FINAL REPORT OF RESEARCH PROJECT

Sewage Treatment Systems at Freeway Rest Areas

Research Agency

Department of Crop & Soil Sciences

and

Department of Civil and Sanitary Engineering

Michigan State University

East Lansing, Michigan 48824

Principal Investigators:

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ACKNOWLEDGEMENTS

The cooperation of numerous individuals within the Michigan Department of Transportation was needed during the course of this project. Specifically, the authors would like to acknowledge the cooperation and suggestion of Jack E. Burton, Supervisor of Roadside Development; Jay W. Bastian, Assistant Supervisor of Roadside Development; Ross Wolfe, Supervisor of Roadside Operations; James Knight, Design Engineer; Louis Cook, Soils Engineer; and numerous other rest area and maintenance personnel who were always available to help.

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INTRODUCTION

The Michigan Department of Transportation is in an accelerated program for the construction of modern toilet facilities both in new rest areas and in modernizing existing vault type facilities. Because of the wide range of soil conditions found throughout the state and the variable requirements of local health authorities, problems exist in finding acceptable methods of sewage treatment.

In the past, soil absorption systems, such as septic tanks and tile fields, have been used where the soils are light and porous. Lagoon systems with surface water discharge have been used when the soils encountered were heavy and non-porous.

All rest area sewage treatment systems, and especially lagoon systems, because of the large amount of earth moving necessary in constructing lagoons, are becoming increasingly more expensive to construct. There is a need of finding less expensive ways of treating rest area sewage.

In addition, the new State and Federal Regulations regarding discharge of treated wastewaters is requiring increasingly higher quality effluents from the sewage treatment systems at freeway rest areas. Many of the systems that are approved today will probably not meet the requirements of the National Pollution Discharge Elimination Standards and will require further modification.

Systems that will give a polishing treatment and dispose of the partially treated wastes from rest areas are needed. The unique features of rest areas and their wastes make land treatment systems a very viable alternative for final treatment and disposal. Spray irrigation, slow or rapid infiltration, overland flow, and the barriered landscape water renovation systems are all possibilities for land treatment depending on the soil and site characteristics. The fact that the rest area waste will peak in summer and during certain days of the week is an advantage for land treatment systems.

Several of the land treatment systems are best operated using spray application of the wastewater to insure more uniform distribution of the wastewater while maintaining aerobic conditions in the soil. This raises concern for the potential of disease transmission from the spray aerosols. It was felt that certain system modifications could reduce the hazard to a negligible value and thus enable spray irrigation of wastewater at highway rest areas.

Previous studies (2) involving Michigan State University and the Michigan Department of State Highways & Transportation measured the amount and composition of sewage produced at Michigan Rest Areas as a function of highway traffic and rest area use under summer conditions. The efficiencies of both septic tank and lagoon systems in rest areas operated by the Michigan Department of Transportation have been evaluated. The environmental impact of the seasonal or continuous release of lagoon influent in receiving streams has been studied. Also studied was the groundwater adjacent to lagoon effluent seepage beds and septic tanks drain fields or seepage pits. These studies have produced data for the identification of problem areas and data for the design of new and modified systems. One such system which was developed and studied under the previous research project was an overland flow system constructed in the highway median to polish and dispose of septic tank treated sewage during the summer season.

To continue these studies and meet the other needs, a new project was developed by Michigan State University with the following objectives:

1. To determine the effectiveness of rest area sewage treatment systems now operating in Michigan.
2. To assess the potential for land disposal of the effluent as a method of polishing to meet future water pollution control regulations.
3. To field test the effect of land treatment systems on the quality of the effluent.
4. To develop and field test a spray system for applying wastewater from highway rest areas to median strips.

5. To determine the cost of effective treatment by each of three alternative techniques:

   a. land disposal of existing effluents;

   b. design alterations in conjunction with land treatment;

   c. design changes without land treatment.

6. To make site specific recommendations for upgrading of existing and new rest area sanitary systems.

This project was supported by the Michigan Department of Transportation and the Federal Highway Administration. It was funded on May 23, 1977 for three years.

The report consists of two parts. Part I is entitled "An Evaluation of Land Treatment Systems at Freeway Rest Areas" and Part II is entitled "Wastewater Spray Aerosols".

PART I

AN EVALUATION OF LAND TREATMENT SYSTEMS AT FREEWAY REST AREAS

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INTRODUCTION

This report is of studies made from 1977 to 1980 at four freeway rest areas in Michigan. These rest areas were selected for study because they had different soil and site conditions which required different types of land treatment to polish the partially treated lagoon effluents. The Clare Rest Area and Travel Information Center had an Overland Flow-System which was oversized so that most of the wastewater infiltrated or evapotranspired. At the Coldwater Rest Area and Travel Information Center, a Barried Landscape Water Renovation System was constructed on the course textured soil with shallow water table. At the Dundee Rest Area and Travel Information Center, seepage beds were used to spread and slowly infiltrate the wastewater into a fine textured soil with shallow water table. At the Watervliet Rest Area lagoon effluent was studied as it passed through a half-mile long sewer or ditch to evaluate possible land treatment in a broad vegetated ditch.

MATERIALS AND METHODS

SAMPLING PROCEDURES

All routine wastewater and surface water samples have been collected as random grab samples. Samples were collected in duplicate polyethylene bottles, one of which contained 2ml concentrated HCl or H_2SO_4 per liter of sample. Additionally, a sterilized glass bottle containing sodium thiosulfate was used to collect a sample for microbial analysis. Samples were stored at 4^oC and analyzed on the same day or as soon as possible to minimize further biological activity.

Sampling sites were preselected in an attempt to assess the efficiency of wastewater treatment as well as impact of the effluent on receiving streams. A description of the sampling sites is included in the rest area description section.

Proportioning pumps (Horizon Ecology Co.) were used to monitor the Coldwater Rest Area when the system was discharging effluent into the receiving stream. They were set to collect a one 1 ounce (30 ml) sample every fifteen minutes on a 24 hour basis.

Wells were established to monitor groundwater quality as related to wastewater treatment at several rest areas. These were drilled during high water table seasons, and the top of the 4 ft (1.2 m) long PVC screen was placed approximately one-half foot above the top of the water table. All wells were in the 5 to 28 ft (1.5-8.5 m) range.

Samples were obtained from these wells by lowering a sterilized glass test tube into the well. Slow submergence and filling of the test tube assured that the sample represented only the surface of the groundwater. The test tube was retrieved, stoppered aseptically and refrigerated. These samples were analyzed for nitrate concentration and microbial composition.

Soil samples were taken within a 3 in. (7.6 cm) bucket auger using 20 subsamples in a composite for analysis.

CHEMICAL ANALYSES

The chemical analyses were performed by standard methods (7 & 8) or with modification of these as follows:

Wastewater pH

Reagents: 1. Standard buffer solution of pH 4.01, 7.00 and 10.00.

Procedure: Read directly with a glass combination electrode and a pH meter (a Leeds-Northrup 7401 was used).

Soil pH

Procedure: Place 10 grams of soil in a 50 ml plastic beaker and add 10 ml of distilled water. Stir intermittently for 20 minutes and read as above.

Temperature (T°C)

Procedure: The YSI meter and probe were calibrated and used in accordance with manufacturers' guidelines.

Biological Oxygen Demand (BOD)

Procedure: The procedure outlined by EPA (7) and *Standard Methods* (10) was used.

Chemical Oxygen Demand (COD)

Procedure: The procedure outlined by EPA (1) and *Standard Methods* (10) was used.

Total Organic Carbon (TOC)

Procedure: A Dohrmann Envirotech DC-50 was used in accordance with manufacturers' specifications.

Suspended Solids

Procedure: The procedure outlined by EPA (7) was used (residue, total non-filterable).

Total Phosphorus (tPO_4)

Reagents:

1. Concentrated perchloric acid ($HClO_4$)
2. Concentrated nitric acid (HNO_3)
3. 2, 4-dinitrophenol indicator. Dissolve 0.25g in 100 ml of deionized water.
4. NaOH 1.0 N
5. HCl 1.0 N

Procedure: Pipet 25 ml of sample into a 100 ml digestion flask. Add 5 ml of concentrated HNO_3 followed by 0.5 ml of concentrated $HClO_4$. Heat gently until water has boiled off. Increase temperature to reflux HNO_3. Boil until white perchlorate fumes appear. Cool. Dilute to approximately 50 ml in the digestion flask. Add 2 drops of indicator and titrate with 1.0 N NaOH and 1.0 N HCl to the faintest discernible yellow. Quantitatively transfer to a 250 ml volumetric and dilute to volume. Analyze as inorganic phosphorus below.

<u>Inorganic Phosphorus (i-PO_4)</u>

Reagents:

1. Sulfuric acid, 4.9 N

   136 ml concentrated H_2SO_4 per liter

2. Ammonium Molydate, $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$

   40 grams per liter

3. Ascorbic acid

   18 grams per liter

4. Antimony Potassium Tartrate, $K(SbO)C_4H_4O_6 \cdot 1/2H_2O$

   3 grams per liter

5. Combined working reagent

a.	Sulfuric acid	50 ml
b.	Ammonium molybdate	15 ml
c.	Ascorbic acid	30 ml
d.	Antimony Potassium Tartrate	5 ml

   Stable about eight hours.

Procedure: Analyze on an autoanalyzer at 880 mm

<u>Extractable Phosphorus on Soils</u>

Reagents:

1. Brays P 1. Add 15 ml of 1.0 N NH_4 and 25 ml of 0.5 HCl to water and dilute to 500 ml solution.

2. Ammonium molybdate - HCl - H_3BO_3 solution. Disolve G $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$ in 850 ml water, filter and cool. Add 1700 mls concentrated HCl to 160 mls water, cool. Mix the two solutions and add g boric acid.

3. Reducing agent mixture. Mix 10 g 1-amino-2-naphthol-4-sulfonic acid with 20 g sodium sulfite and 584 g sodium metabisulfite. Grind fine powder with mortar & pestle.

4. Reducing solution. Dissolve 3.2 g of reagent 3 in 100 mls of warm water. Cool.

Procedure: Weigh 5 g of soil into a 125 ml Erlenmeyer flask and add 20 mls of reagent 1. Shake on a rotary shaker for one minute at 200 rpm and filter through Whatman No. 2 or 42 filter paper. Analyze on an autoanalyzer at 880 mm.

Total Kjeldahl Nitrogen (TKN) on Wastewater

Reagents:

1. Sulfuric acid (H_2SO_4), concentrated.
2. Sodium Hydroxide (NaOH), approximately 10 N. Dissolve 420 g of NaOH. Cool and allow to stand several days to settle out Na_2CO_3. Dilute supernatant to 1 l.
3. Potassium sulfate-catalyst mixture. Mix 100 g of K_2SO_4, 10 g $CuSO_4 \cdot 5H_2O$ and 1 g of selenium in a mortar and pestle.

Procedure: Pipet 10 ml of sample into a micro Kjeldahl flask, add 1.1 g of catalyst and 4 ml of H_2SO_4. Heat gently to remove water, then increase heat to give refluxing of H_2SO_4. Reflux for 2 hours after the solution clears. Cool and add 10 ml water. Analyze as NH_3 below.

Total Kjeldahl Nitrogen on Soils

Reagents: As above.

Procedure: Weigh 1 g of soil into a micro Kjeldahl flask, add 10 ml of water and proceed as for wastewater.

Ammonia (NH_3) in Wastewater; High Level (<5 mg/l)

Reagents:

1. Sodium Hydroxide, 0.1 N
2. Boric Acid. Dissolve 16 g of H_3BO_3 in water and dilute to one liter.
3. Methyl purple indicator solution
4. Pipet 10 ml of sample into a micro Kjeldahl flask. Attach to a steam distillation apparatus and add 10 mls of 0.1 N NaOH (10 N NaOH for TIN). Steam distill the NH_3 into a 5 ml boric acid aliquot to which 2 drops of indicator have been added. Titrate to end point with sulfuric acid.

Ammonia in Wastewater; Low Level (0-10 mg/l)

Reagents:

1. Alkaline Phenol. Dissolve 200 g of NaOH in water. Cool and slowly add 276 ml liquified phenol (88%), cooling and stirring constantly. Dilute to one liter and store in a dark container. Add Brij-35 per liter.
2. Sodium Hypochlorite. Any good household bleach may be used (5.25% available chlorine).
3. Potassium Sodium Tartrate. Dissolve 150 g of $KNaC_4H_4O_6 \cdot 4H_2O$ in deionized water the dilute to one liter. Add 0.5 ml Brij-35 per liter.

Procedure: Analyze on an autoanalyzer at 630 mm.

Extractable Ammonium on Soils

Reagents:

1. Potassium Cloride, 2N. Dissolve 149.2 g KCl in water and dilute to one liter.

Procedure: Weight 10 g of soil into a 125 ml Erlenmeyer flask, add 10 ml of 2 N KCl. Shake for 2 hours on a rotary shaker at 200 rpm.

Filter through Whatman No. 42 filter paper. Analyze on the autoanalyzer at 630 mm.

Nitrate (NO_3) on Wastewater

Reagents: 1. Ammonium Chloride. Dissolve 10 g of NJ4Cl in alkaline water and dilute to one liter. Add 0.5 ml Brij-35.

2. Color Reagent. To approximately 150 ml deionized water add 20 ml concentrted phosphoric acid (H_3PO_4) and 2 g sulfanilanide ($C_6H_8N_2O_2S$). Dissolve with heat if necessary. Add 0.2 g N-1-naphtylethylene-diamine dihydrochloride and dissolve. Dilute to 200 ml and add 1.0 ml Brij-25.

Procedure: Analyze as nitrite on an autoanalyzer at 520 mm.

Nitrate on Soils

Reagents: 1. Saturated calcium sulfate ($CaSO_4$). Add slightly more than 2 g $CaSO_4$ per liter of water, shake thoroughly and allow to equilibrate over night.

Procedure: Weigh 10 g of soil into a 125 ml Erlenmeyer flask and add 10 ml of saturated $CaSO_4$. Shake for 30 minutes on a rotary shaker at 200 rpm. Filter with Whatman No. 42 filter paper. Analyze as nitrate in wastewater.

Nitrite (NO_2) in Wastewater

Procedure: Analyze as for nitrate.

Nitrite on Soils

Reagents: 1. Saturated calcium sulfate (see nitrite in soils).

Procedure: Extract and analyze as for nitrite in soils.

MICROBIAL ANALYSES

Total Coliforms

The coliform tests were run according to the procedures given in Standard Methods for the Examination of Water and Wastewater, (10) using the multiple-tube dilution technique with lauryl tryptose broth. Suitable dilutions of the samples were prepared and three portions in each of a decimal series of dilutions were inoculated into the broth. Tubes were incubated at 35° ± 0.5°C for 48 ± 3 hours. Most probable number (MPN) indices were calculated and reported for these presumptive test results.

Fecal Coliforms

Transfers were made from all the tubes in the total coliform test that were positive in 24 hours into E C Medium by using a sterile loop of at least 3-mm diameter. The tubes were incubated in a water bath controlled to 44.5° ± 0.2°C for 24 ± 2 hours. Fecal coliform densities were determined by the Most Probable Number Method (MPN).

Total Streptococci

The Streptococcal tests were run according to the procedures given in Standard Methods (10) using the multiple-tube dilution technique with azide dextrose broth. Suitable dilutions of the samples were prepared and three portions in each decimal series of dilution were inoculated into the broth. Tubes were incubated at 35° ± 0.5°C for 48 ± 3 hours. Most Probable Number (MPN) indices were calculated and reported for these presumptive test results.

Fecal Streptococci

Transfers were made from all positive tubes in the total streptococci test into ethyl violet ozide broth using a sterile loop of at least 3-mm diameter. The tubes were incubated at 35° ± 0.5°C for 25 ± 2 hours. Fecal Streptococci densities were reported as Most Probable Number (MPN).

REST AREA AND SAMPLING SITE DESCRIPTION

Clare:

The John C. Mackie Rest Area and Travel Information Center at Clare serves both the north and southbound lanes of US-27 and US-10.

The former sewage treatment system consists of a two lagoon arrangement designed for parallel operation. Each lagoon overflows directly into a sand filter bed which is underlaid by a collecting tile field. This tile field drains into a spring-fed stream and then into a county drain which drains into a chain of lakes and has been in operation since 1966.

Samples 1 and 2 were obtained from the south and north lagoons, respectively. Sample 3 was collected directly from the tile outfall from the drainage field, while 3a was collected approximately 10 feet (3 m) downstream from sample 3. Sample 4 was collected from the spring-fed stream just before it entered the county drain. Sample 5 represented the county drain as it left the rest area while sample 6 represented the county drain as it entered the rest area.

Samples 7 and 8 represented two branches of the county drain prior to addition of rest area effluent. Both were upstream from sampling site 6. Site 7 was obtained from a continuously flowing ditch within the freeway median and approximately 500 feet (150 m) north of sampling site 6. Sample 8 was obtained from the western end of the intermittently flowing culvert which passes beneath the south-bound lane.

In the summer of 1977 the overflow from the lagoons onto the sand-filter was stopped. Sewage was directed into the first lagoon which when full overflows into the second lagoon. An Overland Flow-Evapotranspiration System (OF-ET) was constructed on a four acre area directly north of the lagoons. (Figure 1)

A 23,000 gal. (87 cu m) chlorination tank is located at the highest point in the NW corner of the site. The OF-ET area is surrounded by an earth dike which

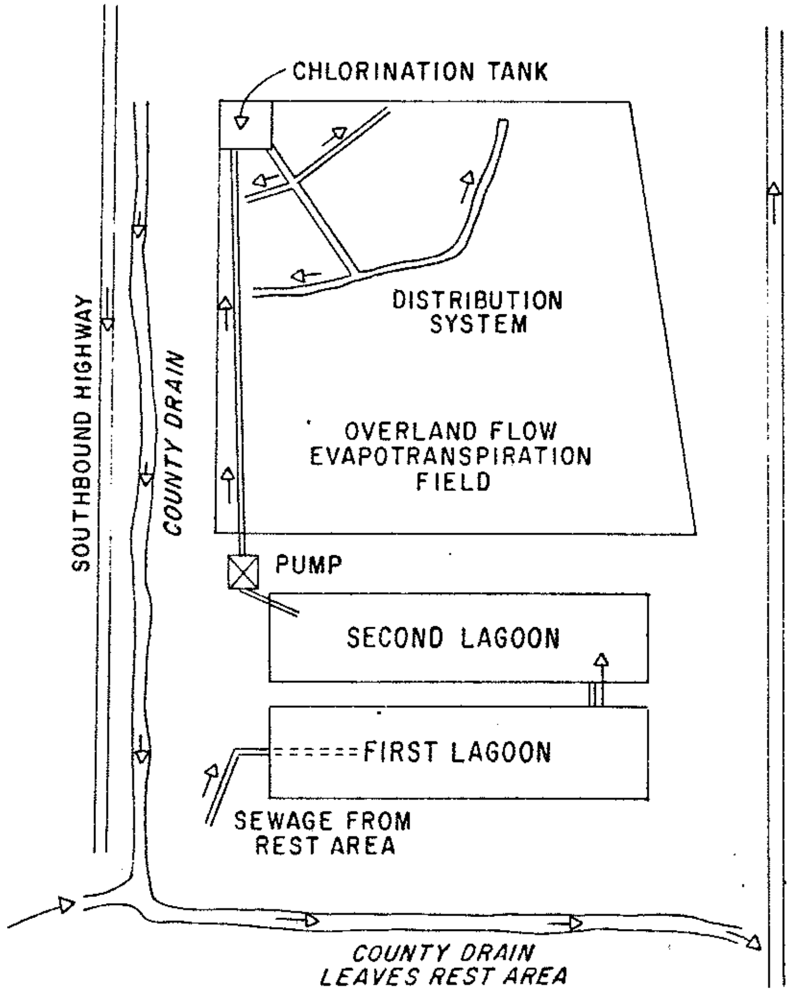


Figure 1. Plan View of Lagoons and Overland Flow Evapotranspiration System. Clare Rest Area and Travel Information Center.

can hold a four inch rain. A perforated pipe distribution system releases the water from the chlorination tank onto the NW portion of the area in a period of four hours. Six level ditches have been plowed on the 908.5, 907.1, 904.0, etc. contours to help redistribute the water at intervals down the slope. (Figure 2)

The operation of the system involves pumping water from the second lagoon up into the chlorination tank in the afternoon and adding hypochlorite to the tank. After standing overnight the chlorination tank is drained by gravity onto the OF-ET the following morning.

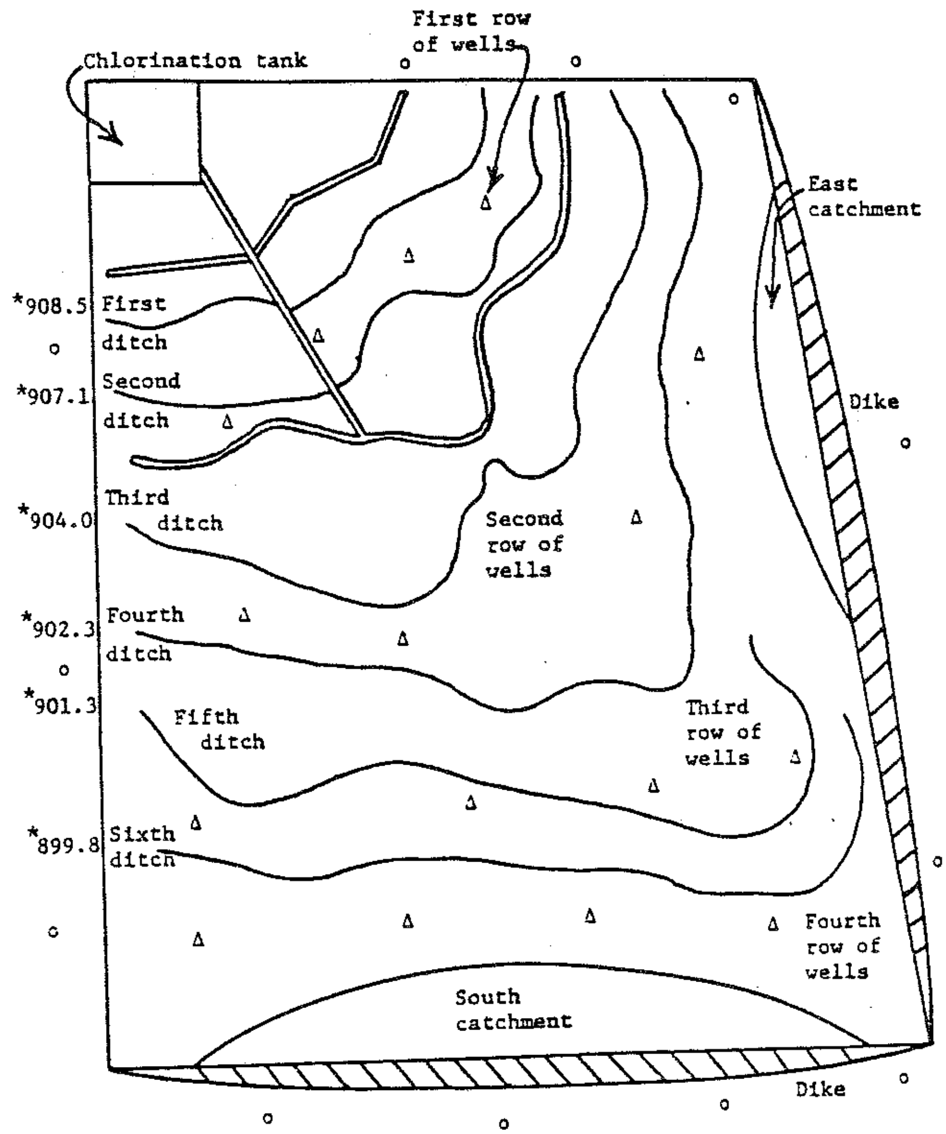
Perimeter wells 1 through 12 go down to the water table surrounding the dike. Sixteen shallow wells which reach the clay subsurface horizon were installed within the treatment area. Originally, surface catchments were installed with the surface wells but later samples have been taken from three points in the level ditches in a location near the wells. (Figure 2)

Coldwater:

The Coldwater Rest Area and Travel Information Center is on northbound I-69 south of Coldwater, Branch County.

The sanitary system at this rest area and information station was a 2-cell lagoon with final discharge into a county drain which opens into a swamp and eventually leads to an open water course. The two lagoons are operated in parallel. This system has been operational since 1969.

Samples 1 and 2 have been obtained directly from lagoon cells 1 and 2, respectively. Sample 3 represented Snyder's private drain as it entered the rest area; it was sampled approximately 5 feet upstream from the injection of any lagoon effluent. Sample 4 was obtained from Snyder's private drain directly west of the highway, after addition of any effluent. Sample 5 was obtained from McCullough private drain as a reference to other local drain waters. Sampling sites 6 and 7 were located at exits from the swamp into the Coldwater River.



o Perimeter well to ground water table
Δ Shallow well to perched water table
* Elevation of ditches

Figure 2. Plan View of Overland Flow Field to Clare Rest Area and Travel Information Center.

Sample 8 was obtained directly from the Coldwater River upstream from the swamp area. Well 1 was placed directly south and well 2 directly west of lagoon cell 1. Wells 3 and 4 were placed directly north of lagoon cells 1 and 2, respectively, and well 5 was placed directly east of lagoon cell 2. Groundwater flow is to the north.

Sampling sites 4, 6 and 7 were used to assess the impact of the discharge of effluent on receiving waters. Proportioning pumps were used to collect these samples.

In order to eliminate the discharge of lagoon effluent into the surface waters, a Barriered Landscape Water Renovation System (BLWRS) was designed for placement on the sandy loam soil with shallow water table that was located in the median between the two highway pavements. Figure 3 is an overview of the rest area, lagoons, highway and BLWRS. Construction was completed in September of 1978.

The BLWRS was 430 ft (131 m) long and 66 ft (20 m) wide with a line of 19 sprinklers down the center. The sprinkler nozzles (Buckner 160 GE 7/64) were selected to give a low angle, large drop size at low pressure to minimize the production of aerosols. The application rate at 25 psi (1.7 Kg/cm^2) water 2000 gal/hr (7.6 cu m/hr) or .12 in. (3 mm) wastewater per hour over the area. The vegetation which was mixed hardwoods with a dense low understory including the usual annual weeds and brambles was left natural. The soils are Gilford and Brady series which have a sandy loam surface which continues down to 5 ft (1.5 m) where the soil becomes a gravelly course sand. There is a fluctuating water table which ranges from 3 to 6 ft (1-1.8 m) deep depending on the season. This water table acts as a barrier to the deep percolation of the applied wastewater and causes it to move away from the area through the organic materials which have been placed in a trench that surround the BLWRS. This trench which is 8 in. (20 cm) wide and

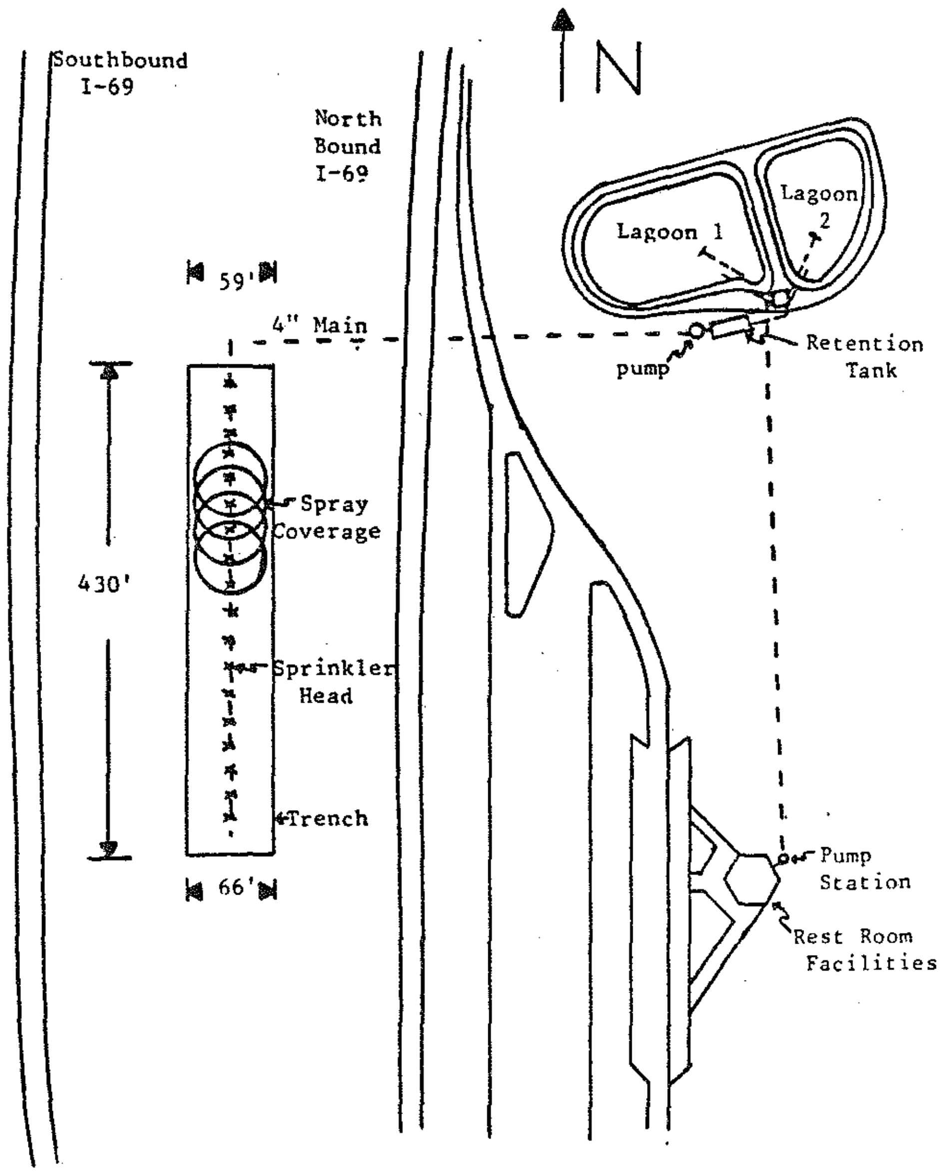


Figure 3. Overview of Lagoons and Barriered Landscape Water Renovation System at Coldwater Information Center.

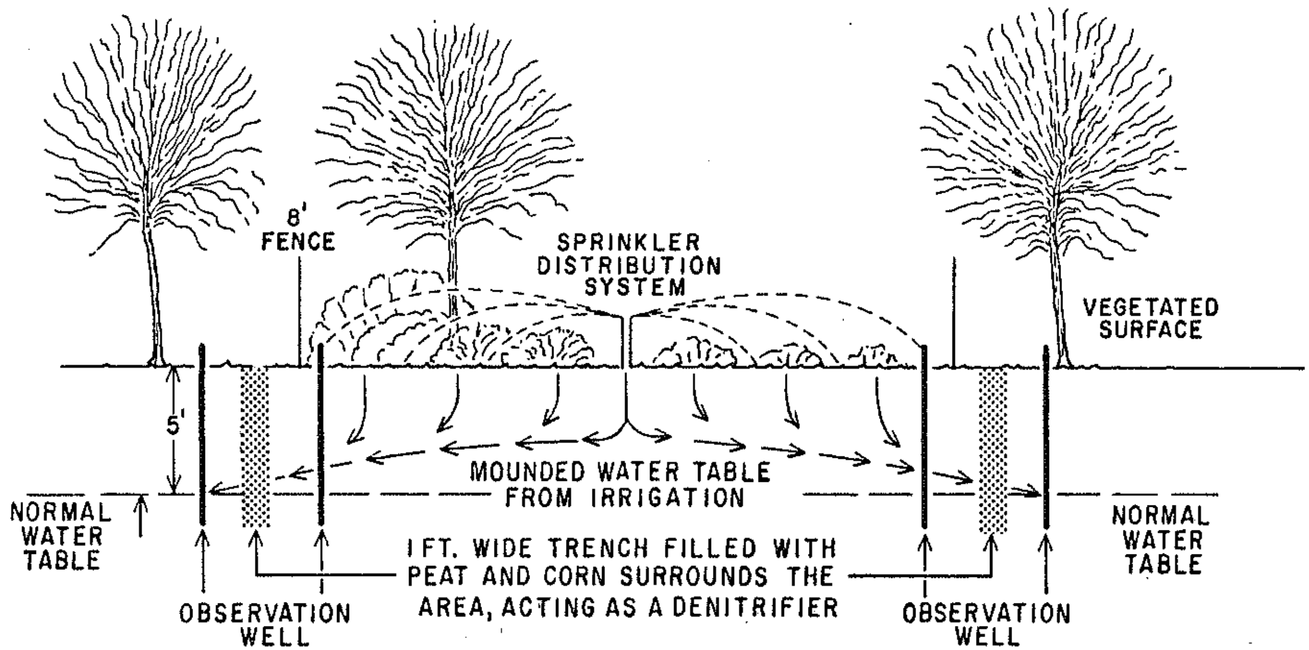


Figure 4. Diagram of the Barriered Landscape Water Renovation System as constructed for the Coldwater Rest Area and Travel Information Center.

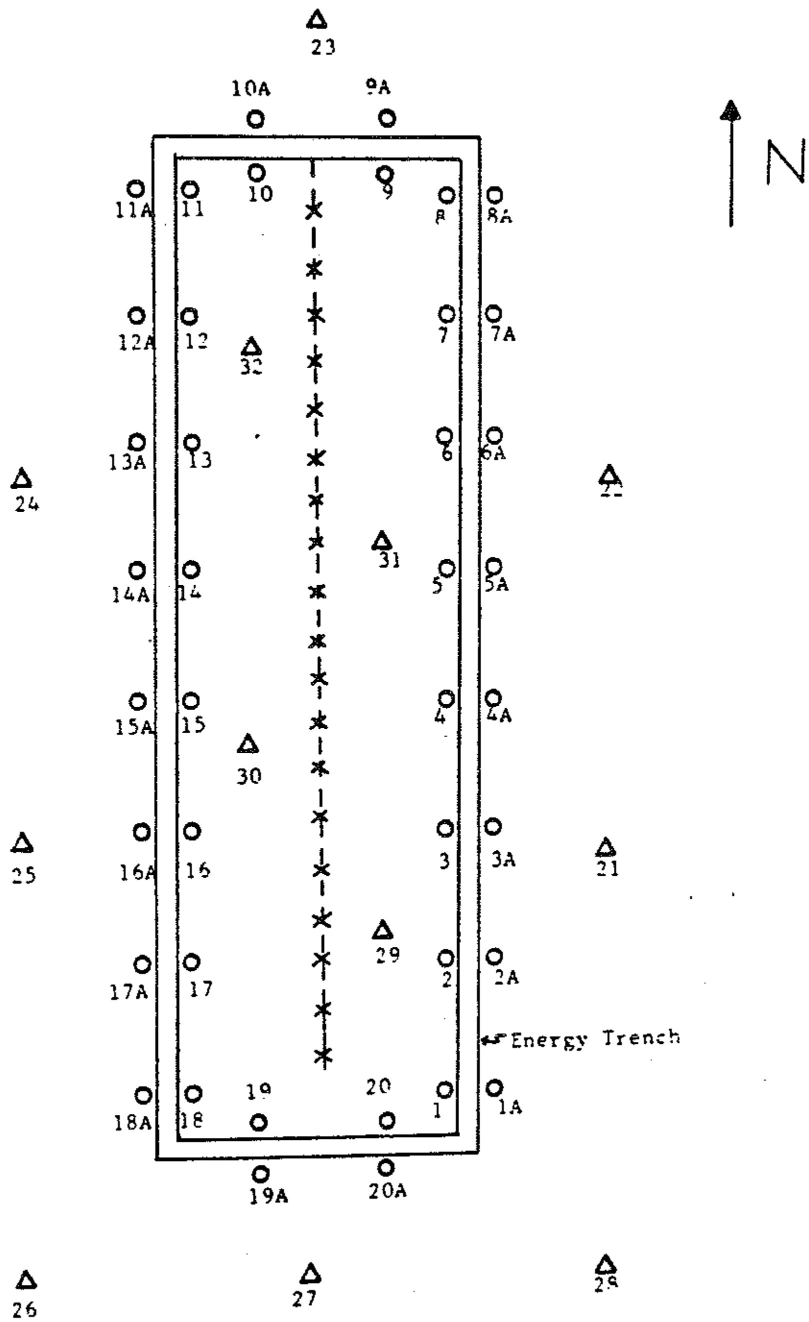


Figure 5. Location of sampling wells on the Barriered Landscape Water Renovation System at the Coldwater Information Center.
(o) Ground Water Sample taken at 6 in. (15 cm).
(Δ) Ground Water Sample taken at 18 in. (45 cm) and Numerical Indication of Sample Number.

extends 6 in. (15 cm) below the dry season water table was backfilled with peat and 1% corn meal to provide a feed source for denitrifying bacteria. A schematic of the BLWRS is shown in Figure 4.

Once a day the BLWRS was automatically irrigated with a 10,000 gal (38 cu m) batch of ozonated wastewater. The irrigation required about 5 hours. The ozonation was performed in a 12,300 gal (47 cu m) retention tank into which effluent from either lagoon could be drained and in which two 1 lb/hr (0.45 Kgr/hr) ozonators were continuously running. The ozonation was primarily for odor control and was very effective.

Sampling of the water in and around the BLWRS was facilitated by 20 pairs of wells surrounding the BLWRS. One of each pair was placed inside the energy trench and another on the outside. These wells were cased with 1 1/4 in. (3.2 cm) plastic pipe with a 4 ft (1.2 m) well point at the bottom. The well points were placed into the water table so that the top of the well point was above the shallowest water table to be experienced. Thus, the top of the water table could be sampled after flushing. Four other wells were placed within the BLWRS and 8 were placed outside. These wells were completely cased and reached 18 in. (45 cm) into the water table to measure any mixing effects. Figure 5 shows the location of these wells.

Dundee:

The Dundee Rest Area and Travel Information Center is on northbound US-23 south of Dundee, Monroe County.

The sanitary system at this rest area consists of a new 3-cell lagoon system with a final ground charge area. It was designed so that each of the small lagoons (cells 2 and 3) would receive influent wastewater one-half of the time, with management objectives to keep the DO in each at the higest possible level. Periodically, these lagoons would discharge partially stabilized wastewater into the larger lagoon cell 1 where further stabilization would occur prior to discharge to the seepage lagoons. This system is located on a clay soil with a shallow water table. This system became operational in 1974.

Samples 1, 2 and 3 were obtained from lagoon cells 1, 2 and 3, respectively. Wells 1, 2 and 3 were placed to sample the groundwater adjacent to the seepage bed area. Wells 4, 5 and 6 were located east of lagoons 3, 2 and 1, respectively, and adjacent to the eastern boundary fence. Well 7 was placed on the southern boundary fence adjacent to lagoon 1. Well 8 was placed along the western boundary fence. Wells 7 and 8 were considered as control wells as groundwater flow is to the northeast.

Watervliet:

The Watervliet Rest Area is on westbound I-94 near Watervliet, Berrien County. Lagoon effluent is discharged through a one-half mile long sewer into a stream. The sewer has manholes at 300 ft (100 m) intervals. A ditch which has a very gentle slope and a 8 to 10 ft (2.5-3 m) wide flat bottom parallels the sewer. Valves and a connecting pipe were installed to permit connecting sewer to the ditch so comparison can be made of the effluent quality as it flows through the sewer or down the ditch. Sampling sites were arranged as follows: (1) East Lagoon, (2) West Lagoon, (3) exit chamber of control structure, (4-12) manholes numbered consecutively East to West (from lagoon to river), (13) outfall of sewer, (0) is point of diversion from sewer to ditch (adjacent to manhole 9), (50) is 50 ft (15 m) west of 0, (100) 100 ft (15 m) is west of 0, etc., (13a) outfall of ditch, (14) Mill Creek upstream of release point, (15) Mill Creek downstream of sewer outfall, (16) Mill Creek downstream of ditch outfall, and (17) Ponded area between ditch outfall and creek (old stream bed).

RESULTS AND DISCUSSION

The data obtained during the course of this project is so voluminous that it has been attached to the back of this report as an Appendix. The results of each rest area or study site will be discussed separately.

Clare

The Clare Travel Information Center and Rest Area has a two cell lagoon system which was supplemented with an OF-ET system in the summer of 1977. The OF-ET was used during the summer when the sewage flows were high and a septic tank-drain field was used during the winter when flows were low. Data from this site are reported in Appendix Tables Ia, Ib, Ic, Id, Ie, If, Ig, Ih and Ii.

System Performance During the First Season

The OF-ET system was operated the first season from July 25 to September 15, 1977. During the 53 days the OF-ET system operated, 31 discharges for a total of 700,000 gal (2650 m^3) or 7.65 in (194 mm) of lagoon wastewater were spread on the OF-ET. During this time, there was also 7.24 in (184 mm) of rain. Fifteen surface water samplings were made on the overland flow area and the perimeter wells were sampled 6 times. Data from this first operation of the system are given Table 1.

The concentrations of all nutrients except NO_3-N were reduced markedly, TOC by 33%, PO_4 by 80% and TKN by 90%. Because only a small fraction of the water ever reached the bottom of the slope, perhaps 10%, the actual percent removal is 93%, 98% and 99%, respectively.

The chemical composition of the water from shallow wells, which were less than one ft (30 cm) to the water table, on the overland flow showed that the iPO_4 concentration was lower than in the runoff at the bottom of the slope but seemed

Table 1. Chemical Composition of Applied Wastewater and Water at Base of the Slope on the Overland Flow-Evapotranspiration System at Clare. 1977 season average in ppm.

	TOC	iPO_4	TKN	NO_3
		ppm		
Wastewater	132	4.6	27	0.7
Bottom of Slope	84	0.9	2.3	0.6

Table 2. Effectiveness of chlorination treatment of the lagoon effluent before discharge to the OF-ET system at Clare, 1977.

	Total Coliforms	Fecal Coliforms
	MPN	
7-24-77 Before	4,000	150
After	4	< 2
9-15-77 Before	2,300	2,300
After	< 20	–

to increase in concentration with time. The TKN was variable and lower in concentration than the runoff but decreased as the season progressed. Nitrate in the shallow wells was on the average higher than in the runoff but seemed to decrease downslope and with the season.

The perimeter wells were very low in nitrate with exception of one. After the August rains, nitrate increased from values in hundredths of ppm to above 0.5 but less than 1. After the initial contamination due to the well drilling was past, the total coliforms settled down to values of less than 2. These studies indicate that there has been no pollution of the groundwater during this first period of operation.

The chlorination before land treatment proved to be excellent with the exception of the first 10 days of August when a series of samples had higher than desired coliforms and streptococci after chlorination. The reason for this was the stirring of the lagoon bottom as the lagoon was drawn down and the transfer of less treated sewage from the first lagoon through the crossover pipe. Once the condition was recognized, the amount of chlorine added was increased and the problem was corrected. (Table 2)

The microbiological data from the OF-ET does not show much reduction. In fact, sometimes the counts increase as the water proceeds down the slope. This could be expected because mice, birds and other animals that frequent the area would be contributing to this biological population.

Data from sample site 7, which was located where the stream enters the rest area and site 5 as it leaves the rest area, show that the stream did not significantly change as it passed through the rest area. This stream carries about 0.5 ppm of iPO_4, 50-80 ppm of TOC and usually less than 0.5 ppm and never more than 0.8 ppm of NO_3-N.

During the 1978 season, the OF-ET system was studied very intensively by Mr.

David Bratt who later reported his studies in an M.S. Thesis presented to the Crop & Soil Sciences Department of Michigan State University (1). This thesis is quoted with some omissions for the remainder of the Clare discussion.

System Performance Under Moderate Loading

During the summer of 1978, from June 22 to the end of July, the system was run under moderate loading conditions. The holding tank was filled and discharged once each day, five days per week for a weekly loading of 2.4 in. (60 mm). The system was rested on weekends. Ten individual sets of samples, about two sets per week, were collected during this period of moderate loading. During this time, 13.9 in. (360 mm) of wastewater were applied and 3.1 in. (80 mm) of rain fell. Evapotranspiration was estimated from open pan evaporation data to be 7.0 in. (18 mm). The runoff was estimated as 1.7 in. (4.3 mm). This results in a relative water distribution of 10% runoff, 42% evapotranspiration, and 48% infiltration and subflow. At no time during this period was there excessive channeling or ponding, indicating that the system was never hydraulically overloaded.

With this low amount of runoff, it is evident that this is not a typical overland flow system. The low percentage of runoff is due to the soil characteristics. A sand layer one to four feet thick lies above a heavy clay loam. The water rapidly infiltrates the upper sandy layer and builds up as a perched water table above the heavy clay loam. As this water flows down the slope beneath the soil surface, it is still in the root zone and available for plant use. The rate of evapotranspiration for the system is quite high. This is largely because the area is at a higher elevation than the surrounding countryside and the moist grasses and soil surface are usually exposed to windy conditions.

In Table 3 the concentrations of BOD_5, TOC, i-PO_4, TKN, NH_3, and NO_3 are tabulated at several stages in the treatment process. TKN, NH_3, and NO_3 are reported as ppm nitrogen in all tables throughout the report. The first lagoon

Table 3. Mean and Standard Deviation of Wastewater Nutrient Concentrations at Several Stages of Treatment During the Period of Moderate Loading (ppm).

Site	BOD_5		TOC		i-PO_4		TKN *		NH_3 *		NO_3 *	
	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S
1st Lagoon	34	16	56.7	28.3	4.02	1.66	43.6	21.1	33.3	18.4	0.39	0.12
2nd Lagoon	38	21	53.4	19.0	2.11	1.16	16.4	6.7	6.9	6.4	0.39	0.12
Chlorination Tank	27	14	53.3	10.8	2.04	0.81	15.7	4.6	5.5	5.2	0.41	0.13
South Catchment	3	2	27.9	5.6	0.05	0.02	2.0	0.7	0.15	0.14	0.41	0.07
East Catchment	5	3	29.7	4.3	0.11	0.04	2.5	1.2	0.18	0.14	0.35	0.06

*Reported in ppm as Nitrogen

contains the raw wastewater as it enters the system, while the second lagoon contains water that has received the amount of treatment provided by the two lagoons in series. An indication of the amount of treatment provided by the two lagoons in series is obtained by comparing the differences in concentrations of nutrients between the first and second lagoons. It is noted that while there was little or no reduction in BOD_5 or TOC between the two lagoons, there is nearly a 50% reduction in i-PO_4 and an even larger decrease in TKN. There is a reduction in NH_3 concentration of similar magnitude to the reduction in TKN. The reductions in both of these is presumably due to volatilization of ammonia, plant uptake of ammonia, and denitrification occurring in the lower depths of the lagoons.

The south and east catchments represent the final runoff. The distance from the gated pipes where the water was released to the south catchment was greater than the distance to the east catchment. This resulted in a slightly but consistently higher water quality in the south catchment than in the east catchment. A comparison of the water quality in the catchment areas with that in the first lagoon indicates the treatment provided by the entire system. The actual efficiency of the entire system is somewhat higher than indicated since the water in the first lagoon has already received some treatment and is not representative of the raw wastewater. This treatment resulted in reductions of 89%, 97%, 95%, and 99% in BOD_5, i-PO_4, TKN, and NH_3, respectively. The changes in water quality from the second lagoon to the runoff indicate the treatment obtained from the land treatment process itself (excluding treatment received in the lagoons). The land treatment process reduced BOD_5, i-PO_4, TKN, and NH_3 by 89%, 95%, 86%, and 98%, respectively. There was approximately a 50% reduction in TOC in the runoff. This reduction represents the easily oxidized organics also indicated by BOD_5. The organic carbon remaining is mostly refractory organics more resistant to decomposition.

In Table 4 the concentrations of i-PO_4, TKN, NH_3, and NO_3 are tabulated for the shallow wells. These wells are 1 to 4 ft. (0.3-1.4 m) deep and represent the water that has infiltrated the sandy layer and is flowing down the slope above the less pervious clay loam. Each well site represents a row of four wells with site number one located near the top of the slope and the other sites moving progressively downhill. There is no discernible difference between the water quality in the first row of wells or that of the other rows of wells as they move downhill and away from the point of release. This indicates that the treatment occurs as the water initially infiltrates the soil, and the amount of treatment received is not a function of distance traveled from the point of release.

The reductions in nutrient concentrations in the infiltration and subflow due to the land treatment process only are 98%, 93% and 98% for i-PO_4, TKN, and NH_3, respectively. The amount of treatment received from the entire system (including the lagoons) was very high with reductions of 99%, 97%, and 99% for i-PO_4, TKN, and NH_3, respectively. It is evident that the water infiltrating the soil is renovated to a greater degree than the runoff.

In Table 5 the concentrations of nutrients in each of the six ditches is listed. These ditches represent the surface runoff as it moves down the slope. Ditch Number 1 is located near the top of the slope with the others moving progressively downhill. Each ditch is approximately 40 ft. (12 m) apart, but the distance varies considerably since the ditches follow contour lines. The amount of treatment received is very similar for the second and third ditches. This is due to the fact that water is released through two different gated pipes. One is at the top of the slope, while the other is located between the second and third ditches. This causes the water in the third ditch to be a mixture of that which has flowed over a considerable amount of land and that just released. This accounts for the seeming lack of treatment between the second and third ditches.

Table 4. Mean and Standard Deviation of Nutrient Concentrations in Shallow Wells Located on the Overland Flow Field During the Period of Moderate Loading (ppm).

Well Site	i-PO_4		TKN		NH_3		NO_3	
	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S
1	0.09	0.03	1.1	0.5	0.13	0.05	0.46	0.08
2	0.09	0.03	1.4	0.4	0.16	0.07	0.43	0.07
3	0.10	0.04	1.0	0.5	0.11	0.05	0.40	0.05
4	0.14	0.03	1.0	0.5	0.16	0.11	0.41	0.15

Table 5. Mean and Standard Deviation of Nutrient Concentrations in the Ditches on the Overland Flow Field During the Period of Moderate Loading (ppm).

Ditch Site	i-PO_4		TKN		NH_3		NO_3	
	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S
2nd Lagoon	2.11	1.16	16.4	6.7	6.9	6.4	0.39	0.12
1	1.01	0.51	5.7	2.1	1.38	1.07	0.44	0.10
2	0.79	0.43	4.0	1.7	0.76	0.63	0.40	0.08
3	0.73	0.30	4.0	1.0	0.70	0.58	0.49	0.13
4	0.25	0.12	2.4	0.5	0.24	0.13	0.37	0.05
5	0.11	0.05	1.9	0.7	0.15	0.07	0.38	0.05
6	0.09	0.05	1.9	0.8	0.13	0.05	0.39	0.08

These data show that the amount of treatment received by the surface runoff is a function of the distance traveled from the point of release. A large proportion of the total treatment received occurs between the point of release and the first ditch. This is illustrated by comparing the water quality in the second lagoon with that in the first ditch.

The nitrate concentration is fairly constant throughout the system. There is certainly plant uptake and denitrification of the NO_3 originally applied, but there is also mineralization of organic nitrogen and nitrification of ammonia. In this system the rates of these processes are roughly equal, resulting in the constant NO_3 concentration. When considering the total amount of nitrogen present at the beginning and at the end of treatment, however, it is obvious that a much larger portion of the total nitrogen is in the nitrate form after treatment.

The perimeter wells to the groundwater were sampled twice each month and analyzed for NO_3 content. The nitrate concentrations of the perimeter wells at each sampling are tabulated in Table I of the Appendix. There were only slight increases in NO_3 concentrations and never did the NO_3 concentration of any one well exceed 1.1 ppm during this period of moderate loading. This is well below the 10 ppm limit specified for health reasons.

The nutrient concentrations in the county drain flowing through the rest area were monitored to determine if any surface water pollution was occurring due to the land treatment system. In Table 6 the concentrations of BOD_5, i-PO_4, TKN, NH_3 and NO_3 are shown as the drain enters and leaves the rest area and at an intermediate point. The intermediate point is where water drained from an adjacent farmer's field enters the main county drain system. These data show that the nutrient level of the stream was not significantly increased due to the operation of the land treatment system and that the surface water leaving the rest area was of an acceptable quality.

Table 6. Mean and Standard Deviation of Nutrient Concentrations in the County Drain System During the Period of Moderate Loading (ppm).

Site	BOD_5		TOC		$i\text{-}PO_4$		TKN		NH_3		NO_3	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Drain Entering Rest Area	1	2	15.3	3.7	0.14	0.03	1.2	0.8	0.11	0.10	0.41	0.07
Additions to County Drain	3	4	20.9	10.1	0.12	0.04	1.5	1.1	0.25	0.16	0.53	0.08
Drain Leaving Rest Area	2	3	10.5	1.4	0.18	0.04	0.8	0.6	0.24	0.11	0.51	0.13

System Performance Under Heavy Loading

During the month of August, in the summer of 1978, the loading rate was increased. The holding tank was filled and discharged twice each day for an average weekly application of 4.3 in. (110 mm). The system was rested on weekends. A total of 11.9 in. (300 mm) of wastewater were applied and 0.82 in. (21 mm) of rain fell during this period. A total of six individual sets of samples were collected during this period. Evapotranspiration was estimated from open pan evaporation data as 3.3 in. (84 mm) and runoff during this period amounted to 2.2 in. (56 mm). Under this heavier loading condition, 26% of the water was lost through evapotranspiration, 17% ran off the surface, and 57% infiltrated the soil. Toward the end of each week there was a noticeable increase in channeling and ponding on the system due to the heavier loading. This did not affect the overall performance of the system, however, as can be seen by comparing overall treatment efficiency during this period with the treatment efficiency during the previous period of lighter loading where no ponding occurred. Two days of rest on the weekend were sufficient for the soil to dry, and channeling and ponding were not evident until the end of the following week. This indicated that the two days of rest on the weekend were necessary to prevent hydraulic overloading under this heavier loading condition.

In Table 7 the average nutrient concentrations are tabulated at various stages in the treatment process for the period of heavy loading. Comparing these values with those for the period of moderate loading listed in Table 3 reveals that the concentrations of nutrients in the first and second lagoons have increased considerably. An examination of individual sampling values reveals a significant and steady increase in nutrient levels in the lagoons during the month of July. This can be explained by the increasingly heavy use received by the rest area during the months of July and August. As the volume of use increases, the

Table 7. Mean and Standard Deviation of Wastewater Nutrient Concentrations at Several Stages of Treatment During the Period of Heaving Loading (ppm).

Site	BOD_5		TOC		$i\text{-}PO_4$		TKN		NH_3		NO_3	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
1st Lagoon	51	22	58.5	8.4	6.06	1.01	73.7	5.9	60.6	5.3	0.49	0.09
2nd Lagoon	54	17	62.5	28.0	4.21	0.64	41.6	4.7	28.0	3.9	0.46	0.05
Chlorination Tank	7.2	14	52.2	4.8	4.78	0.15	36.7	2.8	28.6	3.2	0.47	0.13
South Catchment	2.5	2.2	32.7	8.3	0.09	0.07	1.9	0.5	0.12	0.04	0.45	0.08
East Catchment	2.0	1.3	30.8	5.1	0.10	0.07	2.0	0.4	0.17	0.07	0.49	0.07

retention time of the water in the lagoons decreases and the amount of treatment received in the lagoons will also decrease. As the volume of use levels out in July and August at a consistently heavy volume, the concentrations of the pollutants stabilize at the values shown in Table 7. The strength of the wastewater, as well as the rate of application, is significantly increased during this period.

The system performed very well under the increased loading condition. A greater percentage of applied water infiltrated and ran off the surface, but this did not detract from the overall performance. This loading was much heavier than the moderate loading rate in that not only was the hydraulic loading rate twice as great, but the concentration of nutrients in the water was considerably higher. This resulted in actual increases of 450% in nitrogen loading and 360% in phosphorus loading. The amount of treatment received in the lagoons is somewhat less than during the moderate loading case due to decreased retention time. There is little or no reduction of BOD_5 or TOC between the two lagoons, but there is a 30% reduction in i-PO_4 and a 50% reduction in TKN and NH_3. The reduction in i-PO_4 is probably a result of utilization of this nutrient for growth by algae. The decrease in TKN is due to the decrease in NH_3. This reduction of NH_3 occurs partly through nitrification and utilization of algae, but also through volatilization. The pH of the lagoons will become quite high, especially during the day when photosynthesis by algae is occurring at a high rate. This will result in the ammonia being in the gaseous (NH_3) form and subject to volatilization if sufficient air-water contact is maintained by windy conditions. The water quality in the runoff from the system was very good again. The final runoff is represented in Table 7 as the south and east catchments.

The data in Table 8 show the nutrient concentrations in the shallow wells under heavy loading conditions. These data indicate that the infiltration and

Table 8. Mean and Standard Deviation of Nutrient Concentrations in Shallow Wells Located on the Overland Flow Field During the Period of Heavy Loading (ppm).

Well Site	i-PO_4		TKN		NH_3		NO_3	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
1	0.22	0.14	1.4	0.3	0.17	0.10	0.49	0.09
2	0.22	0.13	1.7	0.4	0.21	0.04	0.42	0.13
3	0.21	0.13	1.2	0.5	0.10	0.03	0.49	0.07
4	0.28	0.19	0.9	0.5	0.13	0.12	0.52	0.07

subflow still received a high degree of treatment, very similar to the moderate loading condition, even though the hydraulic loading was twice as great and the nitrogen and phosphorus loadings were almost four times as great.

The treatment efficiency of the land treatment process during the period of heavy loading for the nutrients i-PO_4, TKN and NH_3 was 97%, 97%, and 99%, respectively. In considering the entire system (including the treatment received in the lagoons) the reductions are 98%, 98% and 99% for these same parameters.

The nutrient levels in the ditches at the top of the slope were considerably higher during the period of heavy loading than during the period of moderate loading. This was due to the combined effect of the increased hydraulic loading and increased nutrient loading. Because of the treatment occurring as the water moves down the slope, however, the water in the lower ditches is of a very good quality and similar to that under moderate loading conditions. The treatment improves as the water moves down the slope. The effect produced by the release of wastewater between the second and third ditches is evident again.

Because of the heavier nitrogen loading there were some higher concentrations of nitrate observed. Values of up to two ppm were noted in the ditches at the top of the slope. Denitrification and plant uptake of nitrate were very effective in reducing the nitrate concentration, however, and the nitrate levels in the shallow wells and in the runoff at the bottom of the slope were usually below 0.5 ppm. These were very similar to the nitrate concentrations during the period of moderate loading. The nitrate concentration of the groundwater was again monitored by sampling the perimeter wells. The nitrate concentration in the groundwater did not increase during this period of heavy loading and the concentration never exceeded 1.0 ppm. These concentrations are shown in Table I in the Appendix.

The county drain was sampled as before. In Table 9 the nutrient

Table 9. Mean and Standard Deviation of Nutrient Concentrations in the County Drain System During the Period of Heavy Loading (ppm).

Site	BOD_5		TOC		$1\text{-}PO_4$		TKN		NH_3		NO_3	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Drain Entering Rest Area	<1.0	--	18.8	9.1	0.25	0.14	1.0	0.7	0.07	0.04	0.53	0.04
Additions to County Drain	<1.0	--	16.0	4.7	0.25	0.12	0.9	0.2	0.11	0.07	0.52	0.09
Drain Leaving Rest Area	<1.0	--	12.3	3.6	0.29	0.14	0.7	0.3	0.06	0.03	0.48	0.09

concentrations as the stream enters and leaves the rest area and at an intermediate point are listed. It is obvious from these data that there is no surface water pollution occurring in the county drain from the land treatment system during the period of heavy loading.

Final effluent characteristics and treatment efficiency are compared for the medium and heavy loading conditions in Table 10. It is interesting to note that the pollutant concentrations are very similar in both cases. The differences are not large enough to be significant. The treatment efficiency, expressed as percent reduction, is greater under the heavy loading condition because of the higher initial nutrient loads and similar effluent characteristics. This comparison reveals that the system could handle a heavy load of 4.3 in. (110 mm) of wastewater per week as efficiently as a more moderate load of 2.4 in. (60 mm) per week. It also gives an indication of the high quality of effluent that can be produced by the land treatment system.

System Performance Under Very Heavy Loading

Another period of interest is that in September, 1978 when the system was loaded very heavily for a two week period. The holding tank was usually filled and discharged three times each day. This was an average weekly loading of 7.2 in. (180 mm). Due to the heavy loading, there was a slight increase in runoff from the system. There was also increased channeling and ponding, but it didn't reduce the overall efficiency. There was only one complete set of samples collected during this period, so all values reported in the tables are the actual values obtained from the one sampling.

Table 11 lists the nutrient concentrations in the lagoons, in the runoff, and in the infiltration and subflow. These values are all very comparable to those in the earlier periods of lighter loadings except that the i-PO_4 levels in the runoff and subflow are higher than before. This is due to the decreased plant uptake of

Table 10. Comparison of Nutrient Concentrations in Runoff and Subflow, and Overall Treatment Efficiency Under Moderate and Heavy Loading Conditions.

	Nutrient Concentration in runoff (ppm)		Nutrient Concentration in subflow (ppm)		Treatment Efficiency (percent reduction, mass basis)	
	Moderate	Heavy	Moderate	Heavy	Moderate	Heavy
BOD_5	4.0	2.0	--	--	--	--
i-PO_4	0.07	0.10	0.10	0.23	96	97
TKN	2.2	2.0	1.1	1.3	96	97
NH_3	0.17	0.15	0.15	0.15	90	99
NO_3	0.38	0.47	0.43	0.48	--	--

phosphorus in the cooler September weather and the decreased ability of the soil to fix phosphorus with the heavier loading condition and resulting saturated soil. Other than this, the system functioned as well as during the previous loading conditions.

The nutrient concentrations in the ditches during this period of heavy loading are listed in Table 12. The nutrient levels in the upper ditches are considerably higher than during the earlier periods of lighter loading. These nutrients are very effectively removed as the water moves down the slope, as demonstrated by the lower concentrations in the lower ditches. The resulting runoff at the bottom of the slope is of a very good quality. Especially interesting is the high NO_3 content in the upper ditches. This was the only period during which a high NO_3 concentration was noted anywhere on the system. The low NO_3 concentration in the lower ditches and in the subflow demonstrate the system's ability to remove NO_3 from the wastewater through the processes of denitrification and plant uptake. Perimeter well samples taken during this period show that nitrate contamination of the groundwater aquifer did not occur. These data are shown in Table VId in the Appendix. The high level of treatment efficiency on the flow area itself is demonstrated by reductions of 80%, 95%, 99%, and 98% for i-PO_4, TKN, NH_3, and NO_3, respectively, between the first and last ditches.

Microbiological Analyses

The results of selected microbial analyses are shown in the Appendix in Table Ib, Ic, Ie If and Ii. These analyses were performed on samples from the lagoons, the chlorination tank, the ditches on the overland flow area, and the perimeter wells to the groundwater table. The analyses on samples from the perimeter wells were performed to assure that no biological contamination of the groundwater was taking place. With the exception of one well, there were never any measurable

Table 11. Nutrient Concentrations at Various Stages of Treatment with a Weekly Loading Rate of 7.2 in. (180 mm) (ppm).

Site	i-PO_4	TKN	NH_3	NO_3
1st Lagoon	4.72	56.8	53.5	1.03
2nd Lagoon	5.40	40.4	37.8	0.55
Chlorination Tank	5.37	38.9	30.2	0.60
Runoff	0.57	0.9	0	0.50
Infiltration and Subflow	0.73	0.6	0	0.48

Table 12. Nutrient Concentrations in the Ditches on the Overland Flow Field with a Weekly Loading Rate of 7.2 in. (180 mm) (ppm).

Ditch	i-PO_4	TKN	NH_3	NO_3
2nd Lagoon	5.40	40.4	37.8	0.55
1	4.05	22.8	18.0	6.86
2	3.59	19.7	15.3	4.57
3	1.71	5.8	2.8	3.38
4	0.90	1.8	0.03	0.24
5	0.91	1.7	0.07	0.24
6	0.80	1.2	0.10	0.11

populations of fecal coliforms in the groundwater samples. These data are shown in Table Ii in the Appendix. One well showed a small population of fecal coliforms for two samplings. The fact that only one well was affected and that it occurred for only two samplings indicates that the contamination probably occurred during the sampling procedure.

Microbial analyses were also performed on samples from the lagoons, ditches, and chlorination tank. The averages of these samples from the summer of 1978 are reported in Table 13. The microbial analysis of the samples from the chlorination tank gives an indication of the effectiveness of the disinfection process. If the operator followed the correct procedure, the chlorination was very effective. Often the correct procedure was not followed, however, and disinfection was less than complete due to insufficient mixing, contact time, or both.

There were large numbers of fecal coliforms on the overland flow area as indicated by the results of the microbial analysis of the ditch samples, as shown in Table 13. These were postulated to result largely from animal, rather than human sources. Even when chlorination of the wastewater was complete, large numbers of fecal coliforms were present on the land treatment area. This indicates that the wastewater is not the source of the fecal coliforms. There was often an increase noted in microbial numbers as the wastewater flowed down the slope. This was obviously the result of contamination from animal sources as fecal bacteria do not multiply rapidly outside of their natural environment. There were large numbers of birds, mice, and other small rodents observed inhabiting the grassy cover provided by the land treatment system, indicating the presence of a sufficient animal population to account for the contamination.

An analysis was performed on these data by comparing the ratio of fecal coliforms to fecal enterococci at various stages in the treatment process. The ratio obtained will give an indication of the source of the contamination

Table 13. Average MPN of Total Coliforms, Fecal Coliforms, Total Enterococci, and Fecal Enterococci in the Lagoons and on the Overland Flow Field During the Summer of 1978.

Site	Total Coliforms	Fecal Coliforms	Total Enterococci	Fecal Enterococci
1st Lagoon	48,000	20,000	24,000	50,000
2nd Lagoon	2,600	280	2,700	390
Chlorination Tank	2,600	38	160	60
1st Ditch	47,000	390	16,000	9,700
2nd Ditch	80,000	370	15,000	6,800
3rd Ditch	170,000	570	23,000	15,000
4th Ditch	23,000	4,900	11,000	5,000
5th Ditch	6,300	2,000	5,600	2,100
6th Ditch	6,100	2,100	6,100	2,100

according to Geldreich et al., 1964 (6). Ratios of 4.4 or above indicate a human source, while values below 0.7 indicate an animal source. Ratios between these values indicate a mixture of sources. The results of this analysis are shown in Table 14. The results reported the ratios of the geometric means of the samples. Samples from the first lagoon, second lagoon, and chlorination tank are analyzed separately for the summers of 1977 and 1978. The results for each are reported. Ratios from the first and last ditches are analyzed for the periods of moderate loading and heavy loading in 1978 and the results for each are reported.

While the ratios in the first lagoon indicate a human source of contamination, the ratios in the second lagoon and chlorination tank are considerably lower. The ratio is well below 0.7 in the chlorination tank, indicating that little bacterial contamination of human origin will survive this long. These data indicate that treatment in the lagoons themselves is effectively reducing the human biological contamination. The ratios in the ditches are also well below 0.7, indicating that this contamination is due to animal activity on the land treatment area. The use of these ratios to indicate the source of pollution is not a widespread practice. This can be an important tool in evaluating the treatment efficiency of land treatment systems. Public health officials are often quick to label the presence of fecal coliforms as an indication of human contamination. These ratios can be used to show that the bacteria are from a non-human source and represent no danger from a public health standpoint.

Mechanisms Involved in Nutrient Removal

The mechanisms involved in the removal of the nitrogen and phosphorus applied to this system can be determined by making several assumptions. It will be assumed that one ton of Reed Canary Grass was produced over the summer. Since there was no harvest, this is a very rough estimate. It will serve, however, to

Table 14. Ratio of Fecal Coliforms to Fecal Enterococci at Various Stages in the Treatment Process.

	Summer 1977	Summer 1978
1st Lagoon	6.72	3.70
2nd Lagoon	2.52	0.94
Chlorination Tank	0.35	0.23
	Moderate Loading 1978	Heavy Loading 1978
1st Ditch	0.034	0.17
6th Ditch	0.22	0.26

give a general indication of the amount of nutrients removed by the crop. Assuming that Reed Canary Grass is 3.7% nitrogen and 0.5% phosphorus, it is estimated that 74 lb (34 kg) of nitrogen and 10 lb (4.5 kg) of phosphorus could be removed by the crop. This is undoubtedly a low estimate as one ton of Reed Canary Grass is probably less than what was produced. During the two periods considered in 1978, a total of 37.2 lb (16.9 kg) of nitrogen and 4.1 lb. (1.8 kg) of phosphorus were applied. It is obvious that even using the low estimate for plant uptake, this mechanism could easily account for the removal of all the nutrients applied. These estimates reveal that the system could handle a much heavier nutrient load than that which was applied. While the Reed Canary Grass was not harvested during this study, it would be a recommended procedure during long-term use to avoid buildup of nutrients within the system.

