling (Quellung) reactions with the same positive sera.

4. RESULTS AND DISCUSSION

4.1 Rainfall and Weather Observations

Daily rainfall data supplied by the Atmospheric Environment Service, Department of the Environment, for the climatological station at Ottawa International Airport, Uplands, Ontario, approximately 3.5 miles from the Greenbelt Farm, are cited in Table 2. Rainfall during the summer of 1972 was abnormally heavy, with unusual amounts of runoff resulting from heavy rain on land already saturated by previous rainfall. A total of 20 of the 73 water sampling dates were arbitrarily selected as representing "Wet" conditions (with 0.5 or more inches of rain in the preceding 48 hours, resulting in increased bacterial counts at all or a majority of the sampling stations); it is questionable, however, whether the remaining 53 sampling dates should be regarded as "Dry", as they are characterized for purposes of data presentation in this Report. In using these terms, it is our intention merely to identify the 20 sampling dates on which the most severe runoff conditions prevailed; these were:

May 31;
June 1; 9; 21; 22; 23; and 26;
July 10; 12; 17; 19; and 24;
August 3; 4; 8; 9; and 10;
October 2; and 23; and
November 9.

TABLE 2. Daily Rainfall, Ottawa Airport, DOE, 1972

	RAINFALL IN INCHES, 1972							
Date	April	May	June	July	Aug.	Sept.	Oct.	Nov.
1		Tr.	* .64	Tr.	*.13		Tr.	
2	Tr.	* .18	.08	. 01	.43		* .04	*0.37
3		.13		.21	*.92	.24	Tr.	.03
4	.10	*.39	Tr.	*	*		Tr.	.10
5	.04	.06	*				*	.04
6	Tr.	.24	.06		.06	*	. 56	*
7			*	* .01	*2.09	*.12*	.22	
8			.19		*.34	.08	.06	1.20
9		*	*.64	Tr.	*.31	Tr.	Tr.	*.03
10				*.63	* Tr.			
11		*.07			Tr.	*.01	*.01	Tr.
12			*	*1.51	.24		Tr.	
13	.71			1.73	Tr.	.20	*	Tr.
14	Tr.	.05	* Tr.	.08	.16*	* Tr.	.16	
15	.27	* Tr.	.31	.60			Tr.	*
16		.27		.78	.02		*.23	
17	*	* Tr.		*	*	.06	Tr.	
18	*.18	* Tr.			*.29	*.39	Tr .	
19	.35		*	*.26			*	.04
20	*			.02				*.18
21			*1.95	Tr.		* .01	.07	
22	.04		* .35	1.06	*.07		.20	Tr.
23	.10	*	.35	.25	*.18		*1.06	* Tr.
24	* Tr.		.20	* .03	*	.03	.22	--
25		*	.27	*.13	Tr.	*.02	.07	--
26	*		* .17	.01		.17	*	--
27			.03	*.02	.40			--
28					.04	*	.49	--
29		*			*	.70	.02	--
30		.68	Tr.			.81	*	--
31	--	* Tr.	--		*	--		--
Totals	1.79	2.07	5.24	7.34	5.68	2.84	3.41	--
Normal	2.71	2.76	2.86	3.20	3.21	3.10	2.59	--

* Water Sampling Dates

A brief summary of weather conditions during the 1972 study period, as abstracted from the monthly reports of the climatological station, is as follows.

April, 1972, was the third coldest April on record since 1890. While the hours of bright sunshine were above normal, the average daily mean temperature of 35.7°F. was 6° below normal. The last measurable snowfall, marking the end of the 1971-72 winter snowfall, occurred on April 5; there was still one inch of snow on the ground when sample collection began on April 17. Total precipitation was nearly an inch below normal.

The first week of May continued cold, with daily mean temperatures nearly 5°F. below normal, and a total of one inch of rainfall. The final two weeks of May, however, constituted the longest rain-free period on record for the month, with above-normal temperatures. The net effect was a month of below-normal rainfall and above-normal temperatures (mean 57.7°F.)

June was generally wet and cold; the average daily mean temperature of 62.2°F was 2.5° below normal, and rainfall was almost twice the normal amount. Most of the rain fell between June 21-26, and was associated with Hurricane Agnes.

The rainfall of 1.95 inches on June 21 was a new record for any June day.

The total of 7.34 inches of rainfall was the highest recorded for the month of July in this century. The total of 11 thunderstorms was abnormally high. The average daily mean temperature (69°F) was surprisingly normal, but hours of bright sunshine fell about 34 hours below normal.

Total rainfall for the month of August was again above normal, particularly during the first ten days of the month. The frequency and amounts of rainfall diminished, however, later in August. Temperatures averaged slightly below normal for the month, and hours of bright sunshine averaged 1.3 hours below normal, partly due to the 19.75 hours of fog experienced. There was again an abnormally high occurrence of thunderstorms.

While statistics for September showed fairly normal weather conditions, the 15 rain-days tended to leave an impression of another rainy month. Surprisingly, the 0.39 inch of rain which fell on September 18 was a record for that date.

Abnormally cold, wet weather prevailed during October. Total precipitation was almost an inch above normal, while the daily mean temperature (41.8°F.) averaged 5.5° below the monthly normal. Rainfall was recorded on 22 days (8 with only trace amounts).

November was also a cold month; temperatures (mean 31.6°F.) averaged about 3° below normal. The coldest day was November 22, when many of the sampling point streams froze; this resulted in our decision to conclude the water sampling program on November 23. While the 1.20 inches of rain which fell on November 8 was a new record for that date, rainfall for the month was near-normal. The first significant snow fall was 1.0 inch on November 4, and 3.0 inches fell on November 20.

4.2 MF Counts, Liquid Manure Samples

MF counts obtained (three bacterial parameters) for 53 samples of liquid manure are given, on a wet weight basis, in Appendix Table A-1. The dry weight factor ranged from 8.4 to 41.1 (mean 17.7), representing percentages of solids ranging from 2.4 to 11.9 (mean 5.6).

Counts for the three test parameters varied widely from sample to sample, with maxima (2.4×10^7 coliforms; 2.4×10^6 fecal coliforms; and 7.1×10^6 fecal streptococci per gram) recorded in relatively fresh sheep and poultry manure samples collected in June and July. Some manure lots were known to contain fresh manure, while some represented relatively long-stored material. Long-stored manure had very low MF counts; two samples were negative (<100 per gram) for coliforms, and no fecal coliforms could be detected in 17 of the samples.

Fecal streptococcus densities tended to be slightly higher than those of the other two parameters, probably reflecting the longer survival time attributed to these organisms by other investigators. These data appear to indicate that extended manure storage periods may be expected to materially reduce fecal bacterial numbers.

The extreme variability of fecal bacterial numbers in liquid manure of varying type and age will make it difficult to estimate mean bacterial loadings on soil during liquid manure application. The data confirm, however, that fresh manure applied to land in this way is a potent source of very large numbers of the three types of pollution index bacteria studied.

4.3 MF Counts, Water Samples

MF counts for the three test parameters obtained from the examination of water samples from A.R.I. Stations 1 - 19 are recorded in Appendix Tables B-1 to B-18, inclusive by Station and date of sample collection; similarly, data for Black Rapids Creek Stations 20 and 21, included in the regular A.R.I. sampling program, are presented in Appendix Tables C-1 and C-2.

The determination of coliform densities was included in the test battery because the coliform group has been used traditionally as a prime water pollution index; numerical objectives and standards based on this parameter are widely used, in Ontario and elsewhere in North America, in the control of recreational water quality, and in assessing public health hazard associated with effluents and receiving waters of various types. Unfortunately, it has become increasingly apparent in the past decade that the determination of coliform numbers in natural waters may not always provide an effective estimate of potential public health hazard.

Some coliform and coliform-like biotypes, under suitable nutrient and temperature conditions, are capable of proliferation in waste streams and in sediments and receiving waters; some are predominantly associated with soil and vegetation flora. The inadequacies of the coliform index of water pollution have recently been reviewed by Dutka (5), who presented the view that fecal coliforms and fecal streptococci are preferred, more reliable indicators of potential health hazard and water quality degradation.

We regard the fecal coliform parameter as the prime index of pollution applied in the present study. Fecal coliform and fecal streptococcus counts for water samples from 8 key Stations are presented graphically, in relation to daily rainfall data, in Figures 2 to 9, inclusive. These key Stations represent A.R.I. drainage system discharge streams (No's. 2 and 5), input streams (No's 6 and 9), points on the internal A.R.I. drainage system (No's. 13 and 16), and two points (No's. 20 and 21) on Black Rapids Creek downstream from the Greenbelt Farm.

In general, graphic presentation of the data demonstrates that fecal bacterial counts in water from these Stations tended to increase during the abnormally-wet summer period, and that the frequent major but transient peaks in bacterial numbers closely followed episodes of heavy rainfall.

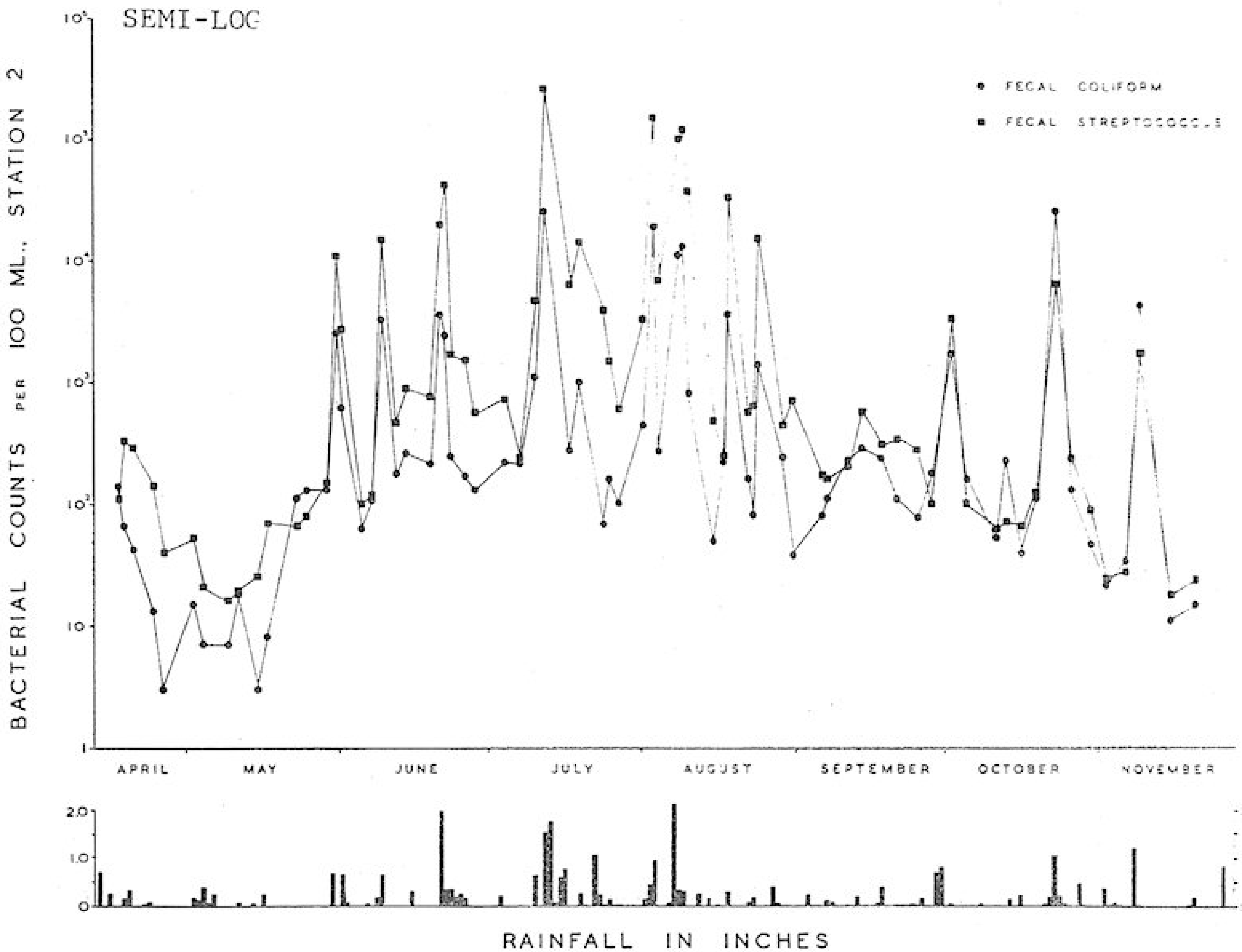

Figure 2: Fecal Coliform and Fecal Streptococcus MF Count, Water Samples, Station 2, 1972, vs Rainfall.

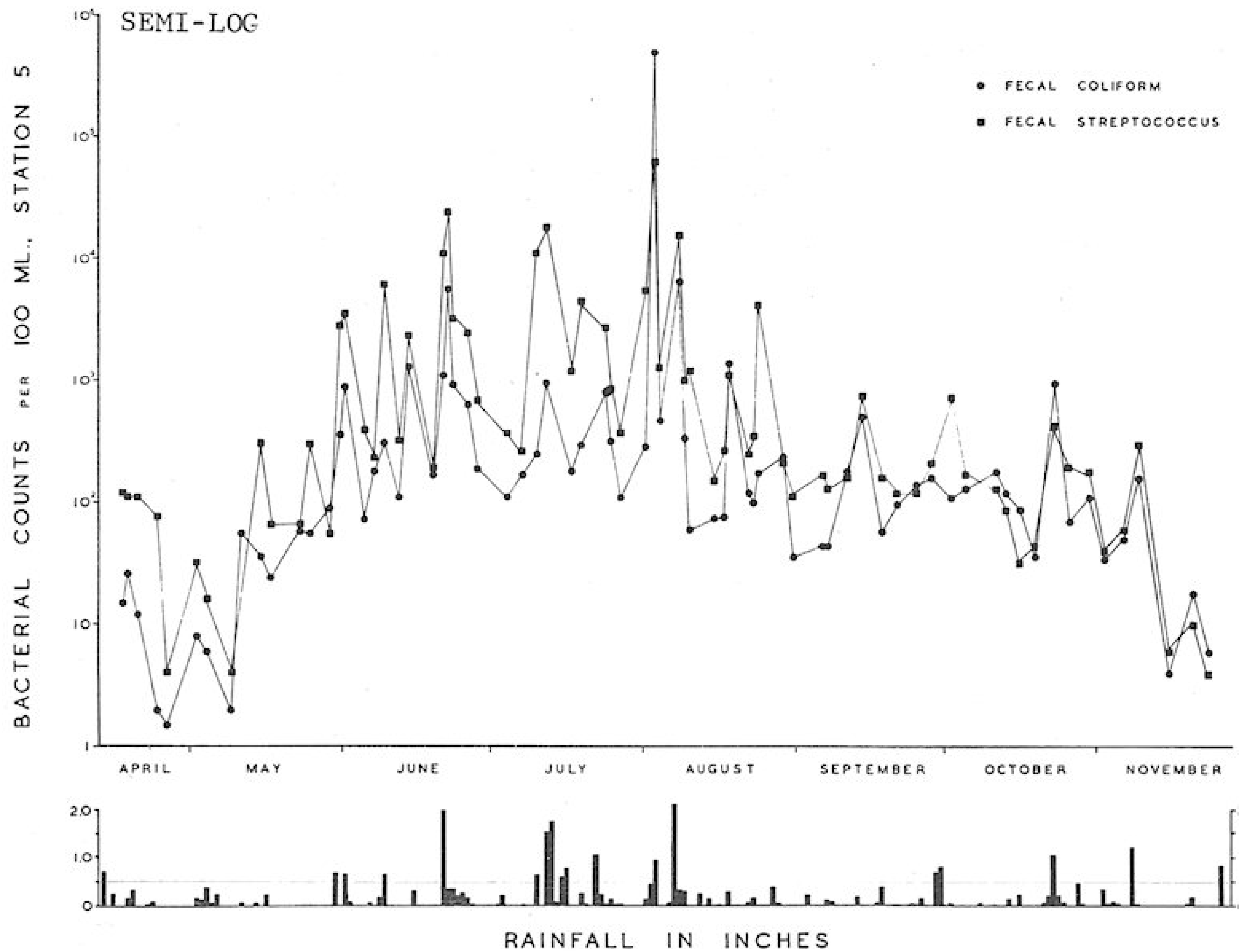

Figure 3: Fecal Coliform and Fecal Streptococcus MF Counts, Water Samples, Station 5, 1972, vs Rainfall.

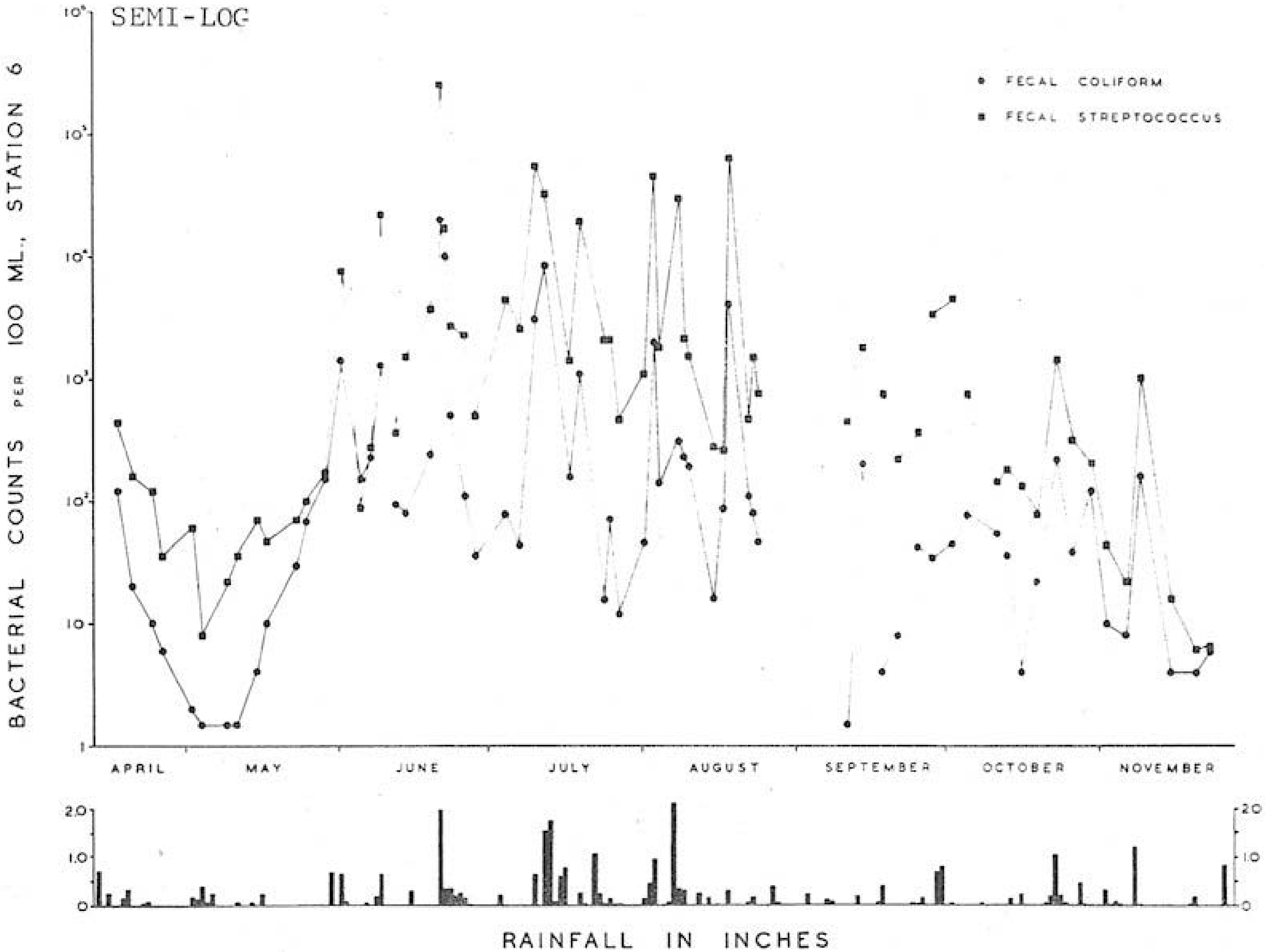

Figure 4: Fecal Coliform and Fecal Streptococcus MF Counts, Water Samples, Station 6, 1972, vs Rainfall.

