SURVEILLANCE OF STORM DRAINAGE AND EFFLUENT DISCHARGE FROM FEDERAL PROPERTIES TO THE RIDEAU RIVER, NATIONAL CAPITAL AREA

by

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ABSTRACT

This report presents and discusses analytical data for water and effluent samples collected in 1974 from storm drainage outfalls and a waste treatment system which discharge from federal property in the National Capital Area to the Rideau River, an important recreational stream. The need for remedial pollution abatement action was demonstrated with respect to a number of small storm drainage systems in the Confederation Heights, RCMP Headquarters, and Bogue Building areas. Further data were presented on the adverse effects of rainfall-induced runoff on bacterial quality in Black Rapids and Uplands Creeks. The data, however, show conclusively that the outfalls from Black Rapids Creek and the CFB Ottawa (South) - Ottawa (Uplands) Airport complex have no significant deleterious effect on the excellent bacterial water quality of the Rideau River.

RESUME

Ca rapport présente et explique les résultats obtenus suite à l'analyse des échantillons d'écoulement des eaux de surface et d'une usine d'épuration d'égout recueillis en 1974 de propriétés fédérales dans la région de la capitale nationale. Toutes les sources échantillonnées se déversaient dans la rivière Rideau, endroit souvent utilisé comme lieu de recréation. La nécessité de remédier â plusieurs de ces sources de pollution est clairement démontrée surtout si l'on examine les résultats obtenus d'échantillons provenant tout particulièrement des conduits d'écoulement déservant Confederation Heights, les quartiers généraux de la G.R.C. et l'édifice Bogue. D'autres données indiquaient l'effet néfaste de l'écoulement des eaux de surface occasionné par la pluie, sur la qualité bactériologique des ruisseau Black Rapids et Uplands. Cependant les résultats obtenus indiquent définitivement que le ruisseau Black Rapids et que plusieurs sources provenant de la base militaire d'Ottawa (Sud) et de l'aérogare d'Ottawa (Uplands) n'ont aucun effet délétère sur l'excellente qualité bactériologique de la rivière Rideau.

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CONCLUSIONS

A number of conclusions can be drawn from the surveillance and monitoring data reported.

1. Low-volume drainage flows at six storm drain outfalls in the vicinity of Confederation Heights, and near the River Road RCMP Headquarters, were shown to periodically contain pollution index bacteria in numbers exceeding Regional Municipal objectives. Further investigation will be required to locate and eliminate the pollution sources involved.

2. Further confirmation was obtained that water bacterial quality in Black Rapids Creek is adversely affected by runoff following episodes of heavy rainfalThe data, however, provide conclusive evidence that flows from this small stream have no significant impact on the excellent bacteriological quality of the Rideau River downstream from the Creek outfall.

3. A ditch and storm drainage system which drains federal and private land near the Bogue Building, River Road, Gloucester Township, failed to meet Regional Municipal water quality objectives. Further abatement action will be required.

4. Data presented offer conclusive proof that waste treatment and storm drainage effluents discharged to the Rideau River from the CFB Ottawa (South) - Ottawa (Uplands) Airport complex have no significant deleterious effect on the bacterial quality of the River water. There has been no degradation in the satisfactory bacterial quality of this reach of the Rideau River since monitor studies began in 1963.

1 INTRODUCTION

The sector of the Rideau River within the Regional Municipality of Ottawa-Carleton is an important recreational stream. To maintain and improve River water quality, the Pollution Control Division of the Regional Municipality hay, mounted a well-planned and sustained 'search and destroy' mission which has located and eliminated miscellaneous domestic waste inputs to the River; these were largely associated with cross connections or infiltration between domestic sewerage and storm drainage systems. This continuing mission has met with a considerable degree of success; in recent years there has been no degradation, and some improvement, in bacteriological water quality in the suburban and urban reaches of the Rideau.

The important Mooney's Bay beach and recreational facility remained open for public use during the summer of 1974, under strict application of Ontario recreational water quality objectives by the Regional Medical Officer of Health. Downstream beaches in the urban (Ottawa) sector of the Rideau remained closed to public bathing, but closely approached these objectives; there is a real possibility that, with continuing abatement and surveillance action, it will be possible to open other beaches to the public in 1975. The degree of success achieved in the maintenance of good recreational quality in a major stream draining a suburban - urban area may be unique in Ontario.

In this context, it is important that the pollution control program of the Regional Municipality be supported and supplemented by the monitoring, surveillance and abatement of waste and storm drainage inputs to the Rideau River from extensive federal properties in the National Capital Area. During recent years, the Environmental Protection Service, in cooperation with the Department of Public Works, the Department of National Defence, the Canada Department of Agriculture, and the National Capital Commission, has conducted a series of studies to estimate and

monitor the quality of drainage water, to determine its impact, it any, on the Rideau River, and to recommend and effect remedial action as required.

In 1974, attention centered on a number of small drainage systems which, on the basis of previous data, showed some possible pollutional potential, or for which no clear explanation of sporadic unsatisfactory water quality had yet been found. The systems subjected to surveillance included networks of storm drains serving the Confederation Heights area and the RCMP complex on River Road, the Uplands Creek drainage system and the CFB Ottawa (South) wastewater treatment plant, and Black Rapids Creek which drains National Capital Commission and Canada Department of Agriculture land to the Rideau River. This Report cites and summarizes data obtained in 1974 from these sources, and compares these results, where possible, to median data from previous years.

2 DATA COLLECTION

2.1 Sampling Program

Water samples were collected periodically during 1974 from the various sampling points by staff of the Field Investigations Section, EPS, Ontario Region. Samples for bacteriological analysis were collected in sterile 8-ounce glass bottles, while samples for chemical analysis were collected in chemically-clean 1-liter plastic bottles. Rideau River samples were collected at depths of 2 to 3 feet (using a reversing grab sampler) by boat at quarter-points on ranges across the River. All samples were delivered immediately after collection to the Laboratories for analysis.

2.2 Bacteriological Procedures

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

streptococcus densities.

Coliforms: m-Endo Agar LES* (35°C, 20 ± 2 hours);

Fecal Coliforms: m-FC Agar* (waterbath; 44.5°C, 20 ± 2 hours);

Fecal Streptococci: m-Enterococcus Agar* (35°C, 48 hours).

The numbers of typical colonies appearing on the membranes for appropriate sample volumes were counted, and bacterial densities were calculated and recorded in terms of MF counts per 100 ml. of water. Where 50 ml. was the largest volume filtered, negative results were expressed as less than 2 (<2) per 100 ml.

2.3 Chemical Procedures

Water samples from selected sampling stations were analysed for the following parameters: Biochemical Oxygen Demand (BOD), Suspended Solids (SS) and Volatile Suspended Solids (VSS) using A.P.H.A. Standard Methods (1); tests were conducted for total Phosphate (P) and Total Kjeldahl Nitrogen (N), using automated methods (Technicon). Results for all parameters were expressed as “mg per liter of water”.

3 RESULTS AND DISCUSSION

3.1 Daily Rainfall Data, Ottawa Airport

Rainfall recorded by the Atmospheric Environment Service, Department of the Environment, at their Climatology Station, Ottawa Airport, during the April to November, 1974, period, is cited in Table 1. These data were used to correlate rainfall with runoff and storm drainage effects on the analytical data obtained.

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

TABLE 1. Rainfall, Ottawa Airport, DOE, April - Nov., 1974

Date	Rainfall in Inches
April	
2	.40
3	.04
4	.51
7	.18
9	.06
12	.05
13	.05
14	.23
15	.09
22	.27
23	.18
29	.42
30	.16
Total	**2.64**
May	
1	.02
3	.44
6	.16
7	.11
9	.91
10	.01
12	1.37
15	.09
16	.01
22	.33
23	.39
24	.13
25	.24
26	.05
27	.01
28	.07
29	.02
31	.43
Total	**4.79**
June	
2	.01
12	.01
13	.48
14	.01
15	.04
16	.45
17	.25
18	.02
20	.20
21	.12
24	.01
30	.03
Total	**1.63**
July	
1	.02
2	.24
4	.25
5	.16
9	.26
18	1.22
19	.02
23	.31
24	.32
26	.01
27	.05
29	.04
31	.16
Total	**3.06**
August	
2	.35
3	.45
4	.03
8	.03
12	.05
17	.02
19	.21
23	.02
27	.12
31	.03
Total	**1.31**
September	
2	.04
3	.31
9	.09
10	.16
12	.02
13	.16
15	.01
17	.02
20	.13
21	.03
25	.18
28	.12
29	.23
Total	**1.50**
October	
2	.24
7	.12
10	.03
12	.14
14	.38
17	.46
25	.13
30	.08
31	.01
Total	**1.59**
November	
1	.14
3	.46
4	.14
12	.50
13	.88
14	.05
17	.18
20	.76
21	.15
24	.38
Total	**3.59**

3.2 Storm Drainage, Confederation Heights Area

The locations of 8 sampling points in storm drain systems in the Confederation Heights Area are shown in Figures 1 and 2. Bacterial count data obtained for water samples from these sampling points are cited in Appendix Table A1, and geometric mean values are recorded in Table 2.

TABLE 2. Geometric Mean Bacterial MF Counts, Storm Drainage, Stations 1-8, 1974.

Sta. No.	No. of Samples	Mean MF Count per 100 ml. of Water		
		Coliform	Fecal Coliform	Fecal Streptococcus
1	10	4,800	460	950
2	18	6,300	1,200	1,100
3	17	5,900	300	580
4	12	4,000	740	790
5	10	250	3	51
6	27	2,800	440	160
7	26	12,000	1,300	83
8	13	3,700	31	28

Thus, geometric mean bacterial counts for six of the eight storm drainage locations failed to meet the objectives recommended by Hauck (2) in his excellent report on the bacterial quality of Ottawa-Carleton Regional storm drainage water in 1972; the objectives advocated were:

Coliforms : $\leq$ 5,000 per 100 ml.;

Fecal Coliforms : $\leq$ 50 per 100 ml.;

Fecal Streptococci : $\leq$ 60 per 100 ml.