There is also a tremendous capacity in this system for nitrogen removal through denitrification. The conditions necessary for denitrification are all met by the land treatment system. The water running down the soil surface was well mixed with air providing an aerobic environment where nitrification of the ammonia occurred. The surface soil was saturated and this provided the anoxic conditions necessary for the denitrifiers to utilize the NO_3 ion as an electron. An adequate energy source was supplied to the denitrifiers through the carbon in the wastewater and plant root exudates. Although plant uptake was the major mechanism of nitrogen removal, it is reasonable to assume that some denitrification did occur. During the short periods of heavy loading in August and September, the capacity for plant uptake was certainly exceeded. The concentrations of both nitrate and total nitrogen were still very low in both the runoff and subflow. As plant uptake could not account for all the nitrogen removal, denitrification is thought to play a major role, particularly during the periods of heavy loading.

It is interesting to note that the overall treatment efficiency of this land treatment system did not decrease as the loading rate was increased. A high quality effluent was produced as the loading rate was increased from 2.4 (60) to 4.3 (110) and again to 7.2 in. (180 mm) per week. The limiting factor involved here was the hydraulic capacity of the soil rather than the nutrient removal capacity of the soil plant system. This limit was approached at the heavier loading rates as increased channeling was observed. Smoothing the soil surface could increase the hydraulic capacity by decreasing channeling. In this case, however, it was decided that the negative aspects of land forming such as soil compaction, destruction of native vegetation, time, and cost outweighed the benefits due to decreased channeling.

As the loading rate was increased, the amount of runoff increased considerably. The system was limited due to the stipulation that the effluent in the catchments, though of good quality, could not be discharged into nearby surface waters. This limitation precluded the use of still heavier loading rates as the capacity of the catchments would have been exceeded and discharge would have been necessary.

CONCLUSION

The overland flow land treatment system performed very effectively in achieving advanced treatment of the wastewater generated at the Clare Travel Information Center and Rest Area. The system performed equally well at a moderate loading rate of 2.4 in. (60 mm) per week and at a heavier loading rate of 4.3 in. (110 mm) per week. The effluent quality was very similar for both conditions and in each case was well within state requirements for effluent discharge. The efficiency of the system, as described by percent reduction of various pollution parameters, was actually greater under heavier loading. At this heavier loading rate, reductions of greater than 96% were noted in BOD_5, i-PO_4, TKN, and NH_3

concentrations. A brief period with a loading rate of 7.2 in. (180 mm) per week indicated the ability of the system to handle this large quantity of wastewater at a similar level of efficiency.

The water quality of the groundwater aquifer was monitored continuously, and at no time did any chemical or biological contamination of the groundwater aquifer occur. The nitrate concentrations were very low and there were no measurable coliform populations in the groundwater samples. Sampling and analysis of nearby surface waters assured that there would be no contamination or eutrophication of area lakes and streams.

Most of the applied wastewater (80-90%) was lost through infiltration and evapotranspiration. The runoff which collected in the catchments at the bottom of the slope was demonstrated to be equal in quality to the nearby surface waters. Discharge of this runoff into the county drain system, though not legally permissible, would have been advantageous for the system at heavier loading rates.

Fecal coliform to fecal enterococci ratios were used in analyzing the results of the microbial analyses. These ratios demonstrated that the microbial contamination encountered in the samples from the land treatment area were from a non-human source. The source of microbial contamination in land treatment systems is often of great concern to local public health officials. These ratios could prove to be a valuable tool in the evaluation of land treatment systems as their use becomes more widespread.

This study showed that land treatment can be a very effective and inexpensive method of wastewater treatment for highway rest areas and other small rural institutions not located near a municipal sewer system. Consideration of wastewater characteristics and flow, as well as area soil characteristics, led to the development of a unique land treatment system. Though the soils of this area were not ideally suited for conventional overland flow or irrigation systems, this modified overland flow evapotranspiration system utilized the soil and landscape characteristics adjacent to the rest area to achieve very effective treatment of the wastewater generated there.

For this system to insure complete evapotranspiration of the effluent, it should be 50% larger. However, the quality of the outfall exceeds any reasonable standards.

Coldwater

The Coldwater Travel Information Center and Rest Area has been monitored periodically during the course of the project. During this time the lagoons were dumped three times. Lagoon No. 2 was dumped November 7, 1977, Lagoon No. 2 was dumped again on May 2, 1978 and Lagoon No. 1 was dumped on May 12, 1978. These data are reported in Tables IIIa, IIIb, IIIc and IIId in the Appendix. Summaries of data are presented for comparison in Table 15.

The Snyder Drain No. 3 sampling site is up stream from the point of lagoon discharge. In the fall it was stagnant and higher in nutrients than would be expected. The discharge of the lagoon caused some flushing and backwash which increased the phosphate and ammonium at this site. This is in contrast to the May discharge period when the Snyder Drain was flowing and the nutrients at sampling site no. 3 did not change during the discharge.

The Snyder Drain No. 4 sampling site which is below the lagoon discharge showed an increase in phosphates and nitrogen after each discharge and is a contrast to the McCullough Drain, the reference drain, which stayed relatively constant during the lagoon discharge periods. The Snyder Drain water did dilute the lagoon effluent which would be expected.

Swamp site no. 1 was close to the discharge of the Snyder Drain while swamp site no. 2 was further into the swamp. BOD and TOC values are not too different from those coming from either Snyder or McCullough Drains. Variations in suspended solids are probably due to problems in sampling. During the fall discharge there was no indication of change in the swamp during or after discharge. During the spring discharges there were slight increase in phosphate and nitrogen. The largest change occurred with the TKN and NH_3 values which even though they increased never were above 2.0 or 1.4 ppm, respectively. The

Table 15: The Influence of Discharge from the Lagoons at the Coldwater Information Center on adjacent environment. ppm.

	BOD	TOC	SS	tPO_4	iPO_4	TKN	NH_3	NO_3	NO_2
				November 7, 1977					
Lagoon 1	5	18	8	3.8	4.8	17.6	14.0	0.52	0.04
Lagoon 2	4	22	12	4.1	3.6	5.1	3.2	0.60	0.06
Sny Dr 3 Before	73	48	96	1.0	1.2	3.0	0.1	6.64	0.02
Sny Dr 3 After	31	26	24	4.0	3.9	9.0	6.5	0.44	0.01
Sny Dr 4 Before	1	11	4	0.4	0.3	0.1	0.1	0.47	0.01
Sny Dr 4 After	5	19	11	4.2	4.2	8.9	3.9	0.52	0.02
MC Dr 5 Before	4	21	3	0.1	0.49	0.6	0.1	0.56	0.01
MC Dr 5 After	1	14	7	0.1	0.53	0.3	0.1	0.44	0.01
Swamp 1-Before	1	21	104	0.2	0.31	1.1	0.1	0.64	0.01
Swamp 1-After	3	22	112	0.1	0.23	1.1	0.1	0.50	0.01
Swamp 1-Before	4	40	293	0.2	0.31	2.4	0.1	0.46	0.01
Swamp 2-After	2	14	45	0.1	0.38	0.1	0.1	0.50	0.01
Coldwater R.	1	16	4	0.1	0.2	0.5	0.1	0.50	0.01

Table 15 (Continued) May 2, 1978

Lagoon 1	3	31	7	1.6	0.84	3.5	1.0	2.57	0.70
Lagoon 2	11	86	87	6.0	4.44	44.3	37.8	0.56	0.30
Sny Dr 3 Before	<1	19	2	<0.1	0.08	<0.1	0.1	0.60	0.03
Sny Dr 3 After	<1	21	<1	0.1	0.13	<0.1	0.4	0.61	0.04
Sny Dr 4 Before	<1	16	5	<0.1	0.09	<0.1	0.3	0.81	0.05
Sny Dr 4 After	<1	40	15	3.1	2.76	22.4	22.5	0.73	0.16
MC Dr Before	2	36	20	<0.1	0.05	0.6	0.3	0.52	0.04
MC Dr After	<1	29	1	0.1	0.05	0.6	0.3	0.54	0.04
Swamp 1-Before	<1	57	4	<0.1	0.08	<0.1	0.1	1.21	0.05
Swamp 1-After	<1	28	35	0.2	0.07	2.0	1.4	0.94	0.07
Swamp 2-Before	1	22	4	<0.1	0.07	0.2	0.1	1.16	0.05
Swamp 2-After	<1	24	1	0.4	0.32	<0.1	0.6	0.51	0.04
Coldwater R.	<1	13	1	0.1	0.09	0.1	0.2	1.30	0.05

Table 15 (Continued) May 12, 1978

Lagoon 1	<1	30	1	3.2	3.15	9.5	6.2	0.24	0.03
Lagoon 2	23	53	39	3.9	2.47	32.5	27.9	0.31	0.38
Sny Dr 3 Before	<1	24	29	0.1	0.1	1.5	0.3	0.31	0.03
Sny Dr 3 After	4	25	2	0.1	0.13	1.1	<0.1	0.33	0.01
Sny Dr 4 Before	<1	35	7	<0.1	<0.1	1.2	0.6	0.25	0.02
Sny Dr 4 After	1	20	2	0.2	0.27	0.7	0.4	0.34	0.02
MC Dr Before	<1	32	4	<0.1	0.05	0.8	0.5	0.23	0.01
MC Dr After	2	26	7	0.1	0.08	1.5	<0.1	0.21	<0.01
Swamp 1-Before	<1	25	8	<0.1	0.07	0.5	0.6	0.66	0.03
Swamp 1-After	<1	22	2	0.1	0.05	0.8	<0.1	0.22	<0.01
Swamp 2-Before	<1	18	2	<0.1	0.08	0.4	0.2	0.72	0.03
Swamp 2-After	10	28	4	0.1	0.06	1.7	0.4	0.37	0.03
Coldwater R.	<1	20	3	0.1	0.11	0.1	0.6	0.76	0.02

reactions with the swamp and/or dilution makes the impact of nutrients from the lagoon discharge of minor consequence. The microbial studies showed that with the exception of one sample taken May 3, 1978 at Snyder Drain No. 4 there was no influence from the lagoon discharges. Since only one sample was involved, the sample could be suspect.

The Coldwater River data is given for reference as this is the ultimate place of discharge and except for the somewhat lower suspended solids, inorganic phosphorus and TKN and higher nitrate there seems to be no appreciable difference between the river water and the swamp.

Even though the discharge from Coldwater Rest Area was not having any appreciable impact on the swamp or the Coldwater River, it was felt that a different system for polishing the lagoon effluent would be appropriate at this site. After considering several alternatives, it was decided to place a Barriered Landscape Water Renovation System in the median which would treat the ozonated lagoon effluent and return the water to the shallow aquifer. A dosing chamber for ozonation and a barriered landscape were constructed in 1978. The BLWRS was operated intensively in 1979. Mr. William A. Rueckert studied the system's operation and reported his findings in a M.S. Thesis (11). This Thesis is quoted extensively in the following discussion.

The Barriered Landscape Water Renovation System

"The Modified Barriered Landscape Water Renovation System at the Coldwater Information Center was operated from June 15 to August 10, 1979. For analyses and discussion, these data are divided into three distinct periods. The first period was during the application of wastewater from Lagoon 2, the smaller of the two lagoons, which contained stabilized waste. The second period of application was the disposal of wastewater from Lagoon 1 which contained partially stabilized waste. The final period was application of wastewater from Lagoon 2. The important difference of this period from the previous two was that Lagoon 2 contained fresh waste in an unstabilized condition and also a mixture of sludge from Lagoon 1. Sludge as introduced from Lagoon 1 since it had been pumped over to the smaller lagoon to sustain the system with an adequate amount of wastewater so spray application could continue for as long as possible. The data from each sampling is shown in Table Va, Vb, Vc, Vd, Ve, Vf and Vg in the Appendix. Data for each of the three periods are reported in terms of the means and standard deviation in tables in this section. Some of the standard deviations are quite high. This variability can be expected when varying conditions in the field are considered.

System Condition Prior to Wastewater Application

"Background samples for the wells were obtained on April 16, May 7 and May 11. Some of the NO_3-N levels were found to be in excess of 10 ppm which is the highest allowable standard for drinking water. The NO_3 was found to be high in only the top 6 in. (15 cm) of the groundwater, whereas the samples taken at the 18 in. (45 cm) level were well below the EPA standards. In Table 16 are the data from 18 well samples that were found to be high in NO_3. The other 34 wells had normal NO_3.

The values in Table 16 show that as the season progressed the NO_3 concentrations fluctuated in some of the wells whereas in most of the wells the NO_3 concentrations decreased. The high NO_3 was due to construction on the site which haphazardly deposited varying amounts of vegetation on the soil surface. As the vegetation decomposed, NO_3 increased in the soil. This NO_3 was then flushed down to the water table due to the fall rains and snow melt in the early spring. Denitrification at this time was minimal and subsequently the NO_3 accumulated in the groundwater. The high NO_3 levels also had some correlation to the growth of vegetation. As the season progressed and temperatures increased there was

Table 16. Sampling Wells of the Top 6 in. (15 cm) of the Ground Water found High in Nitrate Concentration before the Onset of Spray Application.*

Wells	Sampling Dates			
	April 16	May 7	May 11	June 11
	ppm			
1	29.3	32.2	34.2	30.2
2	46.5	32.9	33.3	3.8
2A	53.9	46.3	63.2	29.4
3A	47.8	20.8	19.5	4.6
4	25.7	15.9	14.1	13.4
4A	21.0	7.0	4.6	1.6
5A	36.9	18.8	6.8	0.9
12	21.8	15.0	15.2	5.1
13	32.2	14.7	7.4	1.3
14	37.0	28.9	12.3	6.0
14A	31.0	18.8	7.8	0.7
15A	21.2	1.5	3.4	4.9
16	20.1	17.6	24.1	3.0
17	24.3	31.9	25.3	16.0
17A	17.8	35.4	39.2	43.4
18	45.1	43.9	37.9	25.6
19	26.8	27.6	32.2	30.8
20	19.3	39.2	48.3	31.0

*This represents 18 of 52 wells sampled; 34 of which were less than 15 ppm.

substantial new vegetative growth which was mainly perennial weeds.

The NO_3 concentration decrease in the groundwater was probably due to less NO_3 being leached through the soil profile because of increased NO_3 uptake by the vegetation and by denitrification. As the temperatures increased, the oxygen concentration to the rhizosphere decreased and anaerobic microenvironments developed. With the anaerobic conditions, denitrifier populations utilized the NO_3 as a terminal electron acceptor thereby transforming excess NO_3 to nitrogen gas with eventual release into the atmosphere.

In Table 17 the concentrations of NH_3, NO_3, TKN, i-PO_4, and t-P are tabulated for the system prior to wastewater application. In the early part of the season before application of wastewater, the concentrations of the nitrogen compounds were at their maximum. The first sampling was the highest for NH_3 and NO_3 and was due to the low biological activity since the soil temperature was below 50^{o}F (10^{o}C) until the first of June.

System Conditions During Wastewater Application

Hydrology

Due to the high rate of evaporation and low rainfall, this BLWRS evapotranspired more and leached less than usual for a BLWRS. The hydrologic data is given in Table 18. With the dry weather conditions encountered during wastewater application the watertable steadily dropped. During the approximately eight weeks of application 19.7 in. (490 mm) of wastewater was applied and 4.11 in. (106 mm) of rain fell. Evaporation was estimated from a Class A pan and found to be 13.9 in. (356 mm). This resulted in a relative water distribution of 82% applied effluent, 18% rainfall, and 60% evaporation. Thus, the water available for drainage was calculated to be 9.45 in. (242.25 mm) which was 40% of the wastewater + rainfall or half as much as the wastewater applied. Since the drainage was half as much as the effluent applied, this could have caused the

Table 17. Mean and Standard Deviation of Nutrient Concentrations in Ground Water Samples before Application of Wastewater.

Date of Sampling	NH_3		NO_3		TKN		t-P		$i\text{-}PO_4$	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
	ppm									
4/16	0.92	0.69	14.1	14.8	0.66	0.54	0.07	0.09	0.16*	0.05
5/07	0.23	0.37	11.0	13.1	1.06	2.80	0.02	0.01	0.01	0.01
5/11	0.22	0.40	11.3	14.4	0.43	0.52	0.05	0.14	0.01	0.02
6/11	0.34	0.31	6.9	10.8	0.43	0.46	0.10	0.00	0.02	0.01

*$i\text{-}PO_4$ is larger than t-P due to high clay content in sample. Test for $i\text{-}PO_4$ was run before digest, which removed clay fraction, was performed for t-P analysis.

Table 18. Hydraulic Data of the Barriered Landscape Water Renovation System.

Date	Effluent Applied	Rainfall	Evaporation*
	mm		
6/15-17	10.50	0.00	20.00
6/18-21	10.50	0.75	21.25
6/22-24	20.50	9.75	24.75
6/25-28	15.75	0.00	18.25
6/29-7/01	42.00	4.25	27.25
7/02-05	26.25	1.25	19.50
7/06-08	35.00	23.00	23.00
7/09-12	26.25	3.00	14.25
7/13-15	35.00	0.00	18.75
7/16-19	26.25	0.75	19.00
7/20-22	35.00	0.00	25.00
7/23-26	26.25	0.00	18.75
7/27-29	35.00	8.00	11.75
7/30-8/02	26.25	6.50	19.00
8/03-05	35.00	15.00	20.75
8/06-09	26.25	14.50	22.50
8/10-12	35.00	18.75	18.75
8/13-15	26.25	0.00	13.75
TOTAL	493.00 (19.72 in.)	105.50 (4.11 in.)	356.25 (13.89 in.)

*Data from a Class A pan.

concentration of pollutants in the wastewater to almost double.

Wastewater was applied automatically between 1000 hours and 2000 hours which resulted in 2.4 in. (61 mm) of effluent applied per week. With a rest period of 14 hours, there was never hydraulic overloading and ponding or organic mat formation on the soil surface.

Accurate measurements of the watertable levels were taken during the application of wastewater which indicated that the water was moving away from the BLWRS in both a northerly and southwesterly direction.

Nitrogen

Nitrogen in this system can be traced from the lagoons to the retention tank to the amount that was held in the soil and finally to the concentrations found in the ground water. The values in Table 19 are the average values for TKN, NH_3, and NO_3 in the lagoons and retention tank. The table was divided into three sections, each section designates which lagoon was being used for wastewater application on the BLWRS.

The levels of TKN and NH_3 increased appreciably during the last application period of July 16 to August 10. This occurred on July 20 and 23 when Lagoon 1 was being pumped over to Lagoon 2 so that water could be supplied for application into August. Water from Lagoon 1 was being pumped from the bottom of the lagoon and caused considerable mixing in Lagoon 2 of the untreated and primary treated wastewater which was then transferred into the retention-ozonation tank. There was an increase in NO_3 in the ozonation tanks which caused a decrease in the TKN and NH_3 in the ozonated effluent.

After the wastewater was applied to the BLWRS, the levels of TKN, NH_3 and NO_3 could be followed by soil sampling which occurred on June 22, July 9, and August 13 and is reported in Table 20. TheTKN in the wastewater is completely masked by the TKN associated with the soil organic matter. This organic matter is more

Table 19. Mean and Standard Deviation of Concentrations of Nitrogen Components in the Lagoons and Retention Tank Wastewater.

Period of Sampling	TKN $\bar{X}$	TKN S	NH_3 $\bar{X}$	NH_3 S	NO_2^- $\bar{X}$	NO_2^- S	NO_3^- $\bar{X}$	NO_3^- S	Total N (TKN + NO_2^- + NO_3^-) $\bar{X}$
	ppm								
6/15-7/03*									
Lagoon 1	15.3	7.6	6.1	1.4	0.02	0.01	0.28	0.22	15.6
Lagoon 2	15.2	5.6	8.6	5.8	0.13	0.11	0.17	0.08	15.5
Tank 1	11.6	4.6	6.8	4.4	0.61	0.20	1.88	1.25	14.8
Tank 2	11.0	4.2	7.3	3.6	0.65	0.20	2.13	1.33	14.6
7/04-7/16**									
Lagoon 1	15.8	5.1	7.6	1.4	0.01	<0.01	0.20	0.00	16.0
Lagoon 2	22.3	3.0	14.2	2.6	0.02	0.01	0.20	0.00	22.5
Tank 1	12.7	2.8	9.2	2.7	0.17	0.02	0.68	0.05	13.6
Tank 2	12.8	2.5	8.9	2.3	0.18	0.02	1.10	0.08	14.0
7/17-8/10***									
Lagoon 1	40.6	17.9	25.8	9.9	0.04	0.03	0.58	0.31	41.3
Lagoon 2	35.0	13.7	24.8	4.6	0.01	<0.01	0.13	0.05	35.7
Tank 1	24.6	6.2	22.2	5.8	0.14	0.14	1.95	3.11	26.7
Tank 2	24.8	5.9	20.8	4.3	0.14	0.14	2.15	3.10	27.1

*Spray application water being drawn from Lagoon 2.
**Spray application water being drawn from Lagoon 1.
***Spray application water being drawn from Lagoon 2 after Lagoon 1 had been pumped into Lagoon 2 during 7/20 and 7/23.

Table 20. Concentrations of Nitrogen Components in the Upper Soil Profile of the Spray Area during Wastewater Application.

Date of Sampling	Depth of Sampling cm	(inches)	TKN	NH_3	NO_3^-	NO_3^- in Soil Solution
			ppm			
6/22	0-15	(0-6)	1096	0.86	2.9	20.9
	15-30	(6-12)	608	0.90	1.6	12.8
	30-45	(12-18)	543	1.13	1.4	13.3
7/09	0-15	(0-6)	904	1.43	4.6	25.6
	15-30	(6-12)	706	1.11	1.9	12.5
	30-45	(12-18)	622	0.95	1.7	11.3
8/07	0-15	(0-6)	1240	5.86	6.1	26.4
	15-30	(6-12)	752	3.08	3.2	18.2
	30-45	(12-18)	647	2.55	2.8	17.4

concentrated in the surface soil than at the deeper soil depths. There was also a sharp decrease in NH_3 from that in the wastewater to that found in the surface soil. This reduction can be caused by the volitilization of NH_3 during the sqray irrigation or conversion of NH_3 to NO_3 in the aerobic soil. there is an increase in NO_3-N in the soil water over that in the wastewater, but it is less than could be attributed to the loss in HN_3. Besides the loss of nitrogen from volitilization of NH_3, plant uptake and denitrification of NO_3 could also be occurring.

Nitrate levels at the deeper soil depts indicate that approximately half of all NO_3 found in the surface soil was either being utilized by plants or denitrified in anaerobic pockets in the rhizosphere. The NO_3 not utilized or denitrified in the upper 6 in. (15 cm) layer was available to be leached through the soil profile. Leaching of NO_3 had occurred but the amount leached was further reduced by plant uptake or denitrification. This reduction occurred in spite of the concentrating influence of water uptake and transpiration by the plants.

Ammonia in the water table was low and did not change appreciably during the operation of the BLWRS, Table 21. Levels of NH_3 ranged from a high of 0.24 ppm to a low of 0.13 ppm. This concentration of NH_3 in the water table was 10-20% of the concentration of NH_3 applied to the soil. Ammonia in the wastewater applied to the soil ranged from 4.07 ppm on June 22 to a high of 34.46 ppm on August 6. Considering the levels of NH_3 in the applied water and the concentrations found in the water table, the microbes were very efficient in nitrifing the NH_3 to NO_3 in the upper soil profile.

Any NO_3 not utilized by plants or denitrified was leached and appears in the water table. Table 21. The NO_3 levels in the sampling wells varied throughout the treatment process. The shallower paired wells contained higher concentrations than did the deeper wells. This was due to NO_3 leaching through the soil profile

Table 21. Mean and Standard Deviation of Concentrations of Nitrogen Compounds in Ground Water Sampling Wells and Soil Temperatures.

Date of Sampling	TKN		NH_3		NO_3^- Shallow Paired Wells		NO_3^- Deep Wells (Spray Area)		Soil Temperature	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	^oC	^oF
	ppm									
6/15	0.48	0.48	0.16	0.28	8.4	13.2	1.4	1.3	13.3	56
6/18	0.36	0.39	0.22	0.32	6.9	10.2	1.9	2.0		
6/22	0.41	0.38	0.15	0.32	7.6	12.1	5.7	10.0		
6/25	0.33	0.36	0.15	0.32	6.8	10.0	2.6	3.7	16.7	62
7/01	0.40	0.41	0.18	0.31	4.6	6.1	1.9	1.9		
7/06	0.38	0.35	0.13	0.25	4.5	6.1	2.4	2.2		
7/09	0.37	0.35	0.15	0.26	4.4	5.8	2.5	2.0	20.6	69
7/13	0.95	1.12	0.15	0.26	3.3	3.7	3.0	2.9		
7/16	0.96	0.99	0.24	0.60	3.3	3.2	3.5	3.5		
7/20	0.63	0.53	0.22	0.59	2.2	3.2	3.1	3.1	25.6	78
7/23	0.40	0.45	0.13	0.22	3.4	3.4	3.5	2.9		
7/26	1.03	0.90	0.14	0.25	3.7	3.3	3.5	2.9		
7/30	0.78	0.82	0.14	0.24	3.6	3.2	3.9	3.7	28.3	83
8/03	0.25	0.28	0.14	0.24	4.0	3.8	5.2	5.5		
8/06	0.21	0.28	0.17	0.28	4.3	4.0	6.5	6.3		
8/10	0.23	0.25	0.19	0.36	4.8	5.1	5.5	5.8	32.2	90
8/13	0.32	0.40	0.17	0.29	5.9	6.1	7.3	8.4		

and becoming concentrated on the top of the water table. Here the NO_3 came in contact with an anaerobic environment in the mounded water table which was an ideal environment for denitrification if organic material was present. The water then moved through the energy source trench where additional denitrification took place. Table 22 shows that there is about 1 ppm reduction in NO_3 from the wells, before the energy trench, to the wells on the outside of the trench.

The deep wells in the spray area had low NO_3 concentrations until July 30 when the NO_3 levels began increasing, Table 21. During this time the overall water table was dropping and these wells were sampling at a decreasing depth into the water table. Table 23 compares the NO_3 levels between the deep wells outside the BLWRS to the deep wells on the spray area. These values confirm that no deep movement of NO_3 occurred.

The efficiency of this BLWRS for polishing nitrogen from lagoon effluent is tabulated in Table 24. Efficiency for TKN never dropped below 94%, reduction in NH_3-N was above 97% for the entire application period, and total N efficiency of this system had increased from 75% to over 92% as the concentration of nitrogen in the lagoon effluent increased.

Phosphorus

In Table 25 the concentration of phosphorus contained in the lagoons and in the retention tank before wastewater was applied are tabulated. The first two periods were at similar concentrations but during the third period P increased. This is because Lagoon 1, which was continuously receiving new sewage, was pumped into Lagoon 2 to supply more wastewater for application. The lagoon had been pumped from the bottom which caused considerable mixing of the less treated wastewater with sludge and increased levels of phosphorus. The total amount of P applied was 12 lb/a (13.4 kg/ha), however, this is a small amount compared to the uptake of the vegetation.

Table 22. Mean and Standard Deviation of the Nitrate-Nitrogen Concentration in Ground Water Samples from the Shallow Paired Wells on the Inside of the Energy Trench to the Shallow Wells on the Outside of the Energy Trench.

Date of Sampling	Inside Shallow Wells		Outside Shallow Wells	
	$\overline{X}$	S	$\overline{X}$	S
	ppm			
6/15	7.7	10.2	6.8	12.4
6/18	7.8	9.8	6.0	10.8
6/22	8.4	11.3	6.7	13.1
6/25	9.6	13.1	4.3	4.6
7/01	4.9	7.0	4.5	5.4
7/06	5.0	6.8	4.2	5.5
7/09	4.7	6.6	4.0	5.0
7/13	3.4	3.8	3.1	3.7
7/16	3.0	2.9	3.1	3.1
7/20	2.7	3.7	1.8	2.5
7/23	3.8	3.7	3.0	3.1
7/26	4.0	3.7	3.6	3.0
7/30	3.8	3.6	3.3	2.9
8/03	4.3	4.4	3.6	3.1
8/06	4.6	4.7	3.9	3.4
8/10	5.1	5.5	4.6	4.7
8/13	5.4	6.4	5.9	5.9
AVERAGE	5.2		4.3	

Table 23. Mean and Standard Deviation Comparing the Nitrate-Nitrogen Concentrations in the Deep Wells Outside the BLWRS to the Deep Wells on the Spray Area.

Date of Sampling	Deep Wells Outside the BLWRS		Deep Wells in the Spray Area	
	$\bar{X}$	S	$\bar{X}$	S
	ppm			
7/30	2.7	3.1	5.9	4.2
8/03	3.2	3.7	8.7	7.0
8/06	3.4	3.8	11.8	6.5
8/10	1.9	2.4	11.8	4.0
8/13	2.0	2.5	16.6	6.3

Table 24. Treatment Efficiency of the Barriered Landscape Water Renovation System in Reducing Concentrations of Nitrogen Components from Lagoon Treated Waste.

Period of Samplings	TKN	NH_3	Total N ($TKN + NO_3^-$)
	%		
6/15-7/03	96.4	97.6	75.1
7/04-7/16	94.8	98.1	83.8
7/17-8/10	98.0	99.2	92.2

Table 25. Mean and Standard Deviations of Concentration of Phosphorus Components in the Lagoons and Retention Tank Wastewater.

Period of Sampling	t-P $\bar{X}$	t-P S	i-PO_4 $\bar{X}$	i-PO_4 S
	ppm			
6/15-7/03*				
Lagoon 1	2.70	0.74	1.53	0.40
Lagoon 2	2.93	1.19	1.95	1.17
Tank 1	3.00	0.47	2.38	0.47
Tank 2	2.97	0.43	2.43	0.41
7/04-7/16**				
Lagoon 1	2.85	0.94	1.58	0.60
Lagoon 2	4.65	0.37	3.54	0.11
Tank 1	2.53	0.30	2.04	0.26
Tank 2	2.48	0.33	2.06	0.26
7/17-8/10***				
Lagoon 1	6.11+	1.30+	3.97	1.01
Lagoon 2	6.35	0.19	5.27	0.27
Tank 1	5.75	0.36	5.09	0.26
Tank 2	5.70	0.37	5.11	0.29

*Spray application water being drawn from Lagoon #2.
**Spray application water being drawn from Lagoon #1.
***Spray application water being drawn from Lagoon #2 after Lagoon #1 had been pumped into Lagoon #2 during 7/20 and 7/23.
+These values do not include the sampling while the lagoons were mixed due to sludge contamination.

Table 26. Concentration of Phosphorus Components in the Upper Soil Profile of the Spray Area during Wastewater Application.

Date of Sampling	Depth of Sampling cm	(inches)	t-P	Bray-P
	ppm			
6/22	0-15	(0-6)	266	6.7
	15-30	(6-12)	211	4.1
	30-45	(12-18)	193	3.9
7/09	0-15	(0-6)	265	9.1
	15-30	(6-12)	260	4.7
	30-45	(12-18)	268	5.1
8/07	0-15	(0-6)	290	5.4
	15-30	(6-12)	250	3.6
	30-45	(12-18)	192	3.2

Soil analysis for t-P and extractable P can be found in Table 26. The phosphate values are quite low. The soil is also variable so that it is difficult to detect the small amount of phosphate added which was less than the amount that the vegetation could remove in the season.

Results of the t-P and i-PO_4 in the groundwater samples also showed that the applied P did not leach to the groundwater. Table 26. The mean value for t-P never went above 0.38 ppm and the i-PO_4 never higher than 0.03 ppm. The P was taken up by the vegetation or fixed by the soil.

The treatment efficiency of this BLWRS for P components on the average were 96.7% and 99.6% for t-P and i-PO_4, respectively. The efficiency would be 100% if the samples were corrected for background P. The reduction percentages were determined from the time that the wastewater left the retention tank to where it came in contact with the shallow paired wells. These values indicate that there will be no loss of phosphorus from this BLWRS at these loading rates.

Carbon

In this study, analysis of carbon took on two forms: Biological Oxygen Demand (BOD) and Total Organic Carbon (TOC). Values for BOD in the lagoons and the retention tank are shown in Table 27. There was only a small reduction in BOD in the retention tank. The mean and standard deviation comparing the shallow paired wells and the deep wells for BOD are tabulated in Table 28. There is a large reduction in BOD as the wastewater passes through the BLWRS. The values for the paired wells are slightly higher than for the deep wells. These higher values are understandable in that there is probably a higher content of easily oxidized carbon materials in the upper profile of the water table than in the 18 in. (45 cm) depth. The percent efficiency of this BLWRS for BOD on June 29 and July 26 samplings are 67.5% and 55.3%, respectively.

Results of the analyses for TOC can be found in Table Va in the Appendix.

Table 27. Biological Oxygen Demand of the Lagoons and Retention Tank Wastewater at the Coldwater Information Center.

Sampling Site	Date of Sampling 6/29	7/26
	ppm	
Lagoon 1	15.0	59.0
Lagoon 2	24.0	23.0
Tank 1	20.0	17.0
Tank 2	20.0	17.0

Table 28. Mean and Standard Deviation of the Biological Oxygen Demand in the Well Water below the Barriered Landscape Water Renovation System at the Coldwater Information Center.

Date of Sampling	Shallow Paired Wells		Deep Wells	
	$\bar{X}$	S	$\bar{X}$	S
	ppm			
6/29	6.5	4.0	3.2	1.4
7/26	7.6	4.7	4.4	2.0

Table 29. Concentration of Lagoon and Retention Tank Wastewater for Total Organic Carbon at the Coldwater Information Center.

Sampling Site	Date of Sampling 4/16	5/07	6/11	7/01	8/03
	ppm				
Lagoon 1	45	26	50	39	157
Lagoon 2	46	84	57	45	80
Tank 1		41	23	34	36
Tank 2		48	15	35	36

Lagoon and retention tank concentrations are presented in Table 29. The values obtained for TOC behaves in the same manner as the BOD. In comparing the shallow wells to the deep wells, Table 30, there was only a difference of 4.6 ppm which is not deemed significant since all the results were variable. Since TOC did not increase in the groundwater, it is concluded that the system was removing TOC.

Comparison of the inside wells to the outside wells, Table 31, shows that the energy trench did not add to the C content of the water table since the average of the inside wells and the outside wells were the same.

Treatment efficiency was also calculated for TOC on the July 1 and August 3 samplings. The results were 67.7% for the July sampling and 67.2% for the August 3 sampling. These results show that the BLWRS also greatly reduced the TOC content of the wastewater in spite of the fact a background TOC correction was not used.

Microbiology

Ozonation was used primarily for odor control but had some effect upon populations of microorganisms in the retention tank.

The analysis for total coliform, fecal coliform, total streptococci and fecal streptococci (Tables Vf, g, h) show variable germicidal effectiveness of the ozonation in this situation. Comparison of the indexes from the lagoons to those of the retention tank show some increases and some decreases, but are usually in the same order of magnitude for each organism. Because of the heavy particulate matter, temperature of the water, and other interfering factors, the ozonation cannot be considered a reliable means of reducing these bacterial populations.

Microbiological samples were obtained before the onset of wastewater application to determine if there was any contamination in the wells. The first sampling on April 18 showed some of the wells fairly high in total coliforms but substantially low in MPN of fecal coliforms. This established a base line of

Table 30. Mean and Standard Deviation of Concentration of Total Organic Carbon in the Shallow Paired Wells and the Deep Wells.

Date of Sampling	Shallow Paired Wells		Deep Wells	
	$\bar{X}$	S	$\bar{X}$	S
	ppm			
4/16	22.2	13.2	10.6	2.1
5/07	16.7	7.9	9.9	2.5
6/11	11.3	6.3	9.2	4.1
7/01	11.3	6.9	9.9	3.7
8/03	11.8	4.2	10.9	5.4
AVERAGE	14.7		10.1	

Table 31. Mean and Standard Deviation Comparing the Concentration of Total Organic Carbon between the Shallow Paired Wells Inside the Energy Trench and the Shallow Paired Wells Outside the Energy Trench Surrounding the Barriered Landscape Water Renovation System.

Date of Sampling	Inside Wells $\bar{X}$	Inside Wells S	Outside Wells $\bar{X}$	Outside Wells S
	ppm			
6/11	11.4	6.4	11.7	6.0
7/01	10.8	4.1	12.3	8.6
8/03	12.7	5.2	10.9	2.9
TOTAL	34.9		34.9	

residual soil organisms against which subsequent samples would be compared after wastewater was applied. The second sample taken on May 15 showed that fecal coliform counts had been reduced. This was most likely due to flushing out of the wells a number of times since the first sampling.

After application had proceeded, two additional samples were taken. Populations of fecal coliforms remained at low numbers except for two wells on the July 6 sampling which was probably a result of sampling technique. Numbers of total coliforms were high on some of the wells as can be seen in Table VIII. The number of soil microbes initially found in the soil gives no suggestion that contamination had resulted from spray application.

In Table Vf and Table 32 the average of fecal coliforms in the samples indicate that on July 20 the fecal coliforms had drastically increased. On July 13 the shallow paired wells had been redug deeper as a result of a drop in the water table. Apparently, contamination resulted not from the wastewater but from disturbance and possible contamination of the wells. A final microbial sample was taken on August 3. All but four shallow wells had returned to counts below 200 organisms per 100 milliliters. This indicates that the BLWRS was effectively reducing fecal coliforms in the wastewater and the four wells found high were most likely a result of sampling technique. Data from the entire water application period demonstrates that this type of land application will not allow wastewater contamination of the groundwater.

CONCLUSION

The Modified Barriered Landscape Water Renovation System (BLWRS) at the Coldwater Rest Area and Travel Information Center achieved excellent advanced treatment of human wastewater. The groundwater aquifer was monitored continuously while applying wastewater and indicated that no chemical or biological

Table 32. Average MPN of Fecal Coliforms at the Barriered Landscape Water Renovation System.

Date of Sampling	Shallow Paired Wells	Deep Wells
	MPN/100 ml	
4/18	41.9	0
5/15	20.2	0
6/18	17.3	2.2
7/06	5.5	1.5
7/20	9,148.4*	0.3
8/03	69.1	1.6

*Wells reset before this sampling.

contamination had occurred. The system performed equally well under conditions of applying either stabilized or unstabilized wastewater.

A little more than half (60%) of the wastewater applied was evapotranspired, leaving only 40% of the wastewater available for drainage. This is not representative of a typical BLWRS, but was caused by an unusually dry summer season. At no time during the treatment process was there surface ponding or soil pore clogging which would indicate that the BLWRS was hydraulically overloaded.

Chemical and biological analyses of all the sampling parameters show that this system was an effective treatment system. Nitrification occurred in the upper soil profile and all indications were that denitrification was accomplished in the rhizosphere, saturated zones in the soil, and in the energy trench. Any threat of NO_3 contamination was removed and the efficiency of treatment was greater than 92% for all nitrogen sources. Phosphorus was fixed and/or adsorbed in the upper 15 cm (6 m) of the soil. Phosphorus in stabilized waste was effectively reduced by 96.7% for t-P and 99.6% for i-pO_4. Both BOD and TOC were removed by this system. The energy trench did not increase the carbon content of the groundwater.

Ozonation was effective in controlling odors but was not consistent in reducing total streptococci, fecal streptococci, total coliforms, or fecal coliforms.

Dundee

The Dundee Rest Area and Travel Information Center has a system which consists of a three celled lagoon system which is periodically discharged into seepage beds on a level, slowly permeable clay loam soil with a high water table. The water table will fluctuate from the surface in the spring to 5 or 6 feet in a dry summer. This area had adequate space so that the seepage beds could be constructed at the rest area. The seepage beds were designed so that the release of effluent from one of the lagoons would add between 1 and 1-1/2 ft (30-45 cm) of wastewater to the beds. This provided good aeration of the seepage bed water during the seepage process which proceeded at a rate of 0.5 to 0.6 in. (13-15 mm) per day. This rest area is monitored through the season and the discharge beds are monitored and surrounding wells are measured during the discharge. These data are reported in Table IVa, IVb, IVc, IVd, IVe and IVf of the Appendix. Wells 1, 2, 3 9 and 10 surround the discharge beds, wells 4, 5 and 6 are in the treatment lagoon area and wells 7 and 8 are control wells are at the south and west or upstream as the groundwater flow is northeast.

There were two lagoon discharges during this project period. On August 2, 1977 lagoon No. 2 was discharged to the discharge cells. The lagoon was dropped 36 in. (910 mm) in 27 hours and markers in the discharge cells showed average depths at the markers of 10 3/4 in. (270 mm) and 19 1/2 in. (500 mm) in cells 4 and 5, respectively. In three days the water level in the discharge cells had dropped 2 1/4 in. (57 mm), in six days 3 in., in thirteen days 5 in. and in 20 days cell 4 was drained and cell 5 had 8-10 in. (200-250 mm) remaining. The data taken prior to discharge and after discharge are given in Tables IVd and IVe of Appendix.

The discharge did not show any contamination of nutrients or microbes into the surface water table wells. The data from wells No. 1, 2, and 3, east of the discharge lagoons and wells No. 9 and 10, placed west of the discharge lagoons, were not different from the other shallow wells. It was interesting that all wells increased in NO_3-N from a range of 0.01 to 0.1 ppm to 0.3 to 1.4 ppm on September 8 and September 19. This was after the late summer rains began.

The Dundee lagoons were dumped again between June 20-23 into the seepage lagoons. They had not been used throughout the winter and it was mostly rainfall and snow melt which was dumped. After the dumping of these lagoons, there seemed to be some change which could indicate an increase in nitrate in the groundwater but it was always below 1 ppm and usually below 1/2 ppm. Fecal coliforms in one of the wells seems to be high but this is only one well and the adjacent wells do not have a similar increase in fecal coliforms so it may be a contaminated well.

Further studies of the wells had to be terminated because the water table had dropped below the wells. No attempt to deepen the wells was made because the disturbance during deepening would have confounded the studies.

A discharge which occurred during the previous project on October 27, 1976 also showed no increase in nitrate or fecal coliforms on the shallow wells after discharge.

CONCLUSION

It can be concluded that these lightly loaded seepage beds are filtering the organic matter and microbes, absorbing the phosphate and converting the TKN to NO_3-N. The NO_3-N is denitrified in the anaerobic zone just below the flooded soil surface of the seepage bed. Because the beds are used only once or twice a year, there is ample time for rejuvenation of the soil and vegetation before recharge. As long as these beds are used during the warm part of the year and when the natural water table is several feet below the surface, this system will perform well.

Watervliet

At the Watervliet Rest Area, lagoon effluent is discharged into a creek by passing through a 1600 ft (500 m) long sewer. Comparisons could be made between lagoon effluent changes in the sewer and in a ditch that had 6 to 8 ft (2.5 to 3 m)of flat bottom for most of the way. Discharges were made at three different times during the course of this project. The second lagoon was discharged October 21-28, 1977. On the 21, 22nd and 28th it was passed through the sewer. On the 27th and 28th it was passed down the ditch. Samples were taken three times while the sewer was running and three times while the wastewater was diverted to the ditch. The first lagoon was discharged May 3 and 13, 1978. Five ditch samplings and two sewer samplings were made. The second lagoon at Watervliet was discharged September 18, 19 and 20, 1978. Four samplings were made of the ditch and three of the sewer. The data is found in Table IIA and IIB in the Appendix. A summary in Table 33 compares the effluent at the beginning or entrance to the sewer or ditch and at the outfall which was after the 800 ft (250 m) of passage in either.

There can be considerable pickup of suspended solids in the ditch depending on the nature of the bottom of the ditch. In 1977 there were frequent areas of bare soil so that the SS load increased. In the second season 1978 the reed canary grass was established and there was actually a decrease in the SS as the wastewater flowed down the ditch.

Total phosphate decreased in the ditch by as much as 50% while there was no change in the sewer. Inorganic phosphate also decreased 50% in the ditch but only 10% on the average in the sewer. This decrease in PO_4 indicates that the biological activity in the wastewater as it passed through the ditch released phosphate which was removed from the wastewater by the soil and plants of the ditch.

Total Kejhahl nitrogen decreased as the water traversed the ditch reducing from 12% to 35% from the first and last studies. The nitrogen transformations are related to the temperature and the effect of temperature on biological activity. The temperatures ranged 10-14°C for October, 1977, 10-17°C for May, 1978 and 20-25°C for September, 1978. Ammonia decreased as did TKN. This was due to the conversion of NH_3 and TKN to NO_3 which should have increased the NO_3 concentration. The NO_3 concentration did not change because the extra NO_3 was removed by plants in the ditch. The fact that more NO_3 was not removed is surprising, but perhaps the time of plant-NO_3 contact was not long enough to allow for more plant uptake.

CONCLUSION

This study does show that allowing treated wastewater to flow through a long, well-vegetated ditch can perform a polishing treatment which will reduce phosphate and nitrogen. The practice of confining the treated wastewater in a sewer is an expensive and questionable practice if the discharges are made during the warm periods of the year when further polishing treatment can occur in the ditch.

Table 33. Summary of changes in effluent composition when discharged through a sewer or ditch 800 feet long at Watervliet October, 1977; May, 1978 and September 1978.

	BOD	TOC	SS	tPO_4	iPO_4	TKN	NH_3	NO_3	NO_2
	ppm								
October 1977									
Ditch-beginning	15	23	12	3.4	3.02	4.4	0.5	0.6	0.03
Ditch-end	11	24	163	1.9	1.76	3.9	0.6	0.6	0.02
Sewer-beginning	9	17	10	3.1	2.90	3.2	0.1	0.9	0.03
Sewer-end	12	18	17	3.1	2.80	3.4	0.2	0.9	0.03
May, 1978									
Ditch-beginning	19				1.43	8.4		2.94	0.96
Ditch-end	19				0.66	6.5		2.91	0.88
Sewer-beginning	16				1.50			3.42	0.97
Sewer-end	16				1.35			3.55	0.97
September 1978									
Ditch-beginning	15		44	2.6	1.75	8.3	1.10	0.48	0.10
Ditch-end	9.8		24	1.3	.92	5.4	0.25	0.50	0.05
Sewer-beginning	9.3		50	2.6	1.69	8.1	1.00	0.47	0.07
Sewer-end	9.7		50	2.6	1.34	7.1	0.90	0.53	0.09

COST OF EFFECTIVE TREATMENT

Many alternative treatment techniques may be used to achieve effective treatment of sewage at existing highway rest areas. In this study, we analyzed the effectiveness of three techniques:

a. land treatment of existing effluents;

b. design alterations in conjunction with land treatment;

c. design changes without land treatment

There are, of course, several methods of arriving at each of these techniques. Within the time and budget constraints of this project, two methods were examined for effectiveness for each of techniques (a) and (b). Based on the satisfactory results of the field experiments, the additional cost of improving the effectiveness of treatment was estimated. Although no design changes alone were examined in field studies, data available from other projects were evaluated to estimate the cost of improving the effectiveness of treatment without land treatment.

Land Treatment of Existing Effluents. Dundee and Watervliet serve as two examples of ways of treating existing effluents without major design modifications. In the case of Dundee, the additional cost of land treatment by infiltration-percolation was primarily associated with the acquisition of additional land, diking and fencing it, and the provision of monitoring wells. In the case of Watervliet, the additional cost of land treatment was associated primarily with regrading an existing highway drainage ditch and blocking the existing sewer outfall to form an overland flow treatment system.

The estimated additional costs for effective treatment were $25,000 and $1,500 for Dundee and Watervliet respectively.

Design Alterations and Land Treatment. Clare and Coldwater serve as two examples of ways of implementing land treatment which required design and construction of additional facilities. Each represents an entirely different terrain situation coupled with a difference in proximity and ease of access to the existing site as well as a different means of distributing the wastewater.

Clare represents an example of overland flow over extremely steep terrain covered with grasses and few, if any, shrubs and no trees. The land disposal site is contiguous with the existing treatment lagoons. However, the flow scheme requires a fair run of pipe and a substantial pump lift.

In contrast, the coldwater spray irrigation site is virtually level and contains a substantial growth of trees and shrubs. It is located such that two lanes of highway and a ramp lie between it and the treatment lagoons.

The major design modifications at Clare were as follows:

a. Pump/lift station

b. Run of pipe up hill

c. Chlorine contact tank (earth work lined with plastic) and bubbler system

d. Terracing

e. Perforated pipe distribution system

The major design modifications at Coldwater were as follows:

a. concrete chamber for ozonation

b. Three ozonators

c. Pump/lift station

d. Run of pipe under access ramp and north bound lanes of I-69

e. Solid set spray system (buried)

f. chain link fence with lattice work

The additional costs for effective tretment were estimated to be $25,000 and $100,000 for Clare and Coldwater respectively. Given the inaccessability of the

Coldwater site and the substantial growth of vegetation and the minimal potential for airborne infection, it may be possible to eliminate the fencing at similar sites which may be constructed in the future. This would reduce the Coldwater cost by approximately $20,000.

Design Alterations Without Land Treatment. Although no specific cases in this category were field tested, other data are available to estimate the cost of this alternative. Examples include connection to an existing municipal wastewater treatment plant and the upgrading of a lagoon system to advanced waste treatment (AWT). Both of these cases assume availability of resources which may not be technically possible, i.e. the existence of a nearby municipal wastewater treatment facility willing to accept wastewater in the first instance and the availability of sludge disposal facilities and competent operating personnel in the second instance.

The estimated cost for connection to an existing municipal wastewater collection system within 6.5 kilometers of the rest area is approximately $200,000. This includes the cost of a lift station and highway crossing.

The estimated costs of upgrading to an AWT system vary between $25,000 and $70,000 exclusive of the cost of the sludge disposal facility. The sludge facility would be an order of magnitude greater than that of any land treatment system.

SUMMARY AND CONCLUSIONS. The cost of the various combinations is summarized in Table 34. As can be seen from this table, the cost of land treatment of existing effluents is by far the cheapest method of upgrading the effluent quality. In cases where this is not technically feasible, design modifications in conjunction with land treatment are cheaper to implement and operate than design changes without land treatment to achieve the same quality effluent.

Table 34. Cost of Effective Treatment.

Treatment Alternative	Estimated Cost, $
Overland flow	1,500
Infiltration-Percolation	25,000
Overland flow (steep terrain)	25,000
Spray irrigation	100,000
Sewer Connection (6.5 km)	200,000
AWT (including sludge disposal)	140,000

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PART 2

Aerosol Transport Studies

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AEROSOL TRANSPORT STUDIES

INTRODUCTION

The major effort of the sanitary engineering team has been devoted to an examination of the potential for minimization of the formation and transport of biological aerosols from spray irrigation of lagoon effluent. This section of the report describes the experiments leading to and the results of field tests conducted at the Coldwater rest area.

In order to demonstrate that bacterial transport from the controlled spray of ozonated lagoon effluent does not pose a health problem the following general protocol was followed:

*First, demonstrate our capability in capturing and culturing airborne fecal coliforms under known laboratory conditions;

*Second, demonstrate our capability in capturing and culturing airborne fecal coliforms from a pilot spray system designed to generate aerosol coliforms;

*Third, demonstrate the absence of significant fecal coliform counts under actual field conditions at Coldwater.

The first year of effort was devoted to the development of a capability to capture and culture airborne fecal coliforms. Because of construction delays at Coldwater, the second year's effort was devoted to refinement of the sample collecting system and to pilot testing. The third year's effort was devoted to actual field sampling at Coldwater.

LABORATORY STUDIES

Purpose of Investigation. One of the major problems involved in studying biological aerosols is the selection of a sampling device. There are many samplers available but most are designed for large volume sampling in a laboratory or hospital. For field research few small volume samplers have been designed that are efficient at capturing viable microorganisms. The following sections describe (a) the requirements of aerobiological samplers, (b) the major types of samplers that have been used and (c) the objectives and approach to developing a simple economical microbiological sampler for field research.

Requirements of Samplers. The following parameters must be measured for definitive results in aerobiological research: source strength, decay rate, particle-size distribution and dose response or infectivity. Source strength is a measure of the quantity of microorganisms that become airborne and is recorded as a concentration of microorganisms per unit volume of air or as a percent recovery of the total material aerosolized. The decay rate represents a measure of the rate at which aerosol concentration is reduced as a function of physical deposition and microorganism death. Particle size distribution effects both the physical decay rates and respiratory infection properties. Respiratory infectivity represents a quantitative measure of the number of viable airborne microorganisms required to elicit a given response. Acute clinical infection or death in members of a susceptible host population are two measures which are used to define response.

In order to measure the above parameters an aerosol sampler must provide for a quantitative method of assay. The sampling device should be capable of 'counting' the total number of viable particles in a unit volume of air, as well as determining the number of viable units per particle and the size of the particles. However, this presupposes that 100% of the sample is recovered and that no loss of viability occurs during sampling. Loss of viability may occur by dessication in an impinger or by impaction on an agar surface.

In addition to the selection of a sampling device, a culturing method should be selected that provides for maximum growth of the organism being tested or sampled after it has been captured from the aerosol. Unfortunately, the culturing method that provides maximum growth for unstressed microorganisms may not support growth of microorganisms damaged by aerosolization and collection. The efficiencies of both the sampling device <u>and</u> the culturing method must be considered in analyzing for biological aerosol contamination.

Major Types of Samplers. Methods for sampling bacterial aerosols listed by Tyler and Shipe[1], Anderson and Cox[2] and by Akers and Won[3] include sedimentation, filtration, agar impaction, electrostatic deposition, liquid impingement, centrifugation and thermal precipitation. The most frequently used samplers as reported in the literature since 1969 have been the <u>All Glass Impinger</u> (AGI-30), AGI-30 with a single stage impactor, the multistage liquid impinger and the Andersen sieve sampler.

The all glass impinger operates by drawing the aerosol through an inlet tube and then through a critical orifice (capillary tube). When the ratio of pressure at the capillary outlet to inlet pressure (1 atm) is 0.5 atm or less, particles in the aerosol impinge into the fluid at sonic velocity. The flow rate is constant and once the sampler has been calibrated no flow meter is necessary. For maximum recovery of bacterial cells a volume of 20 milliliters of sampling fluid and a distance of 30 millimeters between the capillary tip and the bottom of the AGI-30 have been experimentally determined to provide the best results[3]. The AGI-30 samples at a flow rate of 12.5 liters per minute. The following investigators have used the AGI-30: Benbough[4,5], Hatch[6,7], Rabey[8], Duboui[9], Gerone[10], Mullica[11], Trouuborst and Dejong[12], Akers[13], Lighthart[14], Ehresmann and Hatch[15], Elliott[16], and DeMik[17].

The all-glass impinger with a single stage impaction device has been gaining popularity. The single stage impaction device is attached to a modified AGI-30. When sampling vegetative or other viable organisms 2 mℓ of a suitable agar are used on the impactation plate to provide a collection surface for the heavier particles of any given sample, while appropriate collecting fluid in the impinger allows the lighter smaller particles to be collected without losing viability. The following investigators have used this sampler: Ehrlich[18], Ehrlich and Miller[19,20,21].

The multistage liquid impinger is designed to sample viable organisms, and to determine their concentration within size ranges of interest in terms of regional respiratory track deposition. When air is drawn through the instrument it enters the intake tube, and flows over a disc, where some of the larger aerosol particles impact on a wet surface. The particles penetrating the second stage pass down the third tube and through a jet. The tangential component of the jet imparts a virgorous swirl to the liquid, which ensures that impingement is always on a wetted surface. This sampler has been used by Hood[22], DeJong[23], Sellers[24], and Fannin[25].

The Andersen sieve sampler is a multistage, multijet cascade impactor, used for the collection and sizing of airborne particles. Particles are collected in aerodynamically graded sizes for determining size distribution and concentration. Air is drawn through the sampler producing a jet of air from each of the 400 holes in each stage. The jet is directed at a collection plate below. The size of the holes is constant for each stage, but is smaller in each successive stage. Consequently the jet velocity is uniform in each stage, but increases in each succeeding stage. When the velocity imparted to a particle is sufficiently great, its inertia will overcome its aerodynamic drag and the particle will impact on the surface. Thus each stage collects smaller particles than the preceeding one. The sampling rate is one cubic foot per minute. The following investigators have used the Andersen Sampler: Green[26], Whyte[27], Adams and Spendlove[28], Steward and Wright[29], Thomas[30, 31], Keline and Scarpino[32], Riley and Kaufman[33] and McGarrity and Coriell[34].

New developments or alterations in samplers are the AGI-30 with humidifier bulb, multi-slit large volume sampler, cyclone separator, simple liquid scrubber and the improved cyclone scrubber. The AGI-30 with humidifier bulb was developed by Hatch and Warren[6] in 1969. The humidifier bulb consists of a 2000 mℓ flash evaporator bulb containing 200 mℓ of distilled water. The lower half of the bulb is immersed in a water bath heated to 40°C. An electric motor turns the bulb at approximately 30 revolutions per minute. A glass insert allows a sample to be drawn from the aerosol chamber through the bulb and then through a narrow tube into an AGI-30 collector.

Buchanan[35] developed the multi-slit large-volume air sampler. The multi-slit impinger sampler operates on the principle of inertial impingement of airborne particles into a liquid film maintained on the surface of a rotating disc. Air is drawn into the sampler through small rectangular slits located very near the surface of the liquid film. The collection liquid is pumped to the center of the disc through a thin stainless-steel tube that is suspended above and across the diameter of the disc. High-velocity air jets directed against the film cause the airborne particles to impinge into the liquid. The particle-laden liquid then flows across the surface of the disc and is removed by a hollow plastic scraper that touches the rim of the disc and allows the liquid to pass into a collection tube from which it is removed by vacuum into the effluent container.

A cyclone separator for aerosol sampling in the field was developed by Errington and Powell[36]. Two sizes were tested, the smaller at a flow rate of 15 ℓ/min with a pressure drop of 75 mm Hg; the larger at about 350 ℓ/min at a pressure drop of 200 mm Hg.

A simple liquid cyclone scrubber for large volume air sampling was developed by Buchanan[37]. The collecting fluid is pumped through a needle into the throat of the inlet arm, where it is aspirated into a fine mist by the airstream. The air enters the right-angle arm tangentially and assumes a spiral path. The mist droplets are thrown out of the airstream onto the walls, forming a continuous film which is moved helically by the airstream to an outlet, where the fluid is collected in a flask with the aid of a slight vacuum. The air-borne particles are removed from the airstream perimarily by impingement into the film of liquid.

White[38] made substantial improvements on Buchanan's cyclone scrubber. It differs from the Buchanan model in several respects: (i) that portion of the transition piece which is inserted into the collector was redesigned to ensure complete collection of the fluid; (ii) vacuum for the collection of the fluid was provided by using the pressure drop between the sample outlet tube and the motor, rather than by a pump; (iii) collecting fluid is provided at a constant rate by means of a screw-driver syringe; (iv) the modified sampler contains a device for the metered addition of sterile distilled water to replace that lost due to evaporation.

Because of the limited scope and funding of this project our consideration was limited to the AGI-30 and modifications thereto. The AGI-30 is well suited for field work because of its small size, minimal power requirements and ease of operation. The objective of the laboratory phase of the project was to improve the efficiency of the AGI-30 for recovery of viable FC microorganisms. The following were examined to determine the factors which gave maximum fecal coliform recovery:

1. Collection media composition.
2. Culturing method.
3. Wind tunnel variance.
4. Holding time.
5. Sampling rate.
6. Sampling time.
7. Collection media at 35°C.
8. Water injection (water injected into impinger inlet).
9. Dilution water spray injection (nebulizer sprayed dilution water into Tee proceeding AGI-30 inlet).
10. Water spray injected (Nebulizer sprayed distilled water into Tee preceeding AGI-30 inlet).
11. AGI-30 with Humidifying Bulb.
12. AGI-30 with Venturi Scrubber.

Test Descriptions. All tests were run in a 0.15 m diameter wind tunnel (Figure 1) with the control impinger on one side of the tunnel and the experimental impinger on the other. A description of each experimental variation follows:

1. Collection Media

Media used to collect a bacterial aerosol sample in an impinger must be non-toxic to the organism being sampled, sustain the organism in a viable state without inducing reproduction and have a low foaming potential to prevent the sample from overflowing the impinger and entering the pump. Three collection media were tested to determine which provided the best recovery without excess foaming. Ten milliliters of media were used instead of the standard twenty milliliters[3] because less carry over occured from foaming.

Lauryl tryptose broth was selected as one of the test media because of its wide use for coliform analysis in water and wastewater. The concentration used in testing was half-strength. Phenol red lactose broth (Difco) was examined because of its use in the two-step phenol red lactose culturing method. M-Fc broth was tested (BBL) because it is used in the standard culturing method for fecal coliform.

2. Culturing Method

Standard Methods describes the standard culturing procedure the M-FC method for recovery of fecal coliform. Lin[39] proposed a new culturing

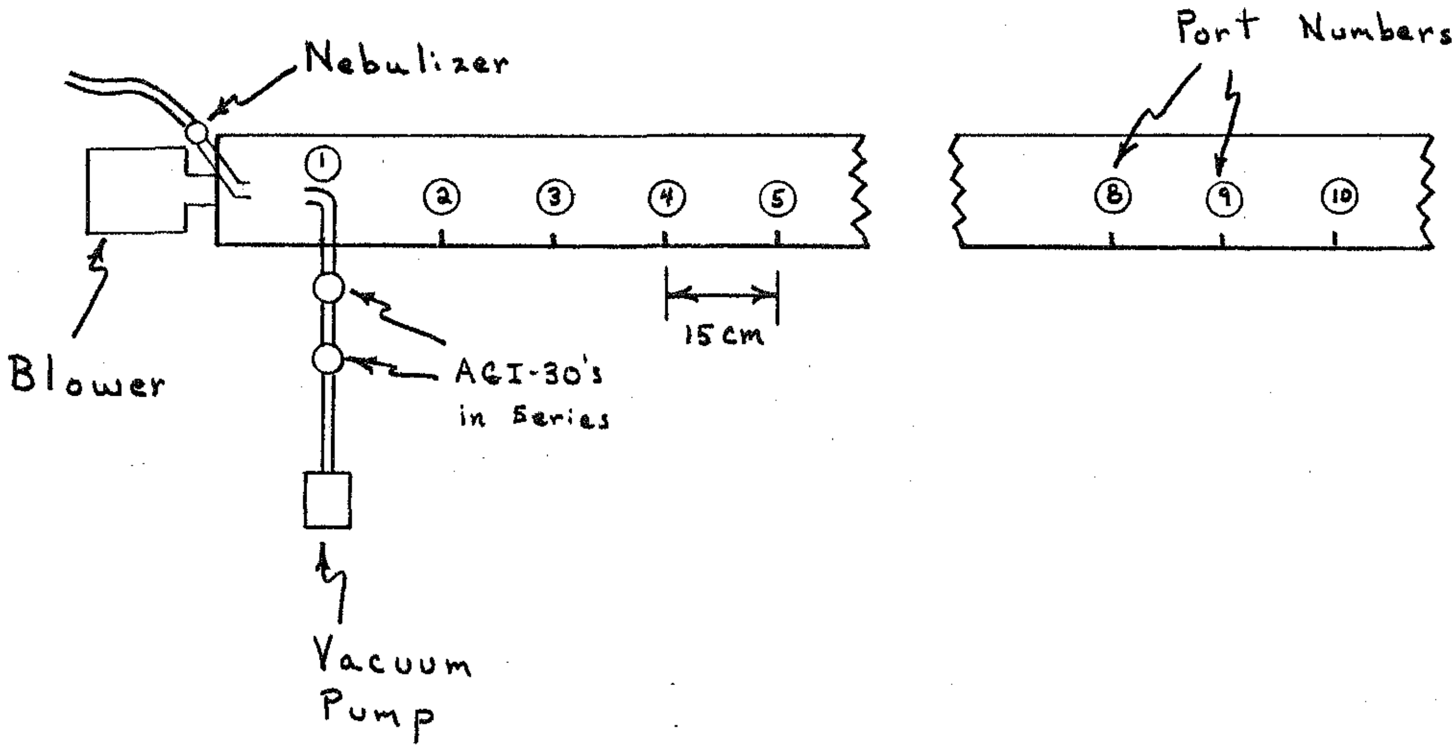

Figure 1 Plan View of Wind Tunnel

method, a two-step phenol red lactose broth (PRLB) procedure, for the recovery of fecal coliform stressed by chlorination. The two-step method was compared to the M-FC method for the recovery of aerosolized fecal coliform. Samples were taken under the same conditions, at a sampling rate of 1.4 ℓ/min. One set was cultured using the M-FC method. The other was cultured using the PRLB method.

3. Wind Tunnel Variance

Before any experiments could be run in the wind tunnel it was necessary to determine if any variation existed between opposing sides of the tunnel. Flow patterns in the tunnel could cause one side to receive a higher bacterial aerosol concentration than the other. Impingers were placed on opposite sides of the tunnel and samples were taken under identical conditions (namely, a sampling rate of 1.4 ℓ/min and cultured using PRLB).

4. Holding Time

Field studies often involve considerable travel time before samples can be analyzed in the lab. It is important to determine if this holding time has any affect on the sample concentration. Sampling was conducted in the wind tunnel under identical conditions (sampling rate 1.4 ℓ/min, cultured using M-FC method). Filtering and culturing were carried out immediately on one set of samples and the others were held at 22°C for two and four hours before assay.

A variation of the holding time test was conducted using ice storage of the test impinger. After each run one impinger was placed in a styrofoam cooler partially filled with ice and left for 6 hours. As before, the control sample was immediately filtered.

5. Sampling Rate

Theoretically the all-glass impinger should be operated at 12.5 ℓ/min. This would allow the capillary exit velocity to approach sonic velocity and thus cause the bacterial particles to impinge in the liquid . This extreme velocity, however, could cause vegetative cells to be injured or killed as they are smashed against the collector bottom. To decrease the possible injury to cells lower flow rates were compared to the standard 12.5 ℓ/min. Five minute runs were conducted at 1.4 ℓ/min versus 13.0 ℓ/min, 4.3 ℓ/min versus 13.0 ℓ/min and 7.5 ℓ/min versus 13.0 ℓ/min. Twenty minute tests were run comparing 1.8 ℓ/min to 13.3 ℓ/min and 5.4 ℓ/min to 13.1 ℓ/min. All samples were cultured using the two-step PRLB method.

6. Sampling Time

One of the parameters governing the representativeness of a sample taken from a bacterial aerosol cloud is the volume of the sample. Obviously, the larger the sample volume the more representative of the ambient condition it will be. Because the sampling rate of the AGI-30 is limited to about 12 to 13 liters per minute and, in fact, as noted above, it operated more effectively at lower sampling rates, the only means to increase the volume of the sample is to extend the sampling time.

The experimental procedure followed that used in comparing flow rates with the following exceptions. For the comparison of the 5 and 10 minute sampling time two impingers were run for 5 minutes and then the system was shut down. The 5 minute control was replaced and the experiment was then continued for another 5 minutes. For the 50 minute run three controls were used: one from 0 to 5 minutes; one from 25 to 30 minutes; and one from 45 to 50 minutes. Furthermore in the 50 minute run it was necessary to replace the nebulizer fluid and make up the liquid in the test impinger.

7. Maintaining Collection Media at 35°C

A decrease in relative humidity causing cooling of the sampler and collection media occurs when air is drawn through the sampler. If the air is very dry, freezing of the broth can occur. Tests were conducted to determine if the cooling has an effect on the recovery of vegetative cells. During sampling the experimental impinger was placed in a 35°C water bath. Control and experimental impingers were run at 1.4 ℓ/min and cultured by the PRLB method.

8. Water Injected into Impinger Inlet

Dessication in the impinger inlet may cause death or damage to vegetative cells[3]. Increasing the relative humidity of the inlet tube may reduce destruction of microorganisms. Relative humidity was increased by injecting dilution water into the inlet, with a syringe at a rate of 0.2 mℓ after each minute of sampling. Samples were taken at 1.4 ℓ/min and cultured using the PRLB method.

9. Nebulizer Spray Dilution Water into Tee Preceeding AGI-30 Inlet

A Tee Connector was placed in the line connecting the wind tunnel and AGI-30 directly preceeding the impinger inlet. Attached to the Tee was a nebulizer no. 640 spraying dilution water during sampling, to increase the inlet relative humidity. The sampling rate was 1.4 ℓ/min and samples were cultured by the PRLB method.

