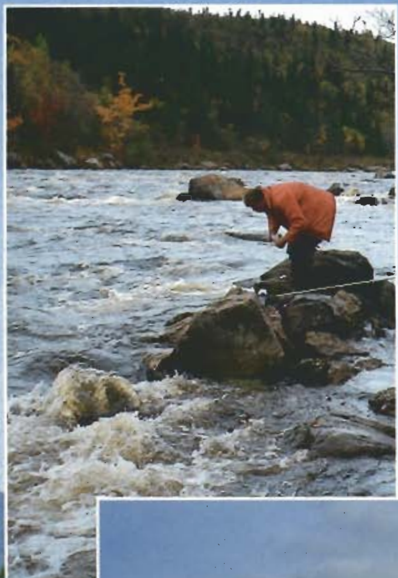
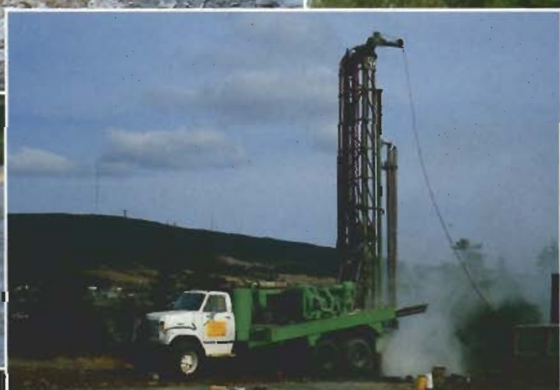
Regional Water Resources Study of the Northern Peninsula and Humber Valley





GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

DEPARTMENT OF ENVIRONMENT AND LANDS
WATER RESOURCES DIVISION

Department of Environment and Lands
St. John's, Newfoundland

Final Report

Regional Water Resources Study of The Northern Peninsula and Humber Valley

June 1990

Acres International Limited
St. John's, Newfoundland

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Executive Summary

The Regional Water Resources Study of the Humber Valley and Northern Peninsula is the fourth in a series of studies of the water resources of the Province of Newfoundland. Its purpose is to provide information to assist the Water Resources Division of the Department of Environment and Lands in its water planning and management activities.

The objectives of the study were

- to assess the quantity of water available (mean annual runoff, low flows, effect of storage);
- to document present water quality and identify areas of concern;
- to identify and document instream uses;
- to compare supply and demand for each community, and identify any communities which are presently experiencing, or may experience, shortages;
- to rank regions within the study area according to their overall water resource situation;
- to make recommendations arising from these investigations.

The study area included the Northern Peninsula, all the land drained by the Humber River, and a small area around the inner part of White Bay. The total area is about 28,000 km^2, and the population is over 70 000.

The conclusions and recommendations for each of the major study items are summarized below.

Availability

Availability: Conclusions

The natural waters of the study area are an abundant and good quality resource. The average annual runoff is about 1100 mm. Natural dependable flows are low, but reliable flows can usually be increased by relatively modest storage. Groundwater availability is variable; the highest producing hydrostratigraphic units are unfortunately located inland, away from most communities.

Availability: Recommendations

- Low flow analyses should be continued and regularly updated.
- A program should be undertaken to improve estimation of runoff from rainfall. In particular, more precipitation stations are required at higher elevations.
- Existing water supplies from small watersheds should be metered, and good continuous records should be kept, to improve the data base for small watersheds.
- Groundwater potential near communities with shortages should be systematically investigated.

Quality

Quality: Conclusions

The natural surface water and groundwater quality is good. Some communities experience occasional problems of aesthetic quality (taste and odour) with their water supplies.

The effects of anthropogenic activities are a concern, particularly the effect of forest operations on fish habitat.

Quality: Recommendations

- The province should strengthen the ability of its departments to monitor activities which may affect water quality, and to enforce the provisions of their regulations.
- Water quality monitoring programs should be continued and expanded, especially those monitoring the effects of anthropogenic activities.
- The effects of land uses, particularly forestry, on the water resource should be a fundamental consideration in all land use planning.

Instream Uses

Instream Uses: Conclusions

The principal instream uses in the study area are hydropower, fisheries, and tourism/recreation. These all bring economic and other benefits to the study area. Conflicts seldom occur at present because these uses are widely dispersed. Small hydro potential is good in the study area.

Instream Uses: Recommendations

- All proposed developments should take into account their effects on instream uses. The abilities of the responsible departments to monitor and enforce legislation relating to instream uses should be strengthened.
- The Province should prepare appropriate policies and legislation for small hydro developments.

Water Supply

Water Supply: Conclusions

Water supply sources are sufficient to meet the demands of most of the communities in the study area. Some communities experience shortages; most have planned improvements to alleviate the shortages, but these require funding.

Water Supply: Recommendations

- Where shortages exist, plans for improvements should be reviewed, and if they meet engineering standards (including reliable yield), they should be funded.
- The Province should maintain its own inventories of municipal and industrial water use. In particular, water use by fish plants should be documented.
- Some watersheds used for water supply are presently unprotected. These should be reviewed and protected if necessary.

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1 - Introduction

1 Introduction

This report on the regional water resources of the Humber Valley and Northern Peninsula is the fourth in a series which will eventually cover the whole province. The first two reports covered the eastern and western parts of the Avalon Peninsula and the third dealt with the Bonavista Bay area (15, 16, 17).

1.1 Study Objectives

The Water Resources Division of the Department of Environment and Lands, Government of Newfoundland and Labrador, is responsible for the management of the water resources of the province. The purpose of the regional water resources studies is to provide information and analysis for the planning and management of these resources. The objectives of the present study of the Humber Valley and Northern Peninsula were similar to those of previous studies, as follows

1. to assess the availability of water based on existing data;
2. to examine the consumptive and nonconsumptive uses of water;
3. to assess water quality;
4. to rank regions within the study area according to their water resource potential;
5. to make recommendations to government relating to water resources.

Chapters 2 and 3 of this study describe surface and groundwater availability respectively. Water quality data are presented in Chapter 4, instream uses are discussed in Chapter 5, and the supply/demand balance is analyzed for each community in Chapter 6. In Chapter 7, the regions within the study area are ranked, and conclusions and recommendations are presented in Chapter 8.

This report brings together the available information on water resources in the region and thus may serve as a prime reference source for the study area. An inventory of 75 community water supplies was carried out as part of the study; Appendix D accompanying this report provides descriptions of these systems. It should be noted that the level of analysis in this report is appropriate for identifying problems and making recommendations, but not for detailed engineering design.

1.2 Sources of Data

The reports and other sources used to obtain data for this study are documented in the List of References at the end of this report. In addition, staff from various levels of government, as well as other agencies, were most helpful in supplying information and comments. These agencies include

- Government of Newfoundland and Labrador
    - Department of Environment and Lands (DOEL), St. John's and Corner Brook
    - Department of Development and Tourism (DODT)
    - Department of Fisheries (DOF)
    - Department of Municipal and Provincial Affairs (DMPA); St. John's and Corner Brook
    - Department of Health
    - Executive Council, Newfoundland Statistics Agency
    - Executive Council, Economic Research and Analysis
    - Department of Forest, Forestry and Agriculture
    - Department of Mines and Energy

- Government of Canada
    - Agriculture Canada
    - Fisheries and Oceans Canada (DFO)
    - Statistics Canada
    - Environment Canada
        - Water Survey of Canada (WSC)
        - Atmospheric Environment Service (AES)

- Deer Lake Power Co. Ltd.

- Newfoundland and Labrador Hydro

- City of Corner Brook

- Community officials (mayors, town clerks).

1.3 Study Area

The location of the study area is shown in Figure 1.1. It covers all the land drained by the Humber River, all the Great Northern Peninsula, and a small area around the inner part of White Bay. The total area is over 28,000 km^2.

The climate of the Island of Newfoundland is modified continental, the extremes of a continental climate being tempered by the ocean. The moderating effect decreases with distance inland.

The Humber Valley part of the study area has a climate similar to the rest of the Island. Corner Brook, for example, has temperatures close to those in Gander, with the overall average being slightly higher. Corner Brook is slightly more continental than coastal locations in the south and east, having slightly cooler winters and slightly warmer summers than St. John's, for example, by a degree or two on the average.

Communities on the Northern Peninsula, however, experience lower temperatures year round, with the effect increasing with latitude. The mean annual temperature in the St. Anthony/Roddickton area is around 2° C, compared with about 3° C in Daniel's Harbour and about 5° C in Corner Brook. The Northern Peninsula is dominated by the Long Range Mountains, which reach heights of over 600 m. The communities are all located near sea level; at higher elevations the differences in temperature would be more pronounced.

The Humber Valley area, by contrast, consists largely of a northeast-southwest trough, in which lie Deer Lake and Grand Lake. The coastal area is mountainous, with numerous fjords. The mountains throughout the study area result in an orographic effect on precipitation. The land rises rapidly from the coast, and there is a decrease in precipitation on the leeward side of the mountains. The resulting distribution of runoff over the area is described in Chapter 2.

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Fig. 1.1

Regional Water Resources Study
Humber Valley & Northern Peninsula

Study Area

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The main economic activities in the area are forestry and fishery. Tourism also has considerable potential, with Gros Morne National Park being a major attraction. The area around Cormack has some of the best agricultural land in the province, but it is a very small proportion of the total study area.

The population of the region is about 70 000 (1986 census); the largest communities are Corner Brook (23 000), Deer Lake (4200), Pasadena (3300) and St. Anthony (3200).

2 - Availability of Surface Water

2 Availability of Surface Water

2.1 Introduction

The first step in assessing the water resources of the study area was to estimate the amount of surface water available. For this study, meteorological and hydrologic data were analyzed to provide estimates of

- mean annual runoff
- low flows, and
- reliable yield from community water supply systems with storage ponds.

Mean annual runoff is a commonly used hydrological characteristic. It expresses the average annual discharge over an area as a depth. Mean annual runoff has a continuous distribution over an area, and can thus be conveniently represented on a map using isolines. Streamflow and precipitation data as well as topography were used to prepare such a map for this study.

Estimates of mean annual runoff have to be supplemented by analyses of the variability of flow. Low flow analyses were carried out and estimates were made of the improvement in yield that would result from the addition of storage.

The hydrological studies thus included the analysis of

- mean annual runoff
- low flows
- improvement in yield from increased storage
- water balance.

Based on these analyses, the natural water availability was then estimated and tabulated for all basins in the study area.

2.2 Mean Annual Runoff

Mean annual runoff (MAR) is the average annual discharge over an area expressed as a depth in millimetres or inches. The purpose of this part of the study was to prepare a runoff map of the study area, showing the variation in average annual runoff over the area. This map can conveniently be used to estimate the mean annual flow at an ungauged site.

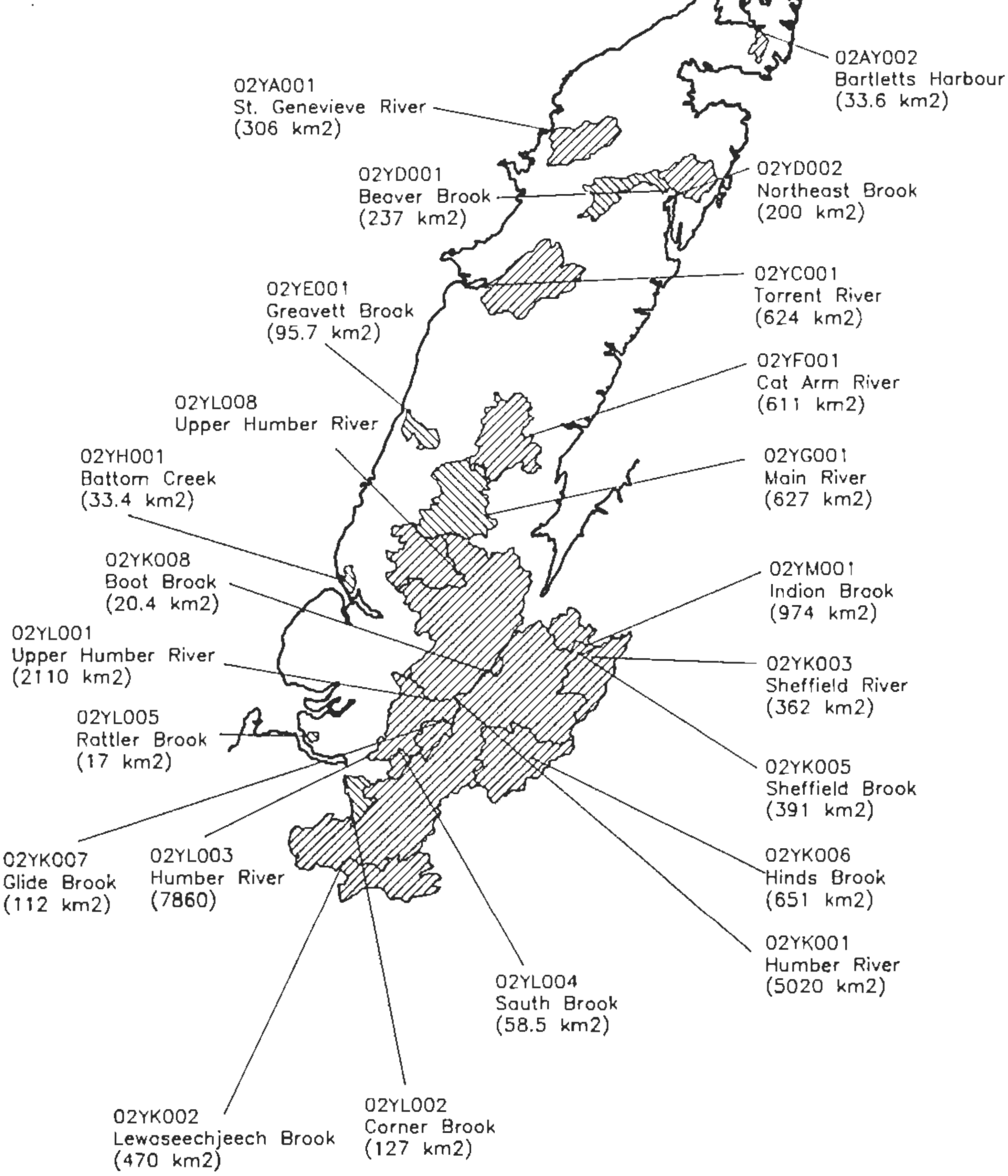
The runoff estimates were based on analysis of streamflow data from the hydrometric stations operated by Water Survey of Canada (WSC) under the Canada-Newfoundland Hydrometric Surveys Agreement, supplemented by precipitation data from the Atmospheric Environment Services (AES) network.

The analysis proceeded as follows

- establish the best estimates of long term MAR for all gauged basins;
- relate the MAR from the gauged basins to physiographic characteristics;
- plot isolines using the MAR from the gauged basins and the relationship derived from the physiographic characteristics.

2.2.1 Long Term MAR for Gauged Basins

The locations of the basins gauged by WSC are shown in Figure 2.1. There is a total of 23 records, with lengths ranging from 3 to 63 years. The annual mean flows from the WSC record were converted to MAR and are presented in Table 2.1. Four of the records are at least 30 years long, and another is 29 years. An additional two are 20 or more years long. The record for the Humber River at Grand Lake is the longest at 63 years. This is a reasonably extensive data set on which to base an estimate of MAR.