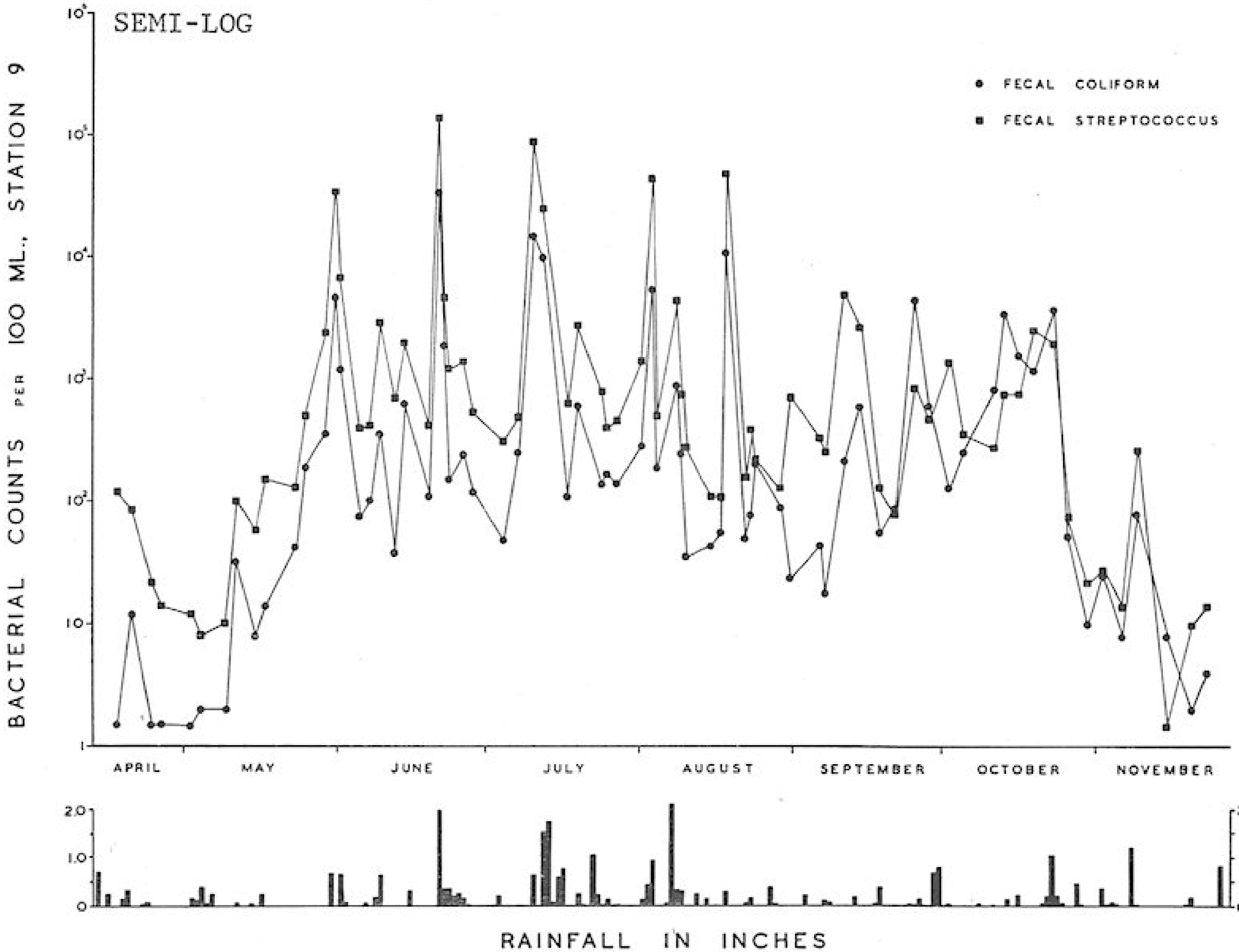

Figure 5: Fecal Coliform and Fecal Streptococcus MF Counts, Water Samples, Station 9, 1972, vs Rainfall.

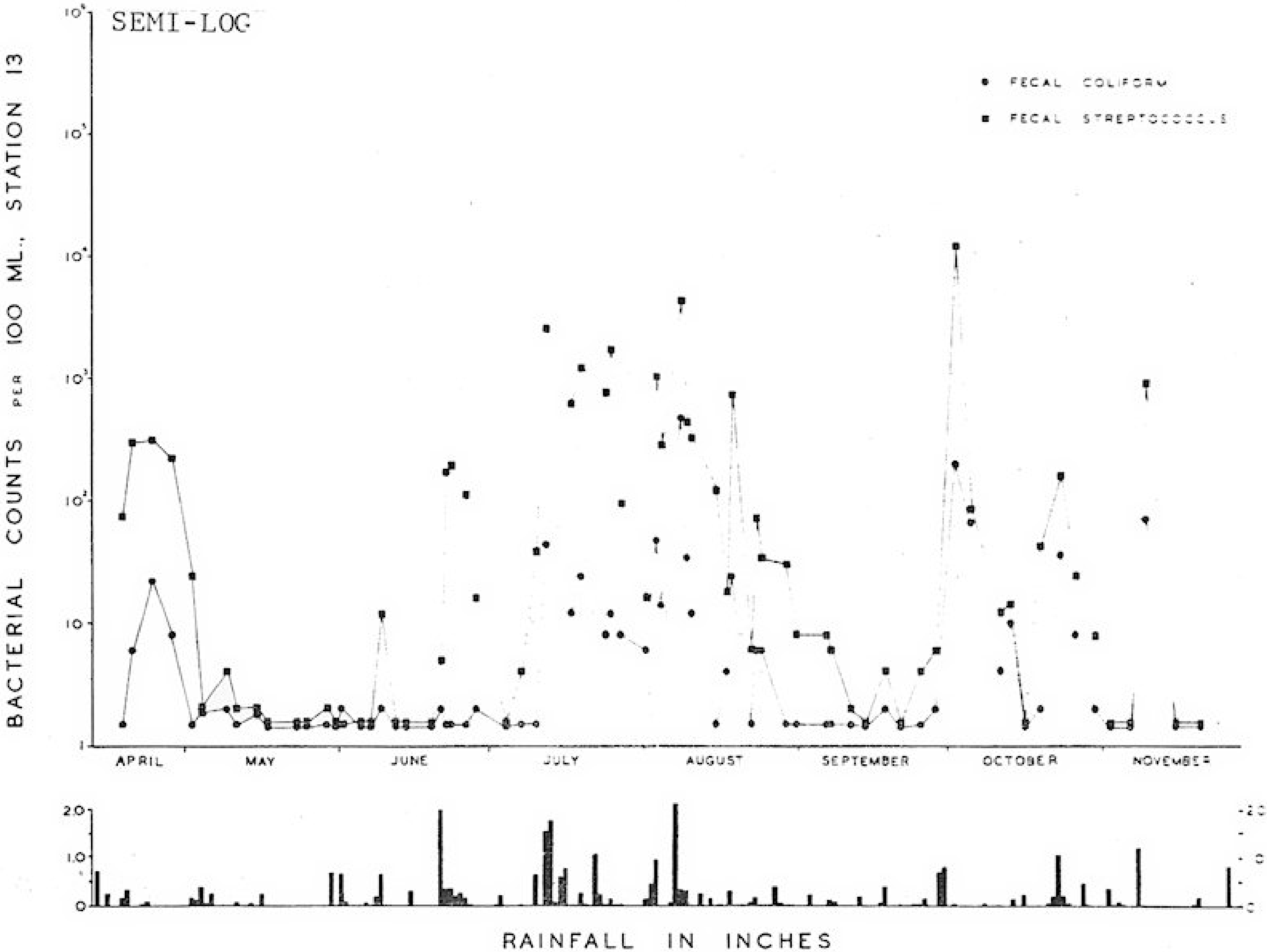

Figure 6: Fecal Coliform and Fecal Streptococcus MF Counts, Water Samples, Station 13, 1972, vs Rainfall.

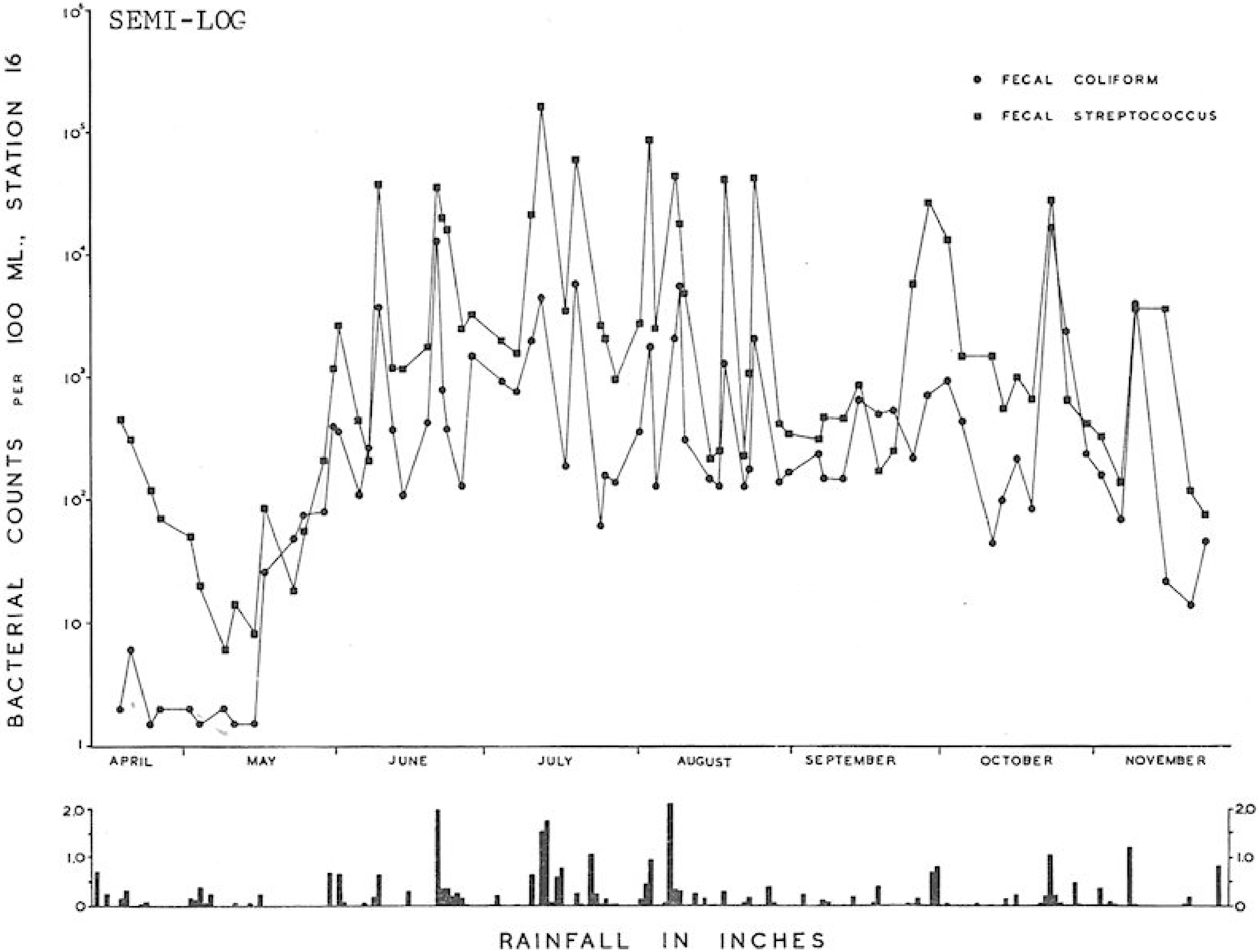

Figure 7: Fecal Coliform and Fecal Streptococcus ME Counts, Water Samples, Station 16, 1972, vs Rainfall.

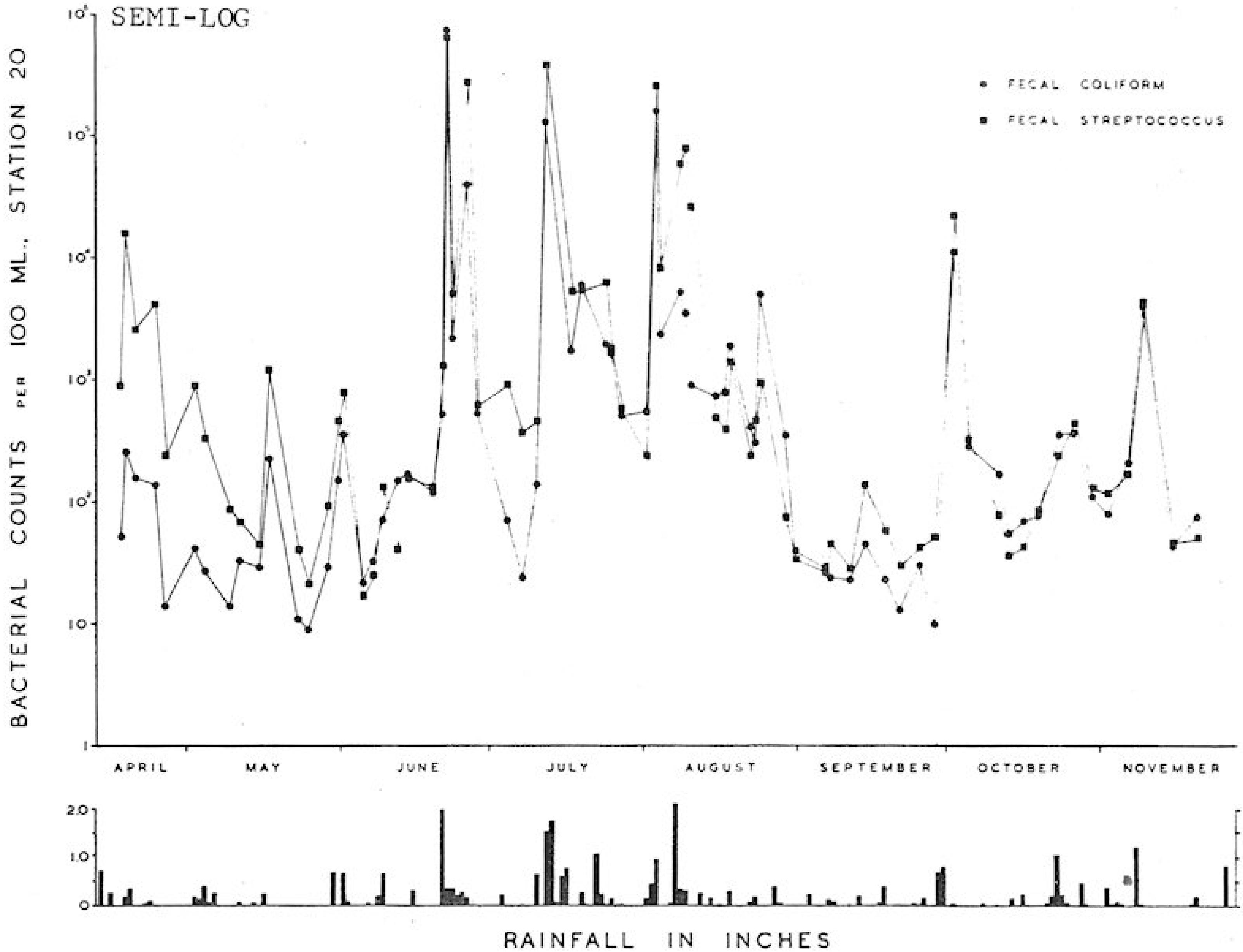

Figure 8: Fecal Coliform and Fecal Streptococcus NP Counts, Water Samples, Station 20, 1972, vs Rainfall.