10. Nebulizer Sprayed Distilled Water into Tee Preceeding AGI-30 Inlet

The test was run as described in 9 except distilled water was sprayed instead of dilution water.

11. AGI-30 with Humidifying Bulb

An all-glass impinger inlet tube was modified to contain a bulb section into which a nebulizer sprayed. This was an attempt to increase inlet relative humidity (Figure 2). The nebulizer was sealed to the impinger bulb section and sprayed dilution water at 0.2 mℓ/min and 0.3 mℓ/min during sampling. Samplers were run at 1.4 ℓ/min and the PRLB method was used for culturing.

12. AGI-30 with Venturi Scrubber

An AGI-30 was modified by removing the capillary section and attaching it to the entrance portion of the impinger (Figure 3). A tube, placed preceeding the capillary section was used for feeding water into the system. While sampling a venturi scrubber was created when water was introduced to the system. Distilled water was fed to the system at 1.5 mℓ/min and 3.7 mℓ/min. The sampling rate was 1.4 ℓ/min and the culturing method was the PRLB procedure.

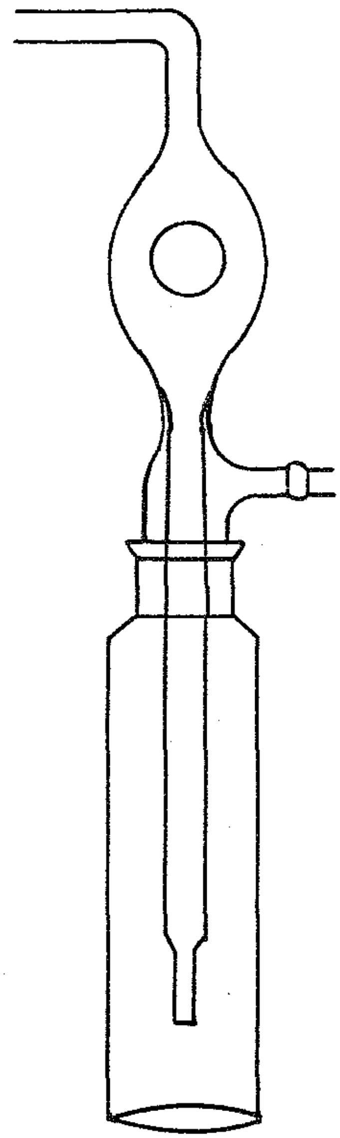

Figure 2. AGI-30 with Humidifying Bulb

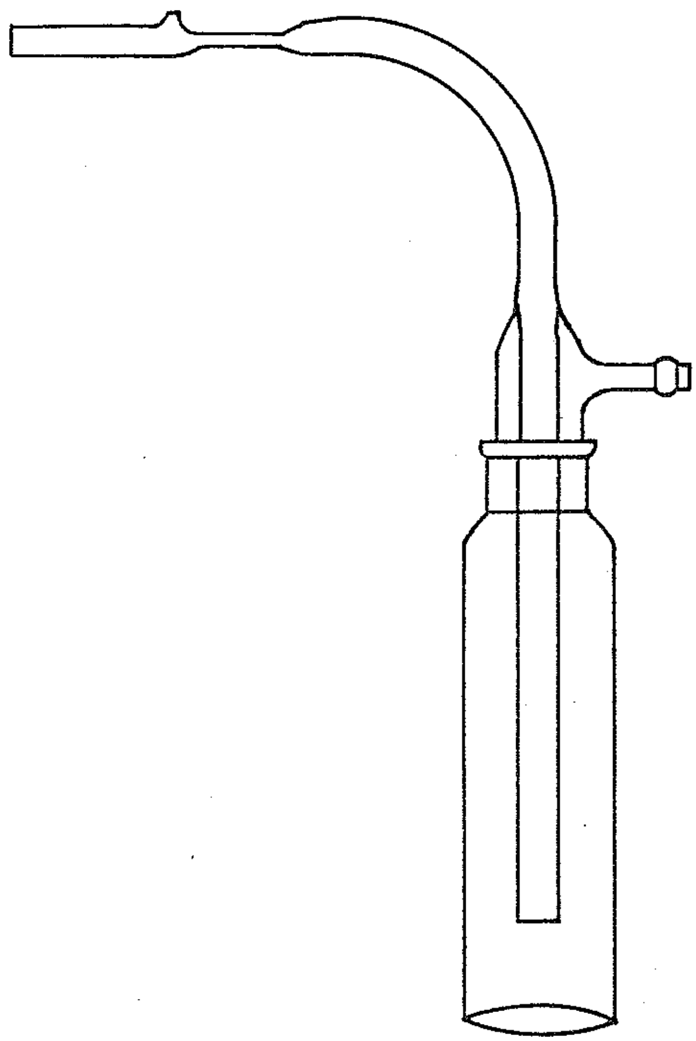

Figure 3. AGI-30 with Venturi Scrubber

Results and Discussion.

1. Collection Media

Lauryl tryptose broth, phenol red lactose broth and M-FC broth were compared to determine which gave the higher fecal coliform recovery when used as a collection media in the all-glass impinger. The results are contained in Table 1. Lauryl tryptose broth when compared to phenol red lactose broth produced a higher mean concentration of fecal coliform (2613 FC/m^3 versus 2130 FC/m^3), but the means were not significantly different. M-FC broth had a significantly lower recovery of fecal coliform (62 FC/m^3) than lauryl tryptose broth (31332 FC/m^3). Of the media tested lauryl tryptose broth produced the highest recovery of aerosolized fecal coliform.

2. Culturing Methods

Results from the experiment comparing the M-FC culturing method to the two-step phenol red lactose broth culturing method are contained in Table 2. Statistical analysis revealed that there was a signficant difference between the M-FC mean concentration of 557 FC/m^3 and the two-step mean concentration of 721 FC/m^3. The two-step phenol red lactose broth culturing method produced a significantly higher recovery of aerosolized fecal coliform than the M-FC culturing method.

The higher recovery of fecal coliform using the two-step method may be because E. Coli injured during physical or chemical treatment fail to form colonies on membrane filters (MF) incubated on M-FC broth[39]. Dutka[40] reported that Gelman and Millipore autoclaved MFs recovered 92% E. Coli at 35°C and 40% at 44.5°C. The combination of the alternate media and temperature acclimation make the two-step phenol red lactose broth method a superior test to the M-FC method for the recovery of aerosolized fecal coliform.

3. Wind Tunnel Variance

Tests were conducted to determine if a variance existed in the bacterial aerosol concentration sampled on the north and south sides of the tunnel. The data are tabulated in Table 3. Analysis of the five minute and twenty minute runs showed no significant difference existed between the bacterial concentrations. Since no significant variance existed in the tunnel it was presumed that any differences between control and experimental tests in subsequent experiments were the result of experimental modifications not variations in flow patterns.

4. Holding Time

Samples must be filtered and cultured within a specified period of time so alteration of the bacterial concentration does not occur. Immediate filtration was compared to holding times of two and four hours before filtration. The data are tabulated in Table 4. A holding time of two hours at 22°C produced no significant change in the concentration of fecal coliform (14859 FC/m^3 at zero hours; 22183 FC/m^3 at two hours). Holding the sample for four hours at 22°C before filtering produced a significant change in the fecal coliform concentration (13920 FC/m^3 at zero hours; 35590 FC/m^3 at four hours). Holding the samples for six hours at 4°C produced no significant change in the concentration of FC (1483 FC/m^3 at zero hours; 1360 FC/m^3 at six hours.)

Table 1. Collection Media

Experiment	Number of runs	Mean (FC/m^3)	Standard Deviation	$t_{calc.}$	$t_{.95}$
1. Lauryl tryptose broth	4	2613	507.3	1.00	1.94
Phenol red lactose broth	4	2130	1065.7		
2. Lauryl tryptose broth	3	31332	3568.5	15.18	2.78*
M-FC broth	3	62	53.7		

* Significant difference between means

Table 2. Culturing Method

Experiment	Number of runs	Mean (FC/m^3)	Standard Deviation	$t_{calc.}$	$t_{.95}$
M-FC Method	25	557	295.6	1.72	1.68*
Two-step PRLB Method	25	721	381.5		

* Significant difference between means

Table 3. Wind Tunnel Variance

Experiment	Number of runs	Mean (FC/m^3)	Standard Deviation	$t_{calc.}$	$t_{.95}$
1. Five minute runs					
North Side	10	742	306.7	0.25	1.73
South Side	11	782	416.0		
2. Twenty minute runs					
North Side	4	568	624.9	0.05	1.94
South Side	4	608	604.2		

Table 4. Holding Time

Experiment	Number of Runs	Mean (FC/m^3)	Standard Deviation	t_{cal}	$t_{.95}$
1. Zero hours	4	15849	1095.3	0.82	1.94
Two hours	4	22183	1983.0		
2. Zero hours	4	13920	1639.2	6.01	2.96*
Four hours	4	35590	7023.0		
3. Zero hours	3	1483	229.8	0.92	2.13
Six hours at 4°C	3	1360	27.7		

*Significant difference between means

Holding the samples for four hours at 22°C allowed the bacteria to reproduce in the collection media. Air samples should be filtered as soon as possible, preferably within two hours of sampling, or they should be stored at 4°C to prevent multiplication of microorganisms.

5. Sampling Rate

Various sampling rates were compared to the recommended sampling rate of at least 12.5 ℓ/min for the AGI-30. Data (corrected for anisokinetic sampling) are tabulated in Table 5. Data for the five minute runs show a significant difference between 1.4 ℓ/min and 4.3 ℓ/min compared to 13.0 ℓ/min. The lower flow rates had a significantly higher recovery of fecal coliform. For example a sampling rate of 1.4 ℓ/min yielded a recovery of 1302 FC/m^3 while a sampling rate of 13.0 ℓ/min yielded only 718 FC/m^3. A flow rate of 7.5 ℓ/min compared to 13.0 ℓ/min did not show a significant difference in recovery between 1.8 ℓ/min (1706 FC/m^3) and 13.3 ℓ/min (577 FC/m^3) and 5.4 ℓ/min (1453 FC/m^3) compared to 13.1 ℓ/min (682 FC/m^3). In all cases lowering the flow rate increased the recovery of fecal coliform.

Tyler and Shipe[1], reported no appreciable difference in recoveries of <u>Bacillus subtilis</u> spores in samplers (AGI-4) with reduced flows between 11.6 and 8.8 ℓ/min. The reduced entrance velocity had no effect on the collection of spores. The above tests indicate a significant effect in reducing flows on the collection of vegetative cells of fecal coliform. It seems apparent that the destruction of vegetative cells my impingement at high speeds is reduced by lowering the flow rate and hence the entrance velocity.

6. Sampling Time

The results of these experiments are shown in Table 6. The low counts in the longer (50 minute) runs were attributed to the loss of impinger fluid. The 5 and 10 minute runs were not significantly different.

7. Maintaining Collection Media at 35°C

The all-glass impinger placed in a 25°C water bath while sampling did not show a significantly higher recovery of fecal coliform than the AGI-30 at ambient conditions (Table 7). The recovery of fecal coliform does not appear to be affected by the reduction in collection media temperature during sampling.

8. Water Injected into Impinger Inlet

Water injected into the inlet of the AGI-30 did not increase the recovery of fecal coliform (Table 7). By the time the bacteria reached the impinger inlet they were probably already damaged by the dry conditions within the wind tunnel. Relative humidity (RH) in the tunnel was 31%. Benbough[41] reported that the survival rate of <u>E. coli</u> sprayed from distilled water at a relative humidity of 30% was <u>approximately</u> 1%. Cox[12] reported survival rates of $< 20\%$ for <u>E. coli</u> sprayed from water at RH = 30%. Reasons for death of <u>E. coli</u> at low <u>RH are</u> oxygen toxicity and an increase of RNA synthesis. Oxygen <u>at low</u> RH caused damage of the electron transport system[41]. The RNA synthesizing ability of <u>E. coli</u> decreases after being aerosolized into higher RH values. The decreases <u>in</u> RNA synthesis enhances the survival rate and may be attributed to mechanisms that degrade or release RNA from the bacteria[41].

9 and 10. Nebulizer Sprayed Water into Tee Preceeding Inlet

Dilution water and distilled water were sprayed into a Tee preceeding the

Table 5. Sampling Rates

Experiment	Number of runs	Mean (FC/m³)	Standard Deviation	t_{calc}	$t_{.95}$
1. Five minute runs					
1.4 ℓ/min	6	1302	380.3	3.26	2.23*
13.0 ℓ/min	6	718	240.9		
4.3 ℓ/min	6	1207	296.2	2.91	2.23*
13.0 ℓ/min	6	787	204.3		
7.5 ℓ/min	6	784	284.1	0.98	2.23
13.0 ℓ/min	6	663	141.9		
2. Twenty minute runs					
1.8 ℓ/min	4	1706	207.4	6.22	2.45*
13.3 ℓ/min	4	577	205.8		
5.4 ℓ/min	4	1453	372.4	4.03	2.45*
13.1 ℓ/min	4	682	168.3		

* Significant difference between means

Table 6. Sampling Time

Experiment	Number of runs	Mean (FC/m³)	Standard Deviation	t_{calc}	$t_{.95}$
1. Five minutes	2	5464	7546	0.04	2.92
Ten minutes	2	5784	8067		
2. Five minutes	3	5050	7474	0.51	2.78
Fifty minutes	3	2634	3559		

Table 7. Modifications to Standard Sampling

Experiment	Number of runs	Mean (FC/m)	Standard Deviation	t_{calc}	t.
1. Maintaining collection media at 35 C					
AGI-30 in bath	4	2370	285.0	1.10	2.45
AGI-30	4	2206	138.3		
2. Water injected into impinger inlet					
AGI-30 injected	4	2572	1403.3	0.26	2.45
AGI-30	4	2777	854.4		
3. Nebulizer sprayed dilution water into Tee preceeding inlet					
AGI-30 sprayed	4	3561	566.7	8.46	2.33*
AGI-30	4	29489	6129.3		
4. Nebulizer sprayed distilled water into Tee preceeding inlet					
AGI-30 sprayed	3	294	26.8	8.44	2.87*
AGI-30	3	1348	214.6		

* Significant difference between means

AGI-30 inlet. The results (Table 7) indicate that when either dilution or distilled water was sprayed into the Tee the fecal coliform recovery was significantly lower than the control impinger. The lower recovery was attributed to water droplets adhearing to the bacterial particles and settling in the line from the tunnel to the impinger inlet. Placing the relative humidity apparatus in the impinger inlet section would alleviate any losses in the line.

11. AGI-30 with Humidifying Bulb

An all-glass impinger with a humidifying bulb was compared to the standard AGI-30 (Table 8). Spray rates of 0.2 mℓ/min and 0.3 mℓ/min in the humidifying bulb impinger showed no significant difference when tested against the AGI-30. Reasons for the similar results are the same as described in 8 above. The bacteria were damaged in the wind tunnel because of the low average RH (13%).

12. AGI-30 with Venturi Scrubber

The all-glass impinger with venturi scrubber was tested at 1.5 mℓ/min and 3.7 mℓ/min against the AGI-30 (Table 8). The modified impinger showed no significant difference in fecal coliform recovery when compared to the AGI-30. Explanation of the similar results were discussed in 8, 9 and 10 above. Low relative humidity in the wind tunnel caused damage to the cells before entering the impinger.

Summary of Laboratory Results. Collection media, culturing methods, flow rates and sampler modifications were tested in an attempt to improve the AGI-30's sampling efficiency. Factors which improved the sampling efficiency were a collection media of lauryl tryptose broth, the PRLB culturing method and lower flow rates. Lauryl tryptose broth collection media provided 19% more recovery of fecal coliform than phenol red lactose broth. The two-step phenol red lactose broth culturing method gave 23% more recovery than the M-FC culturing method. Lowering the sampling rate from 13.0 ℓ/min to 5.4 ℓ/min or less significantly increased the fecal coliform recovery. Phenol red lactose broth collection media, collection media at 35°C, water injected into impinger inlet and the AGI-30 with himidifying bulb and venturi scrubber did not improve the recovery of fecal coliform.

With the exception of the lower sampling rate, all of these modifications were employed in the pilot and field sampling program. The lower sampling rate was difficult to obtain and control under field conditions. Rather than subject our data to extraneous errors from unknown and unreliable flow rates we adopted the higher more consistant rate of 12.5 ℓ/min.

PILOT STUDIES

The pilot experiments were conducted on a level grassed area north-west of the Soils Research Barn on the Michigan State University (MSU) campus. The surrounding area was primarily open grassed plots for a distance of approximately 100 m. Beyond this were large areas planted to corn and beans.

Table 8. Sampler Modifications

Experiment	Number of runs	Mean (FC/m^3)	Standard Deviation	t_{calc}	$t_{.95}$
1. AGI-30 with humidifying bulb					
A. 0.2 mℓ/min					
AGI-30 w/bulb	9	6290	7315.3	0.98	1.74
AGI-30	10	10363	10253.0		
B. 0.3 mℓ/min					
AGI-30 w/bulb	8	10236	7462.5	1.06	2.15
AGI-30	8	14804	9715.1		
2. AGI-30 with venturi scrubber					
A. 1.5 mℓ/min					
AGI-30 w/scrubber	9	905	349.6	1.46	1.74
AGI-30	10	1211	559.3		
B. 3.7 mℓ/min					
AGI-30 w/scrubber	4	683	147.4	1.03	1.94
AGI-30	4	788	143.7		

The well which provided potable water for the barn was used as a source of unchlorinated water. The water was delivered via a hydropneumatic tank. The on-off pressure settings for the pump were 195 kPa and 415 kPa respectively.

The aerosol source resembled a home lawn sprinkler. An adjustable garden hose nozzle, oriented vertically and mounted at a tip height of 0.3 m, was set to produce a fine mist. The apex of the spray was at an elevation of about 2 m.

A laboratory culture of fecal coliform (FC) bacteria was chosen as the biological tracer. Although other investigators have suggested that other organisms, such as Klebsiella[42] and coliphage[43 44], would be better indicators of biological air pollution from sewage sources, the preliminary nature of our investigations precluded the use of these organisms.

Water containing fecal coliform bacteria was injected into the well water flowing to the spray nozzle by means of a pressurized paint spray tank. The tank was pressurized to 345 kPa using compressed air. The spray tank volume was 10 ℓ. The flow from this tank was regulated by a valve on the outlet. The concentrations of FC in the water bieng sprayed were in the range of 10^4 to 10^6 FC/mℓ.

All glass impingers (AGI-30) mounted on wooden stands at a height of 1.5 m were used to sample for airborne concentrations of fecal coliform. The rate at which air was drawn through the impinger was approximately 12 ℓ/min. The flow rate of each impinger/pump combination was determined with a calibrated rotameter. The impinger liquid used was a 1:1 dilution of lauryl tryptose broth (Standard Methods[45] procedure No. 905 C.3.). The volume used in each impinger was 10 mℓ. This dilution of lauryl tryptose broth was found to provide good FC recovery and a high collection efficiency. The standard broth was diluted and the standard 20 mℓ volume was reduced to avoid froth carry over into the pumps.

Four impingers and the impinger stands were aligned downwind of the spray source for each sampling period. The first of the stands was set very close to the spray source and slightly off to one side of the line formed by the remaining impinger stands and spray nozzle. This sampling at the source was done to determine the initial concentration of airborne fecal coliforms produced by the spray. The other three stands were at distances of 5, 10 and 20 m from the spray nozzle.

A Gill propvane was used to monitor the wind speed and direction during sampling. The propvane recorder was calibrated to measure speed and direction directly.

A sling psychrometer was used to determine the relative humidity and the air temperature. Observations were also made of the type and amount of cloud cover, and any changes in weather conditions such as the movements of approaching warm or cold fronts.

An Anderson Viable Sampler was used to determine the aerosol particle size range. The medium used in the petri dishes which serve as the sampler collection surface was 27 mℓ of MFC-agar. The MFC-agar was prepared according to Standard Methods[45] procedure No. 905 C.10. for MFC broth with the following changes: (1) the rosolic acid was deleted because we were using a "pure" FC culture; (2) agar (15. g/ℓ) was added to form a solid medium.

Approximately 18 to 24 hours before the experiment, several tubes containing lauryl tryptose broth were innoculated with fecal coliform from prepared agar slants. The initial culture was obtained from the MSU Department of Microbiology and Public Health. The innoculation tubes were incubated in a water bath at 35°C for the time remaining before the start of the experiment.

Generally 4 sampling runs of 5 minutes each were conducted for each day in the field. In the first of these runs no fecal coliforms were added to the spray tank. Since no coliforms were being sprayed, samples taken during this run were considered to be a measure of background concentrations of fecal coliform.

The majority of the experiments were conducted in the morning hours to allow for time for the processing of the samples in the afternoon. In order to sample during the most stable atmospheric classes, night-time sampling was conducted on two occasions. These sampling periods were from approximately 5:00 AM until dawn. The night-time sampling periods provided calmer wind conditions than the day time experiments. They also allowed us the opportunity to examine the effect of excluding the sun's ultraviolet radiation.

Sampling was conducted under a wide variety of weather conditions. The cloud cover and relative humidity varied greatly. Although most of the sampling was conducted in the summer months, the air temperature varied from 12 to 29°C. The wind speeds were generally low to moderate but gusts up to 11 m/s were experienced.

The liquid from each impinger was processed using the membrane filter method for recovery of fecal coliform proposed by Lin[41]. This method is a variation of the method found in Standard Methods[45] procedure 909 C. As stated earlier the Lin method was found to be more effective in recovery of stressed fecal coliform.

Samples from the spray nozzle were also processed using Lin's method. The Andersen Sampler petri dishes were incubated directly at 44.5°C for 24 hours. After the incubation period each petri dish was inspected for the presence and number of blue fecal coliform colonies.

Results. The Andersen Sampler was used to measure the size of the droplets containing viable FC. The sampler characteristics allow size discrimination in the size range of 0.65 to 7 microns. Droplets larger than 7 microns were observed emanating from the aerosol source. These larger particles were observed to have a larger fallout rate and as a consequence did not travel far enough to reach the sampler. The smaller particles were observed being transported downwind in the form of a fine mist.

The smallest of the viable FC containing droplets captured were in the 2.1 to 3.3 micron range. The particles in the size range of 2.1 to 4.7 microns appeared to provide the greatest downwind transport of viable fecal coliforms. The distribution of particle sizes appeared to vary with distance downwind and atmospheric conditions. There were not enough data collected to determine a relationship between wind conditions and the droplet size distribution produced by the spray system used in this study.

The airborne concentration of viable FC was determined by dividing the number of colonies successfully cultured from the impinger liquid by the volume of air drawn through the impinger during sampling. Each colony formed after a 24 hour incubation period was assumed to be the result of one FC captured during sampling.

Each run was categorized into one of the six Pasquill[46] atmospheric stability classes. The Pasquill stability categories are based on the standard deviation of the wind about a mean direction. These classes are a measure of the turbulent structure of the atmosphere and are indicative of the ability of the atmosphere to disburse pollutants. These classes and the corresponding range of wind direction standard deviations used in this study are listed in Table 9.

The initial concentrations sprayed varied greatly from run to run. In order to standardize each case for comparison, the ratio of the concentration at each point downwind (N) to the initial concentration (N_O) was computed. These ratios were plotted versus downwind distance for each run in each stability class.

In general, the concentration of airborne FC decreased at a decreasing rate with distance downwind. Only a few runs were conducted which fell into stability classes A and B. Other than the general downward trend no other significant information was revealed because of the sparsity of the data.

In stability class C (Figure 4), the curves are rather spread out. The average windspeeds of the runs ranged from 2.4 to 5.7 m/s. The relative humidities varied from 67% to 84%. The angle of reception (i.e., the angle between the average incoming wind direction and the impinger line) varied from 3^{o} to 60^{o}. The temperatures at which these runs were conducted ranged from 23.5^{o}C to 24.5^{o}C.

The cloud cover during the class C runs ranged from 20% to 90% cover. The clouds were classified as cumulus clouds. Although some dependence of the rate of decay on cloud cover was discerned, with the higher percentage of cover giving a lower rate of decay, there are not enough data to confirm this relationship. No relationship with any of the other variables was detected.

In stability class D (Figure 5), the curves appear to have similar shapes. The relative humidities in runs 8-9-2, 7-27-4, and 7-27-3 were all 77%. The temperature at which these runs were conducted was 24^{o}C. The measured conditions which differed between these three runs were wind speed, angle of reception, and cloud cover. The cloud cover is the only parameter of the three which follows any discernable pattern. The cloud cover decreases from the highest curve to each lower curve for all of the curves except for run 7-25-5.

The curves of stability class E (Figure 6) appear to be divided into two pairs. The higher pair of curves are both the results of runs conducted at night. They have similar shapes. These two runs were both conducted at a temperature of 19^{o}C and a relative humidity of approximately 88%. The average wind speeds for these two runs were also fairly close. The angles of reception differed by approximately 10^{o}.

The other pair of curves for stability class E are runs having small angles of reception. These runs were also conducted at approximately the same relative humidity. The average wind speed, temperature and cloud cover differed greatly. The upper curve of this pair had the higher percentage of cloud cover and the lower wind speed and temperature.

The runs conducted under the atmospheric conditions of class F (Figure 7) were all conducted at night. These runs were all conducted at high relative humidities and a rather cool temperature of 13.5^{o}C. The wind speeds ranged from 0.72 m/s to 1.9 m/s. The angles of reception ranged from 2.1^{o} to 18.7^{o}. The curves of runs 8-20-3 and 8-30-4 are fairly close and each had a very small angle of reception of 2^{o}. The average wind speeds of these two runs were also approximately the same.

Comparison of the curves in each stability class was difficult because of the lack of data in some of the classes. Most of the classes have a variety of curves which appear to be interchangeable between classes. Class D is the only class with curves which appear to have a

Table 9. Pasquill Stability Categories

Stability Categories	σ_{θ}
A, extremely unstable	> 22.51°
B, moderately unstable	17.51° - 22.50°
C, slightly unstable	12.51° - 17.50°
D, neutral	7.51° - 12.50°
E, slightly stable	3.26° - 7.50°
F, moderately stable	< 3.25°

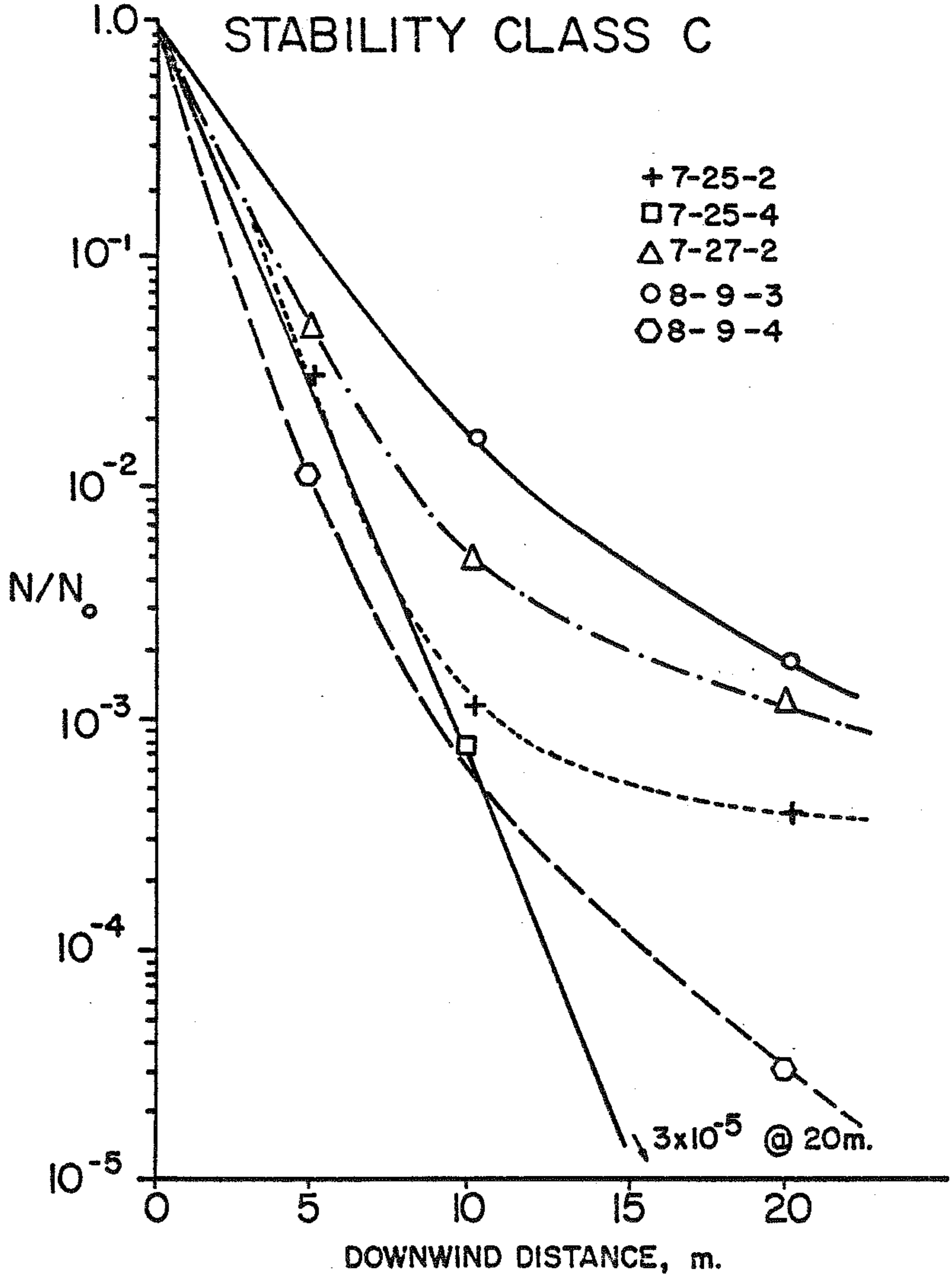

Figure 4. Bacterial Decay for Stability Class C

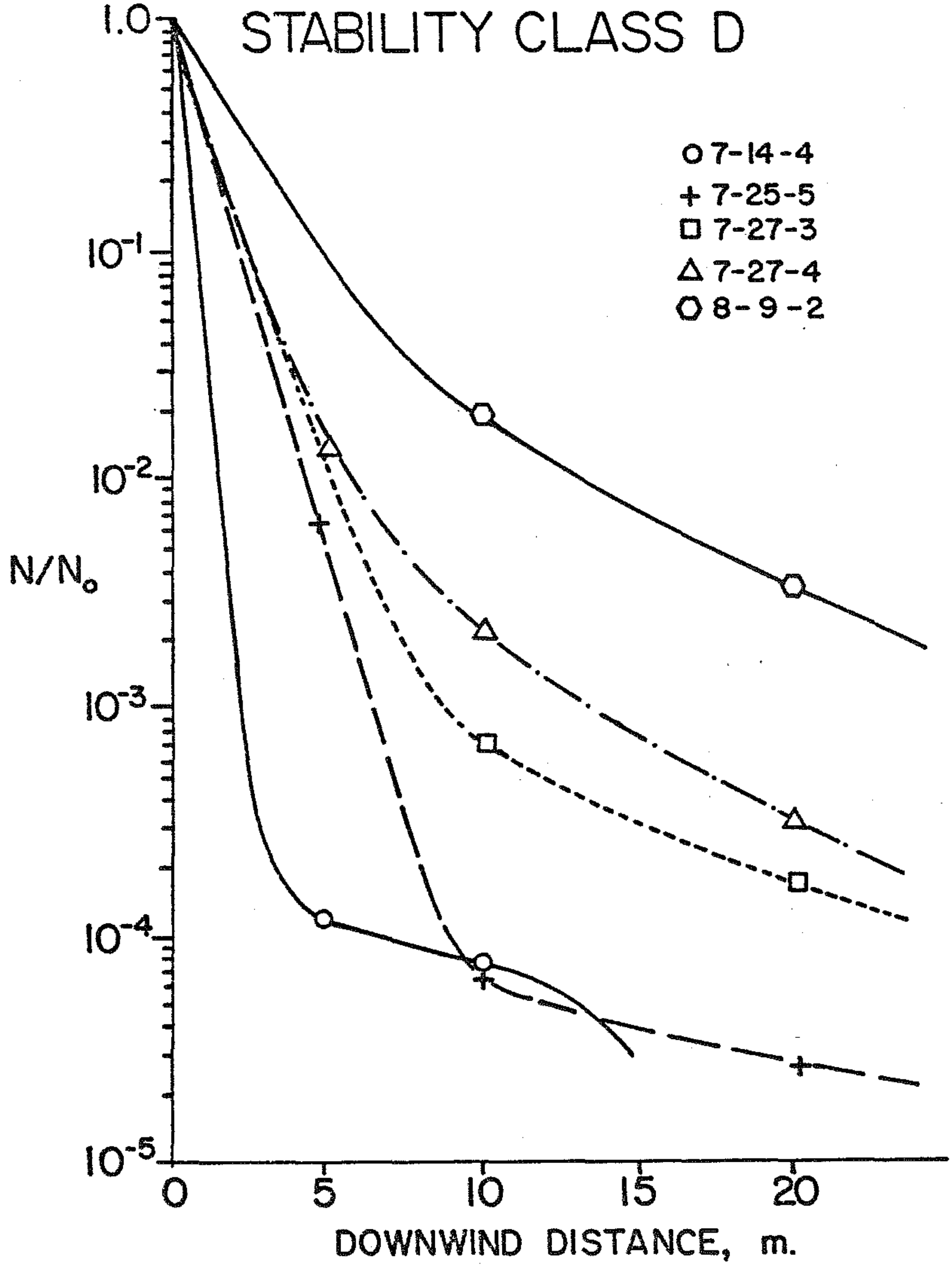

Figure 5. Bacterial Decay for Stability Class D

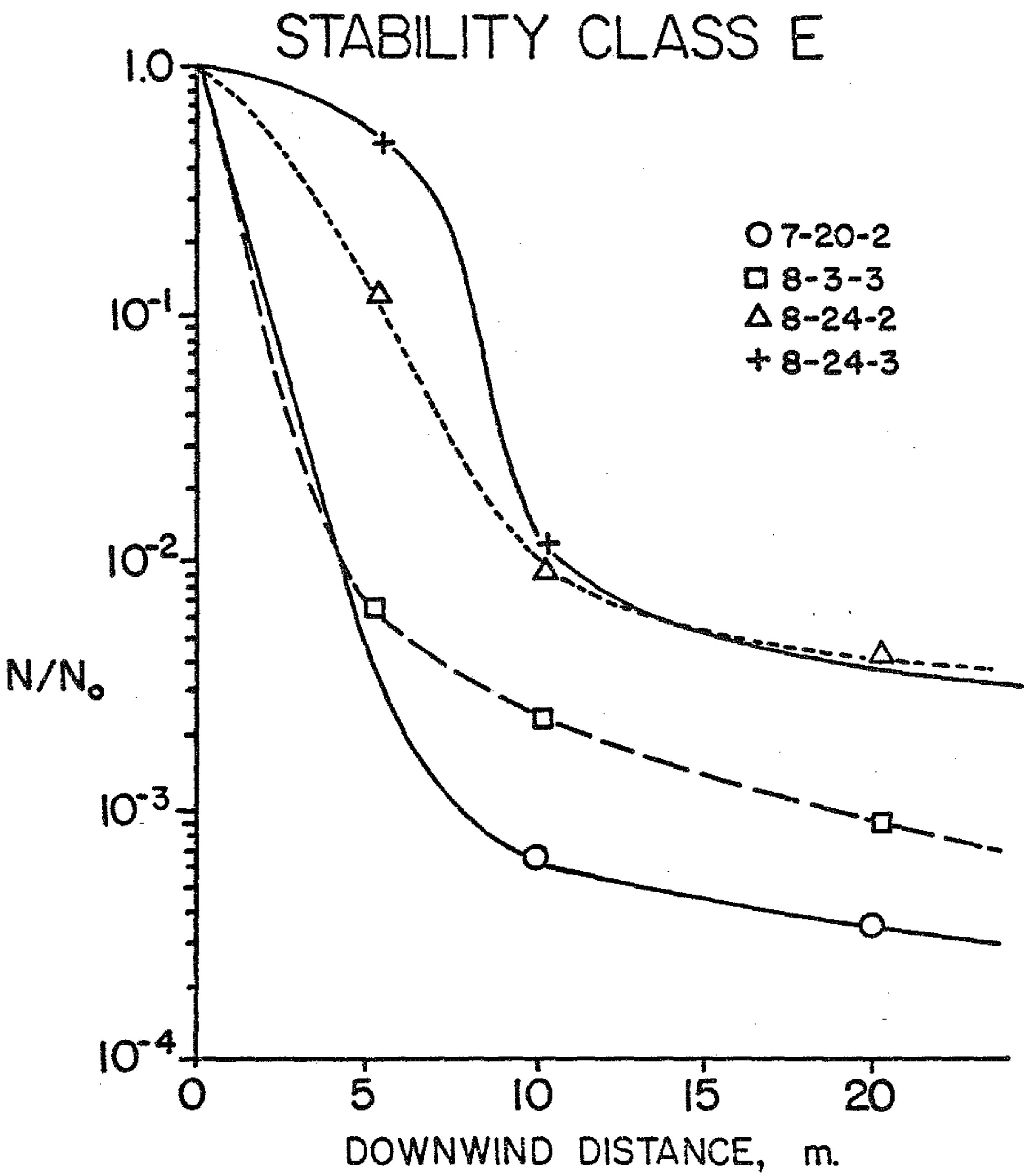

Figure 6. Bacterial Decay for Stability Class E

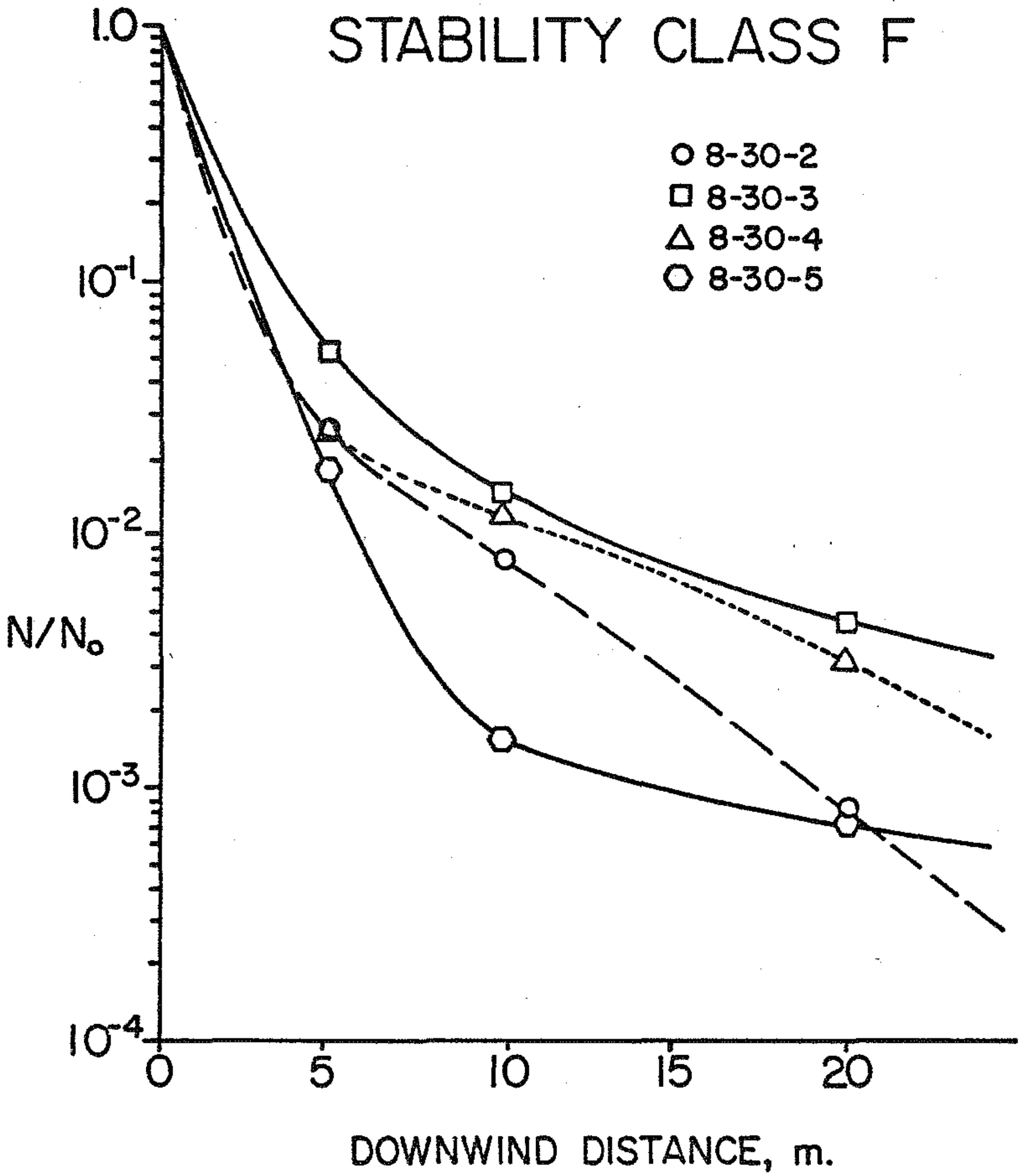

Figure 7. Bacterial Decay for Stability Class F

consistent shape. The curves of classes C and D appear to have more in common than any of the other classes.

Discussion and Conclusions. The results of this study show that there was at least a 2 log reduction in airborne FC concentrations at a distance of 20 m downwind of the source for all meteorological conditions encountered. In some cases the decrease in concentration exceeded a 5 log reduction. The results also indicate that the droplet size which provided the farthest downwind transport of viable organisms was of the order of 4 μm in diameter.

The data indicate two rates of decrease dominate the concentrations within 20 m of the source. From our observations it appears that fallout from the spray is the major reason for the reduction in concentrations close to the source. Under the most adverse meteorological conditions a majority of the spray traveled no farther than 7 m from the nozzle. Further decreases in concentration appear to be due to biological decay. Environmental stresses such as dessication and ultraviolet radiation must certainly increase the decay rate of viable fecal coliforms. In some cases the data suggest that the amount of incident sunlight has an effect on the rate of decrease of the concentrations. Night-time spraying resulted in slightly higher downwind concentrations but these runs were also in the more stable atmospheric stability classes which implies a reduction in the turbulent diffusion process.

The concentrations of FC in water being sprayed in this study were in the range of 10^4 to 10^6 FC/mℓ. As a result of the small airborne concentrations measured downwind, wastewaters disinfected to meet a standard of 200 FC/100 mℓ would not be expected to produce measurable viable FC concentrations more than 20 m downwind from a low pressure spray nozzle mounted at ground level. Spraying during the daylight hours is also suggested to reduce the possibility of viable organisms being carried to a susceptible host beyond the spray site.

FIELD STUDIES

Sampling Protocol. The sampling for bacterial aerosols was conducted along the fence line at the Coldwater rest area spray site. Three AGI-30's were mounted at approximately 5 m intervals along the fence. The three impingers were operated for 5 minutes and then they were replaced. The samples were stored on ice and returned to MSU for assay. Samples of spray effluent were also taken directly from the spray nozzle. The spray site and sampling configuration are shown in Figure 8.

Results and Discussion. Because of further construction delays and equipment malfunction sampling did not begin until 26 June. Manpower, equipment and vehicle availability precluded more than one trip to Coldwater per week. Thus, samples were taken only 5 days before the Coldwater lagoons were emptied and spraying was terminated.

The results for each of the impinger samples on all 5 occasions were negative (Table 10). The spray samples had FC counts ranging from 17 FC/100 m to more than 5000 FC/100 mℓ. The low spray counts occured when lagoon effluent was being drawn from the upper layers while the high counts

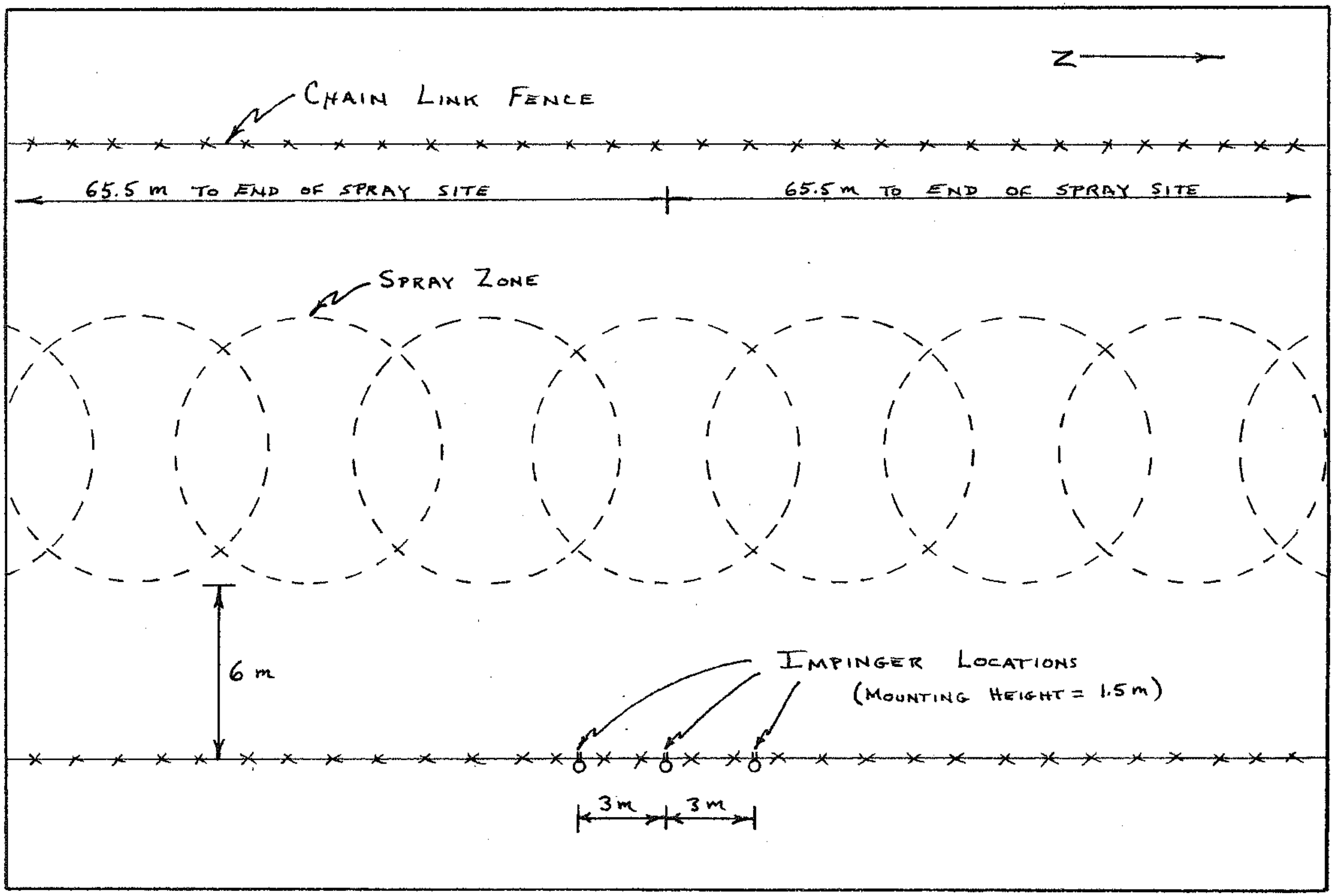

Figure 8. Plan View of Location of Impinger Samplers.

Table 10. Results of Aerosol Sampling at Coldwater Rest Area

Date	Sample Number	FC/m^3	Sample Number	FC/m^3
26 JUNE 1979	57	0	17	0
	55	0	24	0
	45	0	32	0
	23	0	01	0
	12	0	50	0
	40	0	42	0
	27	0		
	63	0	Spray Conc. = 163 FC/100 mℓ	
	04	0		
3 JULY 1979	57	0	03	0
	24	0	04	0
	50	0	32	0
	55	0	01	0
	27	0	42	0
	40	0	23	0
	63	0		
	45	0	Spray Conc. = 17 FC/100 mℓ	
	17	0		
10 JULY 1979	04	0	03	0
	12	0	23	0
	17	0	57	0
	50	0	40	0
	42	0	24	0
	45	0	63	0
	32	0		
	27	0	Spray Conc. = 1100 FC/100 mℓ	
	55	0		
18 JULY 1979	63	0		
	40	0		
	12	0		
	17	0		
	23	0		
	01	0		
	57	0	Spray Conc. > 5000 FC/100 mℓ	
	50	0		
	24	0		
7 AUGUST 1979	12	0		
	40	0		
	61	0		
	45	0		
	32	0		
	42	0		
	17	0		
	03	0		
	04	0		
	27	0	Spray Conc. > 5000 FC/100 mℓ	
	23	0		
	50	0		

Total number of samples = 69

Average aerosol FC Concentration = 0 FC/m^3

Highest aerosol FC Concentration = 0 FC/m^3

occured near the end of the spray period when the lower levels of the lagoon were being sprayed. The increase probably resulted from entrainment of benthic deposits which protected the microorganisms from disinfection in the ozone chamber.

Conclusions. Based on the results of the pilot tests and the field tests, we feel that the potential for airborne infection from vegetative bacterial aerosols from the Coldwater spray system is minimal.

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APPENDIX

Table Ia. CHEMICAL COMPOSITION OF WASTEWATER FROM THE CLARE REST AREA LAGOON SYSTEM.

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	i-PO_4	TKN	NH_3	NO_3	NO_2
								2-14-77					
Lagoon 1	8.2	-	-	145	-	144	37	18.2	4.15	35.8	31.7	0.04	0.09
Lagoon 2	8.5	-	-	170	-	90	51	10.0	1.65	18.3	3.9	0.33	0.07
County Drain 5	7.7	-	-	12	-	37	16	1.5	0.48	4.0	2.2	0.18	0.02
								4-18-77					
Lagoon 1	8.6	-	-	-	-	67	-	6.4	5.80	39.0	22.4	0.02	0.06
Lagoon 2	8.7	-	-	-	-	48	-	1.4	4.53	38.3	28.6	0.48	0.31
County Drain 3	7.7	-	-	-	-	62	-	5.3	4.97	27.6	13.8	1.66	0.11
County Drain 5	7.9	-	-	-	-	58	-	0.3	0.35	6.3	1.5	0.10	<0.01
County Drain 7	7.5	-	-	-	-	81	-	5.0	0.40	4.9	1.1	0.18	<0.01
								5-13-77					
Lagoon 1	-	-	-	-	-	146	-	1.5	-	55.5	-	-	-
Lagoon 2	-	-	-	-	-	29	-	6.8	-	8.0	-	-	-
Drainage Tile 3	-	-	-	-	-	22	-	4.5	-	5.6	-	-	-
County Drain 5	-	-	-	-	-	55	-	0.8	-	2.5	-	-	-
County Drain 7	-	-	-	-	-	58	-	1.3	-	2.9	-	-	-
								6-28-77					
Lagoon 1	-	-	4.5	-	-	75	-	6.6	5.25	23.9	-	0.3	0.08
Lagoon 2	-	-	2.5	-	-	130	-	6.8	5.60	51.7	-	0.4	0.06

Table Ia. (Con't).

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	i-PO_4	TKN	NH_3	NO_3	NO_2
7-7-77													
Lagoon 1	-	-	-	12	-	72	-	2.3	3.08	10.0	-	0.5	0.10
Lagoon 2	-	-	-	>80	-	129	-	5.1	4.90	51.6	-	0.2	0.07
Drainage Tile 3	-	-	-	18	-	104	-	5.9	6.58	40.7	-	0.2	0.07
County Drain 5	-	-	-	4	-	75	-	0.4	0.50	-	-	0.7	0.04
County Drain 7	-	-	-	>80	-	68	-	1.7	0.38	-	-	0.2	0.01
County Drain 8	-	-	-	>80	-	59	-	1.0	0.63	-	-	0.1	<0.01
7-19-77													
Lagoon 1	-	-	-	19	-	77	-	2.2	1.58	-	-	0.3	0.39
Lagoon 2	-	-	-	31	-	89	-	3.6	2.35	-	-	0.4	0.57
Drainage Tile 3	-	-	-	12	-	78	-	5.9	5.85	-	-	0.5	0.05
County Drain 5	-	-	-	2	-	73	-		0.63	-	-	0.4	0.02
County Drain 7	-	-	-	2	-	100	-	0.4	0.33	-	-	0.2	0.02
7-25-77													
Lagoon 1	-	-	-	51	-	153	-	6.3	4.65	-	-	0.5	0.11
7-26-77													
Lagoon 1	-	-	-	>80	-	147	-	6.9	5.45	-	-	0.6	0.05
Lagoon 2	-	-	-	>80	-	176	-		7.30	-	-	0.5	0.13
7-27-77													
Lagoon 1	-	-	-	26	-	95	-	6.1	5.38	-	-	0.06	0.05
Lagoon 2	-	-	-	44	-	111	-	6.4	5.23	-	-	0.06	0.04
7-28-77													
Lagoon 1	-	-	-	52	-	166	-	6.4	5.33	-	-	0.7	0.06
Lagoon 2	-	-	-	63	-	109	-	5.5	5.28	-	-	0.7	0.07

Table Ia. (Con't).

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	i-PO_4	TKN	NH_3	NO_3	NO_2
								<u>8-1-77</u>					
Lagoon 1	–	–	–	63	–	163	–	7.4	4.76	42.4	36.3	0.7	0.08
Lagoon 2	–	–	–	63	–	158	–	8.1	6.65	49.6	40.5	0.6	0.04
								<u>8-4-77</u>					
Lagoon 1	–	–	–	>80	–	163	–	6.5	5.05	56.8	40.8	1.9	0.05
Lagoon 2	–	–	–	67	–	140	–	7.4	5.85	49.3	40.1	1.0	0.03
County Drain 5	–	–	–	8	–	70	–		0.48	ND	0.4	1.1	0.01
County Drain 7	–	–	–	10	–	186	–	1.8	0.30	13.8	4.9	0.8	< 0.01
								<u>8-9-77</u>					
Lagoon 1	–	22	4.2	42	–	128	–	7.0	6.35	53.9	45.6	1.0	0.08
Lagoon 2	–	22	9.0	18	–	116	–	5.4	4.28	24.3	25.4	1.1	0.20
Crossover 9	–	–	–	41	–	134	–	7.4	6.50	54.0	44.4	1.1	0.10
								<u>8-11-77</u>					
Lagoon 1	–	–	–	–	–	141	–	6.6	6.35	58.8	45.4	0.6	0.05
Lagoon 2	–	–	–	–	–	142	–	5.0	3.55	19.2	19.0	0.8	0.26
Crossover 9	–	–	–	–	–	149	–	6.7	6.48	45.0	44.6	0.7	0.04
								<u>8-12-77</u>					
Lagoon 1	–	–	–	–	–	186	–	8.0	6.95	72.8	58.2	1.0	0.06
Lagoon 2	–	–	–	–	–	159	–	7.8	4.05	39.4	13.3	1.3	0.43
Crossover 9	–	–	–	–	–	155	–	7.7	7.03	65.9	55.6	0.8	0.06

Table Ia. (Con't).

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	i-PO_4	TKN	NH_3	NO_3	NO_2
								8-16-77					
Lagoon 1	-	-	-	-	-	161	-	7.2	6.28	57.0	-	0.83	0.05
Lagoon 2	-	-	-	-	-	128	-	4.7	3.92	25.9	-	0.71	0.36
Crossover 9	-	-	-	-	-	162	-	7.9	6.69	57.0	-	0.77	0.05
								8-18-77					
Lagoon 1	-	20	5.1	-	-	260	-	10.9	8.50	96.8	-	0.73	0.05
Lagoon 2	-	20	>20	-	-	146	-	6.0	3.84	30.0	-	1.00	0.26
								8-23-77					
Lagoon 1	7.5	-	-	-	-	230	-	10.9	10.2	88.5	-	0.88	0.07
Lagoon 2	8.1	-	-	-	-	120	-	5.1	5.7	22.6	-	0.93	0.04
								8-26-77					
Lagoon 1	-	19	20	-	-	230(142)	-	11.5	8	94.6	-	0.05	0.05
Lagoon 2	-	19	15.6	-	-	92(34)	-	10.9	3.40	12.6	-	0.71	1.43
								8-29-77					
Lagoon 1	-	-	-	-	-	-	-	7.6	5.7	74.2	-	0.74	0.16
Lagoon 2	-	-	-	-	-	-	-	4.2	3.16	24.7	-	0.93	0.66
Co.Drain 5	-	-	-	-	-	-	-	0.2	0.75	0.4	-	0.72	0.02
Co.Drain 7	-	-	-	-	-	-	-	0.1	0.64	3.2	-	0.62	0.01
Co.Drain 8	-	-	-	-	-	-	-	0.3	0.54	2.7	-	0.77	0.01
Crossover 9	-	-	-	-	-	-	-	7.7	5.7	72.2	-	0.83	0.21

Table Ia. (con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						9-2-77							
Lagoon 1	7.7	-	-	-	-	138(90)	43	6.2	7.43	60.6	48.3	0.78	0.05
Lagoon 2	7.8	-	-	-	-	103(50)	24	5.5	4.53	15.7	7.2	0.64	0.03
Crossover 9	7.6	-	-	-	-	270	300	14.4	13.8	124.0	95.1	0.75	0.05
						9-6-77							
Lagoon 1	-	25	< 20	-	-	22	9	5.0	4.25	52.7	41.7	0.70	0.16
Lagoon 2	-	25	14	-	-	36	4	3.6	3.29	17.5	9.5	0.79	0.72
Co. Drain 5	-	-	-	-	-	26	2	0.4	0.50	0.2	0.5	0.58	0.04
Co. Drain 7	-	-	-	-	-	46	125	0.4	0.47	1.3	0.4	0.61	0.04
Co. Drian 8	-	-	-	-	-	24	3	0.3	0.25	1.4	0.4	0.58	0.03
						9-9-77							
Lagoon 1	-	18	1.2	-	-	69	57	5.9	4	63.2	54.5	0.9	0.24
Lagoon 2	-	19	4.3	-	-	32	23	3.8	3.42	23.4	17.7	0.96	0.86
						9-15-77							
Lagoon 1	-	-	-	-	-	37	38	6.9	6.00	78.8	69.4	0.82	0.05
Lagoon 2	-	-	-	-	-	20	6	5.5	4.47	26.2	21.5	0.98	0.37
Crossover 9	-	-	-	-	-	29	28	6.9	4.94	76.0	68.5	0.70	0.27
						9-22-77							
Lagoon 1	-	14	0.8	-	-	23	14	6.6	6.48	66.4	-	0.56	0.04
Lagoon 2	-	15	1.4	-	-	15	3	5.1	5.08	11.2	-	0.62	0.22
Co. Drain 5	-	-	-	-	-	8	1	0.2	0.56	0.3	-	0.62	0.02
Co. Drain 7	-	-	-	-	-	14	1	0.2	0.47	0.5	-	0.56	0.02
Co. Drain 8	-	-	-	-	-	14	21	0.1	0.44	1.9	-	0.49	0.01
						10-14-77							
Lagoon 1	8.5	10	18	37	-	33	47	2.2	2.60	50	32.4	1.36	0.88
Lagoon 2	7.9	9	< 20	18	-	19	18	4.4	4.72	20	10.8	1.28	0.36
Co. Drain 5	7.6	-	-	< 1	-	12	3	< 0.1	0.51	4	0.5	0.80	0.03
Co. Drain 7	7.5	-	-	< 1	-	18	2	0.2	0.42	5	0.6	0.39	0.02
Co. Drain 8	7.3	-	-	< 1	-	-	10	0.1	0.44	8	0.4	0.37	0.01

Table Ia. (con't.)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						11-29-77							
Lagoon 1	8.4	2	19	11	-	23	-	3.4	2.90	7.8	8.2	1.57	0.21
Lagoon 2	8.4	2	19	6	-	22	-	2.5	2.26	1.3	0.5	0.81	0.05
Co. Drain 5	7.8	-	-	<1	-	-	-	-	0.53	1.3	0.3	0.84	0.01
Co. Drain 7	7.6	-	-	<1	-	15	-	1.2	0.36	1.4	<0.1	1.15	0.03
Co. Drain 8	7.5	-	-	<1	-	10	-	0.3	0.36	<0.1	<0.1	0.71	0.02
						12-22-77							
Lagoon 1	7.1	-	-	15	-	23	24	4.1	3.65	15.7	11.6	0.90	0.08
Drain Tile 3	7.2	-	-	7	-	-	10	2.1	2.46	9.9	6.2	3.50	0.05
Co. Drain 5	7.5	-	-	3	-	14	9	0.3	0.59	4.0	0.8	3.11	0.06
Co. Drain 7	7.2	-	-	2	-	20	16	0.1	0.27	3.3	<0.1	2.24	0.08
Co. Drain 8	7.2	-	-	2	-	12	4	0.2	0.35	2.0	<0.1	3.90	0.08
Pre-Filter	7.5	-	-	30	-	29	82	3.9	2.97	17.4	11.2	<1	0.07
						2-28-78							
Lagoon 1	6.7	-	-	39	-	-	9	4.6	4.90	14.0	13.9	0.60	0.01
Lagoon 2	6.8	-	-	38	-	-	49	1.8	1.70	4.4	2.5	0.91	0.01
Co. Drain 5	7.5	-	-	10	-	-	8	0.2	0.36	0.6	0.3	0.88	0.01
Co. Drain 8	7.2	-	-	< 1	-	-	4	0.1	0.27	0.1	0.3	0.95	0.01
						3-16-78							
Lagoon 1	7.0	-	-	16	-	-	43	3.9	2.71	8.7	0.8	8.12	0.10
Lagoon 2	7.1	-	-	14	-	-	56	1.8	1.37	3.0	2.4	1.21	0.10
Co. Drain 5	7.5	-	-	2	-	-	4	0.1	0.17	0.4	0.5	0.55	0.03
Co. Drain 6	7.5	-	-	< 1	-	-	4	0.1	0.16	1.1	0.5	0.71	0.03
Co. Drain 8	7.2	-	-	4	-	-	39	0.2	0.18	2.1	0.1	0.96	0.04

Table I a. (con't)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
							4-15-78						
Lagoon 1	8.1	-	7.4	5	-	12	17	2.9	2.80	11.4	9.0	0.94	0.05
Lagoon 2	8.1	-	10.8	6	-	35	6	1.6	1.63	5.6	3.2	0.97	0.11
Tile Drain 3	7.3	-	-	4	-	-	< 2	2.2	2.19	0.8	0.1	6.90	0.05
Co. Drain 4	7.9	-	-	<1	-	-	-	0.6	0.26	<0.1	<0.1	0.23	0.01
Co. Drain 5	8.0	-	-	<1	-	22	6	< 0.1	0.12	0.9	0.1	1.37	0.04
Co. Drain 7	7.8	-	11.4	<1	-	-	4	< 0.1	0.10	0.2	<0.1	0.94	0.05
Co. Drain 8	7.9	-	11.6	<1	-	26	6	< 0.1	0.05	1.2	0.5	1.92	0.05
							5-12-78						
Lagoon 1	8.5	-	-	40	-	59	117	2.4	1.07	9.2	2.0	0.24	0.08
Lagoon 2	8.0	-	-	24	-	22	16	1.3	1.47	5.1	2.0	0.24	0.03
Tile Drain 3	7.3	-	-	4	-	-	3	1.4	1.43	2.1	0.6	0.95	0.02
Co. Drain 5	7.5	-	-	2	-	29	4	< 0.1	0.14	1.5	1.2	0.29	0.02
Co. Drain 6	7.3	-	-	1	-	30	4	< 0.1	0.20	0.3	0.4	0.42	0.02
Co. Drain 8	7.4	-	-	1	-	28	<2	< 0.1	0.08	0.8	0.5	0.27	0.02
Ditch 10	7.4	-	-	<1	-	-	38	< 0.1	0.21	0.5	0.4	0.20	0.02
Ditch 10E	7.1	-	-	<1	-	-	<2	< 0.1	0.21	0.1	0.2	0.24	0.02
							5-24-78						
Lagoon 1	8.4	-	>20	15	-	15	19	2.0	1.13	6.6	3.2	0.66	0.06
Lagoon 2	8.6	-	>20	4	-	18	8	2.4	1.16	4.1	0.7	0.57	0.02
Tile Drain 3	7.1	-	-	<1	-	-	4	< 1.0	1.14	1.6	0.1	1.45	0.03
Co. Drain 4	7.3	-	-	1	-	-	28	0.1	0.23	0.8	<0.1	0.58	0.02
Co. Drain 6	7.2	-	-	1	-	19	8	< 0.1	0.13	0.6	0.2	0.53	0.02
Co. Drain 8	7.3	-	-	<1	-	18	2	< 0.1	0.09	1.7	<0.1	0.58	0.02
Ditch 10	7.0	-	-	<1	-	-	16	< 0.1	0.19	0.7	0.1	0.55	0.02
Ditch 10E	7.1	-	-	4	-	-	10	< 0.1	0.22	0.9	<0.1	0.54	0.01
							6-8-78						
Lagoon 1	8.6	21	17.4	26	-	48	19	4.3	3.67	46.0	39.7	0.41	0.18
Lagoon 2	8.3	21	7.4	9	-	30	4	1.7	1.84	4.4	2.8	0.30	0.06
Co. Drain 5	7.7	-	-	<1	-	14	2	< 0.1	0.17	0.2	0.3	0.38	0.01
Co. Drain 6	7.4	-	-	<1	-	27	30	< 0.1	0.12	0.6	0.4	0.38	0.01
Co. Drain 8	7.5	-	-	<1	-	14	10	0.1	0.14	13.6	0.3	0.35	0.01

Table Ia. (con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	PO_4	TKN	NH_3	NO_3	NO_2
						6-22-78							
Lagoon 1	8.4	22	16.2	28	-	62	14	6.3	4.78	31.4	24.8	0.38	1.35
Lagoon 2	9.9	25	> 20	57	-	74	33	2.4	1.08	11.4	3.4	0.53	0.39
Tile Drain 3	7.0	-	-	6	-	-	6	1.2	1.16	0.4	0.6	54.4	0.19
Co. Drain 4	7.4	-	-	7	-	-	30	< 0.1	0.14	0.2	0.2	0.74	0.01
Co. Drain 5	7.7	-	-	7	-	12	4	< 0.1	0.17	0.2	0.2	0.47	0.01
Co. Drain 6	7.2	-	-	11	-	16	14	< 0.1	0.08	1.0	0.6	0.53	0.01
Co. Drain 8	7.5	-	-	5	-	15	16	< 0.1	0.12	0.4	<0.1	0.43	0.01
Ditch 10	7.1	-	-	5	-	-	-	< 0.1	0.13	-	-	0.45	0.01
Ditch 10E	7.1	-	-	6	-	-	-	< 0.1	0.17	< 0.1	0.2	0.38	0.01
						6-27-78							
Lagoon 1	-	25	11.2	14	-	30	15	2.0	1.80	18.0	12.6	0.29	1.30
Lagoon 2	-	26	>20	51	-	60	48	2.5	1.04	13.6	2.0	0.41	0.08
Tile Drain 3	-	-	-	-	-	-	2	0.9	1.14	<0.1	<0.1	>50	0.16
Co. Drain 4	-	-	-	-	-	-	15	< 0.1	0.30	7.1	8.6	0.58	0.11
Co. Drain 5	-	-	-	1	-	12	2	< 0.1	0.26	-	0.4	0.44	0.09
Co. Drain 6	-	-	-	1	-	16	2	< 0.1	0.18	0.6	<0.1	0.48	0.04
Co. Drain 8	-	-	-	1	-	16	2	< 0.1	0.20	0.6	<0.1	0.41	0.05
Ditch 10	-	-	-	-	-	-	22	0.1	0.19	0.1	<0.1	0.49	0.05
Ditch 10E	-	-	-	-	-	-	4	< 0.1	0.19	0.1	<0.1	0.40	0.05
						6-29-78							
Lagoon 1	8.6	23	4.5	21	-	45	34	2.3	1.54	15.4	7.36	0.51	1.16
Lagoon 2	9.1	24	2.8	20	-	35	8	1.9	1.49	6.5	1.26	0.5	<0.09
Tile Drain 3	-	-	-	-	-	-	5	1.0	0.99	1.2	0.12	53.8	0.12
Co. Drain 5	8.1	-	-	< 1	-	10	6	0.2	0.20	1.9	0.20	0.68	0.04
Co. Drain 6	7.6	-	-	8	-	22	76	0.2	0.12	2.4	0.25	0.50	0.01
Co. Drain 8	7.7	-	-	1	-	12	10	< 0.1	0.16	1.5	0.10	0.42	0.01
Ditch 10	-	-	-	-	-	-	52	< 0.1	0.13	1.3	0.06	0.43	<0.01
Ditch 10E	-	-	-	-	-	-	7	< 0.1	0.15	2.3	0.10	0.49	<0.01
						7-7-78							
Lagoon 1	8.9	29	>20	14	-	39	3	3.0	2.41	20.0	12.3	0.45	0.87
Lagoon 2	10.0	29	>20	62	-	82	7	4.2	1.67	19.4	1.8	0.46	0.92
Co. Drain 5	7.4	-	-	3	-	10	16	0.1	0.15	0.4	0.20	0.59	0.03
Co. Drain 6	7.0	-	-	< 1	-	16	28	0.1	0.06	0.9	0.37	0.68	0.02
Co. Drain 8	7.3	-	-	2	-	21	56	0.1	0.11	0.9	0.17	0.52	0.01