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Humber Valley and Northern Peninsula

Locations of Gauged Basins

Fig. 2.1

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Table 2.1
Mean Annual Runoff (mm)

	Hum @ Grnd L outlet (R)	Upper Hum @ Reidv (U)	Ind. B. at Falls (U)	Lewa-seech Jeech (U)	Shel-field R. (U)	HindsB near Grnd L (U)	Cornr B. (R)	Torrnt R. (U)	Beaver B. (U)	Cat Arm R. (U)	Ste. Genev R. (U)	Shel-field B. (U)	North-east B. (U)	Hind's B. at Pwr H. (R)	Hum R. @ Hum V. (R)	South B. (U)	Gree-well B. (U)	Glide B. (U)	Rattle B. (U)	Bart-letts R. (U)	Main R. (U)	Bot-tom Creek (U)	Boot B. (U)
D.A. (km²)	5020	2110	974	470	362	529	127	624	237	611	306	391	200	651	7860	58.5	95.7	112	17	33.6	627	33.4	20.4
Station No.	K001	L001	M001	X002	K003	X004	L002	C001	D001	F001	A001	X005	D002	K006	L003	L004	E001	K007	L005	A002	G001	H001	K008
1926	1081																						
1927	1131																						
1928	786																						
1929	974																						
1930	962	1540																					
1931	930	1288																					
1932	805																						
1933	1138																						
1934	1050																						
1935	899																						
1936	1025																						
1937	811																						
1938	704	1120																					
1939	905	1615																					
1940	918	1201																					
1941	855	1510																					
1942	999	1428																					
1943	855	1307																					
1944	874	1473																					
1945	1076	1555																					
1946	880	1261																					
1947	798	1208																					
1948	641	1101																					
1949	861																						
1950	849																						
1951	767																						
1952	899																						
1953	855	1110																					
1954	836	1347																					
1955	874	939	800																				
1956	886	1122	758	1141	889																		
1957	823	1153	813	1222	880	919																	
1958	817	1072	674	1343	815	968																	
1959	811	1071	841	987	837	841	830																
1960	805	912	871	880	766	805	902	1173	901														
1961	717	1080	706	906	798	793	907	1062	1245														
1962	905	1330	826	1222	1124	1127	1275	1183	1638														
1963	1056	1325	729	1195	1020	1020	1131	1284	1166														
1964	893	1193	629	1121	832	1008	1098	1381	1222														
1965	911	1128	651	994	941	968	919	1295	1244														
1966	943	1159	561	940		799	860	1284	1209														
1967	615	1041	505			871	892	1290	1331														
1968	823	1122	535			948	1051	1133	1250														
1969	1012	1440	752			1139	1163	1583	1266	1617													
1970	955	1041	557			942	939	1148	1085	986	977												
1971	930	1158	616			1074	1126	1492	1064	1415	1124												
1972	886	1407	557			1127	1317	1497	1043	1369	1000												
1973	1031	1387	632	1296		1115	1299	1388	1057	1379	827	920											
1974	930	1092	593	1175		937	1041	1214	770	1064	968	823											
1975	710	1132	554	1141		931	867	1067	871	1214	756	839											
1976	981	1370	583	1115		1036	1240	1254	994	1358	997	889											
1977	1028	1960	748	1544		1253	1401	1770	1598	1844	1299	1154											
1978	1012	1141	499	1014			1083	1335	997	1250	907	886											
1979	767	1276	680	1235		968	986	1659		1648	1145	880											
1980	924	1383	739	1276			1041	1497		1678	1062	1085	1242										
1981	1075	1319	748				1068	1254		1586	815	1009	1002	1207									
1982	1043	1388	629	1390			1235	1370		1539	971	936	910	1202									
1983	1094	1144	599	1437			1044	1143			755	896	718	1129	1176	971							
1984	1012	1289	593	1336			1210	1376			963	815	742	1047	1144	1133	1771	930					
1985	773	1024	441	913			887	1234			980	627	737	834	847	659	1365	541	1268				
1986	781	962	499	1101			867	880			587	754	688	771	899	858	1213	890	975	1155	1404	602	986
1987	717	1018	538	994			835	1138			899	782	718	679	651	933	1263	459	832	1305	1253	603	688
1988	805	1246	677	1289			1140	1183			950	1025	992		980	987	1372	730	1086	1212	1475	740	769
Average	897	1236	636	1162	870	981	1055	1295	1197	1425	925	881	861	981	983	923	1397	670	1040	1224	1377	648	818

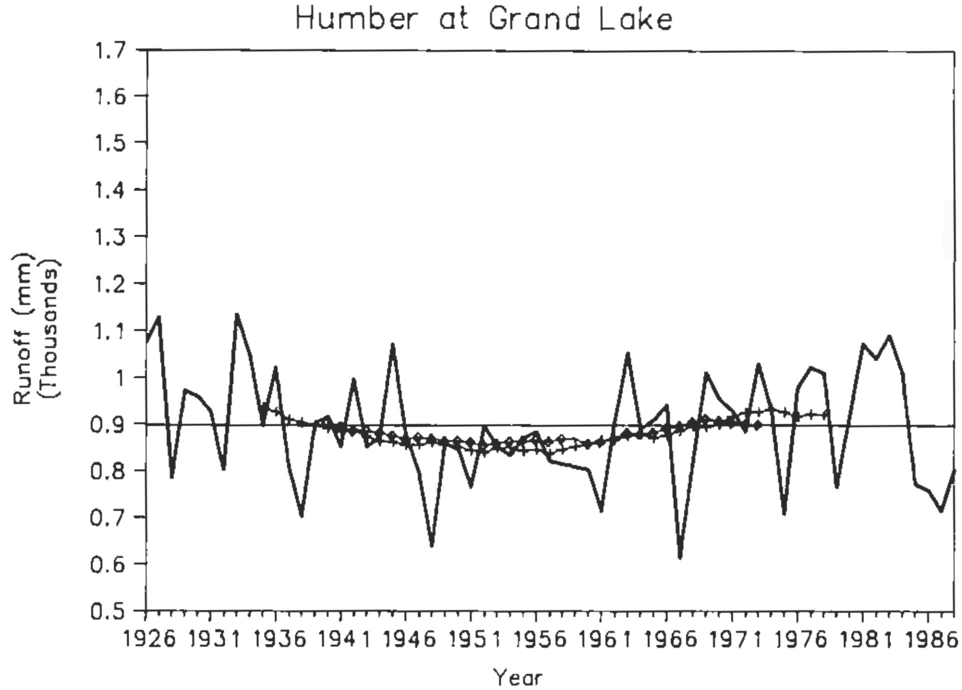
R – Regulated
U – Unregulated

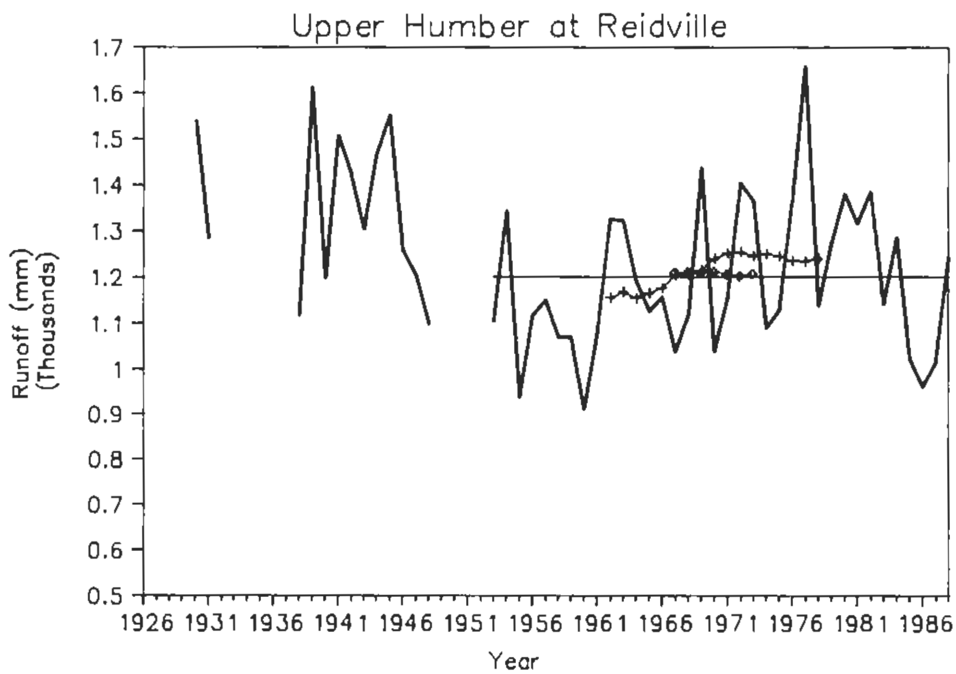
The first task was to adjust all the records to the same period of record. Since seven records were at least 20 years in length, using a 20 year period as representative of the long term mean would have meant that none of these records would have required adjustment. An examination of the 20 year moving means for the two longest records, however, shows that the past 20 years have been wetter than the long term average. An estimate based on the past 30 years, on the other hand, gives a good representation of the entire period for the two longest records. The graphs in Figure 2.2 show the moving means for the two stations, Humber River at Grand Lake and Upper Humber at Reidville. The average value for the 30 year period from 1959 to 1988 was therefore chosen as representing the long term MAR.

The next task was to estimate the 30 year mean for each gauge with less than 30 years of data by proration from a gauge with a record longer than 30 years. The gauges with 30 years or more of data were used as the predictor gauges for the shorter-record gauges. These predictor gauges were Humber River at Grand Lake outlet, Upper Humber at Reidville, Indian Brook at Indian Falls, and Corner Brook.

The annual runoff value for the overlapping periods of record for the short and long record gauges were correlated. The correlation coefficient (r) and Student t values (indicating level of significance of the correlation coefficient r) were calculated for each pair of gauges. The preferred predictor for each shorter record gauge was the one with the highest level of significance, i.e., the one for which the correlation was least likely to have occurred by chance.

All gauges with more than six years of record had very good correlations with at least one predictor gauge. The exceptions were Ste. Genevieve River and Beaver Brook. Their best correlations were with Torrent River, which has 29 years of record, and had therefore been excluded from the group of predictor gauges. The correlation between Torrent River and Ste. Genevieve River was very good; with Beaver Brook it was not as good, but there was none better.





◇ 30 year mean

+ 20 year mean

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Fig. 2.2

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Humber Valley and Northern Penninsula

20 and 30 Year Moving Means

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Since the Torrent River record is only one year short of the required 30 years, it was extended by proration from the Upper Humber at Reidville (the record with which it had the most significant correlation). Torrent River was then used as the predictor gauge for Ste. Genevieve River and Beaver Brook.

The long term MAR was then estimated for each of the shorter records by proration, i.e., $MAR_{L2} = (MAR_{S2}/MARS_{S1}) * MAR_{L1}$, where

MAR_{L2} - long term (30 year) MAR for short record gauge
MAR_{S2} - MAR for period of record of short gauge
MAR_{S1} - MAR for predictor gauge, for overlapping period
MAR_{L1} - long term (30 year) MAR for predictor gauge.

The stations were divided into two categories, those with the more reliable estimates of MAR (generally the longer records), and those with less reliable estimates (shorter records, also Beaver Brook). Table 2.2 shows the 30 year averages for the predictor gauges, and the estimated long term (30 year) MAR for the remaining gauges.

2.2.2 Relationship of MAR to Physiographic Characteristics

An exhaustive stepwise multiple regression analysis was used to identify the physiographic characteristics which best explain the variation in MAR.

Since the long term MAR had itself been estimated at all but five of the gauges, only the estimates based on more than six years of record were used in the regression analysis. The variables used in the regression analysis are given in Table 2.3.

The results indicated that the two most important explanatory variables are elevation of the basin centroid and distance from the sea in a southwesterly direction. This distance was measured in a compass direction of 225 degrees (true) from the

Table 2.2
Estimated Long Term Mean Annual Runoff

	Predictor Gauges					> 6 Years of Record						
	Humb @ Grand L outlet	Upper Humb @ Reidvil	Indian B. B. at Falls	Corner B.	Torrent R.	Lewaseech -jeech B.	HindsB near Grand L.	Beaver B.	Cat Arm R.	Ste. Genev. R.	Shef-field B.	North-east B.
D.A. (km²)	5020	2110	974	127	624	470	529	237	611	306	391	200
Station No.	K001	L001	M001	L002	C001	K002	K004	D001	F001	A001	K005	D002
Gauge for Prediction						Corner Brook	Corner Brook	Torrent River	Upper Humber	Torrent River	Indian Brook	Indian Brook
1959	811	1071	541	830		987	841					
1960	805	912	671	902	1173	880	805	901				
1961	717	1080	706	907	1062	906	793	1245				
1962	905	1330	826	1275	1183	1222	1127	1638				
1963	1056	1325	729	1131	1284	1195	1020	1166				
1964	893	1193	629	1098	1381	1121	1008	1222				
1965	911	1129	651	919	1295	994	966	1244				
1966	943	1159	551	860	1284	940	799	1209				
1967	615	1041	505	892	1290		871	1331				
1968	823	1122	535	1051	1133		948	1250				
1969	1012	1440	752	1163	1583		1139	1266	1617			
1970	955	1041	557	939	1148		942	1085	986	977		
1971	930	1158	616	1126	1492		1074	1864	1415	1124		
1972	886	1407	567	1317	1497		1127	1043	1369	1000		
1973	1031	1367	632	1299	1386	1296	1115	1057	1379	827	920	
1974	930	1092	593	1041	1214	1175	937	770	1064	868	823	
1975	710	1132	554	867	1067	1141	931	871	1214	756	839	
1976	981	1370	583	1240	1254	1115	1038	984	1358	997	888	
1977	1025	1660	748	1401	1770	1544	1253	1598	1844	1299	1154	
1978	1012	1141	499	1083	1335	1014		997	1250	907	686	
1979	767	1276	680	986	1659	1235	966		1648	1145	880	
1980	924	1383	739	1041	1497	1276			1678	1062	1065	1242
1981	1075	1319	748	1068	1254				1586	815	1009	1002
1982	1043	1388	629	1235	1370	1390			1539	971	936	910
1983	1094	1144	599	1044	1143	1437				755	896	718
1984	1012	1289	593	1210	1376	1336				963	815	742
1985	773	1024	441	887	1234	913				880	627	737
1986	761	962	499	867	880	1101				587	754	688
1987	717	1018	538	835	1138	994				699	782	718
1988	805	1246	677	1140	1183	1289				950	1025	992
Average of period of record	897	1236	636	1055	1295	1162	981	1197	1425	925	881	861
30 Year MAR	897	1207	620	1055	1295	1161	979	1182	1325	911	896	879

Table 2.2 (Cont'd)
Estimated Long Term Mean Annual Runoff

	< 6 Years Record							
	South B.	Greavett B.	Glide B.	Rattler B.	Bart-lotte R.	Main R.	Bottom Creek	Boot B.
D.A. (km^2)	58.5	95.7	112	17	33.6	627	33.4	20.4
Station No.	L004	E001	K007	L005	A002	G001	H001	K008
Gauge for Prediction	Indian Brook	Humb. @ Gr. Lk.	Humb. @ Gr. Lk.	umb. Gr. Lk.	Torrent River	Humb. @ Gr. Lk.	Corner Brook	Torrent River
1959								
1960								
1961								
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1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980								
1981								
1982								
1983	971							
1984	1133	1771	930					
1985	658	1365	541	1268				
1986	858	1213	690	975	1155	1404	602	996
1987	933	1263	459	832	1305	1253	603	688
1988	987	1372	730	1086	1212	1475	740	769
Average of period of record	923	1397	670	1040	1224	1377	648	818
30 Year MAR	1026	1541	739	1221	1480	1624	722	989

Table 2.3
Physiographic Variables Used in MAR Regression Analysis

Station	Station Number 02Y	Longterm MAR	Elev. of Centroid (ft)	Distance to Sea W (km)	Distance to Sea SW (km)	Latitude	FFAR	FLSAR
Upper Humber @ Reidv	L001	1207	600	66	145	49.23	0.74	0.11
Indian Brook	M001	620	550	110	271	49.52	0.69	0.31
Lew'schjeech Brook	K002	1161	1700	116	152	48.62	0.55	0.16
Corner Brook	L002	1055	1400	55	160	48.92	0.75	0.14
Torrent River	C001	1290	1000	29	74	50.60	0.33	0.17
Ste. Genevieve	A001	911	267	17	35	51.13	0.64	0.35
Hinds Brook	K004	979	950	110	218	49.07	0.35	0.36
Cat Arm Brook	F001	1325	1800	46	123	50.08	0.69	0.13
Sheffield Brook	K005	896	900	119	266	49.33	0.68	0.17
Northeast Brook	D002	879	360	68	184	51.75	0.83	0.17
Greavett Brook	E001	1541	1600	13	33	50.17	0.50	0.14

Key:
FFAR - Fraction of Forest Area
FLSAR - Fraction of Lake and Swamp Area
MAR - Mean Annual Runoff from Table 2.2
Distance to Sea - Distance due west (270 deg.) or south west (225 deg.) from the centroid of the basin to the coastline (smoothed)
Elevation - Taken from 1:50000 scale mapping - contour intervals 50 feet

centroid to the coastline (smoothed). The plots in Figures 2.3 show MAR in the gauged basins for these two characteristics. The trends are weak, and only when the two variables are combined does the equation become significant. The regression analysis produced the following relationship

$$MAR = 1090.5 + 0.264\,(Elev) - 1.85\,(SW)$$

where MAR is in millimetres, Elev is the elevation of the basin centroid in feet, and SW is the distance in kilometres of the centroid from the sea in a southwesterly direction.