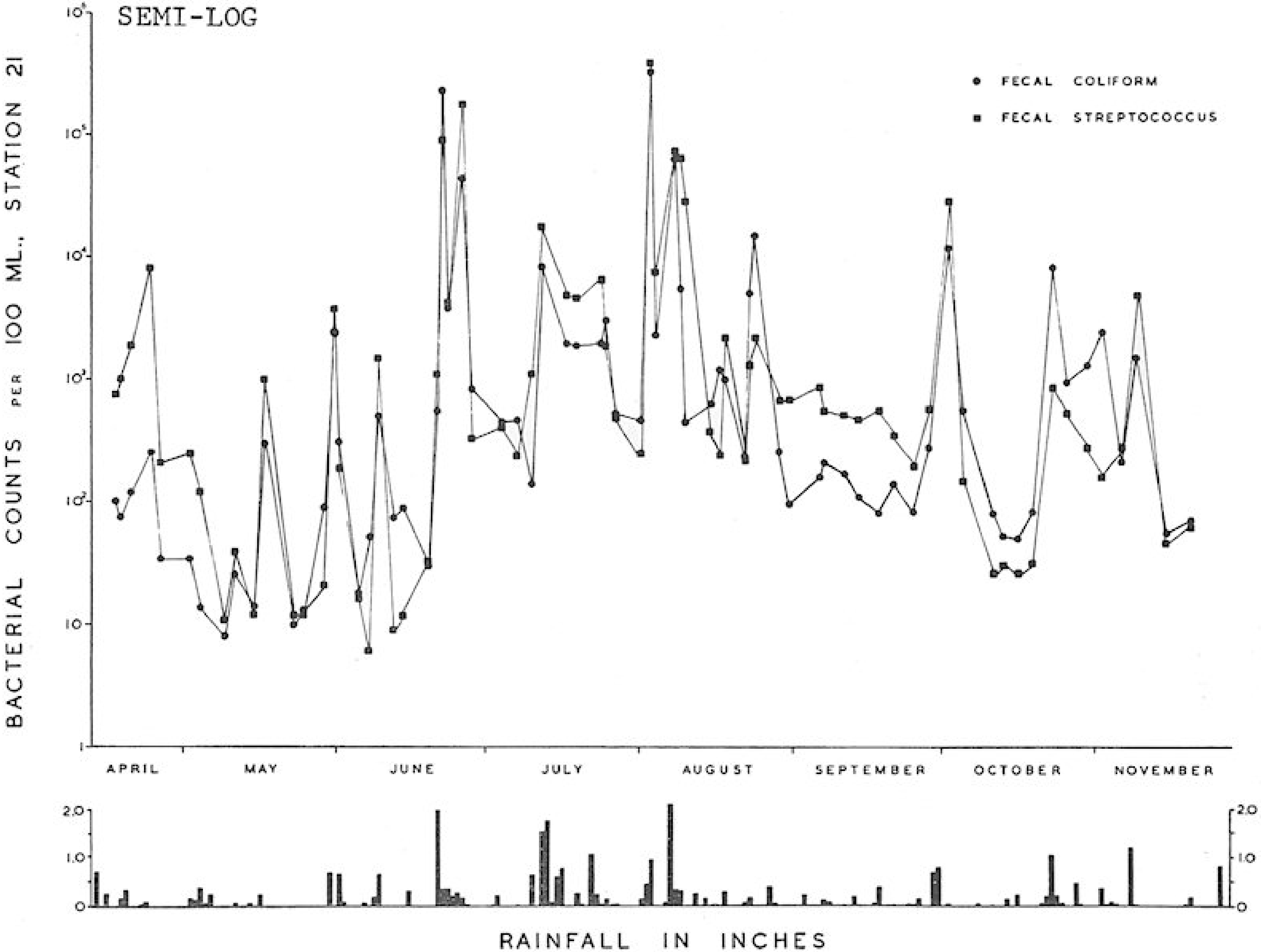

Figure 9: Fecal Coliform and Fecal Streptococcus MF Counts, Water Samples, Station 21, 1972, vs Rainfall.

No close correlation between the application of liquid manure and .fecal bacterial numbers in drainage water is apparent at present, although further correlation of the data with manure application dates and rates may indicate direct or indirect effects. Approximately one third of the manure applied was plowed down on Field No. 10 (65 acres), which is not tile drained, and which would not contribute significantly to any of the sampling points.

About 12 per cent of the manure was used on D.O.T. land which is not tile drained; surface drainage from this sector, however, enters a major ditch upstream from Station 14. A further 10 per cent of the manure was applied to Field No. 15 (60 acres) during the October 9 to November 17 period; tile drainage from this field is included in flows monitored at Station 16. About 31 per cent of the manure was applied to Fields No. 22 and 23 (totalling 95 acres); tile drainage from these fields would flow to Black Rapids Creek at Station 12.

A further 6.6 per cent of the liquid manure was applied to Field No. 24 (60 acres), September 18 to October 13; tile effluent from a total of 400 acres, including this manured sector, was monitored at Station 13. It should be noted that all of the liquid manure was applied to fields on the Black Rapids Creek watershed, and that none was used on land draining to the Baker Creek system. In general, fecal bacterial numbers, and the manner in which they varied, were quite similar at sampling points (6, 7, 8, 9, 17 and 19) representing input streams to A.R.I. property, and at points (4, 5, 10 and 11) on the Baker Creek system, as in samples from stations (2, 3, 12, 13, 14, 15 and 16) on the Black Rapids Creek system; episodes of accelerated runoff caused increases in bacterial counts of at least one order of magnitude at virtually all Stations, regardless of the presence or absence of manuring activity in the drainage area.

While the net effect of manure application on fecal bacterial pollution indices in Black Rapids Creek is difficult to assess in the absence of stream flow data and definitive information on manure application, it is evident that other sources of fecal pollution exist on the Greenbelt Farm. No sources of human domestic sewage are known to exist; all Farm barns and service buildings are connected to a Nepean collector sewer. The major known sources of adventitious fecal pollution are the considerable wild animal and bird populations common to all farming areas, particularly where hunting activity is restricted.

Animals known to be present include foxes and racoons, as well as rabbits, mice and other rodents. Large numbers of birds, including numerous gulls, frequent the fields, and ducks and geese were found in large numbers during the fall period. For example, an estimated minimum of 600 geese were present in fields between Stations 13 and 14 each morning during the week of October 16 to 21, and larger flocks of these birds were noted on A.R.I. property frequently during the migratory period. The net amount of fresh fecal material deposited on soil by these animals and birds would be considerable; the bactericidal effects of drying and exposure to sunlight would be minimized by the very wet, cool summer of 1972, and most of the bacteria in the feces would probably be washed into the drainage systems by the frequent heavy rains. The data appear to indicate that these sources are major contributors of the fecal bacteria isolated from drainage water samples throughout the entire study area.

Counts for the three test parameters obtained under "dry" and "wet" conditions (as described in Section 4.1) are summarized, in terms of 10, 50 (median) and 90 percentile levels, in Table 3. Similarly, the same data are summarized, in relation to arbitrarily-selected numerical objectives for each parameter, in Table 4.

Recreational water quality objectives of 1,000 coliforms and 100 fecal coliforms per 100 ml. are currently used in Ontario in the definition of bacteriologically-satisfactory bathing areas. For agricultural effluents flowing to receiving streams, we suggest that more-realistic objectives would be circa 5,000 coliforms and 1,000 fecal coliforms and fecal streptococci per 100 ml. At these levels, the effect of low- volume farm drainage-system inputs on larger receiving streams could be expected to be minor and transient.

Under "dry" conditions, median coliform and fecal coliform counts for all Stations except No's. 2, 16, 20 and 21 met Ontario recreational water quality objectives, and median coliform, fecal coliform and fecal streptococcus counts at all Stations easily met the suggested effluent objectives.

TABLE 3(a). Summary, Bacterial MF Counts, 10, 50 And 90 Percentile Levels, Water Samples, Greenbelt Farm Stations, 1972

			MF Count Per 100 mL of Water at Three Percentile Levels								
			Coliform			Fecal Coliform			Fecal Strep.		
Sta.	Samples	Period	10	50	90	10	50	90	10	50	90
2	104	Dry	140	1800	21000	6	90	270	24	160	990
	51	Wet	2500	18000	370000	150	1500	24000	1500	9400	130000
	155	All	180	3500	150000	11	160	4000	28	470	38000
3	106	Dry	23	550	4700	<2	24	200	4	99	480
	51	Wet	440	4000	40000	41	160	990	280	1100	5700
	157	All	43	1000	13000	<2	52	460	8	250	2600
4	49	Dry	18	290	7800	<2	6	590	2	130	2200
	27	Wet	1300	15000	240000	34	750	8900	880	7800	200000
	76	All	24	2600	74000	<2	33	2600	6	730	35000
5	57	Dry	69	590	4000	6	74	250	14	150	810
	30	Wet	1300	4300	58000	160	600	8500	730	3900	28000
	87	All	120	1300	15000	12	140	1100	38	310	15000
6	52	Dry	44	470	2100	2	32	160	18	200	2800
	29	Wet	1400	9900	60000	100	430	8700	1400	13000	160000
	79	All	62	1400	36000	4	78	2100	35	750	32000
7	38	Dry	20	250	3200	<2	14	140	6	100	1300
	26	Wet	900	7300	50000	50	580	2300	720	5600	65000
	64	All	41	1000	16000	2	46	1300	12	480	20000
8	40	Dry	16	630	8300	<2	80	440	22	200	850
	25	Wet	960	5400	39000	76	210	930	500	3300	59000
	65	All	38	1600	27000	<2	110	570	28	520	22000

TABLE 3(b). Summary, Bacterial MF Counts, 10, 50, And 90 Percentile Levels. Water Samples, Greenbelt Farm Stations, 1972.

			MF Count Per 100 mL of Water at Three Percentile Levels								
			Coliform			Fecal Coliform			Fecal Strep.		
Sta.	Samples	Period	10	50	90	10	50	90	10	50	90
9	56	Dry	28	420	8200	2	51	990	13	200	2200
	30	Wet	860	5000	160000	110	570	15000	500	2900	88000
	86	All	47	1400	24000	6	140	4800	18	490	30000
10	52	Dry	53	780	2100	2	25	94	6	73	310
	30	Wet	1600	3700	22000	28	190	2100	130	2500	19000
	82	All	99	1400	7000	2	52	410	8	150	6000
11	30	Dry	74	570	4500	<2	12	78	8	110	1500
	19	Wet	1100	4500	43000	34	140	1200	470	2800	26000
	49	All	180	1100	13000	2	30	410	12	410	12000
12	56	Dry	60	720	14000	3	83	490	20	230	1000
	30	Wet	2000	15000	230000	110	1200	5000	1200	9000	140000
	86	All	140	3100	67000	7	130	2000	26	440	25000
13	55	Dry	<2	110	1100	<2	<2	9	<2	4	170
	30	Wet	4	480	37000	<2	3	70	4	220	2500
	85	All	<2	180	7900	<2	<2	32	<2	12	940
14	55	Dry	31	250	2600	2	25	200	19	160	1300
	30	Wet	270	4000	44000	32	310	2000	900	6300	40000
	85	All	39	520	16000	3	52	1100	31	400	25000
15	30	Dry	<2	87	3800	<2	3	230	<2	20	570
	18	Wet	96	3200	29000	<2	30	2000	81	2300	19000
	48	All	<2	260	10000	<2	22	240	<2	110	6800

TABLE 3(c). Summary, Bacterial MF Counts, 10, 50 And 90 Percentile Levels, Water Samples, Greenbelt Farm Stations, 1972.

			MF Count Per 100 mL of Water at Three Percentile Levels								
			Coliform			Fecal Coliform			Fecal Strep.		
Sta.	Samples	Period	10	50	90	10	50	90	10	50	90
16	56	Dry	45	2100	20000	2	140	830	33	340	3000
	30	Wet	2200	25000	320000	130	1400	8900	1100	17000	85000
	86	All	100	4400	100000	4	190	3900	70	1000	42000
17	25	Dry	47	350	7300	<2	2	300	9	82	2400
	22	Wet	1800	7400	95000	130	750	2300	610	5100	30000
	47	All	73	2500	34000	<2	190	1700	10	790	15000
19	34	Dry	16	140	4200	<2	10	220	19	150	1200
	20	Wet	1000	6600	67000	100	720	4600	500	3100	38000
	54	All	34	850	30000	<2	90	2000	26	470	10000
20	105	Dry	200	1200	8700	12	80	660	29	120	1600
	51	Wet	500	27000	990000	93	2200	130000	250	6100	330000
	156	All	380	1800	88000	20	160	7000	35	330	56000
21	105	Dry	300	1700	23000	16	140	1200	13	230	1700
	51	Wet	2600	27000	260000	190	2400	57000	800	5600	180000
	156	All	420	4700	64000	28	300	7400	17	540	27000

TABLE 4(a). Summary, Percent Of Water Samples With Bacterial MF Counts Al Various Selected Levels, Greenbelt Farm Stations, 1972.

Sta.	Number of:		Period	PERCENT OF SAMPLES WITH MF COUNTS LESS THAN:							
				COLIFORM		FECAL COLIFORM			FECAL STREP.		
	Dates	Samples		1000	5000	100	500	1000	100	500	1000
2	52	104	Dry	43	71	53	95	96	35	75	92
	20	51	Wet	2	22	4	31	45	0	0	2
	72	155	All	30	55	37	74	79	23	50	63
3	53	106	Dry	59	91	81	97	98	50	92	97
	20	51	Wet	24	57	29	80	90	0	31	47
	73	157	All	48	80	64	92	96	34	73	81
4	45	49	Dry	55	88	78	90	94	48	69	85
	19	27	Wet	4	30	15	41	56	0	7	7
	64	76	All	37	67	55	72	80	31	47	57
5	53	57	Dry	65	93	58	95	96	32	88	93
	19	30	Wet	3	53	3	50	77	0	7	13
	72	87	All	44	79	39	79	90	21	59	65
6	48	50	Dry	66	98	83	98	98	36	72	79
	20	29	Wet	7	31	7	52	56	0	0	0
	68	79	All	44	73	57	82	84	23	47	52
7	34	38	Dry	76	97	82	100	100	47	84	89
	19	26	Wet	15	46	27	42	62	0	0	23
	53	64	All	52	77	59	77	84	28	50	63
8	36	40	Dry	55	85	65	93	98	35	75	95
	18	25	Wet	8	52	16	84	92	0	8	16
	54	65	All	37	72	46	89	95	22	49	65

TABLE 4(b). Summary, Percent Of Water Samples With Bacterial MF Counts At Various Selected Levels, Greenbelt Farm Stations, 1972.

Sta.	Number of:		Period	PERCENT OF SAMPLES WITH MF COUNTS LESS THAN:							
				COLIFORM		FECAL COLIFORM			FECAL STREP.		
	Dates	Samples		1000	5000	100	500	1000	100	500	1000
9	52	56	Dry	61	82	63	84	91	30	75	88
	20	30	Wet	10	50	7	47	57	0	7	27
	72	86	All	43	71	43	71	79	20	51	66
10	48	52	Dry	62	98	92	100	100	56	94	96
	20	30	Wet	7	63	23	77	83	3	17	30
	68	82	All	41	85	67	91	94	37	66	72
11	26	30	Dry	77	93	97	100	100	50	87	90
	14	19	Wet	5	16	47	84	89	0	5	21
	40	49	All	49	63	78	94	96	31	55	63
12	52	56	Dry	54	77	52	91	95	40	79	91
	20	30	Wet	0	27	7	28	48	0	0	0
	72	86	All	35	59	36	69	79	27	52	60
13	51	55	Dry	91	96	100	100	100	89	96	98
	20	30	Wet	52	69	93	100	100	40	70	83
	71	85	All	77	87	96	100	100	73	88	94
14	51	55	Dry	76	96	80	96	98	35	83	89
	20	30	Wet	13	53	23	57	73	3	3	13
	71	85	All	54	81	60	82	89	24	55	62
15	25	30	Dry	83	97	90	97	100	70	90	97
	13	18	Wet	22	67	72	89	94	17	28	28
	38	48	All	60	85	83	94	98	50	67	71

TABLE 4(c). Summary, Percent Of Water Samples With Bacterial MF Counts At Various Selected Levels, Greenbelt Farm Stations, 1972.

Sta.	Number of: Dates	Number of: Samples	Period	PERCENT OF SAMPLES WITH MF COUNTS LESS THAN: COLIFORM 1000	COLIFORM 5000	FECAL COLIFORM 100	FECAL COLIFORM 500	FECAL COLIFORM 1000	FECAL STREP. 100	FECAL STREP. 500	FECAL STREP. 1000
16	52	56	Dry	38	73	41	82	93	23	63	71
	20	30	Wet	0	23	3	33	43	0	0	7
	72	86	All	24	56	28	65	76	15	41	49
17	21	25	Dry	76	80	76	96	96	56	80	34
	14	22	Wet	0	32	01	38	57	0	5	18
	35	47	All	41	57	41	70	78	30	45	53
19	30	34	Dry	79	91	79	97	97	44	82	88
	15	20	Wet	5	45	5	35	65	0	5	25
	45	54	All	52	74	51	74	85	28	55	65
20	52	105	Dry	46	83	58	87	94	45	74	86
	20	51	Wet	20	31	12	33	41	2	20	27
	72	156	All	37	66	43	69	77	31	56	67
21	52	105	Dry	36	71	41	76	88	33	68	85
	20	51	Wet	0	14	2	14	31	0	6	18
	72	156	All	24	152	28	55	69	22	47	63

Under "wet" conditions, however, no Station had median counts which met all 3 recreational water quality objectives and only Station 13 met the suggested effluent objectives for all 3 parameters. A direct correlation between peak runoff and high fecal bacterial counts is thus readily apparent; rainfall-induced landwash appears to constitute a definite threat to the pollution-free status of downstream recreational waters.

4.4 Black Rapids Creek: downstream pollution sources

While most of the sampling points used during the study were within the Greenbelt Farm property, or on its perimeter, some sampling was also conducted on Black Rapids Creek downstream from Station 2 (between Woodroffe Avenue and the Creek outfall to the Rideau River, near Highway 16). Data for water samples from Stations 20 (Merivale Road) and 21 (Highway 16) on Black Rapids Creek were cited in Section 4.3 (Appendix Tables C-1 and C-2; Tables 3 and 4; Figures 8 and 9), since these Stations were included in the regular Greenbelt Farm sampling program.

MF counts for the three test parameters obtained for water samples from 6 additional stations collected by National Capital Commission personnel on 11 dates in 1972 are recorded in Appendix Table D-1. Three of the N.C.C. sampling points (BR-1, 2 and 6) closely approximate the location of Stations 2, 20 and 21 in the Greenbelt Farm series; sampling point BR-4 represents the flow from the outfall of a storm sewer draining the Simpson Housing Development, while sampling points BR-3 and 5 were in the Creek immediately and below the outfall from this storm sewer.

In addition, water samples were collected by Mr. L.B. Killoran, E.P.S., from the Rideau River on August 22 and 24,1972; MF count data for samples collected at quarter points across the River at Ranges A (above) and B (below the Black Rapids Creek outfall) are reported in Table 5.

TABLE 5. MF Counts, Water Samples, Rideau River, Ranges A And B, August, 1972.

Range and Station	Date	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
A-1	22-8	94	1	8
	24-8	88	10	16
A-2	22-8	70	4	10
	24-8	32	2	16
A-3	22-8	78	8	22
	24-8	80	6	12
Mean		74	6	13
Median		79	5	14
B-1	22-8	56	6	8
	24-8	32	2	20
B-2	22-8	92	16	10
	24-8	48	18	10
B-3	22-8	72	12	10
	24-8	78	12	16
Mean		63	11	11
Median		64	12	10

High fecal bacterial counts were recorded for the first sample of storm drain effluent collected at Station BR-4 on June 7; subsequently, however, bacterial numbers in this effluent varied widely, and counts for all 3 parameters were excessively high on only 3 other dates (July 19; Sept. 26; and October 23). The bacteriological characteristic of this potential pollution source is thus quite similar to that of other urban and suburban storm drainage systems in the Ottawa area; there is no evidence of domestic sewer cross connections, and data for Stations BR-3 and BR-5 indicate that this outfall has only a rather minor impact on bacterial pollution indices in the Creek.

A potentially more-important point source of pollution is a cattle feedlot (enclosed pen) located south of the railway tracks on the George Boyce farm approximately 20 - 30 feet from Black Rapids Creek. A maximum of approximately 300 cattle were maintained on this feedlot during the summer, with numbers diminishing to about 50 head by late November.