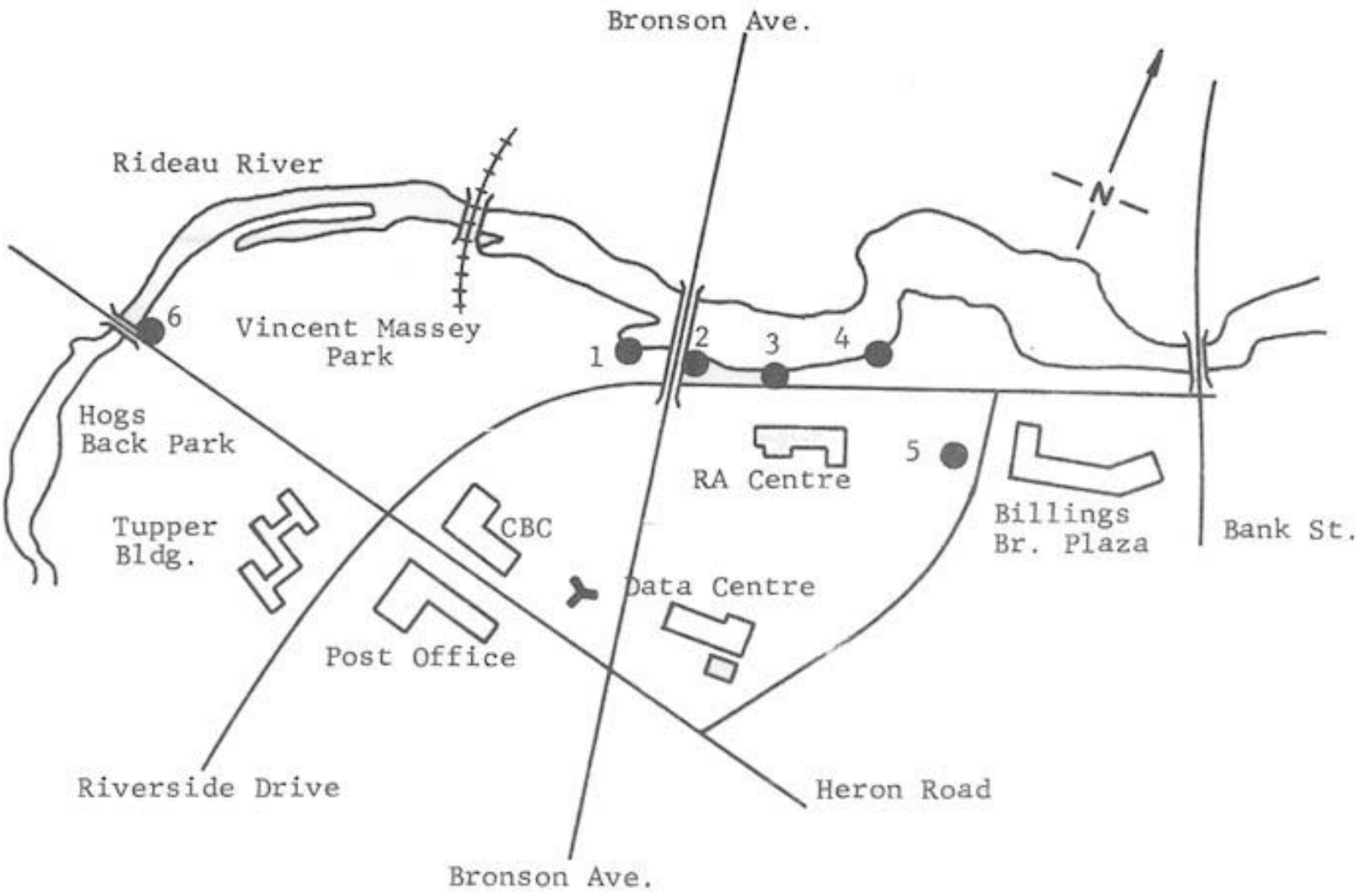

FIGURE 1: Locations Of Storm Drainage Sampling Stations 1 - 6, Confederation Heights Area

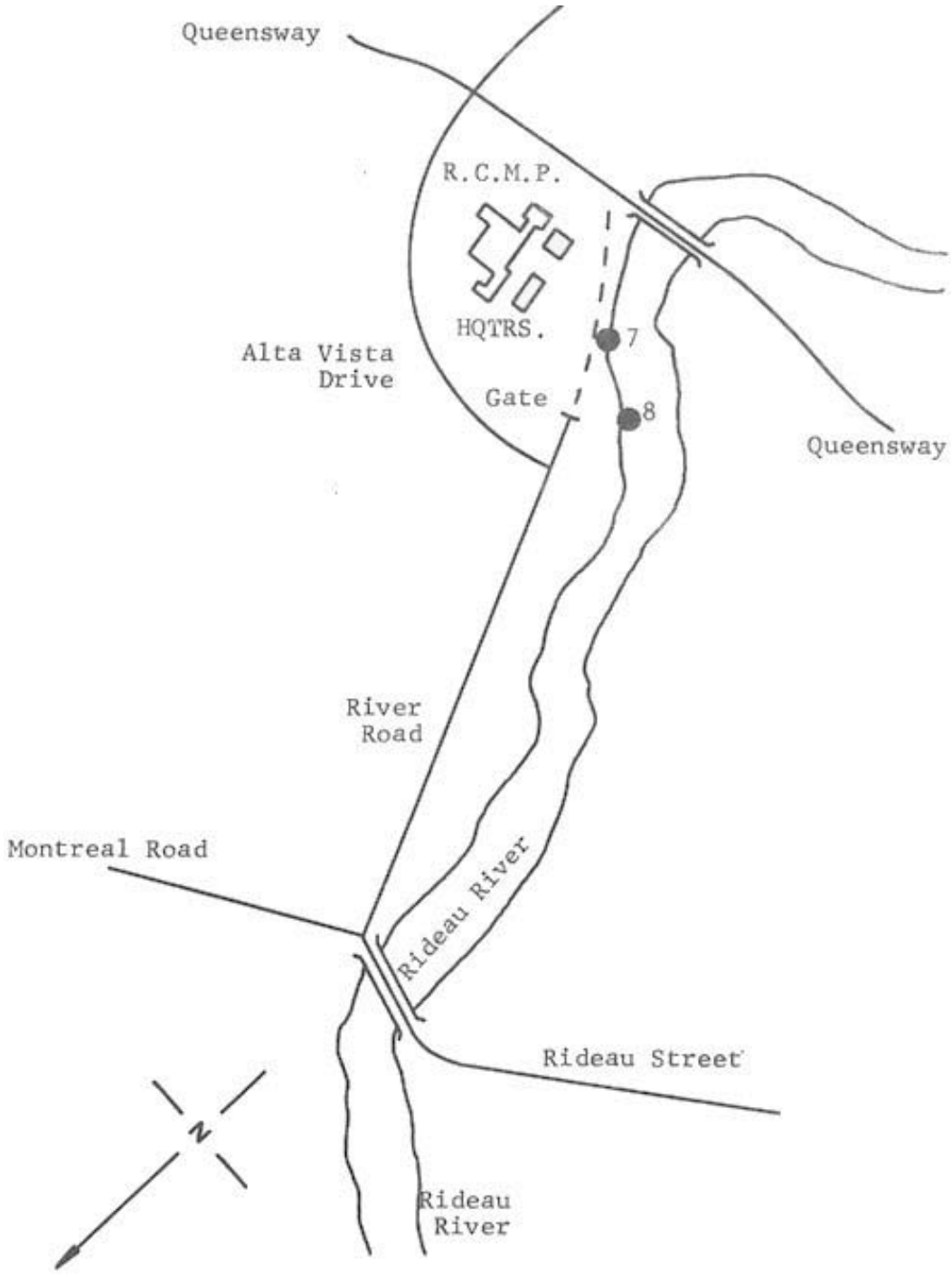

FIGURE 2: Locations Of Storm Drainage Stations 7 And 8, RCMP Headquarters Area, River Road, Ottawa

Only Stations 5 and 8 met all three of these objectives on the basis of geometric mean values.

Hauck (2) confirmed earlier observations by this office and by other workers that urban and suburban drainage water is frequently seriously contaminated by all three index bacterial groups, and that during rainstorms even the cleanest storm sewer systems become extensively contaminated by bacteria. he concluded that representative samples should be collected for bacterial analysis during "dry weather periods".

It should be noted that the eight storm drains studied in 1974 were selected as "problem" locations; other systems were tested previously, and shown to be of satisfactory quality, All eight have very low flows, or do not flow, during dry weather, and were normally sampled only during, or within 24 hours after, moderate or heavy rainfall. They thus represent sporadic pollution sources closely associated with rainfall and accelerated runoff.

3.2.1 Stations 1 and 2, near Bronson Bridge.

Water quality at Station 1 (West of Bronson Bridge) was unsatisfactory in 1968 and 1969. Pollution sources were traced by EPS field staff, and recommended abatement action was implemented by the Department of Public Works. Since that time, periodic bacteriological tests have indicated reasonably satisfactory water quality, with occasional aberrant higher counts. The 1974 data show that, while water quality failed to meet municipal fecal bacterial count objectives, the highest counts were recorded during periods of wet weather, the mean fecal coliform : fecal streptococcus ratio was only 0.48, and 8 of 10 samples had FC : FS ratios of <0.7. The broad picture infers runoff pollution, with no input of domestic wastes.

Station 2 (under Bronson Bridge) storm water samples tested in 1973 gave

results which indicated the possibility of periodic contamination with domestic wastes. While the sporadic high counts recorded in 1974 were largely associated with heavy rainfall, the data generally confirm the possibility of admixture of domestic wastes in the storm drainage. The mean FC : FS ratio was 1.1, and 3 of 18 samples had ratios of more than 4. Seven ratios were <0.7. It is evident that further investigation will be required to define and locate pollution sources in this storm drain system. It has been shown that the R.A. and Data Centres do not contribute pollution to this storm drain.

3.2.2 Stations 3 and 4, East of Bronson Bridge.

Like Station 1, Station 3 was seriously polluted in 1969. Following abatement action by DPW, water quality in this storm drain was considered satisfactory. Occasional high index bacterial counts recorded in 1973, however, led to inclusion of this drain in the 1974 surveillance study. While the geometric mean counts exceeded Municipal objectives, most of the high counts were from samples collected during wet weather periods. The FC : FS mean ratio was only 0.51, 10 of 17 samples had ratios of <0.7, and only two samples had ratios of >4.0. Further examination is required, but it is quite possible that the reported data indicate surface drainage contamination and that no cross connections with domestic sewerage are involved.

Similarly, sporadic very high counts at Station 4 were obtained immediately after heavy rainfall. The mean FC : FS ratio was 0.9; while only 2 of 12 samples had ratios of >4.0, further investigation is needed to determine if domestic waste inputs reach this storm drain.

3.2.3 Station 5, South of Riverside Drive.

Bacterial count data for Station 5 show that this drainage system meets Municipal objectives. The sample of July 24, 1974, which exceeded these objectives, was collected after a period of heavy and sustained rainfall. A very low (0.1) mean FC:FS ratio was calculated, and 9 of 10 samples had ratios of <0.7. The data are

compatible with surface drainage and an absence of domestic wastes.

3.2.4 Station 6, at Heron Road Bridge.

Sampling in 1973 of the storm drain system represented by Station 6 indicated the possibility of pollution of human origin, and a number of problems were rectified in cooperation with DPW. The 1974 data show, however, that further remedial action is necessary. Very high bacterial densities were recorded periodically after rainfall episodes, and the mean fecal coliform : fecal streptococcus ratio was 2.75; 13 of 27 samples had FC : FS ratios of more than 4.0, and only 6 samples had ratios of less than 0.7. The indication of domestic sewerage input is clear, and further attempts to isolate the source involved are required.

3.2.5 Stations 7 and 8, R.C.M.P. Building.

Bacterial count data obtained prior to 1974 have shown that low-volume flows from the R.C.M.P. Building storm drainage system represented by Station 7 are intermittently but significantly contaminated by human wastes. Mean counts in 1974 exceeded Municipal objectives, and the mean FC : FS ratio was 15.7; 17 of 26 samples had ratios of more than 4.0. The Field Investigations Section worked closely with DPW personnel in attempts to trace, identify and eliminate input streams contaminated with domestic wastes, and to divert these to sanitary sewers. These activities continued in early 1975, without complete success, and further abatement action is required.

Bacterial counts recorded at Station 8 at the out-fall of a storm drain 400 feet downstream from the R.C.M.P. Building were generally satisfactory during the May - July, 1974, period. A considerable increase in fecal bacterial numbers was noted in August - September. Thus, while mean bacterial densities met Municipal objectives, some samples had counts which grossly exceeded these objectives, and most of these represented dry weather flows. The mean FC : FS ratio was 1.1, and 4 of 13 samples

had ratios of >4.0. Further investigation and abatement action is required.