This equation was found to be significant at a 99% level of confidence, with a correlation coefficient of 0.89. In general, the equation makes sense hydrologically, in that runoff increases with elevation and decreases as distance from the sea increases. The standard error was quite high, however, at 132 mm; Figure 2.3 shows the scatter. Because of the high standard error, the equation was not used directly to prepare the isolines; rather, when shaping the isolines, the elevation and distance from the sea were taken into account.

2.2.3 Climate Data

The locations of the AES climate stations are shown in Figure 2.4. The annual total precipitation data are given in Table 2.4. Where 30 year means (1951-1980) were available, they were plotted at the locations of the stations (Figure 2.5).

This information was used to assist in identifying the pattern of the isolines of MAR, although the points could not be used directly since they are precipitation values, not runoff.

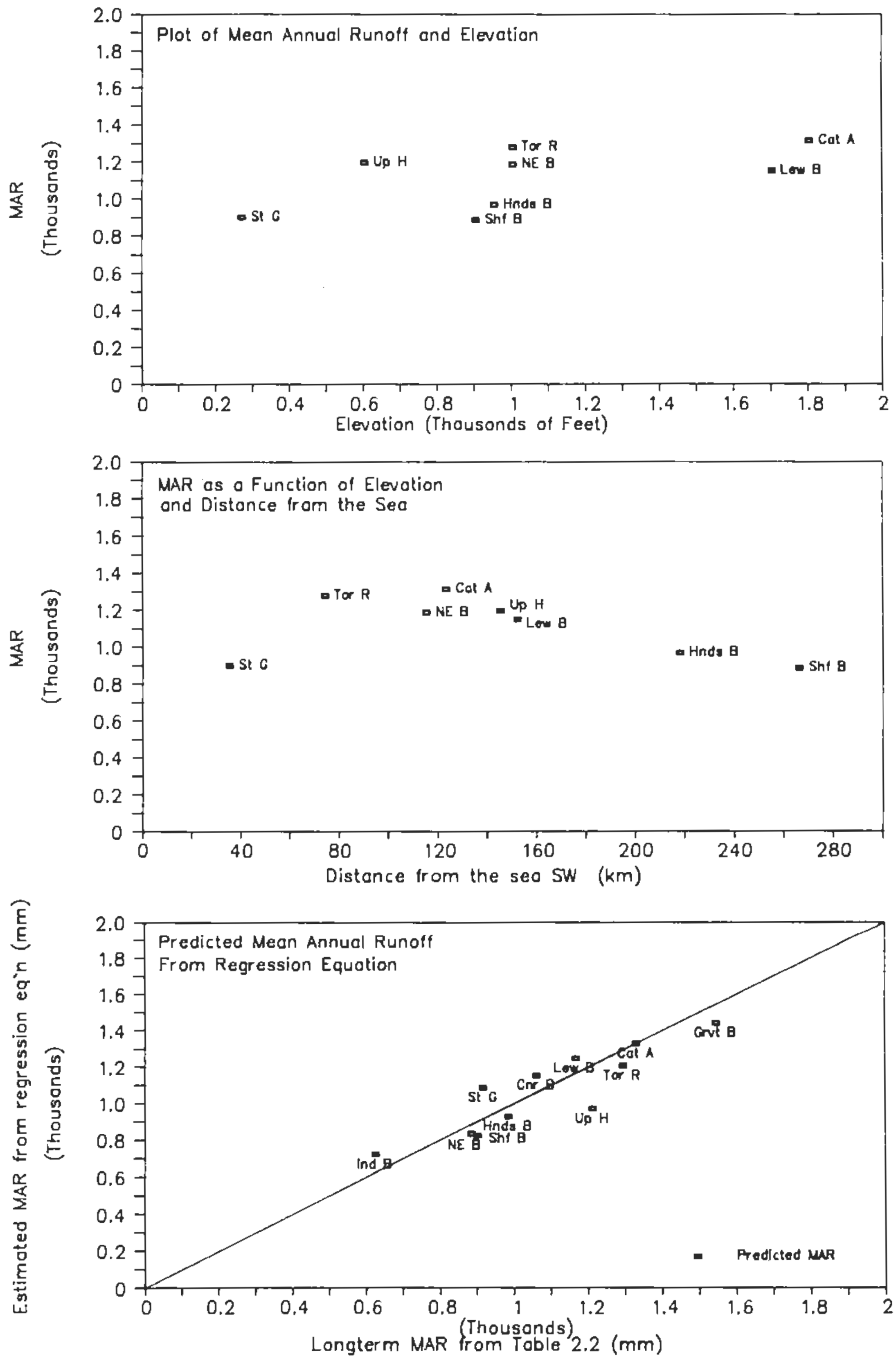

Fig. 2.3

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Humber Valley and Northern Penninsula

Mean Annual Runoff

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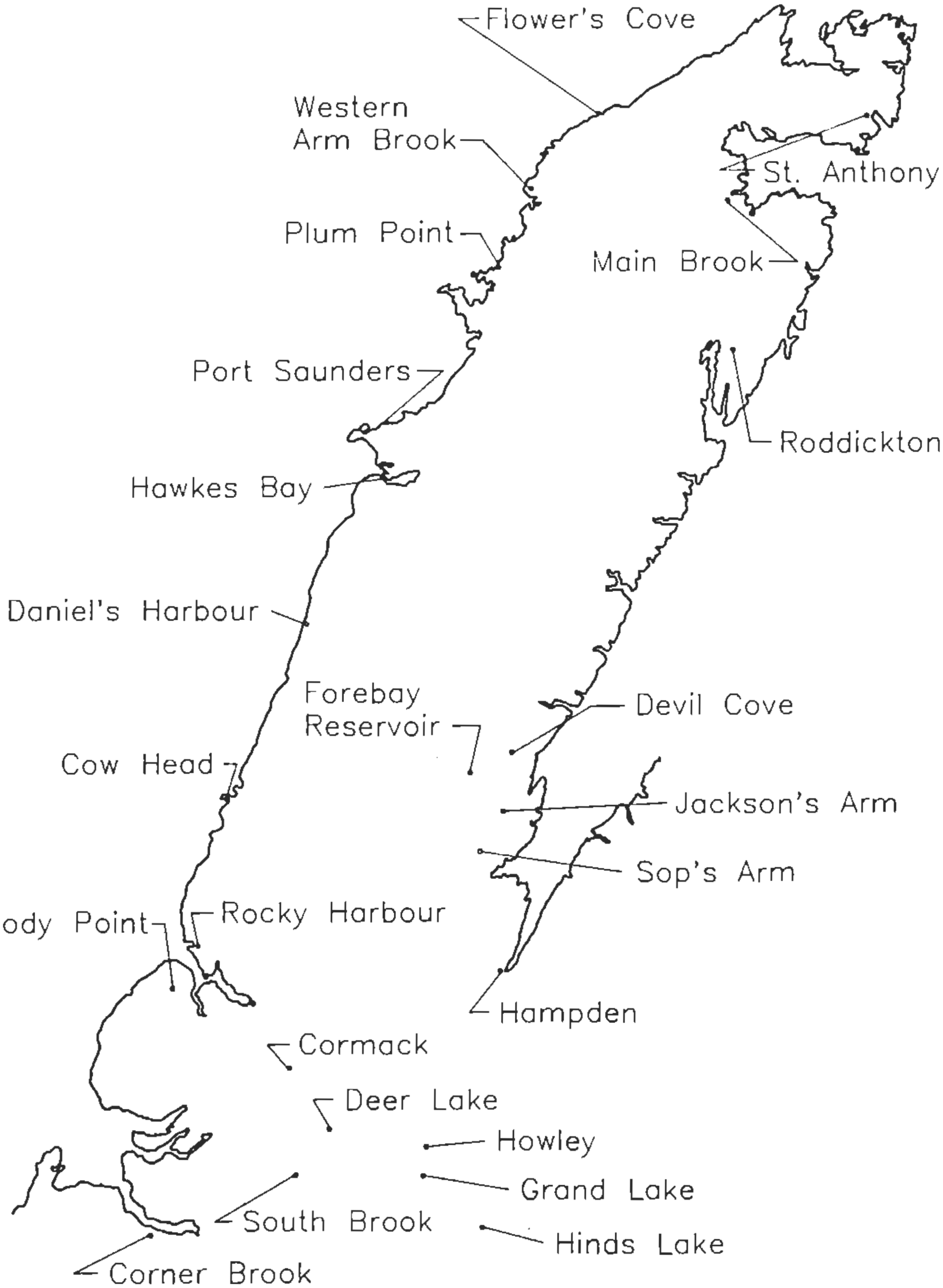

Fig. 2.4

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Humber Valley and Northern Peninsula

Locations of Climate Stations

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Table 2.4
Annual Precipitation at AES Climate Stations

	Buchans 8400698	Cormack 8401286	Corner Brook 8401300	Daniel's Harbour 8401400	Deer Lake 8401500	Deer Lake A 8401501	Grand Lake 8402053	Plum Point 8402958	Rocky Harbour 8403096	Roddick-ton 8403098	St. Anthony 8403401	South Brook 8403693	Woody Point 8404320
Elevation (m)	280	154	5	24	11	22	307	6	40	12	111	38	9
1933	•	•	•	•	•	•	•	•	•	•	•	•	•
1934	•	•	1037.5	•	740.1	•	•	•	•	•	•	•	•
1935	•	•	•	•	870.5	•	•	•	•	•	•	•	•
1936	•	•	1164.0	•	•	•	•	•	•	•	•	•	•
1937	•	•	•	•	760.4	•	•	•	•	•	•	•	•
1938	•	•	1136.4	•	761.2	•	•	•	•	•	•	•	•
1939	•	•	1300.8	•	•	•	•	•	•	•	•	•	•
1940	•	•	1105.4	•	801.3	•	•	•	•	•	•	•	•
1941	•	•	1092.5	•	930.6	•	•	•	•	•	•	•	•
1942	•	•	•	•	778.8	•	•	•	•	•	•	•	•
1943	•	•	•	•	759.3	•	•	•	•	•	•	•	•
1944	•	•	1364.5	•	1267.0	•	•	•	•	•	•	•	•
1945	•	•	1178.0	•	•	•	•	•	•	•	•	•	•
1946	•	•	1198.1	•	1015.8	•	•	•	•	•	•	•	•
1947	•	•	1075.0	•	649.6	•	•	•	•	•	•	•	•
1948	•	•	1109.9	•	798.0	•	•	•	•	•	•	•	•
1949	•	•	1187.8	1007.1	946.1	•	•	•	•	•	•	•	•
1950	•	•	1025.1	•	888.5	•	•	•	•	•	•	•	•
1951	•	•	1263.4	•	1206.3	•	•	•	•	•	•	•	•
1952	•	•	•	•	•	•	•	•	•	•	•	•	•
1953	•	•	1004.2	1061.7	•	•	•	•	•	•	•	•	•
1954	•	•	1121.1	948.0	1095.8	•	•	•	•	•	•	•	•
1955	•	•	1310.3	•	•	•	•	•	•	•	•	•	•
1956	•	•	1116.8	727.9	•	•	•	•	•	•	•	•	•
1957	•	•	1233.4	•	1076.2	•	•	•	•	•	•	•	•
1958	•	•	1190.7	903.9	1069.9	•	•	•	•	•	•	•	•
1959	•	•	911.9	761.0	869.4	•	•	•	•	•	•	•	•
1960	•	•	955.9	711.5	•	•	•	•	•	•	•	•	•
1961	•	•	•	•	•	•	•	•	•	•	•	•	•
1962	•	•	1171.8	993.9	1211.0	•	•	•	•	•	•	•	•
1963	•	•	1215.4	1011.6	1081.8	•	•	•	•	•	•	•	•
1964	•	•	1047.0	1045.7	•	•	•	•	•	•	•	•	•
1965	•	•	1010.6	1242.6	966.8	•	•	•	•	•	•	•	•
1966	•	•	876.7	932.6	808.6	799.1	•	•	•	•	•	•	•
1967	•	•	994.6	1273.2	1060.2	1073.7	•	•	•	•	•	•	•
1968	•	•	1145.3	1199.7	•	1081.9	•	•	•	•	•	•	•
1969	1176.9	•	934.1	956.2	•	1070.1	•	•	•	•	•	•	•
1970	1162.3	•	1185.6	1100.2	•	952.6	•	•	•	•	•	•	•
1971	1135.1	•	1102.6	1269.3	•	1002.3	•	•	•	•	1394.6	•	•
1972	1176.9	•	1296.3	1242.4	1031.0	1127.6	•	•	•	652.6	1211.6	•	1546.2
1973	•	•	•	1145.1	1025.6	1126.4	•	990.5	•	629.1	1115.6	•	1576.0
1974	1081.6	•	1086.6	1149.7	963.6	948.4	•	1163.8	1202.2	844.7	1170.9	•	•
1975	1144.9	•	1191.1	974.1	•	1070.0	•	1040.4	1046.4	•	1060.8	•	1485.3
1976	1168.7	•	1366.6	1176.9	1059.1	1058.0	•	1182.6	1313.2	•	1198.9	•	1620.7
1977	1236.7	•	1263.7	•	•	1238.5	•	1232.4	1623.1	1197.2	1436.7	•	1633.2
1978	897.9	•	1216.3	1231.4	936.8	950.6	•	1242.6	1431.9	826.3	1148.9	•	1898.1
1979	1026.2	•	1259.9	1390.9	1149.8	1141.8	•	1327.6	1785.3	1167.0	1530.7	•	1738.5
1980	997.6	•	1304.9	1336.5	1239.1	1190.0	•	1279.6	1426.0	1165.0	1687.7	•	1610.6
1981	1265.4	1133.9	1269.3	1161.8	1193.1	1037.0	•	1184.6	1413.1	1182.9	1484.3	•	1361.5
1982	1245.1	•	1404.7	1391.0	1329.7	1251.0	•	1278.6	•	669.5	1370.0	•	1840.3
1983	•	1219.2	1330.9	1273.3	1302.9	1202.9	•	1253.6	•	•	•	•	1590.6
1984	1100.6	1271.6	1331.7	•	1260.3	1054.6	•	1313.5	1262.2	•	•	•	1495.6
1985	921.6	1023.0	1057.3	609.4	928.2	789.7	612.6	1177.2	1029.7	838.2	•	•	1246.0
1986	1120.2	1117.6	1154.7	754.4	1014.2	908.6	880.4	•	1170.2	•	•	1013.4	1465.7
1987	•	1063.2	1053.4	847.3	933.0	849.7	1032.3	•	1103.9	•	•	872.0	1570.0
Total Precip. (mm) (1951–1980)	1071.5	N/A	1133.5	1043.5	1033.1	1023.2	N/A		1199.7			N/A	1470.0