It is probable that runoff from this feedlot enters directly into the Creek during periods of wet weather. Fields on the Boyce farm are not tile-drained; because of the unusually-heavy rainfall, which caused the land to remain wet during most of the summer, only 50 acres of corn, in a field northeast of the railway tracks, could be cut. Manure was stored on this field, and later was spread and plowed down.

No precise estimate of the effect on Black Rapids Creek water quality or these known, and other minor potential, pollution sources on the watershed can be derived from the data presented; this is particularly true because of the wide numerical variation in bacterial numbers related to rainfall during the study. Bacterial densities for all three parameters applied tended to be higher, however, at Station 21, near the Creek outfall, than at Station 2, which represented the discharge from the Greenbelt Farm.

It thus appears that there was a reinforcement of bacterial numbers in the downstream sector of Black Rapids Creek, rather than the expected significant die off of fecal coliforms and fecal streptococci normally attributable to the assimilative capacity of the Creek waters. The maintenance and slight increase in fecal bacterial densities in the downstream Creek sector is probably attributable to the input of pollution from a variety of sources; multiplication of these organisms in the Creek is considered improbable.

Fecal coliform : fecal streptococcus MF count ratios were calculated for each water sample from Stations 2 to 21; the ratios for each Station under "dry" and "wet" conditions were arrayed, and the values calculated at five percentile levels are reported in Table 6. Median ratios were very low (0.05 to 0.46) under "dry" conditions at all Greenbelt Farm Stations, and tended to be even lower (0.02 to 0.18) during "wet" periods. These data are thus compatible with the thesis that runoff pollution originating on the A.R.I. Greenbelt Farm property is completely animal in origin.

TABLE 6(a). Fecal Coliform : Fecal Streptococcus Ratios, Percentile Levels, Water Samples, 1972.

Sta.	Number of		Period	FC : FS RATIO AT PERCENTILE LEVEL:				
	Dates	Samples		10	25	50	75	90
2	52	105	Dry	0.07	0.17	0.43	0.89	1.26
	20	51	Wet	0.02	0.05	0.11	0.24	0.51
	72	156	All	0.05	0.10	0.25	0.70	1.25
3	53	103	Dry	<0.01	0.05	0.24	1.00	2.29
	20	51	Wet	0.05	0.09	0.16	0.24	0.55
	73	154	All	0.01	0.07	0.18	0.59	1.88
4	43	45	Dry	<0.01	<0.01	0.06	0.33	0.75
	19	28	Wet	0.01	0.02	0.12	0.19	0.39
	62	73	All	<0.01	0.02	0.08	0.25	0.64
5	52	56	Dry	0.12	0.26	0.46	0.83	1.39
	20	30	Wet	0.02	0.07	0.17	0.47	0.75
	72	86	All	0.05	0.16	0.36	0.75	1.31
6	48	52	Dry	0.01	0.04	0.13	0.28	0.80
	19	25	Wet	0.02	0.04	0.10	0.15	0.20
	67	77	All	0.01	0.04	0.10	0.25	0.67
7	34	38	Dry	<0.01	0.07	0.12	0.24	0.37
	19	26	Wet	0.01	0.03	0.08	0.17	0.28
	53	64	All	<0.01	0.05	0.11	0.23	0.34
8	36	40	Dry	<0.01	0.12	0.30	0.56	1.46
	18	25	Wet	0.01	0.03	0.05	0.08	0.32
	54	65	All	<0.01	0.03	0.13	0.46	1.16
9	49	55	Dry	0.04	0.14	0.29	0.48	1.05
	20	30	Wet	0.09	0.13	0.18	0.28	0.62
	69	85	All	0.06	0.14	0.23	0.43	0.95
10	47	51	Dry	0.01	0.10	0.25	0.68	1.94
	20	30	Wet	0.03	0.06	0.12	0.24	0.45
	67	81	All	0.02	0.09	0.19	0.45	1.39
11	26	30	Dry	<0.01	0.03	0.10	0.22	0.50
	14	19	Wet	<0.01	0.02	0.06	0.10	0.20
	40	49	All	<0.01	0.03	0.08	0.18	0.38

TABLE 6(b). Fecal Coliform : Fecal Streptococcus Ratios, Percentile Levels, Water Samples, 1972.

Sta.	Number of: Dates	Samples	Period	FC : FS RATIO AT PERCENTILE LEVEL: 10	25	50	75	90
12	52	55	Dry	0.10	0.16	0.34	0.68	1.24
	20	30	Wet	0.03	0.04	0.08	0.19	0.56
	72	85	All	0.04	0.08	0.22	0.61	1.00
13	36	36	Dry	<0.01	<0.01	0.05	0.33	0.58
	18	28	Wet	<0.01	<0.01	0.02	0.08	0.18
	54	64	All	<0.01	<0.01	0.03	0.17	0.45
14	50	54	Dry	0.01	0.07	0.14	0.31	0.60
	20	30	Wet	0.02	0.03	0.05	0.09	0.12
	70	84	All	0.02	0.04	0.09	0.17	0.50
15	24	24	Dry	<0.01	<0.01	0.04	0.20	1.47
	13	18	Wet	<0.01	<0.01	<0.01	0.06	0.29
	37	42	All	<0.01	<0.01	0.03	0.20	0.50
16	52	56	Dry	0.02	0.08	0.31	0.50	0.93
	20	30	Wet	0.03	0.05	0.07	0.16	0.64
	72	86	All	0.03	0.05	0.16	0.48	0.77
17	21	25	Dry	<0.01	<0.01	0.13	0.23	0.53
	14	22	Wet	0.05	0.09	0.17	0.20	0.25
	35	47	All	<0.01	0.05	0.13	0.22	0.44
19	30	33	Dry	<0.01	<0.01	0.08	0.24	0.33
	15	20	Wet	0.06	0.08	0.20	0.40	0.77
	45	53	All	<0.01	0.05	0.12	0.32	0.46
20	52	105	Dry	0.06	0.21	0.73	1.25	2.75
	23	51	Wet	0.04	0.15	0.37	0.81	1.09
	75	156	All	0.05	0.19	0.62	1.10	1.75
21	52	103	Dry	0.13	0.32	0.97	2.28	5.73
	23	51	Wet	0.05	0.17	0.41	0.81	2.10
	75	154	All	0.11	0.25	0.64	1.61	4.50

It is of interest to note that median ratios at Stations 20 and 21 tend to be higher (0.37 to 0.97) than at Station 2 (0.11 to 0.43); at the 90 percentile level, ratios of 5.73 and 2.10 were calculated for Station 21 under "dry" and "wet" conditions, as compared to only 1.26 and 0.51 at Station 2. While these calculations cannot be considered definitive, they do appear to reflect the admixture of pollution from other, probably human, sources in the downstream Creek sector.

The fragmentary data presented in Table 5 appear to indicate that, under "dry" weather conditions, the relatively low-volume Black Rapids Creek outfall had no significant impact on the numbers of bacterial pollution indices in the waters of the Rideau River. Very similar MF counts were recorded for the 3 test parameters at ranges above and below the outfall. While very little rainfall preceded sampling on August 22 and 24, MF counts were very high at Station 21 on August 24, and a sample collected by boat at the mouth of Black Rapids Creek on August 24 had coliform, fecal coliform and fecal streptococcus counts of 10,000, 3,500 and 670 per 100 ml., respectively.

Under these conditions, dilution was effective in minimizing the bacteriological impact of the Creek input. No data are available on the effect of the Black Rapids Creek outfall on Rideau River water quality under peak runoff conditions.

4.5 Fecal Coliform Pure Culture Study

The decision to conduct a study of the fecal coliform flora of manure and water samples had several purposes. We wished to determine the fidelity of the fecal coliform test as a means of estimating *Escherichia coli* densities in the samples analysed. *E. coli*, the predominant fecal coliform in the intestine of man and the warm-blooded animals, normally constitutes 80 to 90 per cent of the fecal coliform densities of water samples; in some situations, however, the percentage incidence of this biotype can be much less.

Since the application of long-stored animal feces to land was involved in the present study, it was felt that fecal coliform classification might provide useful information if *E. coli* incidence was unusually low. It was also considered possible that the relative incidence of the various fecal coliform species and biotypes might change with time or during a sequence of activities or events, such as manure application or accelerated runoff, and provide some insight into factors affecting fluctuations in fecal coliform densities.

Biochemical classification data for representative fecal coliform cultures isolated from Greenbelt Farm liquid manure (734 isolates) and water (2,315 isolates) are presented, by source, in Appendix Tables E-1 and F-1. The same data for water samples are given, by sampling date, in Appendix Table F-2. Biochemical reactions for 26 non-*Escherichia* fecal coliform isolates are cited in Appendix Table F-3.

Of the 734 fecal coliforms isolated from 31 specimens of liquid manure, 733 were *Escherichia*; 696 (94.8 per cent) were typical *E. coli* type I strains (IMViC ++--, EC (44.5°C.) gas-positive), while 37 strains were atypical E. coli (indol negative and/or EC gas-negative). The one remaining isolate was classified as a member of the genus

Klebsiella.

Similarly, of 2,315 fecal coliforms isolated from water samples from Stations 2 to 21 throughout the May to October, 1972, period, 2,290 (98.9 percent were classified as *Escherichia*; 2,238 (96.7 per cent) were typical *E. coli* type I, while 52 (2.2 per cent) were classed as atypical *E. coli* because of indol and/or E.C. negativity. Of the remaining 25 strains, one was classified as *Citrobacter freundii*, one was an atypical (indol positive) *Enterobacter* strain, and the remaining 23 cultures were identified as *Klebsiella*.

Thus virtually all of the fecal coliform isolates identified were *E. coli* strains; in the present study, the term "fecal coliform" is virtually synonymous with "*E. coli*". The majority of these strains were completely typical; most of the *Escherichia* cultures classed as atypical on the basis of their failure to produce gas from EC Medium within 24 hours at 44.5°C. regained their EC aerogenicity after 3 serial transfers in lactose broth (35°C.). The same was true for 5 of 15 EC negative *Klebsiella* strains.

The isolation of small numbers of *Klebsiella* from drainage water is not surprising in view of recent reports from various Canadian and U.S. studies of the ubiquitous presence of *K. pneumoniae* strains in a wide variety of environmental sources, including plant materials, soils and industrial wastes. Evans *et al.* (7) have recently reported the finding of *Klebsiella* very similar to *K. pneumoniae* among the nitrogen-fixing flora associated with the nodules and roots of leguminous plants.

Of the 24 strains isolated from all sources in the present study, only 6 could be grouped with *K. pneumoniae* pooled antisera. Biochemically they were reasonably compatible with this potential pathogen. We suggest, however, that they should he regarded as commensals, probably of soil or plant origin, only superficially related to the classic, pathogenic *K. pneumoniae* of hospital origin.

5. CONCLUSIONS

Bacteriological data presented and discussed above permit the following conclusions to be drawn:

1. Coliform, fecal coliform and *fecal* streptococcus MF counts for liquid manure samples varied widely; maximum numbers were recorded for relatively fresh manure applied to the land in June and July. Long-stored manure had relatively low numbers of these bacteria. Extended storage may be a practical, effective procedure for significantly reducing the numbers of pollution index bacteria and potential bacterial pathogens before manure is applied to the land.

2. Under relatively dry weather conditions, median fecal bacterial counts at a majority of the Greenbelt Farm sampling stations met Ontario recreational water quality objectives. Runoff, however, constitutes a definite threat to the pollution-free status of downstream receiving waters.

3. Fecal bacterial counts in Farm drainage water tended to increase during the abnormally-wet summer of 1972, and frequent major but transient peaks in bacterial numbers closely followed episodes of heavy rainfall. Accelerated runoff caused increases in fecal bacterial densities of at least one order of magnitude at virtually all of the sampling stations; this occurred in drainage sectors where no manure was used, as well as in the Black Rapids Creek drainage basin where liquid manure was applied by the plow down technique.

4. It is postulated that wild animal and bird populations contribute very significantly to fecal bacterial pollution, and, during extended periods of wet weather, may be more important than manuring activity in contributing to high fecal bacterial densities in runoff water in the Greenbelt Farm drainage system.

5. Evidence is presented that other sources on the watershed of Black Rapids Creek between the Greenbelt Farm and the Rideau River contributed significant amounts of bacterial pollution to the Creek.

6. In spite of the various bacterial inputs to Black Rapids Creek, the relatively low-volume Creek outfall had no demonstrable effect on numbers of pollution index bacteria in the waters of the Rideau River during a dry weather period in late August.

7. Of 3,049 fecal coliform MF cultures isolated from drainage water and liquid manure samples, 3,023 (99 per cent) were identified as *Escherichia*; 2,914 (96

per cent) *were* typical *E. coli* type I strains. Thus, for these samples, the fecal coliform test had a remarkably high fidelity for *E. coli*, and the terms can be used virtually synonymously in this study.

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APPENDIX

TABLES

TABLE A-1(a). Bacteriological Densities, Liquid Manure Samples, Greenbelt Farm, 1972.

Code	Ref. No.	Dry Wt. Factor	MF COUNT PER GRAM Coliform	Fecal Coliform	Fecal Strep.
May 23.	Young Cattle, Predominantly Forage-fed				
47	209	11.2	710,000	210,000	140,000
48	"	11.9	760,000	330,000	160,000
49	"	14.3	1,100,000	290,000	91,000
50	"	13.6	590,000	330,000	120,000
51	"	13.1	960,000	320,0001	130,000
52	"	10.5	2,700,000	1,000,000	1,400,000
May 31.	Cattle				
1	503	41.1	81,000	27,000	52,000
2	503	35.6	210,000	94,000	110,000
3	503	28.0	590,000	130,000	160,000
71	209	13.1	410,000	300,000	8,700
June 9.	Sheep				
1	903	10.8	4,100,000	1,700,000	1,000,000
2	"	12.1	24,000,000	2,400,000	1,200,000
3	"	10.9	5,500,000	560,000	980,000
4	"	11.3	2,600,000	690,000	1,400,000
7	"	11.2	3,800,000	430,000	1,400,000
June 13.	Sheep				
4;5;6	--	15.7	3,200,000	670,000	610,000
7;8	--	13.2	970,000	250,000	110,000
9;10	--	10.0	910,000	340,000	210,000
11;12	--	8.4	1,600,000	320,000	110,000'
July 13.	Cattle, Winter Storage (Old)				
9;10	503	19.6	500	<100	15,000
9;10	"	13.7	<100	<100	30,000
9;10	"	14.2	200	<100	22,000
9;10	"	16.8	600	<100	20,000
9;10	"	12.7	300	<100	32,000
9;10	"	15.3	800	<100	29,000

TABLE A-1(b). Bacteriological Densities, Liquid Manure Samples, Greenbelt Farm, 1972

Code	Ref. No.	Dry Wt. Factor	MF COUNT PER GRAM Coliform	Fecal Coliform	Fecal Strep.
July 19.	Poultry				
99	417	9.5	530,000	93,000	5,100,000
100	417	12.6	1,800,000	250,000	7,100,000
July 19.	Cattle				
107	503	15.7	1,600	600	24,000
108	"	15.2	200	<100	26,000
109	"	15.5	69,000	2,500	32,000
110	"	15.2	14,000	1,100	22,000
111	"	15.0	6,800	1,700	55,000
112	"	16.1	11,000	1,200	7,000
113	"	18.0	7,800	1,700	5,800
114	"	19.9	4,300	900	5,500
July 20.	Cattle				
115	503	18.6	6,500	1,000	16,000
117	"	15.7	12,000	1,900	18,000
119	"	20.4	1,000	200	4,800
116	"	23.7	400	200	5,600
118	"	18.4	2,700	400	5,500
120	"	16.1	<100	<100	4,500
121	"	17.1	400	<100	4,200
122	"	14.3	300	300	4,300
July 21.	Cattle				
123	503	14.1	2,700	200	4,500
124	"	13.3	2,100	100	5,600
125	"	14.2	2,300	<100	4,700
Sept.20 and 21.	Cattle, Aged; Reserve Tank				
1	208	17.4	2,600	<100	5,300
2	208	16.2	10,000	<100	5,400

TABLE A-1(c). Bacteriological Densities, Liquid Manure Samples, Greenbelt Farm, 1972.