3.3 Black Rapids Creek

This Rideau River tributary drains an extensive area of federal and private land in Nepean Township, on the western shore of the River. In recent years, the Creek has been the subject of extensive study by EPS, Ontario Region, in cooperation with the Canada Department of Agriculture. Two research establishments of Agriculture Canada, the Animal Research Institute (ARI) and the Animal Diseases Research Institute (ADRI), occupy approximately 4,000 acres bounded by Woodroffe Avenue, Fallowfield Road, Cedarview Road, Knoxdale Extension, and the Manordale Subdivision.

Most of the arable land is tile drained to Black Rapids and Baker Creeks. Animal manure is stored in a liquid (slurry) system in impervious concrete trenches and tanks with sufficient storage capacity for six months. Liquid manure is applied to the land in spring, summer and fall, and is immediately incorporated into the soil; the plowdown technique minimizes the possibility of direct contamination of drainage streams by surface runoff. All domestic sewage except that from five septic tanks serving farm dwellings on the Greenbelt Farm perimeter, is discharged into a sanitary sewer at the intersection of Greenbank and Knoxdale Roads. Thus there is no opportunity for the entry of human wastes into Greenbelt Farm storm drains or open drainage ditches.

Black Rapids Creek downstream from Woodroffe Avenue drains parts of two subdivisions, Grenfell Glen and Simpsons Country Place, as well as the NCC-owned Boyce Farm, as well as other areas along Merivale Road and Highway 16. Sampling stations used in the 1972-1974 surveillance studies are shown in Figure 3.

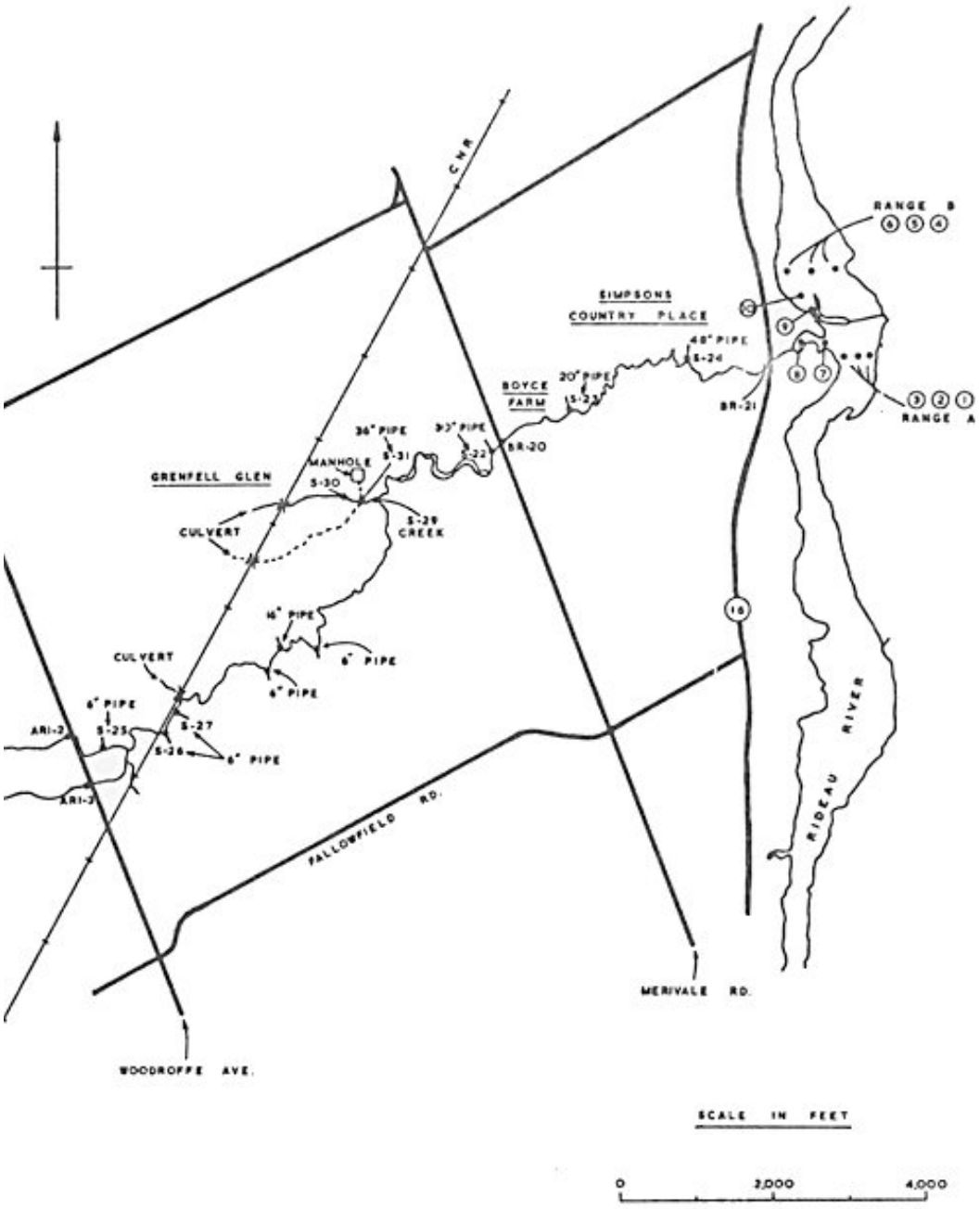

FIGURE 3: Sampling Points, Black Rapids Creek, Downstream From Greenbelt Farm, 1973, 1974

Bacterial MF counts for the three standard pollution parameters from 7 stations on Black Rapids Creek between Woodroffe Avenue and the Creek outfall near Highway 16 are given in Appendix Table A-2. Median values are cited, with similar data for 1972 and 1973, in Table 3.

TABLE 3. Summary, Median Bacterial MF Counts, Black Rapids Creek Stations, 1972 - 1974

Sta. No.	Year	No. of Samples	MEDIAN MF COUNT PER 100 ML.		
			Coliform	Fecal Coliform	Fecal Strep.
2	1972	155	3,500	160	470
	1973	46	3,200	400	400
	1974	8	13,000	2,100	2,300
3	1972	157	1,000	52	250
	1973	43	1,400	180	72
	1974	8	6,000	820	1,300
20	1972	156	1,800	160	330
	1973	45	1,700	290	230
	1974	11	14,000	490	440
21	1972	156	4,700	300	540
	1973	46	2,700	280	190
	1974	11	8,200	380	210
*22	1973	42	23,000	120	510
	1974	11	35,000	62	60
*23	1973	16	17,000	290	220
	1974	11	4,000	250	310
*24	1973	17	11,000	520	480
	1974	11	36,000	530	1,100

* Storm drainage at outfalls to Creek

Stations 2 and 3: Creek at Woodroffe Avenue
Station 20: Creek at Merivale Road
Station 21: Creek at Highway 16, near Outfall to Rideau River.

Similarly, bacterial counts obtained from the analysis of Rideau River water samples obtained from 10 stations on ranges upstream and downstream from the Creek outfall are presented in Appendix Table A-3, and are summarized, with 1972-73 median data, in Table 4. Chemical analytical data for some of these water samples are cited in Appendix Table A-4.

TABLE 4. Summary, Median Bacterial MF Counts, Rideau River At Black Rapids Creek, 1972 - 1974

	Study Period	Samples	MEDIAN MF COUNT PER 100 ML. Year Coliform	Fecal Coliform	Fecal Strep.
Range A, Sta. 1-3, Upstream from Creek Outfall					
1972	August	6	79	5	14
1973	May-Sept.	42	200	17	10
1974	June-Sept.	18	360	6	8
Range B, Sta. 5-6, Downstream from Creek Outfall					
1972	August	6	64	12	10
1973	May-Sept.	42	190	10	14
1974	June-Sept.	18	280	6	7
Stations 7-10, Downstream from Creek Outfall					
1973	May-Sept.	56	250	19	22
1974	June-Sept.	24	390	6	12

The 1974 bacteriological data for Black Rapids Creek tend to confirm 1972 and 1973 data from intensive EPS - Agriculture Canada studies of runoff and water quality in the Creek and in the ARI Greenbelt Farm drainage systems. These investigations showed that, under dry weather conditions, coliform and fecal coliform counts for drainage water met or closely approached Ontario recreational water quality objectives.

Runoff, however, caused major, transient peaks in bacterial numbers immediately following episodes of heavy rainfall; increases of at least one order of magnitude occurred at all stations, and these were not related to the application of liquid manure by the plowdown technique.

Black Rapids Creek flows, which were estimated to range from <1 to 10 CFS during the period under review, have a minimal impact on Rideau River water quality; the Rideau has a mean annual flow of about 2,000 CFS, and a minimum flow of about 200 CFS. Thus, while median fecal bacterial densities in the Creek exceeded Provincial recreational quality objectives, the data presented above show conclusively that, in spite of the various bacterial inputs demonstrated, the Creek outfall had no significant effect on the satisfactory bacterial water quality of the Rideau River.

Fecal coliform : fecal streptococcus ratios for Creek stations ranged from 0.6 to 1.8, while the three storm drain outfalls in the downstream reach of the Creek had mean FC : FS ratios of 1.0, 0.8 and 0.5, respectively. Similarly, the mean ratios for Rideau River water above and below the Creek outfall ranged from 0.4 to 0.9. It appears probable that fecal pollution in the entire study is predominantly animal in origin, largely associated with surface runoff, and that human waste inputs are a negligible factor.

Chemical analytical data for Creek Station 2, and for Stations 5 and 8 in the River, indicate similar levels of P, N, BOD and TOC at all sampling sites.

3.4 Bogue Building Property, River Road

The former Bogue Electric Building property on the River Road, Gloucester Township, was purchased by the Department of Public Works in 1973. The Building will be completely renovated for use by the Department of the Environment as an Environmental Protection Service laboratory and office complex, for occupancy in 1976.

In 1974, a part of the Building was occupied by the Emission Testing Laboratory of the Air Pollution Control Directorate of EPS, with a total staff of about 20 persons. Domestic wastes were inadequately treated in a septic tank systems as a part of the Building renovation contract, sewer lines will be installed to convey domestic wastes to the Regional Municipality waste treatment plant via collector sewers. In addition, a creek - storm drain system provides stormwater drainage from the Bogue Building environs, from Uplands Airport, and from homes near the drainage creek at River Road. The locations of six sampling points on this system are shown on a sketch plan (Figure 4).

Bacterial MF count data for the three index parameters obtained for water samples from these 6 stations are reported in Appendix Table A-5, and geometric mean values for 5 of the stations are cited in Table 5. Chemical analytical data obtained for samples from Stations 1 and 3 are recorded in Appendix Table A-6.