Table Ia (con't)

Sample	pH	$T^{o}C$	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_2	NO_2
						7-11-78							
Lagoon 1	8.3	25	>20	36	–	52	33	5.7	4.67	52.2	43.8	0.25	0.25
Lagoon 2	9.5	25	>20	26	–	40	21	2.6	1.85	12.8	4.80	0.20	0.22
Tile Drain 3	6.8	–	–	8	–	–	–	4.7	4.91	18.2	17.2	8.7	0.07
Co. Drain 4	7.3	–	–	2	–	–	34	< 0.1	0.14	0.9	0.28	0.59	0.05
Co. Drain 5	7.6	–	–	<1	–	12	6	< 0.1	0.11	1.5	0.	0.47	0.02
Co. Drain 6	7.5	–	–	<1	–	18	32	< 0.1	0.09	1.4	0.12	0.38	<0.01
Co. Drain 8	7.6	–	–	<1	–	13	18	< 0.1	0.08	0.8	0.07	0.37	<0.01
Ditch 10	7.0	–	–	<1	–	–	94	< 0.1	0.06	2.1	0.06	0.42	<0.01
Ditch 10E	7.0	–	–	<1	–	–	12	< 0.1	0.08	0.7	0.08	0.41	<0.01
						7-13-78							
Lagoon 1	8.0	21	1.2	46	–	46	36	5.7	4.08	49.0	38.7	0.55	0.03
Lagoon 2	8.8	21	2.8	29	–	34	8	2.4	1.82	11.7	5.38	0.45	0.35
Tile Drain 3	–	–	–	–	–	–	15	4.0	4.33	16.1	14.5	17.5	0.46
Co. Drain 4	–	–	–	–	–	–	7	0.1	0.21	0.7	0.31	0.73	0.05
Co. Drain 5	7.6	–	–	2	–	10	11	< 0.1	0.18	0.5	0.13	0.61	0.03
Co. Drain 6	7.1	–	–	2	–	19	64	< 0.1	0.12	1.4	0.27	0.50	0.01
Co. Drain 8	7.6	–	–	1	–	9	590	< 0.1	0.13	2.9	0.10	0.49	0.01
Ditch 10	–	–	–	–	–	–	44	< 0.1	0.12	1.0	0.08	0.39	<0.01
Ditch 10E	–	–	–	–	–	–	4	< 0.1	0.13	0.6	0.07	0.38	<0.01
						7-17-78							
Lagoon 1	8.4	26	>20	>46	–	130	161	7.7	4.26	65.3	40.1	0.38	0.39
Lagoon 2	9.0	25	>20	15	–	45	12	2.5	1.67	14.1	6.27	0.25	0.38
Tile Drain 3	–	–	–	–	–	–	12	4.9	5.11	20.5	5.36	5.95	0.05
Co. Drain 4	7.2	–	–	<1	–	–	30	0.1	0.22	1.2	17.5	0.63	0.08
Co. Drain 5	7.5	–	–	<1	–	8	7	< 0.1	0.16	0.6	0.56	0.46	0.06
Co. Drain 6	7.0	–	–	<1	–	20	79	< 0.1	0.12	0.9	0.14	0.59	0.04
Co. Drain 8	7.4	–	–	<1	–	20	45	< 0.1	0.14	1.2	0.31	0.36	0.02
Ditch 10	–	–	–	–	–	–	129	< 0.1	0.14	1.6	0.11	0.33	0.02
Ditch 10E	–	–	–	–	–	–	6	< 0.1	0.15	0.7	0.05	0.29	0.02

Table Ia (cont'd.)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						7-20-78							
Lagoon 1	7.7	24	2.8	39	-	72	26	5.5	4.17	47.2	37.6	0.28	0.09
Lagoon 2	8.5	25	16.5	>75	-	80	60	4.2	2.07	24.0	7.67	0.25	0.15
Tile Drain 3	6.7	-	-	13	-	-	14	6.0	5.22	21.3	18.8	7.27	0.09
Co.Drain 4	7.1	-	-	2	-	-	408	1.3	0.19	3.8	0.32	0.54	0.06
Co.Drain 5	7.4	-	-	<1	-	9	13	0.3	0.16	0.6	0.18	0.51	0.04
Co.Drain 6	7.2	-	-	2	-	17	42	< 0.1	0.12	1.3	0.34	0.55	0.03
Co.Drain 8	7.6	-	-	<1	-	15	31	0.1	0.15	2.1	0.19	0.44	0.02
Ditch 10	7.0	-	-	2	-	-	152	0.1	0.15	1.1	0.06	0.34	0.01
Ditch 10E	7.1	-	-	<1	-	-	18	< 0.1	0/15	0.3	0.07	0.29	0.01

Table Ia (con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_2	NO_2
						7-25-78							
Lagoon 1	8.0	-	-	33	-	41	11	6.8	5.79	63.9	54.2	0.23	0.09
Lagoon 2	8.0	-	-	28	-	46	10	4.8	3.95	24.6	16.6	0.44	0.03
Tile Drain 3	-	-	-	-	-	-	<1	5.1	5.20	25.0	23.1	14.7	0.35
Co. Drain 4	-	-	-	-	-	-	636	2.1	0.23	3.8	0.37	0.90	0.05
Co. Drain 5	7.5	-	-	6	-	10	4	0.2	0.21	1.3	0.15	0.63	0.06
Co. Drain 6	7.1	-	-	<1	-	49	386	0.6	0.15	4.3	0.18	0.61	0.02
Co. Drain 8	7.5	-	-	2	-	18	32	< 0.1	0.16	1.1	0.09	0.43	0.02
Ditch 10	7.0	-	-	4	-	-	26	< 0.1	0.14	0.4	0.05	0.28	0.01
Ditch 10E	7.0	-	-	1	-	-	7	< 0.1	0.15	0.3	0.13	0.43	0.01
						7-27-78							
Lagoon 1	7.7	20	0.6	63	-	50	36	8.0	6.66	73.1	61.6	0.55	0.03
Lagoon 2	7.8	22	1.6	17	-	38	9	5.0	4.46	26.1	20.1	0.45	0.02
Co. Drain 4	-	-	-	-	-	-	298	0.4	0.20	1.1	0.09	0.55	0.01
Co. Drain 5	7.6	-	-	2	-	12	5	0.1	0.17	0.6	0.06	0.24	0.01
Co. Drain 6	7.2	-	-	1	-	16	16	0.1	0.15	0.7	0.21	0.50	0.01
Co. Drain 8	7.5	-	-	<1	-	14	18	0.1	0.15	0.9	0.03	0.26	<0.01
Ditch 10E	7.1	-	-	2	-	-	21	0.2	0.19	0.2	0.04	0.33	<0.01
						8-1-78							
Lagoon 1	7.9	23	>20	20	-	44	19	7.1	5.50	68.5	60.0	0.63	0.04
Lagoon 2	7.9	22	>20	62	-	53	32	6.0	4.62	37.3	27.8	0.48	0.06
Tile Drain 3	6.9	-	-	30	-	-	117	2.8	2.31	4.0	3.71	38.9	0.75
Co. Drain 4	7.3	-	-	3	-	-	14	< 0.1	0.15	0.3	0.08	0.60	0.02
Co. Drain 5	7.6	-	-	<1	-	12	12	< 0.1	0.16	1.1	0.09	0.58	0.02
Co. Drain 6	7.0	-	-	<1	-	18	12	< 0.1	0.14	0.9	0.25	0.61	0.02
Co. Drain 8	7.6	-	-	<1	-	17	12	< 0.1	0.12	0.7	0.08	0.49	0.01
Ditch 10	7.2	-	-	<1	-	-	44	< 0.1	0.13	0.2	0.05	0.50	0.01
Ditch 10E	7.0	-	-	<1	-	-	30	< 0.1	0.15	0.1	0.08	0.39	0.01
						8-3-78							
Lagoon 1	7.9	20	1.6	70	-	65	57	8.9	5.45	72.2	55.6	0.37	0.03
Lagoon 2	7.8	21	3.4	53	-	47	22	5.5	4.48	37.1	29.9	0.35	0.08
Tile Drain 3	6.8	-	-	5	-	-	2	2.3	2.06	0.7	0.77	40.9	0.48
Co. Drain 4	7.2	-	-	<1	-	-	10	< 0.1	0.17	0.8	0.03	0.33	0.01
Co. Drain 5	7.6	-	-	<1	-	17	2	< 0.1	0.15	0.6	0.05	0.35	0.01
Co. Drain 6	7.3	-	-	<1	-	12	6	< 0.1	0.13	1.2	0.10	0.37	0.01
Co. Drain 8	7.4	-	-	<1	-	13	14	< 0.1	0.13	0.8	0.11	0.52	0.01
Ditch 10	6.9	-	-	2	-	-	14	< 0.1	0.14	0.2	0.06	0.42	<0.01
Ditch 10E	6.9	-	-	1	-	-	20	< 0.1	0.16	0.7	0.09	0.34	<0.01

Table Ia. (con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						8-8-78							
Lagoon 1	8.2	20	4.6	52	-	55	34	6.9	5.52	70.8	60.2	0.47	0.05
Lagoon 2	7.9	22	4.8	-	-	48	30	5.9	4.58	43.4	34.3	0.46	0.12
Tile Drain 3	6.8	-	-	16	-	-	42	1.9	2.05	2.8	1.27	41.5	0.92
Co. Drain 4	7.3	-	-	<1	-	-	16	< 0.1	0.43	0.4	0.09	0.63	0.01
Co. Drain 5	7.6	-	-	1	-	9	10	0.1	0.42	0.8	0.03	0.55	0.01
Co. Drain 6	7.2	-	-	1	-	15	40	0.1	0.35	0.8	0.10	0.57	0.01
Co. Drain 8	7.5	-	-	<1	-	14	20	0.1	0.37	0.4	0.10	0.57	0.01
Ditch 10	7.1	-	-	<1	-	-	46	0.1	0.32	0.9	0.03	0.49	0.01
Ditch 10E	6.9	-	-	<1	-	-	16	0.1	0.40	0.5	0.03	0.44	0.01
						8-10-78							
Lagoon 1	8.0	20	2.2	28	-	58	47	7.5	6.07	75.7	60.0	0.53	0.10
Lagoon 2	8.3	22	18.4	29	-	50	44	5.1	4.16	40.9	27.3	0.49	0.48
Tile Drain 3	6.9	-	-	<1	-	-	282	2.2	2.28	2.0	1.28	37.7	0.67
Co. Drain 4	7.3	-	-	<1	-	-	10	< 0.1	0.50	0.4	0.07	0.69	0.01
Co. Drain 5	7.6	-	-	<1	-	12	3	< 0.1	0.51	0.4	0.02	0.53	0.01
Co. Drain 6	7.4	-	-	<1	-	16	17	< 0.1	0.44	1.2	0.06	0.58	0.01
Co. Drain 8	7.6	-	-	<1	-	14	10	< 0.1	0.46	1.0	0.02	0.59	0.01
Ditch 10	7.2	-	-	2	-	-	3	< 0.1	0.45	0.6	0.01	0.56	<0.01
Ditch 10E	7.0	-	-	<1	-	-	12	< 0.1	0.46	0.5	0.03	0.57	<0.01
						8-15-78							
Lagoon 1	7.9	23	12.0	61	-	67	72	7.1	5.75	70.3	57.0	0.48	0.04
Lagoon 2	8.5	25	12.8	75	-	119	156	5.6	2.95	49.8	22.7	0.48	0.16
Tile Drain 3	7.1	-	-	-	-	-	4	1.7	2.13	1.2	0.34	37.8	0.35
Co. Drain 4	7.4	-	-	<1	-	-	8	< 0.1	0.23	1.0	0.04	0.44	0.01
Co. Drain 5	7.7	-	-	<1	-	8	6	< 0.1	0.24	0.4	0.04	0.44	0.01
Co. Drain 6	7.5	-	-	<1	-	11	12	< 0.1	0.20	0.6	0.10	0.56	0.01
Co. Drain 8	7.7	-	-	<1	-	18	24	< 0.1	0.20	0.4	0.03	0.51	0.01
Ditch 10	7.3	-	-	<1	-	-	16	< 0.1	0.16	0.5	0.04	0.47	0.01
Ditch 10e	7.1	-	-	<1	-	-	16	< 0.1	0.21	<0.1	0.03	0.43	0.01

Table Ia. (cont.)

Sample	pH	T^{o}C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						8-17-78							
Lagoon 1	7.5	–	–	72	–	62	37	9.3	8.07	84.6	70.6	0.48	0.04
Lagoon 2	7.7	–	–	66	–	57	44	6.2	4.49	41.2	26.0	0.47	0.04
Tile Drain 3	–	–	–	–	–	–	34	3.1	2.19	1.9	0.43	36.2	0.36
Co. Drain 4	7.2	–	–	2	–	–	8	< 0.1	0.26	0.5	0.11	0.51	0.01
Co. Drain 5	7.6	–	–	2	–	16	5	< 0.1	0.27	0.7	0.10	0.44	0.01
Co. Drain 6	7.4	–	–	4	–	24	10	0.1	0.22	0.8	0.07	0.44	0.01
Co. Drain 8	7.5	–	–	4	–	37	164	0.2	0.13	2.4	0.07	0.49	0.01
Ditch 10	7.1	–	–	3	–	–	4	< 0.1	0.19	5.0	0.08	0.42	0.01
Ditch 10 E	7.0	–	–	2	–	–	14	< 0.1	0.24	0.5	0.09	0.41	0.01
						8-22-78							
Lagoon 1	7.9	–	–	61	–	58	44	7.8	5.94	77.5	64.8	0.18	0.05
Lagoon 2	8.0	–	–	36	–	32	31	4.3	4.19	42.5	33.7	0.08	0.19
Tile Drain 3	6.8	–	–	7	–	–	34	1.3	1.42	1.2	0.25	66.2	0.08
Co. Drain 4	7.2	–	–	2	–	–	12	< 0.1	0.37	0.5	0.12	0.27	0.01
Co. Drain 5	7.6	–	–	< 1	–	14	6	< 0.1	0.37	0.3	0.13	0.22	0.02
Co. Drain 6	7.2	–	–	< 1	–	18	32	< 0.1	0.31	1.3	0.25	0.57	0.06
Co. Drain 8	7.5	–	–	< 1	–	20	20	< 0.1	0.33	0.5	0.16	0.49	0.05
Ditch 10	7.2	–	–	< 1	–	–	18	< 0.1	0.32	0.6	0.06	0.31	0.05
Ditch 10 E	7.1	–	–	< 1	–	–	8	< 0.1	0.34	0.5	0.09	0.42	0.05
													0.06
						8-24-78							
Lagoon 1	7.9	22	1.2	32	–	68	30	8.0	6.36	80.2	65.2	0.44	0.74
Lagoon 2	8.3	23	2.2	22	–	44	5	3.5	3.15	35.6	28.6	0.55	0.03
Tile Drain 3	6.9	–	–	2	–	–	< 2	1.0	1.26	< 0.1	0.2	67.0	0.10
Co. Drain 4	7.4	–	–	< 1	–	–	12	< 0.1	0.34	0.5	0.1	0.63	0.02
Co. Drain 5	7.7	–	–	< 1	–	11	2	< 0.1	0.34	0.8	0.2	0.51	0.02
Co. Drain 6	7.4	–	–	< 1	–	24	86	0.2	0.27	1.6	0.1	0.50	0.02
Co. Drain 8	7.6	–	–	< 1	–	14	4	< 0.1	0.32	0.4	0.1	0.66	0.02
Ditch 10	7.2	–	–	2	–	–	18	< 0.1	0.29	1.5	0.1	0.50	0.02
Ditch 10 E	7.1	–	–	< 1	–	–	2	< 0.1	0.32	0.4	0.1	0.55	0.02

Table I b. TOTAL AND FECAL COLIFORM COMPOSITION OF WASTEWATER AT VARIOUS SAMPLING SITES AT THE CLARE REST AREA.

	Organisms/100ml (MPN)															
	1		2		3		5		6		8		9			
	Lagoon (South)		Lagoon (North)		Post Sand Seepage		Co. Drain		Co. Drain		Co. Drain		Crossover Pipe		Chlorination Tank**	
DATE	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
1- -77	-	-	-	-	>240,000	>240,000	46,000	15,000	-	-	-	-	-	-	-	-
2-14-77	24,000	24,000	460,000	460,000	-	-	-	-	-	-	-	-	-	-	-	-
4-18-77	460,000	150,000	2,400	<230	9,300	9,300	4,300	150	24,000	430	-	-	-	-	-	-
5-13-77	240,000	4,300	23	<4	2,400	210	2,400	2,400	930	930	-	-	-	-	-	-
6-28-77	9,300	4,600	>24,000	>24,000	-	-	-	-	-	-	-	-	-	-	-	-
7-7-77	9,300	11,000	>240,000	110,000	110,000	110,000	>240,000	4,300	21,000	4,300	15,000	4,300	-	-	-	-
* 7-19-77	90	20	900	<200	2,400	2,400	4,300	400	2,300	900	-	-	-	-	-	-
7-25-77	>24,000	>24,000	-	-	-	-	-	-	-	-	-	-	-	-	(A) <2	<2
															(B) 4,600	4,600
															(A) <2	<2
7-28-77	>240,000	110,000	>24,000	>24,000	-	-	-	-	-	-	-	-	-	-	(A) 43	4
8-1-77	930,000	930,000	43,000	24,000	-	-	-	-	-	-	-	-	-	-	(A) >24,000	>24,000
8-4-77	>240,000	>240,000	24,000	9,300	-	-	2,300	400	7,500	<200	-	-	-	-	-	-
8-9-77	460,000	150,000	15,000	7,500	-	-	-	-	-	-	-	-	150,000	75,000	(A) >240,000	430
8-11-77	150,000	93,000	12,000	7,500	-	-	-	-	-	-	-	-	>240,000	110,000	(A) >240,000	3,900
8-12-77	240,000	110,000	46,000	4,300	-	-	-	-	-	-	-	-	>240,000	>240,000	-	-
8-16-77	460,000	240,000	46,000	24,000	-	-	-	-	-	-	-	-	930,000	460,000	(A) < 200	-
8-17-77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(A) 2,300	<200
8-18-77	$>2.4x10^6$	$>2.4x10^6$	>24,000	11,000	-	-	-	-	-	-	-	-	-	-	-	-
8-23-77	210,000	93,000	24,000	2,400	-	-	-	-	-	-	-	-	-	-	(A) 430	< 2
8-24-77	110,000	9,300	46,000	300	-	-	-	-	-	-	-	-	-	-	(A) > 24,000	<20
8-29-77	46,000	9,300	9,300	4,300	-	-	-	-	-	-	-	-	93,000	46,000	(A) < 200	-
8-31-77	21,000	9,300	46,000	2,300	-	-	4,600	230	4,600	70	4,600	< 200	$>2.4x10^6$	21,000	(A) 400	<200
9-02-77	46,000	24,000	24,000	4,300	-	-	-	-	-	-	-	-	21,000	4,300	(A) < 200	-
9-06-77	24,000	1,500	4,300	<200	-	-	4,600	230	11,000	230	930	90	-	-	-	-
9-09-77	110,000	110,000	24,000	1,500	-	-	-	-	-	-	-	-	-	-	(B) 43,000	9,300
9-15-77	>240,000	>240,000	9,300	4,300	-	-	-	-	-	-	-	-	$>2.4x10^6$	$>2.4x10^6$	(A) 40	<20
9-22-77	240,000	43,000	>24,000	1,500	-	-	>24,000	750	2,400	430	11,000	4,600	-	-	-	-
10-14-77	24,000	<200	24,000	<200	-	-	460	9	2,400	40	2,400	7	-	-	-	-
11-29-77	230,000	40,000	230,000	90,000	-	-	24,000	< 2	2,400	< 2	2,400	< 2	-	-	-	-

* Samples warm: no ice in cooler

** (A) = After Chlorination
(B) = Before Chlorination

Table I b. (con't)

	Organisms/100ml (MPN)															
	1		2		3		5		6		8		9			
	Lagoon (South)		Lagoon (North)		Post Sand Seepage		Co. Drain		Co. Drain		Co. Drain		Crossover Pipe		Chlorination Tank**	
DATE	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
2-28-78	< 200	–	–	–	–	–	240	9	–	–	240	93	–	–	–	–
3-16-78	230	< 20	230	< 20	–	–	2,400	< 2	–	–	2,400	23	–	–	–	–
4-15-78	2,400	< 20	< 200	–	–	–	2,400	< 2	430	< 2	930	15	–	–	–	–
5-12-78	46,000	2,100	23,000	700	2,400	4	4,600	93	–	–	4,600	390	–	–	(A) 4,300	< 200
5-24-78	240,000	46,000	240,000	1,400	4,600	4	>24,000	93	2,400	75	11,000	240	–	–	–	–
6-08-78	460,000	43,000	9,300	930	–	–	4,600	930	930	240	150	150	–	–	–	–
6-22-78	15,000	4,300	<2	–	930	9	2,100	93	2,400	43	11,000	93	–	–	400	< 2
6-27-78	21,000	12,000	2,300	40	930	930	9,300	2,400	1,500	930	9,300	40	–	–	(A) 24,000	430
6-29-78	23,000	900	11,000	75	11,000	43	24,000	1,500	>24,000	23	24,000	150	–	–	(A) 9,300	< 20
7-07-78	900	<200	40	<20	–	–	1,500	<200	–	–	–	–	–	–	(A) 2,300	90
7-11-78	93,000	2,300	230	40	70	40	15,000	400	15,000	430	15,000	210	–	–	(A) <20	–
7-13-78	46,000	2,300	15,000	1,500	230	230	46,000	400	24,000	90	24,000	90	–	–	(A) >240,000	40
7-17-78	46,000	15,000	750	40	2,400	930	9,300	<200	24,000	90	11,000	90	–	–	(A) 15,000	<20
7-20-78	9,300	9,300	230	90	750	40	24,000	400	46,000	4,600	2,800	230	–	–	(A) 46,000	90
7-25-78	240,000	15,000	7,500	4,600	11,000	4,600	9,300	<200	110,000	400	1,100	40	–	–	(A) 46,000	11,000
7-27-78	460,000	150,000	9,300	4,300	–	–	9,300	400	9,300	400	7,500	230	–	–	–	–
8-01-78	24,000	24,000	24,000	900	>240,000	4,600	1,500	400	460,000	900	930	90	–	–	(A) 210	40
8-03-78	210,000	110,000	2,300	700	1,100	1,100	9,300	9,300	2,300	<200	930	40	–	–	(A) 110,000	210
8-08-78	$1.1x10^6$	460,000	21,000	7,500	2,400	2,400	2,800	2,800	900	900	4,600	4,600	–	–	(A) <20	–
8-10-78	110,000	24,000	110,000	2,300	24,000	930	2,100	<200	24,000	900	4,600	430	–	–	(A) 40	<20
8-15-78	460,000	240,000	24,000	2,100	11,000	90	15,000	400	2,300	900	930	430	–	–	–	–
8-17-78	$1.1x10^6$	110,000	21,000	2,100	750	150	9,300	400	9,300	1,500	4,600	930	–	–	(A) 230	90
8-22-78	$1.1x10^6$	150,000	15,000	9,300	930	430	2,000	400	900	900	930	430	–	–	–	–
8-24-78	930,000	230,000	21,000	2,300	24,000	90	93,000	23,000	24,000	15,000	24,000	900	–	–	–	–

** (A) = After Chlorination
(B) = Before Chlorination

Table I c. TOTAL AND FECAL STREPTOCOCCAL COMPOSITION OF WASTEWATER AT VARIOUS SAMPLING SITES AT THE CLARE REST AREA.

Organisms/100ml (MPN)

	1		2		3		5		7		8		9			
	Lagoon (South)		Lagoon (North)		Post Sand Seepage		Co. Drain		Co. Drain		Co. Drain		Crossover Pipe		Chlorination Tank**	
DATE	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
1- -77	-	-	-	-	15,000	4,300	2,400	210	-	-	-	-	-	-	-	-
2-14-77	75,000	15,000	240,000	240,000	-	-	-	-	-	-	-	-	-	-	-	-
4-18-77	$1.1x10^6$	75,000	93	93	2,400	2,400	930	<23	430	150	-	-	-	-	-	-
5-13-77	9,300	930	43	43	2,400	210	2,400	430	930	430	-	-	-	-	-	-
6-28-77	930	460	4,600	2,400	-	-	-	-	-	-	-	-	-	-	-	-
7-7-77	2,400	2,400	9,300	4,600	2,400	2,400	2,400	2,400	4,300	4,600	4,300	210	-	-	-	-
*7-19-77	2,400	930	400	< 200	7,500	7,500	4,600	460	900	900	-	-	-	-	-	-
7-25-77	4,600	2,400	-	-	-	-	-	-	-	-	-	-	-	-	(A) 4	< 2
															(B) 4,600	150
															(A) 23	23
7-28-77	9,300	11,000	4,600	4,600	-	-	-	-	-	-	-	-	-	-	(A) <2	<2
8-1-77	24,000	24,000	2,400	2,400	-	-	-	-	-	-	-	-	-	-	(A) 4,600	15
8-4-77	46,000	46,000	2,300	2,300	400	<200	400	400	-	-	-	-	-	-	-	-
8-9-77	43,000	4,300	12,000	7,500	-	-	-	-	-	-	-	-	9,300	4,300	(A) 12,000	2,000
8-11-77	240,000	46,000	2,300	2,300	-	-	-	-	-	-	-	-	9,300	4,300	(A) 93,000	110,000
8-12-77	23,000	24,000	4,300	4,300	-	-	-	-	-	-	-	-	46,000	4,600	-	-
8-16-77	93,000	46,000	24,000	9,300	-	-	-	-	-	-	-	-	93,000	93,000	(A) 4,000	4,000
8-17-77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(A) 2,300	900
8-18-77	46,000	46,000	2,400	2,400	-	-	-	-	-	-	-	-	-	-	-	-
8-23-77	24,000	4,300	4,300	1,500	-	-	-	-	-	-	-	-	-	-	(A) 430	460
8-26-77	15,000	2,000	2,300	2,300	-	-	-	-	-	-	-	-	-	-	(A) 24,000	460
8-29-77	4,300	900	2,300	900	-	-	-	-	-	-	-	-	9,300	400	(A) 200	-
8-31-77	24,000	9,300	700	200	-	-	4,600	210	2,400	40	430	230	93,000	24,000	(A) 400	400
9-02-77	24,000	9,300	4,300	1,500	-	-	-	-	-	-	-	-	2,300	900	(A) 200	-
9-06-77	2,000	1,500	1,500	200	-	-	230	40	2,100	40	40	40	-	-	-	-
9-09-77	24,000	24,000	400	400	-	-	-	-	-	-	-	-	-	-	(B) 2,300	2,300
9-15-77	46,000	46,000	200	-	-	-	-	-	-	-	-	-	9,300	9,300	(A) 20	-
9-22-77	9,300	9,300	2,400	930	-	-	930	430	930	150	93	93	-	-	-	-
10-14-77	9,300	9,300	2,300	2,300	-	-	93	43	90	40	43	43	-	-	-	-
11-29-77	< 2	< 2	< 2	< 2	-	-	< 2	< 2	40	40	< 2	< 2	-	-	-	-

* Samples warm: no ice in cooler

** (A) = After Chlorination
(B) = Before Chlorination

Table I c. (con't)

Organisms/100ml (MPN)

DATE	1 Lagoon (South) TOTAL	FECAL	2 Lagoon (North) TOTAL	FECAL	3 Post Sand Seepage TOTAL	FECAL	5 Co. Drain TOTAL	FECAL	6 Co. Drain TOTAL	FECAL	8 Co. Drain TOTAL	FECAL	9 Crossover Pipe TOTAL	FECAL	Chlorination Tanks* TOTAL	FECAL
2-28-78	<200	-	-	-	-	-	23	4	-	-	4	4	-	-	-	-
3-16-78	<20	-	<20	-	-	-	23	< 2	-	-	43	<2	-	-	-	-
4-15-78	40	40	<200	-	-	-	9	9	150	<2	<2	-	-	-	-	-
5-12-78	46,000	400	400	<200	4,600	<2	>24,000	15	-	-	2,400	9	-	- (A)	240,000	<200
5-24-78	1,500	700	<200	-	4,600	4	>24,000	93	2,400	75	11,000	240	-	-	-	-
6-08-78	43,000	2,300	750	40	-	-	4,600	4,600	930	43	4,600	1,500	-	-	-	-
6-22-78	4,300	2,300	<2	-	230	43	2,400	>2,400	2,400	1,100	2,400	1,100	-	- (A)	<2	-
6-27-78	2,300	2,300	430	430	90	90	15,000	9,300	2,400	2,400	430	430	-	- (A)	230	230
6-29-78	2,300	900	2,400	43	11,000	43	24,000	1,500	>24,000	23	24,000	150	-	- (A)	430	70
7-07-78	900	<200	2,300	<20	-	-	1,500	<200	-	-	-	-	-	- (A)	4,300	2,400
7-11-78	9,300	2,300	2,400	70	150	150	4,300	1,500	4,600	430	2,400	210	-	- (A)	<20	-
7-12-78	46,000	46,000	46,000	46,000	930	70	9,300	4,300	11,000	750	4,600	40	-	- (A)	11,000	11,000
7-17-78	46,000	15,000	2,400	150	430	150	9,300	2,300	750	430	430	230	-	- (A)	430	150
7-20-78	46,000	1,100	7,500	1,100	2,400	2,400	2,300	400	2,400	2,400	4,600	930	-	- (A)	230	530
7-25-78	7,500	7,500	2,400	930	930	930	2,300	2,300	2,300	900	930	430	-	-	930	930
7-27-78	93,000	15,000	7,500	1,500	-	-	2,300	2,300	2,300	2,300	15,000	9,300	-	- (A)	-	-
8-01-78	46,000	4,300	24,000	2,300	1,500	1,500	2,300	2,300	9,300	9,300	2,400	2,400	-	- (A)	90	<20
8-03-78	240,000	2,300	9,300	400	4,600	4,600	2,300	900	2,300	2,300	2,400	210	-	- (A)	2,400	930
8-06-78	240,000	110,000	2,300	2,300	4,600	4,600	2,800	1,500	900	400	2,400	930	-	- (A)	<20	-
8-10-78	240,000	7,500	24,000	1,500	2,400	2,400	900	900	900	900	430	230	-	- (A)	<20	-
8-15-78	46,000	46,000	110,000	1,500	2,400	150	2,300	900	2,300	2,300	2,400	2,400	-	-	-	-
8-17-78	460,000	46,000	24,000	1,500	2,400	150	9,300	900	900	900	2,400	2,400	-	- (A)	150	90
8-22-78	240,000	110,000	9,300	9,300	4,600	750	4,300	1,500	2,300	900	4,600	4,600	-	-	-	-
8-24-78	150,000	23,000	43,000	2,000	4,300	40	15,000	15,000	7,000	2,300	4,300	2,300	-	-	-	-

Table Id. CHEMICAL COMPOSITION OF SURFACE WATER ON THE CLARE REST AREA OVERLAND FLOW

Sample #	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						7-25-77					
CTA	-	55	-	138	-	6.7	4.98	-	-	0.4	0.11
CTB	-	32	-	153	-	6.7	4.50	-	-	0.4	0.19
						7-26-77					
CTA	-	30	-	119	-	7.0	5.70	-	-	0.4	0.18
CTB	-	23	-	132	-	6.2	5.08	-	-	0.7	0.13
2Co	-	8	-	80	-	3.7	3.58	-	-	0.7	0.10
						7-27-77					
CTA	-	49	-	118	-	9.1	5.28	-	-	0.6	0.18
1Co	-	10	-	174	-	3.7	3.43	-	-	0.6	0.20
2Co	-	7	-	138	-	3.4	3.25	-	-	0.6	0.16
						7-28-77					
CTA	-	30	-	132	-	5.8	5.38	-	-	0.6	0.10
						8-1-77					
CTA	-	19	-	116	-	6.3	5.53	35.8	26.9	0.5	0.07
1Bo	-	10	-	148	-	2.6	2.50	11.6	4.8	1.2	0.08
2Bo	-	10	-	99	-	4.0	3.40	19.5	13.4	0.2	0.51
2Co	-	9	-	97	-	3.5	3.00	14.2	8.7	0.2	0.28
						8-4-27					
1Co	-	8	-	121	-	2.4	2.63	9.6	5.1	0.7	0.05
1Do	-	7	-	91	-	0.8	0.53	3.0	1.4	2.0	0.59
2Ao	-	5	-	143	-	0.8	0.80	4.6	0.5	1.8	0.34
2Bo	-	10	-	138	-	4.3	4.10	27.4	22.1	1.6	0.45
2Co	-	10	-	110	-	3.9	3.48	17.1	14.7	2.7	0.69
2Do	-	7	-	112	-	0.6	0.83	6.8	1.6	2.4	0.04
3Ao	-	4	-	138	-	0.1	1.23	3.8	0.5	0.1	1.14

Table Id. (con't)

Sample #	pH	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						8-9-77					
CTA	-	30	-	118	-	7.3	7.15	44.3	38.4	1.2	0.04
1Ao	-	14	-	138	-	4.1	3.25	12.0	6.2	0.8	0.05
1Co	-	8	-	124	-	1.9	2.45	7.6	4.3	0.9	0.05
1Do	-	8	-	69	-	0.9	0.75	4.4	1.8	1.4	0.59
						8-11-77					
CTA	-	-	-	109	-	4.9	3.85	31.4	25.7	0.6	0.32
						8-12-77					
2Bo	-	-	-	91	-	2.0	1.95	12.3	9.2	1.5	0.13
2Co	-	-	-	86	-	2.3	1.13	13.5	-	1.3	0.04
2Do	-	-	-	89	-	1.0	1.03	2.8	-	1.5	0.29
						8-16-77					
CTA	-	-	-	143	-	5.8	4.21	37.8	-	0.82	0.33
						8-17-77					
CTA	-	-	-	114	-	5.4	4.29	32.4	-	0.69	0.31
						8-18-77					
1Ao	-	-	-	108	-	2.4	3.50	1.13	-	0.60	0.24
1Bo	-	-	-	103	-	3.1	4.08	1.46	-	0.69	0.15
1Co	-	-	-	99	-	3.3	3.90	1.43	-	0.77	0.27
1Do	-	-	-	98	-	3.8	3.75	1.36	-	0.83	0.25
Pond 1	-	-	-	79	-	0.5	1.18	0.35	-	0.52	<0.01
Pond 2	-	-	-	78	-	0.1	1.18	0.15	-	0.56	0.01

Table Id. (con't)

Sample #	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						8-23-77					
CTA	8.4	-	-	143	-	5.2	3.73	34.8	-	1.27	1.22
1AD	7.5	-	-	104	-	2.9	2.83	12.9	-	0.76	0.90
1BD	7.5	-	-	92	-	3.3	3.13	15.9	-	0.66	1.12
1CD	7.6	-	-	93	-	3.4	3.42	18.3	-	0.83	0.76
2AD	7.2	-	-	69	-	1.5	1.98	6.2	-	0.77	0.33
2BD	7.6	-	-	63	-	2.6	2.22	9.5	-	0.67	0.51
2CD	7.7	-	-	65	-	2.2	2.20	8.3	-	0.89	0.72
3AD	7.6	-	-	67	-	4.0	3.52	22.1	-	0.70	0.54
3BD	7.4	-	-	68	-	3.0	2.76	14.4	-	0.82	0.80
3CD	7.1	-	-	73	-	2.4	2.45	12.0	-	0.25	1.41
4AD	7.2	-	-	81	-	2.2	2.15	11.1	-	0.91	0.59
4BD	7.0	-	-	81	-	1.9	1.97	8.8	-	0.79	0.50
4CD	7.2	-	-	83	-	2.5	2.64	12.5	-	0.74	1.24
5AD	7.0	-	-	96	-	3.3	1.44	5.6	-	0.68	0.38
5BD	7.4	-	-	85(27)	-	3.6	1.92	7.2	-	0.75	0.60
5CD	7.5	-	-	75(28)	-	2.4	1.98	6.4	-	0.72	0.78
6AD	7.3	-	-	83(36)	-	1.5	1.37	3.3	-	0.67	0.41
6BD	7.3	-	-	80(36)	-	1.6	1.50	3.5	-	0.70	0.47
6CD	7.3	-	-	96(42)	-	1.5	1.58	3.9	-	0.69	0.44
						8-26-77					
CTA	-	-	-	-	-	4.6	4.06	23.5	-	0.45	0.78
CTB_1	-	-	-	-	-	4.9	4.45	11.3	-	0.25	0.07
CTB_2		-	-	-	-	4.3	3.56	11.4	-	NS	1.23
1AD	-	-	-	-	-	3.6	3.60	17.8	-	0.45	1.09
1BD	-	-	-	-	-	2.6	2.78	10.7	-	0.50	1.00
1CD	-	-	-	-	-	3.8	3.57	16.1	-	0.50	0.72
2AD	-	-	-	-	-	2.7	2.69	9.2	-	0.30	0.89
2BD	-	-	-	-	-	2.9	2.80	11.3	-	0.40	1.13
3AD	-	-	-	-	-	3.9	3.33	31.1	-	0.53	0.67
3BD	-	-	-	-	-	2.8	2.78	10.5	-	0.42	1.02
3CD	-	-	-	-	-	3.5	3.01	13.9	-	0.75	2.16
4AD	-	-	-	-	-	1.5	1.66	5.3	-	0.45	0.89
4BD	-	-	-	-	-	2.0	1.75	6.1	-	0.38	0.75
4CD	-	-	-	-	-	2.7	2.76	11.1	-	0.50	1.80
5AD	-	-	-	-	-	0.4	0.81	4.0	-	0.27	0.26
6AD	-	-	-	-	-	0.2	1.05	3.4	-	0.21	0.01
6BD	-	-	-	-	-	0.2	0.81	1.9	-	0.25	0.01

Table Id. (con't)

Sample #	pH	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						8-29-77					
CTA	–	–	–	175(80)	–	3.0	3.43	18.3	–	1.07	1.15
S. Pond 1	–	–	–	–	–	0.2	1.08	3.2	–	0.65	< 0.02
S. Pond 2	–	–	–	–	–	0.1	1.00	2.8	–	1.31	0.02
						8-31-77					
CTA	–	–	–	–	–	3.9	4.0	28.2	–	0.79	0.62
1AD	–	–	–	–	–	0.9	1.45	5.6	–	0.82	0.06
1BD	–	–	–	–	–	5.3	1.24	3.8	–	0.59	0.09
1CD	–	–	–	–	–	1.0	1.64	6.4	–	0.69	0.37
2AD	–	–	–	–	–	0.7	1.25	3.8	–	0.70	0.06
2BD	–	–	–	–	–	0.6	1.06	3.8	–	0.62	0.15
3AD	–	–	–	–	–	0.4	0.75	3.3	–	0.63	0.04
3BD	–	–	–	–	–	2.9	1.16	3.3	–	0.75	0.08
3CD	–	–	–	–	–	0.2	0.82	3.7	–	0.74	0.08
4AD	–	–	–	–	–	< 0.1	0.73	3.5	–	0.65	0.01
4BD	–	–	–	–	–	0.1	1.08	0.9	–	0.65	< 0.01
4CD	–	–	–	–	–	0.2	0.71	3.0	–	0.54	0.02
5AD	–	–	–	–	–	< 0.1	0.59	2.9	–	0.70	0.02
5BD	–	–	–	–	–	0.1	0.78	2.0	–	0.62	0.01
5CD	–	–	–	–	–	0.2	0.88	2.3	–	0.58	0.01
6AD	–	–	–	–	–	< 0.1	1.02	3.2	–	0.60	0.01
6BD	–	–	–	–	–	0.3	0.87	2.2	–	1.46	0.03
6CD	–	–	–	–	–	< 0.1	1.07	3.2	–	0.60	0.01
						9-2-77					
CTA	7.7	–	–	28	27	3.6	3.73	21.4	11.9	0.77	0.51
1AD	7.2	–	–	–	–	1.0	1.62	8.0	3.2	0.34	0.16
1BD	7.2	–	–	–	–	0.9	1.45	5.1	2.7	0.43	0.15
1CD	7.3	–	–	–	–	1.7	2.37	8.0	5.7	0.68	0.08
2AD	7.2	–	–	–	–	0.8	1.47	3.9	1.5	0.43	0.22
2BD	7.3	–	–	–	–	9.7	1.28	3.7	0.6	0.63	0.05
3AD	7.2	–	–	–	–	0.7	0.89	3.2	0.6	0.61	0.04
3BD	6.8	–	–	–	–	0.5	0.78	1.7	0.4	0.36	0.14
3CD	7.3	–	–	–	–	0.6	0.89	1.0	0.6	0.72	0.03

Table Id. (con't)

Sample #	pH	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
					9- 2-77 (con't)						
4AD	6.9	-	-	-	-	0.2	0.46	1.3	0.3	0.62	0.03
4BD	7.2	-	-	-	-	0.2	0.68	1.4	0.5	0.45	0.04
4CD	7.1	-	-	-	-	0.3	0.69	3.7	0.4	0.55	0.02
5AD	6.8	-	-	-	-	0.2	0.60	1.0	0.5	0.51	0.02
5BD	7.3	-	-	-	-	10.5	0.83	1.2	0.5	0.42	0.03
5CD	7.4	-	-	-	-	<1	0.85	1.3	0.4	0.56	0.02
6AD	7.2	-	-	-	-	0.3	0.81	1.0	0.4	0.49	0.03
6BD	7.3	-	-	-	-	0.3	0.87	0.9	0.5	0.54	0.02
6CD	7.3	-	-	-	-	0.5	1.06	1.3	0.5	0.48	0.02
S. Pond	7.2	-	-	18	-	1.0	0.61	1.4	0.6	0.42	0.03
					9-6-77						
1AD	-	-	-	-	-	1.3	1.27	6.3	0.3	0.63	0.19
1BD	-	-	-	-	-	1.2	1.18	7.4	1.6	0.57	0.46
1CD	-	-	-	-	-	1.2	0.96	6.5	0.4	0.72	0.36
2AD	-	-	-	-	-	0.7	0.47	10.3	0.4	0.46	0.18
2BD	-	-	-	-	-	0.5	0.33	2.2	0.4	0.42	0.21
3AD	-	-	-	-	-	1.5	1.82	3.6	8.0	0.62	0.08
3BD	-	-	-	-	-	1.5	1.90	9.6	1.4	0.58	0.13
3CD	-	-	-	-	-	0.9	1.04	5.3	3.0	0.56	0. .9
4AD	-	-	-	-	-	0.2	0.29	2.3	0.6	0.46	0.04
4BD	-	-	-	-	-	0.8	0.97	6.3	4.0	0.56	0.08
4CD	-	-	-	-	-	0.7	0.93	3.6	0.3	0.69	0.10
5AD	-	-	-	-	-	0.3	0.33	2.0	0.9	0.53	0.06
5BD	-	-	-	-	-	0.6	0.88	2.4	0.8	0.53	0.05
5CD	-	-	-	-	-	0.7	0.75	2.9	0.8	0.54	0.06
6AD	-	-	-	-	-	0.5	0.60	2.2	0.5	0.75	0.05
6BD	-	-	-	-	-	0.3	0.75	1.7	0.5	0.46	0.05
6CD	-	-	-	-	-	0.3	0.81	2.0	0.9	-	0.05

Table Id. (con't)

Sample #	pH	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
					9-09-77						
CTB	–	–	–	25	5	3.8	3.12	21.5	14.0	1.86	1.09
3AD	–	–	–	–	–	1.2	1.28	8.7	5.3	0.65	0.15
3BD	–	–	–	–	–	1.2	1.23	3.8	0.3	0.64	0.13
3CD	–	–	–	–	–	0.4	0.70	3.8	0.4	0.49	0.07
4AD	–	–	–	–	–	0.3	0.43	2.9	0.4	0.33	0.07
4BD	–	–	–	–	–	0.5	0.97	5.2	0.3	0.70	0.09
4CD	–	–	–	–	–	0.3	0.54	1.3	0.3	0.60	0.11
5AD	–	–	–	–	–	0.2	0.33	2.2	0.5	0.61	0.09
5BD	–	–	–	–	–	0.3	0.43	2.2	0.4	0.58	0.08
5CD	–	–	–	–	–	0.4	0.57	2.4	0.6	0.73	0.10
6AD	–	–	–	–	–	0.3	0.72	0.7	0.4	0.53	0.06
6BD	–	–	–	–	–	0.2	0.59	1.5	0.5	0.63	0.07
6CD	–	–	–	–	–	0.2	0.79	1.8	<0.1	0.59	0.09
S. Pond	–	–	–	20	3	0.7	0.75	2.0	0.6	0.50	0.07
					9-15-77						
CTA	–	–	–	26	12	5.0	5.93	28.7	21.7	0.68	0.10
4AD	–	–	–	–	–	0.9	0.39	3.8	<0.1	0.44	0.01
4BD	–	–	–	–	–	1.0	0.81	2.6	<0.1	0.43	0.03
4CD	–	–	–	–	–	1.2	0.49	1.7	<0.1	0.70	0.04
5AD	–	–	–	–	–	1.3	0.33	1.7	<0.1	0.57	0.01
5BD	–	–	–	–	–	0.3	0.35	1.9	<0.1	0.47	0.02
5CD	–	–	–	–	–	0.3	0.39	2.2	0.5	0.75	0.01
6AD	–	–	–	–	–	0.3	0.38	1.7	<0.1	0.64	0.01
6BD	–	–	–	–	–	1.5	0.36	1.2	<0.1	0.41	0.01
6CD	–	–	–	–	–	0.3	0.37	0.9	<0.1	0.51	0.02

Table Id. (con't)

Sample #	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
					9-22-77						
1BD	-	-	-	-	-	0.3	0.30	3.4	-	0.51	0.01
3BD	-	-	-	-	-	0.1	0.74	2.4	-	0.59	0.10
4BD	-	-	-	-	-	0.4	0.49	1.6	-	0.53	0.01
4CD	-	-	-	-	-	0.3	0.40	3.9	-	0.59	0.01
5AD	-	-	-	-	-	0.8	0.33	1.3	-	0.59	0.01
5BD	-	-	-	-	-	0.2	0.34	3.8	-	0.55	0.01
5CD	-	-	-	-	-	0.2	0.13	1.3	-	0.54	0.01
6AD	-	-	-	-	-	0.2	0.38	1.0	-	0.50	0.01
6BD	-	-	-	-	-	0.4	0.36	1.6	-	0.48	0.01
6CD	-	-	-	-	-	< 0.1	0.33	0.9	-	0.52	0.01
S. Pond	-	-	-	19	3	0.1	0.36	1.6	-	0.43	0.02
					5-12-78						
CTA	8.4	24	-	46	83	2.5	1.30	8.8	1.1	0.39	0.03
1AD	7.2	-	-	-	-	0.9	0.88	4.3	0.7	0.18	0.02
1BD	-	-	-	-	-	0.4	0.40	2.6	0.8	0.23	0.02
1CD	-	-	-	-	-	0.4	0.47	2.4	1.0	0.17	0.01
1DD	-	-	-	-	-	1.1	1.12	3.8	1.5	0.20	0.02
2AD	5.9	-	-	-	-	0.2	0.20	1.6	0.8	0.21	0.01
2BD	-	-	-	-	-	0.2	0.23	2.2	0.6	0.19	0.01
2CD	-	-	-	-	-	0.1	0.23	1.6	0.5	0.18	0.01
2DD	-	-	-	-	-	0.3	0.37	1.7	0.7	0.17	0.01
3AD	7.0	-	-	-	-	< 0.1	0.11	0.7	0.2	0.20	0.01
3BD	-	-	-	-	-	0.1	0.22	1.3	0.4	0.19	0.02
3CD	-	-	-	-	-	0.2	0.26	1.3	0.5	0.17	0.01
3DD	-	-	-	-	-	0.1	0.27	0.1	0.7	0.23	0.01

Table Id. (con't)

Sample	pH	BOD	COD	TOC	SS	t-P	$1PO_4$	TKN	NH_3	NO_3	NO_2
						5-12-78 (con't)					
4AD	7.2	–	–	–	–	0.1	0.13	1.1	0.5	0.18	0.01
4BD	–	–	–	–	–	< 0.1	0.09	0.9	0.2	0.18	0.01
4CD	–	–	–	–	–	0.5	0.13	1.7	0.5	0.20	0.01
S. Pond E.	7.8	5	–	28	4	< 0.1	0.11	1.4	0.4	0.23	0.02
S. Pond W.	7.8	4	–	21	2	< 0.1	0.09	1.2	0.4	0.21	0.02
E. Pond	8.4	7	–	38	< 1	< 0.1	0.16	1.3	0.5	0.26	0.02
					5-24-78						
S. Pond E.	7.7	2	–	24	2	< 0.1	0.01	1.7	0.1	0.45	0.01
S. Pond W.	8.0	1	–	24	22	0.1	0.01	2.2	0.1	0.52	0.01
E. Pond	8.0	1	–	23	2	0.1	0.09	1.7	0.1	0.68	0.02
					6-22-78						
CTA	9.6	9	–	57	40	1.2	1.40	11.9	1.6	0.15	0.41
1AD	–	–	–	–	–	0.8	0.41	3.6	0.5	0.40	0.03
1BD	–	–	–	–	–	0.9	0.59	4.8	0.7	0.37	0.03
1CD	–	–	–	–	–	1.1	0.66	4.9	0.7	0.45	0.07
2AD	–	–	–	–	–	0.6	0.32	3.7	0.5	0.38	0.02
2BD	–	–	–	–	–	0.3	0.21	2.7	0.3	0.35	0.02
2CD	–	–	–	–	–	1.2	1.08	4.2	0.6	0.38	0.02
3AD	–	–	–	–	–	0.4	0.28	2.3	0.3	0.39	0.02
3BD	–	–	–	–	–	0.6	0.38	3.6	0.4	0.39	0.04
3CD	–	–	–	–	–	0.5	0.33	3.3	0.3	0.36	0.02
4AD	–	–	–	–	–	0.2	0.12	2.6	0.2	0.39	0.02
4BD	–	–	–	–	–	0.5	0.32	2.6	0.2	0.40	0.02
4CD	–	–	–	–	–	0.4	0.46	3.0	0.5	0.25	0.02
5AD	–	–	–	–	–	0.1	0.17	1.4	0.3	0.32	0.02
5BD	–	–	–	–	–	0.2	0.23	2.4	0.4	0.29	0.02
5CD	–	–	–	–	–	0.3	0.27	2.9	0.3	0.39	0.02

Table VId. (cont'd.)

Sample	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						6-22-78 (cont'd.)					
6AD	–	–	–	–	–	0.1	0.14	4.3	0.3	0.47	0.02
6BD	–	–	–	–	–	0.1	0.13	1.8	0.1	0.35	0.02
6CD	–	–	–	–	–	0.3	0.28	3.2	0.3	0.37	0.02
S. Pond E.	–	4	–	19	10	< 0.1	0.05	1.3	0.1	0.43	0.04
S. Pond W.	–	3	–	21	4	0.4	0.08	0.9	<0.1	0.34	0.05
E. Pond	–	2	–	31	10	0.1	0.12	1.5	<0.1	0.32	0.05
						6-29-78					
CTA	9.0	42	–	45	22	2.5	1.65	13.5	2.77	0.57	0.06
1AD	–	–	–	–	–	0.9	0.75	4.3	0.54	0.50	0.05
1BD	–	–	–	–	–	1.2	1.06	5.3	0.80	0.27	0.05
1CD	–	–	–	–	–	1.0	0.87	4.3	0.62	0.47	0.07
2AD	–	–	–	–	–	1.1	0.96	4.8	0.60	0.44	0.06
2BD	–	–	–	–	–	0.8	0.70	2.0	0.41	0.31	0.04
2CD	–	–	–	–	–	1.2	1.02	5.0	0.56	0.47	0.08
3AD	–	–	–	–	–	1.0	0.87	5.0	0.58	0.58	0.17
3BD	–	–	–	–	–	0.7	0.66	4.1	0.42	0.71	0.09
3CD	–	–	–	–	–	0.8	0.61	3.6	0.39	0.46	0.05
4BD	–	–	–	–	–	< 0.1	0.10	3.6	0.14	0.38	0.01
4CD	–	–	–	–	–	0.2	0.28	1.8	0.21	0.48	0.02
5AD	–	–	–	–	–	< 0.1	0.13	1.4	0.09	0.39	0.01
5BD	–	–	–	–	–	< 0.1	0.07	1.9	0.16	0.34	0.01
5CD	–	–	–	–	–	< 0.1	0.14	1.9	0.22	0.49	0.01
6AD	–	–	–	–	–	0.2	0.06	1.1	0.10	0.52	0.01
6BD	–	–	–	–	–	< 0.1	0.08	1.1	0.07	0.34	0.01
S. Pond E.	8.0	1	–	25	2	0.2	0.05	2.8	0.06	0.45	0.01
S. Pond W.	7.7	3	–	27	6	0.3	0.06	2.6	0.07	0.40	0.01
E. Pond	7.8	3	–	26	2	1.7	0.14	3.3	0.12	0.45	0.01
						7-7-78					
CTA	9.2	39	–	68	130	2.8	1.65	14.8	3.22	0.49	0.44
2AD	–	–	–	–	–	0.5	0.44	3.0	0.38	0.45	0.02
2BD	–	–	–	–	–	0.7	0.52	3.2	0.19	0.43	0.01

Table VId. (cont'd)

Samples	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						7-7-78 (cont'd)					
2CD	–	–	–	–	–	0.7	0.57	3.8	0.24	0.41	0.01
4AD	–	–	–	–	–	0.2	0.11	1.8	0.16	0.46	0.01
4BD	–	–	–	–	–	0.2	0.13	1.8	0.16	0.29	0.01
4CD	–	–	–	–	–	0.3	0.31	2.2	0.23	0.37	0.01
6AD	–	–	–	–	–	0.1	0.05	1.4	0.10	0.33	0.01
6BD	–	–	–	–	–	0.1	0.02	1.9	0.16	0.33	0.01
6CD	–	–	–	–	–	0.1	0.14	2.1	0.24	0.35	0.01
S. Pond E.	7.6	3	–	26	18	0.1	0.02	1.4	0.29	0.58	0.01
S. Pond W.	7.6	4	–	26	4	0.2	0.04	1.6	0.53	0.54	0.01
E. Pond	7.5	7	–	33	4	0.4	0.18	2.3	0.51	0.44	0.01
						7-11-78					
CTA	9.0	34	–	34	64	3.7	2.06	17.7	5.43	0.36	0.26
1AD	–	–	–	–	–	0.4	0.35	3.1	0.28	0.33	0.03
1BD	–	–	–	–	–	1.2	1.04	6.5	0.62	0.37	0.04
1CD	–	–	–	–	–	1.0	0.82	4.3	0.66	0.39	0.04
2AD	–	–	–	–	–	0.4	0.28	2.9	0.36	0.33	0.02
2BD	–	–	–	–	–	0.6	0.55	3.7	0.24	0.38	0.02
2CD	–	–	–	–	–	0.7	0.69	1.9	0.30	0.40	0.02
3AD	–	–	–	–	–	1.2	0.80	6.0	0.48	0.55	0.05
3BD	–	–	–	–	–	0.8	0.73	2.6	0.48	0.52	0.06
3CD	–	–	–	–	–	0.4	0.37	2.6	0.20	0.39	0.02
4AD	–	–	–	–	–	0.4	0.19	2.4	0.19	0.43	0.02
4BD	–	–	–	–	–	0.2	0.22	2.6	0.16	0.34	0.02
4CD	–	–	–	–	–	0.4	0.45	2.4	0.21	0.35	0.02
5AD	–	–	–	–	–	0.1	0.08	2.6	0.18	0.36	0.01
5BD	–	–	–	–	–	0.1	0.08	3.0	0.14	0.43	0.01
5CD	–	–	–	–	–	0.2	0.16	2.6	0.23	0.47	0.01
6AD	–	–	–	–	–	0.1	0.06	1.0	0.20	0.54	0.01

Table VId. (cont'd.)

Samples	pH	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						7-11-78 (cont'd.)					
6BD	-	-	-	-	-	< 0.1	0.03	2.1	0.10	0.34	0.01
6CD	-	-	-	-	-	0.1	0.18	1.9	0.32	0.52	0.02
S. Pond E.	8.0	2	-	31	10	< 0.1	<0.01	3.2	0.19	0.49	0.01
S. Pond W.	8.3	2	-	34	4	< 0.1	<0.01	2.4	0.12	0.44	0.01
E. Pond	7.8	4	-	27	2	0.1	0.09	5.4	0.24	0.38	0.01
						7-13-78					
CTA	8.6	26	-	39	15	3.0	2.18	14.2	5.57	0.52	0.30
1AD	-	-	-	-	-	2.2	1.93	7.2	2.12	0.61	0.35
1BD	-	-	-	-	-	2.4	2.02	11.3	2.90	0.50	0.26
1CD	-	-	-	-	-	2.2	2.03	8.3	2.51	0.67	0.27
2BD	-	-	-	-	-	1.9	1.61	6.0	1.32	0.65	0.20
2CD	-	-	-	-	-	2.0	1.75	7.1	1.42	0.55	0.22
3AD	-	-	-	-	-	0.7	0.48	3.1	0.45	0.66	0.07
3BD	-	-	-	-	-	0.3	0.19	2.2	0.23	0.50	0.01
3CD	-	-	-	-	-	1.3	1.72	5.3	0.92	0.53	0.17
4AD	-	-	-	-	-	0.8	0.04	2.2	0.13	0.27	0.01
4BD	-	-	-	-	-	0.1	0.04	1.7	0.07	0.31	0.01
4CD	-	-	-	-	-	0.1	0.08	1.4	0.07	0.33	0.01
5AD	-	-	-	-	-	< 0.1	0.05	1.9	0.07	0.41	0.01
5BD	-	-	-	-	-	< 0.1	0.02	2.0	0.04	0.34	0.01
5CD	-	-	-	-	-	< 0.1	0.05	2.0	0.09	0.27	0.01
6AD	-	-	-	-	-	< 0.1	0.03	1.2	0.08	0.33	0.01
6BD	-	-	-	-	-	< 0.1	0.02	1.3	0.06	0.44	0.01
6CD	-	-	-	-	-	< 0.1	0.07	3.1	0.08	0.31	0.01
S. Pond E.	7.4	3	-	29	12	< 0.1	0.06	2.4	0.24	0.44	0.01
S. Pond W.	7.5	2	-	26	20	< 0.1	0.08	1.8	0.16	0.39	0.01
E. Pond	7.3	6	-	26	2	< 0.1	0.11	2.4	0.21	0.04	0.01

Table VId (cont'd.)

Samples	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						7-17-78					
CTA	9.0	<1	–	69	43	4.1	1.87	16.6	5.36	0.39	0.27
1AD	–	–	–	–	–	1.0	0.75	4.3	0.85	0.25	0.05
1BD	–	–	–	–	–	0.8	0.58	4.1	0.66	0.33	0.04
1CD	–	–	–	–	–	1.3	1.00	10.3	1.41	0.41	0.04
2BD	–	–	–	–	–	0.9	0.70	3.2	0.53	0.25	0.05
2CD	–	–	–	–	–	0.9	0.69	5.2	0.39	0.42	0.04
3AD	–	–	–	–	–	1.4	1.07	4.8	0.73	0.55	0.13
3BD	–	–	–	–	–	1.2	0.90	4.5	0.91	0.61	0.09
3CD	–	–	–	–	–	0.7	0.49	3.1	0.28	0.37	0.03
4CD	–	–	–	–	–	0.3	0.23	2.0	0.43	0.42	0.02
S. Pond E.	7.9	3	–	43	40	0.1	0.04	3.2	0.28	0.37	0.03
E. Pond	7.4	2	–	32	4	< 0.1	0.08	2.2	0.23	0.28	0.02
						7-20-78					
CTA	8.5	32	–	54	11	3.9	2.17	15.6	5.94	0.29	0.17
1AD	–	–	–	–	–	1.9	1.37	7.1	1.62	0.65	0.31
1BD	–	–	–	–	–	2.4	1.79	9.1	3.72	0.36	0.22
1CD	–	–	–	–	–	2.5	1.87	9.9	4.23	0.38	0.18
2AD	–	–	–	–	–	1.3	0.74	4.2	0.43	0.34	0.19
2BD	–	–	–	–	–	2.0	1.46	7.3	2.53	0.44	0.15
2CD	–	–	–	–	–	2.1	1.62	7.9	2.50	0.43	0.16
3AD	–	–	–	–	–	2.1	1.58	7.3	2.77	0.90	0.31
3BD	–	–	–	–	–	1.3	0.77	5.6	1.24	0.69	0.16
3CD	–	–	–	–	–	1.5	1.14	5.6	1.28	0.53	0.14
4AD	–	–	–	–	–	0.2	0.14	2.4	0.37	0.54	0.02
4BD	–	–	–	–	–	0.9	0.60	3.4	0.41	0.35	0.09
4CD	–	–	–	–	–	0.9	0.60	4.0	0.54	0.40	0.11
5AD	–	–	–	–	–	< 0.1	0.11	1.5	0.18	0.38	0.02
6AD	–	–	–	–	–	< 0.1	0.05	1.3	0.12	0.42	0.01
S. Pond W.	7.8	<1	–	29	14	< 0.1	0.03	1.4	0.18	0.29	0.01
E. Pond	7.5	6	–	36	4	< 0.1	0.08	2.4	0.17	0.33	0.01

Table VId (cont'd.)

Samples	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						<u>7-25-78</u>					
CTA	7.8	22	-	45	18	5.0	4.04	26.4	18.5	0.50	0.05
1AD	-	-	-	-	-	1.3	1.01	5.9	1.78	0.38	0.05
1BD	-	-	-	-	-	1.2	0.91	5.5	1.73	0.35	0.04
1CD	-	-	-	-	-	1.8	1.42	9.1	4.39	0.36	0.04
2AD	-	-	-	-	-	1.3	1.02	6.0	1.72	0.30	0.04
2BD	-	-	-	-	-	1.3	1.05	5.8	2.52	0.29	0.08
2CD	-	-	-	-	-	1.2	0.93	4.2	0.99	0.37	0.05
3AD	-	-	-	-	-	1.6	1.31	5.6	2.14	0.38	0.06
3BD	-	-	-	-	-	1.3	1.04	4.7	1.82	0.27	0.05
3CD	-	-	-	-	-	0.8	0.59	3.1	0.82	0.35	0.03
4AD	-	-	-	-	-	0.2	0.13	2.3	0.17	0.36	0.01
4BD	-	-	-	-	-	0.8	0.57	3.6	0.26	0.21	0.01
4CD	-	-	-	-	-	0.1	0.54	3.4	0.33	0.34	0.02
5AD	-	-	-	-	-	< 0.1	0.13	1.5	0.10	0.44	<0.01
6AD	-	-	-	-	-	0.4	0.14	3.2	0.16	0.39	0.01
S. Pond E.	8.1	4	-	38	6	< 0.1	0.03	2.6	0.19	0.48	0.02
E. Pond	7.5	3	-	33	2	< 0.1	0.07	2.6	0.18	0.31	0.01
						<u>7-27-78</u>					
1BD	-	-	-	-	-	0.8	0.28	1.9	0.56	0.37	0.01
1CD	-	-	-	-	-	0.7	0.59	2.8	1.08	0.41	0.02
2AD	-	-	-	-	-	0.3	0.24	2.0	0.32	0.31	0.01
2BD	-	-	-	-	-	0.2	0.18	1.2	0.10	0.31	0.02
3BD	-	-	-	-	-	0.6	0.16	2.7	0.06	0.26	0.01
3CD	-	-	-	-	-	0.5	0.25	2.7	0.10	0.33	0.01
4AD	-	-	-	-	-	0.3	0.13	2.5	0.08	0.30	<0.01
4BD	-	-	-	-	-	0.9	0.08	2.1	0.06	0.33	<0.01
4CD	-	-	-	-	-	0.6	0.13	1.9	0.06	0.30	<0.01
5AD	-	-	-	-	-	0.2	0.15	3.9	0.06	0.37	<0.01
5BD	-	-	-	-	-	1.1	0.08	1.9	0.08	0.40	0.01
5CD	-	-	-	-	-	0.1	0.12	3.1	0.10	0.41	0.01

Table VId (cont'd.)

Samples	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						7-27-78 (cont'd.)					
6AD	–	–	–	–	–	< 0.1	0.21	1.5	0.13	0.43	0.01
6BD	–	–	–	–	–	< 0.1	0.11	1.2	0.05	0.44	0.01
6CD	–	–	–	–	–	< 0.1	0.14	1.9	0.13	0.40	0.01
S. Pond E.	7.7	4	–	28	5	0.3	0.09	2.2	0.12	0.32	0.01
S. Pond W.	7.7	2	–	25	–	0.1	0.08	2.2	0.09	0.30	0.01
E. Pond	7.4	3	–	31	–	0.1	0.09	1.5	0.10	0.31	0.01
						8-1-78					
CTA	7.9	<1	–	53	27	5.6	4.87	33.4	27.5	0.48	0.07
1AD	–	–	–	–	–	1.2	1.07	6.0	3.35	0.39	0.06
1BD	–	–	–	–	–	1.3	1.06	6.9	3.03	0.75	0.15
1CD	–	–	–	–	–	1.7	1.43	8.8	5.09	0.47	0.11
2AD	–	–	–	–	–	1.3	1.17	7.4	4.48	0.55	0.06
2BD	–	–	–	–	–	1.5	1.13	7.5	3.71	0.62	0.19
3AD	–	–	–	–	–	2.2	2.07	10.7	7.35	0.93	0.12
4AD	–	–	–	–	–	0.2	0.13	2.4	0.14	0.46	0.01
S. Pond E.	8.2	<1	–	33	<1	< 0.1	0.03	1.8	0.16	0.44	0.01
S. Pond W.	8.3	<1	–	31	<1	< 0.1	0.03	1.9	0.12	0.46	0.01
E. Pond	8.0	1	–	33	2	< 0.1	0.01	2.2	0.21	0.52	0.01
						8-3-78					
CTA	8.0	33	–	33	9	5.0	4.53	35.1	27.2	0.33	0.10
1AD	–	–	–	–	–	3.5	3.28	21.6	17.2	0.51	0.13
1BD	–	–	–	–	–	3.2	2.92	17.9	13.8	1.21	0.32
1CD	–	–	–	–	–	3.4	3.04	21.4	15.7	0.78	0.18
2AD	–	–	–	–	–	4.1	3.75	26.2	20.9	0.58	0.18

Table VId (cont'd.)