Code	Ref. No.	Dry Wt. Factor	MF COUNT PER GRAM		
			Coliform	Fecal Coliform	Fecal Streptococci
October 31.Old Cattle Manure and Seepage Water					
1	210	29.6	1,300	<100	<100
2	"	29.5	1,700	<100	200
3	"	29.8	700	<100	200
4	"	27.2	1,200	<100	300
5	"	27.9	1,100	<100	400

TABLE B-1(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 1, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	4	<4	110
20-4	0845	940	340	750
8-8	0915	31,000	2,300	49,000
8-8	1055	34,000	3,500	52,000
9-11	0930	27,000	4,600	3,500

TABLE B-2(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 2, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	230	140	110
18-4	0915	250	66	330
20-4	0850	520	68	340
20-4	1005	170	16	230
24-4	0855	220	20	120
24-4	1000	140	6	160
26-4	0855	85	6	42
26-4	1005	100	<2	38
2-5	0845	120	8	50
2-5	1025	150	22	56
4-5	0845	200	4	18
4-5	1035	140	10	24
9-5	0855	340	14	20
9-5	1015	2	<2	12
11-5	0845	580	30	24
11-5	1025	22	6	14
15-5	0845	50	4	36
15-5	1010	24	2	14
17-5	0845	280	8	170
17-5	1030	190	30	120
17-5	1205	230	14	55
17-5	1330	130	4	70
17-5	1450	240	6	36
23-5	0840	610	150	80
23-5	1010	470	70	54
25-5	0850	490	110	100
25-5	1025	450	140	55
29-5	0905	1,300	160	160
29-5	1040	1,300	90	140
31-5	0840	14,000	2,900	12,000
31-5	1025	8,500	2,200	9,400
1-6	0900	2,500	330	3,000
1-6	1030	7,200	890	2,400
5-6	0840	480	96	120
5-6	1015	270	30	78

TABLE B-2(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 2, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
7-6	0910	1,300	90	120
7-6	1040	250	120	120
9-6	0855	12,000	660	14,000
9-6	1100	180,000	5,400	69,000
9-6	1330	42,000	3,300	6,100
9-6	1450	69,000	3,300	16,000
12-6	0845	2,000	240	520
12-6	1005	1,100	120	410
14-6	0850	3,200	330	770
14-6	1050	3,300	190	1,000
19-6	0850	2,900	220	990
19-6	1015	1,900	190	550
21-6	0905	10,000	2,700	27,000
21-6	1040	22,000	4,500	43,000
21-6	1300	5,200	5,100	12,000
21-6	1435	2,400	760	6,900
22-6	0850	190,000	1,200	67,000
22-6	1135	28,000	3,500	17,000
23-6	0855	3,700	130	1,700
23-6	1015	2,700	300	3,100
23-6	1330	1,400	250	1,000
26-6	0845	7,100	220	8,500
26-6	1305	900	170	1,400
26-6	1440	3,400	150	1,500
28-6	0855	1,900	200	550
28-6	1035	2,400	54	590
4-7	0850	1,600	270	770
4-7	1005	1,900	160	640
7-7	0905	1,100	350	340
7-7	1100	190	110	110
10-7	0855	1,400	110	520
10-7	1105	3,600	1,300	3,600
10-7	1355	3,500	2,000	11,000
10-7	1500	3,800	900	5,700

TABLE B-2 (c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 2, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
12-7	0855	1,000,000	28,000	280,000
12-7	1030	360,000	21,000	240,000
17-7	0850	13,000	150	6,300
17-7	1010	29,000	400	6,600
19-7	0850	16,000	460	10,000
19-7	1035	18,000	1,600	18,000
24-7	0915	5,500	70	4,000
24-7	1035	7,800	64	3,700
25-7	0900	5,400	110	1,800
25-7	1025	6,000	210	1,100
27-7	0920	4,700	80	600
27-7	1035	2,800	110	590
1-8	0850	8,000	700	2,900
1-8	1035	3,900	170	3,700
3-8	0910	670,000	9,900	800,000
3-8	1135	310,000	25,000	83,000
3-8	1255	600,000	19,000	150,000
4-8	0915	14,000	150	5,000
4-8	1030	29,000	390	8,700
8-8	0920	210,000	7,000	110,000
8-8	1105	130,000	15,000	95,000
9-8	0845	500,000	600	110,000
9-8	1005	370,000	400	130,000
9-8	1245	220,000	25,000	120,000
9-8	1430	280,000	43,000	120,000
10-8	0850	220,000	800	41,000
10-8	1010	86,000	700	33,000
15-8	0850	3,500	80	570
15-8	1005	2,700	18	410
17-8	0840	3,300	160	200
17-8	1005	3,200	270	300
18-8	0850	61,000	3,600	31,000
18-8	1005	46,000	3,500	34,000
22-8	0840	21,000	190	640
22-8	0950	14,000	120	500

TABLE B-2(d). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 2, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
23-8	0855	19,000	90	550
23-8	1010	22,000	70	710
24-8	0850	160,000	1,500	12,000
24-8	1010	230,000	1,200	17,000
29-8	0850	18,000	200	450
29-8	1020	17,000	270	420
31-8	0850	17,000	60	920
31-8	1005	11,000	16	470
6-9	0850	2,800	100	210
6-9	1000	25,000	60	120
7-9	0855	20,000	110	160
7-9	1005	23,000	110	150
11-9	0855	18,000	250	230
11-9	1010	9,300	190	190
14-9	0840	27,000	340	630
14-9	0955	12,000	230	500
18-9	0845	17,000	230	250
18-9	1000	21,000	240	360
21-9	0830	23,000	190	220
21-9	0955	12,000	26	450
25-9	0855	14,000	76	440
25-9	1025	7,700	78	110
28-9	0850	36,000	220	100
28-9	1020	17,000	130	100
2-10	0835	28,000	1,500	3,000
2-10	1000	19,000	1,800	3,500
5-10	0845	2,600	150	90
5-10	1010	2,900	170	110
11-10	0755	1,500	90	74
11-10	0920	970	18	50
13-10	0800	4,300	410	100
13-10	0935	850	46	14
16-10	0920	3,300	62	50
16-10	1040	1,500	18	82

TABLE B-2(e). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 2, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
19-10	0855	1,600	190	180
19-10	1025	770	32	68
23-10	0900	53,000	34,000	7,000
23-10	1030	37,000	16,000	5,600
26-10	0840	4,600	200	230
26-10	1005	740	50	240
30-10	0830	800	52	96
30-10	0950	520	42	80
2-11	0840	150	30	24
2-11	1000	510	16	22
6-11	0840	510	30	30
6-11	0955	140	38	26
9-11	0840	10,000	3,400	1,900
9-11	1010	10,000	5,000	1,400
15-11	0835	290	12	20
15-11	1000	130	10	16
20-11	0905	360	22	24
20-11	1040	450	8	24

TABLE B-3 (a). Bacteriological Densities , Water Samples, Greenbelt Farm Station No. 3, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	4	<4	45
18-4	0915	200	<2	140
20-4	0850	990	15	510
20-4	1005	160	4	290
24-4	0855	310	12	490
24-4	1000	220	<2	490
26-4	0855	380	<2	130
26-4	1005	140	<2	110
2-5	0850	150	8	14
2-5	1025	220	4	26
4-5	0850	110	2	6
4-5	1035	46	<2	8
9-5	0855	10	<2	<2
9-5	1015	<2	<2	2
11-5	0850	22	<2	4
11-5	1025	24	<2	<2
15-5	0850	6	2	4
15-5	1010	<2	<2	2
17-5	0845	36	<2	18
17-5	1030	34	<2	8
17-5	1205	250	6	50
17-5	1330	18	<2	4
17-5	1455	58	2	48
23-5	0840	10	<2	34
23-5	1010	<2	<2	46
25-5	0850	56	4	36
25-5	1025	16	<2	30
29-5	0905	68	65	62
29-5	1045	26	26	26
31-5	0840	600	120	300
31-5	1025	710	110	620
1-6	0905	1,300	160	280
1-6	1030	4,500	740	2,600
5-6	0845	70	14	38
5-6	1015	30	8	28

TABLE B-3(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 3, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
7-6	0915	170	64	44
7-6	1045	92	68	20
9-6	0855	1,300	46	300
9-6	1115	500	74	360
9-6	1330	5,900	1,000	1,800
9-6	1450	4,500	600	1,100
12-6	0850	72	4	76
12-6	1010	46	12	44
14-6	0855	510	28	270
14-6	1055	120	6	130
19-6	0850	390	30	160
19-6	1020	46	12	150
21-6	0905	14,000	1,300	48,000
21-6	1040	5,300	5,100	7,600
21-6	1305	350	150	1,200
21-6	1440	960	230	1,100
22-6	0855	25,000	80	470
22-6	1135	410	94	590
23-6	0855	250	16	110
23-6	1020	470	40	100
23-6	1330	1,400	310	780
26-6	0850	1,600	6	170
26-6	1310	440	110	160
26-6	1440	1,500	880	770
28-6	0900	1,900	36	470
28-6	1040	800	22	290
4-7	0855	340	24	310
4-7	1005	1,000	38	300
7-7	0905	1,100	350	340
7-7	1100	92	22	440
10-7	0855	720	220	2,400
10-7	1105	1,600	230	4,600
10-7	1355	730	190	740
10-7	1505	370	110	690

TABLE B- 3(c). Bacteriological Densities, Water Sample Greenbelt: Farm Station No 3, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
12-7	0900	4,300	440	3,800
12-7	1030	3,600	320	4,900
17-7	0850	4,000	100	660
17-7	1010	2,700	90	460
19-7	0855	17,000	190	2,600
19-7	1035	7,000	280	1,300
24-7	0915	3,000	96	1,000
24-7	1040	10,000	110	610
25-7	0900	6,000	32	340
25-7	1025	6,400	64	300
27-7	0920	2,800	20	130
27-7	1035	1,200	10	120
1-8	0855	1,100	82	730
1-8	1035	880	26	760
3-8	0910	100,000	190	3,900
3-8	1140	38,000	620	4,100
3-8	1300	31,000	3,200	35,000
4-8	0915	7,400	160	2,400
4-8	1030	5,300	98	1,500
8-8	0920	63,000	220	5,800
8-8	1110	49,000	460	6,800
9-8	0850	46,000	72	2,200
9-8	1010	28,000	100	1,100
9-8	1250	1,100	130	1,200
9-8	1430	17,000	240	1,500
10-8	0855	40,000	40	310
10-8	1010	27,000	36	330
15-8	0850	380	80	160
15-8	1005	990	50	190
17-8	0845	1,000	140	260
17-8	1005	2,000	150	290
18-8	0855	32,000	470	6,600
18-8	1010	53,000	770	7,100
22-8	0840	1,600	18	310
22-8	0950	330	36	190

TABLE B-3(d). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 3, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
23-8	0855	810	40	420
23-8	1010	3,500	130	3,300
24-8	0855	2,900	10	390
24-8	1015	1,500	24	210
29-8	0855	1,200	48	500
29-8	1025	7,000	4	470
31-8	0850	1,100	12	400
31-8	1005	1,300	8	370
6-9	0850	2,200	230	470
6-9	1000	3,400	64	240
7-9	0855	2,000	200	310
7-9	1010	1,400	120	200
11-9	0900	1,900	170	88
11-9	1010	1,200	20	54
14-9	0845	7,200	1,400	450
14-9	0955	4,100	1,100	560
18-9	0845	10,000	200	210
18-9	1000	9,700	170	180
21-9	0835	7,900	200	130
21-9	0955	3,400	12	78
25-9	0900	1,800	110	84
25-9	1025	1,200	66	110
28-9	0855	3,500	260	72
28-9	1025	4,100	240	100
2-10	0835	9,500	900	3,700
2-10	1000	13,000	2,000	2,700
5-10	0850	5,200	34	140
5-10	1010	1,400	54	130
11-10	0800	870	72	36
11-10	0920	580	36	26
13-10	0805	1,200	38	32
13-10	0940	1,000	52	26
16-10	0925	1,600	76	30
16-10	1040	1,000	98	54

TABLE B-3(e). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 3, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
19-10	0855	630	32	90
19-10	1025	460	10	66
23-10	0905	1,800	150	410
23-10	1035	2,300	160	410
26-10	0845	3,500	250	250
26-10	1005	520	120	98
30-10	0835	850	22	26
30-10	0950	1,000	24	14
2-11	0840	270	28	1.4
2-11	1005	400	14	6
6-11	0840	380	74	3
6-11	0955	390	14	6
9-11	0840	12,000	70	310
9-11	1010	3,500	60	310
15-11	0840	410	16	2
15-11	1000	600	66	8
20-11	0910	280	4	<2
20-11	1040	390	26	12
23-11	0850	120	6	6
23-11	1005	150	4	4

TABLE B-4(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 4, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
20-4	0920	6,800	2,200	3,100
24-4	0925	22	6	58
26-4	0925	20	<2	24
2-5	0925	10	<2	24
4-5	0920	66	<2	2
9-5	0920	<2	<2	<2
11-5	0930	10	<2	6
15-5	0915	14	4	2
17-5	0920	46	<2	8
17-5	1105	461	<2	24
17-5	1245	28	<2	14
17-5	1400	26	2	12
17-5	1515	30	2	18
23-5	0915	220	2	6
25-5	0925	20	6	12
29-5	0945	190	8	24
31-5	0920	240	30	380
1-6	0930	1,000	20	290
5-6	0915	40	2	76
7-6	0950	88	4	120
9-6	0925	73,000	280	41,000
9-6	1145	25,000	610	31,000
9-6	1405	76,000	3,300	27,000
12-6	0915	290	12	240
14-6	0935	2,200	6	1,300
21-6	0945	63,000	2,400	69,000
21-6	1340	4,000	910	30,000
22-6	0930	67,000	640	35,000
22-6	1200	2,800	330	26,000
23-6	0925	8,400	36	1,500
23-6	1355	2,300	50	4,300
26-6	0915	15,000	1,500	7,800
26-6	1355	6,100	4,600	4,100

TABLE B-4(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 4, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
28-6	0935	1,600	12	350
4-7	0915	2,000	2	750
7-7	0935	48,000	710	19,000
12-7	0925	490,000	23,000	470,000
17-7	0920	28,000	1,900	14,000
19-7	0930	2,700	2,600	6,500
24-7	0940	210,000	31,000	190,000
25-7	0925	3,100	580	730
27-7	0945	3,100	150	620
1-8	0935	3,700	12	2,200
3-8	0945	880,000	7,100	320,000
3-8	1210	97,000	5,900	150000
4-8	0945	89,000	750	3,600
8-8	1000	15,000	1,500	53,000
9-8	0915	5,800	380	2,600
9-8	1330	1,400	310	1,900
10-8	0925	30,000	340	2,100
15-8	0915	58,000	1,700	5,700
17-8	0910	260	14	180
18-8	0920	150,000	2,600	35,000
22-8	0905	16,000	220	2,400
23-8	0925	3,400	18	840
24-8	0920	5,900	180	730
29-8	0930	1,400	2	180
31-8	0920	2,400	4	130
6-9	0915	3,000	<2	620
7-9	0925	2,800	2	1000
11-9	0925	4,800	6	190

TABLE B-4(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 4, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
2-10	0905	4,300	210	1,100
5-10	0920	2,300	190	160
11-10	0830	240	52	850
13-10	0840	1,400	46	92
16-10	0950	86	18	24
19-10	0930	770	6	140
23-10	0935	7,900	430	2,100
26-10	0910	3,300	360	970
30-10	0900	2,200	150	490
2-11	0915	50	16	10
6-11	0910	630	18	24
9-11	0910	8,600	2,100	4,500
15-11	0910	120	<2	4
20-11	0940	210	4	<2
23-11	0910	94	<2	<2

TABLE B-5(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 5, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	610	15	120
18-4	0930	230	26	110
20-4	0925	120	12	110
24-4	0930	16	2	76
26-4	0930	20	<2	4
2-5	0930	52	8	32
4-5	0930	70	6	16
9-5	0925	22	2	4
11-5	0935	130	56	--
15-5	0920	84	36	310
17-5	0925	250	100	370
17-5	1120	160	26	140
17-5	1250	120	24	65
17-5	1405	66	11	62
17-5	1520	150	10	46
23-5	0920	280	68	66
25-5	0930	380	56	130
29-5	0950	320	90	55
31-5	0925	2,000	360	2,800
1-6	0940	4,700	890	3,500
5-6	0920	660	72	390
7-6	0955	1,300	180	230
9-6	0930	7,100	310	16,000
9-6	1150	8,200	240	6,100
9-6	1410	3,200	700	4,200
12-6	0920	260	110	320
14-6	0940	3,900	1,300	2,300
19-6	0925	510	170	190
21-6	0950	6,700	1,300	8,500
21-6	1345	3,700	980	14,000
22-6	0935	58,000	2,600	28,000
22-6	1205	34,000	8,500	19,000
23-6	0930	6,000	750	1,000
23-6	1400	3,700	1,100	5,500

TABLE B-5(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 5, 1972.

Date	Time of Collection	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
26-6	0920	3,900	330	3,000
26-6	1400	1,500	950	1,700
28-6	0940	1,600	190	690
4-7	0915	630	110	370
7-7	0940	1,800	170	260
10-7	0925	1,500	250	27,000
10-7	1145	1,900	160	11,000
10-7	1425	1,300	270	2,300
12-7	0935	13,000	960	18,000
17-7	0925	3,400	180	1,200
19-7	0935	7,500	300	4,900
24-7	0945	18,000	800	2,700
25-7	0940	3,600	320	850
27-7	0950	700	110	370
1-8	0940	4,100	290	5,500
3-8	0950	1,400,000	1,000,000	73,000
3-8	1215	75,000	26,000	54,000
4-8	0950	19,000	470	1,300
8-8	1005	12,000	6,700	16,000
9-8	0920	6,600	190	1,100
9-8	1335	1,900	490	970
10-8	0930	2,000	60	1,200
15-8	0920	360	74	150
17-8	0915	360	76	270
18-8	0925	31,000	1,400	1,100
22-8	0905	470	120	250
23-8	0925	2,100	100	350
24-8	0925	29,000	180	4,200
29-8	0935	730	230	210
31-8	0925	1,400	36	110
6-9	0920	3,100	44	170
7-9	0930	1,300	44	130
11-9	0930	7,100	180	160
14-9	0910	1,000	510	750

TABLE B-5(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 5, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
18-9	0915	1,600	58	160
21-9	0905	1,600	96	120
25-9	0940	780	140	120
28-9	0930	1,300	160	210
2-10	0910	800	110	730
5-10	0925	520	130	170
11-10	0835	640	180	130
13-10	0850	830	120	86
16-10	0950	13,000	88	34
19-10	0935	340	36	48
23-10	0940	1,300	960	450
26-10	0910	1,000	70	200
30-10	0905	1,100	110	180
2-11	0920	120	34	40
6-11	0910	590	50	60
9-11	0915	2,100	160	300
15-11	0915	130	4	6
20-11	0945	340	18	10
23-11	0915	140	6	4

TABLE B-6(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 6, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	880	120	440
20-4	0910	170	20	160
24-4	0915	210	10	120
26-4	0915	65	6	35
2-5	0915	26	2	60
4-5	0910	44	<2	8
9-5	0910	18	<2	22
11-5	0915	32	<2	36
15-5	0905	22	4	70
17-5	0910	80	9	50
17-5	1100	44	10	56
17-5	1235	84	14	16
17-5	1350	70	8	44
17-5	1510	62	12	48
23-5	0905	140	30	70
25-5	0915	290	68	100
29-5	0935	520	160	160
1-6	0925	26,000	1,400	7,500
5-6	0905	1,000	150	88
7-6	0940	900	230	270
9-6	0915	6,000	90	22,000
9-6	1135	36,000	1,300	28,000
9-6	1400	15,000	1,800	8,400
12-6	0910	420	94	360
14-6	0920	1,700	80	1,500
19-6	0910	1,200	240	3,700
21-6	0930	85,000	23,000	220,000
21-6	1335	79,000	17,000	270,000
22-6	0920	41,000	2,100	21,000
22-6	1155	32,000	18,000	13,000
23-6	0915	6,900	930	2,900
23-6	1350	1,400	300	2,500
26-6	0905	3,200	120	3,100
26-6	1340	110	100	1,500

TABLE B-6(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 6, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
28-6	0920	2,000	36	500
4-7	0910	500	78	4,400
7-7	0925	120	44	2,600
10-7	0920	50,000	5,000	130,000
10-7	1130	7,800	1,800	54,000
10-7	1415	9,900	3,100	41,000
12-7	0920	29,000	8,400	32,000
17-7	0910	1,500	160	1,400
19-7	0920	14,000	1,100	19,000
24-7	0935	1,400	16	2,100
25-7	0920	2,600	72	2,100
27-7	0935	3,700	12	470
1-8	0925	450	46	1,100
3-8	0930	58,000	1,400	29,000
3-8	1200	56,000	2,500	56,000
4-8	0935	8,700	140	1,800
8-8	0950	6,500	310	30,000
9-8	0910	26,000	190	2,400
9-8	1320	940	260	1,700
10-8	0915	4,600	190	1,500
15-8	0910	350	16	270
17-8	0905	410	88	260
18-8	0915	65,000	4,100	63,000
22-8	0900	1,500	110	470
23-8	0915	430	80	1,500
24-8	0910	1,800	46	780
11-9	0920	420	<2	440
14-9	0900	2,800	200	1,800
18-9	0905	1,700	4	750
21-9	0855	1,500	8	220
25-9	0920	900	42	360
28-9	0920	2,100	34	3,300
2-10	0900	4,600	430	4,400
5-10	0905	810	76	740