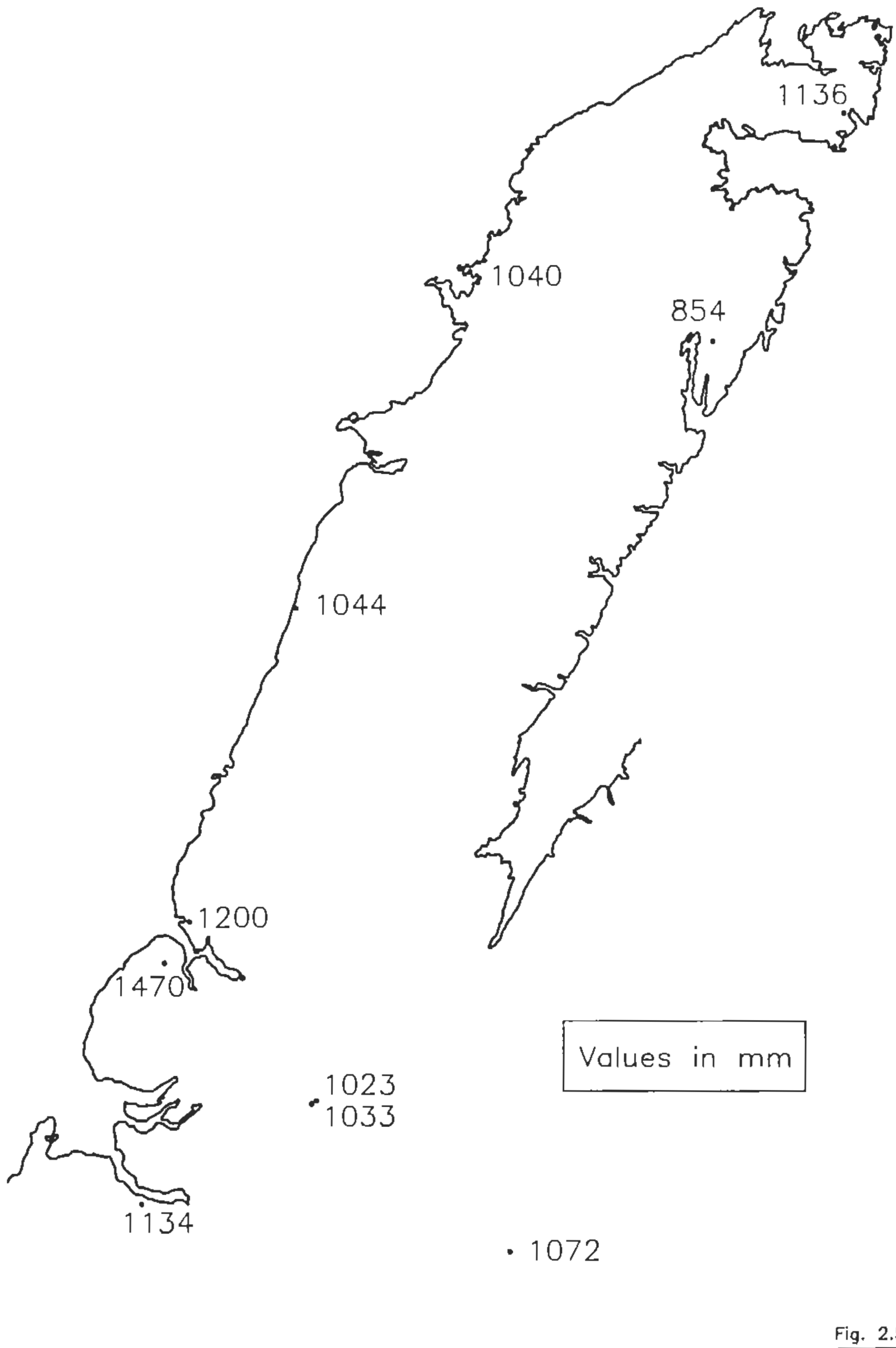

Fig. 2.5

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Humber Valley and Northern Peninsula

Mean Annual Precipitation Points

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2.2.4 Map of Isolines of MAR

The estimates of long term mean annual runoff, the AES data, and the results of the regression analysis were used to draw the map of isolines of MAR. The long term values of MAR from Table 2.2 were first plotted at the centroids of the basins, as shown in Figure 2.6. Then, taking into account elevation, distance from the sea in the southwesterly direction, and precipitation, the isolines of MAR were drawn. The resulting map is shown in Figure 2.7.

2.3 Flow Variation Through the Year

Having estimated the mean annual runoff in the study area, the next step was to consider flow variation through the year.

The pattern is similar to that observed on the rest of the Island, but winter lows are lower and spring peaks are higher. This difference is evident in Figure 2.8, which shows a plot of the normalized mean monthly flows at gauge locations in different parts of the Island of Newfoundland. The basin with the highest peak of the three is Torrent River (02YC001), on the Northern Peninsula. The middle one is in central Newfoundland, Gander River at Big Chute (024Q001). The one with the least variation is Rocky River (02ZK001) on the Avalon Peninsula.

It is clear that the winter climate is milder (more maritime) on the Avalon, where winter precipitation can be either rain or snow, and flows are generally above average all winter long. On the Northern Peninsula, however, and generally throughout the study area, winter precipitation is in the form of snow, and the highest flows occur during the spring snowmelt.

Low flows in the study area tend to occur either in the late winter, or during the summer. On the average, about half of the minimum daily flows in the gauged basins occur in winter and half in summer.

The bottom part of Figure 2.8 shows that this pattern holds for the three gauges in the study area with the longest records, Indian Brook at Indian Falls (02YM001), Upper Humber near Reidville (02YL001), as well as Torrent River (02YC001). Only if the flows are regulated

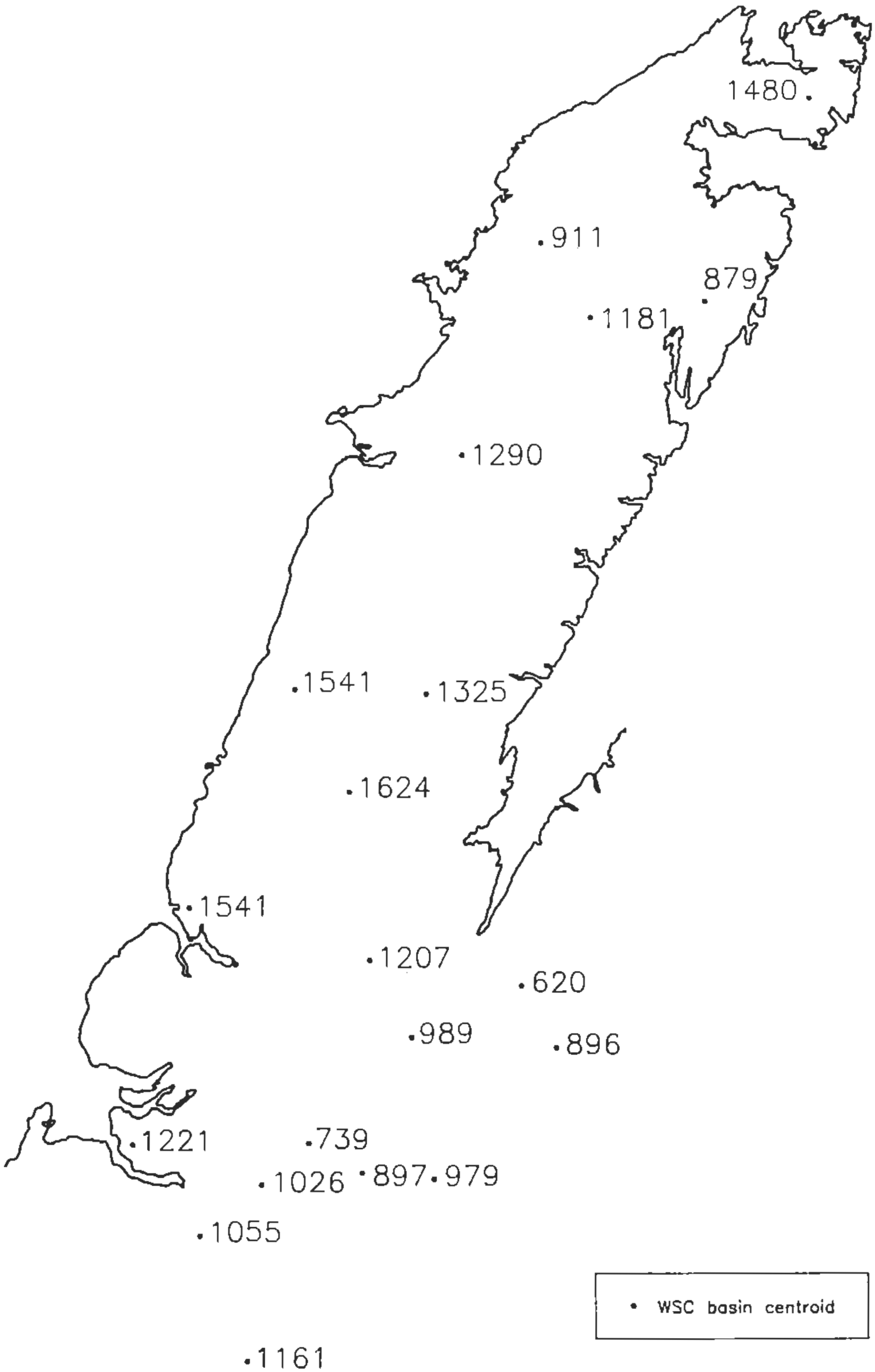

Fig. 2.6

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Humber Valley and Northern Peninsula

Mean Annual Runoff Points

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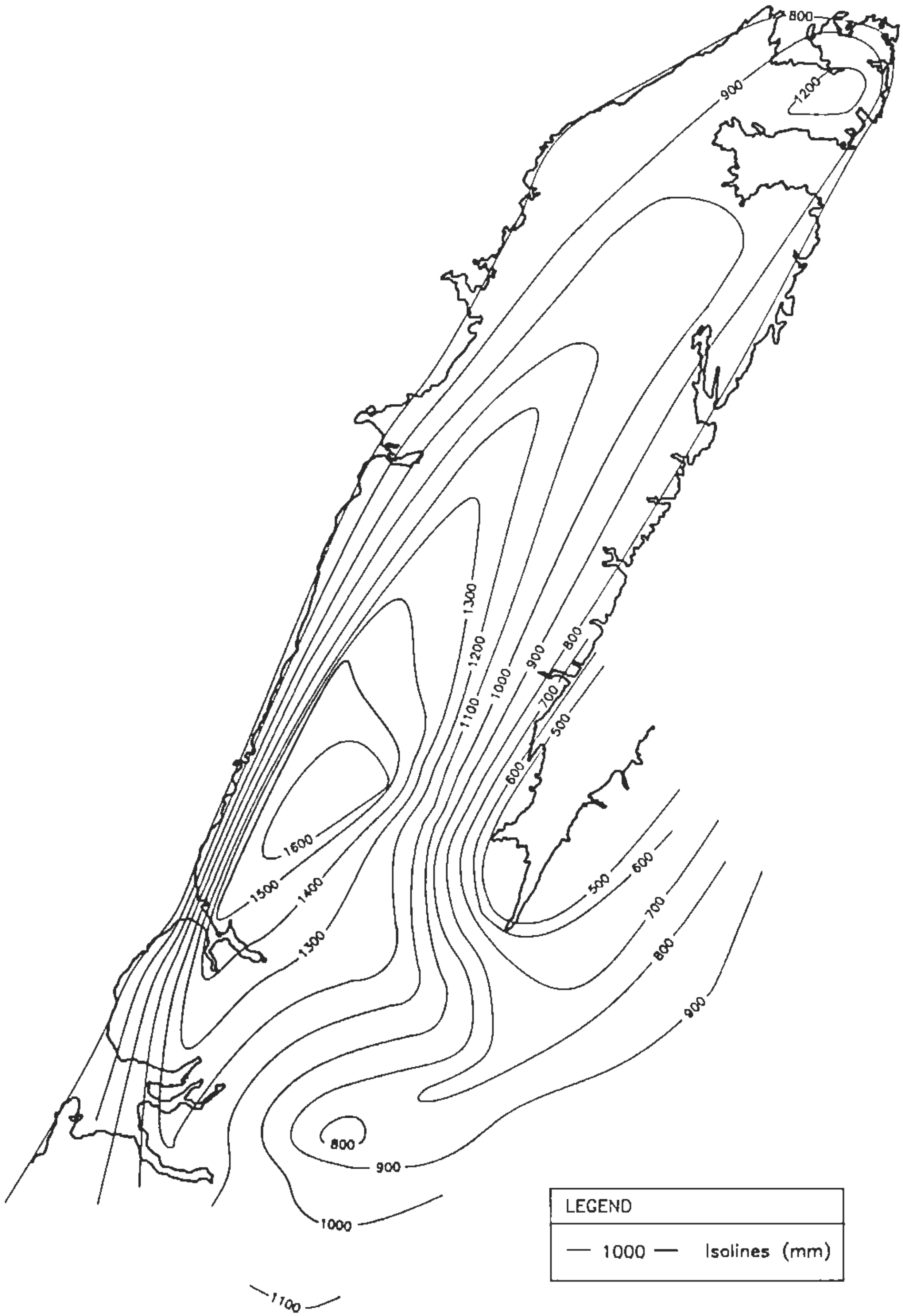

Fig. 2.7

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Humber Valley and Northern Peninsula

Isolines of Mean Annual Runoff

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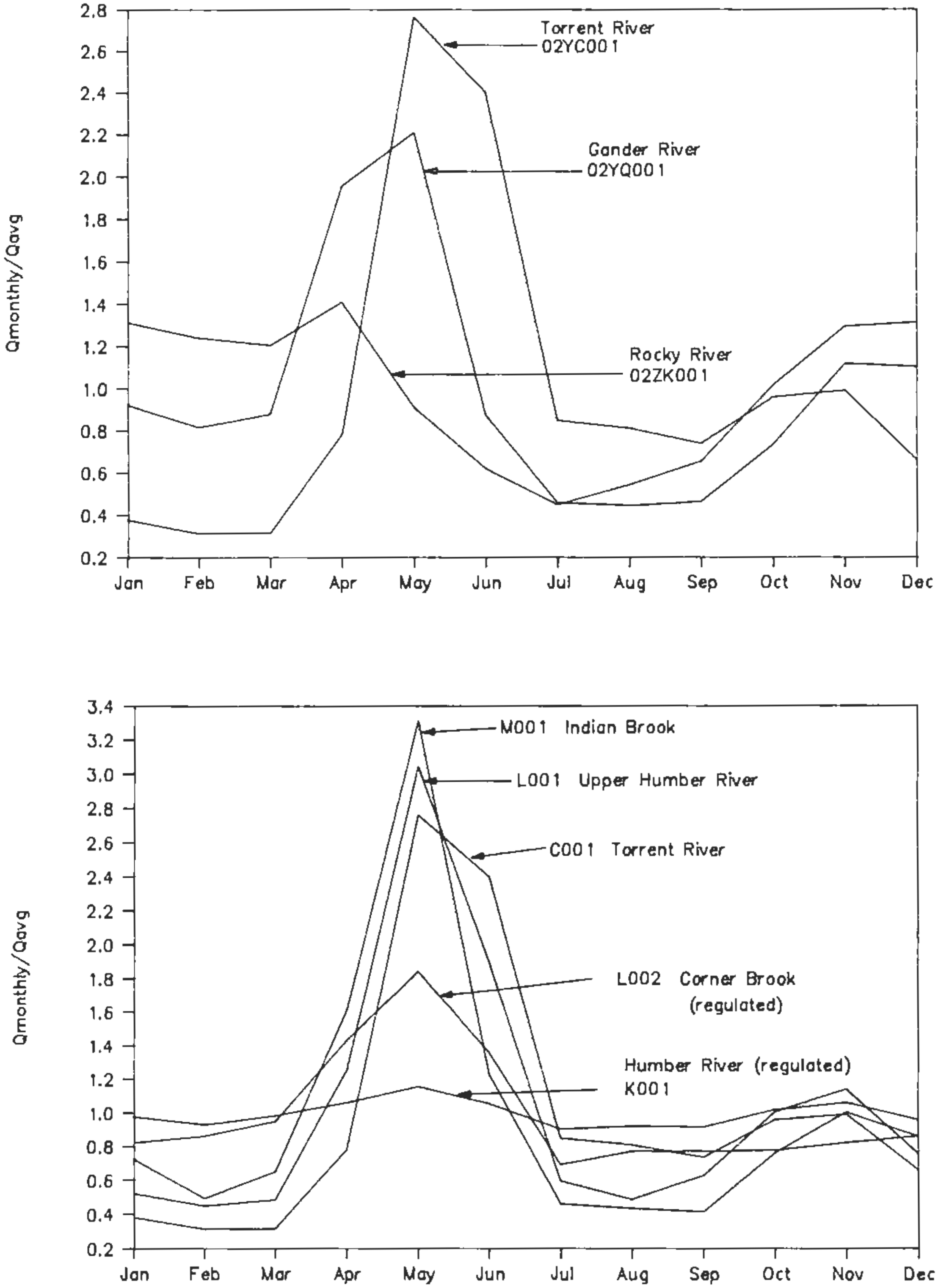

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Fig. 2.8

Regional Water Resources Study
Humber Valley and Northern Penninsula

Mean Monthly Flow

ACRES

does the pattern change. The two basins with the lowest peaks and highest low flows in Figure 2.8 are both regulated, Corner Brook at Watson's Brook Powerhouse (02YL002) and Humber River at Grand Lake Outlet (02YK001).