Samples	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						<u>8-3-78 (cont'd.)</u>					
2BD	-	-	-	-	-	3.1	2.87	19.1	14.5	0.72	0.25
2CD	-	-	-	-	-	3.3	3.03	18.9	13.9	1.08	0.26
3AD	-	-	-	-	-	3.3	3.11	20.1	15.5	0.73	0.17
3BD	-	-	-	-	-	1.8	1.66	9.7	5.60	0.81	0.19
3CD1	-	-	-	-	-	2.8	1.96	12.4	7.46	1.25	0.26
3CD2	-	-	-	-	-	2.5	2.16	12.2	7.52	1.28	0.27
3CD3	-	-	-	-	-	2.3	2.05	12.1	7.56	1.39	0.27
3CD4	-	-	-	-	-	2.4	2.11	12.1	7.97	1.41	0.27
4AD	-	-	-	-	-	1.3	1.11	7.6	4.29	0.86	0.17
4BD	-	-	-	-	-	1.3	1.10	5.2	1.82	0.68	0.17
4CD	-	-	-	-	-	1.0	0.88	4.7	1.84	0.91	0.19
5AD	-	-	-	-	-	1.0	0.78	6.1	2.50	0.65	0.15
5BD	-	-	-	-	-	0.8	0.66	3.7	0.69	0.77	0.10
5CD	-	-	-	-	-	0.4	0.36	3.2	0.36	0.67	0.06
6AD	-	-	-	-	-	0.2	0.32	3.2	0.76	0.61	0.09
6BD	-	-	-	-	-	0.2	0.17	2.8	0.45	0.55	0.05
S. Pond E.	7.9	5	-	34	1	< 0.1	0.02	2.3	0.20	0.33	0.01
S. Pond W.	7.8	6	-	34	<1	< 0.1	0.03	2.7	0.13	0.34	0.01
E. Pond	7.5	3	-	36	<1	< 0.1	0.01	1.7	0.25	0.39	0.01
						<u>8-8-78</u>					
CTA	7.8	<1	-	53	11	5.3	4.82	39.9	34.3	0.53	0.10
1AD	-	-	-	-	-	4.3	4.15	30.5	24.7	0.89	0.31
1BD	-	-	-	-	-	3.8	3.72	27.2	17.9	3.89	0.96
1CD	-	-	-	-	-	4.1	3.88	28.0	21.4	2.23	0.49
2AD	-	-	-	-	-	4.6	4.39	33.5	26.7	0.86	0.30
2BD	-	-	-	-	-	3.7	3.53	25.4	18.8	2.29	0.79
2CD	-	-	-	-	-	3.6	3.43	21.3	14.7	2.58	0.61
3AD	-	-	-	-	-	3.6	3.39	23.3	16.6	1.72	0.43
3BD	-	-	-	-	-	3.3	3.22	21.4	15.2	2.12	0.32
3CD1	-	-	-	-	-	2.6	2.57	15.2	9.6	2.11	0.46

Table VId (cont'd.)

Samples	ph	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						8-8-78 (cont'd.)					
3CD2	-	-	-	-	-	2.5	2.64	14.5	8.9	2.48	0.51
3CD3	-	-	-	-	-	2.5	2.62	15.0	9.9	2.51	0.54
3CD4	-	-	-	-	-	3.0	2.63	15.8	9.3	2.77	0.56
4AD	-	-	-	-	-	1.4	1.48	8.8	5.11	1.67	0.35
4BD	-	-	-	-	-	0.4	0.42	2.4	0.11	0.54	0.01
4CD	-	-	-	-	-	0.1	0.24	1.8	0.07	0.07	0.01
5AD	-	-	-	-	-	0.4	0.24	4.2	0.17	0.49	0.01
5BD	-	-	-	-	-	0.1	0.13	1.8	0.10	0.47	0.01
5CD	-	-	-	-	-	0.1	0.23	2.0	0.03	0.48	0.01
6AD	-	-	-	-	-	0.4	0.28	1.7	0.40	0.51	0.03
6BD	-	-	-	-	-	0.1	0.13	1.7	0.03	0.49	0.01
6CD	-	-	-	-	-	< 0.1	0.18	1.8	0.01	0.54	0.01
S. Pond E.	7.9	<1	-	62	2	0.5	0.13	2.6	0.13	0.44	0.01
S. Pond W.	7.9	4	-	23	6	0.1	0.12	1.6	0.10	0.44	0.01
E. Pond	7.6	<1	-	28	2	0.1	0.17	2.7	0.21	0.46	0.01
						8-10-78					
CTA	8.3	<1	-	59	33	5.4	4.78	39.3	27.3	0.66	0.30
1AD	-	-	-	-	-	4.0	3.99	29.8	22.9	0.96	0.49
1BD	-	-	-	-	-	3.9	3.97	28.0	19.9	2.52	0.76
1CD	-	-	-	-	-	4.5	4.57	31.6	24.6	1.32	0.55
2AD	-	-	-	-	-	4.5	4.48	35.0	25.8	0.86	0.44
2BD	-	-	-	-	-	4.2	3.93	26.5	21.0	1.68	0.71
2CD	-	-	-	-	-	4.0	3.90	24.4	19.3	1.85	0.67
3AD	-	-	-	-	-	4.1	3.88	27.6	21.2	1.11	0.46
3BD	-	-	-	-	-	2.3	2.53	13.7	9.48	1.70	0.54
3CD1	-	-	-	-	-	2.8	3.02	17.5	12.4	2.40	0.63
3CD2	-	-	-	-	-	3.7	2.92	16.7	10.7	2.99	0.74
3CD3	-	-	-	-	-	2.5	2.80	15.5	10.4	3.66	0.81

Table VId (cont'd.)

Samples	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						8-10-78 (cont'd.)					
3CD4	-	-	-	-	-	1.8	2.14	10.1	5.32	2.87	1.27
4AD	-	-	-	-	-	2.2	1.68	13.6	8.66	1.18	0.45
4BD	-	-	-	-	-	2.1	2.12	11.0	7.35	1.59	0.56
4CD	-	-	-	-	-	1.4	1.70	8.4	4.59	2.24	0.59
5AD	-	-	-	-	-	1.7	1.45	12.7	7.15	0.90	0.36
5BD	-	-	-	-	-	1.0	0.76	5.2	2.44	1.21	0.28
5CD	-	-	-	-	-	0.3	0.28	2.4	0.19	0.62	0.06
6AD	-	-	-	-	-	0.5	0.30	5.3	2.27	0.88	0.20
6BD	-	-	-	-	-	< 0.1	0.10	1.4	0.24	0.56	0.02
6CD	-	-	-	-	-	< 0.1	0.10	1.8	0.24	0.51	0.03
S. Pond E.	7.9	2	-	25	2	< 0.1	0.21	1.6	0.07	0.57	0.01
S. Pond W.	7.8	<1	-	20	9	< 0.1	0.19	1.7	0.06	0.57	0.01
E. Pond	7.6	2	-	22	1	< 0.1	0.22	2.0	0.07	0.59	0.01
						8-15-78					
1AD	-	-	-	-	-	-	0.97	13.8	6.65	1.35	0.12
1BD	-	-	-	-	-	-	0.58	4.4	2.16	1.42	0.10
1CD	-	-	-	-	-	-	0.93	9.7	4.86	0.72	0.06
2AD	-	-	-	-	-	-	0.63	7.7	4.71	0.58	0.09
2BD	-	-	-	-	-	-	0.54	4.8	1.37	0.93	0.15
4AD	-	-	-	-	-	-	0.16	3.0	0.64	0.49	0.02
4CD	-	-	-	-	-	-	0.12	3.2	0.18	0.46	0.02
5AD	-	-	-	-	-	-	0.16	22.6	0.44	0.36	0.01
5BD	-	-	-	-	-	-	0.10	3.5	0.26	0.35	0.01
6AD	-	-	-	-	-	-	0.10	2.0	0.19	0.56	0.01
6BD	-	-	-	-	-	-	0.12	4.5	0.07	0.37	0.01
S. Pond E.	8.2	2	-	33	6	< 0.1	0.02	1.9	0.08	0.54	0.02
S. Pond W.	8.2	3	-	27	10	< 0.1	0.05	1.8	0.12	0.52	0.01
E. Pond	8.2	3		32	2	< 0.1	0.04	1.6	0.11	0.48	0.02

Table VId. (cont.)

Sample	pH	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						8-17-78					
1AD	-	-	-	-	-	4.5	4.24	26.4	19.9	2.52	1.03
1BD	-	-	-	-	-	3.5	3.33	15.0	9.84	9.8	0.78
1CD	-	-	-	-	-	4.2	4.00	23.9	15.9	4.99	0.65
2AD	-	-	-	-	-	4.5	4.27	26.7	19.5	2.54	0.78
2BD	-	-	-	-	-	3.0	2.94	15.8	10.4	3.87	1.13
3AD	-	-	-	-	-	3.7	3.57	20.7	14.5	2.48	0.84
3BD	-	-	-	-	-	2.8	2.72	15.0	9.49	3.22	0.49
3CD	-	-	-	-	-	1.4	1.38	7.7	4.40	1.72	0.18
$3CD_1$	-	-	-	-	-	2.6	2.59	14.3	8.66	4.08	0.51
$3CD_2$	-	-	-	-	-	2.5	2.41	12.1	7.76	4.28	0.54
$3CD_3$	-	-	-	-	-	1.7	1.58	9.5	5.16	2.15	0.23
$3CD_4$	-	-	-	-	-	1.6	1.52	7.1	2.60	2.17	1.52
4AD	-	-	-	-	-	0.8	0.20	5.2	1.00	0.51	0.02
4BD	-	-	-	-	-	0.4	0.16	2.9	0.28	0.51	0.02
4CD	-	-	-	-	-	0.4	0.15	3.1	0.16	0.48	0.02
5AD	-	-	-	-	-	0.4	0.19	3.6	0.08	0.37	0.01
5BD	-	-	-	-	-	0.2	0.15	2.0	0.14	0.50	0.02
5CD	-	-	-	-	-	0.2	0.15	2.1	0.22	0.40	0.02
6AD	-	-	-	-	-	0.2	0.20	4.7	0.32	0.56	0.01
6BD	-	-	-	-	-	0.2	0.14	1.7	0.38	0.54	0.01
6CD	-	-	-	-	-	0.1	0.15	2.5	0.18	0.74	0.01
S. Pond E.	7.7	4	-	36	< 4	< 0.1	0.10	2.2	0.11	0.38	0.01
S. Pond W.	7.7	4	-	34	< 2	< 0.1	0.18	0.7	0.14	0.41	0.02
E. Pond	7.5	2	-	34	2	< 0.1	0.13	1.7	0.17	0.48	0.01
						8-22-78					
S. Pond E.	7.6	< 1	-	31	4	< 0.1	0.19	1.8	0.14	0.49	0.06
S. Pond W.	7.6	< 2	-	29	4	< 0.1	0.21	1.9	0.12	0.50	0.04
E. Pond	7.9	< 1	-	31	2	< 0.1	0.05	1.7	0.22	0.49	0.04
						8-24-78					
S. Pond E.	7.6	1	-	29	< 2	< 0.1	0.13	1.9	0.2	0.50	0.02
S. Pond W.	7.8	5	-	32	2	< 0.1	0.08	2.0	0.1	0.48	0.02
E. Pond	7.7	4	-	39	38	< 0.1	0.17	1.8	0.3	0.51	0.04

Table Ie. Total and Fecal Coliform Composition of Surface Water on the Clare Rest Area Overland Flow

Date		Ditch 1		Ditch 2		Ditch 3		Ditch 4		Ditch 5		Ditch 6	
		TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
8-23-77	B	>240,000	150	>240,000	230	>240,000	2,400	>240,000	430	>240,000	930	>240,000	430
8-26-77	B	>240,000	24,000	110,000	1,500	>240,000	1,100	>240,000	900	–	–	9,300	<200
8-31-77	B	240,000	1,500	93,000	400	24,000	930	24,000	930	1,200	150	930	150
9-02-77	B	39,000	<200	43,000	400	46,000	700	4,300	230	2,400	210	430	40
9-06-77	B	23,000	900	93,000	900	46,000	4,300	4,300	150	430	<20	4,600	70
9-09-77	B	–	–	–	–	110,000	7,500	110,000	400	11,000	930	11,000	90
9-15-77	B	–	–	–	–	–	–	15,000	900	9,300	4,600	4,600	230
9-22-77	B	2,400	150	–	–	46,000	2,100	3,900	150	750	150	2,400	150
5-12-78	Avg.	14,000	70	>13,000	36	> 16,000	76	> 7,000	120	–	–	–	–
6-22-78	A	46,000	430	24,000	40	240,000	150	24,000	9	24,000	93	24,000	20
	B	46,000	40	110,000	40	240,000	2,100	110,000	150	24,000	90	46,000	4,000
	C	110,000	2	9,300	2	46,000	90	21,000	90	46,000	23,000	46,000	1,500
6-27-78	A	9,300	400	28,000	200	21,000	400	4,300	2,300	1,500	430	9,300	90
	B	93,000	200	9,300	400	$1.1x10^6$	7,500	21,000	2,300	900	900	23,000	2,100
	C	43,000	2,300	7,500	90	210,000	200	9,300	2,300	2,100	200	–	–
6-29-78	A	24,000	4	110,000	20	240,000	230	–	–	24,000	40	11,000	9
	B	24,000	75	240,000	40	24,000	23	4,600	2	9,300	20	2,400	23
	C	11,000	43	24,000	750	240,000	40	24,000	2	24,000	2	–	–
7-07-78	A	–	–	23,000	900	–	–	43,000	900	–	–	430	90
	B	–	–	93,000	700	–	–	4,300	900	–	–	15,000	15,000
	C	–	–	23,000	200	–	–	21,000	400	–	–	23,000	900
7-11-78	A	$1.1x10^6$	200	240,000	200	93,000	200	150,000	200	24,000	200	9,300	230
	B	240,000	200	93,000	200	150,000	700	15,000	400	7,500	430	43,000	4,300
	C	240,000	200	43,000	400	43,000	200	240,000	200	15,000	400	20,000	400
7-13-78	A	460,000	200	–	–	110,000	400	240,000	2,300	400	200	–	–
	B	$2.4x10^6$	400	240,000	200	15,000	200	46,000	200	930	90	2,300	2,300
	C	$1.1x10^6$	200	$1.1x10^6$	200	$1.1x10^6$	200	15,000	200	24,000	2,300	46,000	200
7-17-78	A	240,000	200	–	–	$1.1x10^6$	200	–	–	–	–	–	–
	B	240,000	200	240,000	4,300	460,000	200	–	–	–	–	–	–
	C	240,000	900	150,000	2,300	93,000	2,100	110,000	900	–	–	–	–

Table VIe. (con't)

Date		Ditch 1		Ditch 2		Ditch 3		Ditch 4		Ditch 5		Ditch 6	
		TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
7-20-78	A	240,000	2,300	110,000	900	460,000	4,300	900	<200	430	430	930	230
	B	460,000	4,300	240,000	900	1.1×10^6	900	110,000	400	–	–	–	–
	C	$>2.4\times10^6$	<200	46,000	400	460,000	1,500	110,000	2,300	–	–	–	–
7-25-78	A	24,000	9,300	21,000	4,300	23,000	4,000	24,000	400	230	90	2,000	750
	B	20,000	2,300	43,000	4,000	–	–	23,000	4,000	–	–	–	–
	C	15,000	4,000	46,000	9,300	210,000	<2,000	460,000	4,000	–	–	–	–
7-27-78	A	–	–	15,000	400	–	–	4,300	<200	4,600	110	2,100	40
	B	9,300	<200	23,000	<2,000	4,300	< 200	23,000	<2,000	7,500	90	<200	–
	C	15,000	<2,000	–	–	43,000	< 2,000	9,000	<2,000	2,300	<200	9,300	400
8-01-78	A	46,000	900	240,000	900	460,000	1,500	46,000	900	–	–	–	–
	B	15,000	400	75,000	900	–	–	–	–	–	–	–	–
	C	1.1×10^6	23,000	–	–	–	–	–	–	–	–	–	–
8-03-78	A	240,000	400	1.1×10^6	900	460,000	4,000	460,000	900	>240,000	2,400	110,000	90
	B	150,000	<200	110,000	1,500	240,000	9,300	210,000	14,000	>240,000	2,400	46,000	46,000
	C	1.1×10^6	9,000	460,000	2,100	210,000	43,000	46,000	4,300	150,000	4,300	–	–
8-08-78	A	110,000	9,300	110,000	200	240,000	4,000	240,000	<200	11,000	230	11,000	2,100
	B	240,000	900	240,000	2,300	1.1×10^6	900	43,000	4,000	2,400	430	11,000	90
	C	240,000	9,000	240,000	2,100	93,000	4,000	9,300	4,300	9,300	2,300	7,500	1,500
8-10-78	A	210,000	24,000	460,000	4,800	150,000	7,000	240,000	2,300	>240,000	4,600	46,000	2,400
	B	240,000	400	210,000	1,500	110,000	400	460,000	4,000	110,000	70	4,600	40
	C	750,000	4,000	1.1×10^6	900	1.1×10^6	4,000	460,000	900	46,000	2,300	75,000	700
8-15-78	A	1.1×10^6	400	460,000	900	–	–	24,000	<200	240,000	430	110,000	200
	B	46,000	<200	46,000	< 200	–	–	–	–	11,000	150	11,000	1,500
	C	240,000	<2,000	–	–	–	–	14,000	<200	–	–	–	–
8-17-78	A	240,000	400	24,000	900	240,000	< 2,000	240,000	4,300	46,000	200	4,600	200
	B	150,000	400	460,000	400	240,000	1,500	240,000	15,000	4,600	150	4,600	930
	C	150,000	9,000	–	–	93,000	9,000	9,300	400	2,300	900	4,300	900

Table If. Total and Fecal Streptococcal Composition of Surface Water on the Clare Rest Area Overland Flow

		Ditch 1		Ditch 2		Ditch 3		Ditch 4		Ditch 5		Ditch 6	
Date		TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
8-23-77	B	>240,000	11,000	4,600	280	>240,000	280	>240,000	9,300	>240,000	280	11,000	280
8-26-77	B	110,000	2,800	>240,000	46,000	110,000	4,300	24,000	4,300	–	–	2,300	<200
8-31-77	B	2,400	150	430	70	2,400	150	230	40	430	90	430	230
9-02-77	B	1,500	700	1,500	430	2,300	900	2,400	930	2,400	150	430	90
9-06-77	B	900	400	7,500	70	400	<200	90	40	90	<20	230	40
9-09-77	B	–	–	–	–	9,300	2,100	4,300	930	1,500	110	1,500	1,500
9-15-77	B	–	–	–	–	–	–	2,400	2,400	430	430	750	200
9-22-77	B	1,500	1,500	–	–	700	400	4,300	2,400	430	70	90	90
5-12-78	Avg.	34,000	400	>18,000	180	125,000	46	>19,000	62	–	–	–	–
6-22-78	A	>240,000	46,000	46,000	200	110,000	110,000	>24,000	11,000	11,000	11,000	>24,000	11,000
	B	21,000	1,500	110,000	21,000	46,000	46,000	7,500	2,000	24,000	2,100	15,000	930
	C	21,000	15,000	24,000	2,100	46,000	24,000	110,000	21,000	110,000	93,000	24,000	2,100
6-27-78	A	4,300	4,300	4,300	4,300	4,300	4,300	93,000	93,000	2,400	2,400	4,600	4,600
	B	9,300	9,300	7,500	7,500	7,500	7,500	2,300	2,300	40	40	2,300	2,300
	C	15,000	15,000	240,000	15,000	93,000	93,000	2,300	2,300	9,300	9,300	–	–
6-29-78	A	11,000	11,000	>24,000	24,000	4,600	4,600	–	–	430	430	1,500	1,500
	B	11,000	11,000	4,600	4,600	24,000	11,000	430	75	230	<20	2,400	43
	C	>24,000	11,000	11,000	11,000	4,600	4,600	4,600	4,600	11,000	4,600	–	–
7-07-78	A	–	–	9,300	4,300	–	–	23,000	2,300	–	–	4,300	280
	B	–	–	75,000	2,000	–	–	9,300	2,100	–	–	4,300	<200
	C	–	–	4,300	2,300	–	–	23,000	4,300	–	–	9,300	700
7-11-78	A	4,300	2,300	24,000	9,300	43,000	43,000	9,300	2,100	4,600	4,600	9,300	9,300
	B	9,300	9,300	4,300	4,300	4,300	2,300	9,300	9,300	46,000	930	43,000	15,000
	C	24,000	2,100	2,300	400	4,300	1,500	15,000	1,100	4,300	2,300	43,000	1,500
7-13-78	A	46,000	46,000	–	–	9,300	9,300	2,300	2,300	2,300	2,300	–	–
	B	15,000	15,000	110,000	110,000	4,300	4,300	4,300	4,300	7,500	70	4,300	4,300
	C	24,000	24,000	46,000	46,000	110,000	110,000	4,300	4,300	4,300	2,300	24,000	24,000
7-17-78	A	46,000	15,000	–	–	46,000	46,000	–	–	–	–	–	–
	B	4,300	4,300	24,000	24,000	46,000	46,000	–	–	–	–	–	–
	C	46,000	9,300	24,000	9,300	15,000	15,000	–	–	–	–	–	–

Table If. (con't)

Date		Ditch 1 TOTAL	Ditch 1 FECAL	Ditch 2 TOTAL	Ditch 2 FECAL	Ditch 3 TOTAL	Ditch 3 FECAL	Ditch 4 TOTAL	Ditch 4 FECAL	Ditch 5 TOTAL	Ditch 5 FECAL	Ditch 6 TOTAL	Ditch 6 FECAL
7-20-78	A	4,300	4,300	9,300	4,300	24,000	9,300	2,300	2,300	110,000	2,300	2,400	2,400
	B	2,300	2,300	46,000	46,000	7,500	7,500	110,000	46,000	-	-	-	-
	C	24,000	24,000	15,000	15,000	460,000	460,000	24,000	9,300	-	-	-	-
7-25-78	A	110,000	110,000	21,000	21,000	43,000	43,000	15,000	7,500	2,400	2,400	4,600	4,600
	B	15,000	9,300	21,000	21,000	-	-	7,000	7,000	-	-	-	-
	C	9,000	9,000	7,500	7,500	23,000	23,000	43,000	43,000	-	-	-	-
7-27-78	A	-	-	900	900	-	-	400	400	11,000	210	930	210
	B	900	400	2,000	-	46,000	1,500	9,000	4,000	230	230	<200	-
	C	9,000	4,000	-	-	9,000	4,000	4,000	4,000	1,500	400	4,300	400
8-01-78	A	24,000	24,000	240,000	110,000	46,000	15,000	9,300	4,300	-	-	-	-
	B	110,000	110,000	46,000	24,000	-	-	-	-	-	-	-	-
	C	240,000	240,000	-	-	-	-	-	-	-	-	-	-
8-03-78	A	15,000	7,500	24,000	24,000	75,000	75,000	46,000	24,000	24,000	24,000	>240,000	110,000
	B	24,000	24,000	24,000	9,300	46,000	46,000	240,000	15,000	21,000	21,000	110,000	110,000
	C	23,000	9,000	24,000	9,300	43,000	15,000	110,000	110,000	75,000	75,000	-	-
8-08-78	A	15,000	15,000	4,300	4,300	15,000	9,000	110,000	110,000	1,500	930	4,600	4,600
	B	9,300	9,300	9,300	9,300	9,300	9,300	23,000	4,000	4,600	4,600	4,600	4,600
	C	23,000	9,000	4,300	4,300	21,000	21,000	7,500	7,500	2,300	2,300	2,300	2,300
8-10-78	A	75,000	20,000	46,000	9,300	23,000	9,000	21,000	9,300	24,000	210	4,600	4,600
	B	15,000	4,300	24,000	9,300	110,000	4,300	15,000	700	15,000	15,000	2,400	2,400
	C	43,000	23,000	9,300	9,300	9,000	9,000	15,000	15,000	24,000	24,000	2,300	900
8-15-78	A	9,300	2,300	4,300	900	-	-	900	<200	240,000	1,500	15,000	430
	B	1,500	400	900	<200	-	-	-	-	2,400	2,400	930	150
	C	2,000	-	-	-	-	-	2,300	2,300	-	-	-	-
8-17-78	A	24,000	2,300	24,000	900	15,000	4,000	4,300	1,500	24,000	430	4,600	930
	B	240,000	700	46,000	2,100	15,000	1,500	< 2,000	-	4,600	4,600	2,400	210
	C	93,000	9,000	-	-	4,000	4,000	2,300	2,300	900	900	2,300	2,300

Ditch 2

Table Ig. CHEMICAL COMPOSITION OF SHALLOW WELL WATER ON THE CLARE REST AREA OVERLAND FLOW.

WELL	TOC	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			7-27-77				
1C	337	6.3	0.30	-	-	0.7	0.06
2C	251	2.6	0.25	-	-	1.2	0.11
			8-1-77				
1A	227	-	0.38	-	-	0.9	0.03
1B	214	2.6	0.18	7.5	0.3	0.4	0.06
2A	350	6.4	0.13	11.4	0.5	0.5	0.06
2B	-	2.9	0.15	8.6	1.3	1.2	0.04
2C	-		0.20	9.1	0.9	0.7	0.07
3A	-	5.6	0.13	14.7	0.4	0.9	0.03
			8-3-77				
1A	84	0.2	0.20	2.3	0.3	1.2	0.02
1C	115	1.0	0.23	2.8	0.1	1.1	0.03
1D	-	1.2	0.23	3.8	0.4	1.5	0.05
2A	157	2.7	0.25	3.5	0.4	1.1	0.06
2B	133	0.7	0.23	4.3	0.6	1.4	0.05
2D	-	1.1	0.28	6.6	0.4	1.6	0.07
3A	157	0.8	0.45	2.8	0.4	2.1	0.07
			8-9-77				
1A	119	0.7	0.30	1.0	0.8	1.0	0.03
1C	170	2.4	0.40	1.8	0.3	1.3	0.06
1D	105	-	0.28	1.8	0.8	1.2	0.19
2A	-	0.9	0.23	4.3	0.5	1.0	0.05
2B	-	4.0	0.35	2.1	0.3	0.8	0.05
2D	-	-	0.23	14.8	0.5	0.9	0.05
3A	-	-	0.35	7.6	0.4	1.4	0.04
3B	-	-	0.10	3.5	0.3	0.9	0.04
4A	-	0.9	0.35	0.9	0.4	1.1	0.03
4C	-	-	0.33	3.0	0.3	1.0	0.06

Table Ig. (con't)

WELL #	TOC	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
			8-11-77				
CTA	109	0.2	3.85			0.6	0.32
1A	–	0.4	0.25	1.0	0.8	0.8	0.01
1C	–	0.8	0.25	1.8	0.3	–	0.01
1D	–	1.7	0.23	1.8	0.8	0.9	0.01
2A	–	1.0	0.18	4.3	0.5	2.0	0.01
2B	–	1.0	0.20	2.1	0.3	0.3	0.01
2C	–	–	0.23	–	–	0.8	0.01
2D	–	4.0	0.15	14.8	0.5	0.6	0.01
3A	–	4.2	0.28	7.6	0.4	0.8	0.01
3B	–	–	0.25	3.5	0.3	0.8	0.01
4A	–	<0.1	0.30	0.9	0.4	0.8	0.01
4D	–	2.5	0.30	3.0	0.3	0.8	0.02
			8-12-77				
1A	83	0.6	0.30	0.4	0.5	0.9	0.02
1B	–	–	0.13	0.8	0.3	1.5	0.01
1C	–	0.4	0.30	0.5	<0.1	1.3	0.02
1D	–	0.5	0.30	1.4	<0.1	1.2	0.02
2A	136	1.0	0.25	4.2	<0.1	1.1	0.02
2B	153	0.2	0.23	0.9	0.4	1.4	0.01
2C	–	–	1.18	52.5	0.3	1.3	0.13
2D	–	–	0.30	17.1	–	1.6	0.01
3A	–	–	0.50	0.1	–	1.6	0.01
3B	–	1.3	0.25	3.4	–	1.4	0.02
			8-16-77				
1B	–	–	0.39	–	–	0.22	<0.01

Table Ig. (con't)

WELL #	TOC	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			8-17-77				
1A	96	0.5	0.59	3.4	-	0.54	0.01
1C	127	<0.1	0.68	0.9	-	0.87	0.02
1D	85	0.2	0.54	0.4	-	0.56	0.01
2A	97	<0.1	0.60	1.1	-	0.50	0.02
2B	145	<0.1	0.64	1.3	-	1.14	0.01
2D	134	<0.1	0.69	2.4	-	0.71	0.01
3A	-	<0.1	0.94	0.4	-	0.74	0.01
3B	-	1.7	0.66	4.2	-	1.23	0.04
3C	102	<0.1	0.70	0.5	-	0.62	0.01
3D	83	0.6	0.75	0.8	-	1.30	0.02
4A	108	<0.1	0.89	1.9	-	1.80	0.01
4C	-	-	0.70	6.2	-	0.52	0.02
6C	-	-	1.60	-	-	1.07	0.01
			8-18-77				
1A	105	0.1	0.72	0.5	-	0.72	0.02
1C	-	0.7	0.83	3.3	-	1.08	0.03
1D	90	0.3	0.74	0.5	-	0.76	0.01
2A	-	<0.1	0.60	1.4	-	0.68	0.01
2B	-	0.1	0.80	1.0	-	0.70	0.01
2D	-	-	0.61	1.4	-	0.58	0.01
3A	-	-	0.88	2.8	-	0.74	0.01
3B	-	2.5	0.66	4.7	-	0.45	0.10
3D	-	0.1	0.72	1.4	-	1.90	0.03
4A	-	<0.1	0.99	0.4	-	0.44	0.01

Table Ig. (con't)

WELL#	TOC	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			<u>8-23-77</u>				
1A	123(24)	0.8	0.45	0.8	-	0.65	0.02
1B	-	1.8	0.35	1.9	-	0.59	0.02
1C	128(38)	0.9	0.68	2.0	-	0.88	0.04
1D	-	0.7	0.52	1.1	-	0.72	0.05
2A	132(58)	1.1	0.63	2.5	-	0.84	0.05
2B	-	1.0	0.61	1.8	-	0.75	0.04
2C	-	3.8	1.43	10.0	-	1.10	0.08
2D	-	-	5.47	1.1	-	0.46	0.03
3A	-	0.9	0.82	0.1	-	0.83	0.03
3B	-	7.5	0.90	16.3	-	1.08	0.05
3C	-	0.7	0.58	0.9	-	1.14	0.02
3D	-	0.1	0.75	2.1	-	1.66	0.04
4A	-	0.5	0.85	0.4	-	0.57	0.01
			<u>8-26-77</u>				
1A		1.0	0.83	0.6	-	0.32	0.01
1B		1.0	0.36	1.9	-	0.66	0.02
1C		< 0.2	0.52	1.4	-	0.82	0.02
1D		< 0.1	0.42	2.4	-	0.65	0.02
2A		0.1	0.41	1.6	-	0.71	0.02
2B		0.1	0.50	0.9	-	0.63	0.01
2C		3.0	0.6	9.1	-	1.15	0.07
2D		-	0.47	2.2	-	0.57	0.02
3A		< 0.1	0.71	1.4	-	0.58	0.02
3B		0.7	0.63	3.5	-	1.22	0.04
3C		0.6	0.51	1.0	-	1.57	0.02
3D		< 0.1	0.58	1.6	-	1.27	0.04
4A		0.1	0.62	0.5	-	0.65	0.02

Table Ig. (con't)

WELL #	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
		8-31-77				
1A	0.7	0.54	2.4	-	0.54	0.01
1B	< 0.1	0.42	5.0	-	0.67	0.01
1C	0.7	0.64	3.2	-	0.90	0.02
1D	0.3	0.56	2.0	-	0.83	0.02
2A	1.2	0.54	4.2	-	0.95	0.03
2B	0.2	0.57	2.4	-	0.68	0.02
2C	< 0.3	0.71	2.6	-	0.71	0.02
2D	-	0.49	1.4	-	0.67	0.01
3A	< 0.3	0.74	1.0	-	0.74	0.01
3B	-	0.64	7.7	-	1.04	0.03
3C	< 0.1	0.56	0.3	-	1.15	0.04
3D	0.5	0.67	2.0	-	1.8	-
4A	0.1	0.69	1.4	-	0.79	0.01
4D	-	0.51	2.7	-	0.99	0.02
		9-02-77				
1A	0.4	0.50	0.7	0.4	0.63	0.02
1B	0.2	0.37	1.0	0.5	0.50	0.02
1C	0.4	0.56	1.2	0.4	0.63	0.02
1D	0.4	0.45	0.8	0.4	0.53	0.02
2A	0.5	0.29	1.8	0.5	0.57	0.03
2B	0.8	0.39	4.1	0.5	0.27	0.01
2C	0.4	0.52	2.6	0.5	0.18	0.01
2D	-	0.31	1.8	0.3	0.49	0.03
3A	-	0.61	1.3	0.6	0.51	0.02
3B	1.0	0.50	3.4	0.4	0.72	0.05
3C	0.2	0.48	0.9	0.3	1.18	0.07
3D	0.5	0.58	3.2	0.5	1.08	0.05
4A	0.3	0.57	0.9	0.3	0.57	0.03
4C	1.0	0.50	2.3	0.8	0.82	0.04
4D	0.2	0.46	2.7	0.4	0.74	0.02

Table Ig. (con't)

WELL#	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
		9-06-77				
1A	0.3	0.42	1.7	0.3	0.55	0.05
1C	0.3	0.41	1.2	0.3	0.79	0.05
1D	0.4	0.65	1.3	0.3	0.50	0.05
2A	1.0	0.57	3.2	0.5	0.83	0.06
2B	0.5	0.68	1.4	0.5	0.81	0.06
2C	-	-	3.8	0.8	0.67	0.08
2D	1.0	0.3	4.7	1.3	0.72	0.07
3A	-	0.4	9.8	0.3	0.56	0.07
3B	3.4	0.4	2.7	0.4	0.64	0.06
3D	1.4	0.6	1.7	0.3	1.18	0.08
4A	1.2	0.7	1.0	0.5	0.64	0.07
4D	-	0.4	2.3	-	0.84	0.07
5B	-	0.4	1.5	-	0.54	0.07
		9-09-77				
1A	1.2	0.58	2.4	<0.1	0.51	0.12
1C	-	2.11	-	-	0.61	0.08
2A	0.6	0.73	2.0	<0.1	0.70	0.13
2C	-	0.56	3.7	<0.1	0.39	0.07
2D	-	0.60	1.9	-	0.42	0.08
3A	-	0.48	2.0	-	0.50	0.07
3B	-	0.62	2.4	-	0.56	0.09
3C	0.3	0.45	0.9	<0.1	0.50	0.10
4A	0.1	0.41	0.2	<0.1	1.10	0.12

Table Ig. (con't)

Well #	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
		<u>9-15-77</u>				
1A	0.2	0.36	1.4	0.5	0.46	0.01
2A	0.5	0.44	2.2	0.4	0.44	0.02
2B	0.5	0.37	1.7	< 0.1	0.65	0.01
2C	0.8	0.34	1.9	< 0.1	0.54	0.02
2D	1.5	0.34	6.4	< 0.1	0.88	0.04
3A	0.9	0.45	0.9	< 0.1	0.48	0.02
3B	0.4	0.34	1.5	< 0.1	0.65	0.01
3C	0.3	0.39	0.8	< 0.1	0.75	0.02
3D	0.4	0.40	1.9	< 0.1	1.02	0.04
4A	0.1	0.43	0.6	< 0.1	0.33	0.02
		<u>9-22-77</u>				
1A	0.2	0.36	0.8	-	0.45	0.01
1C	0.1	0.46	1.4	-	0.44	0.04
1D	< 0.1	0.32	0.2	-	0.81	0.02
2A	< 0.1	0.48	2.3	-	0.53	0.02
2B	1.4	0.72	4.8	-	0.65	0.07
2C	-	0.42	3.3	-	0.40	0.03
2D	0.2	0.43	2.0	-	0.53	0.02
3A	0.1	0.54	1.5	-	0.60	0.03
3B	0.5	0.53	3.8	-	0.58	0.05
3D	0.3	0.62	2.5	-	0.71	0.04
4A	< 0.1	0.53	7.8	-	0.60	0.03
4C	-	0.76	4.3	-	0.74	0.10
		<u>10-14-77</u>				
1A	0.1	0.47	4	0.8	0.39	0.02
1C	< 0.1	0.30	4	0.5	0.34	0.02
2A	0.1	0.40	9	0.5	0.18	0.03
2B	0.1	0.45	5	0.5	0.32	0.02
2D	0.9	0.36	4	0.4	0.28	0.01
3A	0.7	0.54	2	0.4	0.75	0.02
3B	0.2	0.29	6	0.4	0.24	0.01
3D	< 0.1	0.51	6	0.1	0.45	0.02
4A	< 0.1	0.52	4	0.1	0.39	0.01

Table Ig. (con't)

WELL #	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
			5-12-78			
1A	< 0.1	0.18	1.1	0.2	0.24	0.02
1B	0.3	0.09	1.5	<0.1	0.38	0.02
1C	0.5	0.14	1.3	<0.1	0.69	0.02
1D	0.1	0.10	0.7	<0.1	0.32	0.02
2A	< 0.1	0.12	0.3	<0.1	0.28	0.02
2B	< 0.1	0.11	0.8	<0.1	0.26	0.01
2C	0.4	0.10	2.2	0.2	0.30	0.02
2D	< 0.1	0.10	1.1	0.2	0.24	0.01
3A	0.4	0.14	2.7	<0.1	0.29	0.01
3B	0.1	0.07	2.0	0.1	0.17	0.01
3C	< 0.1	0.14	0.3	<0.1	0.72	0.01
3D	< 0.1	0.13	0.7	0.1	1.03	0.02
4A	0.3	0.22	1.5	<0.1	0.67	0.02
4B	0.3	0.14	0.9	0.2	0.48	0.01
4D	0.3	0.15	6.8	0.2	0.52	0.02
			5-24-78			
1A	< 0.1	0.18	1.0	0.4	0.51	0.01
2A	0.4	0.18	7.3	<0.1	0.52	0.03
2B	1.0	0.18	3.4	0.5	0.86	0.03
2C	0.2	0.13	–	0.2	0.80	0.02
2D	0.1	0.12	1.0	0.2	0.62	0.01
3A	0.3	0.18	0.6	<0.1	0.47	0.02
3B	0.1	0.14	–	<0.1	0.61	0.01
3C	< 0.1	0.16	0.2	<0.1	1.07	0.02
3D	< 0.1	0.13	–	<0.1	0.67	0.01
4A	0.5	0.22	1.2	<0.1	0.53	0.02

Table Ig. (cont'd.)

Well #	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			6-22-78			
1A	0.2	0.08	0.8	<0.1	0.98	0.06
1B	0.2	0.08	0.8	<0.1	0.46	0.05
1C	0.2	0.08	0.2	<0.1	0.72	0.04
1D	0.1	0.08	0.4	<0.1	0.33	0.03
2A	0.4	0.10	1.6	<0.1	0.90	0.04
2B	0.2	0.08	0.5	<0.1	0.40	0.04
2C	0.2	0.11	1.2	<0.1	0.40	0.04
2D	-	0.11	0.5	<0.1	0.40	0.04
3A	0.2	0.07	<0.1	<0.1	0.30	0.03
3B	0.1	0.04	0.1	<0.1	0.38	0.05
3C	0.1	0.11	0.6	<0.1	0.57	0.04
4A	-	0.14	1.0	<0.1	0.62	0.04
			6-27-78			
1A	0.1	0.12	0.6	0.10	0.60	<0.01
1B	< 0.1	0.08	0.7	0.10	0.49	<0.01
1C	< 0.1	0.07	0.6	0.11	0.42	<0.01
1D	< 0.1	0.09	0.6	0.11	0.37	<0.01
2A	0.1	0.09	0.7	0.10	0.68	<0.01
2B	< 0.1	0.08	0.6	0.06	0.41	<0.01
2C	< 0.1	0.11	1.2	0.15	0.43	<0.01
2D	0.1	0.12	0.6	0.17	0.40	<0.01
3A	0.1	0.09	0.4	0.07	0.36	<0.01
3B	< 0.1	0.08	1.1	0.12	0.40	<0.01
3C	< 0.1	0.10	0.5	0.12	0.45	<0.01
3D	0.2	0.12	0.4	0.22	0.44	<0.01
4A	0.1	0.18	<0.1	0.44	0.09	<0.01

Table Ig. (Cont'd.)

Well #	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			6-29-78			
1A	< 0.1	0.08	2.6	0.15	0.60	0.01
1B	< 0.1	0.05	2.2	0.10	0.48	0.01
1C	< 0.1	0.05	1.9	0.07	0.48	0.01
1D	0.2	0.09	2.9	0.06	0.39	0.01
2A	0.1	0.07	3.0	0.09	0.53	0.01
2B	< 0.1	0.05	1.5	0.05	0.35	0.01
2C	< 0.1	0.09	2.1	0.17	0.30	0.01
2D	0.3	0.09	1.8	0.25	0.29	0.01
3A	< 0.1	0.06	2.4	0.12	0.34	0.01
3B	0.4	0.05	2.5	0.08	0.42	0.01
3C	< 0.1	0.09	1.1	0.05	0.44	0.01
3D	< 0.1	0.08	1.8	0.15	0.41	0.01
4A	< 0.1	0.12	1.9	0.14	0.48	0.01
			7-7-78			
1A	< 0.1	0.05	0.6	0.19	0.57	0.02
1B	< 0.1	0.05	1.4	0.13	0.39	0.01
1C	< 0.1	0.03	1.2	0.13	0.49	0.01
1D	< 0.1	0.06	1.0	0.09	0.35	0.01
2A	< 0.1	0.04	1.2	0.16	0.59	0.01
2B	< 0.1	0.03	1.0	0.13	0.53	0.01
2C	0.1	0.11	2.4	0.22	0.34	0.01
2D	< 0.1	0.01	1.0	0.26	0.54	0.01
3A	< 0.1	0.05	0.8	0.19	0.44	0.01
3B	< 0.1	0.04	2.0	0.13	0.39	0.01
3C	< 0.1	0.07	0.9	0.13	0.77	0.01
3D	< 0.1	0.07	1.2	0.07	0.33	0.01
4A	< 0.1	0.10	1.1	0.14	0.55	0.01

Table Ig. (cont'd.)

Well #	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			7-11-78			
1A	< 0.1	0.07	0.6	0.24	0.56	0.01
1B	< 0.1	0.05	1.0	0.08	0.59	0.01
1C	< 0.1	0.04	1.2	0.06	0.53	0.01
1D	< 0.1	0.08	0.4	0.13	0.45	0.01
2A	< 0.1	0.06	1.5	0.10	0.53	0.01
2B	< 0.1	0.05	1.7	0.11	0.47	<0.01
2C	< 0.1	0.09	3.4	0.19	0.44	0.01
2D	< 0.1	0.06	1.8	0.16	0.15	<0.01
3A	< 0.1	0.08	0.9	0.06	0.38	<0.01
3B	< 0.1	0.05	1.3	0.11	0.38	0.01
3C	< 0.1	0.09	0.8	0.11	0.34	0.01
3D	< 0.1	0.07	1.6	0.05	0.38	<0.01
4A	< 0.1	0.11	0.8	0.14	0.41	0.01
			7-13-78			
1A	< 0.1	0.08	1.1	0.33	0.39	0.01
1B	< 0.1	0.06	0.8	0.13	0.43	0.01
1C	< 0.1	0.03	0.8	0.07	0.41	0.01
1D	< 0.1	0.07	0.8	0.16	0.37	0.01
2A	0.1	0.06	1.6	0.13	0.49	0.01
2B	< 0.1	0.03	1.2	0.07	0.21	0.01
2C	< 0.1	0.11	1.6	0.31	0.39	0.01
2D	< 0.1	0.08	1.0	0.38	0.36	0.01
3A	< 0.1	0.06	0.6	0.12	0.27	0.01
3B	< 0.1	0.04	1.3	0.10	0.28	0.01
3C	< 0.1	0.07	1.0	0.08	0.38	0.01
3D	< 0.1	0.07	0.7	0.12	0.37	0.01
4A	< 0.1	0.11	0.9	0.13	0.39	0.01

Table Ig. (cont'd.)

Well #	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			7-17-78			
1A	< 0.1	0.11	0.7	0.30	0.25	0.01
1B	< 0.1	0.10	1.1	0.15	0.41	0.01
1C	< 0.1	0.13	1.6	0.16	0.54	0.02
1D	< 0.1	0.13	0.5	0.07	0.39	0.01
2A	0.1	0.16	1.3	0.18	0.50	0.02
2B	< 0.1	0.13	1.1	0.11	0.48	0.01
2C	< 0.1	0.10	1.7	0.12	0.53	0.01
2D	< 0.1	0.13	0.9	0.16	0.48	0.01
3A	< 0.1	0.16	1.2	0.15	0.51	0.01
3C	< 0.1	0.16	0.5	0.16	0.43	0.01
3D	< 0.1	0.15	0.7	0.12	0.43	0.01
4A	< 0.1	0.17	1.2	0.17	0.49	0.01
			7-20-78			
1A	0.1	0.10	1.0	0.25	0.38	0.02
1B	0.1	0.07	1.4	0.11	0.38	0.01
1C	0.1	0.08	1.2	0.15	0.40	0.02
1D	< 0.1	0.12	1.1	0.13	0.39	0.01
2A	< 0.1	0.08	0.8	0.12	0.32	0.01
2B	< 0.1	0.08	1.0	0.13	0.37	0.01
2C	< 0.1	0.02	2.0	0.24	0.34	0.01
2D	< 0.1	0.08	0.8	0.26	0.31	0.01
3A	< 0.1	0.10	0.8	0.13	0.33	0.01
3B	< 0.1	0.07	0.9	0.15	0.29	0.01
3C	< 0.1	0.10	1.0	0.09	0.29	0.01
3D	< 0.1	0.11	0.9	0.08	0.33	0.01
4A	< 0.1	0.15	0.8	0.12	0.27	0.01

Table Ig. (cont'd.)

Well #	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			7-25-78			
1A	< 0.1	0.11	1.0	0.21	0.33	<0.01
1B	0.1	0.11	1.2	0.18	0.43	<0.01
1C	0.1	0.09	0.9	0.12	0.36	<0.01
1D	< 0.1	0.14	1.0	0.15	0.32	<0.01
2A	< 0.1	0.11	1.0	0.18	0.29	<0.01
2B	< 0.1	0.11	1.1	0.18	0.33	<0.01
2C	< 0.1	0.10	1.9	0.17	0.48	<0.01
2D	< 0.1	0.13	1.4	0.38	0.51	<0.01
3A	0.1	0.13	0.6	0.12	0.40	<0.01
3C	0.1	0.15	0.6	0.15	0.30	<0.01
3D	< 0.1	0.14	0.8	0.10	0.35	<0.01
4A	< 0.1	0.17	1.2	0.16	0.31	<0.01
			7-27-78			
1A	< 0.1	0.13	1.0	0.15	0.41	0.01
1B	0.4	0.10	1.5	0.11	0.38	0.01
1C	0.2	0.10	1.6	0.16	0.39	0.01
1D	0.1	0.17	1.3	0.14	0.46	0.01
2A	0.7	0.14	1.6	0.19	0.44	0.01
2B	< 0.1	0.13	1.4	0.15	0.40	0.01
2C	1.6	0.13	1.6	0.31	0.38	0.01
2D	0.5	0.14	1.8	0.33	0.49	0.01
3A	< 0.1	0.15	0.4	0.18	0.38	0.01
3B	< 0.1	0.10	1.9	0.30	0.41	0.01
3C	< 0.1	0.10	0.9	0.13	0.44	0.01
3D	< 0.1	0.13	0.9	0.16	0.41	0.01
4A	0.1	0.17	1.0	0.14	0.47	0.01

Table Ig. (cont'd.)

Well #	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
			<u>8-1-78</u>			
1A	< 0.1	0.11	0.6	0.53	0.44	0.01
1C	0.2	0.09	2.5	0.29	0.44	0.01
1D	0.1	0.11	1.5	0.23	0.42	0.02
2A	< 0.1	0.11	1.2	0.20	0.41	0.01
2B	< 0.1	0.10	0.9	0.14	0.32	0.01
2D	< 0.1	0.12	1.7	0.19	0.28	0.01
3A	< 0.1	0.12	1.0	0.06	0.34	0.01
3C	< 0.1	0.09	1.0	0.13	0.41	0.01
4A	< 0.1	0.15	1.0	0.12	0.45	0.01
			<u>8-3-78</u>			
1A	< 0.1	0.31	1.0	0.27	0.54	0.01
1B	< 0.1	0.23	1.2	0.17	0.57	0.01
1C	< 0.1	0.29	1.0	0.25	0.73	0.02
1D	< 0.1	0.35	1.0	0.18	0.53	0.01
2A	< 0.1	0.35	1.0	0.23	0.52	0.01
2B	< 0.1	0.37	1.8	0.12	0.53	0.01
2C	< 0.1	0.20	1.7	0.14	0.55	0.01
2D	< 0.1	0.33	1.5	0.27	0.22	<0.01
3A	< 0.1	0.38	0.8	0.17	0.58	0.01
3B	< 0.1	0.28	1.2	0.17	0.56	0.01
3C	< 0.1	0.37	0.6	0.12	0.49	0.01
4A	< 0.1	0.47	0.6	0.11	0.52	0.01

Table Ig. (cont'd.)

Well #	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
			8-8-78			
1A	< 0.1	0.34	1.0	0.29	0.66	0.01
1B	< 0.1	0.26	1.2	0.08	0.48	0.01
1C	< 0.1	0.28	1.4	0.07	0.62	0.01
1D	< 0.1	0.36	1.5	0.03	0.51	<0.01
2A	< 0.1	0.34	1.6	0.21	0.55	0.01
2B	< 0.1	0.38	1.6	0.10	0.40	<0.01
2C	< 0.1	0.23	1.5	0.12	0.49	0.01
2D	< 0.1	0.34	1.3	0.18	0.56	0.01
3A	< 0.1	0.39	1.1	0.04	0.55	<0.01
3B	< 0.1	0.31	0.9	0.10	0.64	0.01
3C	< 0.1	0.41	0.6	0.04	0.58	<0.01
3D	< 0.1	0.41	0.4	0.06	0.59	0.01
4A	< 0.1	0.51	0.5	0.10	0.61	0.01
			8-10-78			
1A	< 0.1	0.05	0.5	0.21	0.50	0.01
1B	< 0.1	0.05	1.4	0.03	0.53	<0.01
1C	< 0.1	0.04	1.4	0.03	0.64	0.01
1D	< 0.1	0.03	1.0	0.12	0.60	<0.01
2A	< 0.1	0.03	1.6	0.20	0.51	<0.01
2B	< 0.1	0.03	1.5	0.14	0.59	0.01
2C	< 0.1	0.03	2.2	0.36	0.56	0.01
2D	< 0.1	0.03	1.5	0.30	0.64	0.01
3A	< 0.1	0.03	0.8	0.12	0.69	0.01
3B	< 0.1	0.03	1.2	0.10	0.40	<0.01
3C	0.1	0.03	0.8	0.11	0.45	<0.01
3D	< 0.1	0.03	0.6	<0.01	0.43	0.01
4A	< 0.1	0.03	0.7	0.37	0.54	0.01
5A	0.4	0.03	1.8	0.29	0.56	0.01
5B	0.1	0.03	2.0	1.11	0.52	0.01

Table Ig. (cont'd.)

Well #	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
			8-15-78			
1A	-	0.18	2.5	0.23	0.29	0.01
1B	-	0.15	1.1	0.10	0.44	0.01
1C	-	0.14	2.2	0.17	0.44	0.01
1D	-	0.21	1.6	0.08	0.34	0.01
2A	-	0.18	1.9	0.27	0.35	0.01
2B	-	0.21	1.8	0.13	0.34	0.01
2C	< 0.1	0.16	2.6	0.25	0.44	0.01
2D	< 0.1	0.18	2.3	0.22	0.59	0.01
3A	< 0.1	0.20	1.9	0.09	0.49	0.01
3B	< 0.1	0.15	3.1	0.16	0.54	0.01
3C	< 0.1	0.21	1.8	0.10	0.37	0.01
3D	< 0.1	0.21	1.8	0.04	0.39	0.01
4A	< 0.1	0.21	1.9	0.10	0.59	0.01
5A	0.1	0.30	2.3	0.47	0.60	0.02
5B	0.1	0.42	1.7	0.86	0.62	0.02
			8-17-78			
1A	< 0.1	0.21	1.2	0.24	0.39	0.01
1B	< 0.1	0.11	1.7	0.02	0.38	0.01
1C	< 0.1	0.14	1.3	0.04	0.48	0.01
1C	< 0.1	0.21	1.9	0.06	0.40	0.01
2A	< 0.1	0.19	1.5	0.30	0.32	0.01
2B	< 0.1	0.21	2.3	0.15	0.36	0.01
2C	< 0.1	0.19	2.1	0.30	0.31	0.03
2D	< 0.1	0.19	2.1	0.28	0.41	0.01
3A	< 0.1	0.21	0.7	0.10	0.60	0.02
3B	< 0.1	0.13	1.9	0.10	0.53	0.02
3C	< 0.1	0.15	1.8	0.16	0.39	0.01
3D	< 0.1	0.21	0.6	0.10	0.40	0.02
4A	< 0.1	0.28	0.7	0.03	0.43	0.02
5A	< 0.1	0.37	1.3	0.25	0.51	0.02
5B	< 0.1	0.46	0.9	0.56	0.59	0.02

Table Ig. (cont.)

WELL #	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
			8-24-78			
1A	< 0.1	0.31	1.3	0.35	0.53	0.01
1C	–	0.24	1.1	0.15	0.55	0.01
2A	< 0.1	0.29	1.5	0.38	0.79	0.01
2D	< 0.1	0.26	1.5	0.24	0.49	0.01
3A	< 0.1	0.31	1.2	0.11	0.57	0.01
3B	–	0.24	1.2	0.11	0.38	0.01
3C	< 0.1	0.30	1.3	0.20	0.50	0.01
3D	< 0.1	0.34	0.9	0.42	0.54	0.01
4A	0.1	0.29	1.2	0.33	0.57	0.01
5A	0.1	0.54	1.2	0.24	0.60	0.01
5B	< 0.1	0.63	1.2	0.65	0.34	0.01
			8-24-78			
1A	< 0.1	0.23	1.1	0.48	0.40	0.02
2A	< 0.1	0.24	2.0	0.42	0.60	0.02
2B	< 0.1	0.31	1.5	0.15	0.73	0.02
2D	< 0.1	0.25	1.4	0.24	0.49	0.01
3A	< 0.1	0.27	0.6	0.05	0.52	0.01
3B	< 0.1	0.22	1.4	0.13	0.71	0.02
3C	< 0.1	0.27	1.1	0.14	0.52	0.01
4A	< 0.1	0.35	0.8	0.15	0.58	0.01
5A	< 0.1	0.47	1.4	0.20	0.57	0.02
5B	0.1	0.60	1.1	0.46	0.46	0.01

Table Ih. NITRATE CONCENTRATION IN GROUNDWATER FROM THE CLARE REST AREA

DATE	(ppm) Well #											
	1	2	3	4	5a	6a	7	8	9	10	11	12
7-02-77	–	–	0.02	0.05	<0.01	–	0.61	0.15	–	0.67	–	<0.01
7-05-77	–	–	< 0.01	<0.01	0.31	0.06	0.26	0.42	0.03	0.58	<0.01	<0.01
7-11-77	–	–	< 0.01	0.01	0.10	<0.01	0.05	0.06	<0.01	0.58	0.01	<0.01
8-04-77	–	–	0.01	0.02	0.05	0.02	0.29	0.01	0.01	0.58	0.02	0.01
8-11-77	–	–	0.01	0.02	0.10	0.02	0.22	0.03	0.04	0.64	0.02	0.02
8-17-77	–	–	0.04	0.01	0.08	0.04	0.07	0.03	0.02	0.62	0.03	0.03
8-29-77	–	–	–	<0.01	0.02	<0.01	0.02	0.02	0.01	0.63	0.03	0.01
9-06-77	–	–	0.65	0.65	0.44	0.54	0.65	0.70	0.54	1.23	0.42	0.61
9-15-77	–	–	0.50	0.50	0.60	0.29	0.89	0.61	0.47	1.18	0.63	0.49
9-22-77	–	–	0.53	0.42	0.59	0.51	0.60	0.44	0.53	1.21	0.58	0.63
10-14-77	–	–	–	–	0.38	0.47	0.37	0.42	–	–	–	–
12-22-77	–	–	0.10	0.05	0.10	0.10	1.22	–	–	1.71	–	–
2-28-78	–	–	0.85	0.77	0.62	0.68	–	0.64	1.15	1.34	0.73	0.87
3-16-78	–	–	0.04	0.03	0.03	0.03	–	0.03	0.11	0.27	0.03	0.04
4-15-78	–	–	< 0.01	0.03	0.03	0.03	0.03	0.05	0.09	0.25	0.04	0.04
5-24-78	–	–	0.07	0.56	<0.01	<0.01	<0.01	0.46	<0.01	0.14	0.36	<0.01
6-08-78	–	–	0.04	0.49	<0.01	<0.01	0.95	<0.01	0.10	0.44	<0.01	<0.01
6-22-78	–	–	0.47	0.55	0.42	0.40	0.97	0.62	0.44	0.76	0.42	0.86
7-07-78	–	–	0.43	0.31	0.40	0.36	0.48	0.45	0.37	0.78	<0.2	0.41
7-13-78	–	–	–	–	–	0.93	0.28	0.77	–	–	–	–
7-17-78	–	–	–	–	–	0.35	0.76	0.47	–	–	–	–
7-20-78	–	–	–	–	–	0.24	0.67	0.34	–	–	–	–
7-25-78	–	–	–	–	–	0.54	0.94	0.58	–	–	–	–
7-27-78	–	–	0.36	0.55	0.70	0.52	1.06	0.46	0.47	0.94	0.51	0.58
8-01-78	–	–	–	–	–	0.32	0.66	0.39	–	–	–	–
8-03-78	–	–	0.44	0.35	0.54	0.36	0.96	0.45	0.53	0.92	0.46	0.79
8-08-78	–	–	–	–	–	0.64	0.84	0.57	–	–	–	–
8-10-78	–	–	–	–	–	0.55	0.79	0.52	–	–	–	–
8-17-78	–	–	0.43	0.34	0.43	0.51	0.65	0.44	0.49	0.73	0.37	0.70

Table I i. TOTAL COLIFORM CONCENTRATION OF GROUND WATER FROM THE CLARE REST AREA.

DATE	(MPN/100ml) WELL # 1	2	3	4	5a	6a	7	8	9	10	11	12
7-1-77	-	-	9	< 2	15	< 2	> 2,400	23	4	4	93	< 2
7-5-77	-	-	4	< 2	240	< 2	> 240,000	460	1,100	4	460	< 2
7-11-77	-	-	4	< 2	150	4	> 2,400	9	> 2,400	4	1,100	150
8-4-77	-	-	9	< 2	7	< 2	40	< 2	460	< 2	75	43
8-11-77	-	-	< 2	< 2	< 2	< 2	< 20	< 2	210	< 2	23	4
8-17-77	-	-	< 2	< 2	< 2	< 2	< 2	< 2	43	< 2	< 2	< 2
8-29-77	-	-	< 2	< 2	< 2	< 2	< 2	< 2	15	< 2	< 2	< 2
9-06-77	-	-	< 2	< 2	< 2	< 2	< 2	< 2	43	< 2	23	< 2
9-15-77	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
9-22-77	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	23	< 2
10-14-77	-	-	-	-	< 2	< 2	< 2	< 2	-	-	-	-
2-28-78	-	-	< 2	< 2	< 2	< 2	-	< 2	< 2	< 2	< 2	< 2
3-16-78	-	-	< 2	< 2	< 2	< 2	4	< 2	< 2	< 2	< 2	< 2
4-15-78	-	-	< 2	< 2	< 2	< 2	43	< 2	< 2	< 2	< 2	< 2
5-24-78	-	-	< 2	< 2	< 2	< 2	-	< 2	< 2	< 2	< 2	< 2
6-08-78	-	-	< 2	< 2	< 2	< 2	93	23	< 2	< 2	< 2	< 2
6-22-78	-	-	< 2	< 2	< 2	< 2	43	< 2	4	< 2	< 2	< 2
7-07-78	-	-	< 2	< 2	< 2	< 2	9	< 2	< 2	< 2	< 2	< 2
7-27-78	-	-	< 2	< 2	43	< 2	9	< 2	< 2	< 2	750	< 2
8-03-78	-	-	< 2	< 2	9	4	< 2	4	< 2	< 2	23	< 2
8-17-78	-	-	< 2	< 2	23	4	43	< 2	< 2	< 2	460	23
9-05-78	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	4

Table IIa. Chemical Composition of Wastewater at the Watervliet Rest Area

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
							8-24-77						
Lagoon 1	8.2	21	13.0	-	-	74(37)	-	3.9	2.84	4.9	-	0.14	0.01
Lagoon 2	8.7	21	7.5	-	-	61(20)	-	3.2	2.90	2.7	-	0.16	0.75
							9-16-77						
Lagoon 1	-	18	7.3	-	-	29	24	4.3	3.56	5.7	<0.1	0.74	0.13
Lagoon 2	-	18	11.0	-	-	28	14	4.9	3.65	5.4	0.3	0.67	0.11
							9-30-77						
Lagoon 1	-	17	5.6	-	-	37	34	4.6	3.72	+3.3	-	0.49	0.38
Lagoon 2	-	17	2.4	-	-	21	10	4.2	3.82	5.2	-	0.60	0.09
							10-21-77 X						
Mill Creek 14-	-	-	1	-	-		2	0.2	0.43	0.6	0.3	1.6	0.02
Mill Creek 15-	-	-	1	-	-		1	< 0.1	0.43	1.4	0.1	1.6	0.02
							10-21-77 A						
Lagoon 1	-	12	18.0	38	-	33	8	2.6	2.49	7.8	0.9	4.2	0.08
Lagoon 2	-	12	14.8	8	-	-	8	2.9	2.81	2.7	0.3	1.1	0.05
Cont. St. 3	-	10	12.8	6	-	14	8	2.9	2.88	1.4	0.3	1.2	0.04
Sewer 4	-	11	12.9	7	-	-	10	2.8	2.87	1.5	0.1	0.9	0.04
Sewer 5	-	11	12.5	8	-	-	10	2.8	2.83	4.8	0.1	0.9	0.05
Sewer 6	-	11	13.0	8	-	-	3	2.7	2.80	3.2	0.3	1.0	0.04
Sewer 8	-	11	12.2	6	-	-	10	2.8	2.80	2.5	0.1	1.1	0.04
Sewer 9	-	11	11.8	7	-	-	12	2.9	2.74	2.8	0.1	1.1	0.04
Sewer 10	-	11	12.5	6	-	-	63	3.0	2.75	3.0	0.5	1.1	0.04
Sewer 11	-	11	11.4	6	-	-	14	2.7	2.75	2.8	0.1	1.1	0.04
Sewer 12	-	11	11.5	8	-	-	15	4.9	2.82	2.3	0.3	1.2	0.04
Sewer 13	-	11	12.5	10	-	18	23	2.9	2.76	2.8	0.1	1.1	0.05
Mill Cr. 14	-	11	11.2	1	-	5	2	< 0.1	0.43	1.6	0.1	1.7	0.02
Mill Cr. 15	-	12	10.6	2	-	4	14	0.4	0.59	1.4	0.1	1.7	0.02
Pond 17	-	12	3.3	8	-	16	4	0.2	0.27	0 9	0.3	0.6	0.02

Table IIa (Con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
							10-22-77 B						
Lagoon 1	-	10	9.5	42	-	30	50	2.7	2.50	9.1	0.6	4.6	0.05
Lagoon 2	-	10	11.0	10	-	18	11	2.7	2.80	3.7	0.4	1.0	0.04
Cont. St. 3	-	10	11.6	10	-	21	16	3.0	2.83	3.9	<0.1	1.1	0.04
Sewer 4	-	10	11.3	7	-	-	13	-	2.82	3.7	0.1	1.1	0.04
Sewer 5	-	10	11.2	6	-	-	13	-	2.83	3.2	0.4	1.2	0.04
Sewer 6	-	10	11.6	6	-	-	10	-	2.87	3.3	0.3	1.0	0.03
Sewer 8	-	10	11.0	6	-	-	13	-	2.85	2.8	0.1	1.2	0.04
Sewer 9	-	10	11.2	4	-	-	9	-	2.80	3.2	0.3	1.0	0.02
Sewer 10	-	10	11.1	7	-	-	11	-	2.73	2.8	0.8	1.2	0.05
Sewer 11	-	10	11.0	7	-	-	10	-	2.74	2.7	<0.1	1.3	0.04
Sewer 12	-	11	10.8	3	-	-	11	-	2.78	2.7	0.1	1.2	0.04
Sewer 13	-	11	11.2	6	-	18	12	3.0	2.78	3.0	<0.1	1.3	0.04
Mill Creek 14	-	10	9.7	< 1	-	-	7	-	0.45	0.4	<0.1	1.6	0.02
Mill Creek 15	-	10	9.8	< 1	-	-	4	0.5	0.57	0.6	<0.1	1.5	0.02
							10-22-77 C						
Lagoon 1	-	10	10.8	40	-	30	38	2.9	2.47	7.6	0.8	4.0	0.05
Lagoon 2	-	11	12.6	6	-	20	12	2.9	2.83	2.9	1.0	1.0	0.04
Cont. St. 3	-	10	12.8	8	-	17	16	3.1	2.94	3.7	2.8	1.1	0.04
Sewer 4	-	10	12.2	6	-	-	16	-	2.82	2.0	0.8	1.0	0.04

Table IIa. (con't)

Sample	pH	$T^{o}C$	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
								10-27-77 D					
Lagoon 1	-	11	3.5	36	-	-	32	-	2.57	3.9	0.8	2.9	0.06
Lagoon 2	-	12	10.0	14	-	19	15	3.4	3.02	1.8	0.5	0.6	0.03
Cont. St. 3	-	11	10.2	10	-	29	12	3.3	3.00	4.0	0.8	0.6	0.03
Ditch 0	-	12	9.5	9	-	24	74	2.8	2.52	3.3	0.6	0.8	0.03
Ditch 50	-	12	10.3	8	-	-	37	-	2.68	3.3	0.4	0.6	0.02
Ditch 100	-	12	9.0	6	-	-	12	-	2.59	3.2	0.4	0.6	0.03
Ditch 200	-	12	10.1	8	-	-	29	-	2.44	2.9	0.4	0.6	0.03
Ditch 400	-	12	10.8	4	-	-	11	-	2.21	2.7	0.3	0.5	0.02
Ditch 800	-	12	10.5	2	-	-	16	-	0.54	1.5	1.0	0.5	0.02
Ditch 13a	-	13	10.8	1	-	22	102	0.7	0.43	1.4	0.5	0.6	0.02
Mill Creek 14	-	-	-	<1	-	-	4	-	0.43	<0.1	0.5	1.4	0.02
Pond 17	-	11	0.4	9	-	-	10	0.9	0.54	0.8	0.5	0.5	0.02
								10-27-77 E					
Lagoon 1	-	14	12.2	49	-	29	32	3.5	2.59	6.8	0.8	2.9	0.06
Lagoon 2	-	14	14.8	8	-	20	8	3.3	3.07	3.7	1.0	0.6	0.04
Cont. St. 3	-	13	15.2	22	-	21	16	3.5	2.99	6.4	0.8	0.5	0.02
Ditch 0	-	13	14.5	21	-	21	24	3.6	2.94	6.2	0.6	0.6	0.03
Ditch 50	-	13	14.8	20	-	-	31	-	2.94	5.4	0.8	0.5	0.02
Ditch 100	-	13	14.2	20	-	-	17	-	2.93	5.9	0.8	0.6	0.03
Ditch 200	-	12	15.0	20	-	-	21	-	2.90	5.2	0.4	0.6	0.02
Ditch 400	-	13	13.9	18	-	-	25	-	2.85	4.9	<0.1	0.6	0.03
Ditch 800	-	14	14.0	12	-	-	13	-	2.66	4.4	<0.1	0.6	0.02
Ditch 13a	-	14	10.8	12	-	24	299	1.7	2.29	3.9	<0.1	0.5	0.03
Mill Creek 14	-	12	10.6	<1	-	4	2	0.3	0.54	0.5	<0.1	1.5	0.02
Pond 17	-	14	5.2	4	-	18	90	1.2	1.19	2.4	0.4	0.5	0.03