TABLE B-6(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 6, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
11-10	0820	630	54	140
13-10	0825	1,000	36	180
16-10	0940	1,600	4	130
19-10	0920	380	22	78
23-10	0930	2,000	220	1,400
26-10	0905	1,200	38	310
30-10	0850	1,700	120	200
2-11	0900	60	10	44
6-11	0900	380	8	22
9-11	0900	15,000	160	1,000
15-11	0900	170	4	16
20-11	0930	490	4	6
23-11	0900	74	6	6

TABLE B-7(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 7, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	20	<4	25
20-4	0915	64	12	160
24-4	0915	130	<2	60
26-4	0920	6	<2	6
2-5	0915	30	2	26
4-5	0915	20	2	18
9-5	0910	16	<2	6
11-5	0915	40	<2	8
15-5	0910	72	52	60
17-5	0915	340	38	150
17-5	1100	230	40	120
17-5	1240	100	28	80
17-5	1355	42	12	48
17-5	1510	120	16	62
23-5	0910	96	4	28
25-5	0920	1,100	26	120
31-5	0905	8,200	980	18,000
1-6	0930	10,000	1,500	6,700
5-6	0910	150	150	350
9-6	0920	40,000	1,100	24,000
9-6	1140	3,400	140	12,000
9-6	1405	19,000	2,300	8,500
22-6	0925	40,000	1,100	12,000
22-6	1155	12,000	4,200	16,000
23-6	0915	15,000	1,900	4,900
23-6	1350	3,400	2,000	4,200
26-6	0905	7,000	500	3,900
26-6	1345	1,500	530	1,800
28-6	0925	2,000	100	870
10-7	0920	46,000	1,200	210,000
12-7	0925	110,000	2,300	97,000
17-7	0915	900	170	1,400
19-7	0925	7,500	640	3,500
24-7	0935	1,500	86	800

TABLE B-7(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 7, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
25-7	0920	3,200	140	1,400
27-7	0940	1,300	48	370
1-8	0930	930	150	1,300
3-8	0935	56,000	1,000	44,000
3-8	1205	13,000	630	21,000
4-8	0940	3,300	68	6,200
8-8	0950	12,000	320	24,000
9-8	0910	3,900	60	910
9-8	1320	690	88	750
10-8	0915	900	20	580
15-8	0910	110	8	100
17-8	0905	140	12	130
18-8	0915	11,000	310	4,500
22-8	0900	340	110	160
23-8	0920	3,400	62	2,800
24-8	0915	460	38	270
2-10	0900	4,100	150	1,600
5-10	0910	4,000	100	690
11-10	0820	620	24	100
13-10	0830	1,700	24	210
16-10	0940	1,400	10	170
19-10	0920	260	4	74
23-10	0930	980	90	600
26-10	0905	790	52	220
30-10	0855	330	10	52
2-11	0905	72	2	24
6-11	0900	270	<2	4
9-11	0900	3,200	38	710
15-11	0900	180	4	6
20-11	0935	480	2	8

TABLE B- 8(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 8, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
20-4	0915	80	<2	170
24-4	0920	6	<2	120
26-4	0920	12	<2	34
2-5	0920	16	<2	30
4-5	0915	14	<2	22
9-5	0915	36	<2	8
11-5	0920	28	<2	24
15-5	0910	120	70	48
17-5	0915	190	94	160
17-5	1100	230	80	270
17-5	1240	250	60	210
17-5	1355	94	42	75
17-5	1515	150	28	110
23-5	0910	40	22	42
25-5	0920	190	66	25
1-6	0930	1,600	250	190
5-6	0910	1,400	130	270
9-6	0920	2,400	260	8,000
9-6	1140	27,000	360	13,000
9-6	1405	1,400	160	6,200
22-6	0925	45,000	450	43,000
22-6	1155	8,100	300	31,000
23-6	0920	19,000	88	2,100
23-6	1355	1,100	110	850
26-6	0910	6,000	180	3,300
26-6	1350	1,000	260	3,400
28-6	0930	3,300	160	750
10-7	0920	2,100	160	3,000
12-7	0925	26,000	480	60,000
17-7	0915	3,000	210	2,800
19-7	0925	3,000	64	3,500
24-7	0935	1,400	24	780
25-7	0920	2,000	64	540
27-7	0940	1,300	82	610
1-8	0930	8,300	440	850

TABLE B-8(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 8, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
3-8	0935	200,000	540	73,000
3-8	1205	28,000	860	42,000
4-8	0940	11,000	130	1,600
8-8	0955	13,000	9,000	58,000
9-8	0910	22,000	320	4,500
9-8	1325	1,700	100	1,600
10-8	0920	840	110	1,000
15-8	0910	1,300	610	190
17-8	0910	360	140	350
18-8	0915	6,000	160	1,900
22-8	0900	58,000	36	88
23-8	0920	9,300	96	240
24-8	0920	3,500	170	260
29-8	0925	630	200	600
31-8	0915	470	6	58
6-9	0915	13,000	100	100
11-9	0920	7,000	160	520
2-10	0900	33,000	1,000	2,100
5-10	0910	1,700	310	1,300
11-10	0825	1,800	80	660
13-10	0835	4,400	1,200	890
16-10	0945	1,800	96	320
19-10	0925	640	92	390
23-10	0930	930	120	220
26-10	0905	1,200	190	310
30-10	0855	3,400	600	290
2-11	0910	80	22	88
6-11	0905	620	2	16
9-11	0905	5,400	90	1,300
15-11	0905	60	12	8

TABLE B-9(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 9, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	55	<4	120
20-4	0930	95	12	85
24-4	0935	2	<2	22
26-4	0935	6	<2	14
2-5	0935	26	<2	12
4-5	0935	22	2	8
9-5	0930	42	2	10
11-5	0940	180	32	100
15-5	0930	68	8	58
17-5	0925	170	14	150
17-5	1130	100	12	180
17-5	1250	210	36	150
17-5	1410	130	11	95
17-5	1525	200	26	40
23-5	0925	150	42	130
25-5	0940	1,400	190	500
29-5	0950	1,100	360	2,400
31-5	0935	21,000	4,600	34,000
1-6	0945	11,000	1.200	6,800
5-6	0925	770	76	400
7-6	1000	250	100	410
9-6	0935	6,400	300	3,300
9-6	1200	4,700	350	2,900
9-6	1415	2,900	510	2,100
12-6	0925	460	38	700
14-6	0945	7,100	630	2,000
19-6	0930	890	110	420
21-6	0950	160,000	61,000	240,000
21-6	1350	22,000	6,600	38,000
22-6	0940	19,000	1,400	5,800
22-6	1210	8,300	2,300	3,600
23-6	0930	3,100	140	800
23-6	1405	1,600	160	1,500
26-6	0920	1,900	190	2,200
26-6	1405	860	280	680

TABLE B-9(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 9, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
28-6	0945	2,900	120	540
4-7	0925	380	48	310
7-7	0930	680	250	490
10-7	0930	330,000	2,100	140,000
10-7	1155	140,000	15,000	88,000
10-7	1430	130,000	71,000	73,000
12-7	0940	63,000	10,000	25,000
17-7	0930	4,300	110	640
19-7	0945	5,200	620	2,800
24-7	0950	1,000	140	800
25-7	0940	1,800	170	410
27-7	0955	550	140	460
1-8	0945	3,400	290	1,400
3-8	0950	220,000	5,900	62,000
3-8	1220	24,000	5,000	28,000
4-8	0955	3,500	190	510
8-8	1010	2,800	900	4,400
9-8	0925	2,100	190	1,000
9-8	1340	540	310	500
10-8	0930	600	36	280
15-8	0925	340	44	120
17-8	0925	320	56	120
18-8	0930	60,000	11,000	49,000
22-8	0910	300	50	160
23-8	0930	1,200	78	390
24-8	0930	1,000	210	210
29-8	0940	300	90	130
31-8	0925	630	24	720
6-9	0925	2,800	44	340
7-9	0930	2,400	18	260
11-9	0930	7,900	220	5,000
14-9	0915	15,000	610	2,700
18-9	0920	8,900	56	130
21-9	0910	8,500	88	80

TABLE B-9(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 9, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
25-9	0945	24,000	4,600	860
28-9	0935	6,800	610	480
2-10	0915	2,100	130	1,400
5-10	0930	1,200	260	360
11-10	0835	3,000	850	280
13-10	0855	6,300	3,500	770
16-10	0955	5,100	1,600	780
19-10	0940	4,100	1,200	2,600
23-10	0945	7,900	3,800	2,000
26-10	0915	200	52	76
30-10	0910	290	10	22
2-11	0925	30	26	28
6-11	0915	30	8	14
9-11	0920	1,400	80	270
15-11	0915	50	8	<2
20-11	0950	10	2	10
23-11	0920	98	4	14

TABLE B-10(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 10, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
2-5	1010	46	2	18
4-5	1020	22	<2	16
9-5	1010	10	<2	6
11-5	1015	96	4	36
15-5	0955	310	<2	28
17-5	1010	340	16	180
17-5	1150	510	12	110
17-5	1320	1,400	8	70
17-5	1435	830	8	42
17-5	1555	960	<2	22
23-5	0955	1,700	2	22
25-5	1015	920	2	18
29-5	1030	1,700	6	60
31-5	1005	3,800	85	1,700
1-6	1030	22,000	190	4,900
5-6	1005	2,700	70	60
7-6	1030	1,300	86	14
9-6	1005	2,900	210	3,800
9-6	1225	5,200	980	4,000
9-6	1440	3,700	330	2,500
12-6	0955	1,300	50	110
14-6	1030	1,300	32	98
19-6	1005	1,900	24	230
21-6	1030	11,000	1,900	17,000
21-6	1430	7,200	170	2,500
22-6	1020	5,100	180	2,800
22-6	1245	4,900	160	1,700
23-6	1005	3,700	130	550
23-6	1440	2,300	140	270
26-6	0955	2,100	110	1,200
26-6	1430	1,600	190	990
28-6	1025	1,400	52	130
4-7	0955	1,100	44	90
7-7	1045	690	2	190

TABLE B-10(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 10, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
10-7	1000	31,000	7,600	17,000
10-7	1245	2,600	1,600	13,000
10-7	1455	2,600	660	5,700
12-7	1015	13,000	430	13,000
17-7	1000	1,800	100	580
19-7	1020	1,600	150	3,200
24-7	1020	1,900	32	2,700
25-7	1015	2,200	110	740
27-7	1025	870	80	400
1-8	1020	4,000	94	2,600
3-8	1030	150,000	11,000	19,000
3-8	1245	6,000	270	21,000
4-8	1020	2,200	12	380
8-8	1045	14,000	2,100	37,000
9-8	0955	4,600	340	2,000
9-8	1420	1,700	330	1,400
10-8	1005	6,300	70	760
15-8	0955	790	28	110
17-8	0955	410	26	76
18-8	1000	11,000	130	6,100
22-8	0940	320	34	110
23-8	1000	2,100	32	310
24-8	1005	1,200	150	200
29-8	1005	1,400	36	170
31-8	0955	450	4	210
6-9	0955	120	20	310
7-9	1000	800	52	280
11-9	1000	1,000	46	110
14-9	0945	770	94	130
18-9	0950	1,400	84	66
21-9	0945	1,100	66	170
25-9	1015	140	62	130
28-9	1010	2,000	160	56

TABLE B-10(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 10, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
2-10	0945	700	28	130
5-10	1000	590	66	18
11-10	0910	440	18	14
13-10	0925	360	52	26
16-10	1030	310	86	8
19-10	1015	180	14	10
23-10	1015	210	18	11
26-10	0955	520	20	110
30-10	0940	110	4	6
2-11	0955	140	4	2
6-11	0945	80	20	4
9-11	1000	1,600	40	110
15-11	0945	30	2	4
20-11	1025	30	2	<2
23-11	0955	80	6	6

TABLE B-11(a), Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 11, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
2-5	1015	190	8	42
4-5	1025	74	4	12
9-5	1010	22	<2	4
11-5	1015	230	30	36
15-5	0955	800	25	130
17-5	1010	540	10	520
17-5	1150	240	24	260
17-5	1320	190	18	200
17-5	1435	200	10	90
17-5	1600	260	8	85
22-6	1020	42,000	350	18,000
22-6	1250	4,500	1,400	9,000
23-6	1005	9,900	90	4,100
23-6	1440	2,100	190	2,800
26-6	1000	1,400	36	4,300
26-6	1430	800	68	790
28-6	1025	4,500	4	470
17-7	1000	7,200	68	1,200
19-7	1025	1,600	150	3,200
24-7	1025	3,200	14	1,000
25-7	1015	7,000	78	2,600
27-7	1025	950	8	150
3-8	1050	100,000	860	26,000
3-8	1250	18,000	410	20,000
4-8	1020	12,000	66	1,000
8-8	1050	6,400	1,200	28,000
9-8	1000	5,400	140	1,700
9-8	1420	1,500	210	1,800
10-8	1005	6,600	230	720
15-8	0955	480	20	130
17-8	0955	550	8	160
18-8	1000	25,000	410	2,900
22-8	0940	580	14	260
23-8	1000	4,200	40	1,500

TABLE B-11(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 11, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
24-8	1005	2,200	10	320
2-10	0950	3,700	82	11,000
5-10	1000	1,900	30	410
11-10	0910	720	16	52
13-10	0925	880	20	52
16-10	1030	2,200	98	96
19-10	1015	650	44	74
23-10	1015	1,100	98	510
26-10	0955	900	44	310
30-10	0940	900	4	32
2-11	0955	260	<2	82
6-11	0945	410	2	8
9-11	1005	1,500	50	120
15-11	0950	10	2	4
20-11	1030	90	<2	8

TABLE B-12(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 12, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
18-4	0900	490	55	250
20-4	0950	210	34	340
24-4	0945	190	12	110
26-4	0955	150	2	26
2-5	0955	58	14	48
4-5	1005	62	2	16
9-5	0950	10	2	2
11-5	1000	20	2	26
15-5	0945	28	2	18
17-5	950	180	16	130
17-5	1140	190	16	90
17-5	1305	190	4	65
17-5	1425	130	8	38
17-5	1545	160	8	38
23-5	0945	440	110	80
25-5	1000	330	76	50
29-5	1015	340	75	120
31-5	0950	6,300	1,300	900
1-6	1000	9,200	1,300'	5,700
5-6	0950	420	80	96
7-6	1020	400	180	66
9-6	0950	230,000	3,500	70,000
9-6	1210	41,000	2,200	21,000
9-6	1425	24,000	1,700	13,000
12-6	0940	400	120	430
14-6	1010	1,700	340	540
19-6	0945	930	330	500
21-6	1010	23,000	2,200	29,000
21-6	1405	2,700	1,300	9,400
22-6	1000	70,000	1,200	34,000
22-6	1230	6,900	700	9,000
23-6	945	4,100	590	2,900
23-6	1420	3,100	260	1,500
26-6	0940	4,900	40	4,300
26-6	1415	1,100	110	1,000

TABLE B-12(b). Bacteriological Densities, Water Samples Greenbelt Farm Station No. 12, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
28-6	1010	3,000	130	600
4-7	0935	1,600	100	530
7-7	1025	610	280	280
10-7	0945	13,000	660	11,000
10-7	1225	16,000	1,300	30,000
10-7	1440	3,100	860	3,800
12-7	1000	590,000	6,800	200,000
17-7	0945	9,000	70	3,400
19-7	1010	61,000	1,500	20,000
24-7	1005	1,300	150	4,700
25-7	1000	6,600	280	1,800
27-7	1015	3,600	100	460
1-8	1000	6,200	1,100	2,900
3-8	1015	740,000	3,900	140,000
3-8	1235	200,000	3,900	88,000
4-8	1010	31,000	800	1,800
8-8	1025	87,000	4,800	69,000
9-8	0940	65,000	370	8,100
9-8	1400	150,000	20,000	290,000
10-8	0950	13,000	130	3,800
15-8	0940	4,200	110	400
17-8	0940	2,300	86	680
18-8	0945	55,000	1,600	22,000
22-8	0925	1,700	110	360
23-8	0945	3,500	110	790
24-8	0945	200,000	1,500	11,000
29-8	0955	3,200	180	280
31-8	0945	4,200	39	440
6-9	0940	5,900	110	250
7-9	0945	6,800	340	230
11-9	0945	10,000	370	260
14-9	0930	19,000	510	350
18-9	0935	15,000	550	1,100
21-9	0930	19,000	470	310

TABLE B-12(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 12, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
25-9	1000	12,000	290	310
28-9	0955	8,900	350	320
2-10	0930	25,000	320	4,200
5-10	0945	13,000	130	380
11-10	0855	750	22	46
13-10	0915	490	6	22
16-10	1010	1,800	22	96
19-10	1000	690	22	56
23-10	1000	2,000	620	1,100
26-10	0945	1,000	180	210
30-10	0925	1,300	42	100
2-11	0940	26	20	44
6-11	0930	230	8	12
9-11	0935	9,000	1,200	1,200
15-11	0935	300	10	14
20-11	1010	130	6	30
23-11	0935	560	14	26

TABLE B-13(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 13, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
18-4	0900	60	<2	75
20-4	0955	390	6	300
24-4	0950	900	22	310
26-4	0955	4,200	8	220
2-5	1000	610	<2	24
4-5	1005	320	2	2
9-5	0950	78	2	4
11-5	1000	30	<2	2
15-5	0945	2	2	2
17-5	0955	8	<2	4
17-5	1140	16	<2	<2
17-5	1305	6	<2	<2
17-5	1425	4	<2	<2
17-5	1545	20	<2	<2
23-5	0945	<2	<2	<2
25-5	1000	16	<2	<2
29-5	1015	4	<2	2
31-5	0955	<2	<2	<2
1-6	1005	10	2	<2
5-6	0950	2	<2	<2
7-6	1020	<2	<2	<2
9-6	0950	480	2	12
9-6	1210	200	<2	12
9-6	1425	86	2	12
12-6	0945	<2	<2	<2
14-6	1015	<2	<2	<2
19-6	0945	<2	<2	<2
21-6	1015	<2	<2	6
21-6	1410	4	4	4
22-6	1000	1,800	2	74
22-6	1230	270	<2	260
23-6	0950	310	<2	62
23-6	1425	16	<2	310
26-6	0940	350	<2	180
26-6	1415	130	<2	30