2.3.1 Flow Duration Curves

Flow duration curves also give a picture of the proportion of high and low flows in a basin. The flow duration curves for the stations in the study area are presented in Appendix A. These were prepared by ranking all the daily flows from highest to lowest, and dividing by the mean annual flow for the period of record.

Not surprisingly, the most regulation can be seen in the curve for the Humber River at Grand Lake. The rivers with the most variation include Beaver Brook, Bartletts River, Upper Humber, Sheffield Brook, and Boot Brook. These curves are useful in estimating the proportion of time the flow exceeds a given value.

2.4 Low Flow Analysis

The mean monthly flows and flow duration curves described in Section 2.3 are of interest in calculating such characteristics as the average energy available at a site if it were developed for hydropower, or the average flow available for fish and aquatic life. Often, however, estimates of low flow are required for purposes such as water supply, firm energy production, or fisheries requirements. Regulatory agencies usually request a particular index of low flow, based either on frequency analysis or flow duration curves.

The purpose of the low flow analysis was to analyze the low flows in gauged basins, and to develop a procedure for predicting low flows in ungauged basins. This required the steps listed below.

(a) Select the most appropriate indices of low flow (duration, return period).

(b) Identify gauge records suitable for analysis, and calculate the required indices for these gauged basins.

(c) Using the results from the gauged basins, determine a suitable method for estimating low flows at ungauged sites.

2.4.1 Indices of Low Flows

Indices of low flows commonly used in the Province of Newfoundland are based on frequency analysis, and include

- 1:10 year 7-day low flow, or 1:10(7), i.e., the annual minimum flow averaged over a period of 7 consecutive days is expected to equal or be less than the 1:10(7) flow, on the average, at least once in 10 years.

- 1:20 year 7-day low flow, or 1:20(7), i.e., the annual minimum flow averaged over a period of 7 consecutive days is expected to equal or be less than the 1:20(7) flow, on the average, at least once in 20 years.

- 1:10 year 1-day low flow, or 1:10(1), i.e., the annual minimum daily flow is expected to equal or be less than the 1:10(7) flow, on the average, at least once in 10 years.

Flow duration curve indices of low flow can also be used. They are described in terms of exceedance levels. The 95% exceedance level, for example, is the flow that is exceeded on 95% of the days of record. These exceedance levels can be read from the curves in Appendix A.

Because regulatory agencies in the province usually request frequency based estimates of low flows, the analysis in this study concentrated on the 1:10 and 1:20 year 7-day low flows, and the 1:10 year 1-day low flow.

2.4.2 Low Flows at Gauged Basins

The low flows were calculated for all the basins meeting two principal criteria

- record length of at least 10 years
- defined as natural flow by WSC (i.e., unregulated by dams or other structures).

The shortest record used was that of Cat Arm River, at 14 years.

The computer program LOFLOW, produced by the Water Resources Branch, Inland Waters Directorate of Environment Canada, was used to estimate the low flows for the required return periods. The results are summarized in Table 2.5. Detailed results are presented in Appendix B.

Before the LOFLOW program was run, nonparametric tests were carried out on the annual series of low flows for each basin. The tests were done to verify that the data sets were random, homogeneous, and independent, and that there were no significant trends over time. Results of all these tests were satisfactory, with the exception of Hinds Lake.

The Hinds Lake series contained two unexpected values - two successive years with low flows of zero. Discussions with WSC staff indicated that major works had been carried out by one of the paper companies at the outlet of Hinds Lake in the first year, and repair work had been done in the second. The two zero values were thus dropped from the series before the frequency analysis was carried out.

It can be seen from the bottom part of Table 2.5 that the ratios between the 1:10(7) and 1:10(1), and between the 1:10 (7) and the 1:20(7) are quite consistent (for the level of accuracy of this analysis). This result is useful because it means that once the 1:10(7) low flow for a basin has been obtained, the other low flows for that basin can be estimated by applying the appropriate factor.

When these ratios were first calculated, the ratio between the 1:10(7) and the 1:10(1) low flow for the Upper Humber River at Reidville was 1.46, much higher than expected. The explanation was that the 1:10(1) had been estimated by the LOFLOW program using an annual series of daily low flows for the period 1929 to 1988. The 1:10(7) on the other hand, had been estimated for 1954-1988, the period for which the WSC data were available on tape. When the 1:10(1) was re-estimated for the same period as the 1:10(7), the ratio was very similar to the others (1.11).

Table 2.5
Results of Low Flow Analysis

Gauge	Gauge No. (02Y)	Qlow (m³/s) 1:10 (7)	1:20 (7)	1:10 (1)
Lewaseechjeech Brook	K002	1.608	1.358	1.541
Upper Humb. @ Reidv.	L001	5.159	4.511	4.653
Cat Arm River	F001	0.836	0.764	0.750
Hind's Brook	K004	2.039	1.782	1.975
Sheffield Brook	K005	0.949	0.780	0.900
Torrent River	C001	2.692	2.396	2.573
Beaver Brook	D001	0.264	0.228	0.237
Ste. Genevieve River	A001	1.608	1.413	1.527

Gauge	Gauge No. (02Y)	Qlow as a fraction of Qavg* 1:10 (7)	1:20 (7)	1:10 (1)
Lewaseechjeech Brook	K002	0.0930	0.0785	0.0891
Upper Humb. @ Reidv.	L001	0.0639	0.0559	0.0577
Cat Arm River	F001	0.0326	0.0298	0.0292
Hind's Brook	K004	0.1242	0.1086	0.1203
Sheffield Brook	K005	0.0855	0.0703	0.0811
Torrent River	C001	0.1055	0.0939	0.1009
Beaver Brook	D001	0.0297	0.0257	0.0267
Ste. Genevieve River	A001	0.1820	0.1599	0.1729
Mean		0.0896	0.0778	0.0847
Standard Deviation		0.0468	0.0411	0.0454

Gauge	Gauge No. (02Y)	Ratios 1:10 (7) to 1:20 (7)	1:10 (7) to 1:10 (1)
Lewaseechjeech Brook	K002	1.1841	1.0435
Upper Humb. @ Reidv.	L001	1.1436	1.1087
Cat Arm River	F001	1.0942	1.1147
Hind's Brook	K004	1.1442	1.0324
Sheffield Brook	K005	1.2167	1.0544
Torrent River	C001	1.1235	1.0462
Beaver Brook	D001	1.1579	1.1139
Ste. Genevieve River	A001	1.1380	1.0530
Mean		1.15	1.07
Standard Deviation		0.03	0.03

* Qavg is the estimated long term mean annual flow, obtained from the long term runoff from Table 2.2 and the drainage area.

This difference points out the fact that using the longer record length results in a 1:10(1) low flow which is nearly 25% lower than the estimate based on the 1954-1988 period, 3.54 m^3/s compared with 4.65 m^3/s. The three lowest daily flows occurred in 1940, 1953 and 1948. There are no other unregulated gauges or climate stations with such long uninterrupted records, so this observation could not be confirmed. To be consistent, the results for the 1954-1988 period were used in this analysis, but it must be noted that all the low flows could be somewhat overestimated.

2.4.3 Development of Predictive Equations

The last step in the analysis was to develop a suitable equation to predict the low flow ($Q_{1:10(7)}$) at an ungauged site. Three equations were developed and tested. This section first discusses the development of the equations, then compares them.

The first simply takes the low flow as a proportion of average flows, i.e.,

$$Q1{:}10(7) = \alpha * Q_{avg}$$

Where Q_{avg} is the estimated long term mean annual flow, obtained from Table 2.2 for gauged basins, or from Figure 2.7 and the drainage area for ungauged basins. The coefficient α was taken as the mean proportion for the unregulated gauged rivers in the study area, in this case 0.0896 (Table 2.5).

This equation has the advantage of being very simple to use; an estimate of Q_{avg} can be obtained from the runoff map (Figure 2.7) and the drainage area, and then multiplied by the ratio 0.0896. There are several important disadvantages, however;

1) the variance of α is very high; the standard deviation of 0.0468 is about half the mean;

2) the mean annual runoff itself has considerable uncertainty;

3) The coefficient was obtained from the average of eight gauges with drainage areas ranging from 237 km^2 to 2110 km^2. Low flows are frequently required at locations with much smaller drainage areas, and strictly speaking, the equation should not be used.

Despite the inaccuracy of the equation, it can be useful as a screening tool or to obtain quick preliminary estimates. For any particular application users may want to add or subtract a standard deviation (i.e. $\pm$ 0.0468 Q_{avg}), depending on how conservative they want to be.

In order to develop a better predictive equation, and in particular to avoid predicting low flow using Q_{avg}, which itself has considerable uncertainty, a regression analysis was carried out.

Various physiographic characteristics for the eight basins available were tabulated (Table 2.6). An exhaustive stepwise multiple regression analysis was then carried out to determine whether any of the relationships were significant.

The results of the analysis showed that a nonlinear equation based on drainage area alone was significant at the 99% level, but overall the equation was not much better as a predictor than the equation based on Q_{avg}.

(The equation was $Q_{1:10(7)} = 0.00180\ DA^{1.064}$, with a correlation coefficient r of 0.866, and a standard error of the regression equation of 0.82.) One advantage over the first equation is that it does not require an estimate of mean annual runoff.

The best results were obtained by incorporating another variable, the area of lakes and swamps (L&S). The following nonlinear form of the relationship had the highest correlation coefficient (r = 0.94) and the lowest standard error of the regression equation (s.e. = 0.63).

$$Q_{1:10(7)} = 0.00422\ DA^{0.279}\ L\&S^{0.905}$$

Table 2.6
Physiographic Variables used in Low Flow Regression Analysis

Station	Stn. No. (02Y)	Low flow (m³/s) 1:10 7 day	1:20 7 day	1:10 1 day
Lewaseechjeech	K002	1.608	1.358	1.541
Up. Humber @	L001	5.159	4.511	3.544
Cat Arm River	F001	0.836	0.764	0.75
Hinds Brook	K004	2.039	1.782	1.975
Sheffield Brk	K005	0.949	0.78	0.9
Torrent River	C001	2.692	2.396	2.573
Beaver Brook	D001	0.264	0.228	0.237
Ste. Genevieve	A001	1.608	1.413	1.527

Station	Stn. No. (02Y)	FFAR	FBAR	FLSAR	FACLS	DD	SF	SL	LMC	ELD
Lewaseechjeech	K002	0.55	0.29	0.16	1	0.63	2.32	0.59	54.9	561
Up. Humber @	L001	0.74	0.15	0.11	0.75	0.79	1.56	0.4	119	678
Cat Arm River	F001	0.69	0.18	0.13	1	0.58	1.86	0.73	30.2	250
Hinds Brook	K004	0.35	0.29	0.36	0.95	0.64	1.78	0.32	49.3	320
Sheffield Brk	K005	0.68	0.15	0.17	0.94	0.19	1.98	1.07	38.1	378
Torrent River	C001	0.33	0.5	0.17	0.99	0.78	1.45	1.01	48.3	479
Beaver Brook	D001	0.81	0.11	0.08	0.73	0.34	2.23	0.67	40.6	328
Ste. Genevieve	A001	0.64	0.002	0.35	0.96	0.54	1.48	0.23	38.86	88

Key:
FFAR - Fraction of forest area
FBAR - Fraction of barren area
FLSAR - Fraction of lake and swamp area
FACLS - Fraction of area controlled by lakes and swamps
DD - Drainage density (km-1)
SF - Shape factor
SL - Slope of main channel (%)
LMC - Length of main channel (km)
ELD - Elevation difference between divide and gauging station (m-l.c.)

The equation improves the fit for the data set, but it is slightly less convenient, since it requires measurement of the area of lakes and swamps in the basin. It has the same disadvantage as any empirical equation that it is not strictly applicable outside the range of the data set used to develop it.

2.4.4 Evaluation of Predictive Equation

The recommended procedure for evaluating equations intended for prediction is data splitting. The correlation coefficient and standard error from the regression analysis are useful but they reflect the quality of fit, not the quality of prediction.

In data splitting, a portion of the data set is set aside and not used in the regression analysis. The resulting equations are tested on the portion which has been set aside to see how well they predict.

With only eight gauged basins in the data set, the data set could not be split. Another technique, which withholds observations one at a time, is similar in concept to data splitting and was used to assess the predictive equations.

Each low flow ($Q_{1:10(7)}$) was withheld in turn, and the parameters of the equations were recalculated. The low flow was then predicted for each basin, using the parameters derived when it was withheld. The PRESS statistic (predicted sum of squares) was then calculated summing the squares of these new residuals. They are referred to as PRESS residuals to distinguish them from ordinary residuals.

As expected, the results summarized below confirm that of the three equations the one incorporating drainage area and area of lakes and swamps gives the best predictions.

Equation	PRESS	Ordinary
$Q_{1:10(7)} = a * Q_{avg}$	10.28	7.89
$Q_{1:10(7)} = a * DA^{b}$	12.30	4.03
$Q_{1:10(7)} = a * DA^{b1} * L\&S^{b2}$	4.06	1.98

2.4.5 Estimating Flows at Ungauged Sites

The results of these analyses show that at present there is no accurate method of predicting low flows with any certainty. If the low flows at a project site must be known accurately, there is no substitute for streamflow records at the site.

If some uncertainty is acceptable, then the following procedure may be used.

1. Measure drainage area (DA) and the area of lakes and swamps in the basin (L&S). Take areas from NTS 1:50 000 topographic maps if the drainage area is less than 2000 km^2; if greater than 2000 km^2, use 1:250 000 scale maps. L&S is the total area of the basin marked as lakes and swamps on the topographic maps.

2. Plot DA and L&S on Figure 2.9 to ensure that they fall within the range of the data. The equations are not applicable outside of this range.

3. Calculate $Q_{1:10(7)}$ as follows

   $$Q_{1:10(7)} = 0.00422DA^{0.279}\ L\&S^{0.905}.$$

4. Adjust to other frequencies and durations as follows.

   $$Q_{1:10(1)} = Q_{1:10(7)} * 0.935$$

   $$Q_{(1:20)7} = Q_{(1:10)7} * 0.870.$$

The Water Resources Division of DOEL is presently analyzing low flows on the Island of Newfoundland. Other variables may turn out to be significant with the larger data base. The procedure described above should be updated when the Island-wide analysis is completed.