Table IIa. (con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
10-28-77 F													
Lagoon 1	7.9	12	5.1	30	–	29	26	3.2	2.87	5.1	<0.1	2.8	0.08
Lagoon 2	8.4	12	10.3	13	–	16	21	3.5	3.10	3.9	<0.1	0.7	0.04
Cont. St. 3	8.4	11	10.9	13	–	19	9	–	3.07	2.9	<0.1	0.6	0.04
Ditch 0	8.4	12	10.8	14	–	18	11	3.5	3.08	3.8	0.4	0.6	0.04
Ditch 50	8.3	12	10.8	12	–	–	20	–	3.05	10.1	0.5	0.7	0.03
Ditch 100	8.2	12	10.4	13	–	–	13	–	3.03	3.4	0.5	0.5	0.04
Ditch 200	8.3	12	10.6	20	–	–	11	–	2.94	4.8	0.4	0.7	0.03
Ditch 400	8.2	12	11.0	16	–	–	9	–	2.83	4.6	0.4	0.5	0.02
Ditch 800	8.7	12	13.8	18	–	–	14	–	2.81	4.2	<0.1	0.4	0.04
Ditch 13a	8.7	12	11.8	19	–	24	89	3.2	2.54	6.3	1.3	0.7	0.02
Mill Cr 14	8.0	11	10.2	< 1	–	–	6	0.4	0.43	0.5	<0.1	1.4	0.03
Mill Cr. 16	7.9	11	10.6	< 1	–	4	2	0.2	0.44	0.1	0.4	1.5	0.03
Pond 17	8.2	12	8.0	22	–	–	25	2.2	2.04	3.4	<0.1	0.7	0.03
10-28-77 G													
Lagoon 1	8.8	14	16.7	28	–	30	25	3.3	2.70	5.7	<0.1	2.9	0.13
Lagoon 2	9.0	14	18.7	12	–	18	11	3.6	2.95	4.9	<0.1	0.7	0.02
Cont. St. 3	8.8	13	13.4	11	–	16	7	3.4	3.00	4.4	<0.1	0.5	0.01
Sewer	8.8	12	13.2	14	–	–	8	–	3.01	5.7	<0.1	0.4	0.01
Sewer 5	8.8	12	13.2	14	–	–	10	–	2.99	4.8	<0.1	0.6	0.01
Sewer 6	8.9	13	13.2	19	–	–	8	–	2.98	5.6	<0.1	0.4	0.01
Sewer 8	8.9	13	13.4	16	–	–	110	–	2.97	4.9	<0.1	0.6	0.01
Sewer 9	8.9	13	12.9	20	–	–	39	–	2.84	4.7	<0.1	0.6	0.01
Sewer 10	8.8	13	12.8	24	–	–	11	–	2.9	4.9	<0.1	0.5	0.01
Sewer 11	9.0	13	12.8	14	–	–	15	–	2.90	7.2	<0.1	0.5	0.01
Sewer 12	8.5	13	13.4	16	–	–	13	–	3.07	4.6	0.3	0.5	0.01
Sewer 13	9.0	14	11.4	19	–	17	17	3.4	2.87	4.4	0.6	0.4	0.01
Mill Cr. 14	8.2	12	11.6	< 1	–	13	6	0.4	0.42	0.4	<0.1	1.2	0.02
Mill Cr. 15	8.2	12	11.6	< 1	–	–	9	0.2	0.47	0.3	<0.1	1.4	0.01
Mill Cr. 16	8.2	12	11.2	< 1	–	–	8	0.3	0.48	0.4	<0.1	1.2	0.01
Pond 17	9.0	14	16.0	38	–	–	23	1.7	2.37	4.9	2.3	0.5	0.01

Table IIa. (con't)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
							12-29-77						
Lagoon 1	7.7	-	-	14	-	28	17	3.0	2.70	11.1	5.8	1.93	0.16
Lagoon 2	7.5	-	-	10	-	16	6	3.5	3.45	5.7	2.8	0.90	0.08
Mill creek	7.7	-	-	< 1	-	5	10	3.2	0.34	0.5	< 0.1	2.14	0.06
							1-23-78						
Lagoon 1	-	-	4.1	16	-	28	19	4.5	4.12	20.0	14.7	0.52	0.05
Lagoon 2	-	-	2.1	13	-	17	9	4.6	4.09	7.2	3.0	0.70	0.15
Mill Creek 14	-	-	-	< 1	-	-	1	0.1	0.37	0.9	0.3	2.25	0.05
							2-25-78						
Lagoon 1	7.2	-	-	16	-	-	29	4.3	4.02	18.7	16.1	0.53	0.01
Lagoon 2	6.8	-	-	41	-	-	657	7.6	6.42	21.9	5.8	0.77	0.01
Mill Creek 14	7.6	-	-	1	-	-	8	0.2	0.26	1.0	0.3	2.03	0.01
							3-23-78						
Lagoon 1	-	1	9.5	16	-	-	25	1.3	1.16	6.4	5.5	0.87	0.04
Lagoon 2	-	1	5.5	6	-	-	17	1.3	1.00	1.0	0.6	0.97	0.03
Mill Creek 14	-	-	-	< 1	-	-	30	<0.1	0.15	1.0	-	2.49	0.03
							4-22-78						
Lagoon 1	8.7	-	18.2	18	-	58	48	3.2	2.42	15.7	9.6	3.12	0.37
Lagoon 2	9.2	-	10.6	20	-	48	24	2.4	1.96	9.2	4.5	0.68	0.16
Mill Creek 14	7.9	-	-	< 1	-	24	6	-	0.13	0.1	0.1	1.72	0.04
							5-03-78 A						
Lagoon 1	9.3	-	-	22	-	58	42	2.5	1.35	8.5	5.0	3.08	0.93
Lagoon 2	9.1	-	-	23	-	45	31	3.0	1.93	10.4	6.6	0.09	0.30
Mill Creek 14	8.0	-	-	< 1	-	6	<1	0.1	0.10	0.2	0.5	1.28	0.02
Mill Creek 15	7.9	-	-	< 1	-	11	2	0.1	0.11	< 0.1	0.6	1.30	0.02
Mill Creek 16	7.9	-	-	< 1	-	6	<1	0.1	0.10	0.2	0.5	1.26	0.02
Pond 17	7.3	-	-	< 1	-	-	<1	0.1	0.05	0.4	0.2	0.14	0.01

Table II a. (Con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						5-03-78 B							
Lagoon 1	9.6	-	-	26	-	50	33	2.3	1.26	7.8	3.4	2.95	0.93
Lagoon 2	9.4	-	-	38	-	44	44	2.9	1.94	11.7	6.7	< 0.2	0.30
Cont. Str. 3	9.4	-	-	26	-	-	38	2.4	1.35	7.7	3.5	2.95	0.95
Ditch 0	9.4	-	-	27	-	48	36	2.6	1.39	7.5	3.3	3.03	0.98
Ditch 50	9.4	-	-	26	-	-	45	2.6	1.33	7.9	3.4	3.01	0.98
Ditch 100	9.2	-	-	24	-	-	38	2.4	1.39	7.1	2.9	3.07	0.98
Ditch 200	9.3	-	-	22	-	-	45	2.1	1.26	7.6	3.3	3.04	0.96
Ditch 400	9.2	-	-	26	-	-	48	2.2	1.26	7.3	3.5	3.01	0.94
Ditch 800	8.9	-	-	26	-	-	36	1.9	1.16	7.6	3.4	2.91	0.88
Ditch 13a	8.8	-	-	26	-	61	110	1.8	1.06	7.1	2.6	2.80	0.85
Mill Creek 14	8.3	-	-	1	-	8	4	0.2	0.12	0.1	0.5	1.26	0.01
Pond 17	7.8	-	-	19	-	-	231	0.9	0.44	5.3	2.0	1.70	0.46
Pond 18	7.6	-	-	1	-	-	5	0.1	0.05	0.2	0.4	< 0.2	0.01
						5-03-78 C							
Lagoon 1	9.6	15	9.9	36	-	52	57	2.5	1.28	8.2	4.0	3.04	0.96
Lagoon 2	9.5	15	<20	42	-	50	39	2.9	1.79	11.9	7.7	< 0.2	0.33
Cont. Str. 3	9.4	10	6.4	26	-	-	36	2.3	1.37	9.2	3.4	2.94	0.96
Ditch 0	9.4	13	9.4	24	-	52	32	2.1	1.33	8.3	2.6	3.02	0.98
Ditch 50	9.3	12	9.9	32	-	-	57	2.1	1.25	8.7	2.4	3.11	1.02
Ditch 100	9.2	13	10.2	29	-	-	40	1.8	1.22	7.3	3.2	2.59	0.96
Ditch 200	9.2	13	10.5	32	-	-	187	1.9	1.26	8.9	3.1	2.99	0.94
Ditch 400	9.1	14	11.1	32	-	-	34	1.7	1.34	8.1	3.4	3.05	0.96
Ditch 800	9.2	16	10.8	24	-	-	37	1.6	1.22	7.3	3.5	3.06	0.93
Ditch 13a	9.1	17	10.2	26	-	51	108	2.0	1.15	5.9	3.2	3.02	0.92
Mill Creek 14	8.4	12	14.7	1	-	11	8	<0.1	0.12	0.5	< 0.1	1.73	0.02
Mill Creek 15	8.4	12	14.6	1	-	-	8	0.4	0.11	0.7	0.5	1.63	0.02
Mill Creek 16	8.3	12	14.8	1	-	6	6	<0.1	0.18	0.3	< 0.1	1.71	0.02
Pond 17	8.8	16	10.5	18	-	-	48	1.2	0.92	6.4	3.5	3.01	0.72
Pond 18	8.2	17	11.0	11	-	-	45	0.7	0.61	4.4	1.5	2.03	0.46

Table II a. (Con't)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
							5-03-78 D						
Lagoon 1	9.6	17	17.7	29	-	50	36	2.4	1.34	8.1	4.2	3.55	1.00
Lagoon 2	9.6	16	>20	20	-	50	29	2.2	1.66	10.1	5.2	0.6	0.34
Cont. Str.3	9.4	12	8.5	17	-	50	20	2.3	1.28	7.7	2.5	3.42	0.97
Sewer 4	9.4	11	8.7	22	-	-	32	2.3	1.33	8.2	2.3	3.52	0.98
Sewer 5	9.3	11	9.1	16	-	-	28	2.2	1.31	9.0	1.5	3.47	0.97
Sewer 6	9.4	11	7.8	17	-	-	29	2.1	1.28	7.4	1.7	3.57	0.97
Sewer 8	9.4	10	8.8	18	-	-	52	2.2	1.24	7.1	1.3	3.57	0.98
Sewer 10	9.3	10	9.3	17	-	-	28	2.1	1.21	7.1	1.3	3.71	0.96
Sewer 11	9.3	10	8.5	16	-	-	34	2.0	1.21	7.9	1.5	3.51	0.95
Sewer 12	9.3	9	10.4	16	-	-	29	2.0	1.17	7.1	2.0	3.64	0.96
Sewer 13	9.3	9	10.0	15	-	46	38	1.9	1.17	7.1	1.8	3.58	0.97
Mill Creek 14	8.5	12	14.2	< 1	-	6	2	< 0.1	0.19	1.1	0.4	1.62	0.02
Mill Creek 15	8.5	13	13.5	< 1	-	8	2	< 0.1	0.18	0.7	0.4	1.68	0.03
Mill Creek 16	8.5	13	12.6	< 1	-	-	4	< 0.1	0.15	1.3	0.2	1.81	0.04
Pond 17	9.0	17	12.6	-	-	-	39	1.3	0.85	7.5	2.3	3.10	0.78
							5-13-78 A						
Lagoon 1	8.1	16	7.1	28	-	32	17	2.7	2.20	8.6	3.2	1.00	0.79
Lagoon 2	8.7	16	7.5	26	-	45	27	2.5	1.64	7.0	2.2	0.14	0.49
Ditch 13 a	7.6	14	9.8	11	-	25	55	0.2	0.09	0.9	< 0.1	0.27	0.01
Mill Creek 14	7.3	14	8.0	6	-	36	286	0.4	0.13	1.9	< 0.1	0.58	0.02
Mill Creek 15	7.1	14	8.0	6	-	-	280	0.4	0.13	1.9	< 0.1	0.59	0.02
Mill Creek 16	7.2	14	7.8	6	-	-	260	0.3	0.13	1.9	< 0.1	0.73	0.02
Pond 17	7.4	14	8.0	8	-	-	85	0.3	0.14	1.2	0.1	0.28	0.02
							5-13-78 B						
Lagoon 1	8.4	-	-	21	-	40	21	2.6	2.17	6.6	3.7	1.26	0.82
Lagoon 2	9.0	-	-	17	-	49	27	2.4	1.57	7.0	2.9	0.28	0.48
Cont. Str. 3	8.9	-	-	12	-	-	31	2.3	1.57	4.5	1.6	0.22	0.47
Sewer 4	8.9	-	-	12	-	-	32	2.4	1.59	5.7	2.0	0.23	0.47
Ditch 0	7.7	-	-	17	-	61	131	2.2	0.99	6.4	2.9	0.76	0.39
Ditch 50	6.8	-	-	9	-	-	177	0.9	0.20	3.5	< 0.1	0.52	0.08
Ditch 100	7.0	-	-	1	-	-	111	0.4	0.11	2.5	0.1	0.24	0.01
Ditch 200	7.5	-	-	<1	-	-	9	0.1	0.08	2.2	0.1	0.17	0.01

Table II a. (Con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
							5-13-78 B (con't)						
Ditch 400	7.6	-	-	<1	-	-	19	< 0.1	0.07	1.3	0.2	0.21	0.01
Ditch 800	7.6	-	-	<1	-	-	23	< 0.1	0.07	0.7	< 0.1	0.24	0.01
Ditch 13 a	7.8	-	-	<1	-	24	33	0.1	0.08	0.7	0.2	0.21	0.01
Mill Creek 16	7.5	-	-	2	-	41	216	0.3	0.14	7.6	< 0.1	0.78	0.03
Pond 17	7.6	-	-	<1	-	-	65	0.2	0.09	1.0	0.1	0.25	0.01
							5-13-78 C						
Lagoon 1	8.4	-	-	19	-	40	24	2.5	2.09	3.5	0.6	1.23	0.83
Lagoon 2	8.9	-	-	15	-	44	32	2.4	1.51	4.7	0.6	0.18	0.50
Cont. Str. 3	8.4	-	-	12	-	-	20	2.3	-	5.1	0.6	-	-
Sewer 4	8.2	-	-	12	-	-	49	2.6	-	4.6	< 0.1	-	-
Ditch 0	8.1	-	-	12	-	40	16	2.1	1.52	4.7	1.3	0.25	0.45
Ditch 50	7.8	-	-	8	-	-	56	1.7	1.44	3.9	0.3	0.16	0.44
Ditch 100	7.8	-	-	8	-	-	22	1.9	1.37	5.0	1.5	0.25	0.41
Ditch 200	7.8	-	-	9	-	-	34	1.6	1.04	4.1	1.1	0.18	0.32
Ditch 400	7.6	-	-	10	-	-	27	1.2	0.95	2.8	0.1	0.15	0.29
Ditch 800	7.6	-	-	7	-	-	22	0.1	0.62	1.4	0.1	0.20	0.20
Ditch 13 a	7.6	-	-	6	-	28	51	< 0.1	0.34	0.7	0.1	0.22	0.13
Mill Creek 16	7.3	-	-	4	-	29	188	0.2	0.18	1.5	< 0.1	0.92	0.03
Pond 17	7.9	-	-	2	-	-	75	0.4	0.11	0.5	0.1	0.30	0.02
							5-13-78 D						
Lagoon 1	8.4	-	-	19	-	26	21	2.5	2.09	3.5	0.7	1.23	0.83
Lagoon 2	8.9	-	-	15	-	30	27	2.3	1.51	5.1	1.3	0.18	0.50
Ditch 0	8.1	-	-	12	-	-	24	2.2	1.52	3.3	0.1	0.25	0.45
Ditch 50	7.8	-	-	8	-	-	37	2.0	1.44	3.2	< 0.1	0.16	0.44
Ditch 100	7.8	-	-	8	-	31	28	1.9	1.37	4.4	1.0	0.26	0.31
Ditch 200	7.8	-	-	9	-	-	39	1.3	1.04	3.0	0.3	0.18	0.32
Ditch 400	7.6	-	-	10	-	-	24	1.4	0.95	3.2	0.1	0.15	0.29
Ditch 800	7.6	-	-	7	-	-	36	0.8	0.34	3.0	0.2	0.22	0.13
Ditch 13a	7.6	-	-	6	-	21	-	0.5	0.18	1.3	0.3	0.92	0.03
Mill Creek 16	7.3	-	-	4	-	18	-	0.2	0.18	1.3	0.3	0.92	0.03
Pond 17	7.9	-	-	2	-	-	46	0.1	0.11	1.2	0.4	0.30	0.02

Table IIa. (con't)

Sample	pH	$T^{o}C$	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						5-13-78 E							
Lagoon 1	8.5	-	-	19	-	25	20	2.6	2.11	4.4	0.3	1.04	0.78
Lagoon 2	8.9	-	-	18	-	30	46	2.4	1.58	4.4	0.1	0.20	0.50
Cont. Str. 3	8.7	-	-	15	-	29	19	2.5	1.71	5.7	1.2	0.09	0.46
Sewer 4	8.8	-	-	14	-	-	17	2.2	1.66	3.8	<0.1	0.17	0.48
Sewer 5	8.8	-	-	14	-	-	92	2.6	1.54	5.6	0.8	0.11	0.42
Sewer 6	8.8	-	-	15	-	-	79	2.7	1.56	6.4	0.8	0.19	0.51
Sewer 8	8.7	-	-	16	-	-	37	2.4	1.60	4.5	0.5	0.07	0.48
Sewer 10	8.6	-	-	15	-	-	42	2.2	1.64	4.7	1.1	0.29	0.47
Sewer 11	8.7	-	-	16	-	-	38	2.4	1.57	5.6	0.7	0.31	0.48
Sewer 12	8.7	-	-	18	-	-	48	2.2	1.53	5.4	0.8	0.11	0.49
Sewer 13	8.7	-	-	17	-	27	35	2.2	1.54	6.4	0.9	0.23	0.48
Mill Creek 14	7.4	-	-	4	-	17	150	0.2	0.19	1.5	<0.1	0.87	0.04
Mill Creek 15	7.4	-	-	3	-	18	122	0.2	0.19	1.8	0.2	0.90	0.04
Mill Creek 16	7.4	-	-	2	-	-	144	0.2	0.20	1.4	<0.1	0.85	0.04
						7-1-78							
Lagoon 1	-	-	-	26	-	-	26	1.7	1.26	11.3	3.90	0.36	0.04
Lagoon 2	-	-	-	20	-	93	365	2.8	1.20	12.5	0.26	0.52	0.02
Mill Creek 14	-	-	-	4	-	-	54	0.2	0.17	1.2	0.18	1.81	0.05
						7-30-78							
Lagoon 1	8.84	22	8.0	36	-	60	30	2.6	1.67	16.6	5.13	0.56	0.11
Lagoon 2	7.20	22	1.8	5	-	26	3	4.9	4.83	10.0	8.09	0.62	0.01
Mill Creek 14	7.79	17	10.2	4	-	12	6	1.3	0.10	0.8	0.14	1.52	0.01
						8-25-78							
Lagoon 1	8.66	24	6.4	6	-	64	32	3.2	2.46	14.1	7.26	0.53	0.69
Lagoon 2	8.77	24	13.4	3	-	48	8	2.3	2.03	13.4	9.44	0.59	1.69
Mill Creek 14	7.91	18	8.4	< 1	-	10	-	< 0.1	0.19	0.1	1.50	1.50	0.03

Table IIa (cont.)

Sample	pH	T^0C	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						9-18-78 A							
Lagoon 1	7.30	21	2.6	25	-	33	29	4.5	4.33	14.0	8.63	0.57	0.08
Lagoon 2	8.01	21	3.4	21	-	38	19	2.3	2.12	7.5	2.00	0.44	0.09
Cont. Str. 3	7.77	20	4.4	21	-	-	24	2.5	2.13	7.4	2.21	0.56	0.09
Ditch 0	7.37	20	5.4	23	-	71	460	2.9	0.83	10.5	1.70	0.83	0.09
Ditch 50	7.60	20	5.2	19	-	-	32	2.1	1.60	8.0	1.83	0.78	0.07
Ditch 100	7.62	20	5.0	17	-	-	35	2.0	1.47	6.7	1.58	0.76	0.07
Ditch 200	7.55	20	5.8	21	-	-	89	2.0	1.33	7.7	1.43	0.51	0.06
Ditch 400	7.37	20	5.9	16	-	-	26	1.1	0.69	5.5	1.03	0.55	0.05
Ditch 800	7.65	20	6.9	9	-	-	7	0.1	0.11	1.5	0.10	0.38	< 0.01
Ditch 13a	7.78	20	8.0	9	-	19	20	0.1	0.29	1.7	0.12	0.46	0.01
Mill Creek 16	7.27	19	6.8	9	-	26	48	0.2	0.21	1.3	0.10	0.81	0.04
Pond 17	7.41	20	7.2	9	-	-	24	0.1	0.12	1.1	0.14	0.58	0.02
						9-18-78 B							
Lagoon 1	8.31	22	3.8	20	-	50	53	3.0	2.02	10.4	1.52	0.53	0.08
Lagoon 2	7.89	22	7.8	8	-	32	17	4.3	4.42	12.3	8.30	0.60	0.14
Cont. Str. 3	8.29	21	6.0	7	-	-	38	2.6	1.97	8.1	1.65	0.47	0.08
Ditch 0	7.89	20	4.2	6	-	49	33	2.4	1.89	7.1	1.65	0.66	0.09
Ditch 50	7.81	20	3.8	14	-	-	30	2.3	1.72	7.0	1.62	0.71	0.09
Ditch 100	7.82	20	4.0	14	-	-	24	2.0	1.59	5.8	1.50	0.57	0.08
Ditch 200	7.53	21	4.4	12	-	-	25	1.7	1.41	6.3	1.40	0.67	0.08
Ditch 400	7.77	22	7.8	9	-	-	19	1.3	1.04	5.3	0.92	0.65	0.06
Ditch 800	7.80	22	7.8	6	-	-	20	0.8	0.52	7.0	0.24	0.58	0.04
Ditch 13a	7.85	22	7.2	4	-	36	186	0.6	0.32	4.4	0.20	0.45	0.02
Mill Creek 14	7.49	20	6.4	4	-	42	62	0.1	-	1.2	-	-	-
Mill Creek 16	7.29	20	6.6	4	-	24	54	0.1	0.23	1.7	0.16	1.76	0.03
Pond 17	7.47	21	6.8	< 1	-	-	27	< 0.1	0.12	1.2	0.10	0.69	0.02

Table IIa. (cont.)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						9-19-78 C							
Lagoon 1	8.57	25	>20	23	–	50	51	2.6	1.71	7.7	0.20	0.48	0.12
Lagoon 2	8.41	24	>20	6	–	27	10	4.0	3.99	9.4	7.14	0.58	0.19
Cont. Str. 3	8.73	25	16	16	–	–	50	2.6	1.63	8.0	0.24	0.48	0.10
Ditch 0	8.46	23	3	18	–	44	50	2.4	1.63	7.1	0.48	0.39	0.09
Ditch 50	8.43	23	8.8	18	–	–	74	2.8	1.63	6.2	0.54	0.47	0.11
Ditch 100	8.48	23	10	16	–	–	46	2.6	1.68	7.4	0.47	0.54	0.11
Ditch 200	8.38	22	8.2	17	–	–	48	2.5	1.67	7.5	0.51	0.49	0.11
Ditch 400	8.47	23	10.6	15	–	–	100	2.7	1.66	8.0	0.46	0.52	0.10
Ditch 800	8.23	24	7.4	13	–	–	35	2.4	1.79	7.3	0.52	0.50	0.08
Ditch 13a	8.16	24	9.4	12	–	38	38	2.2	1.73	5.9	0.42	0.44	0.06
Mill Creek 14	7.37	20	7.8	2	–	17	28	< 0.1	0.18	0.9	0.11	1.78	0.03
Mill Creek 16	7.35	20	6.8	1	–	–	32	< 0.1	0.21	0.9	0.10	1.67	0.03
Pond 17	8.04	22	8.4	6	–	–	40	2.2	1.47	6.8	0.51	0.61	0.09
						9-19-78 D							
Lagoon 1	9.39	27	>20	24	–	80	109	3.7	1.13	13.6	0.25	0.48	0.13
Lagoon 2	8.62	27	>20	5	–	27	13	4.0	3.72	9.9	6.59	0.74	0.26
Cont. Str. 3	9.52	28	>20	14	–	–	65	2.8	1.26	9.7	0.28	0.42	0.13
Ditch 0	8.88	22	15.6	19	–	62	193	4.0	1.41	10.9	0.39	0.49	0.13
Ditch 50	8.90	22	14.8	14	–	–	68	3.0	1.38	10.2	0.30	0.50	0.10
Ditch 100	8.73	22	12.2	15	–	–	69	2.7	1.38	9.3	0.26	0.51	0.09
Ditch 200	8.63	23	9.2	18	–	–	55	2.5	1.41	8.0	0.25	0.51	0.09
Ditch 400	8.70	25	12	17	–	–	46	2.2	1.33	6.9	0.20	0.42	0.07
Ditch 800	8.67	24	10.4	11	–	–	34	1.8	12.6	5.8	0.15	0.52	0.06
Ditch 13a	8.69	25	9.4	4	–	41	56	1.8	1.20	6.1	0.20	0.48	0.04
Mill Creek 14	7.50	20	8.0	2	–	18	28	<0.1	0.20	0.6	0.16	1.72	0.03
Mill Creek 16	7.49	24	8.6	< 1	–	17	40	<0.1	0.27	0.6	0.18	1.91	0.04
Pond 17	8.41	20	7.8	9	–	–	19	0.7	1.45	3.5	0.27	0.57	0.08

Table IIa (cont.)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						9-20-78 E							
Lagoon 1	8.85	24	7.4	4	-	35	26	2.1	1.58	4.5	0.55	0.39	0.08
Lagoon 2	8.38	24	15.4	< 1	-	32	24	3.7	3.46	9.8	5.94	0.74	0.34
Cont. Str. 3	8.94	23	8.1	< 1	-	56	55	2.9	1.69	9.1	0.84	0.47	0.08
Sewer 4	8.84	22	8.6	10	-	-	59	2.8	1.63	9.0	0.85	0.48	0.08
Sewer 5	8.81	22	8.4	10	-	-	58	2.9	0.60	9.0	0.76	0.42	0.08
Sewer 6	8.75	22	8.6	10	-	-	59	2.9	0.59	9.0	0.80	0.35	0.08
Sewer 8	8.63	22	7.8	10	-	-	46	3.0	0.77	8.0	0.96	0.42	0.08
Sewer 10	8.75	23	6.8	10	-	-	49	2.7	0.70	8.4	0.75	0.44	0.08
Sewer 11	8.72	22	7.4	10	-	-	49	2.8	0.71	7.6	0.81	0.47	0.08
Sewer 12	8.69	22	7.2	8	-	-	46	2.6	0.72	7.4	0.81	0.48	0.08
Sewer 13	8.63	22	7.3	6	-	41	43	2.6	0.81	7.1	0.92	0.54	0.09
Mill Creek 15	7.92	19	7.6	< 1	-	11	19	0.1	0.29	0.7	0.15	1.62	0.02
						9-20-78 F							
Lagoon 1	9.03	25	12.3	21	-	46	87	2.4	1.58	8.5	1.01	0.56	0.08
Lagoon 2	8.81	25	>20	10	-	90	136	4.4	3.19	22.0	4.85	1.19	0.51
Cont. Str. 3	8.74	24	9.6	24	-	44	46	2.7	1.91	8.6	1.43	0.46	0.06
Sewer 4	8.65	23	9.3	22	-	-	46	2.6	1.92	8.4	1.50	0.44	0.06
Sewer 5	8.64	23	9.8	23	-	-	48	2.6	1.91	8.0	1.49	0.57	0.07
Sewer 6	8.69	23	8.6	18	-	-	51	2.7	1.89	8.5	1.50	0.48	0.07
Sewer 8	8.63	24	8.6	19	-	-	50	2.7	1.94	8.5	1.50	0.41	0.07
Sewer 10	8.74	24	8.4	18	-	-	55	2.7	1.86	8.2	1.37	0.55	0.07
Sewer 11	8.72	23	8.9	16	-	-	53	2.8	1.90	8.6	1.39	0.47	0.08
Sewer 12	8.70	23	8.1	22	-	-	48	2.6	1.86	9.1	1.35	0.45	0.08
Sewer 13	8.64	23	8.4	20	-	44	54	2.7	1.90	7.7	1.41	0.60	0.08
Mill Creek 14	7.80	19	7.6	6	-	13	20	< 0.1	0.23	0.2	0.16	1.78	0.02
Mill Creek 15	7.79	20	7.5	1	-	13	22	0.2	0.34	0.7	0.20	1.74	0.02

Table IIa (cont.)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						<u>9-20-78 G</u>							
Lagoon 1	9.20	27	18.4	8	-	39	57	2.2	1.42	6.1	0.80	0.47	0.07
Lagoon 2	8.82	26	20	1	-	27	9	3.2	3.07	7.4	5.14	0.96	0.44
Cont. Str. 3	9.28	26	13.8	3	-	41	50	2.3	1.47	6.8	0.72	0.48	0.07
Sewer 4	9.35	26	14.4	12	-	-	46	2.3	1.45	6.4	0.52	0.56	0.08
Sewer 5	9.32	26	12.8	10	-	-	46	2.3	1.41	6.8	0.58	0.48	0.07
Sewer 6	9.25	26	14.2	-	-	-	51	2.4	1.46	6.9	0.66	0.38	0.08
Sewer 8	9.26	26	13.0	-	-	-	58	2.4	1.40	6.9	0.48	0.44	0.08
Sewer 10	9.23	26	10.9	-	-	-	58	2.4	1.40	8.2	0.43	0.40	0.08
Sewer 11	9.27	25	11.6	-	-	-	58	2.5	1.40	7.3	0.49	0.50	0.08
Sewer 12	9.25	25	9.2	8	-	-	53	2.5	1.37	7.5	0.44	0.46	0.08
Sewer 13	9.40	25	9.4	3	-	44	53	2.5	1.33	6.5	0.38	0.47	0.08
Mill Creek 14	7.84	20	7.0	2	-	12	16	< 0.1	0.26	0.2	0.20	1.80	0.02
Mill Creek 15	7.91	20	7.6	< 1	-	11	17	< 0.1	0.31	0.7	0.14	1.73	0.03

Table IIb. Total & fecal Coliform Composition of Wastewater at the Watervliet Rest Area

	8-24-77		9-16-77		9-20-77		10-21-77 X		10-21-77 A		10-22-77 B	
Sample	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
Lagoon 1	4,600	90	> 24,000	> 24,000	> 2.4×10^6	1.1×10^6	–	–	24,000	24,000	240,000	110,000
Lagoon 2	4,600	4,600	2,100	930	1,500	430	–	–	2,400	930	7,500	70
Cont. Str. 3	–	–	–	–	–	–	–	–	2,100	390	4,600	70
Sewer 4	–	–	–	–	–	–	–	–	11,000	70	4,300	< 200
Sewer 5	–	–	–	–	–	–	–	–	2,400	230	4,600	150
Sewer 6	–	–	–	–	–	–	–	–	2,400	2,400	1,500	750
Sewer 7	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 8	–	–	–	–	–	–	–	–	4,600	230	430	230
Sewer 9	–	–	–	–	–	–	–	–	4,600	930	11,000	70
Sewer 10	–	–	–	–	–	–	–	–	4,600	430	4,600	150
Sewer 11	–	–	–	–	–	–	–	–	24,000	930	11,000	150
Sewer 12	–	–	–	–	–	–	–	–	4,600	930	930	430
Sewer 13	–	–	–	–	–	–	–	–	24,000	390	11,000	930
Ditch 0	–	–	–	–	–	–	–	–	–	–	–	–
Ditch 50	–	–	–	–	–	–	–	–	–	–	–	–
Ditch 100	–	–	–	–	–	–	–	–	–	–	–	–
Ditch 300	–	–	–	–	–	–	–	–	–	–	–	–
Ditch 400	–	–	–	–	–	–	–	–	–	–	–	–
Ditch 800	–	–	–	–	–	–	–	–	–	–	–	–
Ditch 13a	–	–	–	–	–	–	–	–	–	–	–	–
Mill Creek 14	–	–	–	–	–	–	4,600	40	2,400	90	930	430
Mill Creek 15	–	–	–	–	–	–	2,400	230	460	70	2,400	930
Mill Creek 16	–	–	–	–	–	–	–	–	–	–	–	–
Pond 17	–	–	–	–	–	–	–	–	750	< 20	–	–

Table IIb. (con't)

	10-22-77 C		10-27-77 D		10-27-77 E		10-28-77 F		10-28-77 G		1-23-78	
Sample	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
Lagoon 1	110,000	110,000	46,000	24,000	460,000	43,000	46,000	46,000	93,000	15,000	>240,000	46,000
Lagoon 2	4,600	2,400	2,400	<20	2,400	< 20	430	<20	930	40	–	–
Cont. Str. 3	4,600	150	9,300	40	11,000	< 20	930	<20	1,500	<20	–	–
Sewer 4	2,400	930	–	–	–	–	–	–	930	<20	–	–
Sewer 5	–	–	–	–	–	–	– –	–	430	<20	–	–
Sewer 6	–	–	–	–	–	–	–	–	430	<20	–	–
Sewer 7	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 8	–	–	–	–	–	–	–	–	11,000	<20	–	–
Sewer 9	–	–	–	–	–	–	–	–	2,400	<20	–	–
Sewer 10	–	–	–	–	–	–	–	–	2,400	40	–	–
Sewer 11	–	–	–	–	–	–	–	–	4,600	30	–	–
Sewer 12	–	–	–	–	–	–	–	–	2,400	<20	–	–
Sewer 13	–	–	–	–	–	–	–	–	930	<20	–	–
Ditch 0	–	–	4,300	40	930	<20	2,400	<20	–	–	–	–
Ditch 50	–	–	9,300	<20	4,600	<20	2,400	<20	–	–	–	–
Ditch 100	–	–	24,000	<20	46,000	<20	390	<20	–	–	–	–
Ditch 200	–	–	2,100	90	2,400	40	2,400	<20	–	–	–	–
Ditch 400	–	–	24,000	430	1,500	<20	15,000	400	–	–	–	–
Ditch 800	–	–	11,000	1,500	2,400	40	2,100	< 20	–	–	–	–
Ditch 13a	–	–	4,600	150	9,300	90	4,600	< 20	–	–	–	–
Mill Creek 14	–	–	930	430	4,300	750	4,600	430	4,600	750	460	4
Mill Creek 15	–	–	–	–	4,600	90	–	–	2,400	430	–	–
Mill Creek 16	–	–	–	–	–	–	930	230	4,600	390	–	–
Pond 17	–	–	2,400	<20	–	–	2,400	<20	11,000	150	–	–

Table IIb. (con't)

Sample	2-25-78 TOTAL	2-25-78 FECAL	3-23-78 TOTAL	3-23-78 FECAL	4-22-78 TOTAL	4-22-78 FECAL	5-3-78 A TOTAL	5-3-78 A FECAL	5-3-78 B TOTAL	5-3-78 B FECAL	5-3-78 C TOTAL	5-3-78 C FECAL
Lagoon 1	7,500	2,300	4,600	140	930	7	230	230	< 200	–	2,800	< 200
Lagoon 2	2.4×10^6	3,000	460	14	4,600	4,600	4,000	4,000	230	230	2,300	400
Cont. Str. 3	–	–	–	–	–	–	–	–	230	230	–	–
Sewer 4	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 5	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 6	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 7	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 8	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 9	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 10	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 11	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 12	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 13	–	–	–	–	–	–	–	–	–	–	–	–
Ditch 0	–	–	–	–	–	–	–	–	430	< 20	230	90
Ditch 50	–	–	–	–	–	–	–	–	11,000	–	9,300	930
Ditch 100	–	–	–	–	–	–	–	–	24,000	<200	9,300	140
Ditch 200	–	–	–	–	–	–	–	–	430	90	1.1×10^6	1,500
Ditch 400	–	–	–	–	–	–	–	–	2,300	<200	–	–
Ditch 800	–	–	–	–	–	–	–	–	230	40	460,000	900
Ditch 13a	–	–	–	–	–	–	–	–	–	–	15,000	210
Mill Creek 14	1.100	1,100	240,000	150	1,500	210	1,500	200	930	930	1,500	1,500
Mill Creek 15	–	–	–	–	–	–	–	–	–	–	930	750
Mill Creek 16	–	–	–	–	–	–	460	460	460	150	4,600	930
Pond 17	–	–	–	–	–	–	23	23	11,000	11,000	9,300	430
Pond 18	–	–	–	–	–	–	–	–	1,100	28	230	40

Table IIb. (con't)

	5-3-78 D		5-13-78 A		5-13-78 B		5-13-78 C		5-13-78 D		5-13-78 E	
Sample	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
Lagoon 1	390	< 20	24,000	11,000	23,000	23,000	24,000	11,000	46,000	46,000	>240,000	>240,000
Lagoon 2	21,000	21,000	110,000	1,500	23,000	23,000	4,600	240	24,000	230	4,600	90
Cont. Str. 3	930	< 20	–	–	23,000	900	2,400	2,400	–	–	230	110
Sewer 4	2,300	< 200	–	–	24,000	< 200	11,000	11,000	–	–	2,300	2,200
Sewer 5	430	< 20	–	–	–	–	–	–	–	–	24,000	400
Sewer 6	4,300	110	–	–	–	–	–	–	–	–	4,300	< 200
Sewer 7	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 8	930	150	–	–	–	–	–	–	–	–	11,000	9,000
Sewer 9	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 10	2,400	40	–	–	–	–	–	–	–	–	1,500	400
Sewer 11	–	–	–	–	–	–	–	–	–	–	24,000	<200
Sewer 12	930	< 20	–	–	–	–	–	–	–	–	2,400	<200
Sewer 13	900	900	–	–	–	–	–	–	–	–	21,000	40
Ditch 0	–	–	–	–	43,000	9,000	930	150	24,000	< 200	–	–
Ditch 50	–	–	–	–	460,000	4,000	24,000	24,000	43,000	300	–	–
Ditch 100	–	–	–	–	46,000	13	46,000	3,000	>240,000	>240,000	–	–
Ditch 200	–	–	–	–	> 24,000	4,600	240,000	900	24,000	750	–	–
Ditch 400	–	–	–	–	> 24,000	240	46,000	430	11,000	4,600	–	–
Ditch 800	–	–	–	–	> 24,000	460	>240,000	>240,000	11,000	280	–	–
Ditch 13a	–	–	46,000	9,300	> 24,000	460	4,600	430	9,300	4,600	–	–
Mill Creek 14	430	43	$> 2.4x10^6$	75,000	–	–	–	–	–	–	$>2.4x10^6$	240,000
Mill Creek 15	230	23	$> 2.4x10^6$	20	–	–	–	–	–	–	$2.4x10^6$	11,000
Mill Creek 16	230	21	$4.6x10^6$	23,000	$> 2.4x10^6$	210,000	$>2.4x10^6$	15,000	$>2.4x10^6$	46,000	$>2.4x10^6$	75,000
Pond 17	2,300	2,300	23,000	9,300	21,000	21,000	46,000	46,000	2,300	<200	–	–
Pond 18	–	–	–	–	–	–	–	–	–	–	–	–

Table IIb. (con't)

Sample	7-1-78 TOTAL	7-1-78 FECAL	7-30-78 TOTAL	7-30-78 FECAL	8-25-78 TOTAL	8-25-78 FECAL	9-18-78 A TOTAL	9-18-78 A FECAL	9-18-78 B TOTAL	9-18-78 B FECAL	9-19-78 C TOTAL	9-19-78 C FECAL
Lagoon 1	24,000	2,400	9,300	900	9,300	<200	2,300	<20	2,400	<20	930	40
Lagoon 2	1,500	930	24,000	2,400	4,600	4,600	1,500	<20	15,000	700	4,600	<20
Cont. Str.3	-	-	-	-	-	-	24,000	<200	4,300	<200	930	<20
Sewer 4	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 5	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 6	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 7	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 8	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 9	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 10	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 11	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 12	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 13	-	-	-	-	-	-	-	-	-	-	-	-
Ditch 0	-	-	-	-	-	-	110,000	400	9,000	<2,000	4,600	<20
Ditch 50	-	-	-	-	-	-	46,000	400	15,000	<2,000	4,600	150
Ditch 100	-	-	-	-	-	-	9,300	100	700	400	11,000	90
Ditch 400	-	-	-	-	-	-	24,000	9,300	46,000	2,300	11,000	<20
Ditch 800	-	-	-	-	-	-	24,000	40	24,000	230	46,000	230
Ditch 13a	-	-	-	-	-	-	15,000	<200	11,000	230	930	90
Mill Creek 14	11,000	2,400	2,400	2,400	11,000	4,600	-	-	110,000	46,000	24,000	930
Mill Creek 15	-	-	-	-	-	-	460,000	43,000	-	-	-	-
Mill Creek 16	-	-	-	-	-	-	-	-	93,000	15,000	110,000	2,100
Pond 17	-	-	-	-	-	-	-	-	11,000	900	11,000	150

Table II b. (cont.)

Sample	9-19-78 D TOTAL	9-19-78 D FECAL	9-20-78 E TOTAL	9-20-78 E FECAL	9-20-78 F TOTAL	9-20-78 F FECAL	9-20-78 G TOTAL	9-20-78 G FECAL
Lagoon 1	930	<20	1,500	<200	900	<200	150	40
Lagoon 2	9,300	400	11,000	70	24,000	90	4,600	230
Cont. Str. 3	430	<20	700	<200	200	<20	40	<20
Sewer 4	-	-	4,300	<200	2,300	<200	-	-
Sewer 5	-	-	9,300	400	750	<20	230	<20
Sewer 6	-	-	700	<200	1,500	<20	230	<20
Sewer 7	-	-	-	-	-	-	-	-
Sewer 8	-	-	9,300	<200	150	<20	2,400	<20
Sewer 9	-	-	-	-	-	-	-	-
Sewer 10	-	-	930	<20	150	40	430	<20
Sewer 11	-	-	750	40	400	<200	430	<20
Sewer 12	-	-	1,500	<200	2,300	<200	90	<20
Sewer 13	-	-	430	<20	230	40	430	40
Ditch 0	4,300	<200	-	-	-	-	-	-
Ditch 50	9,300	<200	-	-	-	-	-	-
Ditch 100	24,000	<200	-	-	-	-	-	-
Ditch 200	2,100	<20	-	-	-	-	-	-
Ditch 400	11,000	70	-	-	-	-	-	-
Ditch 800	11,000	70	-	-	-	-	-	-
Ditch 13a	46,000	400	-	-	-	-	-	-
Mill Creek 14	46,000	930	11,000	1,500	4,600	430	11,000	4,600
Mill Creek 15	-	-	4,600	430	11,000	750	11,000	930
Mill Creek 16	11,000	930	-	-	-	-	-	-
Pond 17	24,000	70	-	-	-	-	-	-

Table IIc. Total & Fecal Streptococcal Composition of Wastewater at the Watervliet Rest Area.

Sample	8-24-77 TOTAL	8-24-77 FECAL	9-16-77 TOTAL	9-16-77 FECAL	9-20-77 TOTAL	9-20-77 FECAL	10-21-77 X TOTAL	10-21-77 X FECAL	10-21-77 A TOTAL	10-21-77 A FECAL	10-22-77 B TOTAL	10-22-77 B FECAL
Lagoon 1	1,500	23	11,000	4,600	240,000	240,000	-	-	11,000	11,000	4,600	4,600
Lagoon 2	2,400	2,400	4,600	150	430	230	-	-	230	<20	430	<20
Cont. Str. 3	-	-	-	-	-	-	-	-	430	40	430	40
Sewer 4	-	-	-	-	-	-	-	-	90	40	930	40
Sewer 5	-	-	-	-	-	-	-	-	70	<20	230	<20
Sewer 6	-	-	-	-	-	-	-	-	150	40	230	40
Sewer 7	-	-	-	-	-	-	-	-	-	-	-	-
Sewer 8	-	-	-	-	-	-	-	-	230	< 2	430	40
Sewer 9	-	-	-	-	-	-	-	-	230	<20	40	40
Sewer 10	-	-	-	-	-	-	-	-	90	<20	430	<20
Sewer 11	-	-	-	-	-	-	-	-	230	<20	40	<20
Sewer 12	-	-	-	-	-	-	-	-	930	230	430	<20
Sewer 13	-	-	-	-	-	-	-	-	230	40	230	<20
Ditch 0	-	-	-	-	-	-	-	-	-	-	-	-
Ditch 50	-	-	-	-	-	-	-	-	-	-	-	-
Ditch 100	-	-	-	-	-	-	-	-	-	-	-	-
Ditch 200	-	-	-	-	-	-	-	-	-	-	-	-
Ditch 400	-	-	-	-	-	-	-	-	-	-	-	-
Ditch 800	-	-	-	-	-	-	-	-	-	-	-	-
Ditch 13a	-	-	-	-	-	-	-	-	-	-	-	-
Mill Creek 14	-	-	-	-	-	-	430	40	430	70	930	<20
Mill Creek 15	-	-	-	-	-	-	430	<2	750	40	230	40
Mill Creek 16	-	-	-	-	-	-	-	-	-	-	-	-
Pond 17	-	-	-	-	-	-	-	-	930	70	-	-

Table IIc. (con't)

Sample	10-22-77 C TOTAL	10-22-77 C FECAL	10-27-77 D TOTAL	10-27-77 D FECAL	10-27-77 E TOTAL	10-27-77 E FECAL	10-28-77 F TOTAL	10-28-77 F FECAL	10-28-77 G TOTAL	10-28-77 G FECAL	1-23-78 TOTAL	1-23-78 FECAL
Lagoon 1	4,600	4,600	2,400	2,400	2,400	930	7,500	7,500	930	930	2,400	90
Lagoon 2	90	90	150	<20	210	40	430	30	40	<20	–	–
Cont. Str. 3	<20	–	90	<20	39,000	40	70	40	40	<20	–	–
Sewer 4	230	90	–	–	–	–	–	–	40	<20	–	–
Sewer 5	–	–	–	–	–	–	–	–	230	<20	–	–
Sewer 6	–	–	–	–	–	–	–	–	70	<20	–	–
Sewer 7	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 8	–	–	–	–	–	–	–	–	2,400	90	–	–
Sewer 9	–	–	–	–	–	–	–	–	430	150	–	–
Sewer 10	–	–	–	–	–	–	–	–	90	<20	–	–
Sewer 11	–	–	–	–	–	–	–	–	90	4	–	–
Sewer 12	–	–	–	–	–	–	–	–	40	<20	–	–
Sewer 13	–	–	–	–	–	–	–	–	<20	–	–	–
Ditch 0	–	–	230	<20	$>2.4\times10^6$	<2,000	<20	–	–	–	–	–
Ditch 50	–	–	90	40	21,000	400	90	90	–	–	–	–
Ditch 100	–	–	150	150	230	40	230	70	–	–	–	–
Ditch 200	–	–	430	70	2,400	< 20	40	< 20	–	–	–	–
Ditch 400	–	–	930	230	2,100	70	430	< 20	–	–	–	–
Ditch 800	–	–	2,100	930	230	40	150	< 20	–	–	–	–
Ditch 13a	–	–	230	90	9,300	230	430	430	–	–	–	–
Mill Creek 14	–	–	430	30	150	40	1,500	< 20	230	230	43	9
Mill Creek 15	–	–	–	–	2,400	70	–	–	110	30	–	–
Mill Creek 16	–	–	–	–	–	–	430	90	90	4	–	–
Pond 17	–	–	< 20	–	–	–	230	230	430	150	–	–

Table IIc. (con't)

	2-25-78		3-23-78		4-22-78		5-3-78 A		5-3-78 B		5-3-78 C	
Sample	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
Lagoon 1	<200	–	90	<20	23	9	< 20	<20	< 200	–	< 200	–
Lagoon 2	<2,000	–	4	< 2	2,400	120	900	400	40	<20	< 2	
Cont. Str. 3	–	–	–	–	–	–	–	–	< 20	–	–	–
Sewer 4	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 5	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 6	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 7	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 8	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 9	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 10	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 11	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 12	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 13	–	–	–	–	–	–	–	–	–	–	–	–
Ditch 0	–	–	–	–	–	–	–	–	< 20	–	< 20	–
Ditch 50	–	–	–	–	–	–	–	–	230	–	< 20	–
Ditch 100	–	–	–	–	–	–	–	–	< 200	< 200	1,500	< 20
Ditch 200	–	–	–	–	–	–	–	–	<< 2	< 2	<200	<200
Ditch 400	–	–	–	–	–	–	–	–	700	< 200	–	–
Ditch 800	–	–	–	–	–	–	–	–	< 2	–	<200	–
Ditch 13a	–	–	–	–	–	–	–	–	–	–	230	< 2
Mill Creek 14	<2	–	75	<20	2,400	30	43	14	9	9	11	11
Mill Creek 15	–	–	–	–	–	–	–	–	–	–	< 2	< 2
Mill Creek 16	–	–	–	–	–	–	93	93	23	4	< 2	< 2
Pond 17	–	–	–	–	–	–	< 2	<2	2,400	1,100	230	40
Pond 18	–	–	–	–	–	–	–	–	23	4	< 2	–

Table IIc. (con't)

Sample	5-3-78 D		5-13-78 A		5-13-78 B		5-13-78 C		5-13-78 D		5-13-78 E	
	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
Lagoon 1	2,400	< 20	2,300	930	400	230	2,400	430	930	930	4,600	4,600
Lagoon 2	23,000	<200	150	90	<200	–	2,400	40	230	<20	930	230
Cont. Str. 3	<20	–	–	–	2,300	400	240	40	–	–	230	90
Sewer 4	<200	–	–	–	2,300	2,300	2,400	2,400	–	–	2,400	150
Sewer 5	230	< 20	–	–	–	–	–	–	–	–	<200	–
Sewer 6	2,300	< 20	–	–	–	–	–	–	–	–	240,000	900
Sewer 7	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 8	<20	–	–	–	–	–	–	–	–	–	2,400	930
Sewer 9	–	–	–	–	–	–	–	–	–	–	–	–
Sewer 10	<20	–	–	–	–	–	–	–	–	–	2,300	2,300
Sewer 11	–	–	–	–	–	–	–	–	–	–	2,300	900
Sewer 12	<20	–	–	–	–	–	–	–	–	–	2,300	400
Sewer 13	900	900	–	–	–	–	–	–	–	–	230	< 20
Ditch 0	–	–	–	–	40,000	40,000	430	<20	2,300	<200	–	–
Ditch 50	–	–	–	–	<2,000	–	430	430	2,300	<200	–	–
Ditch 100	–	–	–	–	2,400	900	2,300	2,300	11,000	11	–	–
Ditch 200	–	–	–	–	1,100	9	2,300	<20	2,400	930	–	–
Ditch 400	–	–	–	–	11,000	28	430	70	930	90	–	–
Ditch 800	–	–	–	–	240	240	>240,000	24,000	2,400	1,100	–	–
Ditch 13a	–	–	4,300	4,300	2,100	21	4,600	43	430	90	–	–
Mill Creek 14	43	< 2	2,300	9,300	–	–	–	–	–	–	11,000	11,000
Mill Creek 15	23	< 2	15,000	7,500	–	–	–	–	–	–	23,000	4,000
Mill Creek 16	43	23	93,000	90,000	23,000	23,000	75,000	75,000	46,000	300	93,000	<200
Pond 17	400	400	2,300	2,300	21,000	400	4,600	1,500	<200	–	–	–
Pond 18	–	–	–	–	–	–	–	–	–	–	–	–

:ble IIc. (con't)

..mple	7-1-78 TOTAL	7-1-78 FECAL	7-30-78 TOTAL	7-30-78 FECAL	8-25-78 TOTAL	8-25-78 FECAL	9-18-78 A TOTAL	9-18-78 A FECAL	9-18-78 B TOTAL	9-18-78 B FECAL	9-19-78 C TOTAL	9-19-78 C FECAL
..goon 1	11,000	11,000	4,300	4,300	900	400	2,400	2,100	230	230	230	230
..goon 2	2,400	240	4,600	4,600	2,400	1,100	430	70	4,300	4,300	750	430
..t. Str. 3	-	-	-	-	-	-	400	<20	2,300	900	90	90
..wer 4	-	-	-	-	-	-	-	-	-	-	-	-
..wer 5	-	-	-	-	-	-	-	-	-	-	-	-
..wer 6	-	-	-	-	-	-	-	-	-	-	-	-
..wer 7	-	-	-	-	-	-	-	-	-	-	-	-
..wer8	-	-	-	-	-	-	-	-	-	-	-	-
..wer 9	-	-	-	-	-	-	-	-	-	-	-	-
..wer 10	-	-	-	-	-	-	-	-	-	-	-	-
..wer 11	-	-	-	-	-	-	-	-	-	-	-	-
..wer 12	-	-	-	-	-	-	-	-	-	-	-	-
..wer 13	-	-	-	-	-	-	-	-	-	-	-	-
..tch 0	-	-	-	-	-	-	110,000	46,000	<2,000	-	4,600	930
..tch 50	-	-	-	-	-	-	4,300	2,300	9,000	4,000	210	150
..tch 100	-	-	-	-	-	-	2,300	2,300	900	900	230	230
..tch 400	-	-	-	-	-	-	4,300	4,300	2,300	2,300	230	230
..tch 800	-	-	-	-	-	-	4,600	930	2,400	2,400	2,400	2,400
..tch 13a	-	-	-	-	-	-	4,300	4,300	2,400	930	930	930
..l Creek 14	24,000	2,100	460	460	1,500	1,500	-	-	110,000	46,000	11,000	4,600
..ll Creek 15	-	-	-	-	-	-	150,000	75,000	-	-	-	-
..ll Creek 16	-	-	-	-	-	-	-	-	240,000	21,000	11,000	11,000
..ad 17	-	-	-	-	-	-	-	-	46,000	15,000	210	150

Table II c. (cont.)

Sample	9-19-78 D TOTAL	9-19-78 D FECAL	9-20-78 E TOTAL	9-20-78 E FECAL	9-20-78 F TOTAL	9-20-78 F FECAL	9-20-78 G TOTAL	9-20-78 G FECAL	TOTAL	FECAL	TOTAL	FECAL
Lagoon 1	150	90	900	<200	400	400	<20	–				
Laboon 2	2,300	2,300	11,000	2,400	2,400	2,400	4,600	4,600				
Cont. Str. 3	430	230	40	40	230	230	40	40				
Sewer 4	–	–	400	<200	<200	–	–	–				
Sewer 5	–	–	400	400	430	90	40	<20				
Sewer 6	–	–	900	<200	430	430	90	90				
Sewer 7	–	–	–	–	–	–	–	–				
Sewer 8	–	–	400	<200	230	230	90	40				
Sewer 9	–	–	–	–	–	–	–	–				
Sewer 10	–	–	150	90	430	150	430	70				
Sewer 11	–	–	230	<20	<200	–	230	90				
Sewer 12	–	–	900	<200	900	900	230	40				
Sewer 13	–	–	210	70	430	150	150	40				
Ditch 0	4,300	2,300	–	–	–	–	–	–				
Ditch 50	<200	–	–	–	–	–	–	–				
Ditch 100	4,300	2,300	–	–	–	–	–	–				
Ditch 200	2,400	2,400	–	–	–	–	–	–				
Ditch 400	2,400	930	–	–	–	–	–	–				
Ditch 800	4,600	2,400	–	–	–	–	–	–				
Ditch 13a	2,300	2,300	–	–	–	–	–	–				
Mill Creek 14	15,000	4,600	2,400	2,400	2,100	2,400	930	430				
Mill Creek 15	–	–	930	930	4,600	930	930	930				
Mill Creek 16	2,400	930	–	–	–	–	–	–				
Pond 17	930	430	–	–	–	–	–	–				

Table IIIa. CHEMICAL COMPOSITION OF WASTEWATER FROM THE COLDWATER REST AREA.

Sample	pH	$T^{o}C$	DO	BOD	COD	TOC	SS	t-P	$i-PO_4$	TKN	NH_3	NO_3	NO_2
								2-21-77					
Lagoon 1	7.7	-	-	155	-	147	27	8.9	4.92	9.48	0.23	0.21	0.03
Lagoon 2	8.0	-	-	160	-	106	46	7.8	3.05	4.69	1.39	0.08	<0.01
Coldwater R.8	7.8	-	-	6	-	23	2	0.5	0.12	1.86	0.15	0.16	0.03
								3-21-77					
Lagoon 1	7.9	-	-	295	-	75	39	5.0	-	-	-	-	-
Lagoon 2	7.8	-	-	135	-	59	36	4.8	-	-	-	-	-
								4-25-77					
Lagoon 1	81	14	0.9	330	-	33	48	-	5.42	6.37	0.13	0.94	0.22
Lagoon 2	7.9	14	1.2	215	-	48	31	-	4.95	12.92	2.44	2.12	0.53
Coldwater R.8	8.2	-	-	12	-	22	18	0.3	0.31	2.68	0.09	0.28	0.07
								5-17-77					
Lagoon 1	-	-	-	-	-	63	-	2.5	-	6.3	-	-	-
Lagoon 2	-	-	-	-	-	90	-	6.1	-	41.0	-	-	-
Snyder's Drain 4	-	-	-	-	-	77	-	0.4	-	1.1	-	-	-
Coldwater R.8	-	-	-	-	-	18	-	0.4	-	4.3	-	-	-
								5-18-77					
Lagoon 1	-	-	-	-	-	76	-	1.9	-	-	-	-	-
Lagoon 2	-	-	-	-	-	40	-	6.3	-	38.4	-	-	-
Snyder's Drain 3	-	-	-	-	-	53	-	0.9	-	4.3	-	-	-
Snyder's Drain 4	-	-	-	-	-	182	-	5.6	-	44.6	-	-	-
McCullough Drain 5	-	-	-	-	-	50	-	0.5	-	2.9	-	-	-
Coldwater R.8	-	-	-	-	-	29	-	0.6	-	-	-	-	-

Table IIIa. (con't)

Sample	pH	$T^{o}C$	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
								6-16-77					
Lagoon 1	–	–	–	–	–	74	–	4.2	3.40	10.9	–	0.5	0.12
Lagoon 2	–	–	–	–	–	88	–	4.2	2.75	39.2	–	–	1.20
Snyder's Drain 4	–	–	–	–	–	56	–	1.4	0.30	2.0	–	0.4	<0.02
McCullough Drain 5	–	–	–	–	–	33	–	0.6	0.28	4.0	–	0.4	0.02
Coldwater R.8	–	–	–	–	–	18	–	0.6	<0.05	2.9	–	0.4	0.01
								7-13-77					
Lagoon 1	–	–	1.5	11	–	63	–	3.6	3.53	10.7	–	0.3	0.03
Lagoon 2	–	–	3.0	16	–	79	–	4.5	3.45	–	–	0.3	0.16
Snyder's Drain 3	–	–	–	7	–	113	–	0.3	0.40	–	–	0.2	0.06
Snyder's Drain 4	–	–	–	2	–	92	–	0.3	0.23	–	–	0.4	0.02
McCullough Drain 5	–	–	–	4	–	66	–	0.3	0.25	4.0	–	0.3	0.02
Coldwater R.8	–	–	–	3.5	–	28	–	0.3	0.05	4.2	–	0.3	0.02
								7-18-77					
Lagoon 1	–	–	–	9	–	75	–	2.8	2.23	–	–	0.5	0.14
Lagoon 2	–	–	–	29	–	91	–	5.7	3.98	–	–	0.1	0.35
Snyder's Drain 3	–	–	–	14	–	142	–		0.45	–	–	0.2	0.02
Snyder's Drain 4	–	–	–	5	–	43	–	2.0	0.33	–	–	0.3	0.02
McCullough Drain 5	–	–	–	5	–	38	–	0.5	0.58	–	–	0.2	0.01
Coldwater R.8	–	–	–	1	–	20	–	0.4	0.08	–	–	0.2	0.02
								8-19-77					
Lagoon 1	–	19	10.8	–	–	72	–	3.2	3.09	3.4	–	0.64	0.38
Lagoon 2	–	19	9.1	–	–	65	–	4.1	4.69	3.4	–	1.02	1.44
Snyder's Drain 4	–	15	6.0	–	–	64	–	0.1	0.49	<0.1	–	0.42	0.01
McCullough Drain 5	–	–	–	–	–	60	–	0.5	0.99	0.5	–	0.57	0.016
Coldwater R.8	–	–	–	–	–	28	–	0.3	0.36	0.1	–	0.57	–

Table IIIa. (con't)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
9-16-77													
Lagoon 1	-	17	1.1	-	-	27	19	5.0	4.76	19.6	15.4	0.74	0.02
Lagoon 2	-	17	0.8	-	-	33	6	5.1	5.39	11.2	8.1	0.54	0.02
Snyder's Dr 4	-	-	-	-	-	11	6	0.3	0.38	1.9	<0.1	0.90	0.04
McCullough Drain 5	-	-	-	-	-	13	3	0.2	0.37	1.4	<0.1	0.49	0.03
Coldwater 8	-	-	-	-	-	8	2	0.6	0.18	0.9	<0.1	0.53	0.02
9-20-77													
Lagoon 1	-	18	4.7	-	-	23	9	4.2	4.11	16.1	10.1	0.73	0.16
Lagoon 2	-	17	0.9	-	-	26	4	3.9	5.02	10.7	6.8	0.53	0.04
Snyder's Dr 3	-	-	-	-	-	27	7	0.6	1.05	2.1	0.3	1.08	0.12
Snyder's Dr 4	-	-	-	-	-	9	9	0.4	0.43	1.3	<0.1	0.75	0.05
McCullough Drain 5	-	-	-	-	-	15	18	0.2	0.42	1.9	<0.1	0.52	0.02
Coldwater 8	-	-	-	-	-	10	2	0.1	0.19	1.4	<0.1	0.43	0.02
10-19-77													
Lagoon 1	7.8	10	2.5	6	-	-	8	3.3	2.80	19.0	12.9	0.60	0.04
Lagoon 2	7.2	10	2.6	8	-	-	3	4.4	4.20	10.9	8.6	0.63	0.02
Snyder's Dr 3	-	-	-	5		16	1	0.9	0.83	1.6	0.1	3.23	0.06
Snyder's Dr 4	-	-	-	<1	-	18	12	0.2	0.25	<0.1	0.1	0.6	0.01
McCullough Drain 5	-	-	-	2	-	15	2	0.1	0.39	0.5	0.3	0.38	0.01
Coldwater 8	-	-	-	<1	-	-	1	< 0.1	0.26	3.7	0.4	0.58	0.02
11-07-77													
Lagoon 1	-	11	1.7	3	-	16	3	4.6	4.80	17.4	15.3	0.64	0.04
Lagoon 2	-	13	1.0	3	-	22	-	3.9	3.67	4.9	3.3	0.56	0.06
Snyder's Dr 3	-	-	-	73	-	48	96	1.0	1.21	3.0	<0.1	6.64	0.02
Snyder's Dr 4	-	-	-	1	-	11	5	0.4	0.29	<0.1	<0.1	0.47	0.01
McCullough Drain 5	-	-	-	4	-	21	31	0.1	0.49	0.6	<0.1	0.56	0.01
Swamp 6	-	-	-	1	-	21	104	0.2	0.31	1.1	<0.1	0.64	0.01
Swamp 7	-	-	-	4	-	40	293	0.2	0.31	2.4	<0.1	0.46	0.01
Coldwater 8	-	-	-	<1	-	28	3	0.1	0.19	1.1	<0.1	0.47	0.01

Table IIIa. (con't)

Sample	pH	$T^{o}C$	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
11-08-77													
Lagoon 1	-	14	1.8	6	-	20	4		4.81	17.7	12.9	0.48	0.04
Lagoon 2	-	12	1.0	3	-	20	13	3.4	3.48	5.2	3.3	0.64	0.06
Snyder's Dr 3	-	-	-	34	-	26	33	4.8	3.86	8.7	5.9	0.49	0.01
Snyder's Dr 4	-	-	-	4	-	18	6	4.0	4.15	9.4	1.8	0.44	0.02
McCullough Drain 5	-	-	-	<1	-	7	4	4.8	0.53	0.4	<0.1	0.43	0.01
Swamp 6	-	-	-	1	-	8	7	<0.1	0.23	<0.1	<0.1	0.41	0.01
Swamp 7	-	-	-	2	-	16	76	0.1	0.38	<0.1	<0.1	0.55	0.01
Coldwater 8	-	-	-	<1	-	8	1	0.1	0.22	<0.1	<0.1	0.65	0.02
Swamp 6*	-	-	-	-	-	18	-	0.3	0.23	0.4	<0.1	0.37	<0.01
11-09-77													
Lagoon 1	7.4	14	1.8	6	-	17	16	4.4	4.93	17.7	13.9	0.50	0.04
Lagoon 2	7.9	12	1.0	6	-	22	10	3.5	3.48	5.2	2.9	0.59	0.06
Snyder's Dr 3	6.1	-	-	28	-	26	15	4.1	3.99	9.2	7.1	0.36	0.01
Snyder's Dr 4	7.2	-	-	6	-	20	16	3.7	4.06	8.5	5.9	0.61	0.02
McCullough Drain 5	7.4	-	-	2	-	20	11	0.1	0.56	0.1	<0.1	0.44	0.01
Swamp 6	7.3	-	-	4	-	35	216	0.1	0.34	2.1	<0.1	0.59	0.01
Swamp 7	7.5	-	-	<1	-	12	15	0.1	0.24	<0.1	<0.1	0.45	0.01
Coldwater 8	7.7	-	-	2	-	11	7	<0.1	0.20	<0.1	<0.1	0.39	0.01
Swamp 6*	-	-	-	-	-	14	-	0.2	0.41	0.1	<0.1	0.51	0.01
Swamp 7*	-	-	-	-	-	16	-	0.2	0.10	0.1	<0.1	<0.01	<0.01
12-5-77													
Lagoon 1	7.2	-	-	3	-	17	4	3.4	3.44	-	16.9	1.21	0.09
Lagoon 2	7.2	-	-	12	-	24	18	4.0	3.51	21.6	20.6	2.64	0.05
Snyder's Dr.3	6.9	-	-	2	-	12	6	<0.1	0.35	0.1	<0.1	1.35	0.05
Snyder's Dr.4	7.0	-	-	<1	-	12	5	<0.1	0.32	0.4	<0.1	1.11	0.05
McCullough Drain 5	7.2	-	-	<1	-	20	1	<0.1	0.26	0.9	0.4	3.26	0.14
Coldwater R.8	7.6	-	-	<1		9	2	<0.1	0.22	0.1	<0.1	<0.5	0.04

* Composite Sample

Table IIIa. (con't.)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						1-12-78							
Lagoon 1	6.8	–	–	4	–	19	7	5.2	4.74	20.4	18.5	0.83	0.05
Lagoon 2	7.0	–	–	24	–	55	141	7.2	5.48	49.2	39.9	0.59	0.06
Snyder's Dr 3	6.8	–	–	8	–	230	1444	5.0	0.37	26.5	1.9	0.58	0.04
Snyder's Dr 4	7.0	–	–	< 1	–	42	263	0.9	0.32	8.6	0.6	0.56	0.04
McCullough Drain 5	6.9	–	–	< 1	–	16	2	0.1	0.30	0.7	0.3	0.98	0.04
Coldwater R 8	7.4	–	–	5	–	9	1	0.2	0.24	0.3	0.5	0.56	0.04
						2-07-78							
Lagoon 1	7.2	–	–	22	–	19	18	3.8	5.50	19.6	17.1	1.24	0.06
Lagoon 2	6.8	–	–	26	–	22	21	4.8	7.24	46.5	44.9	0.66	0.02
Snyder's Dr 3	6.8	–	–	9	–	22	159	0.4	0.15	2.0	0.9	1.12	< 0.01
Snyder's Dr 4	7.0	–	–	8	–	22	30	< 0.1	0.23	0.4	0.5	0.89	< 0.01
McCullough Drain 5	7.0	–	–	7	–	11	3	–	0.22	0.9	0.5	0.80	< 0.01
Coldwater R 8	7.4	–	–	1	–	10	49	0.7	0.18	1.0	0.4	0.77	< 0.01
						3-09-78							
Lagoon 1	7.4	–	–	< 1	–	–	15	8.7	7.67	34.6	30.2	0.78	0.69
Lagoon 2	7.1	–	–	33	–	–	13	7.7	7.27	56.3	54.2	0.46	0.21
Snyder's Dr 3	6.9	–	–	8	–	–	59	2.5	0.21	1.1	–	1.21	0.03
Snyder's Dr 4	7.3	–	–	4	–	–	164	1.6	0.20	8.8	2.5	0.93	0.05
McCullough Drain 5	7.0	–	–	< 1	–	–	9	< 0.1	0.16	0.9	0.9	0.51	0.03
Coldwater R 8	7.6	–	–	< 1	–	–	2	< 0.1	0.12	0.4	0.5	0.64	0.04
						4-07-78							
Lagoon 1	8.6	–	–	11	–	–	33	3.0	2.53	13.7	11.8	0.57	0.21
Lagoon 2	7.5	–	–	45	–	–	39	6.4	6.09	53.4	51.1	0.40	0.07
Snyder's Dr 3	7.0	–	–	< 1	–	–	3	< 0.1	0.09	1.1	0.3	0.87	0.04
Snyder's Dr 4	7.1	–	–	< 1	–	–	4	< 0.1	0.16	4.3	0.5	0.91	0.04
McCullough Drain 5	7.4	–	–	< 1	–	–	6	< 0.1	0.05	1.5	0.5	1.49	0.04
Coldwater R 8	7.5	–	–	< 1	–	–	4	0.1	0.11	1.9	0.3	1.84	0.04

Table III a. (con't)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
							5-2-78						
Lagoon 1	9.3	14	17.2	5	-	31	8	1.6	0.81	3.4	1.3	2.61	0.73
Lagoon 2	8.4	14	>20	15	-	68	64	5.9	4.75	43.3	38.4	0.51	0.28
Snyder's Dr 3	7.5	7	7.0	<1	-	19	2	< 0.1	0.08	<0.1	0.1	0.60	0.03
Snyder's Dr 4	7.4	8	14.5	<1	-	16	5	< 0.1	0.09	<0.1	0.3	0.81	0.05
McCullough Drain 5	7.5	9	9.2	2	-	36	20	< 0.1	0.05	0.6	0.3	0.52	0.04
Swamp 6	8.0	9	11.5	<1	-	57	4	< 0.1	0.08	<0.1	0.1	1.21	0.05
Swamp 7	7.9	10	9.3	1	-	22	4	< 0.1	0.07	0.2	0.1	1.16	0.05
Coldwater R 8	8.0	10	13.5	<1	-	12	2	< 0.1	0.09	<0.1	0.1	1.26	0.05
							5-3-78						
Lagoon 1	9.5	16	18.1	<1	-	31	6	1.6	0.88	3.6	0.7	2.51	0.66
Lagoon 2	8.7	16	>20	7	-	104	110	6.2	4.12	45.4	37.1	0.61	0.32
Snyder's Dr 3	7.0	8	7.3	<1	-	21	< 1	0.1	0.13	<0.1	0.4	0.61	0.04
Snyder's Dr 4	7.3	9	9.2	<1	-	40	15	3.1	2.76	27.4	22.5	0.73	0.16
McCullough Drain 5	7.4	9	9.4	<1	-	29	1	0.1	0.05	0.6	0.3	0.54	0.04
Swamp 6	7.4	8	7.4	<1	-	28	35	0.2	0.07	2.0	1.4	0.94	0.07
Swamp 7	7.3	7	7.3	<1	-	24	1	0.4	0.32	<0.1	0.6	0.51	0.04
Coldwater R 8	7.9	10	12.4	<1	-	14	< 1	0.1	0.09	0.2	0.4	1.34	0.06
							5-12-78						
Lagoon 1	7.2	14	1.4	<1	-	32	1	3.2	2.95	11.4	6.6	0.20	0.03
Lagoon 2	8.7	14	1.4	21	-	61	46	4.1	2.4	33.5	28.6	0.21	0.38
Snyder's Dr 3	7.2	12	4.0	<1	-	24	29	< 0.1	0.1	1.5	0.3	0.31	0.03
Snyder's Dr 4	7.2	12	5.4	<1	-	35	7	< 0.1	<0.1	1.2	0.6	0.25	0.02
McCullough Drain 5	7.5	12	8.0	<1	-	32	4	< 0.1	0.05	0.8	0.5	0.23	0.01
Swamp 6	7.9	12	8.4	<1	-	25	8	< 0.1	0.07	0.5	0.6	0.66	0.03
Swamp 7	7.9	11	10.2	<1	-	18	2	< 0.1	0.08	0.4	0.2	0.72	0.03
Coldwater R 8	7.9	12	10.2	<1	-	16	4	< 0.1	0.13	< 0.1	1.0	0.66	0.02

Table III a. (con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						5-13-78							
Lagoon 1	-	-	-	<1	-	29	1	3.3	3.18	7.6	5.9	0.28	0.02
Lagoon 2	-	-	-	25	-	46	32	3.7	2.54	31.6	27.2	0.41	0.38
Snyder's Dr 3	-	-	-	4	-	25	2	0.1	0.13	1.1	< 0.1	0.33	0.01
Snyder's Dr 4	-	-	-	1	-	20	2	0.2	0.27	0.7	0.4	0.34	0.02
McCullough Drain 5	-	-	-	2	-	26	7	0.1	0.08	1.5	< 0.1	0.21	< 0.01
Swamp 6	-	-	-	<1	-	22	2	0.1	0.05	0.8	< 0.1	0.22	< 0.01
Swamp 7	-	-	-	10	-	28	4	0.1	0.06	1.7	0.4	0.37	0.03
Coldwater R 8	-	-	-	2	-	24	2	0.2	0.09	0.2	0.2	0.86	0.02
						6-28-78							
Lagoon 1	6.8	28.5	0.6	66	-	114	346	5.6	2.58	18.5	1.11	0.44	0.01
Lagoon s	9.0	29	>20	23	-	43	13	2.4	1.94	13.1	6.92	0.52	0.09
Snyder's Dr.3	6.9	-	-	6	-	50	184	1.2	0.13	3.5	0.22	0.63	0.02
Snyder's Dr.4	7.5	-	-	< 1	-	21	10	0.1	0.13	0.4	0.19	0.70	0.03
McCullough Drain 5	6.9	-	-	1	-	26	10	0.1	0.06	1.3	0.17	1.76	0.25
Coldwater R.8	8.0	-	-	< 1	-	19	4	0.2	0.03	0.6	0.16	0.80	0.02
						8-16-78							
Lagoon 1	6.94	26	0.6	24	-	540	779	6.3	2.78	79.3	2.00	0.91	0.03
Lagoon 2	8.01	26	17.8	8	-	49	17	16.2	5.65	41.0	32.3	0.39	0.07
						8-18-78							
Lagoon 1	6.31	25	0.6	22	-	107	361	5.8	4.21	25.9	27.6	0.42	0.96
Lagoon 2	8.35	27	13.2	57	-	80	75	7.0	4.12	46.5	3.27	0.85	0.04
						8-21-78							
Lagoon 1	6.26	22	0.6	11	-	139	416	6.1	3.58	24.1	5.22	0.49	0.03
Lagoon 2	7.72	27	12.0	7	-	51	14	6.2	5.52	41.7	37.00	0.23	0.22

Table III a. (cont.)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
						8-28-78							
Lagoon 1	-	22	0.6	18	-	249	687	8.2	1.96	37.4	3.86	0.81	0.07
Lagoon 2	-	22	0.6	16	-	44	18	6.2	5.48	39.0	30.90	0.68	0.06

Table IIIb. TOTAL AND FECAL COLIFORM COMPOSITION OF WASTEWATER AT VARIOUS SAMPLING SITES AT THE COLDWATER REST AREA.