TABLE B-13(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No 13, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
28-6	1010	90	2	16
4-7	0935	2	<2	<2
7-7	1030	<2	<2	4
10-7	0950	220	<2	130
10-7	1230	20	<2	38
10-7	1440	110	2	10
12-7	1005	5,600	44	2,500
17-7	0945	3,900	12	620
19-7	1010	9,200	24	1,200
24-7	1010	1,400	8	850
25-7	1000	6,600	12	1,700
27-7	1015	3,200	8	94
1-8	1005	200	6	16
3-8	1015	62,000	26	1,100
3-8	1235	7,100	70	970
4-8	101.0	8,600	14	280
8-8	1035	25,000	470	4,300
9-8	0945	36,000	14	480
9-8	1400	1,500	54	380
10-8	0950	29,000	12	320
15-8	0940	250	<2	120
17-8	0940	530	4	18
18-8	0945	25,000	24	730
22-8	0930	260	<2	6
23-8	0945	250	6	70
24-8	0945	350	6	34
29-8	0955	380	<2	30
31-8	0945	140	<2	8
6-9	0940	110	<2	8
7-9	0950	84	<2	6
11-9	0950	120	<2	2
14-9	0935	80	<2	<2
18-9	0940	54	2	4
21-9	0930	42	<2	<2

TABLE B-13(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 13, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
25-9	1000	44	<2	4
28-9	1000	28	2	6
2-10	0935	72,000	200	12,000
5-10	0950	1,200	66	84
11-10	0855	880	4	12
13-10	0920	630	10	14
16-10	1010	260	<2	<2
19-10	1000	110	2	42
23-10	1005	1,500	36	160
26-10	0945	230	8	24
30-10	0925	380	2	8
2-11	0940	86	<2	<2
6-11	0935	270	<2	<2
9-11	0940	2,900	70	900
15-11	0935	150	<2	<2
20-11	1010	140	<2	<2

TABLE B-14(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 14, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML, OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
18-4	0910	180	36	490
20-4	1000	240	25	280
24-4	0955	100	26	120
26-4	1000	10	2	22
2-5	1000	32	<2	38
4-5	1010	38	<2	32
9-5	0955	4	<2	4
11-5	1005	12	6	38
15-5	0950	4	4	40
17-5	0955	82	8	70
17-5	1145	56	6	70
17-5	1310	72	6	70
17-5	1430	30	10	30
17-5	1550	72	6	36
23-5	0950	88	18	58
25-5	1005	1,800	140	180
31-5	1000	5,500	1,300	17,000
1-6	1010	2,800	610	6,100
5-6	0955	250	110	170
7-6	1025	240	210	420
9-6	0955	16,000	300	14,000
9-6	1215	44,000	1,300	70,000
9-6	1430	2,400	1,200	7,400
12-6	0950	270	110	230
14-6	1015	2,500	690	710
19-6	0950	1,200	320	1,900
21-6	1020	18,000	4,800	88,000
21-6	1415	4,600	2,500	31,000
22-6	1005	18,000	630	17,000
22-6	1235	50	12	2,200
23-6	0955	2,800	310	2,900
23-6	1430	270	150	1,400
26-6	0945	1,300	56	2,000
26-6	1420	10	2	80

TABLE B-14(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 14, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
28-6	1015	1,000	20	310
4-7	0945	470	110	670
7-7	1035	120	30	320
10-7	0950	46,000	1,000	40,000
10-7	1235	8,800	780	13,000
10-7	1445	2,100	2,000	14,000
12-7	1010	15,000	680	23,000
17-7	0950	2,900	56	1,600
19-7	1015	8,600	250	4,100
24-7	1015	930	64	800
25-7	1005	3,200	88	1,700
27-7	1020	3,000	90	460
1-8	1010	250	52	1,700
3-8	1020	78,000	310	27,000
3-8	1240	19,000	710	31,000
4-8	1015	15,000	200	3,200
8-8	1035	14,000	1,900	39,000
9-8	0950	5,900	32	2,100
9-8	1405	3,000	200	1,700
10-8	0955	2,900	46	910
15-8	0945	350	20	170
17-8	0945	220	34	140
18-8	0950	66,000	1,400	31,000
22-8	0935	250	36	230
23-8	0950	2,700	82	860
24-8	0955	1,100	30	480
29-8	1000	370	58	380
31-8	0950	390	13	320
6-9	0945	130	2	150
7-9	0950	500	2	130
11-9	0955	54	8	100
14-9	0940	870	190	260
18-9	0940	360	90	190
21-9	0935	1,100	62	360

TABLE B-14(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 14, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
25-9	1005	5,000	300	5,800
28-9	1005	1,700	130	1,100
2-10	0940	3,200	200	6,400
5-10	0950	1,000	74	240
11-10	0900	520	18	.140
13-10	0920	280	8	90
16-10	1015	630	22	46
19-10	1005	500	16	110
23-10	1005	1,100	480	900
26-10	0950	350	66	220
30-10	0930	290	58	110
2-11	0945	250'	24	18
6-11	0940	150	10	20
9-11	0945	3,300	110	1,000
15-11	0940	70	8	8
20-11	1015	40	<2	6
23-11	0945	80	4	<2

TABLE B-15(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 15, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
20-4	1000	30	4	100
24-4	0955	60	8	110
26-4	1000	460	24	190
2-5	1000	480	22	110
4-5	1010	170	22	60
9-5	0955	4	<2	2
11-5	1005	2	<2	2
15-5	0950	<2	<2	<2
17-5	0955	<2	<2	<2
17-5	1145	2	<2	<2
17-5	1310	<2	<2	2
17-5	1430	<2	<2	<2
17-5	1550	2	<2	<2
22-6	1005	3,000	32	2,200
22-6	1240	3,300	630	6,600
23-6	0955	200	<2	90
23-6	1430	<2	<2	88
26-6	0945	120	<2	54
26-6	1420	480	120	1,200
28-6	1015	190	<2	18
12-7	1010	18,000	7,200	14,000
17-7	0950	1,000	22	2,300
19-7	1015	4,200	150	460
24-7	1015	1,100	4	6,100
25-7	1005	8,100	16	770
27-7	1020	3,900	18	570
1-8	1010	78	18	20
3-8	1020	75,000	28	15,000
3-8	1240	11,000	44	7,100
4-8	1015	8,900	4	1,700
8-8	1040	14,000	260	33,000
9-8	0950	8,900	18	2,600
9-8	1405	2,400	60	2,700
10-8	0955	3,600	6	1,100

TABLE B-15(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 15, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
15-8	0945	590	2	74
17-8	0945	150	6	32
18-8	0950	3,800	30	1,000
22-8	0935	54	<2	8
23-8	0950	150	4	20
24-8	0955	150	<2	10
26-10	0950	1,500	900	240.
30-10	0930	1,100	240	130
2-11	0945	310	230	22
6-11	0940	96	10	22
9-11	0945	1,100	62	220
15-11	0940	8	2	<2
20-11	1015	14	<2	4
23-11	0945	10	<2	6

TABLE B-16(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 16, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
18-4	0910	180	2	450
20-4	1000	56	6	310
24-4	0955	34	<2	120
26-4	1000	44	2	70
2-5	1005	62	2	50
4-5	1015	42	<2	20
9-5	1000	4	2	6
11-5	1005	14	<2	14
15-5	0950	40	<2	8
17-5	1000	190	22	190
17-5	1145	130	30	150
17-5	1315	200	28	70
17-5	1430	190	24	85
17-5	1550	170	26	82
23-5	0950	190	48	18
25-5	1010	240	76	56
29-5	1025	1,000	80	210
31-5	1000	3,800	400	1,200
1-6	1020	3,800	360	2,700
5-6	0955	450	110	450
7-6	1025	530	270	230
9-6	0955	40,000	3,800	80,000
9-6	1215	32,000	6,200	38,000
9-6	1430	49,000	1,800	17,000
12-6	0950	1,500	380	1,200
14-6	1020	4,200	110	1,200
19-6	0955	2,500	430	1,800
21-6	1020	25,000	2,500	42,000
21-6	1420	100,000	24,000	29,000
22-6	1010	54,000	1,000	25,000
22-6	1245	11,000	600	14,000
23-6	1000	4,200	150	2,200
23-6	1430	1,700	600	940
26-6	0945	7,100	110	4,000
26-6	1425	1,000	140	980

TABLE B-1 6 (b). Bacteriological Densities, Ities, Water Samples, Greenbelt Farm Station No. 16, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
28-6	1020	11,000	1,500	3,300
4-7	0945	8,400	930	2,000
7-7	1035	3,600	770	1,600
10-7	0955	24,000	3,300	21,000
10-7	1240	25,000	1,000	38,000
10-7	1450	4,500	2,000	13,000
12-7	1010	340,000	4,600	160,000
17-7	0955	8,700	190	3,500
19-7	1015	320,000	5,800	60,000
24-7	1015	2,200	62	2,700
25-7	1010	8,000	160	2,100
27-7	1020	3,500	140	990
1-8	1015	7,400	360	2,800
3-8	1025	740,000	180	130,000
3-8	1240	140,000	3,500	48,000
4-8	1015	11,000	130	2,500
8-8	1040	11,000	2,100	45,000
9-8	09.50	130,000	8,900	18,000
9-8	1415	23,000	4,500	17,000
10-8	1000	30,000	310	4,900
15-8	0950	2,100	150	220
17-8	0950	770	130	250
18-8	0955	190,000	1,300	42,000
22-8	0935	1,200	130	230
23-8	0955	4,900	180	1,100
24-8	1000	32,000	2,100	42,000
29-8	1000	2,600	140	410
31-8	0950	4,600	170	340
6-9	0950	6,100	240	310
7-9	0955	1,700	150	470
11-9	1000	2,400	150	460
14-9	0940	6,000	660	860
18-9	0945	6,700	510	170
21-9	0940	2,800	550	250

TABLE B-16(c). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 16, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
25-9	1010	73,000	220	5,700
28-9	1005	1,400,000	720	26,000
2-10	0940	120,000	960	13,000
5-10	0955	120,000	440	1,500
11-10	0905	12,000	44	1,500
13-10	0920	2,300	100	560
16-10	1020	8,000	220	1,000
19-10	1005	3,200	84	670
23-10	1010	100,000	18,000	28,000
26-10	0950	11,000	2,400	650
30-10	0930	4,200	240	420
2-11	0950	2,000	160	330
6-11	0940	1,400	70	140
9-11	0955	24,000	4,000	3,700
15-11	0940	150	22	36
20-11	1020	600	14	120
23-11	0945	1,000	48	76

TABLE B-17(a). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 17, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	150	<4	220
20-4	0940	85	4	220
24-4	0940	10	<2	82
26-4	0945	90	<2	30
2-5	0945	110	2	16
4-5	0950	120	2	16
9-5	0940	50	<2	18
11-5	0950	78	<2	10
15-5	0935	62	<2	10
17-5	0940	520	90	400
17-5	1135	810	190	310
17-5	1255	800	90	200
17-5	1415	390	80	200
17-5	1535	350	76	90
23-5	0935	160	<2	10
29-5	1005	44	2	2
1-6	0955	2,600	130	640
14-6	0955	600	2	54
19-6	0930	400	2	8
21-6	1000	58,000	1,200	.8,800
21-6	1355	5,300	610	5,700
22-6	0950	17,000	370	6,700
22-6	1215	2,100	750	3,700
23-6	0940	8,100	190	2,700
23-6	1415	2,500	1,300	610
26-6	0930	16,000	340	1,500
26-6	1410	3,000	280	790
28-6	0955	1,000	8	64
7-7	0955	80	2	45
10-7	0940	1,700	100	5,100
10-7	1215	6,700	2,300	14,000
10-7	1435	5,900	1,900	18,000
12-7	0950	12,000	960	3,900
17-7	0935	2,800	220	1,200

Table B-17(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 17, 1972.

Date	Time of Collection	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
19-7	0955	140,000	1,400	28,000
24-7	1000	9,000	1,200	5,100
25-7	0950	5,700	230	1,400
27-7	1005	7,800	120	950
1-8	0950	5,900	1,000	2,300
3-8	1055	97,000	4,900	100,000
3-8	1230	6,700	1,700	8,300
4-8	1000	86,000	1,900	10,000
8-8	1025	24,000	3,200	30,000
9-8	0930	9,000	510	2,600
9-8	1355	1,200	210	340
18-9	0925	6,700	280	2,700
21-9	0920	16,000	310	2,500

TABLE B-18(a). BACTERIOLOGICAL DENSITIES, WATER SAMPLES, GREENBELT FARM STATION NO. 19, 1972.

0:110	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococcus
17-4	a. m.	40	<4	5
20-4	0935	52	2	20
24-4	0935	4	<2	36
26-4	0940	84	<2	48
2-5	0940	24	4	64
4-5	0940	30	<2	48
9-5	0935	38	<2	36
11-5	0945	110	10	92
15-5	0930	14	2	190
17-5	0935	130	20	140
17-5	1135	54	10	170
17-5	1255	150	10	85
17-5	1410	70	6	1.20
17-5	1530	700	10	220
23-5	0930	290	65	160
1-6	0950	11,000	2,000	2,600
22-6	0945	13,000	680	5,300
22-6	1215	6,500	2,000	3,300
23-6	0935	6,600	1530	1,900
23-6	1410	10,000	1,800	5,700
26-6	0925	2,600	150	750
26-6	1410	900	420	490
28-6	0950	3,100	210	340
10-7	0935	67,000	3,900	38,000
17-7	0935	3,700	870	2,900
19-7	0950	37,000	900	6,300
24-7	0955	19,000	2,700	5,500
25-7	0945	5,000	270	1,200
3-8	0955	92,000	530	29,000
3-8	1255	54,000	5,600	100,000
8-8	1020	2,000	760	13,000
9-8	0930	2,700	100	1,300
9-8	1345	19,000	4,600	4,000
10-8	0935	1,300	48	660

TABLE B-18(b). Bacteriological Densities, Water Samples, Greenbelt Farm Station No. 19, 1972.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
15-8	0925	790	38	540
17-8	0925	570	100	330
18-8	0935	72,000	1,700	21,000
22-8	0915	6,800	90	430
23-8	0935	1,200	210	630
24-8	0935	2,100	140	350
2-10	0920	4,700	400	2,100
5-10	0935	1,400	230	1,100
11-10	0840	290	14	58
13-10	0900	270	32	5,200
16-10	1000	280	24	68
19-10	0945	70	2	470
23-10	0950	1,600	100	830
26-10	0920	330	52	160
30-10	0915	140	8	24
2-11	0930	150	2	28
6-11	0920	10	2	6
9-11	0925	1,000	200	500
15-11	0920	56	6	150
20-11	0955	64	<2	18

TABLE C-1 (a). Bacteriological Densities, Water Samples, Black Rapids Creek, Merivale Road, NCC Property, Station No. 20

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	380	52	900
18-4	0945	1,500	260	16,000
20-4	0855	1,300	190	2,100
20-4	1015	630	130	3,100
24-4	0905	780	200	.5,600
24-4	1010	790	83	2,800
26-4	0900	390	16	340
26-4	1045	120	12	140
2-5	0900	200	38	690
2-5	1030	390	46	1,100
4-5	0855	120	4	380
4-5	1045	260	50	280
9-5	0900	130	14	100
9-5	1025	40	14	74
11-5	0900	240	18	78
11-5	1035	380	48	58
15-5	0855	240	52	36
15-5	1015	320	6	54
17-5	0855	930	260	4,700
17-5	1050	800	190	2,900
17-5	1210	1,400	140	770
17-5	1335	490	230	800
17-5	1500	490	120	1,200
23-5	0845	60	16	30
23-5	1015	64	6	50
25-5	0855	78	8	28
25-5	1030	84	10	14
29-5	0915	220	38	88
29-5	1050	210	20	95
31-5	0850	1,700	150	510
31-5	1030	390	150	410
1-6	0910	4,300	440	1,200
1-6	1035	2,600	280	350
5-6	0850	270	10	20
5-6	1020	570	34	14

TABLE C-1 (b). Bacteriological Densities, Water Samples, Black Rapids Creek, Merivale Road, NCC Property, Station No. 20

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
7-6	0920	280	28	36
7-6	1050	180	38	14
9-6	0905	1,100	54	270
9-6	1120	500	42	140
9-6	1340	300	88	120
9-6	1455	320	98	98
12-6	0855	400	160	40
12-6	1015	790	130	40
14-6	0905	4,800	90	130
14-6	1100	1,800	240	180
19-6	0900	1,500	150	100
19-6	1025	1,100	80	160
21-6	0915	1,600	470	1,900
21-6	1050	6,100	6,000	1,900
21-6	1315	900	330	620
21-6	1450	700	600	590
22-6	0900	700,000	500,000	570,000
22-6	1140	1,200,000	1,000,000	710,000
23-6	0900	30,000	5,300	4,800
23-6	1025	27,000	2,200	23,000
23-6	1340	24,000	4,700	5,000
26-6	0855	210,000	23,000	220,000
26-6	1325	450,000	40,000	340,000
26-6	1450	430,000	50,000	280,000
28-6	0905	5,200	600	630
28-6	1045	9,000	470	600
4-7	0900	1,100	88	140
4-7	1010	1,500	54	1,700
7-7	0915	740	32	620
7-7	1105	310	16	120
10-7	0905	6,100	480	10,000
10-7	1115	540	190	620
10-7	1400	420	90	300
10-7	1510	270	92	260

TABLE C- 1(c). Bacteriological Densities, Water Samples, Black Rapids Creek, Merivale Road, N.C.C. Property, Station No. 20

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
12-7	0905	1,000,000	120,000	150,000
12-7	1035	1,800,000	130,000	610,000
17-7	0900	15,000	1,500	5,300
17-7	1015	26,000	2,100	5,300
19-7	0905	20,000	3,200	4,600
19-7	1040	63,000	8,800	6,100
24-7	0920	9,000	1,300	6,900
24-7	1045	12,000	2,700	5,600
25-7	0905	17,000	1,900	1,800
25-7	1030	14,000	1,500	1,700
27-7	0925	14,000	530	780
27-7	1040	5,000	700	590
1-8	0905	8,300	490	300
1-8	1045	6,600	620	160
3-8	0915	2,400,000	22,000	670,000
3-8	1145	520,000	160,000	190,000
3-8	1305	420,000	270,000	260,000
4-8	0920	52,000	3,000	8,200
4-8	1035	66,000	1,800	8,200
8-8	0930	62,000	2,700	59,000
8-8	1120	81,000	7,900	58,000
9-8	0855	170,000	100	82,000
9-8	1015	230,000	600	81,000
9-8	1300	160,000	10,000	53,000
9-8	1435	200,000	6,500	74,000
10-8	0900	85,000	900	29,000
10-8	1015	46,000	900	22,000
15-8	0855	3,800	890	500
15-3	1010	3,000	620	470
17-8	0850	2,800	880	320
17-8	1010	4,100	720	450
18-8	0900	24,000	2,200	1,400
18-8	1015	16,000	1,600	1,300
22-8	0845	5,300	490	180
22-8	0955	2,700	340	300