TABLE 5. Geometric Mean MF Counts, Bogue Building Drainage System Stations, 1974

No.	Location	Samples	MEAN MF COUNT PER 100 ML.		
			Coliform	Fecal Coliform	Fecal Strep.
1	Bogue Drain, Manhole	14	28,000	180	350
2	South Side Drain to Creek	14	22,000	110	170
3	Creek, Downstream	21	31,000	770	280
4	North Side Drain to Creek	14	970	45	27
5	Creek, upstream from Bogue outfall	14	280,000	3,700	3,200

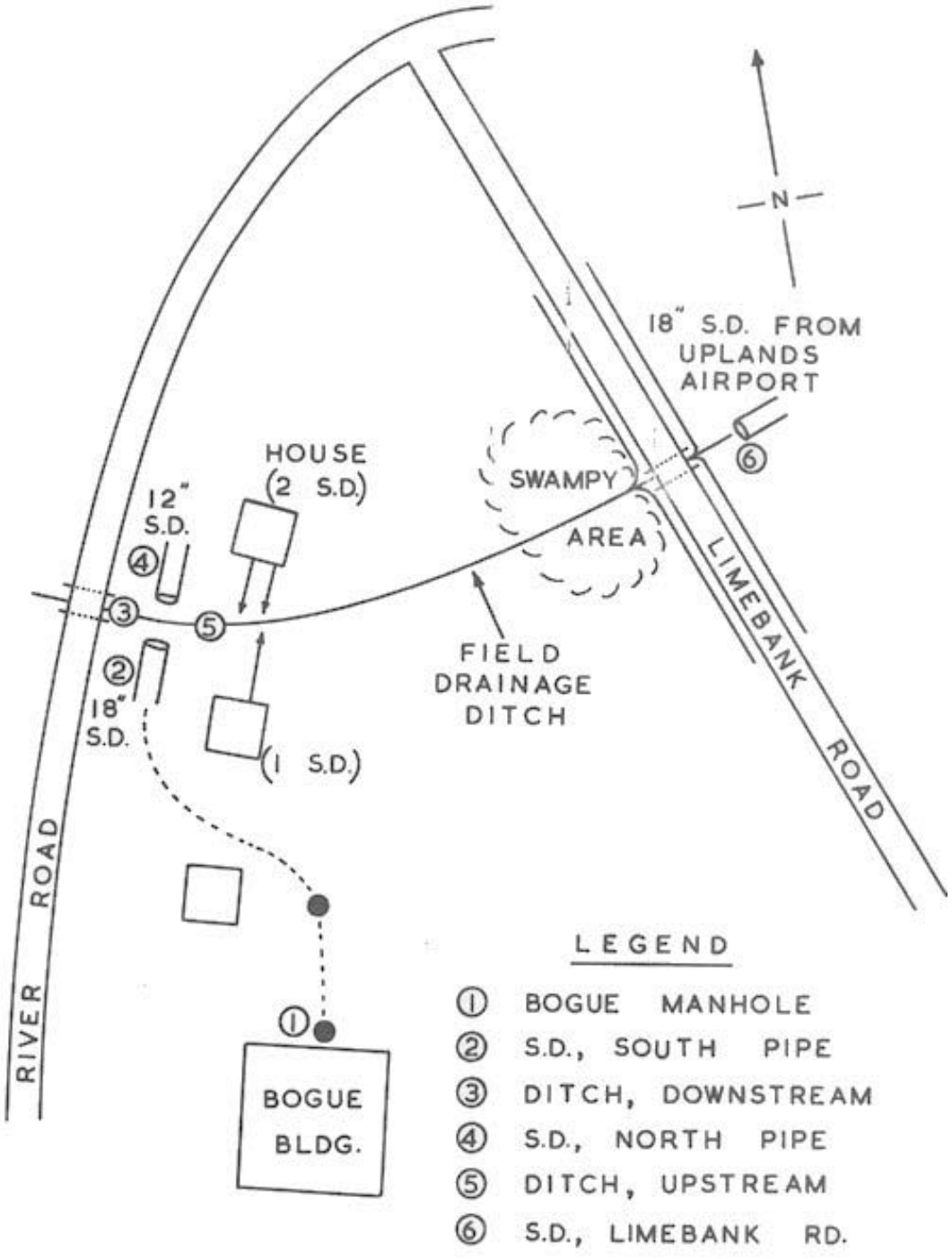

FIGURE 4: Sampling Stations, Bogue Bldg. Property

The drainage creek studied originates with flows from an 18-inch storm drain which carries runoff from a sector of Ottawa (Uplands) Airport (Station 6). Unfortunately, samples were collected from this sampling point on only three dates at the end of the study. A coliform count of 11,000 was recorded on October 17 after heavy rainfall; the fecal coliform count was only 36, and counts for all three parameters were low on October 25 and 31. The FC : FS ratios were very low (<0.1), and it is probable that flows at this point represent incidental surface runoff containing wild animal and avian, but not human, pollution.

The situation was different at Station 5. The field drainage creek between Limebank Road and Station 5 drains a swampy area, and receives storm drain inputs from two homes near River Road. MF counts were variable but high, and sporadic very high counts did not appear to be related to rainfall. The mean FC : FS ratio was 1.2, 7 of 14 samples had ratios of <0.7, and 2 samples had ratios of >4.0. It appears probable that there is some domestic sewage entering storm drainage from one or both of the homes.

Station 1 represents drainage water collected from a manhole near the Bogue Building. High fecal coliform counts, and high FC : FS ratios characterized this drainage stream until midsummer, when it was shown that seepage from the septic tank system was contaminating storm drainage. After mid-August, the septic tank was used as a holding tank, and wastes were removed by a commercial pump-out firm for haulage to the Regional waste treatment plant. Thereafter there was a considerable improvement in the bacterial quality of storm drainage water at Station 1.

This mid-August improvement in water quality was also reflected in the data for samples from Station 2, which represents the flow from the 18-inch Bogue Building storm drain at the point of entry to the drainage creek. Mean counts were very similar

to those recorded for Station 1, and were much lower for all three parameters than those obtained at Station 5.

Station 4 represents flows from a 12-inch storm drain flowing to the drainage creek near River Road from the north side. While occasional samples had counts for one or more parameters which exceeded the norm, mean values met Municipal quality objectives.

The data for Station 3 reflect a combination of the flows described above; the Station represented drainage creek water as it flowed under River Road en route to the Rideau River. As might be expected, there was a wide variation in bacterial numbers; coliform densities ranged from 2,000 to 600,000, and fecal coliform counts varied from 50 to 50,000. Of the 21 samples, 7 had FC : FS ratios of more than 4.0, and the mean ratio was 2.8. These data appear to confirm the admixture of human wastes in storm drainage from this area, and indicate the need for further remedial action.

The fragmentary chemical analytical data cited in Appendix Table A-6 indicate low levels of P and N and moderately high SS and BOD levels at Stations 1 and 3.

3.5 CFB Ottawa (South) and Uplands Creek Drainage System

Since 1963, annual surveillance studies have been conducted to monitor treated effluent and storm drainage inputs to the Rideau River from the CFB Ottawa (South) - Ottawa (Uplands) Airport complex, and to determine the impact, if any, of these flows on the bacteriological quality of the River. This report cites data obtained in 1974, and records comparable median data for previous years. Kamp *et al.* (3) reported data accumulated in the 1963-1967 period, but no formal reports are available for the 1968-1973 monitor data. The locations of sampling points used in all of these studies are given in Figure 5.

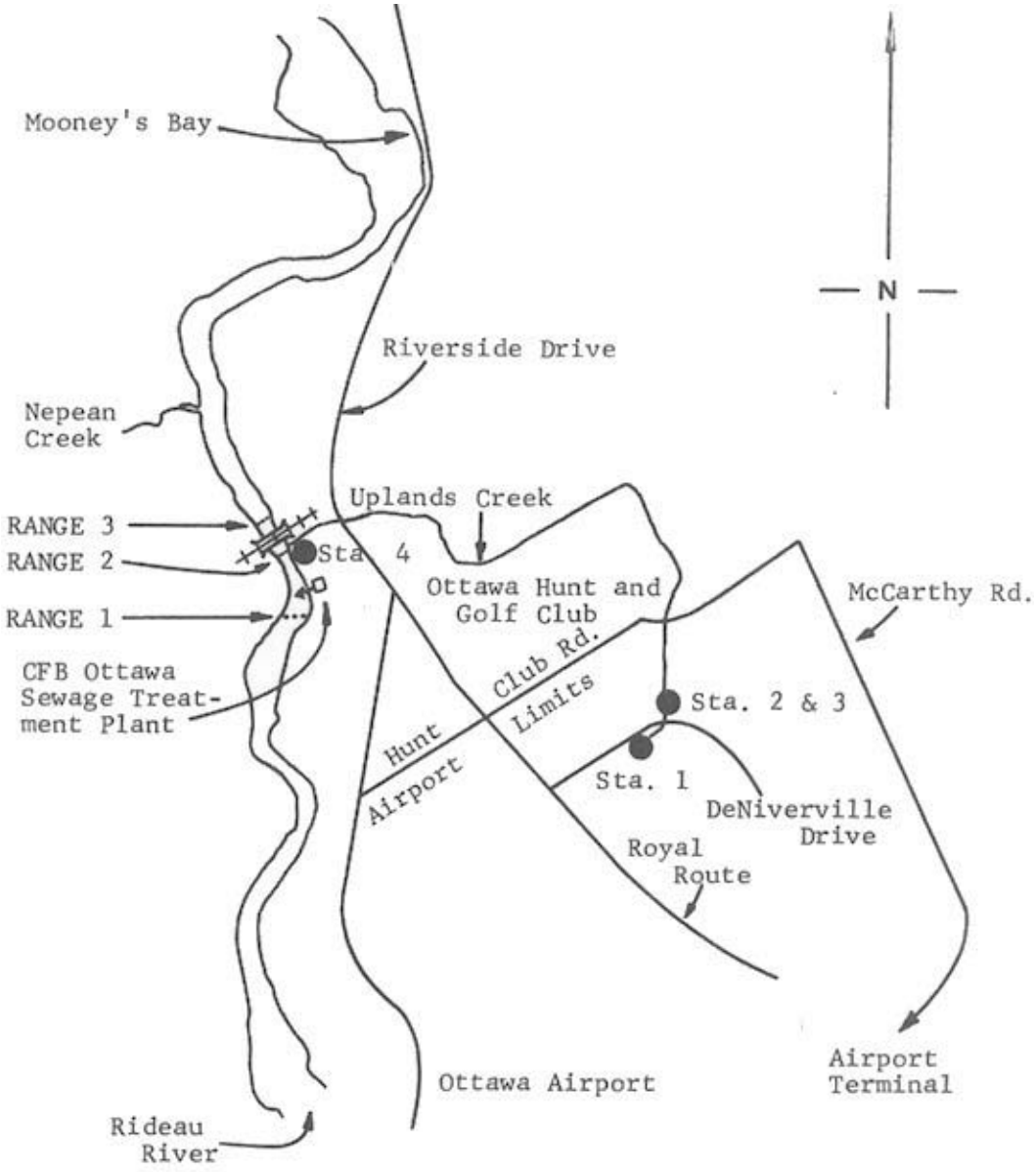

FIGURE 5: Sampling Stations, CFB Ottawa (South) And Ottawa (Uplands) Airport

3.5.1 CFB Ottawa (South) Sewage Treatment Plant Effluent.

A conventional activated sludge sewage treatment plant at CFB Ottawa (South), operated by the Department of National Defence, provides waste treatment for the entire base-airport complex. In 1972, the final effluent chlorine mixing capacity was increased from a retention time of 14 minutes to 30 minutes by the installation of a large-volume chlorine contact chamber, and phosphate removal by an alum process also began in 1972. Present plans call for the phasing-out of the treatment plant in 1976; wastes will be diverted for treatment at the Regional Municipality of Ottawa-Carleton waste treatment plant.

Bacterial MF counts recorded for 63 samples of treated plant effluent before chlorination, collected by EPS and DND staff in 1974, are given in Appendix Table A-7; chemical analytical data for 11 samples appear in Appendix Table A-8. Median bacterial counts for effluent samples before chlorination, calculated for a total of 209 specimens analysed in the 1968 - 1974 period, are reported in Table 6.

Similarly, bacterial density estimates for 78 samples of treated effluent after chlorine disinfection are given in Appendix Table A-8. Median bacterial counts for 336 final effluent samples analysed in the 1963 to 1974 period are included in Table 6.