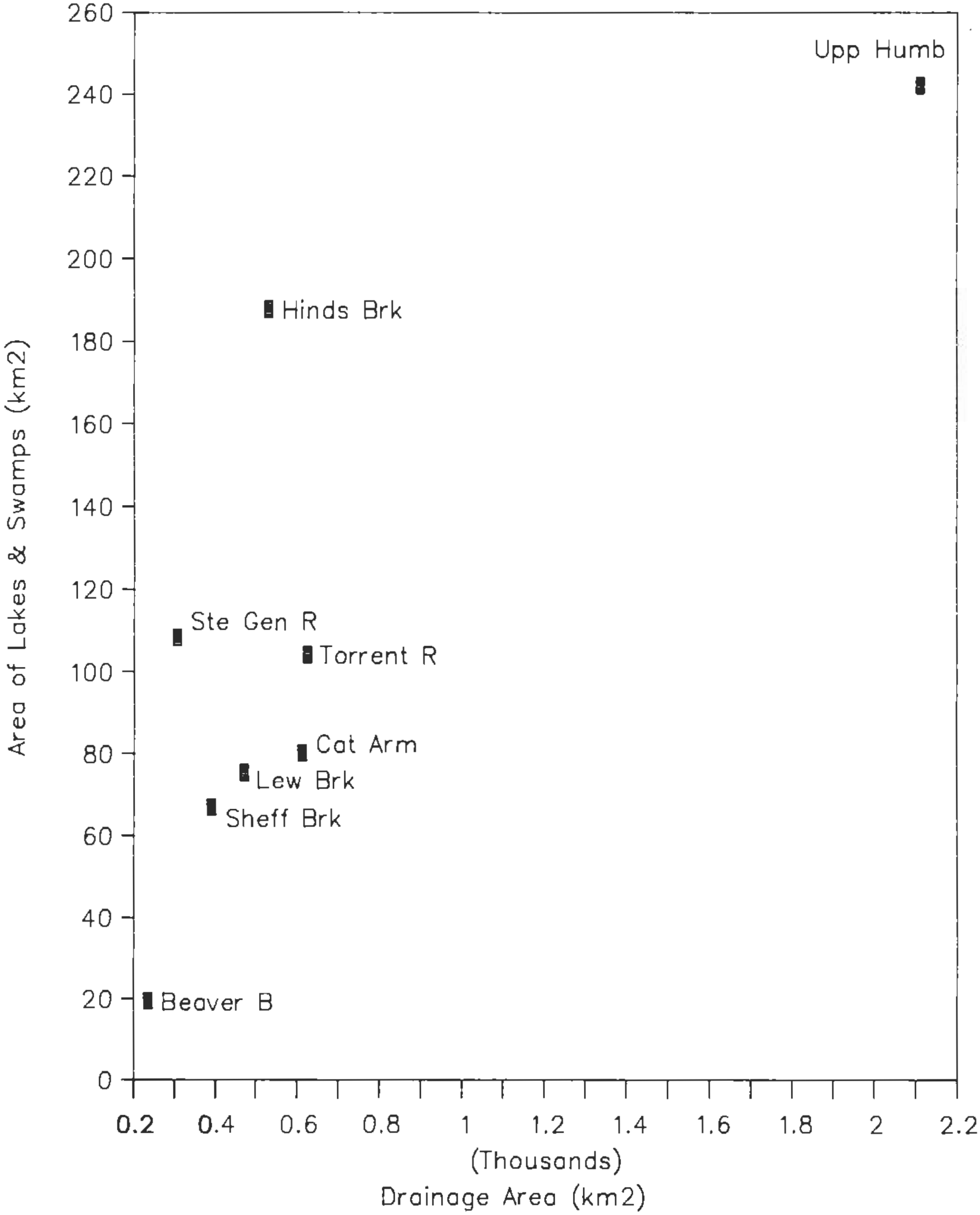

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Fig. 2.9

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Humber Valley and Northern Penninsula

Range of Data for Low Flow Prediction

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2.5 Storage/Yield Analysis

Major water uses such as water supply or hydroelectric generation require an estimation of the effect of storage. The natural low flow measures are not appropriate for estimating yield when dams and control structures have been built.

The reliable yield for a water supply is the amount of water that can safely be withdrawn over a specified period of time. If the source is a natural stream, without dams or control structures to provide storage, the reliable yield is the lowest dry weather flow of the stream during the period. For this report, the reliable yield for systems without storage is taken as the one in 10 year 7 day low flow.

For a water supply system with storage (usually a dammed lake) the reliable yield is the maximum constant rate of withdrawal which will not deplete the reservoir during the specified period. Calculating this rate usually requires a site specific analysis. A daily or monthly series of inflows is obtained, from a long term gauge record if possible. The characteristics of the project are defined, in particular the demand rate on the reservoir, the spillway (or other) outflows and the volume/elevation relationship for the reservoir. The operation of the system is then simulated on a daily or monthly basis over the period of the streamflow sequence.

For this study, a regional curve was developed which could be applied to any basin to estimate the reliable yield for the existing system and for increased storage if required.

Detailed analyses were carried out for all the gauged rivers, assuming that they were being used for water supply. Each of the gauged basins was analysed assuming various live storage volumes. For each volume of storage, daily operation of the storage reservoir was simulated for several different withdrawal rates. For each withdrawal rate, the amount of storage required in order to avoid failure was determined.

The results were then combined to produce a regional storage/yield curve. This curve gives an estimate of the constant rate at which water can be withdrawn without running short more often than once every ten years, on the average.

The results were made nondimensional by expressing the volumes of storage and the withdrawal rates as fractions of mean annual flow. By examining the yields from each basin, a regional nondimensional curve was prepared. The results are summarized below.

Yield/Storage Relationship

Yield (Fraction of Average Flow)	Storage (Fraction of Average Annual Volume)
0.2	0.075
0.4	0.200
0.6	0.400
0.7	0.500

The top part of Figure 2.10 shows the storage required to guarantee yields ranging from 20% to 80% of the average annual flow throughout the period of record for all the gauges in the study area. The bottom part of the figure shows the lower envelope curve, which can be used to estimate the increase in yield with storage at an ungauged site.

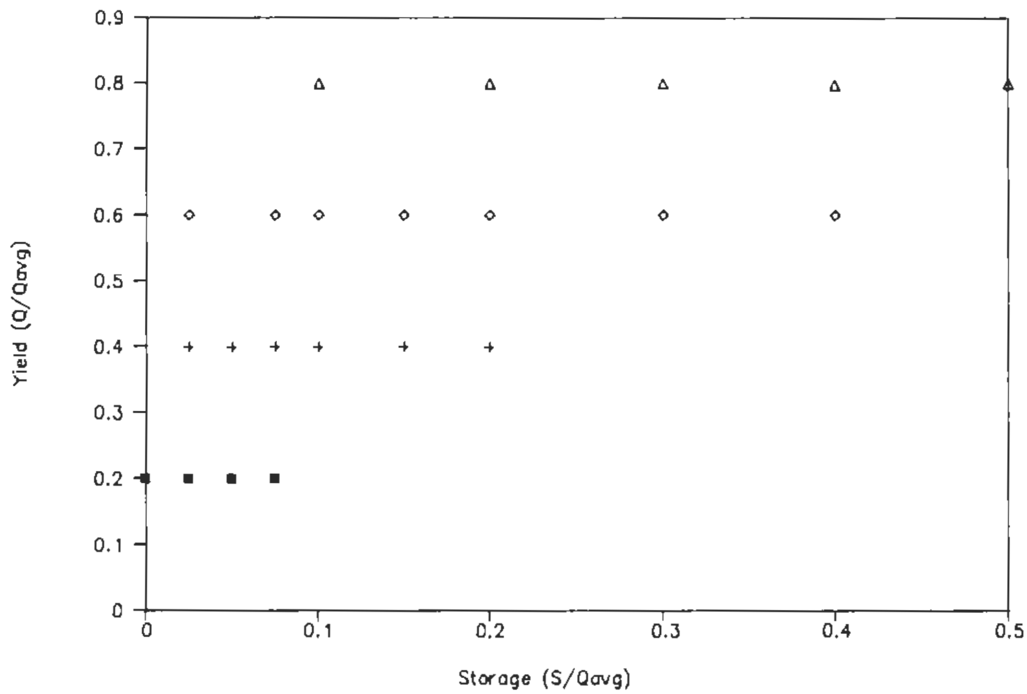
A sample calculation using the curve is given below.

1. Calculate mean annual flow volume.

Drainage Area	50 km^2	
Mean Annual Runoff	1200 mm	(Figure 2.10)
Mean Annual Flow Vol.	60 Mm^3	(DA X MAR)

2. Calculate Storage Volume.

Pond Area	9 km^2
Live Storage Depth	2 m
Storage Volume	18 Mm^3



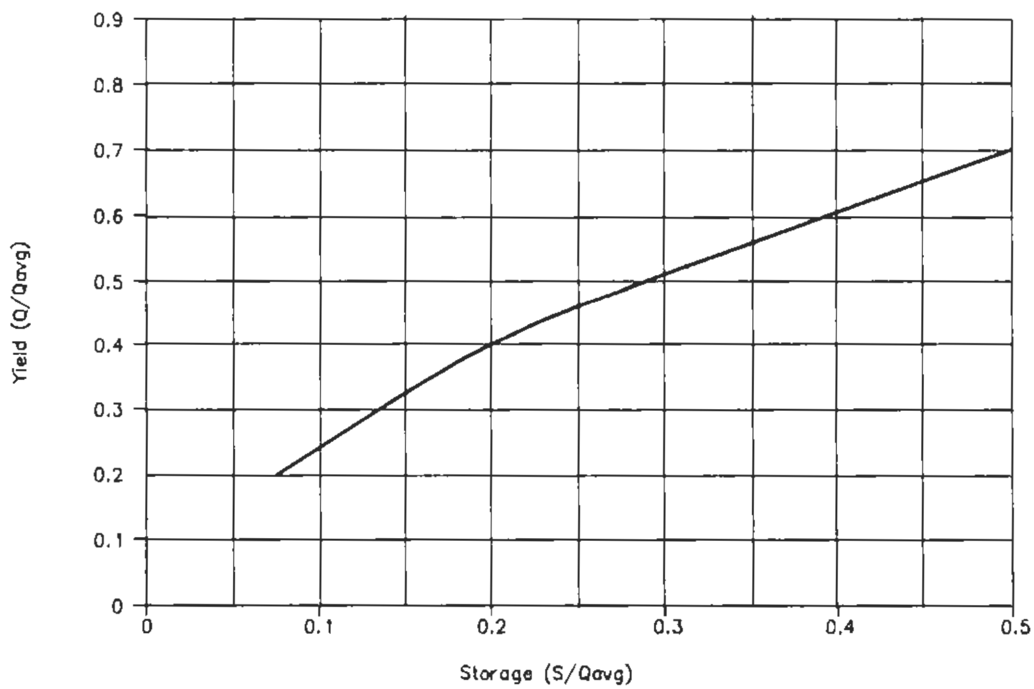


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Fig. 2.10

Regional Water Resources Study
Humber Valley and Northern Penninsula

Storage/Yield Curve

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3. Calculate Storage Ratio = Storage Volume/Mean Annual Flow Volume
   = 18/60
   = 0.3

4. Obtain Yield Ratio from Figure 2.10.
   For Storage Ratio = 0.3, Yield Ratio = 0.4.
   Yield = 0.4 X Mean Annual Flow Volume
   = 0.4 X 60 Mm^3
   = 24 Mm^3/year
   = 65,700 m^3/day.

5. If 65,700 m^3/day is not sufficient, obtain new storage ratio from Figure 2.10. If 100,000 m^3/day is required, calculate yield ratio.

   100,000 m^3/day = 36.5 Mm^3/year
   36.5/60 = 0.61

   From Figure 2.10, for yield ratio = 0.6, storage ratio = 0.4.

   Required Storage Volume = 0.4 x Mean Annual Flow Volume
   = 0.4 x 60
   = 24 Mm^3.

   For a pond area of 9 km^2, the required depth for this volume is

   $$\frac{24\ Mm^3}{9\ km^2} = 2.7\ m$$

   i.e. The intake must be lowered or the dams raised 0.7 m to obtain the additional storage.

Figure 2.10 is used extensively in the supply/demand analysis in Chapter 6 to estimate reliable yield for the communities with surface supplies in the study area, since data on reliable yields are not available for most community water supply systems. Since these calculations were for preliminary estimates, straight sided reservoirs were assumed. If a volume-elevation curve is available, it can be used to calculate depths and storage volumes.

2.6 Water Balance

A water balance for a basin requires that the runoff (the output) be equal to the precipitation (the input) minus the losses through evapotranspiration. Water balance calculations are useful in estimating expected losses, or in assessing the reliability of runoff estimates made from precipitation data. Although streamflow measurements are values averaged over the basin area, not point values, it can be assumed (for the purpose of these calculations) that the mean runoff value taken at the basin centroid is approximately equal to the mean areal value.

Two approaches were used to estimate the expected losses in the water balance equation

1. direct rainfall runoff comparison;
2. Thornthwaite evapotranspiration method.

Rainfall - Runoff Comparison

A comparison of the locations of the climate stations and the basin centroids (Figures 2.5 and 2.7) shows that there are no precipitation stations located near basin centroids. Of those that are reasonably close, some have very short records or considerable amounts of missing data (Table 2.4).

A precipitation station located outside a basin might be acceptable if it had similar elevation and distance from the sea to the southwest. Unfortunately all the climate stations are located at low elevations.

The importance of elevation is shown when losses are calculated for two areas which have both precipitation and stream flow data, Deer Lake/Humber River and Corner Brook/South Brook. Deer Lake and Corner Brook are climate stations, Humber River and South Brook are gauged rivers. The calculated losses are

	Precipitation P (mm)	Runoff R (mm)	Estimated Evapotransp P-R (mm)	Ratio R/P
Deer Lake/ Humber R. @GL	1033	897	136	87%
Corner Brook/ South Brook	1133	1026	107	91%

The elevation of the Humber River basin centroid is about 75 m above the Deer Lake station, and the South Brook centroid is about 120 m above Corner Brook. The precipitation at these elevations is probably considerably higher than the values recorded at the climate stations. If the runoff were then subtracted from the precipitation, the estimates of evaporation would be higher. Even in a maritime climate such as Newfoundland's, annual average evapotranspiration is unlikely to be as low as the values shown in the table above.

Thornthwaite Method

Another approach, used by AES, is to estimate evaporation from temperature data by the Thornthwaite method. This method is based on an extensive set of experiments to establish the correlation between temperature and evapotranspiration; it was specifically developed for an area with close-set vegetation and adequate water supply in the latitudes of the United States. The original calculation was modified by AES to improve the snow storage and snowmelt runoff component.

The results, based on 1941-1970 precipitation means for the stations in the study area, are as follows.

	Precipitation P (mm)	Runoff R (mm)	Estimated Evapotransp P-R (mm)	Ratio R/P
Corner Brook	1093	569	524	52%
Daniels Harbour	939	460	479	49%
Deer Lake	981	467	514	48%
Deer Lake A	1030	533	497	52%

These evapotranspiration losses are much higher than those calculated in the previous table. Losses of 500 mm per year seem overly high for a cool maritime climate. The explanation for the discrepancy is most likely that the data for the Thornthwaite method were acquired in an area with a different climate, probably with much less cloud cover and fog. The presence of cloud and fog would tend to reduce evapotranspiration.

The results of the water balance analysis show that neither the direct rainfall-runoff method nor the Thornthwaite method are very useful in Newfoundland. The true value of evapotranspiration is probably somewhere between the two sets of values presented here, in the range 100 mm to 500 mm per year. Data from both precipitation and streamflow gauges at similar elevations are required before a good estimate can be made.