TABLE C-1(d). Bacteriological Densities, Water Samples, Black Rapids Creek, Merivale Road, NCC Property, Station No. 20.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliforms	Fecal Coliforms	Fecal Streptococci
23-8	0905	600	340	440
23-8	1015	7, 700	280	500
24-8	0900	23,000	6,400	1,300
24-8	1020	12,000	3,800	610
29-8	0900	2,500	330	72
29-8	1030	3,300	380	76
31-8	0855	2,000	60	46
31-8	1010	2,400	20	22
6-9	0900	2,000	30	38
6-9	1005	1,800	28	16
7-9	0905	14,000	30	50
7-9	1015	11,000	18	40
11-9	0905	900	20	22
11-9	1015	690	26	34
14-9	0850	7,400	30	140
14-9	1000	6,700	60	140
18-9	0850	4,300	16	58
18-9	1005	3,600	30	58
21-9	0840	1,500	14	36
21-9	1000	2,000	12	24
25-9	0905	1,700	10	32
25-9	1030	1,300	50	52
28-9	0900	2,100	8	46
28-9	1030	870	12	56
2-10	0845	83,000	12,000	20,000
2-10	1005	90,000	10,000	23,000
5-10	0855	2,900	270	290
5-10	1015	2,100	310	350
11-10	0805	1,200	220	80
11-10	0925	940	110	76
13-10	0810	540	54	26
13-10	0945	450	56	46
16-10	0930	1,900	78	52
16-10	1045	880	60	34

TABLE C-1(e). Bacteriological Densities, Water Samples, Black Rapids Creek, Merivale Road, NCC Property, Station No. 20.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
19-10	0900	1,300	94	110
19-10	1030	590	70	56
23-10	0915	1,400	390	220
23-10	1040	900	330	250
26-10	0850	5,000	390	470
26-10	1010	2,100	340	410
30-10	0840	1,600	140	140
30-10	0955	2,600	80	110
2-11	0850	230	80	110
2-11	1010	550	80	120
6-11	0845	1,000	300	260
6-11	1000	410	110	76
9-11	0845	29,000	5,000	4,600
9-11	1015	20,000	3,000	4,000
15-11	0845	1,200	70	56
15-11	1005	410	20	34
20-11	0915	1,500	60	56
20-11	1045	820	88	46

TABLE C-2(a). Bacteriological Densities, Water Samples, Black Rapids Creek, Highway 16, NCC Property, Station No. 21

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
17-4	a.m.	300	100	760
18-4	0950	290	75	1,000
20-4	0900	1,300	140	1,800
20-4	1020	940	100	1,900
24-4	0910	770	270	11,000
24-4	1015	490	220	5,100
26-4	0905	360	18	220
26-4	1050	540	50	200
2-5	0905	250	38	270
2-5	1035	200	30	230
4-5	0900	150	2	140
4-5	1050	130	26	96
9-5	0905	110	6	6
9-5	1030	66	10	16
11-5	0905	450	14	42
11-5	1040	360	38	36
15-5	0900	480	16	12
15-5	1020	220	12	12
17-5	0900	5,200	300	1,000
17-5	1050	1,300	410	1,100
17-5	1230	16,000	870	1,600
17-5	1340	2,700	220	900
17-5	1505	4,700	160	250
23-5	0855	1,100	8	16
23-5	1020	1,100	12	8
25-5	0900	1.200	16	14
25-5	1035	1,500	10	10
29-5	0925	28,000	140	28
29-5	1055	16,000	40	14
31-5	0900	41,000	2,300	5,100
31-5	1040	38,000	2,700	2,400
1-6	0915	6,900	150	150
1-6	1040	14,000	470	220
5-6	0855	190	10	14
5-6	1030	680	26	20

TABLE C-2(b). Bacteriological Densities, Water Samples, Black Rapids Creek, Highway 16, NCC Property, Station No. 21

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
7-6	0930	740	48	10
7-6	1055	610	56	2
9-6	0910	7,700	1,100	3,500
9-6	1125	10,000	270	2,100
9-6	1350	5,200	670	900
9-6	1500	5,700	330	690
12-6	0900	520	72	12
12-6	1020	630	78	6
14-6	0910	1,100	84	6
14-6	1105	620	92	18
19-6	0905	1,000	50	34
19-6	1030	340	10	30
21-6	0920	2,400	190	1,100
21-6	1055	7,900	7,300	4,100
21-6	1325	2,400	450	800
21-6	1455	2,500	670	1,100
22-6	0905	37,000	2,600	4,200
22-6	1145	600,000	450,000	180,000
23-6	0905	34,000	3,900	5,600
23-6	1030	36,000	6,700	4,100
23-6	1345	19,000	3,500	1,400
26-6	0900	4,400	380	2,000
26-6	1325	240,000	45,000	200,000
26-6	1455	250,000	50,000	180,000
28-6	0910	3,600	770	280
28-6	1050	6,000	1,200	370
4-7	0905	2,600	520	230
4-7	1015	5,400	380	580
7-7	0920	4,500	660	280
7-7	1110	3,100	270	190
10-7	0910	5,700	80	430
10-7	1120	1,000	180	3,700
10-7	1405	3,100	100	1,200
10-7	1515	2,000	680	930

TABLE C-2(c). Bacteriological Densities, Water Samples, Black Rapids Creek, Highway 16, N.C.C. Property, Station No. 21, 1972

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
12-7	0910	32,000	12,000	8,400
12-7	1040	56,000	5,000	27,000
17-7	0905	18,000	1,800	6,000
17-7	1025	18,000	2,100	3,800
19-7	0855	26,000	1,300	6,100
19-7	1045	26,000	2,400	3,300
24-7	0925	10,000	1,000	7,100
24-7	1050	21,000	3,000	6,300
25-7	0910	23,000	4,200	1,700
25-7	1035	13,000	2,000	2,000
27-7	0930	5,700	350	470
27-7	1045	4,200	700	540
1-8	0915	7,400	300	220
1-8	1050	9,000	630	270
3-8	0925	260,000	58,000	390,000
3-8	1150	2,900,000	1,000,000	390,000
3-8	1320	930,000	330,000	190,000
4-8	0925	43,000	1,200	7,100
4-8	1040	49,000	3,300	8,100
8-8	0940	48,000	2,600	74,000
8-8	1120	170,000	130,000	76,000
9-8	0900	340,000	500	180,000
9-8	1020	240,000	8,000	67,000
9-8	1310	200,000	10,000	55,000
9-8	1440	170,000	4,000	62,000
10-8	0905	110,000	600	37,000
10-8	1020	75,000	500	21,000
15-8	0855	3,800	890	500
15-8	0905	3,400	360	260
17-8	0855	4,900	1,700	200
17-8	1020	3,200	690	270
18-8	0905	11,000	810	1,200
18-8	1020	16,000	1,200	3,200
22-8	0850	2,200	230	250
22-8	1000	870	250	210

TABLE C-2(d). Bacteriological Densities, Water Samples, Black Rapids Creek, Highway 16, NCC Property, Station No. 21

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
23-8	0910	2,900	110	420
23-8	1020	7,300	500	2,200
24-8	0905	45,000	16,000	2,500
24-8	1025	37,000	14,000	1,900
29-8	0905	3,200	340	710
29-8	1030	3,200	170	640
31-8	0900	1,700	120	690
31-8	1015	2,800	72	670
6-9	0905	3,800	140	1,000
6-9	1010	3,100	180	750
7-9	0910	6,100	280	710
7-9	1020	3,700	140	410
11-9	0910	950	200	620
11-9	1020	690	130	410
14-9	0855	1,100	80	530
14-9	1005	22,000	130	410
18-9	0855	51,000	92	530
18-9	1010	43,000	70	590
21-9	0845	29,000	170	390
21-9	1005	14,000	110	300
25-9	0910	14,000	92	140
25-9	1035	17,000	76	150
28-9	0910	4,600	290	630
28-9	1035	2,000	270	520
2-10	0850	130,000	7,700	28,000
2-10	1010	180,000	16,000	29,000
5-10	0900	1,700	570	140
5-10	1020	1,500	570	160
11-10	0810	580	110	26
11-10	0930	570	50	26
13-10	0820	420	36	38
13-10	0950	230	68	22
16-10	0935	1,500	46	32
16-10	1050	420	54	20

TABLE C-2(e). Bacteriological Densities, Water Samples, Black Rapids Creek, Highway 16, NCC Property, Station No. 21.

Date	Time of Collection (Hours)	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
19-10	0910	550	110	30
19-10	1035	500	54	34
23-10	0920	27,000	8,900	880
23-10	1045	25,000	7,500	810
26-10	0855	8,400	1,100	460
26-10	1015	5,400	780	620
30-10	0845	36,000	1,200	190
30-10	1000	30,000	1,400	160
2-11	0855	27,000	2,100	110
2-11	1015	20,000	2,700	200
6-11	0855	900	220	360
6-11	1005	740	200	190
9-11	0850	18,000	2,000	7,000
9-11	1020	12,000	1,000	2,800
15-11	0845	1,200	70	56
15-11	1010	550	40	36
20-11	0925	1,800	60	62
20-11	1050	1,300	80	62

TABLE D-1(a). Bacteriological Densities, Water Samples, Black Rapids Creek, NCC Stations, 1972.

Station	Date	MF COUNT PER 100 ML. OF SAMPLE		
		Coliform	Fecal Coliform	Fecal Streptococci
BR-1	7-6	26,000	40	56
(ARI	13-6	1,000	30	300
No.2)	20-6	3,600	160	1,100
	28-6	1,000	110	410
	5-7	1,200	270	630
	19-7	36,000	2,200	17,000
	9-9	960	120	100
	26-9	15,000	100	480
	11-10	2,900	270	90
	23-10	4,800	660	1,200
	9-11	5,400	2,000	820
BR-2	7-6	350	40	12
(ARI	13-6	1,100	170	78
No.20)	20-6	1,600	20	32
	28-6	1,600	250	430
	5-7	900	160	200
	19-7	53,000	5,200	21,000
	9-9	5,400	130	82
	26-9	60,000	170	2,100
	11-10	740	180	100
	23-10	33,000	19,000	4,900
	9-11	12,000	3,100	3,100
BR-3	7-6	200	12	26
	13-6	14,000	50	130
	20-6	2,500	210	260
	28-6	3,100	350	640
	5-7	4,000	100	170
	19-7	24,000	2,200	12,000
	9-9	6,200	40	44
	26-9	10,000	200	1,100
	11-10	830	150	56
	23-10	2,200	290	310
	9-11	7,000	3,200	1,600

TABLE D-1(b). Bacteriological Densities, Water Samples, Black Rapids Creek, NCC Stations, 1972.

Station		Date	MF COUNT PER 100 ML. OF SAMPLE		
			Coliform	Fecal Coliform	Fecal Streptococci
BR-4		7-6	2,000,000	4,800	13,000
		13-6	5,400	10	20
		20-6	810	4	26
		28-6	2,700	630	170
		5-7	2,700	46	60
		19-7	24,000	2,200	8,300
		9-9	1,200	80	46
	*	18-9	60	<2	4
	*	19-9	280	12	30
		26-9	170,000	8,300	39,000
		11-10	660	42	18
		23-10	31,000	3,200	690
	*	31-10	50	2	<2
	*	9-11	1,200	110	4,600
		9-11	680	140	5,600
BR-5		7-6	8,900	180	120
		13-6	7,600	70	130
		20-6	2,800	110	220
		28-6	3,000	250	580
		5-7	3,900	100	250
		19-7	31,000	3,500	6,300
		9-9	1,900	200	94
		26-9	11,000	1,000	4,100
		11-10	1,000	160	60
		23-10	8,200	500	730
		9-11	13,000	3,100	4,400
BR-6		7-6	1,200	30	14
(ARI		13-6	560	44	10
No.21)		20-6	1,000	86	130
		28-6	3,500	210	280
		5-7	3,000	460	140
		19-7	13,000	4,000	9,200
	*	24-8	10,000	3,500	670
		26-9	2,600	500	3,000
		11-10	170	130	34
		23-10	27,000	3,700	1,200
		9-11	6,900	3,800	3,400

* Samples collected by Mr. L.B Killoran, EPS.

TABLE E-1. Classification Of Fecal Coliform Isolates From Liquid Manure, A.R.I. Greenbelt Farm Study, 1972, By Sampling Date

ISOLATE CLASSIFICATION BY IMViC REACTIONS AND E.C. (44.5°C.) POSITIVITY

Date	Specimens		Escherichia				Other	Totals
		IMViC	++--	++--	-+--	-+--	--++	
		E.C.	+	-	+	-	+	
23-5	Cattle (6)		159	14	1			174
31-5	Cattle (4)		105	2				107
9-6	Sheep (5)		115	1		2		118
13-6	Sheep (4)		98	1	1			100
17-7	Poultry (2)		48		9			57
18-7	Cattle (6)		112	4	2		1	119
19-7	Cattle (2)		31					31
20-7	Cattle (2)		28					28
All	All (31) Specimens		696 94.8%	22	13	2	1	734

TABLE F-1 (a). Classification Of Fecal Coliform Isolates From Water Samples, A.r.i. Greenbelt Farm Study, By Station

		ISOLATE CLASSIFICATION BY IMViC REACTIONS AND E.C. (44.5°C.) POSITIVITY							
				Escherichia			Other Coliforms		
Station	IMViC	++--	++--	+---	-+--	--++	--++	+-++	Totals
Number	E.C.	+	-	+	+	+	-	+	
Input to A.D.R.I. Property									
17		43			2			1	46
19		79							79
Total		122	0	0	2	0	0	1	125
Input to A.R.I. Property (from A.D.R.I. and N.C.C. Land)									
6		106	3			1			110
7		104	1	1					106
8		137					1		138
9		138			1				139
Total		485	4	1	1	1	1	0	493

TABLE F-1 (b). Classification Of Fecal Coliform Isolates From Water Samples, A.R.I. Greenbelt Farm Study, 1972, By Station

	ISOLATE CLASSIFICATION BY IMViC REACTIONS AND E.C. (44.5°C.) POSITIVITY									
	Escherichia					Other Coliforms				
Station Number	IMViC ++-- +	++-- -	+--- +	+--- -	-+-- +	-+-+ +	-+-+ -	--++ +	--++ -	Totals
Internal A.R.I. Stations (drain to Black Rapids Creek system)										
12	123						1	1		125
13	16				1			1	1	19
14	86	1			2					89
15	12		1		1					14
16	108	3						1	1	113
Total	345	4	1	0	4	0	1	3	2	360
A.R.I. Output to Black Rapids Creek system										
2	220	2	4	1		1		1	4	233
3	158	1			3			1	3	166
Total	378	3	4	1	3	1	0	2	7	399

TABLE F-1 (c). Classification Of Fecal Coliform Isolates From Water Samples, A.R.I. Greenbelt Farm Study, 1972, By Station

ISOLATE CLASSIFICATION BY IMVIC REACTIONS AND E.C. (44.5°C.) POSITIVITY

Station Number	IMViC / E.C.	Escherichia				Other Coliforms			Totals
	IMViC	++--	++--	+---	-+--	++-+	--++	--++	
	E.C.	+	-	+	+	+	+	-	
A.R.I. Output to Baker Creek system									
4		83	2	1					86
5		152	3		3		1	1	160
10		144	1						115
11		69							69
Total		418	6	1	3	0	1	1	430
Black Rapids Creek (Merivale Road and Highway 16)									
20		231	4		3	1		2	241
21		259	3		4			1	267
Total		490	7	0	7	1	0	3	508

TABLE F-2. Classification Of Fecal Coliform Isolates From Water Samples, A.R.I. Greenbelt Farm Study, 1972, All Stations, By Sampling Date

	ISOLATE CLASSIFICATION BY IMViC REACTIONS AND E.C. (44.5°C.) POSITIVITY											
Date	Escherichia					Other Coliforms						Totals
IMViC	++--	++--	+---	+---	-+--	-+-+	-+-+	++-+	--++	--++	+-++	
E.C.	+	-	+	-	+	+	-	+	+	-	+	
15-5	406				2							408
17-5	99.5%											
12-6	292	3						1	2			298
	98.0%											
26-6	447	4	2	1	5		1		1	1	1	463
	96.5%											
22-8	315	10	3		7	1			2	11		349
	90.3%											
11-9	308	6										314
	98.1%											
23-10	470	1	2		6				2	2		483
	97.3%											
All Dates	2238	24	7	1	20	1	1	1	7	14	1	2315
	96.7%											

TABLE F-3. Classification Of 26 Non-escherichia Fecal Coliform Isolates, Water And Manure Samples, ARI, Greenbelt Farm Study, 1972.

Source (Sta.)	Date	Iso. No.	IMVC	EC 44.5°	Motility		H_2S T.S.I.	Ornithine	Lysine	Urea	Dulcitol	ONPG	Genus	Quellung (Pool Sera)
					35°	22°								
12	12-6	995	--++	+	-	-	-	-	+	+	-	+	Klebsiella	12
16	12-6	1,021	--++	+	-	-	-	-	+	+	-	+	“	None
20	12-6	1,045	++-+	+	+	+	-	+	-	+	+	+	Citrobacter	
2	26-6	1,250	--++	+	-	-	-	-	+	+	+	+	Klebsiella	12
12	26-6	1,488	-+-+	-(-)	-	-	-	-	+	+	-	+	“	17
16	26-6	1,552	--++	-(-)	-	-	-	-	+	+	-	+	“	None
17	26-6	1,587	+-++	+	+	+	-	+	+	-	+	+	Enterobacter	
Manure	19-7	1,763	--++	+	-	-	-	-	+	+	+	+	Klebsiella	None
2	18-8	1,919	--++	-(+)	-	-	-	-	+	+	+	+	“	11
2	18-8	1,921	--++	-(-)	-	-	-	-	+	+	-	+	“	None
2	18-8	1,932	-+-+	+	-	-	-	-	+	+	-	+	“	6
2	18-8	1,935	--++	-(+)	-	-	-	-	+	+	-	+	“	None
2	18-8	1,937	--++		-	-	-		+		-	+	“	None
3	18-8	1,959	--++	-(-)	-	-	-	-	+	+	+	+	‘	None
3	18-8	1,970	--++	-(-)	-	-	-	-	+	+	-	+	“	None
5	18-8	2,005	--++	-(+)	-	-	-	-	+	+	-	+	“	15
5	18-8	2,008	--++	+	-	-	-	-	+	+	-	+	“	None
6	18-8	2,016	--++	+	-	-	-	-	+	+	-	+	“	None
8	18-8	2,051	--++	-(+)	-	-	-	-	+	+	-	+	“	None
20	18-8	2,178	--++	-(-)	-	-	-	-	+	+	-	+	“	None
20	18-8	2,202	--++	-(+)	-	-	-	-	+	+	+	+	“	None
21	22-8	2,237	--++	-(-)	-	-	-	-	+,	+	-	+	“	None
3	23-10	2,641	--++	-(-)	-	-	-	-	+	+	-	+	“	None
3	23-10	2,657	--++	+	-	-	-	-	+	+	-	+	‘	None
13	23-10	2,982	--++	-(-)	-	-	-	-	+	+	+	+	“	None
13	23-10	2,988	–++	+	-	-	-	-	+	+	+	+	“	None