Phosphate removal, as applied in this waste treatment system, is intended to reduce the P level to 1.0 mg/L or less; the mean value (0.95 mg/L) for 11 samples just achieves this. Three of the samples had P levels ranging from 1.28 to 2.85, and, as might be expected, these higher values were associated with an increased Kjeldahl N and BOD content. Samples of treated effluent before chlorination varied widely in their fecal bacterial content but median values indicated reasonably good treatment efficiency. Effluent disinfection was quite effective in producing a final effluent which met Provincial recreational water quality objectives (coliforms, 1000, fecal coliforms,

TABLE 6. Summary, Median MF Counts, Effluent Samples, CFB Ottawa (S), 1963 To 1974.

Year	Study period	No. of Samples	MEDIAN MF COUNT PER 100 ML.		
			Coliform	Fecal Coliform	Fecal Strep.
Treated Effluent Before Chlorination					
1968	June-Aug.	12	160,000	--	--
1969	May-Sept.	44	320,000	14,000	3,000
1971	Apr.-Oct.	49	410,000	30,000	4,600
1972	June-Oct.	14	200,000	6,000	3,300
1973	May-Nov.	27	96,000	5,400	1,300
1974	June-Dec.	63	130,000	18,000	4,200
Treated Effluent After Chlorination					
1963	Oct.	10	1,400	480	--
1964	May	4	3,600	1,300	--
1967	May-Sept.	24	280	20	--
1968	June-July	13	100	--	--
1969	May-Sept.	113	250	12	38
1971	Apr.-Oct.	48	840	23	47
1972	June-Oct.	18	1,000	57	68
1973	Apr.-Nov.	28	180	10	7
1974	Mar.-Dec.	78	110	8	6

100, per 100 ml.). Median values easily met these standards, but 12 (15 per cent) of the 78 samples failed to meet one or both of these objectives, and gross failure of disinfection occurred in only two instances. It is probable that disinfection failures resulted from equipment or operational breakdowns. In general, the plant in 1974 produced a satisfactory effluent which would not be expected to have a significant deleterious effect on bacterial quality in the Rideau River.

3.5.2 Uplands Creek Storm Drainage.

The locations of four storm drainage sampling stations on the Uplands Creek drainage system are shown in Figure 5. Bacterial MF count data for water samples collected from these stations are reported in Appendix Table A-10. Median counts obtained for two of these stations in the 1969 to 1974 period are given in Table 7.

Station 1 represents flows in a 12-inch storm drain which drains a part of the Canadian Forces Base and discharges to Uplands Creek at DeNiverville Drive. Median coliform, fecal coliform and fecal streptococcus counts of 2,200, 24 and 42, respectively, were calculated for the 11 samples. Eight samples from Station 2, in Uplands Creek at DeNiverville Drive, had median counts of 36,000, 99 and 410, respectively, during the same study period. Thus storm drainage to the Creek from the Base-Airport complex was characterized by variable but generally high coliform densities, low fecal coliform numbers, and low to moderately-high fecal streptococcus counts. The data were considered to represent surface drainage, with wild animal and bird contamination of the water but no significant input of human wastes. The relatively high coliform content was tentatively considered to be associated with periodic multiplication of some coliform biotypes in nutrient-rich storm drains; while such contamination would probably be of minimal public health hazard, it would affect the bacterial quality of the receiving stream. For this reason, a chlorination program was implemented at this point on the Creek (Station 3) in 1969.

The data presented for Station 3 show that disinfection has materially reduced fecal bacterial numbers, although frequent periods when the hypochlorinator has been inoperative because of inadequate servicing and maintenance have produced results which have been less than optimum. In any case, data for samples collected at Station 3 are representative of runoff water quality at the CFB Ottawa (South) property boundary.

TABLE 7. Summary, Median MF Counts, Water Samples, Uplands Creek Stations, 1969 TO 1974

Year	Study	Samples	MEDIAN MF COUNT PER 100 ML.		
			Coliform	Fecal Coliform	Fecal Strep.
Uplands Creek at DeNiverville Drive (After Chlorination)*					
1969	Apr.-Sept.	59	23,000	9	50
1970	May-Sept.	23	7,500	8	36
1971	May-Sept.	29	1,000	6	62
1972	May-Dec.	24	1,200	<2	5
1973	Jan.-Mar.	15	31,000	6	86
1973	Apr.-Nov.	29	2,200	4	16
1974	June-Sept.	12	18,000	24	170
Uplands Creek at Rideau River (Outfall)					
1969	Apr.-Sept.	76	6,100	250	420
1970	May-Sept.	9	450	18	13
1971	May-Sept.	29	2,800	110	480
1972	May-Oct.	18	3,900	120	290
1973	May-Nov.	23	10,000	340	360
1974	June-Sept.	13	7,500	720	370

* Periodic chlorination during summer periods.

Between Station 3 and the Uplands Creek outfall to the Rideau River at Station 4, the Creek drains a large section of land which is not federal property, and which is under the jurisdiction of the Regional Municipality of Ottawa-Carleton. It is probable that other pollution sources exist in this sector; in 1974, there was an increase of more than one order of magnitude in fecal coliform numbers between Stations 3 and 4, and similar data were recorded in previous years. For this reason, bacterial quality of the Creek water at its outfall to the Rideau River failed to meet Municipal objectives for all three index parameters.

3.5.3 Rideau River Bacterial Quality.

Water samples were collected, at the quarter points on three ranges across the Rideau River, for bacteriological analysis. Range location is shown in Figure 5. Range 1 is upstream from all CFB-Uplands Airport inputs. Range 2 is downstream from the CFB Ottawa (South) waste treatment plant chlorinated effluent outfall, while Range 3 is downstream from the Uplands Creek outfall as well as from the STP effluent.

Bacterial count data for 9 stations on these three Ranges are recorded in Appendix Table A-11. Chemical analytical data obtained for three of the same Stations (No. 2, 5 and 8) are shown in Appendix Table A-12.

Median bacterial counts for water samples collected from the three Ranges in the 1963 to 1974 period are cited in Table 8.

The 1974 bacterial count data show conclusively that fecal bacterial numbers were satisfactory, in terms of Provincial water quality objectives, and that they were very similar at each Station on each Range. There was no increase in estimated bacterial numbers from Range 1 to Range 2, or from Range 2 to Range 3.

TABLE 8. Summary, Median MF Counts, Rideau River at CFB Ottawa (South), 1963 To 1974

Year	Study Period	Samples	MEDIAN MF COUNT PER 100 ML		
			Coliform	Fecal Coliform	Fecal Strep.
Range 1, Sta. 1-3, Upstream from STP Effluent Outfall					
1963	Oct.	9	130	8	--
1964	May	15	140	33	--
1967	Aug.	18	110	20	--
1969	May-Sept.	63	260	11	7
1970	May-Sept.	27	160	7	6
1971	May-Aug.	39	130	6	4
1972	Aug.	6	57	8	8
1973	May-Sept.	51	310	10	10
1974	June-Sept.	33	270	4	10
Range 2, Sta. 4-6, Downstream from STP Effluent Outfall					
1963	Oct.	9	78	13	--
1964	May	15	130	33	--
1967	Aug.	18	140	20	--
1969	May-Sept.	63	260	10	8
1970	May-Sept.	27	130	8	4
1971	May-Aug.	39	140	6	4
1972	Aug.	6	58	5	10
1973	May-Sept.	51	320	12	12
1974	June-Sept.	33	260	8	6
Range 3, Sta. 7-9, Downstream from STP Effluent Outfall					
1964	May	15	170	40	--
1967	Aug.	18	170	20	--
1969	May-Sept.	63	320	16	12
1970	May-Sept.	27	210	10	13
1971	May-Aug.	39	150	8	4
1972	Aug.	6	77	8	14
1973	May-Sept.	51	330	20	10
1974	June-Sept.	33	330	8	10

Mean fecal coliform : fecal streptococcus ratios were low at each Range (0.5 at Range 1; 0.9 at Range 2; 0.8 at Range 3). Mean chemical analytical data for Stations 2 (Range 1), 5 (Range 2) and 8 (Range 3) were virtually identical. In spite of periodic deficiencies in the quality of the STP and Uplands Creek effluents previously noted, these input flows had no demonstrable deleterious effect on the excellent bacterial and chemical quality of this reach of the Rideau River. This confirms the conclusions of Kamp, et al. (3), and the data accumulated in previous years; it is evident that no degradation has occurred in the bacterial quality of this sector of the Rideau River since 1963.

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APPENDIX

TABLES

TABLE A-1(a). Bacterial MF Counts, Storm Drainage To Rideau R., Confederation Heights Area, 1974

	Date, 1974	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococcus
	Storm Drains (2) Near Data Centre			
	24-5	690	<2	8
	24-5	<10	<2	<2
1.	Storm Drain, West of Bronson Avenue Bridge			
	18-6	1,900	200	320
	26-6	1,600	95	480
	3-7	3,700	260	1,500
	10-7	43,000	8,400	3,500
	17-7	5,600	500	2,400
	24-7	2,800	660	2,200
	30-7	8,400	680	1,500
	7-8	3,900	290	210
	13-8	4,300	340	610
	21-8	6,100	440	710
	Median	4,100	390	1,100
	G. Mean	4,800	460	950
2.	Storm Drain, Under Bronson Avenue Bridge			
	18-6	24,000	13,000	1,400
	26-6	2,400	1,400	580
	3-7	7,500	3,600	400
	10-7	16,000	3,800	3,800
	17-7	380	56	100
	24-7	18,000	7,900	16,000
	30-7	3,100	900	1,300
	7-8	3,500	90	260
	13-8	15,000	2,800	620
	28-8	35,000	2,200	3,100
	4-9	1,500	1,500	1,200
	11-9	7,800	550	1,500
	17-9	1,500	160	400
	26-9	3,100	1,900	660
	11-10	1,200	200	210
	17-10	58,000	32,000	13,000
	25-10	19,000	48	450
	31-10	14,000	4,700	3,700
	Median	7,700	1,700	930
	G. Mean	6,300	1,200	1,100

TABLE A-1(b). Bacterial MF Counts, Storm Drainage To Rideau R., Confederation Heights Area, 1974

	Date, 1974	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococcus
3.	Storm Drain, East of Bronson Avenue Bridge			
	18-6	19,000	28	800
	26-6	6,800	38	40
	3-7	1,900	90	240
	10-7	1,200	130	610
	17-7	800	110	310
	24-7	5,300	2,000	9,000
	30-7	2,400	34	1,200
	7-8	5,600	590	94
	13-8	4,700	70	180
	21-8	2,800	42	52
	28-8	19,000	6,000	1,000
	4-9	3,700	2,700	1,000
	11-9	5,800	1,800	590
	17-9	12,000	1,100	2,400
	11-10	21,000	64	34
	17-10	34,000	1,000	8,400
	31-10	17,000	4,700	17,000
	Median	5,600	130	610
	G. Mean	5,900	300	580
4.	Storm Drain, East of Bronson Avenue Bridge			
	18-6	1,900	870	140
	26-6	800	180	250
	3-7	6,500	5,800	1,400
	10-7	17,000	2,200	4,200
	17-7	900	14	62
	24-7	28,000	6,000	48,000
	30-7	5,700	2,800	860
	7-8	2,200	1,300	510
	13-8	4,900	120	840
	21-8	2,500	240	360
	11-10	600	68	56
	17-10	38,000	21,000	13,000
	Median	3,700	1,100	680
	G. Mean	4,000	740	790

TABLE A-1(c). Bacterial MF Counts, Storm Drainage To Rideau R., Confederation Heights Area, 1974