Organisms/100ml (MPN)

Date	Lagoon #1		Lagoon #2		3 Snyder Private Drain		4 Snyder Private Drain		5 Kenyon-McCullough Private Drain		8 Coldwater River	
	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
2-21-77	93,000	24,000	15,000	1,100	-	-	-	-	-	-	430	< 2
3-21-77	7,000	2,400	1,500	1,500	-	-	-	-	-	-	-	-
4-25-77	24,000	2,400	24,000	24,000	-	-	-	-	-	-	21,000	150
5-17-77	210,000	70	2,400	40	-	-	24,000	930	-	-	7,500	40
5-18-77	930	93	4,300	2,400	46,000	9,300	240	1,500	> 240,000	2,000	2,400	93
6-16-77	23	9	> 24,000	> 24,000	-	-	> 24,000	93	430	93	93	4
7-13-77	1,500	50	> 24,000	1,100	> 24,000	1,100	> 24,000	1,500	4,600	120	2,100	930
7-18-77	46,000	< 20	110,000	2,400	110,000	150	11,000	< 20	1,500	40	460	150
8-19-77	9,300	4,600	4,600	230	-	-	240	43	11,000	230	240	9
9-16-77	9,300	11,000	40	40	-	-	11,000	930	> 24,000	430	4,600	2,400
9-20-77	>24,000	11,000	93	< 2	> 24,000	4,600	4,600	90	4,300	90	430	150
10-19-77	>240,000	12,000	1,100	23	2,400	20	150	20	4,600	40	430	70
11-07-77	46,000	46,000	4,600	1,500	75,000	2,800	930	210	24,000	930	2,400	930
11-08-77	> 24,000	>24,000	24,000	20	240,000	200	11,000	11,000	4,600	230	930	43
11-09-77	> 24,000	>24,000	4,600	930	460,000	24,000	24,000	11,000	2,400	40	750	430
12-05-77	24,000	<2	110,000	110,000	1,100	400	11,000	110	15,000	150	430	<2
1-12-78	2,400	90	1.1×10^6	230,000	2.3×10^6	<2	90,000	<2	2,400	<2	240	<2
2-07-78	4,300	<200	110,000	15,000	< 200,000	-	1,100	<2	2,400	<2	90	<20
3-09-78	240	4	24,000	24,000	900	900	230	< 200	2,400	11	43	< 2
4-07-78	9,300	1,500	460,000	460,000	11,000	140	2,400	2,400	4,600	110	4,600	43
5-02-78	4,600	750	4,300	4,300	4,600	1,500	230	230	2,400	210	210	9
5-03-78	46,000	7,500	24,000	700	2,100	140	2,300	2,300	250	150	23	< 2
5-12-78	240	9	46,000	46,000	11,000	11,000	240	9	< 24,000	460	4,600	23
5-13-78	460	30	24,000	11,000	11,000	-	2,100	2,100	11,000	930	240	240
6-28-78	24,000	430	24,000	430	24,000	2,400	24,000	930	2,400	460	4,600	4,600
8-18-78	21	7	2,400	-	-	-	-	-	-	-	-	-

Table IIIc. TOTAL AND FECAL STREPTOCOCCAL COMPOSITION OF WASTEWATER AT VARIOUS SAMPLING SITES AT THE COLDWATER REST AREA.

Organisms/100ml (MPN)

Date	Lagoon #1		Lagoon #2		3 Snyder Private Drain		4 Snyder Private Drain		5 Kenyon-McCullough Private Drain		8 Coldwater River	
	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
2-21-77	4,600	4,600	2,400	460	-	-	-	-	-	-	23	0
3-21-77	2,400	2,400	2,400	430	-	-	-	-	-	-	-	-
4-25-77	70	43	240	93	-	-	-	-	-	-	23	23
5-17-77	93	93	430	<23	-	-	4,300	150	-	-	930	210
5-18-77	930	43	930	150	110,000	24,000	4,300	4,300	110,000	15,000	430	430
6-16-77	240	240	2,400	150	-	-	430	150	1,500	1,500	230	93
7-13-77	4,600	460	2,400	75	2,400	1,100	11,000	210	2,400	1,100	150	15
7-18-77	46,000	<20	4,600	90	2,400	230	2,400	150	930	430	93	7
8-19-77	930	430	2,400	150	-	-	460	460	4,600	210	4	4
9-16-77	930	210	40	<20	-	-	930	930	11,000	200	930	930
9-20-77	11,000	11,000	23	< 2	4,600	4,600	230	230	<200	-	430	230
10-19-77	2,400	430	240	43	90	< 20	40	<20	930	30	40	<20
11-07-77	230	90	240	93	400	<200	930	23	230	230	75	75
11-08-77	240	93	20	-	46,000	46,000	430	93	230	230	23	4
11-09-77	4,600	150	20	-	400	<200	430	90	930	<20	75	43
12-05-77	<2	<2	11,000	11,000	1,500	300	430	150	430	150	<2	<2
1-12-78	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	43	<2
2-07-78	<200	<200	1,400	900	< 200,000	-	23	4	9	<2	40	< 20
3-09-78	4	2	230	40	< 200	< 200	< 200	< 200	< 2	< 2	< 2	< 2
4-07-78	< 200	< 200	24,000	24,000	43	43	240	240	75	20	9	9
5-02-78	430	430	2,300	2,300	23	23	23	9	9	< 2	< 2	-
5-03-78	400	400	2,300	2,300	210	210	1,100	1,100	23	< 2	< 24,000	7
5-12-78	93	< 2	4,600	210	4,600	750	240	< 2	240	< 2	23	4
5-13-78	23	4	2,400	2,400	4,600	-	230	21	2,400	1,100	15	15
6-28-78	11,000	150	930	460	11,000	240	4,600	210	4,600	430	930	93
8-18-78	240	240	750	750	-	-	-	-	-	-	-	-

Table IIId. Microbiological Composition of Swamp Effluent During Discharge at the Coldwater Rest Area

	Swamp 6				Swamp 7							
	Coliform		Enterococci		Coliform		Enterococci					
Date	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
11-07-77	9,300	4,300	430	150	4,300	750	230	230				
11-08-77	2,400	70	150	90	110,000	230	430	90				
11-09-77	46,000	<200	<200	–	460	460	75	9				
5-02-78	230	230	< 2	–	210	21	4,600	140				
5-03-78	250	250	>24,000	< 2	250	250	> 24,000	3				
5-12-78	240	9	43	< 2	240	15	240	4				
5-13-78	4,600	4,600	2,400	150	4,600	1,500	4,600	21				

Table IIIe. CHEMICAL & BACTERIAL COMPOSITION OF WELL WATER FROM THE COLDWATER BLWRS.

Sample	NH_3	NO_3^-	NO_2^-	iPO_4^{-3}	Coliforms Total	Coliforms Fecal
8-16-78						
1	0.06	0.64	0.01	0.22	–	–
1A	0.11	0.42	0.01	0.24	–	–
2	0.20	0.72	0.02	0.23	–	–
2A	0.27	0.57	0.02	0.30	–	–
3	0.15	0.45	0.01	0.25	–	–
3A	0.19	0.36	0.01	0.55	–	–
4	–	–	–	–	–	–
4A	0.10	0.38	0.01	0.54	–	–
5	0.04	0.70	0.01	0.24	–	–
5A	0.29	0.55	0.02	0.44	–	–
6	0.10	3.15	0.01	0.17	–	–
6A	0.13	0.84	0.03	0.28	–	–
7	–	–	–	–	–	–
7A	0.29	0.37	0.01	0.30	–	–
8	0.22	0.35	0.01	0.25	–	–
8A	0.28	0.58	0.02	0.25	–	–
9	0.45	0.44	0.01	0.49	–	–
9A	0.24	0.42	0.01	0.30	–	–
10	0.23	0.45	0.01	0.30	–	–
10A	0.20	0.38	0.01	0.25	–	–
11	0.45	0.50	0.02	0.23	–	–
11A	0.14	0.50	0.01	0.30	–	–
12	0.32	0.38	0.01	0.30	–	–
12A	1.03	0.41	0.01	0.38	–	–
13	–	–	–	–	–	–
13A	–	–	–	–	–	–
14	0.69	0.50	0.02	0.29	–	–
14A	0.91	0.41	0.02	0.42	–	–
15	0.03	0.47	0.01	0.25	–	–
15A	0.07	0.45	0.01	0.30	–	–
16	–	–	–	–	–	–
16A	–	–	–	–	–	–
17	0.10	1.12	0.01	0.21	–	–
17A	0.11	1.05	0.01	0.28	–	–
18	0.03	2.82	0.01	0.16	–	–
18A	0.14	0.99	0.03	0.22	–	–
19	0.16	0.45	0.01	0.28	–	–
19A	0.07	0.50	0.01	0.45	–	–
20	0.22	0.38	0.01	0.24	–	–
20A	0.19	0.38	0.01	0.25	–	–
21	0.22	0.9	0.02	0.21	–	–
22	0.10	0.84	0.17	0.29	–	–
23	0.10	0.51	0.01	0.14	–	–
24	0.17	1.00	0.01	0.37	–	–
25	0.19	0.88	0.01	0.24	–	–
26	0.14	0.57	0.01	0.18	–	–
27	0.32	0.92	0.02	0.15	–	–
28	–	–	–	–	–	–
29	0.20	0.73	0.02	0.18	–	–
30	0.29	1.28	0.01	0.19	–	–
31	0.45	2.30	0.05	0.32	–	–
32	0.11	0.49	0.01	0.30	–	–

Table IIIe. (con't)

Sample	NH_3	NO_3^-	NO_2^-	iPO_4^{-3}	Coliforms Total	Coliforms Fecal	Sample	NH_3	NO_3^-	NO_2^-	iPO_4^{-3}	Coliforms Total	Coliforms Fecal
						8-18-78							
1	0.20	0.86	0.03	0.26	>24,000	23	15	–	–	–	–	93	4
1A	0.22	0.48	0.02	0.28	1,500	240	15A	–	–	–	–	93	<2
2	0.22	0.62	0.03	0.30	750	21	16	–	–	–	–	–	–
2A	0.23	0.68	0.03	0.30	>24,000	2	16A	–	–	–	–	–	–
3	0.14	0.64	0.02	0.29	750	2	17	0.22	1.78	0.03	0.27	2,400	<2
3A	0.11	0.91	0.02	0.25	43	2	17A	0.25	1.51	0.03	0.33	23	<2
4	–	–	–	–	–	–	18	–	–	–	–	24,000	<2
4A	0.30	0.41	0.02	0.49	2,400	4	18A	–	–	–	–	750	<2
5	–	–	–	–	–	–	19	0.07	0.60	0.02	0.23	1,100	460
5A	0.23	0.78	0.04	0.44	1,100	4	19A	–	–	–	–	–	–
6	0.15	3.74	0.03	0.20	150	7	20	0.16	0.70	0.02	0.24	2,400	93
6A	0.14	0.94	0.04	0.30	1,100	<2	20A	0.15	0.64	0.02	0.24	93	4
7	0.57	0.96	0.04	0.32	4,600	4	21	–	–	–	–	23	<2
7A	0.15	0.63	0.02	0.45	>24,000	210	22	0.56	1.13	0.12	0.30	23	<2
8	0.25	0.51	0.02	0.30	>24,000	93	23	0.14	0.61	0.02	0.18	23	<2
8A	–	–	–	–	–	–	24	0.14	0.65	0.0	0.35	23	<2
9	0.26	0.50	0.03	0.53	28	4	25	–	–	–	–	–	–
9A	–	–	–	–	4,600	2,400	26	–	–	–	–	240	<2
10	–	–	–	–	–	–	27	0.13	0.99	0.04	0.19	2	–
10A	0.22	0.47	0.03	0.39	11,000	4,600	28	–	–	–	–	–	–
11	–	–	–	–	200	23	29	0.15	0.93	0.05	0.22	93	<2
11A	–	–	–	–	2,400	<2	30	0.12	0.63	0.04	0.24	460	4
12	0.14	0.62	0.03	0.32	43	<2	31	–	–	–	–	<2	–
12A	1.21	0.48	0.02	0.41	24,000	1,100	32	0.13	0.98	0.05	0.30	4	<2
13	–	–	–	–	–	–							
13A	–	–	–	–	–	–							
14	–	–	–	–	4,600	7							
14A	0.82	0.46	0.02	0.43	240	93							

Table IVa. CHEMICAL COMPOSITION OF WASTEWATER FROM THE DUNDEE REST AREA

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	i-PO_4	TKN	NH_3	NO_3	NO_2
								5-27-77					
Lagoon 1	–	–	–	–	–	84	–	3.4	–	17.4	–	0.3	0.03
Lagoon 2	–	–	–	–	–	51	–	6.7	–	8.1	–	0.2	0.02
Lagoon 3	–	–	–	–	–	34	–	1.5	–	23.1	–	0.1	0.01
								7-14-77					
Lagoon 1	–	–	9.0	9	–	67	–	2.6	2.00	9.6	–	0.6	0.12
Lagoon 2	–	–	2.2	7	–	50	–	5.4	5.63	6.6	–	0.5	0.03
Lagoon 3	–	–	0.5	9	–	55	–	5.0	5.30	4.6	–	0.2	0.02
								7-21-77					
Lagoon 1	–	30	8.5	11	–	54	–	1.1	0.88	–	–	0.2	0.05
Lagoon 2	–	29	4.2	6	–	46	–	6.0	5.95	–	–	0.2	0.03
Lagoon 3	–	29	8.7	9	–	67	–	5.6	4.98	–	–	0.3	0.01
								8-2-77					
Lagoon 1	–	–	–	13	–	73	–	2.4	1.73	6.6	1.9	0.5	0.27
Lagoon 2	–	–	–	4	–	49	–	6.0	6.18	2.4	0.5	0.5	0.02
Lagoon 3	–	–	–	4	–	57	–	4.3	4.34	2.7	0.4	0.4	0.02
								8-3-77					
Lagoon 1	–	25	5.0	14	–	62	–	2.2	1.73	9.6	3.8	0.6	0.23
Lagoon 2	–	23	1.1	4	–	50	–	6.0	6.35	2.4	0.5	0.7	0.02
Lagoon 3	–	25	6.3	6	–	58	–	4.3	4.25	3.5	0.6	0.5	0.02
Discharge Cell 4	–	–	–	5	–	74	–	6.1	6.03	2.8	0.5	0.4	0.02
Discharge Cell 5	–	–	–	5	–	55	–	5.7	6.03	3.1	0.3	0.7	0.02

Table IVa. (con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	i-PO_4	TKN	NH_3	NO_3	NO_2
								8-5-77					
Lagoon 1	-	27	9.5	8	-	70	-	2.0	2.20	6.6	2.4	1.5	[illegible]
Lagoon 2	-	25	5.0	12	-	78	-	6.0	6.43	9.4	4.8	1.3	[illegible]
Lagoon 3	-	25	9.2	8	-	-	-	4.4	3.93	2.5	0.3	1.5	[illegible]
Discharge Cell 4	-	-	-	6	-	56	-	5.6	6.10	3.2	0.8	1.8	[illegible]
Discharge Cell 5	-	-	-	6	-	51	-	6.1	6.18	2.9	0.8	1.5	[illegible]
								8-8-77					
Lagoon 1	-	-	-	12	-	-	-	3.1	2.98	4.2	2.0	1.4	0.10
Lagoon 2	-	-	-	8	-	50	-	6.2	6.48	8.3	4.8	1.4	0.04
Lagoon 3	-	-	-	9	-	54	-	4.9	4.95	3.3	1.0	1.6	[illegible]
Discharge Cell 4	-	-	-	14	-	70	-	4.9	5.45	2.5	0.8	1.3	0.02
Discharge Cell 5	-	-	-	9	-	66	-	5.7	6.08	2.9	0.5	1.6	0.04
								8-15-77					
Lagoon 1	-	26	>20	-	-	64	-	1.9	1.23	8.0	0.6	0.5	[illegible]
Lagoon 2	-	25	12.5	-	-	68	-	5.4	5.60	5.7	2.5	0.4	[illegible]
Lagoon 3	-	26	9.5	-	-	52	-	4.0	2.35	1.3	0.4	0.4	[illegible]
Discharge Cell 4	-	-	-	-	-	68	-	2.8	2.08	3.8	0.6	0.7	[illegible]
Discharge Cell 5	-	-	-	-	-	61	-	4.1	4.78	4.3	0.6	0.6	[illegible]
								8-22-77					
Lagoon 1	-	-	-	-	-	62	-	4.7	4.32	8.1	-	0.68	[illegible]
Lagoon 2	-	-	-	-	-	56	-	10.5	5.82	4.8	-	0.62	0.05
Lagoon 3	-	-	-	-	-	50	-	4.1	3.26	1.9	-	0.81	[illegible]
Discharge Cell 5	-	-	-	-	-	68	-	4.5	4.48	2.0	-	0.88	[illegible]
Ditch 2	-	-	-	-	-	110	-	0.7	1.10	0.1	-	0.56	ND
Ditch 3	-	-	-	-	-	106	-	0.4	1.10	ND	-	0.63	ND

Table IVa. (con't)

Sample	pH	T^oC	DO	BOD	COD	TOC	SS	t-P	tPO_4	TKN	NH_3	NO_3	NO_2
							8-30-77						
Lagoon 1	–	–	–	–	–	–	–	1.7	2.24	5.1	–	0.67	0.46
Lagoon 2	–	–	–	–	–	–	–	4.6	6.0	5.1	–	0.74	0.04
Lagoon 3	–	–	–	–	–	–	–	3.0	3.57	2.7	–	0.73	0.01
Cell 5	–	–	–	–	–	–	–	3.4	4.6	3.4	–	0.78	0.02
Ditch 2	–	–	–	–	–	–	–	< 0.1	0.94	1.4	–	0.52	0.01
							9-8-77						
Lagoon 1	–	23	5.5	–	–	58(39)	8	2.2	2.16	4.2	–	0.57	0.20
Lagoon 2	–	21	0.5	–	–	47(23)	6	5.4	6.02	3.7	–	0.49	0.06
Lagoon 3	–	23	5.7	–	–	36(20)	4	3.1	3.59	1.7	–	0.49	0.06
							9-19-77						
Lagoon 1	–	21	12.0	–	–	29	33	5.6	5.28	14.9	3.2	0.34	0.31
Lagoon 2	–	20	7.0	–	–	21	4	7.2	5.43	4.6	1.1	0.56	0.05
Lagoon 3	–	21	8.9	–	–	17	7	3.2	2.96	2.5	0.1	0.51	0.04
							12-19-77						
Lagoon 1	7.3	1	11.6	–	–	9	6	3.8	4.20	4.6	0.5	1.31	0.07
Lagoon 2	6.9	0	5.2	–	–	13	2	2.5	2.71	3.3	0.4	1.25	0.07
Lagoon 3	6.9	1	9.3	–	–	6	1	0.2	0.16	1.3	<0.1	0.72	0.05
Discharge Cell 4	6.9	–	–	–	–	7	1	0.2	0.18	2.0	<0.1	0.46	0.04
Discharge Cell 5	7.0	–	–	–	–	7	7	0.2	0.26	<1.0	<0.1	0.46	0.04
Ditch	6.6					14	4	0.4	0.27	0.1	<0.1	0.57	0.05
							1-17-78						
Lagoon 1	–	–	–	6	–	29	20	15.1	14.1	11.0	6.6	0.63	0.07
Lagoon 2	–	–	–	3	–	27	5	7.4	6.89	5.8	2.5	0.98	0.07
							2-14-78						
Lagoon 1	–	–	–	14	–	54	49	22.4	>10	22.6	15.2	0.55	0.02
Lagoon 2	–	–	–	3	–	23	7	4.7	7.40	4.0	3.3	0.68	0.05
Lagoon 3	–	–	–	15	–	23	26	1.2	3.48	11.8	3.3	0.68	<0.01

Table IV a. (con't)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO_4	TKN	NH_3	NO_3	NO_2
							3-12-78						
Lagoon 1	7.1	-	-	26	-	-	49	19.5	18.3	11.3	0.7	10.6	0.04
Lagoon 2	7.0	-	-	10	-	-	3	8.3	8.10	6.2	0.5	4.34	0.0[illegible]
Lagoon 3	7.1	-	-	8	-	-	2	3.4	3.37	3.2	0.5	1.21	0.0[illegible]
							4-29-78						
Lagoon 1	8.6	-	15.6	20	-	39	13	6.1	5.50	4.1	1.9	0.65	0.61
Lagoon 2	7.3	-	5.8	4	-	31	11	3.9	3.77	1.9	0.4	0.48	0.54
Lagoon 3	7.9	-	10.7	3	-	28	13	1.6	1.25	1.0	0.6	0.51	0.[illegible]
							5-27-78						
Lagoon 1	7.4	23	0.9	<1	-	22	2	10.6	10.4	4.2	2.2	0.47	0.03
Lagoon 2	8.0	23	9.5	<1	-	17	1	3.5	3.60	1.3	<0.1	0.50	0.01
Lagoon 3	8.8	24	12.2	<1	-	23	<1	1.3	1.08	1.3	--	0.50	0.01
							6-20-78						
Lagoon 1	7.6	26	2.8	-	-	30	2	13.8	13.9	7.1	7.3	0.35	0.06
Lagoon 2	8.3	25	11.0	-	-	24	<1	4.0	3.72	1.6	0.5	0.28	<0.01
Lagoon 3	9.7	26	14.6	-	-	26	1	0.3	0.32	0.2	<0.1	0.28	<0.01
							6-23-78						
Lagoon 1	7.3	-	-	1	-	27	2	13.9	13.7	7.3	4.6	0.61	0.06
Lagoon 2	8.4	-	-	1	-	23	3	3.4	3.42	1.7	<0.1	0.60	0.03
Lagoon 3	10.2	-	-	<1	-	23	2	0.4	0.26	2.1	0.1	0.57	0.02
							6-30-78						
Lagoon 1	7.4	28	2.5	2	-	-	8	13.1	13.4	8.2	4.50	0.46	0.09
Lagoon 2	8.0	28	9.8	6	-	-	4	8.0	8.25	3.5	2.16	0.32	0.03
Lagoon 3	10.3	28	12.0	4	-	33	9	0.3	0.22	1.7	0.10	0.39	0.01
							7-14-78						
Lagoon 1	7.40	26	6.0	5	-	35	2	8.7	8.80	7.6	5.11	0.31	0.57
Lagoon 2	8.82	26	10.4	2	-	27	1	1.7	1.51	2.4	0.30	2.40	0.03
Lagoon 3	10.11	26	16.4	<1	-	39	1	0.1	0.15	1.6	0.09	<0.4	0.02
							7-31-78						
Lagoon 1	7.38	23	1.8	36	-	50	10	10.4	9.97	10.4	7.97	0.49	0.04
Lagoon 2	9.58	22	9.8	5	-	69	6	0.7	0.40	2.4	0.20	0.76	0.19
Lagoon 3	9.08	22	6.2	4	-	45	4	2.4	0.75	1.6	0.12	0.51	0.01

Table IV a. (cont.)

Sample	pH	T°C	DO	BOD	COD	TOC	SS	t-P	iPO$_4$	TKN	NH$_3$	NO$_3$	NO$_2$
						8-29-78							
Lagoon 1	–	23	2.0	8	–	42	10	3.5	3.70	8.2	4.43	0.68	0.42
Lagoon 2	–	23	6.6	< 1	–	24	5	0.7	0.68	3.2	0.21	0.56	0.04
Lagoon 3	–	23	2.5	< 1	–	47	8	5.8	5.89	2.3	0.26	0.60	0.04
						10-8-78							
Lagoon 1	7.74	10	8.6	13	–	–	–	9.6	–	–	–	–	–
Lagoon 2	7.56	10	7.7	< 1	–	–	–	6.7	–	–	–	–	–
Lagoon 3	9.05	10	11.8	< 1	–	–	–	1.7	–	–	–	–	–

Table IV b. TOTAL AND FECAL COLIFORM COMPOSITION OF WASTEWATER AT VARIOUS SAMPLING SITES AT THE DUNDEE REST AREA.

	Organisms/100ml (MPN)									
	Lagoon #1		Lagoon #2		Lagoon #3		Discharge Cell 4		Discharge Cell 5	
DATE	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
5-27-77	90	<23	23	9	23	0	-	-	-	-
7-14-77	>2,400	75	93	9	460	9	-	-	-	-
7-21-77	4,600	40	93	4	240	93	-	-	-	-
8-2-77	>2,400	93	>2,400	15	>2,400	23	-	-	-	-
8-3-77	1,100	9	>2,400	93	>2,400	23	>2,400	9	>2,400	40
8-5-77	1,100	1,100	11,000	2,400	2,100	750	>2,400	9	1,100	>2
8-8-77	460	240	150	93	210	93	>2,400	39	>2,400	1,100
8-15-77	240	93	460	43	460	150	430	9	230	9
8-22-77	2,400	1,100	390	23	11,000	430	-	-	240	240
8-30-77	4,600	200	240	9	930	40	-	-	750	460
9-08-77	930	930	460	93	2,400	230	-	-	-	-
9-19-77	>24,000	1,500	240	23	2,100	90	-	-	-	-
1-17-78	>240,000	>240,000	2,400	2,400	-	-	-	-	-	-
2-14-78	24,000	430	11,000	3	2,400	<2	-	-	-	-
3-11-78	< 24,000	750	1,100	<2	240	15	-	-	-	-
4-29-78	9,300	< 200	210	<2	460	<2	-	-	-	-
5-27-78	> 24,000	3	230	3	11,000	3	-	-	-	-
6-20-78	11,000	430	>24,000	23	93	4	-	-	-	-
6-23-78	430	9	230	<2	<2	-	-	-	-	-
6-30-78	2,400	43	11,000	230	43	23	-	-	-	-
7-14-78	11,000	460	93	<2	<2	-	-	-	-	-
7-31-78	4,600	4,600	23	<2	240	240	-	-	-	-
8-29-78	4,600	4,600	430	430	90	23	-	-	-	-

Table IV c. TOTAL AND FECAL STREPTOCOCCAL COMPOSITION OF WASTEWATER AT VARIOUS SAMPLING SITES AT THE DUNDEE REST AREA.

	Organisms/100ml (MPN)									
	Lagoon #1		Lagoon #2		Lagoon #3		Discharge Cell 4		Discharge Cell 5	
DATE	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL	TOTAL	FECAL
5-27-77	2,400	930	150	150	93	93	-	-	-	-
7-14-77	1,000	4	1,000	>7	1,000	3	-	-	-	-
7-21-77	930	930	43	23	23	23	-	-	-	-
8-2-77	150	9	28	15	43	43	-	-	-	-
8-3-77	240	9	1,100	4	240	9	>2,400	14	>2,400	210
8-5-77	93	15	930	430	930	210	23	23	75	75
8-8-77	460	93	460	9	93	93	-	-	1,100	1,100
8-15-77	1,100	93	240	43	240	4	4,600	240	230	93
8-22-77	2,400	23	21	4	430	93	-	-	21	3
8-30-77	230	<20	240	4	2,400	2,400	-	-	2,400	2,400
9-08-77	930	230	93	43	230	20	-	-	-	-
9-19-77	4,600	930	39	14	2,400	40	-	-	-	-
1-17-78	930	70	23	4	-	-	-	-	-	-
2-14-78	40	40	23	<2	4	<2	-	-	-	-
3-11-78	23	4	23	<2	11	<2	-	-	-	-
4-29-78	<200	-	< 2	-	< 2	-	-	-	-	-
5-27-78	2	-	4	<2	39	2	-	-	-	-
6-20-78	>24,000	210	4,600	93	930	1,100	-	-	-	-
6-23-78	230	93	93	93	43	43	-	-	-	-
6-30-78	93	43	230	4	93	9	-	-	-	-
7-14-78	93	43	4,600	14	210	9	-	-	-	-
7-31-78	2,400	1,100	240	93	750	75	-	-	-	-
8-29-78	>24,000	750	2,400	2,400	430	150	-	-	-	-

Table IVd. NITRATE CONCENTRATION IN GROUNDWATER FROM THE DUNDEE REST AREA

(ppm)

WELL #

DATE	1	2	3	4	5	6	7	8	9	10
5-27-77	–	1.81	0.04	<0.01	0.07	–	–	–	–	–
7-14-77	0.08	0.10	0.07	0.12	<0.01	<0.01	0.13	0.37	–	–
7-21-77	<0.01	0.02	0.12	0.19	<0.01	<0.01	<0.01	0.01	–	–
8-2-77	–	–	–	–	–	–	–	0.06	–	–
8-3-77	–	0.14	0.08	–	–	–	–	0.04	–	–
8-5-77	–	0.01	0.02	–	–	0.18	–	0.04	–	–
8-8-77	0.05	0.01	<0.01	0.13	0.04	0.03	0.10	0.16	–	–
8-15-77	0.01	0.02	0.02	0.04	0.04	0.01	0.12	0.49	–	–
8-22-77	<0.01	0.04	0.02	0.03	0.05	0.02	0.09	0.12	–	–
8-30-77	0.02	0.04	0.07	0.05	0.01	0.02	0.07	0.40	–	–
9-08-77	0.49	0.57	0.75	1.34	0.72	0.74	0.64	1.03	–	–
9-19-77	0.78	0.62	0.33	0.60	0.61	0.61	0.61	1.46	0.73	1.06
12-19-77	0.11	0.37	0.09	0.11	0.57	0.30	0.80	0.86	0.09	0.24
1-17-78	< 0.01	<0.01	–	<0.01	–	1.27	–	0.16	0.05	–
2-14-78	0.74	0.62	–	0.72	–	–	–	1.25	0.67	–
3-11-78	< 0.06	0.08	–	0.35	–	< 0.03	–	0.10	0.05	0.36
4-29-78	0.02	0.07	0.04	0.04	0.17	0.46	0.43	0.04	0.01	< 0.01
5-27-78	< 0.01	<0.01	< 0.01	0.39	<0.01	0.04	< 0.01	0.26	< 0.01	
6-20-78	–	–	–	0.45	0.50	0.48	< 0.01	0.62	0.56	0.34
6-23-78	0.60	0.41	0.44	0.36	0.41	0.65	0.42	0.72	0.46	–
6-30-78	–	–	–	–	0.42	–	–	–	–	0.47
7-14-78	0.41	0.38	0.32	0.34	0.31	0.33	0.39	0.42	0.35	–
7-31-78	–	–	–	–	–	–	–	0.78	0.44	0.44
										–

Table IVe. TOTAL COLIFORM CONCENTRATION OF GROUND WATER FROM THE DUNDEE REST AREA

	(MPN/100ml)									
	WELL #									
DATE	1	2	3	4	5	6	7	8	9	10
5-27-77	–	>2,400	4	0	0	–	–	–	–	–
7-14-77	460	>2,400	1,100	>2,400	>2,400	> 2,400	1,100	>2,400	–	–
7-21-77	9	930	1,100	150	40	> 4,600	<2	<20	–	–
8-02-77	–	–	–	–	–	–	–	>2,400	–	–
9-03-77	–	>2,400	>2,400	–	–	> 2,400	–	150	–	–
8-05-77	–	460	240	210	>24,000	390	–	70	–	–
8-08-77	<2	460	< 2	<2	400	> 2,400	<2	<2	–	–
8-15-77	39	23	>2,400	>2,400	240	1,100	2,400	>2,400	–	–
8-22-77	4	240	<2	< 2	9	1,500	<2	<20	–	–
8-30-77	9	23	<2	< 2	23	<20	4	<2	–	–
9-08-77	<2	43	<2	93	<2	<20	9	460	–	–
9-19-77	> 2,400	240	1,100	460	<2	460	<2	<2	<2	<2
2-14-78	<2	<2	–	<2	–	–	–	<2	<2	–
3-11-78	240	23	–	93	–	23	–	23	240	23
4-29-78	<2	240	<2	<2	<2	<2	<2	<2	<2	93
5-27-78	<2	<24,000	43	<2	<2	<2	<2	2	<2	<2
6-20-78	–	–	110,000	1,500	15,000	15,000	430	430	<2	2,300
6-23-78	230	23	<2	2,400	90	930	<2	2	<2	9
6-30-78	–	–	–	–	2,400	–	–	–	–	–
7-14-78	240	43	460	1,100	2,100	>24,000	2,400	11,000	<2	<2
7-31-78	–	–	–	–	–	–	–	11,000	9	–

Table IVf. FECAL COLIFORM CONCENTRATION OF GROUNDWATER FROM THE DUNDEE REST AREA

	(MPN/100ml) WELL #									
DATE	1	2	3	4	5	6	7	8	9	10
5-27-77	-	0	0	0	0	0	-	-	-	-
7-17-77	<2	> 2,400	4	9	1,100	240	15	9	-	-
7-21-77	<2	< 20	4	<20	<20	<20	0	0	-	-
8-02-77	-	-	-	-	-	-	-	23	-	-
8-03-77	-	1,100	<2	-	-	1,100	-	<2	-	-
8-05-77	-	93	<2	<20	930	4	-	<20	-	-
8-08-77	0	11	0	0	200	75	0	0	-	-
8-15-77	9	4	1,100	240	9	1,100	460	240	-	-
8-22-77	<2	<2	-	-	<2	11	-	-	-	-
8-30-77	<2	<2	-	-	4	-	4	-	-	-
9-08-77	-	23	-	7	-	3	4	460	-	-
9-19-77	21	93	210	15	-	<20	-	-	-	-
2-14-78	<2	<2	-	<2	-	-	-	<2	<2	-
3-11-78	<2	<2	-	<2	-	<2	-	9	15	<2
4-29-78	-	<2	-	-	-	-	-	-	-	-
5-27-78	-	<2	<2	-	-	-	-	-	-	-
6-20-78	-	-	<2	7	2,300	<2	<2	<2	-	90
6-23-78	<2	4	-	<2	<2	9	-	-	-	<2
6-30-78	-	-	-	-	2,400	-	-	-	-	-
7-14-78	<2	43	9	<2	93	93	4	23	-	-
7-31-78	-	-	-	-	-	-	-	-	93	<2

Table Va. Nutrient Concentrations of Ground Water Monitoring Wells on the Barriered Landscape Water Renovation System Spray Area at the Coldwater Rest Area. 1979.

Date 4/16

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	0.45	0.054	29.3	0.12	0.07		
1A	0.65	0.041	9.3	0.17	0.04		
2	0.29	0.054	46.5	0.22	0.03		
2A	0.56	0.039	53.9	0.09	0.02		
3	0.46	0.033	12.3	0.18	0.08		
3A	1.15	0.034	47.8	0.16	0.05		
4	1.15	0.049	25.7	0.14	0.03		
4A	1.17	0.060	21.0	0.14	0.03		
5	0.87	0.038	6.3	0.20	0.02		
5A	0.25	0.033	36.9	0.16	0.05		
6	1.53	0.068	14.6	0.25	0.03	0.5	43
6A	1.15	0.038	5.0	0.32	0.42	0.7	
7	0.54	0.043	1.2	0.18	0.11	1.5	
7A	0.94	0.025	0.6	0.17	0.06	1.1	13
8							
8A							
9	2.61	0.034	0.8	0.11	0.03	3.0	27
9A	0.87	0.026	2.9	0.18	0.05	0.9	19
10	3.33	0.029	0.7	0.12	0.14		
10A	3.04	0.032	0.9	0.22	0.12		
11	0.58	0.031	7.5	0.15	0.43	0.5	
11A	0.75	0.044	10.0	0.23	0.06	0.9	
12	0.36	0.030	21.8	0.13	0.07	0.4	
12A	1.14	0.022	7.2	0.13	0.09	0.9	
13	0.28	0.026	32.2	0.05	0.03	0.4	
13A	1.29	0.032	2.7	0.15	0.01	0.3	
14	0.27	0.049	37.0	0.18	0.03	0.6	
14A	0.25	0.038	31.0	0.11	0.03	1.1	29
15	0.59	0.037	15.1	0.12	0.03	0.7	11
15A	1.66	0.043	21.2	0.18	0.01	0.5	
16	0.59	0.041	20.1	0.12	0.01	0.2	
16A	0.76	0.059	0.5	0.18	0.01	0.3	
17	0.79	0.040	24.3	0.15	0.10	0.3	40
17A	1.02	0.043	17.8	0.11	0.10	0.3	
18	0.49	0.039	45.1	0.12	0.02	0.7	
18A	0.24	0.037	11.3	0.15	<0.01	0.7	
19	0.39	0.038	26.8	0.11	0.06	0.3	10
19A	0.94	0.038	9.1	0.09	0.03	0.5	
20	1.31	0.029	19.3	0.09	0.01	0.1	8
20A	0.56	0.034	3.0	0.14	0.02	1.0	
21	0.93	0.026	0.7	0.20	0.02	0.5	9
22	1.61	0.026	2.3	0.20	0.03	0.1	10
23	0.29	0.033	2.0	0.12	0.01	0.4	15
24	0.31	0.028	1.6	0.22	<0.01	0.7	11
25	2.12	0.035	3.4	0.27	<0.01	0.1	11
26	1.00	0.037	3.2	0.23	0.13	0.5	
27	1.10	0.025	2.4	0.16	0.05	0.3	
28	0.60	0.031	0.6	0.08	0.19	0.6	
29	1.39	0.027	1.6	0.15	0.03	0.3	10
30	0.41	0.025	2.3	0.19	0.02	0.6	8
31	0.44	0.027	5.1	0.23	0.21	0.7	9
32	0.53	0.028	1.2	0.20	0.04	1.9	12
Lagoon 1	0.33	0.062	0.6	0.90	2.08	6.8	45
Lagoon 2	36.5	0.226	0.9	4.87	5.57	47.3	46
Tank 1							
Tank 2							

Table Va. (Continued)

Date 5/07							
Sampling Site	NH_3	NO_2	NO_3	$i-PO_4$	t-P	TKN	TOC
	ppm						
1	0.11	0.008	32.2	0.005	0.02	2.8	13
1A	0.33	0.020	3.2	0.044	<0.01	0.8	20
2	1.34	0.033	32.9	0.066	0.01	0.5	
2A	0.15	0.016	46.3	0.019	0.01	20.1	10
3	0.20	0.022	2.0	0.031	0.08	1.6	
3A	0.13	0.012	20.8	0.018	0.06	0.9	
4	0.22	0.028	15.9	0.028	0.02	0.4	30
4A	0.22	0.009	7.0	0.012	<0.01	1.2	14
5	0.27	0.009	9.1	0.012	<0.01	0.5	
5A	0.28	0.019	18.8	0.008	<0.01	0.3	15
6	0.13	0.014	1.8	0.017	<0.01	0.3	17
6A	0.19	0.019	14.2	0.017	<0.01	0.5	11
7							
7A	0.18	0.024	1.1	0.017	<0.01	0.6	
8	0.26	0.253	0.4	0.037		3.2	
8A	0.12	0.006	0.1	0.006	<0.01	0.3	19
9	2.18	0.005	0.1	0.006	<0.01	2.6	
9A	0.23	0.014	0.1	0.014	<0.01	0.7	18
10	0.91	0.010	0.1	0.006	0.02	1.7	23
10A	1.06	0.006	0.1	<0.001	0.02	1.8	20
11	0.11	0.012	4.5	0.013	0.02	0.5	11
11A	0.09	0.007	5.7	0.009	<0.01	0.8	14
12	0.01	0.004	15.0	0.006	0.02	0.3	16
12A	0.01	0.003	5.4	0.005	<0.01	0.2	
13	0.13	0.009	14.7	0.008	<0.01	0.4	36
13A	0.14	0.014	0.3	0.015	0.01	<0.1	15
14	0.11	0.096	28.9	0.010	0.01	0.8	
14A	0.16	0.161	18.8	0.013	0.05	2.6	38
15	0.20	0.023	8.1	0.026	0.05	0.7	10
15A	0.19	0.019	1.5	0.021	0.04	0.1	9
16	0.26	0.022	17.6	0.032	0.01	0.3	12
16A	0.15	0.015	0.2	0.012	<0.01	0.3	
17	0.17	0.036	31.9	0.017	0.03	2.0	28
17A	0.15	0.019	35.4	0.015	0.03	<0.1	10
18	0.21	0.022	43.9	0.020	0.03	0.2	
18A	0.21	0.023	17.3	0.024	0.03	0.2	12
19	0.26	0.026	27.6	0.029	<0.01	0.1	13
19A	0.20	0.022	10.4	0.020	<0.01	<0.1	12
20	0.06	0.006	39.2	0.007	<0.01	<0.1	10
20A	0.02	0.003	10.3	0.004	<0.01	<0.1	11
21	0.04	0.003	0.4	0.004	0.03	<0.1	12
22	0.01	0.002	2.0	0.006	0.01	<0.1	7
23	0.01	0.002	0.2	0.005	0.04	<0.1	11
24	0.03	<0.002	0.1	0.002	<0.01	0.2	
25	0.01	<0.002	1.2	0.002	<0.01	0.5	7
26	0.02	0.004	1.3	0.006	<0.01	<0.1	9
27	0.05	0.010	0.6	0.014	0.08	<0.1	
28	0.05	0.010	0.1	0.012	0.02	0.1	14
29	0.07	0.011	1.7	0.017	0.02	<0.1	12
30	0.07	0.007	2.8	0.005	<0.01	<0.1	7
31	0.02	<0.002	8.1	0.003	0.01	1.5	11
32	0.07	0.006	2.0	0.008	0.01	0.1	9
Lagoon 1	12.7	0.022	0.1	2.99	3.45	14.9	26
Lagoon 2	4.6	1.59	2.7	1.30	3.32	20.8	84
Tank 1	17.8	0.037	0.1	3.06	3.65	23.0	41
Tank 2	19.6	0.035	0.1	3.09	3.35	26.0	48

Table Va. (Continued)

Date 5/11

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	0.05	0.001	34.2	<0.01	<0.01	<0.1	
1A	0.13	0.003	1.3	<0.01	<0.01	0.2	
2	0.10	0.010	33.3	<0.01	<0.01	0.2	
2A	0.42	0.001	63.2	<0.01	<0.01	0.1	
3	0.06	0.003	2.1	<0.01	<0.01	<0.1	
3A	0.10	<0.001	19.5	<0.01	<0.01	<0.1	
4	0.11	0.019	14.1	<0.01	<0.01	<0.1	
4A	0.33	0.017	4.6	<0.01	<0.01	0.6	
5	0.23	0.012	6.8	<0.01	0.05	0.3	
5A	0.45	0.005	9.7	<0.01	<0.01	0.8	
6	0.08	0.001	2.0	<0.01	0.04	0.1	
6A	0.10	0.002	12.1	<0.01	<0.01	0.3	
7							
7A	0.08	0.003	1.3	<0.01	<0.01	0.1	
8	0.36	0.061	0.2	<0.01	<0.01	0.8	
8A	0.22	0.001	<0.1	<0.01	<0.01	0.1	
9	2.51	0.003	<0.1	<0.01	<0.01	2.9	
9A	0.25	0.003	<0.1	<0.01	<0.01	0.4	
10	1.20	0.004	<0.1	<0.01	0.03	1.8	
10A	1.10	0.002	<0.1	<0.01	0.03	1.5	
11	0.39	<0.001	4.5	<0.01	0.02	0.5	
11A	0.15	0.006	13.6	<0.01	0.07	0.4	
12	0.11	0.001	15.2	<0.01	0.01	0.6	
12A	0.09	<0.001	4.4	<0.01	0.01	0.3	
13	0.05	0.002	7.4	<0.01	0.01	0.1	
13A	0.06	0.004	0.6	<0.01	0.01	0.2	
14	0.15	0.048	12.3	<0.01	0.09	1.0	
14A	0.21	0.126	7.8	0.01	0.06	1.3	
15	0.07	0.003	9.9	0.01	0.04	0.2	
15A	0.07	0.002	3.4	0.01	0.03	<0.1	
16	0.07	0.003	24.1	0.02	0.03	0.4	
16A	0.08	0.001	0.6	<0.01	0.07	0.6	
17	0.08	<0.001	25.3	<0.01	0.01	<0.1	
17A	0.07	0.002	39.2	<0.01	<0.01	0.3	
18	0.05	0.004	37.9	<0.01	<0.01	0.4	
18A	0.07	0.001	21.1	<0.01	0.02	0.3	
19	0.11	0.002	32.3	<0.01	0.11	0.3	
19A	0.05	<0.001	13.0	<0.01	<0.01	<0.1	
20	0.14	0.008	48.3	0.01	<0.01	0.2	
20A	0.05	<0.001	14.2	<0.01	<0.01	0.1	
21	0.04	<0.001	1.0	<0.01	<0.01	<0.1	
22	0.05	<0.001	1.3	<0.01	0.03	0.1	
23	0.05	<0.001	0.3	<0.01	0.08	0.2	
24	0.05	<0.001	0.1	<0.01	0.03	0.1	
25	0.05	<0.001	1.0	<0.01	0.01	0.2	
26	0.05	<0.001	1.4	<0.01	0.01	0.1	
27	0.05	<0.001	0.7	<0.01	0.04	0.5	
28	0.05	<0.001	0.1	0.01	0.05	0.5	
29	0.05	<0.001	2.1	0.02	0.05	0.3	
30	0.05	<0.001	2.9	0.01	0.16	<0.1	
31	0.71	<0.001	10.7	0.17	0.02	1.2	
32	0.09	0.001	2.4	0.01	<0.01	0.3	
Lagoon 1	13.8	0.008	0.1	3.00	3.15	18.8	
Lagoon 2	2.05	1.32	0.2	0.91	2.37	13.3	
Tank 1							
Tank 2							

Table Va. (Continued)

Date 6/11

Sampling Site	NH_3	NO_2	NO_3	$i\text{-}PO_4$	t-P	TKN	TOC
	ppm						
1	0.21	0.023	30.1	0.02	<0.1	0.2	6
1A	0.39	0.050	23.2	0.02	<0.1	1.0	18
2	0.18	0.027	3.8	0.03	<0.1	0.3	5
2A	0.20	0.032	29.4	0.02	<0.1	0.2	10
3	0.09	0.028	1.2	0.02	<0.1	0.3	11
3A	0.17	0.045	4.6	0.02	<0.1	0.1	8
4	0.17	0.078	13.4	0.01	<0.1	0.3	7
4A	0.42	0.041	1.6	0.01	<0.1	0.9	24
5	0.26	0.059	0.8	0.01	<0.1	1.0	9
5A	0.83	0.042	0.8	0.01	<0.1	2.1	13
6	0.24	0.052	1.1	0.03	<0.1	0.5	9
6A	0.30	0.121	2.3	0.03	<0.1	0.2	14
7	0.30	0.074	0.7	0.03	<0.1	0.1	8
7A	0.16	0.075	0.6	0.02	<0.1	0.2	10
8	0.46	0.095	0.9	0.02	<0.1	0.8	11
8A	0.45	0.076	0.7	0.01	<0.1	0.7	7
9	1.58	0.063	0.6	0.02	<0.1	2.1	34
9A	0.29	0.062	0.6	0.01	<0.1	0.7	11
10	0.97	0.056	0.6	0.01	<0.1	1.5	21
10A	0.50	0.038	0.6	<0.01	<0.1	1.0	13
11	0.26	0.035	0.7	0.01	<0.1	0.2	11
11A	0.37	0.041	1.4	0.01	<0.1	0.4	12
12	0.13	0.077	5.1	0.01	<0.1	0.2	10
12A	0.71	0.073	0.9	0.01	<0.1	0.7	12
13	0.12	0.082	1.3	0.01	<0.1	0.1	12
13A	0.16	0.072	0.7	0.01	<0.1	0.3	29
14	0.18	0.094	6.0	0.01	<0.1	0.6	14
14A	0.29	0.054	0.7	0.01	<0.1	0.6	10
15	0.07	0.097	2.1	0.01	<0.1	<0.1	10
15A	0.08	0.080	4.9	0.01	<0.1	0.3	7
16	0.06	0.062	3.0	0.01	<0.1	<0.1	10
16A	0.06	0.064	0.7	0.01	<0.1	0.1	6
17	0.02	0.045	16.0	0.01	<0.1	<0.1	14
17A	0.05	0.047	43.4	0.01	<0.1	<0.1	6
18	0.04	0.053	25.6	0.01	<0.1	<0.1	7
18A	0.04	0.046	30.7	0.01	0.1	<0.1	6
19	0.07	0.035	30.8	<0.01	<0.1	0.1	11
19A	0.03	0.030	10.4	<0.01	<0.1	<0.1	8
20	0.06	0.050	31.0	<0.01	<0.1	<0.1	8
20A	0.04	0.033	5.1	<0.01	<0.1	0.1	10
21	0.13	0.045	2.2	0.01	<0.1	0.2	7
22	0.67	0.002	3.2	0.01	<0.1	0.2	10
23	0.56	0.002	0.3	0.01	<0.1	0.2	8
24	0.80	0.003	0.2	0.07	<0.1	0.2	9
25	0.29	0.002	1.4	0.01	<0.1	0.2	21
26	0.59	0.028	0.9	0.01	<0.1	0.3	7
27	0.57	0.026	0.7	0.01	<0.1	0.1	7
28	0.72	0.011	0.3	0.01	<0.1	0.7	
29	0.35	0.031	3.8	0.05	<0.1	0.4	10
30	0.61	0.003	2.0	0.02	<0.1	0.2	7
31	0.71	0.003	2.7	0.01	<0.1	<0.1	6
32	0.64	0.003	3.0	0.01	<0.1	0.2	9
Lagoon 1	8.73	0.006	0.8	2.20	3.1	13.5	50
Lagoon 2	10.4	0.064	0.3	2.35	3.8	15.5	57
Tank 1	0.62	0.081	20.4	2.59	2.7	4.3	23
Tank 2	0.73	0.068	19.6	2.63	2.6	3.8	15

Table Va. (Continued)

Date 6/15

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	0.01	0.001	27.3	<0.01	<0.1	<0.1	
1A	0.26	0.016	22.2	<0.01	<0.1	0.9	
2	0.07	0.009	2.7	<0.01	<0.1	0.8	
2A	0.03	0.002	24.5	<0.01	<0.1	0.2	
3	0.02	0.001	2.0	<0.01	<0.1	0.3	
3A	<0.01	0.007	2.2	<0.01	0.2	0.3	
4	0.16	0.042	14.3	<0.01	<0.1	0.3	
4A	0.37	0.021	2.2	<0.01	<0.1	1.0	
5	0.24	0.020	0.6	<0.01	<0.1	0.8	
5A	0.84	0.002	0.1	<0.01	<0.1	1.2	
6	0.02	0.001	0.7	<0.01	<0.1	0.3	
6A	0.15	0.058	1.9	<0.01	<0.1	0.4	
7	0.03	0.007	0.3	<0.01	<0.1	0.3	
7A	0.02	0.001	<0.1	<0.01	<0.1	0.4	
8	0.28	0.006	<0.1	<0.01	<0.1	0.6	
8A	0.27	0.002	<0.1	<0.01	<0.1	0.8	
9	1.64	0.003	<0.1	<0.01	<0.1	2.4	
9A	0.15	0.001	<0.1	<0.01	<0.1	0.7	
10	0.95	0.003	<0.1	<0.01	<0.1	1.5	
10A	0.51	0.001	<0.1	<0.01	<0.1	0.7	
11	0.04	0.001	0.2	<0.01	<0.1	0.1	
11A	0.35	0.003	0.1	<0.01	<0.1	0.6	
12	0.03	0.001	5.6	<0.01	<0.1	0.1	
12A	0.51	0.013	1.5	<0.01	<0.1	0.7	
13	0.03	0.008	0.3	<0.01	<0.1	0.1	
13A	0.34	0.013	<0.1	<0.01	<0.1	0.7	
14	0.18	0.021	5.0	<0.01	<0.1	0.7	
14A	0.25	0.004	0.1	<0.01	<0.1	0.9	
15	<0.01	0.018	3.4	<0.01	<0.1	<0.1	
15A	<0.01	0.002	1.9	<0.01	<0.1	<0.1	
16	0.01	0.001	5.1	<0.01	<0.1	0.1	
16A	0.01	0.001	<0.1	<0.01	<0.1	0.2	
17	<0.01	0.002	13.9	<0.01	<0.1	<0.1	
17A	<0.01	0.003	47.6	<0.01	<0.1	<0.1	
18	<0.01	0.001	13.6	<0.01	<0.1	0.1	
18A	<0.01	0.002	20.2	0.03	<0.1	<0.1	
19	0.06	0.003	29.3	0.01	<0.1	<0.1	
19A	<0.01	0.006	7.4	<0.01	<0.1	0.1	
20	0.01	0.013	29.7	<0.01	<0.1	<0.1	
20A	<0.01	0.008	2.6	<0.01	<0.1	0.1	
21	<0.01	0.021	1.6	<0.01	<0.1	0.1	
22	<0.01	0.001	2.6	<0.01	<0.1	0.5	
23	<0.01	0.002	0.1	0.02	<0.1	0.2	
24	0.03	0.002	<0.1	<0.01	<0.1	0.4	
25	0.01	0.002	0.9	<0.01	<0.1	0.2	
26	0.02	0.057	0.6	<0.01	<0.1	0.2	
27	<0.01	0.008	0.5	<0.01	<0.1	0.1	
28	0.10	0.020	<0.1	<0.01	<0.1	0.7	
29	0.06	0.004	4.0	0.02	<0.1	0.3	
30	0.01	0.003	1.5	<0.01	<0.1	0.5	
31	0.07	0.003	2.4	0.01	<0.1	0.4	
32	0.01	0.004	2.9	<0.01	<0.1	0.2	
Lagoon 1	6.31	0.005	0.5	1.99	2.5	9.6	
Lagoon 2	3.21	0.289	0.2	0.99	2.2	10.5	
Tank 1	6.85	1.83	0.9	2.21	3.2	11.9	
Tank 2	6.85	1.97	0.9	2.30	2.9	10.8	

Table Va. (Continued)

Date 6/18

Sampling Site	NH_3	NO_2	NO_3	$i-PO_4$	t-P	TKN	TOC
	ppm						
1	0.12	0.013	26.0	0.02	<0.1	<0.1	
1A	0.21	0.048	16.1	0.02	<0.1	0.1	
2	0.20	0.029	4.3	0.03	<0.1	0.2	
2A	0.08	0.007	18.1	0.01	<0.1	<0.1	
3	0.08	0.010	4.0	0.01	<0.1	0.1	
3A	0.11	0.011	1.6	0.02	<0.1	0.2	
4	0.21	0.052	15.8	0.01	<0.1	<0.1	
4A	0.32	0.020	6.7	0.01	<0.1	0.5	
5	0.43	0.014	0.5	<0.01	<0.1	0.7	
5A	1.20	0.009	<0.1	<0.01	<0.1	1.4	
6	0.04	0.005	2.7	<0.01	<0.1	<0.1	
6A	0.12	0.059	3.0	<0.01	<0.1	0.2	
7	0.13	0.025	0.3	0.01	<0.1	0.2	
7A	0.09	0.008	<0.1	0.01	<0.1	0.2	
8	0.34	0.020	<0.1	0.02	0.1	0.5	
8A	0.30	0.007	<0.1	0.01	0.1	1.3	
9	1.42	0.007	<0.1	0.01	<0.1	1.9	
9A	0.25	0.007	<0.1	0.01	<0.1	0.6	
10	1.13	0.011	<0.1	0.01	<0.1	1.5	
10A	0.60	0.006	<0.1	0.01	<0.1	0.7	
11	0.06	0.004	0.4	0.01	<0.1	0.1	
11A	0.35	0.011	0.1	0.01	<0.1	0.5	
12	0.07	0.010	6.7	0.01	<0.1	<0.1	
12A	0.53	0.016	2.3	0.01	<0.1	0.5	
13	0.10	0.011	0.1	0.01	<0.1	0.1	
13A	0.29	0.015	0.2	0.01	<0.1	0.5	
14	0.13	0.013	1.5	0.01	0.1	0.5	
14A	0.30	0.007	<0.1	0.01	0.1	0.5	
15	0.05	0.014	5.2	0.01	<0.1	<0.1	
15A	0.01	0.005	2.8	0.01	<0.1	<0.1	
16	0.04	0.010	3.6	0.01	<0.1	0.1	
16A	0.13	0.016	<0.1	0.02	0.1	0.2	
17	0.02	0.009	13.7	0.01	<0.1	0.1	
17A	0.01	0.006	44.7	0.01	<0.1	0.1	
18	0.04	0.009	13.6	0.01	<0.1	<0.1	
18A	0.06	0.011	14.2	0.01	0.3	<0.1	
19	0.04	0.021	28.9	0.01	<0.1	0.1	
19A	0.02	0.030	7.6	0.01	<0.1	0.3	
20	0.03	0.025	27.9	0.01	<0.1	0.1	
20A	0.03	0.014	2.4	0.01	<0.1	0.5	
21	<0.01	0.009	1.5	0.01	<0.1	0.2	
22	<0.01	0.006	2.7	0.01	<0.1	0.5	
23	<0.01	0.002	0.2	0.01	<0.1	0.3	
24	0.04	0.003	<0.1	0.01	<0.1	0.4	
25	0.02	0.005	1.1	0.01	<0.1	0.3	
26	0.05	0.064	0.7	0.01	<0.1	0.4	
27	0.03	0.009	0.5	0.01	<0.1	0.1	
28	0.16	0.010	<0.1	0.01	<0.1	0.6	
29	0.06	0.006	4.4	0.01	<0.1	0.2	
30	0.06	0.008	1.4	0.01	<0.1	0.3	
31	0.08	0.004	6.7	0.01	<0.1	<0.1	
32	0.06	0.004	2.9	0.01	<0.1	0.2	
Lagoon 1	4.83	0.022	0.1	1.59	2.1	9.2	
Lagoon 2	3.56	0.141	0.1	1.16	1.9	9.7	
Tank 1	1.97	3.80	3.6	2.22	2.7	5.4	
Tank 2	2.32	3.90	3.9	2.27	2.8	5.2	

Table Va. (Continued)

Date 6/22

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
				ppm			
1	0.04	0.002	22.4	<0.01	0.1	0.7	
1A	0.06	0.027	16.1	<0.01	<0.1	<0.1	
2	0.05	0.007	5.6	<0.01	<0.1	0.4	
2A	0.04	0.004	20.9	<0.01	<0.1	0.1	
3	0.03	0.002	4.0	<0.01	<0.1	0.1	
3A	0.02	0.002	2.9	<0.01	0.1	0.4	
4	0.08	0.033	17.5	<0.01	<0.1	0.2	
4A	0.31	0.013	3.8	<0.01	<0.1	0.6	
5	0.20	0.016	0.2	<0.01	<0.1	0.5	
5A	1.34	0.003	0.1	<0.01	<0.1	1.4	
6	0.02	0.001	1.4	<0.01	<0.1	0.4	
6A	0.02	0.046	5.1	<0.01	<0.1	0.2	
7	0.04	0.006	0.2	0.01	<0.1	0.1	
7A	0.02	0.004	0.1	<0.01	<0.1	0.2	
8	0.12	0.014	0.1	<0.01	<0.1	0.3	
8A	0.21	0.005	0.1	<0.01	<0.1	0.5	
9	1.68	0.008	0.1	0.01	<0.1	1.8	
9A	0.20	0.004	0.1	0.01	<0.1	0.6	
10	1.00	0.004	0.1	<0.01	<0.1	1.2	
10A	0.53	0.001	0.1	<0.01	<0.1	0.8	
11	0.02	0.001	0.6	<0.01	<0.1	1.5	
11A	0.42	0.003	0.1	0.01	<0.1	0.9	
12	0.05	0.010	6.6	0.01	<0.1	0.2	
12A	0.21	0.014	5.1	<0.01	<0.1	0.5	
13	0.06	0.001	0.3	0.10	<0.1	0.2	
13A	0.16	0.033	0.4	0.01	<0.1	0.4	
14	0.10	0.010	2.1	0.01	0.1	0.8	
14A	0.27	0.001	0.1	<0.01	<0.1	0.6	
15	0.02	0.002	4.7	<0.01	<0.1	0.4	
15A	<0.01	0.034	2.7	0.01	0.1	0.2	
16	0.06	0.004	6.6	<0.01	0.1	0.9	
16A	0.06	0.004	0.2	<0.01	<0.1	0.3	
17	0.05	0.005	9.6	<0.01	<0.1	0.2	
17A	0.06	0.001	56.9	<0.01	<0.1	0.1	
18	0.05	0.005	14.6	<0.01	<0.1	0.1	
18A	0.04	0.005	12.2	<0.01	<0.1	0.3	
19	0.04	0.007	41.1	<0.01	<0.1	<0.1	
19A	0.03	0.014	5.7	<0.01	<0.1	0.2	
20	0.03	0.010	29.6	<0.01	<0.1	0.2	
20A	0.02	0.020	4.4	<0.01	0.1	0.2	
21	0.02	0.007	1.6	<0.01	<0.1	<0.1	
22	<0.01	0.001	3.8	<0.01	0.1	0.2	
23	<0.01	0.001	0.4	<0.01	<0.1	0.1	
24	0.03	0.005	0.3	<0.01	<0.1	0.3	
25	0.01	0.009	1.1	<0.01	<0.1	0.1	
26	<0.01	0.027	0.8	<0.01	0.1	0.2	
27	<0.01	0.004	0.6	<0.01	<0.1	0.1	
28	0.02	0.005	<0.1	<0.01	0.1	0.4	
29	<0.01	0.016	4.6	0.02	<0.1	0.4	
30	<0.01	0.027	1.5	0.02	<0.1	0.3	
31	0.04	0.046	11.5	0.05	0.1	<0.1	
32	0.04	0.095	3.0	0.02	0.1	0.2	
Lagoon 1	4.07	0.041	0.3	1.37	2.7	16.6	
Lagoon 2	5.70	0.215	0.3	1.28	2.5	13.9	
Tank 1	5.89	0.594	2.7	1.97	2.6	9.8	
Tank 2	5.56	0.625	2.9	2.03	2.6	9.5	

Table Va. (Continued)

Date 6/25

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	0.06	0.015	14.8	<0.01	<0.1	<0.1	
1A	0.12	0.030	13.4	<0.01	<0.1	<0.1	
2	0.08	0.019	5.7	0.01	0.1	0.2	
2A	0.04	0.014	14.8	<0.01	<0.1	<0.1	
3	0.03	0.013	5.5	<0.01	<0.1	<0.1	
3A	0.02	0.017	4.2	<0.01	<0.1	<0.1	
4	0.12	0.033	20.8	<0.01	<0.1	<0.1	
4A	0.21	0.025	5.4	<0.01	<0.1	0.7	
5	0.21	0.017	0.2	<0.01	<0.1	0.4	
5A	1.40	0.015	0.1	<0.01	<0.1	1.4	
6	0.01	0.022	2.3	<0.01	<0.1	<0.1	
6A	0.06	0.049	4.3	<0.01	<0.1	0.2	
7	0.10	0.023	0.3	<0.01	<0.1	0.2	
7A	0.04	0.023	0.3	<0.01	<0.1	0.3	
8	0.15	0.021	<0.1	<0.01	<0.1	0.3	
8A	0.22	0.015	<0.1	<0.01	<0.1	0.4	
9	1.55	0.014	<0.1	<0.01	<0.1	1.6	
9A	0.20	0.017	<0.1	<0.01	<0.1	0.5	
10	1.00	0.015	<0.1	<0.01	<0.1	1.4	
10A	0.51	0.013	<0.1	<0.01	<0.1	0.8	
11	0.03	0.008	0.4	<0.01	<0.1	0.2	
11A	0.51	0.013	0.1	<0.01	<0.1	0.9	
12	0.05	0.009	6.7	<0.01	<0.1	0.3	
12A	0.17	0.024	5.7	<0.01	<0.1	0.3	
13	0.03	0.009	0.2	<0.01	<0.1	0.3	
13A	0.06	0.026	0.3	<0.01	<0.1	0.3	
14	0.14	0.015	1.7	<0.01	<0.1	0.8	
14A	0.26	0.011	0.1	<0.01	<0.1	1.0	
15	0.03	0.011	3.9	<0.01	<0.1	0.1	
15A	0.03	0.014	5.4	<0.01	<0.1	0.1	
16							
16A	0.08	0.012	0.1	<0.01			
17	<0.01	0.008	43.5	<0.01	<0.1	<0.1	
17A	<0.01	0.010	8.1	<0.01	<0.1	0.1	
18	<0.01	0.008	14.8	<0.01	<0.1	<0.1	
18A	<0.01	0.012	8.9	<0.01	<0.1	<0.1	
19	0.03	0.014	35.6	<0.01	<0.1	0.1	
19A	0.01	0.018	7.0	<0.01	<0.1	0.1	
20	0.01	0.019	26.4	<0.01	<0.1	<0.1	
20A	0.01	0.022	4.0	<0.01	<0.1	<0.1	
21	<0.01	0.007	2.0	<0.01	<0.1	0.2	
22	<0.01	0.011	4.2	<0.01	<0.1	0.4	
23	<0.01	0.009	0.3	<0.01	<0.1	0.1	
24	0.03	0.008	0.2	<0.01	<0.1	0.2	
25	0.04	0.011	1.1	<0.01	<0.1	0.3	
26	<0.01	0.029	0.8	<0.01	<0.1	0.1	
27	<0.01	0.011	0.8	<0.01	<0.1	0.2	
28	0.04	0.009	0.1	<0.01	<0.1	0.3	
29	0.01	0.014	3.9	0.01	<0.1	0.2	
30	0.03	0.017	1.5	0.01	0.1	<0.1	
31	0.01	0.008	13.6	<0.01	0.1	0.2	
32	0.01	0.006	3.0	<0.01	0.1	0.3	
Lagoon 1	8.05	0.017	0.6	1.92	2.7	14.1	
Lagoon 2	9.58	0.071	0.2	1.93	2.6	14.9	
Tank 1	6.83	0.890	2.6	2.30	2.5	9.6	
Tank 2	6.66	0.901	3.1	2.35	2.5	9.7	

Table Va. (Continued)

Date 6/29*

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1							
1A							
2							
2A							
3							
3A							
4							
4A							
5							
5A							
6							
6A							
7							
7A							
8							
8A							
9	1.54	0.003	<0.1	<0.01	<0.1	1.6	
9A	0.23	0.003	<0.1	<0.01	0.1	0.3	
10	1.02	0.005	<0.1	<0.01	<0.1	1.0	
10A	0.53	0.001	<0.1	<0.01	0.1	0.7	
11	0.08	0.001	0.1	<0.01	<0.1	0.2	
11A	0.56	0.006	<0.1	<0.01	<0.1	0.7	
12	0.08	0.002	3.9	<0.01	0.1	0.3	
12A	0.11	0.022	5.6	<0.01	<0.1	0.1	
13	0.07	0.003	0.2	<0.01	<0.1	0.1	
13A	0.08	0.022	0.1	<0.01	0.1	0.2	
14	0.17	0.008	2.2	<0.01	0.1	0.4	
14A	0.40	<0.001	<0.1	<0.01	<0.1	0.6	
15							
15A							
16							
16A							
17							
17A							
18							
18A							
19							
19A							
20							
20A							
21							
22							
23	0.04	<0.001	<0.1	<0.01	<0.1	0.2	
24							
25							
26							
27							
28							
29							
30							
31							
32							
Lagoon 1	6.21	0.005	<0.1	0.90	4.1	29.7	
Lagoon 2	11.1	0.040	<0.1	2.16	3.2	16.7	
Tank 1	9.64	0.604	1.0	2.30	3.3	14.1	
Tank 2	9.50	0.652	1.2	2.38	2.7	13.2	

* Inclement weather limited sampling.