2.7 Natural Surface Water Availability

To estimate the total natural surface water availability, the study area was divided into 85 natural drainage basins. In addition, about 50 small coastal areas drained by surface runoff or small brooks were identified. The natural drainage basins were grouped into two regions, according to the direction of drainage, east or west. For each of these basins, the drainage area was measured and the average flow was calculated.

The procedure was as follows

- identify all the major streams draining to the sea
- mark their watershed boundaries
- measure drainage area
- locate the centroid of each basin
- select appropriate mean annual runoff from Figure 2.7
- calculate mean annual flow, using mean annual runoff and the drainage basin area.

Figure 2.11 shows the locations of the identified watersheds, and Table 2.7 lists all the basins identified in the study area, together with their drainage areas and average flow.

The total mean annual flow volume for the major basins is over 25 x 10^9 m^3 in the study area. The average annual runoff is about 1100 mm.

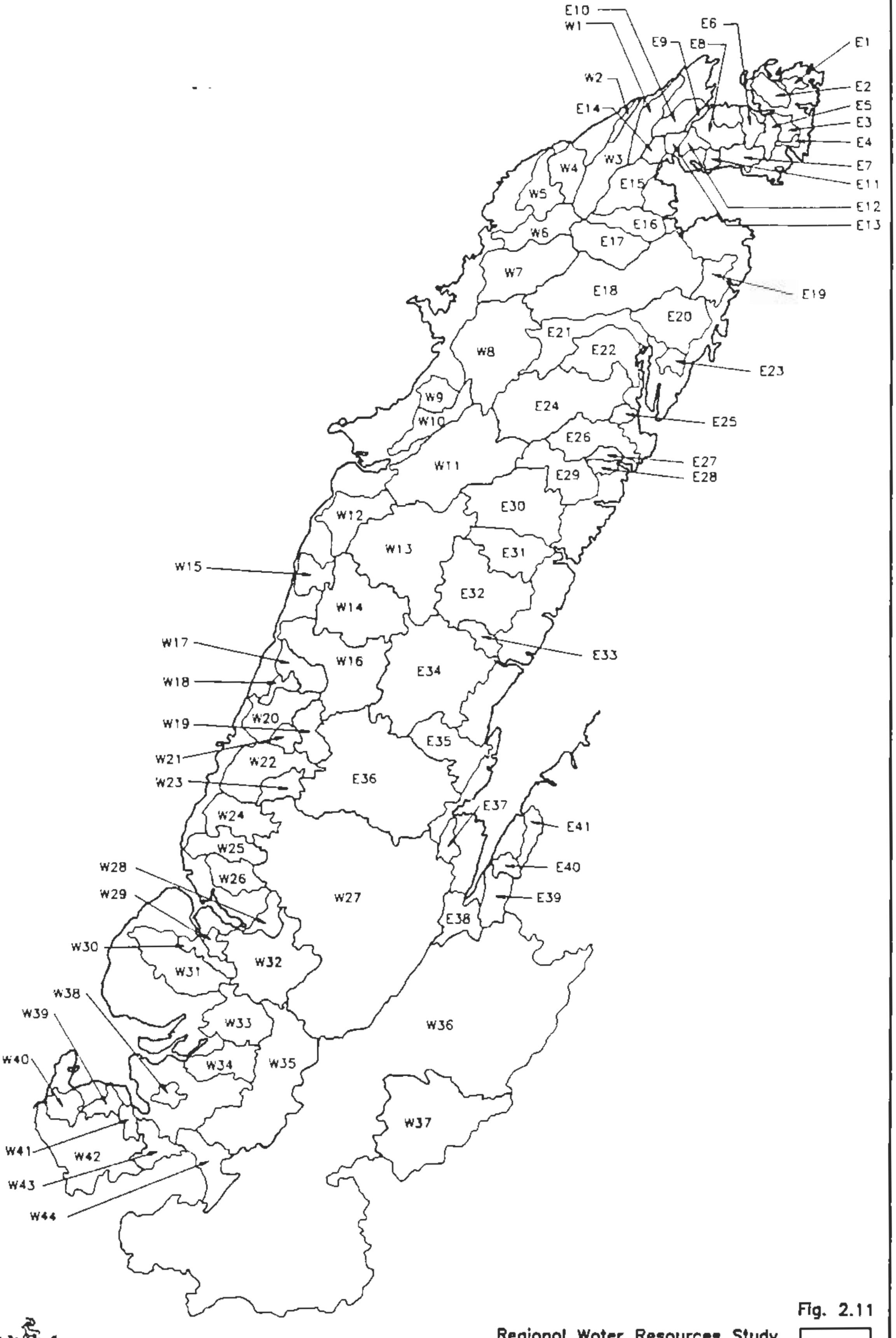

Fig. 2.11

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Regional Water Resources Study
Humber Valley and Northern Peninsula

Drainage Basins in Study Area

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Table 2.7
Drainage Basin Data

Ref. No.	Drainage Basin	Drainage Area (km^2)	Avg. Annual Runoff (mm)	Mean Ann. Flow (m^3/s)
E 1	South Road	20.3	900	0.58
E 2	Carpon Cove	60.6	1050	2.02
E 3	Milan Arm	35.5	1300	1.46
E 4	St. Anthony Bight	11.8	1050	0.39
E 5	Bartletts River	46.1	1400	2.05
E 6	Parker River	47.6	1300	1.96
E 7	Ireland's Brook	61.1	1200	2.32
E 8	Nameless, Pistolet Bay	88.3	1200	3.36
E 9	Nameless, Pistolet Bay	12.9	950	0.39
E 10	Nameless, Pistolet Bay	78.1	900	2.23
E 11	Brimstone Pond	21.0	1200	0.80
E 12	Northeast Stream	34.2	1150	1.25
E 13	Nameless, Hare Bay	25.0	950	0.75
E 14	Northwest Arm, Hare Bay	35.2	950	1.06
E 15	Nameless, Hare Bay	149.5	950	4.50
E 16	West Brook	119.1	1200	4.53
E 17	Main Brook, Hare Bay	182.9	1200	6.96
E 18	Salmon River	667.5	1200	25.38
E 19	Freshwater Creek	98.9	900	2.82
E 20	Coles Pond	239.1	900	6.82
E 21	Beaver Brook	237.3	1200	9.02
E 22	Northwest Brook, Castor Cove	225.4	1150	8.21
E 23	Roddickton	41.7	850	1.12
E 24	Cloud River	525.3	1200	19.98
E 25	Pebble Hill, Torrent Cove	30.9	900	0.88
E 26	Duckbill Point	196.4	950	5.91
E 27	Hooping Harbour	29.4	850	0.79
E 28	Silver Cove	28.3	850	0.76
E 29	Fourche Harbour	209.7	950	6.31
E 30	Soufflets River	399.0	1050	13.28
E 31	Great Harbour Deep	215.3	1000	6.82
E 32	Little Harbour Deep River	441.5	1050	14.69
E 33	Great Cat Arm	59.5	950	1.79
E 34	Cat Arm River	709.2	1200	26.97
E 35	Great Coney Arm	214.9	800	5.45
E 36	Main River, Sop's Arm	996.0	1300	41.03
E 37	Sop's Arm	46.7	500	0.74
E 38	Hampden River	125.0	750	2.97
E 39	The Beaches, White Bay	104.1	600	1.98
E 40	Nameless, White Bay	40.3	500	0.64
E 41	Purbeck's Brook	59.3	500	0.94

Table 2.7 (cont'd)
Drainage Basin Data

Ref. No.	Drainage Basin	Drainage Area (km²)	Avg. Annual Runoff (mm)	Mean Ann. Flow (m³/s)
W 1	Open Bay	106.3	850	2.86
W 2	Nameless, near Big Brook	23.6	850	0.64
W 3	Big Brook	197.8	850	5.33
W 4	Eddies Covr	113.3	850	3.05
W 5	Green Island Brook	126.6	850	3.41
W 6	Black Duck Cove	148.8	900	4.24
W 7	Ten Mile Lake	316.9	900	9.04
W 8	Castor's River	486.4	1000	15.41
W 9	Doctor's Brook	80.4	1000	2.55
W 10	East River	128.0	1050	4.26
W 11	Torrent River	616.5	1250	24.42
W 12	River of Ponds, Bad Bay	188.0	1000	5.96
W 13	River of Ponds, Blue Mountain	682.0	1350	29.18
W 14	Brian's Pond	413.9	1400	18.36
W 15	Bound Brook	89.0	1000	2.82
W 16	Inner Pond	437.8	1400	19.42
W 17	Portland Creek Pond	106.3	1400	4.72
W 18	River into Parsons Pond (North)	37.5	1300	1.54
W 19	River into Parsons Pond (East)	111.8	1600	5.67
W 20	Parsons Pond	160.2	1500	7.62
W 21	River into Parsons Pond (South)	46.9	1600	2.38
W 22	St. Paul's Inlet	242.2	1600	12.28
W 23	St. Paul's River	77.5	1650	4.05
W 24	Western Brook Pond	173.1	1550	8.50
W 25	Bakers Brook	136.4	1550	6.70
W 26	Deer Brook	118.2	1500	5.62
W 27	Upper Humber River	2305.5	1200	87.67
W 28	South Ease Arm, Bonne Bay	69.7	1300	2.87
W 29	South Arm, Bonne Bay	36.2	1350	1.55
W 30	Middle Brook	62.9	1350	2.69
W 31	Trout River	268.8	1300	11.07
W 32	Lomond River	414.7	1200	15.77
W 33	Goose Arm Brook	213.3	1150	7.77
W 34	Otter Brook	154.0	1050	5.12
W 35	Humber River	608.5	900	17.36
W 36	Grand Lake	4830.2	900	137.76
W 37	Rapids Brook	628.1	1000	19.90
W 38	Gillams Brook	39.3	1200	1.49
W 39	Blow Me Down Brook	52.4	1000	1.66

Table 2.7 (cont'd)
Drainage Basin Data

Ref. No.	Drainage Basin	Drainage Area (km²)	Avg. Annual Runoff (mm)	Mean Ann. Flow (m³/s)	
W 40	Riley's Brook	74.5	850	2.01	
W 41	Clarks Brook	37.8	1100	1.32	
W 42	Serpentine River	432.6	1000	13.71	
W 43	Cooks Brook	98.8	1150	3.60	
W 44	Corner Brook	155.7	1100	5.43	
	Total:	22818.30	km²	790.72	m3/s
		Average Runoff		1093.50	mm

3 - Groundwater Availability

3 Groundwater Availability

The hydrogeology of the study area has been the subject of two reports commissioned by the Water Resources Division, Reports 2.1 and 2.5 of the Groundwater Series. The first was a study of the Great Northern Peninsula, carried out by Golder Associates and the second was a study of the Humber Valley, carried out by Nolan, White and Associates (18, 19). The locations of the study areas are shown in Figure 3.1. The material in this section summarizes the findings in those reports. Additional information on the performance of groundwater systems is contained in the inventory accompanying this study (Appendix D).

3.1 Physiography

The two regions, the Humber Valley and the Great Northern Peninsula, are physiographically distinct. The Great Northern Peninsula is dominated by the great northern highlands section of the Long Range mountains underlain by Grenville basement rocks. Bedrock is near the surface everywhere. The west coast lowland, from Canada Bay to Bonne Bay, is a low lying area with rocks thickly buried beneath marine and glacial deposits. A steep escarpment, incised by glacially cut fiords, rises to the highlands. Vegetation is scrubby and sparse, except in lowland sheltered areas. The eastern side of the mountains is underlain by gneiss, shirt and foliated granite.

The Humber Valley, on the other hand, has large tracts of forest, and deep overburden in many areas. The region from the Bay of Islands north to Bonne Bay, and east almost to Deer Lake, consists of dissected plateaus and mountains rising abruptly from the Gulf. In this region of steep-sided fiords and valleys, the mountains are sparsely forested and the plateau near the coast is barren. The Grand Lake lowlands to the east, including Grand Lake, Deer Lake and Sandy Lake, form a conspicuously flat valley floor, covered with forest and bogs.

3.2 Bedrock Hydrogeology

3.2.1 Northern Peninsula

The most notable fact about the bedrock aquifers on the Northern Peninsula is that their permeability is nearly always secondary, i.e., due to the presence of joints, faults

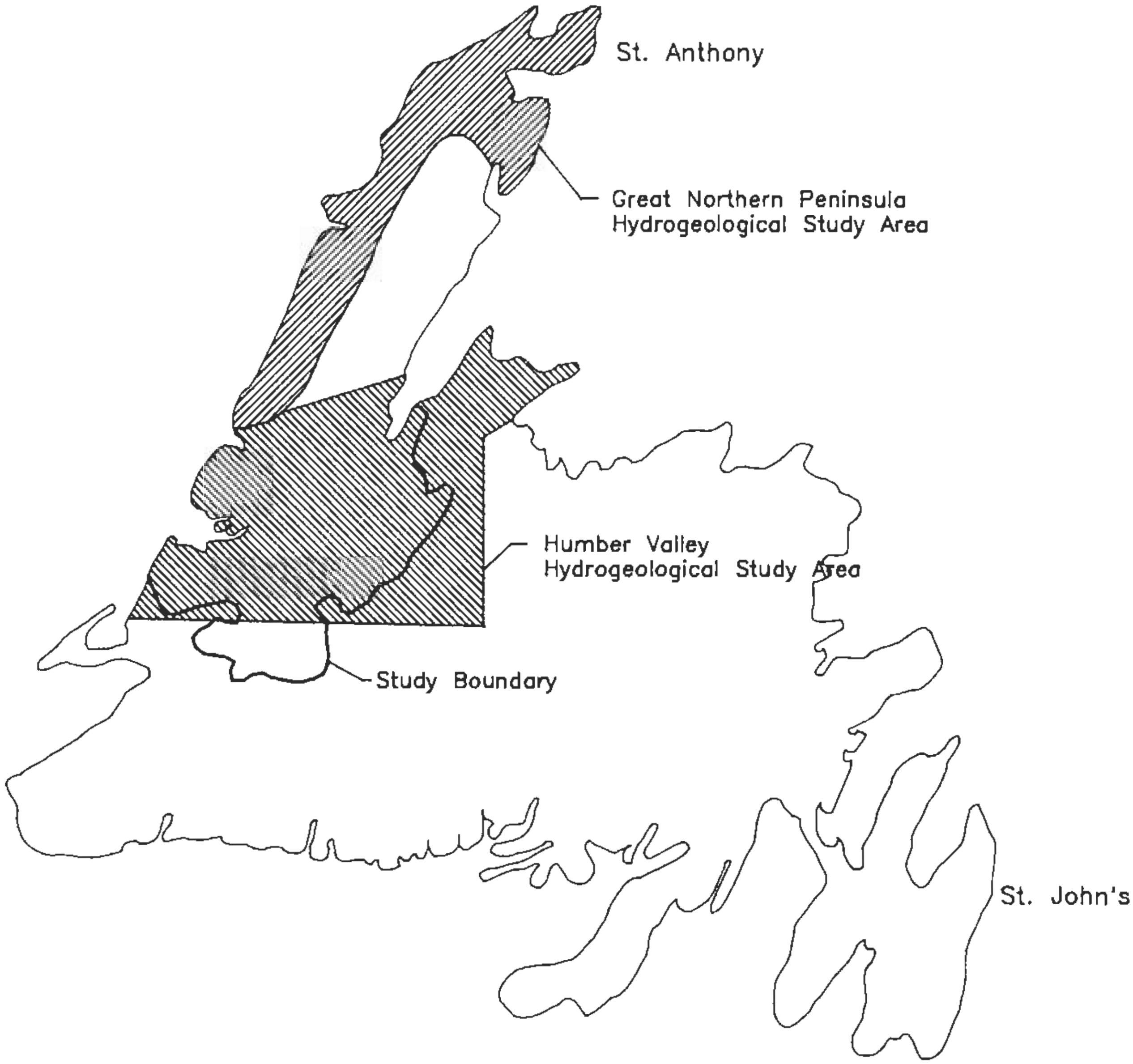

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Fig. 3.1

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Humber Valley & Northern Peninsula

Groundwater Reports — Study Areas

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and solution cavities. The solution cavities are found in carbonate rocks, which in general are rare in the rest of the province. Because the permeability is secondary, yields are highly variable. A few of the aquifers have high yield potential, as indicated by the high flows reported from mine dewatering at Daniel's Harbour. But most wells drilled in bedrock on the Northern Peninsula have low yields, although they are rarely dry.