	Date,	MF COUNT PER 100 ML. OF WATER		
	1974	Coliform	Fecal Coliform	Fecal Streptococcus
5.	Manhole, South of Riverside Drive			
	18-6	40	2	2
	26-6	30	<2	2
	3-7	2,500	46	270
	10-7	<10	<2	58
	17-7	260	2	32
	24-7	1,300	230	1,300
	30-7	1,400	26	450
	7-8	230	4	44
	13-8	120	2	60
	21-8	450	4	16
	Median	250	3	51
	G. Mean	170	6	47
6.	Storm Drain at Heron Road Bridge			
	22-5	310	18	340
	4-6	900	360	30
	18-6	1,800	90	40
	26-6	120	9	6
	3-7	2,700	1,100	34
	10-7	810	8	130
	17-7	320	5	120
	24-7	46,000	18,000	3,300
	30-7	4,800	2,600	52
	7-8	410	140	60
	13-8	8,100	5,500	300
	21-8	1,400	42	30
	28-8	5,500	4,600	160
	4-9	2,900	1,900	330
	11-9	1,500	84	120
	17-9	870	170	52
	26-9	850	240	250
	11-10	610	190	24
	17-10	1,200,000	580,000	1,800
	23-10	1,400	540	92
	25-10	2,000	140	3,300
	31-10	8,400	1,300	590
	6-11	330,000	33,000	800
	14-11	5,000	200	4,000
	19-11	1,500	220	10
	28-11	5,700	330	310
	6-1-75	7,700	4,600	650
	Median	1,800	330	130
	G. Mean	2,800	440	160

TABLE A-1(d). Bacterial MF Counts, Storm Drainage To Rideau R., Confederation Heights Area, 1974

	Date, 1974	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococcus
7.	Storm Drain, RCMP Building			
	22-5	10,000	2,300	600
	27-5	29,000	5,400	770
	10-6	18,000	7,400	830
	18-6	56,000	22,000	360
	26-6	2,200	1,300	42
	26-6	240,000	130,000	700
	3-7	2,800	20	88
	10-7	60,000	260	<2
	17-7	11,000	90	<2
	24-7	5,800	1,200	<2
	30-7	19,000	130	<2
	7-8	10,000	1,600	<2
	13-8	150	4	8
	21-8	700	18	20
	28-8	1,800	180	100
	4-9	1,800	180	730
	11-9	5,600	1,000	270
	17-7	19,000	3,500	12
	26-9	670	140	32
	11-10	220,000	79,000	790
	17-10	7,500	870	1,500
	25-10	130,000	45,000	3,500
	31-10	110,000	25,000	1,100
	6-11	58,000	11,000	900
	28-11	31,000	5,700	280
	6-1-75	23,000	5,300	140
	Median	15,000	1,500	210
	G. Mean	12,000	1,300	83

TABLE A-1(e). Bacterial MF Counts, Storm Drainage To Rideau R., Confederation Heights Area, 1974

Date, 1974	MF COUNT PER 100 ML. OF WATER		
	Coliform	Fecal Coliform	Fecal Streptococcus
8. Storm Drain, 400 Feet Downstream From RCMP Building			
22-5	170	<2	<2
18-6	420	3	2
26-6	800	<2	<2
3-7	2,100	4	8
10-7	3,000	66	40
17-7	7,000	<2	190
24-7	460	110	390
30-7	91,000	80	4,500
7-8	4,900	140	22
13-8	28,000	660	26
21-8	85,000	560	12
28-8	1,600	6	200
4-9	12,000	12,000	24
Median	3,000	66	24
G. Mean	3,700	31	28

TABLE A-2(a). Bacterial MF Counts, Black Rapids Creek Stations, 1974

Date	MF COUNT PER 100 ML. OF WATER		
	Coliform	Fecal Coliform	Fecal Streptococcus
Black Rapids Creek at Woodroffe Avenue (Station 2)			
19-7	270,000	2,700	100,000
25-7	270,000	24,000	94,000
1-8	21,000	3,300	5,800
6-8	41,000	4,800	2,300
15-8	3,200	720	250
22-8	5,500	1,400	1,500
29-8	4,100	550	2,200
5-9	1,400	610	360
Med.	13,000	2,100	2,300
G.M.	17,000	2,100	3,700
Black Rapids Creek at Woodroffe Avenue (Station 3)			
19-7	110,000	2,100	7,700
25-7	3,500	550	650
1-8	5,900	980	1,100
6-8	1,900	690	310
15-8	8,500	950	1,600
22-8	6,000	380	1,400
29-8	5,200	610	710
5-9	8,300	5,200	1,500
Med.	6,000	820	1,300
G.M.	7,500	990	1,200
Black Rapids Creek at Merivale Road (Station 20)			
21-6	14,000	910	240
4-7	23,000	700	1,800
11-7	12,000	600	480
18-7	11,000	200	280
25-7	22,000	490	1,300
1-8	11,000	1,600	400
6-8	360,000	36,000	13,000
15-8	15,000	250	1,500
22-8	27,000	300	440
29-8	12,000	70	420
5-9	4,700	60	290
Med.	14,000	490	440
G.M.	18,000	520	730

TABLE A-2(b). Bacterial MF Counts, Black Rapids Creek Stations, 1974

Date	MF COUNT PER 100 ML. OF WATER		
	Coliform	Fecal Coliform	Fecal Streptococcus
Black Rapids Creek at Highway 16 (Station 21)			
21-6	2,800	320	160
4-7	14,000	900	1,200
11-7	5,800	230	210
18-7	5,400	340	430
25-7	8,200	190	300
1-8	11,000	640	1,500
6-8	63,000	13,000	2,900
15-8	14,000	390	120
22-8	3,800	380	48
29-8	2,500	130	110
5-9	10,000	1,100	100
Med.	8,200	380	210
G.M.	8,100	520	290
Storm Drain into Black Rapids Creek (Station 22)			
21-6	8,000	420	110
4-7	19,000	240	990
11-7	4,000,000	45,000	30
18-7	150,000	8	56
25-7	14,000	250	120
1-8	35,000	42	520
6-8	51,000	62	40
15-8	30,000	70	34
22-8	220,000	10	60
29-8	100,000	2	12
5-9	560	<2	490
Med.	35,000	62	60
G.M.	43,000	59	95

TABLE A-2(c). Bacterial MF Counts, Black Rapids Creek Stations, 1974

Date	MF COUNT PER 100 ML. OF WATER		
	Coliform	Fecal Coliform	Fecal Streptococcus
Storm Drain to Black Rapids Creek, Opposite Simpson Development (Station 23)			
21-6	2,000	52	300
4-7	24,000	440	2,100
11-7	4,000	250	820
18-7	16,000	2,600	470
25-7	2,900	1,100	410
1-8	10,000	420	1,200
6-8	3,800	76	260
15-8	24,000	90	150
22-8	17,000	610	270
29-8	2,900	120	240
5-9	1,500	40	310
Med.	4,000	250	310
G.M.	6,300	240	430
Storm Drain to Black Rapids Creek, 1000' E. of Station 23 (Station 24)			
21-6	2,400	330	480
4-7	25,000	530	4,700
11-7	1,200	54	120
18-7	59,000	140	4,500
25-7	36,000	8,400	1,700
1-8	2,800	1,000	1,700
6-8	170,000	630	490
15-8	33,000	380	1,100
22-8	71,000	5,500	1,100
29-8	40,000	100	12,000
5-9	87,000	12,000	270
Med.	36,000	530	1,100
G.M.	22,000	690	1,200

TABLE A-3(a). Bacterial MF Counts, Rideau River At Black Rapids Creek, 1974

Range and Station Number	Date	MF COUNT PER 100 ML. Coliform	Fecal Coliform	Fecal Streptococcus
RANGE A				
Station 1	28-6	100	2	2
(Upstream from	11-7	480	6	4
B.R. Creek)	25-7	540	26	4
	6-8	1,000	22	8
	22-8	140	6	8
	5-9	110	2	10
Station 1	Med.	310	6	6
Station 1	G.M.	270	7	5
RANGE A				
Station 2	28-6	32	<2	2
(Upstream from	11-7	650	18	6
B.R. Creek)	25-7	700	50	14
	6-8	700	18	8
	22-8	48	2	4
	5-9	180	2	4
Station 2	Med.	420	10	5
Station 2	G.M.	210	6	5
RANGE A				
Station 3	28-6	30	<2	22
(Upstream from	11-7	430	6	10
B.R. Creek)	25-7	710	48	12
	6-8	400	130	30
	22-8	320	10	20
	5-9	110	6	14
Station 3	Med.	360	8	17
Station 3	G.M.	220	11	17
Stations 1-3	Med.	360	6	8
Stations 1-3	G.M.	230	8	8

TABLE A-3(b). Bacterial MF Counts, Rideau River At Black Rapids Creek, 1974

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
RANGE B				
Station 4	28-6	1,000	6	40
(Downstream from	11-7	130	12	4
B.R. Creek)	25-7	3,000	30	22
	6-8	1,100	48	12
	22-8	80	2	<2
	5-9	250	4	4
Station 4	Med.	630	9	8
Station 4	G.M.	450	10	7
RANGE B				
Station 5	28-6	220	<2	<2
(Downstream from	11-7	160	6	4
B.R. Creek)	25-7	850	42	22
	6-8	500	40	14
	22-8	210	2	8
	5-9	220	2	6
Station 5	Med.	220	4	7
Station 5	G.M.	300	6	6
RANGE B				
Station 6	28-6	1,100	4	<2
(Downstream from	11-7	170	12	6
B.R. Creek)	25-7	420	18	8
	6-8	800	34	6
	22-8	150	2	8
	5-9	310	2	8
Station 6	Med.	370	8	7
Station 6	G.M.	380	7	5
Stations 4-6	Med.	280	6	7
Stations 4-6	G.M.	370	7	6

TABLE A-3(c). Bacterial MF Counts, Rideau River At Black Rapids Creek, 1974

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
MOUTH OF B.R. CREEK				
Station 7	28-6	1,000	6	24
	11-7	250	6	6
	25-7	860	74	14
	6-8	900	56	18
	22-8	80	<2	8
	5-9	230	4	22
Station 7	Med.	510	6	16
Station 7	G.M.	390	9	14
MOUTH OF B.R. CREEK				
Station 8	28-6	500	<2	5
	11-7	410	36	22
	25-7	82,000	46	6
	6-8	8,800	910	24
	22-8	140	2	14
	5-9	380	4	4
Station 8	Med.	460	20	10
Station 8	G.M.	1,400	15	10
Stations 7 & 8	Med.	460	6	14
Stations 7 & 8	G.M.	740	12	12

TABLE A-3(d). Bacterial MF Counts, Rideau River At Black Rapids Creek, 1974

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
LOCK CHANNEL				
Station 9	28-6	1,000	<2	11
	11-7	170	8	14
	25-7	590	38	16
	6-8	390	20	12
	22-8	100	4	16
	5-9	110	<2	4
Station 9	Med.	280	6	13
Station 9	G.M.	270	5	11
LOCK CHANNEL				
Station 10	28-6	370	<2	4
	11-7	150	4	4
	25-7	740	12	6
	6-8	800	34	14
	22-8	140	<2	8
	5-9	250	6	2
Station 10	Med.	310	5	5
Station 10	G.M.	320	5	5
Stations 9 & 10	Med.	310	5	10
Stations 9 & 10	G.M.	300	5	8

TABLE A-4. Chemical Analyses, Black Rapids Creek Stations, 1974. Milligrams/liter.