Table Va. (Continued)

Date 7/01

Sampling Site	NH_3	NO_2	NO_3	$i\text{-}PO_4$	t-P	TKN	TOC
	ppm						
1	0.04	0.004	4.4	<0.01	0.1	0.1	14
1A	0.04	0.009	7.7	<0.01	<0.1	0.1	11
2	0.26	0.024	5.7	0.03	0.1	1.0	7
2A	0.03	<0.001	8.0	<0.01	<0.1	<0.1	11
3	0.04	<0.001	3.7	<0.01	<0.1	0.1	9
3A	0.04	<0.001	4.8	<0.01	<0.1	<0.1	11
4	0.08	0.007	22.8	<0.01	<0.1	<0.1	10
4A	0.41	0.010	7.3	<0.01	<0.1	0.3	46
5	0.34	0.012	0.2	<0.01	<0.1	0.6	19
5A	1.38	<0.001	<0.1	<0.01	<0.1	1.4	14
6	0.04	<0.001	2.2	<0.01	<0.1	0.1	5
6A	0.04	0.009	4.4	<0.01	<0.1	0.3	6
7	0.04	0.003	0.4	<0.01	<0.1	0.3	14
7A	0.05	0.009	0.7	<0.01	<0.1	0.2	11
8	0.18	0.010	0.4	<0.01	<0.1	0.4	13
8A	0.33	0.002	<0.1	<0.01	<0.1	0.6	11
9	1.49	0.012	<0.1	<0.01	<0.1	1.6	13
9A	0.21	0.001	<0.1	<0.01	<0.1	0.5	8
10	0.80	0.005	<0.1	<0.01	<0.1	1.0	13
10A	0.42	0.005	<0.1	<0.01	<0.1	0.7	7
11	0.04	0.001	<0.1	<0.01	<0.1	0.1	10
11A	0.40	0.007	<0.1	<0.01	<0.1	1.9	10
12	0.06	0.002	2.6	<0.01	<0.1	0.2	10
12A	0.12	0.017	4.0	<0.01	<0.1	0.3	10
13	0.04	0.001	0.1	<0.01	<0.1	0.1	13
13A	0.20	0.003	<0.1	<0.01	<0.1	0.9	13
14	0.17	0.005	0.9	<0.01	<0.1	0.5	12
14A	0.47	<0.001	<0.1	<0.01	<0.1	0.7	16
15	0.06	0.002	4.1	<0.01	0.1	<0.1	7
15A	0.03	0.003	1.6	<0.01	0.1	0.4	9
16	<0.01	<0.001	1.6	<0.01	0.1	<0.1	
16A							
17	0.03	0.002	3.4	0.01	0.1	0.2	7
17A	<0.01	<0.001	9.7	0.01	0.1	0.2	8
18	<0.01	<0.001	7.8	0.01	0.1	0.3	5
18A	<0.01	<0.001	13.7	0.02	0.1	0.1	14
19	<0.01	<0.001	23.3	0.01	<0.1	0.1	18
19A	0.03	0.002	19.7	0.01	0.1	0.1	11
20	0.01	0.002	10.1	<0.01	<0.1	0.1	6
20A	<0.02	<0.005	4.0	<0.01	0.1	0.1	6
21	<0.01	<0.001	2.0	<0.01	<0.1	0.1	21
22	0.01	<0.001	5.5	<0.01	<0.1	0.1	9
23	0.01	<0.001	<0.1	<0.01	<0.1	0.4	9
24	0.06	<0.001	<0.1	<0.01	<0.1	0.3	11
25	0.02	<0.001	1.0	<0.01	0.1	0.6	8
26	0.04	0.002	0.4	<0.01	0.1	0.2	8
27	<0.01	<0.001	1.0	<0.01	<0.1	<0.1	6
28	0.11	0.001	<0.1	<0.01	<0.1	0.4	9
29	0.08	0.015	3.8	0.04	<0.1	0.2	10
30	0.13	0.014	1.6	0.06	0.1	0.6	10
31	0.17	0.016	4.7	0.11	0.1	0.3	9
32	0.53	0.245	2.3	0.23	0.1	0.9	9
Lagoon 1	6.98	0.006	<0.1	1.38	2.1	12.3	39
Lagoon 2	18.6	0.010	<0.1	4.15	5.2	25.3	45
Tank 1	13.8	0.367	0.5	3.30	3.7	18.8	34
Tank 2	13.0	0.406	0.8	3.23	3.7	17.7	35

Table Va. (Continued)

Date 7/06

Sampling Site	NH_3	NO_2	NO_3	$i\text{-}PO_4$	t-P	TKN	TOC
	ppm						
1	0.04	0.004	2.9	0.01	<0.1	<0.1	
1A	0.04	0.009	9.7	0.01	0.1	0.1	
2	0.03	0.006	6.1	0.01	<0.1	0.1	
2A	0.02	0.001	15.4	0.01	<0.1	<0.1	
3	0.01	<0.001	9.3	0.01	<0.1	<0.1	
3A	0.02	0.001	3.7	0.01	<0.1	<0.1	
4	0.03	0.026	23.0	0.01	<0.1	0.1	
4A	0.43	0.022	4.0	<0.01	<0.1	0.3	
5	0.24	0.027	0.4	<0.01	<0.1	0.3	
5A	1.14	<0.001	<0.1	<0.01	<0.1	1.2	
6	0.02	0.001	4.4	0.01	<0.1	<0.1	
6A	0.03	0.026	2.9	<0.01	<0.1	0.2	
7	0.02	0.005	0.6	<0.01	<0.1	0.1	
7A	0.03	0.011	0.9	<0.01	<0.1	0.1	
8	0.06	0.002	<0.1	<0.01	<0.1	0.2	
8A	0.26	0.001	<0.1	<0.01	<0.1	0.4	
9	1.16	0.003	<0.1	<0.01	<0.1	1.2	
9A	0.17	0.001	<0.1	<0.01	<0.1	0.2	
10	0.47	0.004	<0.1	0.01	<0.1	0.6	
10A	0.36	0.001	0.1	0.01	0.1	0.4	
11	0.01	<0.001	0.2	<0.01	0.1	<0.1	
11A	0.50	0.013	0.3	<0.01	0.1	0.6	
12	0.01	<0.001	1.6	<0.01	<0.1	<0.1	
12A	0.17	0.023	2.4	<0.01	<0.1	0.2	
13	0.02	0.002	0.9	<0.01	<0.1	<0.1	
13A	0.17	0.011	0.2	<0.01	<0.1	0.1	
14	0.10	0.007	1.0	<0.01	<0.1	0.2	
14A	0.41	0.001	0.1	<0.01	<0.1	0.6	
15	0.01	0.009	4.2	<0.01	<0.1	0.1	
15A	0.01	<0.001	3.0	<0.01	0.1	0.2	
16							
16A	0.01	0.004	0.1	<0.01	0.1	0.2	
17	0.01	0.018	1.9	<0.01	<0.1	<0.1	
17A	<0.01	0.002	5.1	<0.01	<0.1	<0.1	
18	<0.01	0.002	6.6	<0.01	<0.1	0.2	
18A	<0.01	0.003	10.0	<0.01	<0.1	0.9	
19	<0.01	0.003	21.5	<0.01	<0.1	0.1	
19A	0.01	0.010	18.8	<0.01	<0.1	0.2	
20	<0.01	0.009	10.4	<0.01	<0.1	0.6	
20A	<0.01	0.029	3.5	<0.01	<0.1	<0.1	
21	<0.01	0.003	2.1	0.01	<0.1	0.1	
22	<0.01	0.002	5.8	<0.01	0.1	0.2	
23	<0.01	0.003	0.3	<0.01	<0.1	0.5	
24	<0.01	0.001	0.2	<0.01	<0.1	0.3	
25	<0.01	0.001	1.2	<0.01	<0.1	0.4	
26	0.05	0.010	0.7	<0.01	<0.1	0.4	
27	<0.01	0.002	1.7	<0.01	<0.1	0.1	
28	0.10	0.008	0.2	<0.01	<0.1	0.2	
29	0.02	0.019	5.2	<0.01	<0.1	0.1	
30	0.01	0.015	4.9	<0.01	<0.1	0.1	
31	0.06	0.029	3.9	0.09	0.1	0.2	
32	0.35	0.161	2.3	0.16	0.2	0.8	
Lagoon 1	7.37	0.008	0.2	1.31	2.6	13.8	
Lagoon 2	17.4	0.034	0.2	3.48	4.2	22.7	
Tank 1	13.3	0.155	0.7	2.14	2.6	16.8	
Tank 2	12.4	0.162	1.1	2.18	2.5	16.5	

Table Va. (Continued)

Date 7/09

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	0.04	0.003	2.3	<0.01	0.1	<0.1	
1A	0.06	0.006	8.4	<0.01	<0.1	<0.1	
2	0.08	0.011	6.2	0.01	<0.1	<0.1	
2A	0.04	0.003	15.0	<0.01	<0.1	<0.1	
3	0.04	0.004	11.9	<0.01	<0.1	<0.1	
3A	0.03	0.004	3.7	<0.01	<0.1	<0.1	
4	0.03	0.002	26.2	<0.01	<0.1	<0.1	
4A	0.32	0.020	12.4	<0.01	<0.1	0.1	
5	0.25	0.010	0.3	<0.01	<0.1	0.2	
5A	1.20	0.002	0.1	<0.01	<0.1	1.0	
6	0.05	0.003	7.0	<0.01	<0.1	<0.1	
6A	0.04	0.006	2.8	<0.01	<0.1	<0.1	
7	0.02	0.005	0.7	<0.01	<0.1	0.1	
7A	0.06	0.009	1.5	<0.01	<0.1	0.1	
8	0.09	0.003	<0.1	<0.01	<0.1	0.3	
8A	0.24	0.003	<0.1	<0.01	<0.1	0.3	
9	1.00	0.004	<0.1	<0.01	<0.1	1.1	
9A	0.20	0.003	<0.1	0.01	<0.1	0.3	
10	0.55	0.005	<0.1	<0.01	<0.1	0.8	
10A	0.44	0.004	<0.1	<0.01	0.1	0.7	
11	0.04	0.004	0.1	<0.01	0.1	<0.1	
11A	0.32	0.005	0.3	<0.01	0.1	0.3	
12	0.05	0.004	2.9	<0.01	0.1	<0.1	
12A	0.14	0.016	2.7	<0.01	<0.1	<0.1	
13	0.01	0.005	1.8	<0.01	<0.1	<0.1	
13A	0.09	0.007	0.6	<0.01	<0.1	<0.1	
14	0.13	0.005	0.5	<0.01	<0.1	0.2	
14A	0.43	0.006	0.1	<0.01	<0.1	0.4	
15	0.01	0.038	2.9	<0.01	<0.1	<0.1	
15A	0.01	0.003	2.9	<0.01	<0.1	<0.1	
16	0.01	0.003	0.8	<0.01			
16A	0.03	0.002	0.2	<0.01	<0.1	0.1	
17	0.01	0.005	2.5	<0.01	<0.1	<0.1	
17A	0.01	0.003	3.3	<0.01	<0.1	<0.1	
18	0.09	0.004	6.6	<0.01	<0.1	<0.1	
18A	<0.01	0.002	6.5	<0.01	<0.1	<0.1	
19	<0.01	0.003	15.7	<0.01	<0.1	0.2	
19A	<0.01	0.003	15.3	<0.01	<0.1	<0.1	
20	0.02	0.005	5.7	<0.01	<0.1	0.5	
20A	0.02	0.025	3.2	0.01	<0.1	0.1	
21	0.02	0.005	3.6	0.01	<0.1	<0.1	
22	0.02	0.002	3.6	0.01	<0.1	0.2	
23	<0.01	0.004	0.3	0.01	<0.1	0.2	
24	0.07	0.001	0.2	<0.01	<0.1	0.2	
25	0.01	0.003	1.0	<0.01	<0.1	0.2	
26	0.02	0.005	0.5	0.01	<0.1	0.3	
27	0.01	0.003	3.5	0.01	<0.1	0.1	
28	0.15	0.006	0.1	0.01	<0.1	0.4	
29	0.04	0.009	4.0	0.01	<0.1	0.2	
30	0.04	0.003	4.8	0.01	<0.1	0.4	
31	0.04	0.001	5.8	0.01	<0.1	0.2	
32	0.02	0.002	2.3	<0.01	0.2	0.4	
Lagoon 1	5.93	0.009	0.2	1.04	2.0	11.7	
Lagoon 2	15.2	0.016	0.2	3.70	5.0	26.0	
Tank 1	7.78	0.151	0.6	1.73	2.2	11.5	
Tank 2	7.85	0.163	1.0	1.75	2.1	11.5	

Table Va. (Continued)

Date 7/13

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	<0.01	0.281	2.0	<0.01	<0.1	3.2	
1A	<0.01	0.013	8.4	<0.01	<0.1	0.5	
2	0.01	0.035	2.6	<0.01	<0.1	1.7	
2A	0.01	0.235	12.8	<0.01	<0.1	0.9	
3	<0.01	0.007	12.0	<0.01	<0.1	0.3	
3A	<0.01	0.468	3.4	<0.01	<0.1	0.3	
4	0.01	0.002	6.1	<0.01	<0.1	0.9	
4A	0.77	0.047	5.0	<0.01	<0.1	0.8	
5	0.39	0.008	0.1	<0.01	<0.1	1.3	
5A	1.56	0.002	0.1	<0.01	<0.1	4.0	
6	0.08	0.001	9.5	<0.01	<0.1	0.6	
6A	0.04	0.046	3.0	<0.01	<0.1	0.3	
7	0.04	0.007	0.5	<0.01	<0.1	1.6	
7A	0.08	0.008	1.1	<0.01	<0.1	0.3	
8	0.27	0.005	0.1	<0.01	<0.1	1.8	
8A	0.41	0.005	0.1	<0.01	<0.1	0.8	
9	0.47	0.004	<0.1	<0.01	<0.1	3.4	
9A	0.19	0.005	<0.1	<0.01	<0.1	1.2	
10	0.32	0.015	0.2	<0.01	<0.1	2.1	
10A	0.39	0.004	0.1	<0.01	0.2	6.0	
11	0.06	0.006	0.9	<0.01	<0.1	0.7	
11A	0.15	0.008	0.6	<0.01	<0.1	0.9	
12	0.04	0.004	1.2	<0.01	<0.1	1.0	
12A	0.30	0.068	2.4	<0.01	<0.1	1.4	
13	0.06	0.006	2.1	<0.01	<0.1	0.6	
13A	0.25	0.014	0.2	<0.01	<0.1	0.9	
14	0.27	0.008	0.3	<0.01	<0.1	1.1	
14A	0.34	0.005	0.1	<0.01	<0.1	1.4	
15	0.05	0.002	2.0	<0.01	<0.1	0.3	
15A	<0.01	0.005	1.1	<0.01	<0.1	0.3	
16							
16A							
17	<0.01	0.002	2.9	<0.01	<0.1	0.7	
17A	0.02	0.002	1.6	<0.01	<0.1	0.7	
18	0.01	0.006	8.5	<0.01	<0.1	0.6	
18A	0.02	0.037	3.8	<0.01	<0.1	0.6	
19	0.02	0.001	9.5	<0.01	<0.1	<0.1	
19A	0.02	0.001	10.3	<0.01	<0.1	<0.1	
20	0.08	0.002	4.0	<0.01	<0.1	<0.1	
20A	0.04	0.040	5.0	<0.01	<0.1	<0.1	
21	0.02	<0.001	4.5	<0.01	<0.1	<0.1	
22	0.04	0.001	2.4	<0.01	<0.1	0.2	
23	0.04	0.001	0.1	<0.01	<0.1	<0.1	
24	0.10	<0.001	<0.1	<0.01	<0.1	<0.1	
25	0.04	<0.001	1.5	<0.01	<0.1	<0.1	
26	0.05	<0.001	0.4	<0.01	<0.1	0.5	
27	0.11	<0.001	8.0	<0.01	<0.1	<0.1	
28	0.37	0.024	0.1	0.02	<0.1	0.3	
29	<0.01	0.002	2.0	0.01	<0.1	0.5	
30	<0.01	0.001	5.7	0.01	<0.1	0.5	
31	0.04	0.012	7.8	<0.01	<0.1	0.3	
32	0.01	0.004	2.9	<0.01	<0.1	<0.1	
Lagoon 1	7.84	0.008	0.2	1.52	2.6	14.4	
Lagoon 2	12.5	0.012	0.2	3.44	4.9	21.7	
Tank 1	7.58	0.177	0.7	1.96	2.4	10.7	
Tank 2	7.44	0.190	1.2	1.97	2.4	11.1	

Table Va. (Continued)

Date 7/16

Sampling Site	NH_3	NO_2	NO_3	$i\text{-}PO_4$	t-P	TKN	TOC
	ppm						
1	0.10	0.017	1.9	0.01	0.1	2.4	
1A	0.03	0.005	6.6	0.01	0.1	1.1	
2	0.11	0.006	4.6	0.01	<0.1	0.9	
2A	0.11	0.067	8.3	<0.01	0.1	0.6	
3	0.02	0.005	11.3	<0.01	<0.1	0.1	
3A	0.02	0.058	5.9	<0.01	0.1	0.4	
4	<0.01	0.008	6.7	<0.01	<0.1	0.2	
4A	0.54	0.025	6.7	<0.01	<0.1	1.1	
5	0.54	0.006	0.1	<0.01	0.1	1.5	
5A	1.27	0.003	0.1	<0.01	0.1	1.9	
6	<0.01	0.002	8.6	0.01	<0.1	<0.1	
6A	<0.01	0.008	4.4	<0.01	<0.1	0.2	
7	<0.01	0.006	0.2	<0.01	<0.1	0.3	
7A	0.06	0.009	0.6	<0.01	<0.1	<0.1	
8	0.11	0.003	0.1	<0.01	<0.1	2.1	
8A	0.43	0.001	0.1	<0.01	<0.1	1.0	
9	0.39	0.006	0.1	<0.01	<0.1	1.3	
9A	0.94	0.003	0.1	0.01	<0.1	1.5	
10	0.24	0.011	0.5	0.01	<0.1	0.8	
10A	0.42	0.003	0.1	<0.01	<0.1	3.7	
11	0.02	0.004	0.5	<0.01	<0.1	0.2	
11A	0.02	0.002	0.6	<0.01	0.3	1.0	
12	0.08	0.002	5.9	<0.01	0.7	<0.1	
12A	0.11	0.011	4.5	<0.01	0.3	1.2	
13	0.04	0.002	1.3	<0.01	0.1	0.1	
13A	0.21	0.006	0.2	<0.01	0.8	1.4	
14	0.35	0.010	0.2	<0.01	0.5	1.5	
14A	0.70	0.003	<0.1	<0.01	0.1	0.8	
15	0.06	0.002	2.8	<0.01	0.2	0.2	
15A	0.02	0.002	1.1	<0.01	0.2	<0.1	
16							
16A							
17	0.02	0.002	4.2	<0.01	1.3	4.6	
17A	0.02	0.002	1.2	<0.01	0.8	1.8	
18	0.03	0.006	7.5	<0.01	0.6	<0.1	
18A	0.02	0.009	3.5	<0.01	0.4	<0.1	
19	0.02	0.004	6.6	<0.01	0.1	<0.1	
19A	0.03	0.005	8.7	<0.01	0.1	<0.1	
20	0.02	0.062	4.1	<0.01	0.7	0.3	
20A	0.02	0.004	5.1	<0.01	0.6	2.4	
21	0.02	0.002	5.4	<0.01	0.4	1.2	
22	0.02	0.001	1.7	<0.01	0.6	0.2	
23	0.02	<0.001	0.2	0.01	0.4	1.0	
24	0.04	0.001	0.1	<0.01	0.3	0.8	
25	0.08	0.001	2.5	<0.01	2.3	2.9	
26	0.04	0.001	0.6	<0.01	0.5	0.9	
27	0.04	0.004	9.3	<0.01	0.1	<0.1	
28	0.04	0.002	0.2	<0.01			
29	0.25	0.002	1.8	0.01	0.1	1.5	
30	0.06	0.002	8.1	0.01	0.1	<0.1	
31	0.05	0.002	8.4	0.01	0.7	0.9	
32	0.05	0.002	3.6	<0.01	0.9	0.2	
Lagoon 1	9.26	0.010	0.2	2.43	4.2	23.2	
Lagoon 2	11.7	0.013	0.2	3.55	4.5	18.8	
Tank 1	8.15	0.197	0.7	2.33	2.9	11.8	
Tank 2	7.97	0.198	1.1	2.35	2.9	11.9	

Table Va. (Continued)

Date 7/20

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	0.02	0.013	1.8		<0.01	0.7	
1A	0.02	0.008	3.6		<0.01	1.1	
2	0.02	<0.001	5.7		<0.01	0.4	
2A	0.09	0.017	6.3		<0.01	0.5	
3	0.03	0.002	12.3		<0.01	0.4	
3A	0.01	0.081	6.6		<0.01	0.2	
4	0.03	0.004	8.4		<0.01	0.4	
4A	0.26	0.017	7.0		<0.01	0.6	
5	0.53	0.006	<0.1		<0.01	1.4	
5A	1.17	0.001	<0.1		0.03	2.5	
6	0.02	0.010	8.2		<0.01	0.3	
6A	0.03	0.028	3.7		<0.01	0.2	
7	0.02	0.003	0.2		<0.01	0.3	
7A	0.05	0.005	0.1		<0.01	0.4	
8	0.25	0.001	<0.1		0.04	1.3	
8A	0.31	0.003	<0.1		<0.01	1.7	
9	0.32	0.006	<0.1		<0.01	1.2	
9A	0.58	<0.001	<0.1		<0.01	1.3	
10	0.11	0.017	0.3		<0.01	1.7	
10A	0.30	<0.001	<0.1		<0.01	1.7	
11	0.03	0.001	0.5		<0.01	<0.1	
11A	0.04	0.002	0.4		<0.01	0.2	
12	0.02	0.001	6.2		<0.01	0.4	
12A	0.32	0.020	3.1		<0.01	1.5	
13	0.02	0.003	1.9		<0.01	0.2	
13A	0.19	0.016	0.3		<0.01	0.4	
14	0.30	0.003	0.1		<0.01	0.6	
14A	0.64	0.001	<0.1		<0.01	1.0	
15	0.02	<0.001	4.1		<0.01	<0.1	
15A	0.02	0.001	1.5		<0.01	<0.1	
16							
16A							
17	<0.01	0.001	<0.1		<0.01	0.2	
17A	<0.01	<0.001	<0.1		<0.01	0.7	
18	<0.01	0.002	<0.1		<0.01	0.4	
18A	<0.01	<0.001	<0.1		<0.01	0.4	
19	<0.01	0.001	<0.1		<0.01	0.4	
19A	<0.01	0.007	<0.1		<0.01	0.4	
20	<0.01	0.001	<0.1		<0.01	0.2	
20A	<0.01	0.009	<0.1		<0.01	0.4	
21	<0.01	<0.001	<0.1		<0.01	0.4	
22	0.04	0.001	1.2		<0.01	0.7	
23	0.06	0.002	0.1		0.03	0.4	
24	0.08	0.001	<0.1		<0.01	0.4	
25	0.06	0.001	1.8		<0.01	0.4	
26	0.05	<0.001	1.1		<0.01	0.2	
27	0.04	<0.001	8.5		<0.01	0.2	
28							
29	0.05	0.001	3.0		<0.01	0.3	
30	0.30	0.002	7.0		<0.01	1.0	
31	0.06	<0.001	7.1		<0.01	0.4	
32	0.04	0.002	3.6		0.03	0.4	
Lagoon 1	10.7	0.010	0.1		4.70	23.6	
Lagoon 2	19.4	0.014	0.1		6.57	26.7	
Tank 1	17.0	0.218	0.7		5.18	21.5	
Tank 2	16.8	0.224	0.9		5.15	21.2	

Table Va. (Continued)

Date 7/23

Sampling Site	NH_3	NO_2	NO_3	$i\text{-}PO_4$	t-P	TKN	TOC
	ppm						
1	0.04	0.003	1.5		0.01	0.1	
1A	0.03	0.002	5.0		<0.01	0.2	
2	0.02	0.001	4.8		<0.01	<0.1	
2A	0.10	0.010	6.6		0.01	0.3	
3	0.04	0.002	12.9		0.01	<0.1	
3A	0.04	0.055	7.4		0.01	0.4	
4	0.02	0.003	7.5		0.01	0.1	
4A	0.21	0.034	7.9		<0.01	0.5	
5	0.39	0.004	0.1		<0.01	1.0	
5A	1.37	0.002	<0.1		<0.01	2.0	
6	0.02	<0.001	9.2		<0.01	0.1	
6A	0.07	0.010	4.7		<0.01	0.3	
7	0.01	0.002	0.1		<0.01	0.2	
7A	0.09	0.001	<0.1		<0.01	0.3	
8	0.32	0.002	<0.1		<0.01	1.0	
8A	0.29	0.001	<0.1		<0.01	1.0	
9	0.45	0.005	<0.1		0.08	1.2	
9A	0.20	0.001	<0.1		0.04	1.0	
10	0.13	0.012	0.2		0.02	0.6	
10A	0.26	0.001	<0.1		0.02	1.9	
11	0.04	<0.001	0.4		<0.01	<0.1	
11A	0.04	0.003	0.4		<0.01	<0.1	
12	0.03	<0.001	4.6		<0.01	<0.1	
12A	0.36	0.013	2.5		<0.01	0.6	
13	0.03	<0.001	3.8		<0.01	0.1	
13A	0.09	0.003	2.1		<0.01	0.2	
14	0.28	<0.001	<0.1		<0.01	0.6	
14A	0.62	<0.001	<0.1		<0.01	1.0	
15	0.04	0.002	5.2		<0.01	0.1	
15A	0.03	0.001	0.7		<0.01	0.4	
16							
16A							
17	0.01	0.001	7.6		<0.01	<0.1	
17A	0.02	0.001	0.9		<0.01	<0.1	
18	0.03	0.001	6.4		<0.01	<0.1	
18A	0.02	0.001	4.5		<0.01	<0.1	
19	0.02	0.001	4.9		<0.01	<0.1	
19A	0.02	0.013	8.6		<0.01	<0.1	
20	0.05	0.006	2.9		<0.01	<0.1	
20A	0.01	0.003	4.5		<0.01	<0.1	
21	0.01	0.001	5.9		<0.01	<0.1	
22	0.02	<0.001	1.0		<0.01	0.5	
23	0.01	0.002	0.1		<0.01	0.3	
24	0.07	0.001	<0.1		<0.01	0.4	
25	0.06	0.002	1.8		<0.01	0.5	
26	0.03	0.002	1.5		<0.01	0.3	
27	0.01	0.001	7.8		<0.01	0.1	
28							
29	0.02	0.001	3.1		<0.01	0.2	
30	0.03	0.006	7.0		<0.01	<0.2	
31	0.01	0.001	6.9		<0.01	0.3	
32	0.03	0.028	3.5		<0.01	0.1	
Lagoon 1	19.6	0.036	0.7		93.3	7.26	
Lagoon 2	27.3	0.012	0.1		6.17	34.8	
Tank 1	22.0	0.407	1.6		5.85	28.7	
Tank 2	22.0	0.412	1.9		5.80	28.3	

Table Va. (Continued)

Date 7/26

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	<0.01	0.012	2.1	<0.001	0.04	0.2	
1A	<0.01	0.008	4.1	0.003	0.01	0.3	
2	<0.01	<0.001	7.0	<0.001	0.01	<0.1	
2A	0.03	0.013	6.7	<0.001	0.01	0.1	
3	<0.01	0.001	11.2	<0.001	0.02	<0.1	
3A	<0.01	0.028	8.0	<0.001	0.02	0.2	
4	<0.01	0.006	7.7	<0.001	0.02	0.3	
4A	0.12	0.123	7.7	<0.001	0.02	0.6	
5	0.54	0.007	<0.1	<0.001	0.02	1.1	
5A	1.27	0.002	<0.1	<0.001	0.01	2.1	
6	0.02	<0.001	9.8	0.004	<0.01	<0.1	
6A	0.03	0.013	6.2	0.004	0.01	<0.1	
7	0.02	0.003	0.3	0.002	0.01	<0.1	
7A	0.04	0.009	0.2	0.002	0.01	<0.1	
8	0.30	0.002	<0.1	0.002	0.01	0.6	
8A	0.30	0.001	<0.1	0.006	0.02	0.6	
9	0.46	0.019	<0.1	0.005	0.02	1.0	
9A	0.10	0.003	<0.1	0.002	0.10	0.4	
10	0.13	0.015	0.3	0.007	0.05	0.4	
10A	0.26	0.004	<0.1	0.005	0.02	1.2	
11	0.01	0.002	0.3	0.005	0.02	0.3	
11A	0.02	0.003	0.3	0.010	0.02	0.4	
12	0.02	0.002	6.0	0.006	0.02	0.4	
12A	0.30	0.050	3.0	0.005	0.02	1.0	
13	0.01	0.005	4.1	0.004	0.02	0.5	
13A	0.12	0.019	3.2	0.004	0.02	0.8	
14	0.36	0.012	0.1	0.004	0.03	1.4	
14A	0.57	0.003	<0.1	0.004	0.02	2.1	
15	0.04	0.003	4.1	0.004	0.02	1.4	
15A	0.02	0.001	1.3	0.004	0.02	0.8	
16							
16A							
17	0.01	0.001	9.3	0.005	0.03	2.5	
17A	<0.01	0.001	4.2	0.005	<0.01	0.5	
18	<0.01	<0.001	5.6	0.007	<0.01	0.8	
18A	<0.01	0.001	5.0	0.007	<0.01	0.5	
19	<0.01	<0.001	4.1	0.006	0.01	1.5	
19A	<0.01	0.001	7.5	0.005	0.08	4.2	
20	<0.01	0.002	3.7	0.008	0.03	0.4	
20A	<0.01	0.003	4.1	0.007	<0.01	0.9	
21	<0.01	0.001	5.8	0.005	0.01	0.5	
22	<0.01	0.001	1.0	0.005	0.01	1.4	
23	0.01	0.001	0.1	0.008	0.02	2.8	
24	0.13	0.002	<0.1	0.004	0.01	1.7	
25	0.02	0.001	1.5	0.007	0.01	1.8	
26	0.01	0.001	1.6	0.004	0.02	1.7	
27	0.01	0.001	6.9	0.003	0.02	1.7	
28							
29	0.03	0.006	2.7	0.003	0.02	2.7	
30	0.06	0.001	7.9	0.013	0.02	1.5	
31	0.10	0.003	7.1	0.038	0.04	2.6	
32	0.04	0.009	3.4	0.006	0.02	1.9	
Lagoon 1	17.4	0.027	0.9	2.67	51.7	42.5	
Lagoon 2	24.7	0.013	0.1	4.91	6.14	31.3	
Tank 1	26.7	0.166	0.6	4.92	6.16	32.7	
Tank 2	26.5	0.160	0.7	4.89	6.07	32.4	

Table Va. (Continued)

Date 7/30

Sampling Site	NH_3	NO_2	NO_3	$i\text{-}PO_4$	t-P	TKN	TOC
	ppm						
1	0.18	0.014	2.0	0.023	0.02	1.4	
1A	0.10	0.003	4.3	0.009	0.04	1.7	
2	0.07	0.003	8.5	0.007	0.01	1.0	
2A	0.16	0.018	6.4	0.007	0.26	3.1	
3	0.04	0.003	8.5	0.010	0.04	1.9	
3A	0.05	0.022	9.0	0.006	0.01	1.9	
4	0.05	0.003	7.7	0.005	0.01	1.3	
4A	0.18	0.061	7.1	0.003	<0.01	2.0	
5	0.67	0.004	<0.1	<0.001	0.01	2.3	
5A	1.34	0.003	<0.1	0.004	0.01	4.0	
6	<0.01	0.002	7.9	0.003	<0.01	<0.1	
6A	<0.01	0.004	6.3	0.004	0.01	0.2	
7	<0.01	0.011	0.7	0.003	0.01	<0.1	
7A	0.04	0.004	0.2	0.003	0.01	0.4	
8	0.26	0.003	<0.1	0.004	0.01	0.5	
8A	0.26	0.002	<0.1	0.003	0.01	0.5	
9	0.52	0.003	<0.1	0.003	0.02	1.0	
9A	0.05	0.003	<0.1	0.007	0.02	0.4	
10	0.06	0.056	0.2	0.010	0.03	0.4	
10A	0.32	0.003	<0.1	0.005	0.02	0.8	
11	0.01	0.002	0.2	0.008	0.13	0.2	
11A	<0.01	0.003	0.3	0.006	0.04	0.2	
12	<0.01	0.002	11.4	0.004	<0.01	<0.1	
12A	0.48	0.037	3.8	0.003	<0.01	1.0	
13	0.01	0.003	3.6	0.003	<0.01	0.4	
13A	0.05	0.008	3.8	0.006	<0.01	0.4	
14	0.32	0.004	0.1	0.004	<0.01	0.6	
14A	0.53	0.001	<0.1	0.003	<0.01	1.0	
15	0.02	0.002	2.8	0.010	<0.01	0.4	
15A	<0.01	0.002	2.1	0.005	<0.01	0.3	
16							
16A							
17	<0.01	0.003	6.7	0.008	<0.01	0.4	
17A	<0.01	0.003	5.1	0.008	<0.01	0.4	
18	<0.01	0.003	4.8	0.008	<0.01	0.6	
18A	<0.01	0.003	6.0	0.012	<0.01	0.5	
19	<0.01	0.004	2.8	0.008	0.02	0.3	
19A	<0.01	0.012	5.4	0.005	0.02	0.3	
20	<0.01	0.005	3.4	0.008	0.01	0.5	
20A	<0.01	0.007	3.1	0.012	0.01	0.3	
21	<0.01	0.003	5.5	0.008	0.01	0.5	
22	<0.01	0.003	0.5	0.007	0.01	0.5	
23	0.03	0.003	0.1	0.003	0.03	0.2	
24	0.24	0.003	<0.1	0.002	<0.01	0.2	
25	0.03	0.003	2.1	0.005	<0.01	<0.1	
26	0.18	0.015	2.2	0.011	<0.01	0.6	
27	0.04	0.003	8.4	0.013	<0.01	<0.1	
28							
29	0.06	0.005	1.8	0.011	0.01	<0.1	
30	0.06	0.003	6.4	0.010	<0.01	<0.1	
31	0.13	0.004	11.6	0.010	0.02	<0.1	
32	0.06	0.003	3.9	0.006	0.01	<0.1	
Lagoon 1	23.2	0.024	0.6	3.28	18.1	13.6	
Lagoon 2	22.3	0.012	0.1	5.23	6.20	28.0	
Tank 1	23.6	0.183	0.4	5.19	5.91	28.5	
Tank 2	23.7	0.185	0.4	5.23	5.93	28.7	

Table Va. (Continued)

Date 8/03

Sampling Site	NH_3	NO_2	NO_3	$i-PO_4$	t-P	TKN	TOC
				ppm			
1	0.10	0.020	2.1	0.015	<0.01	0.1	13
1A	0.06	0.018	4.7	0.010	<0.01	0.1	9
2	0.12	0.013	6.7	0.009	<0.01	0.2	29
2A	0.14	0.067	6.6	0.009	<0.01	0.2	15
3	0.15	0.014	8.2	0.017	<0.01	0.1	12
3A	0.12	0.030	8.3	0.009	<0.01	0.1	12
4	0.05	0.017	6.6	0.005	<0.01	0.1	10
4A	0.17	0.062	6.4	0.009	<0.01	1.0	11
5	0.73	0.011	<0.1	0.002	0.01	1.5	14
5A	1.22	0.011	<0.1	0.002	<0.01	0.1	15
6	0.12	0.013	7.6	0.009	<0.01	0.1	9
6A	0.04	0.024	6.0	0.006	<0.01	0.1	9
7	0.03	0.024	1.0	0.006	<0.01	0.1	7
7A	0.09	0.020	0.4	0.006	<0.01	0.4	7
8	0.24	0.012	<0.1	0.008	<0.01	0.2	21
8A	0.28	0.014	<0.1	0.007	<0.01	0.7	15
9	0.70	0.014	<0.1	0.005	<0.01	0.1	16
9A	0.10	0.012	<0.1	0.009	<0.01	0.1	12
10	0.08	0.058	0.1	0.009	<0.01	0.7	14
10A	0.33	0.014	0.1	0.007	<0.01	0.2	11
11	0.01	0.012	0.1	0.006	0.01	0.2	10
11A	0.01	0.017	0.2	0.005	0.01	0.1	13
12	0.04	0.014	16.4	0.009	0.02	0.2	10
12A	0.38	0.070	8.1	0.005	<0.01	0.1	10
13	0.01	0.017	5.0	0.005	<0.01	0.1	10
13A	0.06	0.039	2.8	0.003	<0.01	0.2	8
14	0.36	0.017	0.3	0.001	<0.01	0.5	12
14A	0.68	0.011	0.1	0.001	<0.01	0.8	7
15	0.05	0.013	1.6	0.005	<0.01	0.2	14
15A	0.01	0.014	2.2	0.003	<0.01	0.4	13
16							
16A							
17	<0.01	0.014	6.6	0.007	<0.01	<0.1	10
17A	<0.01	0.014	5.4	0.007	<0.01	<0.1	8
18	<0.01	0.014	10.3	0.009	<0.01	<0.1	11
18A	<0.01	0.014	7.1	0.009	<0.01	<0.1	15
19	<0.01	0.014	4.2	0.007	0.01	0.1	6
19A	<0.01	0.017	5.3	0.003	0.01	0.1	9
20	<0.01	0.014	5.2	0.010	0.01	0.1	13
20A	<0.01	0.014	4.4	0.010	0.01	<0.1	8
21	<0.01	0.012	5.9	0.011	0.01	0.3	10
22	<0.01	0.011	0.4	0.005	<0.01	0.3	11
23	<0.01	0.008	0.2	0.002	<0.01	0.1	10
24	0.03	0.008	0.2	0.002	<0.01	0.1	16
25	0.12	0.008	3.7	0.002	0.01	0.1	12
26	0.05	0.009	2.3	0.038	<0.01	0.5	16
27	<0.01	0.011	10.0	0.013	<0.01	0.1	20
28							
29	<0.01	0.007	2.9	0.005	<0.01	0.5	8
30	<0.01	0.012	8.3	0.005	<0.01	<0.1	
31	<0.01	0.017	18.6	0.003	<0.01	<0.1	7
32	0.05	0.013	4.9	0.001	<0.01	<0.1	9
Lagoon 1	28.34	0.009	0.9	3.98	7.42	50.00	157
Lagoon 2	22.46	0.003	0.1	5.00	6.25	28.20	80
Tank 1	22.36	0.017	0.4	5.37	5.96	25.0	36
Tank 2	22.57	0.020	0.5	5.48	5.93	26.5	36

Table Va. (Continued)

Date 8/06

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	0.23	0.024	2.3	0.028	<0.01	0.1	
1A	0.12	0.012	4.4	0.011	<0.01	<0.1	
2	0.11	0.014	7.1	0.011	<0.01	<0.1	
2A	0.14	0.040	7.5	0.012	<0.01	<0.1	
3	0.05	0.011	6.4	0.009	<0.01	0.2	
3A	0.10	0.018	8.0	0.009	<0.01	0.2	
4	0.08	0.012	7.1	0.007	<0.01	0.1	
4A	0.16	0.043	6.4	0.008	<0.01	0.1	
5	0.70	0.013	<0.1	0.005	<0.01	1.0	
5A	1.30	0.014	<0.1	0.001	<0.01	1.6	
6	<0.01	0.020	7.9	0.001	<0.01	0.2	
6A	0.03	0.020	7.8	0.001	<0.01	<0.1	
7	0.01	0.014	0.9	0.001	<0.01	<0.1	
7A	0.11	0.009	0.6	0.001	<0.01	<0.1	
8	0.24	0.009	<0.1	0.001	<0.01	0.2	
8A	0.23	0.010	<0.1	0.001	<0.01	<0.1	
9	0.77	0.012	<0.1	0.001	<0.01	0.5	
9A	0.09	0.010	<0.1	0.005	<0.01	<0.1	
10	0.06	0.025	<0.1	0.009	0.02	<0.1	
10A	0.33	0.011	<0.1	0.001	<0.01	0.5	
11	0.03	0.010	0.2	0.014	<0.01	<0.1	
11A	0.03	0.011	0.2	0.009	<0.01	<0.1	
12	0.03	0.011	15.2	0.008	<0.01	<0.1	
12A	0.43	0.048	9.5	0.007	<0.01	<0.1	
13	0.25	0.011	4.6	0.005	<0.01	<0.1	
13A	0.11	0.018	5.4	0.005	<0.01	<0.1	
14	0.47	0.015	0.4	0.009	0.01	0.5	
14A	0.71	0.011	<0.1	0.006	<0.01	0.7	
15	0.06	0.010	1.4	0.007	<0.01	0.1	
15A	0.08	0.011	1.9	0.007	<0.01	0.1	
16							
16A							
17	<0.01	0.010	12.5	0.009	<0.01	<0.1	
17A	<0.01	0.014	4.2	0.009	<0.01	<0.1	
18	0.01	0.014	11.2	0.009	<0.01	<0.1	
18A	<0.01	0.010	8.2	0.009	<0.01	<0.1	
19	<0.01	0.013	5.7	0.009	<0.01	<0.1	
19A	<0.01	0.023	5.4	0.009	<0.01	<0.1	
20	<0.01	0.012	4.2	0.009	<0.01	<0.1	
20A	<0.01	0.028	4.0	0.011	<0.01	<0.1	
21	<0.01	0.014	6.1	0.009	<0.01	<0.1	
22	<0.01	0.014	0.1	0.008	<0.01	0.3	
23	0.14	0.003	<0.1	0.009	<0.01	0.1	
24	<0.01	0.003	<0.1	0.006	<0.01	0.2	
25	0.05	0.003	4.6	0.004	<0.01	<0.1	
26	<0.01	0.003	2.7	0.016	0.01	0.6	
27	<0.01	0.014	10.0	0.009	<0.01	<0.1	
28							
29	0.03	0.008	7.3	0.010	<0.01	<0.1	
30	<0.01	0.010	15.0	0.009	<0.01	<0.1	
31	<0.01	0.013	19.4	0.010	0.01	<0.1	
32	0.01	0.011	5.6	0.009	<0.01	<0.1	
Lagoon 1	37.75	0.009	0.8	3.61	4.74	32.60	
Lagoon 2	34.46	0.003	<0.1	5.50	6.35	26.50	
Tank 1	32.06	0.021	0.4	5.21	5.90	24.50	
Tank 2	21.24	0.021	0.4	5.27	5.84	24.40	

Table Va. (Continued)

Date 8/10

Sampling Site	NH_3	NO_2	NO_3	i-PO_4	t-P	TKN	TOC
	ppm						
1	<0.01	0.003	1.9	0.007	<0.01	<0.1	
1A	<0.01	0.003	3.3	0.029	<0.01	<0.1	
2	0.14	0.003	5.8	0.005	<0.01	<0.1	
2A	<0.01	0.031	6.8	0.001	<0.01	0.2	
3	<0.01	0.005	7.3	0.001	<0.01	0.1	
3A	<0.01	0.011	6.7	0.011	<0.01	0.1	
4	<0.01	0.005	5.5	0.005	<0.01	0.1	
4A	<0.01	0.020	5.4	0.001	<0.01	0.1	
5	0.81	0.010	<0.1	<0.001	<0.01	0.8	
5A	1.15	0.005	<0.1	<0.001	<0.01	1.2	
6	<0.01	0.008	5.7	<0.001	<0.01	0.1	
6A	<0.01	0.005	9.6	<0.001	<0.01	0.1	
7	<0.01	0.012	0.8	<0.001	<0.01	0.2	
7A	<0.01	0.005	0.7	<0.001	<0.01	0.2	
8	0.26	0.003	<0.1	<0.001	<0.01	0.4	
8A	0.17	0.005	<0.1	<0.001	<0.01	0.1	
9	1.54	0.020	<0.1	<0.001	<0.01	1.0	
9A	0.04	0.009	<0.1	<0.001	<0.01	0.2	
10	0.04	0.008	<0.1	0.005	<0.01	0.2	
10A	0.24	0.008	<0.1	<0.001	<0.01	0.5	
11	<0.01	0.005	0.3	0.001	<0.01	0.1	
11A	<0.01	0.003	0.2	0.003	<0.01	0.1	
12	<0.01	0.003	12.2	0.001	<0.01	0.1	
12A	0.67	0.037	6.6	<0.001	<0.01	0.6	
13	0.04	0.009	8.4	<0.001	<0.01	0.3	
13A	0.02	0.012	11.4	0.005	<0.01	0.3	
14	0.37	0.010	0.2	<0.001	<0.01	0.5	
14A	0.87	0.009	<0.1	<0.001	<0.01	0.8	
15	0.06	0.005	2.7	0.002	<0.01	0.3	
15A	<0.01	0.005	1.8	0.002	<0.01	0.3	
16							
16A							
17	<0.01	0.005	15.7	0.007	<0.01	<0.1	
17A	<0.01	0.005	4.0	0.006	<0.01	<0.1	
18	<0.01	0.005	17.7	0.003	<0.01	<0.1	
18A	<0.01	0.005	17.5	0.005	<0.01	<0.1	
19	<0.01	0.005	9.0	0.005	<0.01	<0.1	
19A	<0.01	0.005	6.3	0.003	<0.01	<0.1	
20	<0.01	0.009	2.5	0.002	<0.01	<0.1	
20A	<0.01	0.009	5.6	0.016	<0.01	<0.1	
21	<0.01	0.003	5.6	0.007	<0.01	<0.1	
22	<0.01	0.005	<0.1	0.003	<0.01	<0.1	
23	<0.01	0.010	<0.1	0.003	<0.01	<0.1	
24	0.01	0.009	<0.1	0.003	<0.01	<0.1	
25	0.27	0.008	<0.1	0.003	<0.01	<0.1	
26	0.04	0.005	4.4	0.005	<0.01	<0.1	
27	0.04	0.010	2.8	0.004	<0.01	<0.1	
28							
29	0.01	0.003	8.9	0.003	0.01	<0.1	
30	0.01	0.038	8.5	0.009	0.03	<0.1	
31	0.01	0.024	12.7	0.007	0.02	<0.1	
32	0.13	0.101	17.1	0.010	0.10	<0.1	
Lagoon 1	30.69	0.009	0.4	4.84	6.60	43.7	
Lagoon 2	22.69	0.014	0.2	5.46	6.50	28.2	
Tank 1	20.76	0.011	2.0	5.14	5.20	23.6	
Tank 2	20.76	0.011	2.9	5.11	5.10	23.9	

Table Va. (Continued)

Date 8/13							
Sampling Site	NH_3	NO_2	NO_3	$i-PO_4$	t-P	TKN	TOC
	ppm						
1	0.04	0.009	1.8	0.008	<0.01	0.3	
1A	0.04	0.007	3.6	0.010	<0.01	0.5	
2	0.04	0.014	6.8	0.007	<0.01	0.2	
2A	0.09	0.031	5.9	0.010	<0.01	0.6	
3	0.01	0.010	8.3	0.009	<0.01	0.3	
3A	0.13	0.017	8.0	0.012	<0.01	0.4	
4	0.01	0.009	5.4	0.006	<0.01	0.5	
4A	0.17	0.009	6.3	0.003	<0.01	0.2	
5	1.03	0.015	<0.1	<0.001	<0.01	2.5	
5A	1.54	0.009	<0.1	<0.001	<0.01	0.5	
6	<0.01	0.008	3.9	0.009	<0.01	0.3	
6A	0.02	0.010	9.3	0.007	<0.01	0.3	
7	0.02	0.039	1.4	0.006	<0.01	0.3	
7A	0.04	0.017	0.4	0.006	<0.01	0.3	
8	0.32	0.008	<0.1	0.006	<0.01	0.3	
8A	0.30	0.008	<0.1	0.002	<0.01	0.3	
9	0.68	0.009	<0.1	0.002	<0.01	0.3	
9A	0.09	0.008	<0.1	0.007	<0.01	0.3	
10	0.09	0.008	<0.1	0.009	<0.01	1.3	
10A	0.32	0.008	<0.1	0.019	<0.01	1.5	
11	0.03	0.009	0.4	0.011	<0.01	0.1	
11A	0.04	0.010	0.3	0.007	<0.01	0.1	
12	0.04	0.009	13.2	0.009	<0.01	0.1	
12A	0.61	0.046	8.6	0.011	<0.01	0.1	
13	0.09	0.011	11.7	0.006	<0.01	0.3	
13A	0.04	0.010	16.1	0.001	<0.01	0.3	
14	0.45	0.010	0.3	0.004	<0.01	0.5	
14A	0.74	0.009	<0.1	0.009	<0.01	0.1	
15	0.09	0.009	5.2	0.003	<0.01	<0.1	
15A	0.02	0.003	4.4	0.002	<0.01	<0.1	
16							
16A							
17	0.08	0.010	18.4	0.006	<0.01	0.3	
17A	0.08	0.010	8.3	0.011	<0.01	0.1	
18	0.08	0.010	20.6	0.007	<0.01	<0.1	
18A	0.08	0.010	20.9	0.020	<0.01	0.1	
19	0.08	0.010	12.4	0.009	<0.01	0.1	
19A	0.08	0.012	12.1	0.005	<0.01	0.1	
20	0.08	0.014	3.2	0.004	<0.01	0.4	
20A	0.08	0.013	5.2	0.014	<0.01	0.5	
21	0.08	0.010	5.6	0.006	<0.01	0.1	
22	0.08	0.014	<0.1	0.003	<0.01	0.1	
23	0.02	0.009	<0.1	0.005	<0.01	<0.1	
24	0.17	0.009	<0.1	0.013	<0.01	0.1	
25	0.02	0.010	<0.1	0.004	<0.01	0.1	
26	0.02	0.009	5.0	0.005	<0.01	0.1	
27	0.02	0.009	3.0	0.005	<0.01	0.1	
28							
29	0.02	0.009	8.7	0.019	<0.01	<0.1	
30	0.02	0.007	14.6	0.009	<0.01	<0.1	
31	0.02	0.009	20.1	0.005	<0.01	<0.1	
32	0.06	0.014	23.1	0.009	<0.01	<0.1	
Lagoon 1	38.72	0.008	0.2	5.41	7.10	46.50	
Lagoon 2	25.01	0.014	0.2	5.52	6.60	30.80	
Tank 1	12.90	0.009	9.5	4.64	5.80	12.00	
Tank 2	12.55	0.009	9.5	4.66	5.80	12.80	

Table Vb. Nutrient Concentrations of the Soil on the Barriered Landscape Water Renovation System at the Coldwater Rest Area. 1979.

Date	Nutrient	Spray			Non-Spray		
		0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
		ppm					
4/16	NH_3			2.65			5.89
	NO_3^-			0.80			0.50
	TKN			1099			437
	t-P			204			166
	Bray-P			5.2			4.4
6/22	NH_3	0.86	0.90	1.13	0.86	1.21	2.94
	NO_3^-	2.9	1.6	1.4	1.8	1.6	1.3
	TKN	1096	608	543	1156	798	622
	t-P	266	211	193	267	216	187
	Bray-P	6.7	4.1	3.9	7.6	5.1	4.7
7/09	NH_3	1.43	1.11	0.95	1.12	1.01	0.82
	NO_3^-	4.6	1.9	1.7	1.9	1.6	1.5
	TKN	904	706	622	1444	804	573
	t-P	265	260	268	327	239	186
	Bray-P	9.1	4.7	5.1	8.6	6.3	4.7
8/07	NH_3	5.86	3.08	2.55	1.61	1.14	1.61
	NO_3^-	6.1	3.2	2.8	1.6	1.2	1.6
	TKN	1240	752	647	724	645	670
	t-P	290	250	192	202	219	230
	Bray-P	5.4	3.6	3.2	1.8	1.8	2.8

Table Vc. Moisture Content of the Soil on the Barriered Landscape Water Renovation System at the Coldwater Rest Area. 1979.

Date of Sampling	Spray			Non-Spray		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
	%					
4/16			13.29			12.18
6/22	13.90	12.45	10.51	8.91	8.73	8.79
7/09	18.04	15.17	15.08	13.88	10.21	9.13
8/07	23.13	17.59	16.09	11.63	10.88	9.93

Table Vd. Biological Oxygen Demand of the Barriered Landscape Water Renovation System at the Coldwater Rest Area. 1979.

Well	6-29	7-26	Well	6-29	7-26
	ppm				
1	1.8	3.0	16	--	--
1A	7.8	4.2	16A	--	--
2	2.4	3.6	17	1.8	1.2
2A	3.6	6.0	17A	3.0	2.4
3	3.6	2.4	18	3.0	1.8
3A	3.0	9.6	18A	2.4	1.2
4	6.0	4.8	19	5.4	7.2
4A	9.6	9.0	19A	4.2	10.8
5	6.0	10.2	20	5.4	8.4
5A	12.0	11.4	20A	3.6	10.8
6	3.6	2.4	21	3.0	2.4
6A	10.2	6.0	22	4.2	6.0
7	4.2	10.8	23	3.0	3.6
7A	7.2	5.4	24	3.0	6.6
8	9.0	15.0	25	1.2	2.4
8A	9.0	10.8	26	3.6	5.4
9	13.8	18.0	27	3.6	2.4
9A	9.0	9.6	28	1.8	--
10	18.0	6.6	29	0.6	1.2
10A	18.0	13.2	30	4.8	5.4
11	6.6	5.4	31	4.2	7.2
11A	5.4	9.0	32	5.4	5.4
12	3.0	6.0			
12A	9.6	20.4			
13	5.4	3.0	Lagoon 1	15.0	59.0
13A	6.6	13.2	Lagoon 2	24.0	23.0
14	9.0	7.8	Tank 1	20.0	17.0
14A	6.6	9.6	Tank 2	20.0	17.0
15	3.6	1.8			
15A	5.4	5.4			

Table Ve. Effluent Applied and Environmental Data at the Coldwater Rest Area, 1979.

Date	Effluent Applied	Rainfall	Evaporation	Radiation (total langleys)	Temperature Aug. Max.	Temperature Aug. Min.	Relative Humidity Aug. Max.	Relative Humidity Aug. Min.
	----------mm----------				(°C)		(%)	
6/12-14	10.50	0.00	20.00	128.88	22.2	11.1	71	36
6/15-17	10.50	0.75	21.25	125.28	26.7	16.1	69	41
6/18-21	20.50	9.75	24.75	180.48	24.4	16.1	94	53
6/22-24	15.75	0.00	18.25	136.08	20.6	11.7	88	51
6/25-28	42.00	4.25	27.25	222.72	32.8	20.6	96	54
6/29-7/01	26.25	1.25	19.50	34.56	27.8	22.2	100	66
7/02-05	35.00	23.00	23.00	212.16	23.9	11.7	99	53
7/06-08	26.25	3.00	14.25	124.56	25.0	11.7	100	51
7/09-12	35.00	0.00	18.75	181.44	28.3	17.2	100	65
7/13-15	26.25	0.75	19.00	77.04	27.8	18.9	99	69
7/16-19	35.00	0.00	25.00	231.36	26.7	12.8	96	48
7/20-22	26.25	0.00	18.75	113.76	27.8	13.9	98	47
7/23-26	35.00	8.00	11.75	139.20	27.2	20.0	96	73
7/27-29	26.25	6.50	19.00	97.92	27.8	17.7	97	56
7/30-8/02	35.00	15.00	20.75	111.36	25.0	19.4	88	67
8/03-05	26.25	14.50	22.50	85.68	27.2	17.2	89	61
8/06-09	35.00	18.75	18.75	173.76	28.3	19.4	87	57
8/10-12	26.25	0.00	13.75	84.24	22.8	13.9	88	53
Total	493.00 (19.72 in.)	105.50 (4.11 in.)	356.25 (13.89 in.)	2460.40				

Table Vf. Total Coliform Concentration in the Ground Water Monitoring Wells (MPN/100 ml), 1979.

Sampling Site	Date					
	4-18	5-15	6-18	7-06	7-20	8-03
1	43	<3	150	93	>1,100	430
1A	240	43	93	230	>1,100	240
2	21	430	240	43	9	750
2A	93	<3	23	43	<110,000	110,000
3	240	43	240	230	15	150
3A	930	<3	240	43	>110,000	460
4	2,400	230	93	23	93	4,600
4A	240	23	240	930	4,300	150
5	2,400	21	150	230	4,300	93
5A	120	430	23	2,300	93,000	430
6	23	210	>1,100	1,500	23	230
6A	1,500	43	23	15	2,300	2,400
7	93		150	43	4,300	
7A	43	43	460	93	240	430
8		2,300	150	930	23,000	210
8A		4	2,100	430	43	43
9		15	240	4,300	15,000	430
9A	23	4	15,000	24,000	>110,000	750
10	4,600	1,100	9,300	7,500	4,600	430
10A	<4	9,300	210	24,000	46,000	2,300
11	460	120	93	15	110,000	4,300
11A	240	43	430	240	150	430
12	23	<3	93	240	93	230
12A	9	<3	240	23	240	15,000
13	210	930	93	3	240	230
13A	1,100	4,300	43	240	46,000	1,100
14	750	43	1,100	9	4,300	1,500
14A	23	9	93	43	1,500	230
15	240	2,100	>1,100	9	9,300	200
15A	240	39	150	<3	4	93
16	2,400	9	210	<3		
16A	460	<3	43	43		
17	46,000	23	93	<3	900	750
17A	2,400	75	43	4	900	230
18	1,100	43	1,100	43	150	430
18A	2,400	7	460	<3	210	43
19	43	<3	46,000	4	120	15
19A	75	<3	43	<3	9	<3
20	<4	<3	93	<3	4	<3
20A	<4	<3	23	15	4	43
21	<4	<3	<3	<3	<3	<3
22	<4	<3	240	<3	<3	<3
23	<4	<3	<3	<3	<3	<3
24	<4	<3	<3	<3	<3	<3
25	<4	<3	<3	<3	<3	<3
26	<4	<3	7	<3	<3	<3
27	<4	<3	93	<3	<3	4
28	<4	<3	>1,100	<3		
29	<4	<3	93	<3	<3	<3
30	<4	<3	>1,100	4	<3	<3
31	<4	<3	9	43	<3	<3
32	<4	<3	43	9	9	43
Lagoon 1	23	93	14,000	93,000	9,300	>110,000
Lagoon 2	>110,000	9,300	11,000	43,000	21,000	43,000
Tank 1			2,800	230,000	7,500	9,300
Tank 2			20,000	150,000	15,000	4,000

Table Vg. Fecal Coliform Concentration in the Ground Water Monitoring Wells (MPN/100 ml). 1979.

Sampling Site	Date					
	4-18	5-15	6-18	7-06	7-20	8-03
1	<4	0	<3	<3	900	<4
1A	93	<3	<3	<3	<4	<4
2	0	<30	240	<3	<3	<4
2A	<4	0	<3	<3	<3	15,000
3	<40	<3	240	<3	<3	9
3A	<40	0	<4	<3	23,000	150
4	<40	<30	<3	<3	11	40
4A	<40	<3	<3	<3	<4	21
5	<40	<3	<3	<3	4,300	<3
5A	<4	<3	<3	<3	2,100	90
6	<4	<3	<4	<3	<3	<4
6A	<40	<3	<3	<3	2,300	400
7	<4		<3	<3	4,300	
7A	0	<3	<4	<3	230	70
8		<300	<3	40	<4	7
8A		<3	<4	40	43	4
9		<3	<3	4,300	2,800	90
9A	<4	<3	<4	<4	240,000	90
10	0	<30	<4	40	4,600	90
10A	0	<300	90	>11,000	46,000	400
11	<40	<3	<3	4	4,000	<4
11A	<40	<3	<4	<3	150	40
12	<4	0	<3	<3	<3	90
12A	0	0	<3	<3	40	<4
13	0	<3	<3	<3	<4	<4
13A	<40	<3	<3	<3	7,000	700
14	<40	<3	<3	<3	4,300	<4
14A	0	<3	<3	<3	1,500	90
15	0	<30	<4	<3	<4	7
15A	<40	<3	<3	0	<3	<4
16	<400	<3	<4	0		
16A	<40	0	<3	<3		
17	<4,000	<3	<3	0	<3	<4
17A	460	<3	<3	<3	<3	<4
18	<40	<3	<3	<3	7	40
18A	0	<3	<4	0	<3	<4
19	9	0	<3	<3	<3	<4
19A	0	0	<3	0	<3	0
20	0	0	<3	0	<3	0
20A	0	0	<3	<3	<3	<4
21	0	0	0	0	0	0
22	0	0	<3	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	<4
25	0	0	0	0	0	0
26	0	0	<3	0	0	0
27	0	0	<3	<3	0	<3
28	0	0	<4	0		
29	0	0	<3	0	0	<3
30	0	0	<4	<3	0	0
31	0	0	<3	<3	0	<3
32	0	0	<3	9	<3	4
Lagoon 1		23	14,000	93,000	9,300	9,000
Lagoon 2		900	11,000	43,000	12,000	<4
Tank 1			2,800	23,000	400	2,300
Tank 2			20,000	150,000	700	4,300

Table Vh. Total and Fecal Streptococci Concentration in the Ground Water Monitoring Wells (MPN/100 ml). 1979.

Sampling Site	Total Enterococci			Fecal Streptococci	
	Date			Date	
	4-18	7-20	8-03	7-20	8-03
1	43	390	430	390	70
1A	1,100	>1,100	0	2,300	0
2	<40	240	430	<4	<4
2A	<40	9,300	7,500	9,300	1,500
3	93	93	0	<3	0
3A	15	>110,000	430	230,000	430
4	240	4,300	230	400	40
4A	460	460,000	230	240,000	230
5	210	430	230	430	230
5A	240	2,300	2,400	2,300	400
6	240	240	0	<4	0
6A	460	7,500	430	700	40
7	240	2,300		<4	
7A	<4	2,300	0	<4	0
8		4,300	430	4,300	90
8A	93	300	2,300	300	<4
9	43	930	430	930	230
9A	<40	>110,000	2,300	240,000	2,300
10	43	2,400	430	2,300	430
10A	240	2,300	4,300	2,300	<4
11	<40	900	2,300	900	400
11A	<40	430	0	30	0
12	240	2,400	0	<4	0
12A	43	93	930	93	430
13		430	230	430	<4
13A		7,500	24,000	7,500	23,000
14	460			1,500	<4
14A	43			2,300	430
15	1,100			<4	0
15A	240			<4	<4
16	240				
16A	240				
17	460			400	<4
17A	1,100			430	<4
18	460			<4	0
18A	240			<4	0
19	240			40	0
19A	460			<4	0
20	<40			<4	
20A	<40			<3	
21	<40			0	
22	<40			<3	
23	<40			4	
24	<40			<3	
25	<40			<4	
26	<40			<4	
27	<40			<3	
28	<40				
29	<40			<3	
30	<40			<3	
31	<40			<3	
32	<40			<4	
Lagoon 1	93	7,500	75,000	7,500	9,000
Lagoon 2	4,300	930,000	9,300	30,000	9,300
Tank 1		4,300	7,500	4,300	1,500
Tank 2		9,300	21,000	1,500	900