Date, 1974	Mg per liter of Water Sample				
	Phosphate (P)	Total Kjeldahl (N)	Nitrate	BOD	TOC
Black Rapids Creek at Woodroffe Avenue (Station 2)					
11-7	0.13	1.40	0.014	4	13
25-7	0.10	1.45	--	1	11
6-8	0.10	1.55	--	--	11
22-8	0.16	1.50	--	3	10
5-9	0.10	1.42	--	1	--
Mean	0.12	1.46	--	2.2	11
Rideau River, Range B, Station 5 (Downstream from B.R. Creek)					
11-7	0.07	1.65	0.020	2	14
25-7	0.10	1.35	--	1	11
6-8	<0.1	1.40	--	--	11
22-8	0.16	1.50	--	4	12
5-9	0.13	1.42	--	1	--
Mean	0.11	1.46	--	2	12
Rideau River, Station 8 (at Mouth of Black Rapids Creek)					
11-7	0.13	1.45	0.022	2	18
25-7	0.10	1.55	--	2	13
Mean	0.12	1.50	--	2	16

TABLE A-5(a). Bacterial MF Counts, Bogue Building Area Drainage System, 1974

Date, 1974	MF COUNT PER 100 ML. OF WATER		
	Coliform	Fecal Coliform	Fecal Streptococcus
1. Bogue Building Drain, at Manhole			
25-4	180,000	3,300	20
6-6	77,000	110	24
13-6	10,000	330	20
18-6	370,000	15,000	1,100
27-6	59,000	2,400	50
19-7	3,900,000	13,000	2,800
25-7	7,500	100	410
1-8	2 7, 000	70	1,000
7-8	830,000	21,000	600
*6-9	9, 500	10	900
11-9	18,000	10	2,50C
17-10	680	18	1,800
25-10	400	2	1,300
31-10	2,200	<2	210
Median	23,000	110	750
G. Mean	28,000	180	350
2. South Side Drain Discharging to Creek			
10-6	4,100	66	4
13-6	290,000	1,000	560
18-6	14,000	2,100	40
27-6	7,400	190	190
19-7	840,000	4,100	1,000
25-7	15,000	96	290
1-8	3,100	270	810
7-8	1,100	4	30
21-8	3,600	<2	110
6-9	350,000	130	110
11-9	55,000	10	160
17-10	170,000	180	300
25-10	11,000	430	4,100
31-10	10,000	42	72
Median	13,000	160	180
G. Mean	22,000	110	170

* No flow at Manhole on August 21, 1974

TABLE A-5(b). Bacterial MF Counts, Bogue Building Area Drainage System, 1974

	Date, 1974	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococcus
3.	Creek, Downstream from Bogue Building Outfall			
	25-4	73,000	1,300	670
	16-5	8,000	1,100	84
	22-5	370,000	51,000	900
	23-5	63,000	11,000	330
	27-5	53,000	3,800	90
	4-6	23,000	440	72
	6-6	22,000	96	18
	10-6	2,000	100	160
	13-6	10,000	1,500	220
	18-6	17,000	1,300	740
	27-6	11,000	410	200
	19-7	600,000	3,000	1,200
	25-7	7,000	140	190
	1-8	4,200	580	1,100
	7-8	140,000	700	6,100
	21-8	5,200	160	130
	6-9	100,000	50	82
	11-9	160,000	1,300	390
	17-10	230,000	1,300	550
	25-10	20,000	170	1,200
	31-10	22,000	1,100	52
	Median	22,000	1,100	220
	G. Mean	31,000	770	280
4.	North Side Drain Discharging to Creek			
	10-6	10	10	2
	13-6	4,600	3,300	240
	18-6	900	26	28
	27-6	120	4	<2
	19-7	49,000	280	1,300
	25-7	3,400	20	26
	1-8	720	270	56
	7-8	250	4	42
	21-8	1,000	90	18
	6-9	800	4	<2
	11-9	22,000	1,100	190
	17-10	650	4	84
	25-10	300	4	14
	31-10	1,200	1,000	28
	Median	760	23	28
	G. Mean	970	45	27

TABLE A-5(c). Bacterial MF Counts, Bogue Building Area Drainage System, 1974

	Date, 1974	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococcus
5.	Creek, Upstream from Bogue Building Outfall			
	10-6	34,000	1,500	1,800
	13-6	22,000	2,200	1,200
	18-6	23,000	1,700	8,800
	27-6	130,000	4,100	3,000
	19-7	82,000	5,600	14,000
	25-7	170,000	1,800	1,700
	1-8	74,000	3,300	10,000
	7-8	880,000	4,700	31,000
	21-8	880,000	500	900
	6-9	3,900,000	3,900	6,700
	11-9	19,000,000	14,000	7,000
	17-9	620,000	25,000	4,800
	25-10	220,000	410	590
	31-10	950,000	81,000	210
	Median	200,000	3,600	3,900
	G. Mean	280,000	3,700	3,200
6.	Storm Drain from Ottawa Airport			
	17-10	11,000	36	1,400
	25-10	1,800	14	120
	31-10	100	<2	42

TABLE A-6. Chemical Analyses, Bogue Building Area Drainage System, 1974. Milligrams/liter

	Mg per liter of Water Sample				
Date, 1974	Total Phosphate (P)	Total Kjeldahl N	Suspended Solids	Volatile Suspended Solids	BOD
1. Bogue Building Drain, at Manhole					
25-4	0.10	1.0	20	18	13
25-7	0.07	1.25	6	--	<1
3. Creek, Downstream from Bogue Bldg. Outfall					
25-4	0.2	1	7	7	8
23-5	N.D.*	N.D.*	10	-	3.5
25-7	0.3	0.85	53	--	<1

* N.D. = None Detected

TABLE A-7(a). Bacterial MF Counts, Treated Effluent Before Chlorination, CFB Ottawa (S), Ontario, 1974

	Date	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococci
1.	Treated Effluent Before Chlorination			
	19-6	610,000	160,000	14,000
	20-6	430,000	75,000	13,000
	20-6	410,000	110,000	10,000
	21-6	160,000	53,000	10,000
	24-6	110,000	22,000	5,400
	26-6	110,000	15,000	4,700
	28-6	160,000	36,000	30,000
	28-6	5,300	5,3C0	900
	2-7	39,000	9,900	3,200
	4-7	54,000	23,000	6,000
	5-7	160,000	37,000	10,000
	5-7	800,000	51,000	9,000
	*8-7	80,000	23,000	13,000
	9-7	100,000	280,000	59,000
	11-7	140,000	36,000	8,500
	12-7	80,000	10,000	3,700
	12-7	79,000	12,000	4,200
	* 15-7	60,000	7,100	3,600
	16-7	80,000	13,000	4,200
	18-7	66,000	23,000	1,800
	19-7	130,000	10,000	2,300
	19-7	140,000	18,000	3,200
	* 22-7	150,000	9,000	2,100
	25-7	240,000	34,000	3,100
	26-7	160,000	29,000	2,200
	26-7	130,000	34,000	3,300
	* 29-7	68,000	14,000	1,400
	1-8	6000	8,500	1,500
	2-8	68,000	14,000	3,100
	2-8	61,000	8,000	2,000
	*6-8	48,000	4,100	1,100
	9-8	180,000	15,000	1,700

* Samples Collected by DND Staff

TABLE A-7(b). Bacterial MF Counts, Treated Effluent Before Chlorination, CFB Ottawa (S), Ontario, 1974.

Date	MF COUNT PER 100 ML. OF WATER		
	Coliform	Fecal Coliform	Fecal Streptococci
1. Treated Effluent Before Chlorination			
9-8	110,000	16,000	1,500
12-8	42,000	6,700	1,300
* 12-8	37,000	5,700	1,000
16-8	140,000	30,000	15,000
16-8	1,200,000	200,000	44,000
* 19-8	38,000	8,000	2,100
23-8	200,000	51,000	8,000
23-8	440,000	48,000	19,000
* 26-8	110,000	1,900	6,000
30-8	90,000	14,000	10,000
30-8	240,000	27,000	2,900
*3-9	63,000	18,000	3,200
6-9	720,000	12,000	26,000
6-9	620,000	180,000	41,000
*9-9	100,000	16,000	11,000
13-9	240,000	55,000	11,000
* 16-9	160,000	42,000	5,200
* 23-9	87,000	11,000	4,900
* 30-9	100,000	11,000	2,700
*7-10	56,000	10,000	4,000
13-10	180,000	22,000	4,000
* 15-10	54,000	8,300	4,000
* 21-10	91,000	11,000	2,100
* 28-10	240,000	25,000	9,400
*4-11	81,000	12,000	3,800
* 12-11	130,000	16,000	1,600
* 18-11	350,000	37,000	4, 300
* 25-11	150,000	27,000	5,500
*2-12	390,000	82,000	14,000
*9-12	120,000	31,000	11,000
* 16-12	140,000	38,000	11,000
Med.	130,000	18,000	4,200
G. Mean	130,000	21,000	5,100

* Samples Collected by DND Staff

TABLE A-8. Chemical Analyses, Treated Effluent Before Chlorination, CFB Ottawa (S), 1974. Milligrams/liter

Date	Mg per liter of Water Sample				
	Total Phosphate (P)	Total Kjeldahl N	Suspended Solids	Volatile Suspended Solids	BOD
1973					
7-11	0.82	1.9	24	--	42
4-12	0.33	1.0	193	--	--
1974					
9-1	0.40	1.5	20	8	30
6-2	1.28	7.3	34	--	26
12-3	0.72	--	21	--	17
22-5	2.85	8.5	29	--	46
2-6	0.65	2.5	52	32	21
10-7	0.65	0.5	14	--	15
5-9	0.36	8.0	1	--	7
13-11	1.60	7.0	25	18	32
9-12	0.80	2.5	24	--	8
Mean	0.95	4.1	40	--	24

TABLE A-9(a). Bacterial MF Counts, Treated Effluent After Chlorination, CFB Ottawa (S), Ontario, 1974

Date	$C1_2$ Residual ppm	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococci
2. Treated Effluent After Chlorination				
* 13-3	--	190	30	2
* 19-3	--	130	8	4
* 1-4	--	24	8	6
* 8-4	--	120	12	2
* 16-4	--	100	20	48
* 22-4	--	4,000	180	400
* 29-4	--	210	28	18
* 6-5	--	160	14	10
* 13-5	--	2,500	32	180
* 27-5	--	3,400	120	46
* 3-6	--	110	22	6
* 10-6	--	150	20	6
* 17-6	--	60	14	6
19-6	0.8	150	14	8
20-6	1.6	160	20	<2
20-6	1.6	60	16	7
21-6	1.3	60	6	2
* 24-6	--	130	20	10
24-6	1.4	160	20	4
26-6	--	20	4	4
28-6	1.9	10	2	<2
28-6	1.9	<10	<2	<2
* 2-7	--	2,000	6	2
2-7	--	<10	2	<2
4-7	--	10	4	2
5-7	--	320	14	18
5-7	--	1,100	130	300
* 8-7	--	20	6	<2
9-7	1.0	240	48	36
11-7	--	30	5	6
12-7	1.5	100	8	6
12-7	1.0	42	16	10
* 15-7	--	210	13	4
16-7	--	170	86	12
18-7	--	90	80	10
19-7	--	210	56	8
19-7	--	220	18	10
* 22-7	--	30	2	2
25-7	1.2	30	4	<2
26-7	2.8	30	4	<2

* Samples Submitted by DND Staff

TABLE A-9(b). Bacterial MF Counts, Treated Effluent After Chlorination, CFB Ottawa (S), Ontario, 1974

Date	$C1_2$ Residual ppm	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococci
2. Treated Effluent After Chlorination				
26-7	2.7	70	8	<2
* 29-7	--	150,000	29,000	1,800
1-8	1.8	100	2	2
2-8	1.8	40	2	<2
2-8	1.8	4	<2	<2
* 6-8	--	20	2	<2
9-8	2.0	160	2	<2
9-8	2.4	20	2	<2
* 12-8	--	30	2	<2
12-8	1.5	30	4	4
16-8	2.7	6	<2	<2
16-8	0.4	2,200	380	320
* 19-8	--	260	6	2
23-8	0.8	110	6	36
23-8	1.7	10	<2	<2
* 26-8	--	280	-9	10
30-8	2.1	50	4	<2
30-8	1.2	90	4	2
* 3-9	--	30	<2	<2
6-9	2.3	980	<2	4
6-9	2.6	10	6	<2
* 9-9	--	140	8	10
13-9	1.8	1,700	110	170
* 16-9	--	40	2	4
* 23-9	--	<10	<2	8
* 30-9	--	<10	<2	<2
* 7-10	--	2,800	2,800	12
13-10	1.1	610	12	18
* 15-10	--	40	4	2
* 23-10	--	120,000	14,000	3,200
* 28-10	--	90	6	11
* 4-11	--	10,000	46	66
* 12-11	--	250	2	4
* 18-11	--	2,100	130	44
* 25-11	--	20	20	16
* 2-12	--	680	170	30
* 9-12	--	150	24	6
* 16-12	--	290	64	12
Med.	--	110	8	6
G. Mean	--	130	13	8

* Samples Submitted by DND Staff

TABLE A-10(a). Bacterial MF Counts, Water Samples, Uplands Creek Stations, CFB Ottawa (S), 1974

	Date	MF COUNT PER 100 ML. OF WATER		
		Coliform	Fecal Coliform	Fecal Streptococci
1.	Storm Drain (12") to Uplands Creek at DeNiverville Drive			
	20-6	80	6	5
	5-7	2,200	20	220
	12-7	260	<2	38
	19-7	3,700	200	500
	26-7	110	24	42
	2-8	2,400	56	`8
	9-8	3,100	16	28
	16-8	1,500	8	14
	23-8	1,500	42	16
	30-8	160,000	8,000	44
	6-9	9,500	370	220
	Med.	2,200	24	42
	G. Mean	1,800	33	47
2.	Uplands Creek at DeNiverville Drive (Before Chlorination)			
	20-6	340,000	92	3,200
	5-7	35,000	140	440
	12-7	13,000	410	420
	19-7	8,600	86	550
	26-7	1,500,000	210	300
	23-8	31,000	4	100
	30-8	200,000	26	3,000
	6-9	37,000	18	62
	Med.	36,000	99	410
	G. Mean	68,000	60	450

TABLE A-10(b). Bacterial MF Counts, Water Samples, Uplands Creek Stations, CFB Ottawa (S), 1974

Date	MF COUNT PER 100 ML. OF WATER		
	Coliform	Fecal Coliform	Fecal Streptococci
3. Uplands Creek at DeNiverville Drive (After Chlorination)			
20-6	130,000	32	2,300
5-7	23,000	300	670
* 12-7	10	<2	<2
19-7	3,100	70	280
** 26-7	740,000	220	630
2-8	76,000	16	62
9-8	48,000	34	850
16-8	6	<2	<2
23-8	10	<2	<2
30-8	13,000	2	26
* 6-9	590	4	6
** 13-9	310,000	130	330
Med.	18,000	24	170
G. Mean	4,300	17	65
4. Uplands Creek at Rideau River			
20-6	10,000	240	120
28-6	6,700	300	430
5-7	5,900	470	550
12-7	22,000	4	100
19-7	37,000	1,900	12,000
26-7	7,500	440	280
2-8	9,700	1,000	1,100
9-8	3,400	260	480
16-8	8,000	220	300
23-8	2,900	260	520
30-8	2,900	240	370
6-9	2,400	350	340
13-9	12,000	720	230
Med.	7,500	720	370
G. Mean	7,300	290	440

Chlorine Residuals

* July 12, 1.5 ppm; Sept. 6, 0.9 ppm
** July 26 and Sept. 13, 0.0 ppm

TABLE A-11(a). Bacterial MF Counts, Rideau River at CFB Ottawa (South), 1974.

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
RANGE 1				
Station 1	28-6	250	2	<2
(Upstream from	5-7	240	<2	12
STP Effluent)	12-7	800	3	6
	19-7	300	10	36
	26-7	520	8	8
	2-8	460	10	18
	9-8	210	10	6
	16-8	170	3	6
	23-8	250	<2	6
	30-8	140	2	4
	6-9	110	2	4
Station 1	Med.	250	3	6
Station 1	G.M.	270	3	7
RANGE 1				
Station 2	28-6	110	2	11
(Upstream from	5-7	280	2	12
STP Effluent)	12-7	1,000	2	26
	19-7	54	16	26
	26-7	580	20	14
	2-8	510	8	10
	9-8	200	6	2
	16-8	350	3	6
	23-8	290	2	10
	30-8	38	2	2
	6-9	190	<2	6
Station 2	Med.	280	2	10
Station 2	G.M.	220	4	9

TABLE A-11(b). Bacterial MF Counts Rideau River At CFB Ottawa (South), 197+

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
RANGE 1				
Station 3	28-6	370	3	8
(Upstream from	5-7	390	8	26
STP Effluent)				
	12-7	900	8	6
	19-7	500	110	190
	26-7	680	10	6
	2-8	270	6	20
	9-8	250	4	4
	16-8	110	20	12
	23-8	530	4	24
	30-8	170	2	16
	6-9	150	6	26
Station 3	Med.	370	6	16
Station 3	G.M.	330	8	16
Stations 1-3	Med.	270	4	10
Stations 1-3	G.M.	270	5	10

TABLE A-11(c). Bacterial MF Counts Rideau River At CFB Ottawa (South), 1974

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
RANGE 2				
Station 4	28-6	500	6	2
(Downstream from	5-7	390	4	30
STP Effluent)	12-7	1,000	2	12
	19-7	260	10	70
	26-7	580	10	<2
	2-8	380	18	18
	9-8	160	2	2
	16-8	250	2	<2
	23-8	370	6	4
	30-8	200	4	2
	6-9	50	10	4
Station 4	Med.	370	6	4
Station 4	G.M.	300	5	5
RANGE 2				
Station 5	28-6	160	<2	<2
(Downstream from	5-7	210	20	16
STP Effluent)	12-7	1,500	8	12
	19-7	350	10	30
	26-7	1,800	28	6
	2-8	300	16	12
	9-8	72	12	2
	16-8	110	10	4
	23-8	190	<2	4
	30-8	150	<2	8
	6-9	90	<2	4
Station 5	Med.	190	10	6
Station 5	G.M.	250	5	6

TABLE A-11(d). Bacterial MF Counts, Rideau River At CFB Ottawa (South), 1974

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
RANGE 2				
Station 6	28-6	110	4	4
(Downstream from	5-7	800	22	46
STP Effluent)				
	12-7	560	2	10
	19-7	500	66	140
	26-7	470	20	8
	2-8	470	22	8
	9-8	110	4	6
	16-8	200	12	12
	23-8	640	8	24
	30-8	130	2	<2
	6-9	150	6	2
Station 6	Med.	470	8	8
Station 6	G.M.	300	9	10
Stations 4-6	Med.	260	8	6
Stations 4-6	G.M.	280	6	7

TABLE A-11(e). Bacterial MF Counts, Rideau River At CFB Ottawa (South), 1974

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
RANGE 3				
Station 7	28-6	1,000	16	12
(Downstream from	5-7	390	38	48
STP Effluent)	12-7	1,600	10	18
(Downstream from				
Uplands Creek)	19-7	540	30	190
	26-7	590	14	20
	2-8	320	13	24
	9-8	170	4	4
	16-8	300	4	2
	23-8	440	8	12
	30-8	110	4	8
	6-9	110	2	8
Station 7	Med.	390	10	12
Station 7	G.M.	370	9	14
RANGE 3				
Station 8	28-6	160	2	4
(Downstream from	5-7	330	54	36
STP Effluent)	12-7	390	6	14
(Downstream from				
Uplands Creek)	19-7	400	28	32
	26-7	590	16	4
	2-8	350	20	12
	9-8	170	6	6
	16-8	220	4	2
	23-8	730	6	10
	30-8	70	<2	<2
	6-9	100	2	<2
Station 8	Med.	330	6	6
Station 8	G.M.	260	7	6

TABLE A-11(f) . Bacterial MF Counts, Rideau River At CFB Ottawa (South), 1974

Range and Station Number	Date	MF COUNT PER 100 ML.		
		Coliform	Fecal Coliform	Fecal Streptococcus
RANGE 3				
Station 9	28-6	250	2	4
(Downstream from	5-7	1,800	350	510
STP Effluent)				
(Downstream from	12-7	370	36	80
Uplands Creek)	19-7	350	100	100
	26-7	450	6	10
	2-8	300	10	15
	9-8	300	2	4
	16-8	170	<2	<2
	23-8	330	24	40
	30-8	170	4	10
	6-8	190	22	4
Station 9	Med.	300	10	10
Station 9	G.M.	300	12	16
Stations 7-9	Med.	330	8	10
Stations 7-9	G.M.	310	9	11

TABLE A-12(a). Chemical Analyses, Rideau River At CFB Ottawa (South), 1974. Milligrams/liter.

Date, 1974	Mg per liter of Water Sample				
	Total Phosphate (P)	Total Kjeldahl N	Nitrate (N)	BOD	TOC
Station 2.Upstream from STP Effluent					
* 5-7	0.13	1.10	N.D.	2	10
12-7	N.D.	1.60	0.012	4	12
19-7	0.1	1.50	--	2	11
26-7	0.2	1.50	--	1	19
2-8	0.1	1.25	--	2	12
9-8	<0.1	1.45	--	2	10
16-8	0.16	1.45	--	3	10
23-8	0.13	1.50	--	3	10
30-8	0.13	1.21	--	2	--
6-9	0.13	1.35	--	1	--
Mean	0.12	1.39	--	2.2	11.8
Station 5. Downstream from STP Effluent					
* 5-7	N.D.	1.15	N.D.	2	10
12-7	0.07	1.60	0.02	2	18
19-7	0.10	1.50	--	2	16
26-7	0.10	1.45	--	1	14
2-8	0.50	1.25	--	2	12
9-8	0.10	1.40	--	2	11
16-8	0.13	1.40	--	2	9
23-8	0.16	1.52	--	2	9
30-8	0.03	1.30	--	2	--
6-9	0.13	1.35	--	1	--
Mean	0.11	1.39	--	1.8	12.4

N.D. = None Detected

* On July 5, Ammonia (N) levels at Stations 2 and 5 were 0.3 and 0.4 mg/L, respectively.

TABLE A-12(b). Chemical Analyses, Rideau River At CFB Ottawa (South), 1974. Milligrams/liter.

Date, 1974	Mg per liter of Water Sample				
	Total Phosphate (P)	Total Kjeldahl N	Nitrate (N)	BOD	TOC
Station 8. Downstream from STP Effluent & Creek					
* 5-7	N.D.	1.10	N.D.	1	11
12-7	N.D.	1.55	0.02	4	16
19-7	0.20	1.55	--	3	12
26-7	0.10	1.30	--	1	14
2-8	0.20	1.30	--	2	10
9-8	<0.10	1.40	--	2	10
16-8	0.13	1.45	--	2	11
23-8	0.07	1.50	--	3	9
30-8	0.03	1.25	--	2	--
6-9	0.13	1.36	--	1	--
Mean	0.10	1.38	--	2.1	11.6

N.D. = None Detected

* On July 5, Ammonia (N) levels at Station 8 was 0.5 mg/L.