The bedrock hydrostratigraphic units identified on the Northern Peninsula are listed in Table 3.1. Figure 3.2 shows the locations of the better units, based on the Groundwater Series report, modified according to more recent data from the Department of Mines and Energy.

The unit with the best yield is the St. George's group, with yields ranging from 2 to 182 L/min (average 70 L/min), at a mean depth of about 40 m. The next best is the Forteau (Hawkes Bay) formation, with yields ranging from 0 to 230 L/min (average 45 L/min) at a mean depth of about 30 m. As the wide ranges show, these units are not guaranteed producers, but they do have the best potential.

3.2.2 Humber Valley

The bedrock geology of the Humber Valley area includes sedimentary, volcanic and granite rock strata. Folding and faulting have occurred in southwest-northeast trends, reflected by the southwest-northeast alignment of the mountains and valleys in this part of the study area. As on the Northern Peninsula, groundwater occurrences result from open jointing, bedding planes, and fracture zones. For this reason, the southwest-northeast fault structures may be a good groundwater source even though they do not form a hydrostratigraphic unit.

Data obtained by DOEL from an experimental watershed near Corner Brook suggest that fault lines crossing watershed boundaries can lead to interbasin water transfer. Groundwater divides probably do not correspond to watershed divides in these areas.

Table 3.1

Bedrock Hydrostratigraphic Units - Northern Peninsula

Unit #	Groups/Geology	# of Wells	Mean Depth (m)	Well Yield (L/min) Low	High	Mean
1 High Yield	St. George's/ Carbonates	28	39	2	182	70
2 Above Avg. Yield	Forteau (Hawkes Bay)/ Dolomite, shale, quartzite	42	30	0	230	45
3	Humber Arm, Maiden Pt., St. Anthony	16	58	0	91	15
4 Low	Other Bedrock units	5	66	-	5	-

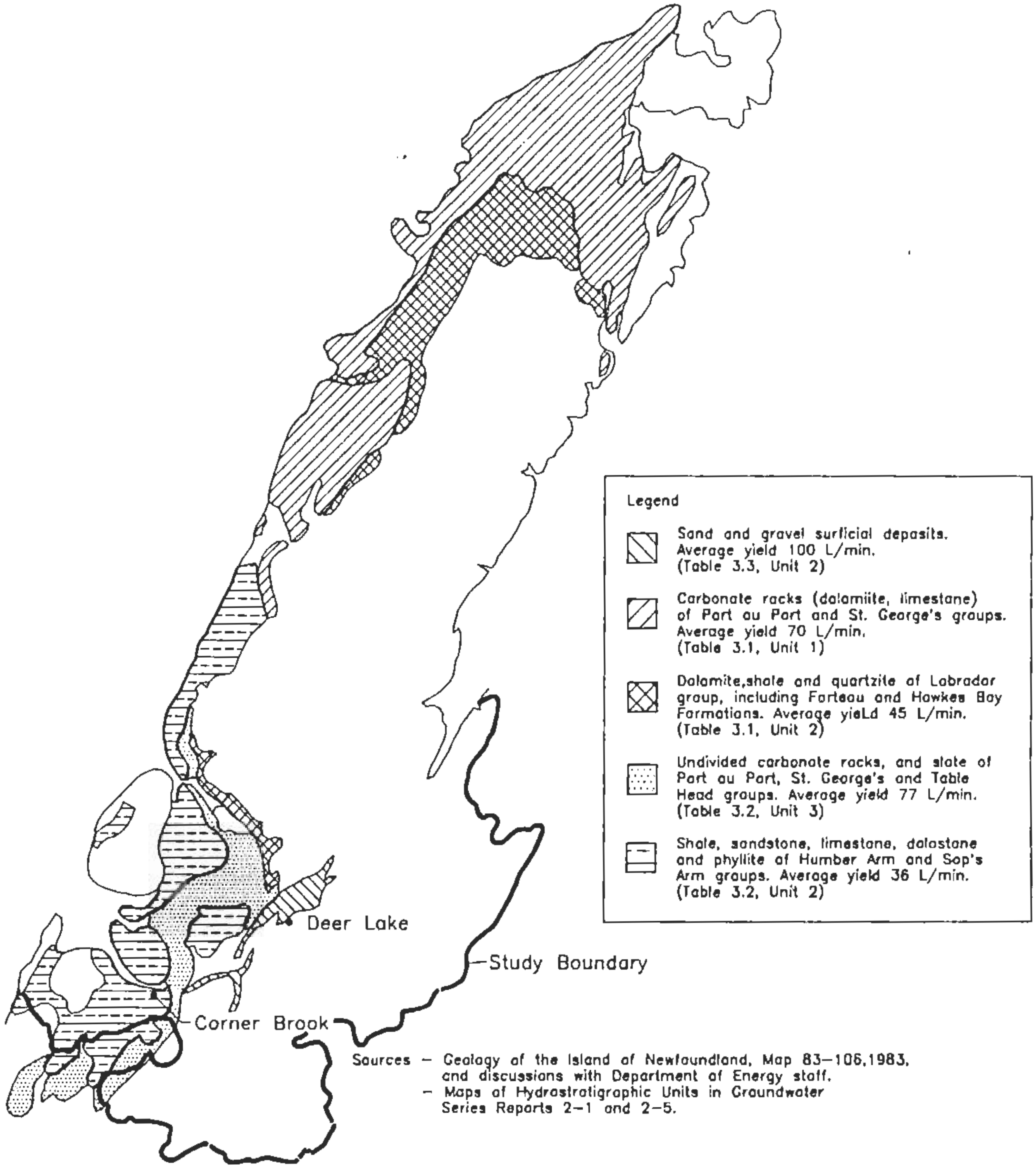

Fig. 3.2

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Humber Valley and Northern Penninsula

Hydrostratigraphic Units with Best Potential

ACRES

The hydrostratigraphic units identified in the Humber Valley are listed in Table 3.2. Carbonate rocks extend from Bonne Bay south towards Corner Brook, and form the most extensive bedrock hydrostratigraphic unit within the study area. Again, as on the Northern Peninsula, solution weathering, joints and fracturing are important sources of permeability. Disappearing streams and lakes with internal drainage suggest that bedrock permeability can be high in this unit.

As is the case throughout the study area, the potentially high yields of this group are not likely to be very useful since in general the formation occurs in wilderness areas. Only near Corner Brook and Rocky Harbour/Norris Point is there some potential for tapping this unit.

The only other hydrostratigraphic unit with moderate potential is the clastic sedimentary strata. Within this strata, most records have come from the Humber Arm group. Wells from this group can provide good domestic supplies.

The locations of the two best units are also shown in Figure 3.2.

As Table 3.2 shows, the other units have low or at best low to moderate yield potential, able to supply single dwellings, for example.

Both groundwater reports noted that yields do not increase with depth. Since fracturing and jointing provide the permeability in the bedrock, this observation is not surprising. At depth, the bedrock is usually less fractured, and if anything will be less permeable.

3.3 Surficial Hydrogeology

Many wells in the study area, as in the rest of the province, are dug in the surficial layer. These shallow wells provide domestic supplies, usually to one or at most a few homes. Little information is kept on the performance of these wells.

Table 3.2

Bedrock Hydrostratigraphic Units - Humber Valley

Unit #	Groups/Geology	# of Wells	Mean Depth (m)	Well Yield (L/min) Low	High	Mean	Median
1 Low Yield	Fleur de Lys/ schist, quartzite	10	40	0.27	0.55	10	6.8
2 Moderate Yield	Humber Arm, Labrador, Victoria Lake, Sops Arm/ shale, sandstone, limestone, dolostone, phyllite	41	53	0	145	3.6	22.7
3 High Yield	St. George's/Limestone dolostone, shale, phyllite	12	38	13.6	159	77.3	45
4, 4a Low to Med	Anguille, Deer Lake/ sandstone, conglomerate, siltstone, mudstone	35	54	0.45	91	21.8	17.3
5 Moderate Yield	Volcanic/volcanic flows, tuffs, minor sediments	38	42	1.1	455	58.2	22.7
6 Low Yield	Ophiolite Complexes/ Ultramafic, gabbro	14	54	2.3	18.2	9.5	9.1
7 Low Yield	Granite, Long Range Complexes/granite, granite gneiss, diorite, porphyry	25	-	-	-	20.5	9.1

3.3.1 Northern Peninsula

The Groundwater Series report for the Northern Peninsula does not separate the surficial layer into hydrostratigraphic units. The surficial deposits are generally thin and discontinuous. They consist of a thin mantle of glacial till with varying proportions of silt, sand and gravel. The thinness of the layer means that aquifers have little storage, and the only storage for users is that provided in the well itself. As a result, groundwater supply from surficial deposits is vulnerable to dry periods.

The two types of surficial deposits on the Northern Peninsula are raised beaches/glacial outwash, and glacial drift. The raised beaches do not give good yields because all the water drains out of them. They are thick ancient beaches, deposited when the sea was about 160 m higher than it is at present. They are now left high and dry. The fact that these deposits are thick and well drained with good permeability makes them more suitable as sources of construction material than as aquifers.

Areas of glacial drift occur in the lowlands near the shore. Some shallow wells in this layer may give good yields because of the general wetness of the west coast. Quality may be poor, however, due to boggy terrain and poor surface drainage. Data are not available, but yields are estimated to average around 5 L/min.

The Groundwater Series report notes that the value of springs as groundwater sources on the Northern Peninsula is overemphasized. Yields from springs are rarely greater than 10-15 L/min, and wells drilled near springs rarely produce good yields.

3.3.2 Humber Valley

In the Groundwater Series report for the Humber Valley, two hydrostratigraphic units were identified, as shown in Table 3.3. The first is similar to the glacial drift unit of the Northern Peninsula, i.e., till ranging from silty sand to clayey silt, suitable as a source for single family domestic wells. There is little aquifer storage.

The second surficial unit, sand and gravel, provides the greatest groundwater yield potential in the study area. These deposits are extensive in the Deer Lake/Upper Humber River Valley and in the Indian Brook/Birchy Lake Valley as shown in Figure 3.2. Elsewhere they are restricted to narrow stream valleys. Yields for seven drilled wells in these deposits ranged from 4 to 340 L/min. At Deer Lake Airport, the 20 year safe yield for a well in this deposit is reported to be 330-894 L/min.

Some buried sand and gravel aquifers are possible groundwater sources, but they are difficult to locate. Some potential has been noted in the Reidville/Cormack area.

Table 3.3

Surficial Hydrostratigraphic Units

Humber Valley

Unit #	Geology	Well Yield (L/min) Low	High	Mean	Median
1 Low Yield	Till	0	45.5	9.1	-
2 Moderate to High Yield	Sand and Gravel(1)	5.5	273	24.7	22.7
	Sand and Gravel(2)	4.5	341	100	45.5

(1) Hydrogeological Study: Notre Dame Bay Area, Report 2-2.

(2) Hydrogeological Study: Humber Valley Area, Report 2-5.

3.4 Experience with Groundwater Supply

About a third of the communities in the Inventory obtain their water from groundwater, or a combination of groundwater and surface water sources (Appendix D). Generally, homes and businesses outside incorporated communities or local service districts also have wells.

The information in the Inventory carried out for this study indicates that many of these systems are inadequate; about 60 percent report problems. They may run dry in dry periods, freeze in winter, or have poor quality water. These problems result from the shallowness of the layer in which most of the wells are dug. Wells drilled into bedrock may also experience problems because bedrock aquifers depend on flow in joints, fractures and cavities which carry surface runoff to the wells.

Nevertheless, for individual homes or small communities, groundwater is often the most economic water supply option. Wells must be carefully located and built and protected from freezing to minimize problems. Reservoir (tank) storage can also be added to provide water during short dry periods.

4 - Water Quality

4 Water Quality

4.1 Available Data

Surface water quality is monitored regularly by DOEL in a joint program with Environment Canada. Data at 16 locations on rivers in the study area have been obtained under this program and are archived in the National Water Quality Data Base (NAQUADAT) maintained by Environment Canada.

The monitored rivers and the numbers of samples taken from each are given in Table 4.1.

Table 4.1

Monitored Rivers in the Study Area

Rivers	Period of Sampling From	To	No. of Samples
Ste. Genevieve near Forresters Point	1971	1989	77
Torrent R. at Bristol's Pool	1971	1989	217
Torrent R. at Bridge	1986	1988	40
Beaver Brook	1971	1979	79
Portland Creek	1986	1989	46
Western Brook at Bridge	1986	1989	39
Cat Arm River	1971	1982	34
Main River at Bridge	1986	1989	49
Grand Lake at Canal	1966	1978	117
Grand Lake at Deer Lake	1955	1956	13
Upper Humber at Reidville	1971	1979	78
Corner Brook at Corner Brook	1953	1956	18
Humber River near Deer Lake	1955	1981	13
Humber River at Little Falls Bridge	1986	1989	27
Humber River at Humber Village Bridge	1986	1989	34
Corner Brook at Bridge	1986	1989	48

Data obtained through other sampling programs such as those undertaken by Department of Fisheries and Oceans (DFO), or spot samples from community water supplies, are also stored in NAQUADAT.

No information is available on water quality at the end of the distribution system, i.e., in homes and businesses. Possible problems in the distribution systems include bacteriological contamination, or dissolved copper and lead. Copper and lead if present in pipes can dissolve in soft, low pH water typical of many water supplies. Although no such problems have been reported, they may show up with testing.

4.2 Characteristic Water Quality in Study Area

4.2.1 Surface Water Quality

Since most of the monitored rivers are located in areas largely unaffected by human activity, the water quality reports for those rivers can be considered as typical of the study area. Possible contamination by pollutants transported through the atmosphere from outside the province is discussed in Section 4.4.5. At present it is not thought to affect the overall characteristic water quality.

The natural water chemistry in the study area reflects the composition of the soils and bedrock. Because parts of the Northern Peninsula are underlain by limestone, the water chemistry differs somewhat in these areas from the rest of the island. The water is more alkaline, with higher concentrations of dissolved constituents. These areas are chiefly along the west coast and northern part of the Northern Peninsula. The water on the east coast of the Northern Peninsula and in the Humber Valley is much more like the rest of the island, very soft, acidic and coloured. Typical results for some of the major parameters are described below.

pH: Measured values of pH in some areas in the northern and western regions have exceeded 8.0, although most are between 7 and 8. In the rest of the study area, values between 5 and 6 are more typical, as they are throughout most of the island.

Alkalinity: The alkalinity (measured as equivalent mg/L of $CaCO_3$) again is highest in the northern part of the area. Values in the range of 20 mg/L to 70 mg/L are usual there, whereas concentrations of less than 5 mg/L are typical elsewhere. Values less than 24 mg/L are still considered low; alkalinity may reach 500 mg/L in other parts of Canada.

Conductivity: Conductivity reflects the total concentration of dissolved constituents. Again, because of geology, areas along the west and north coasts of the study have a much higher conductivity than elsewhere. Measured values have exceeded 160 μS/cm, compared with typical values of about 20 μS/cm elsewhere.

Hardness: Although the water is somewhat harder where it drains areas underlain by limestone, the water is generally soft throughout the region (<60 mg/L $CaCO_3$).

Positive Ions (Calcium, Magnesium, Sodium, Potassium): Concentrations of all positive ions are low, although they are higher in the areas to the north and west. Calcium is the dominant positive ion. Values may exceed 20 mg/L in these areas, compared with typical island concentrations of 2-4 mg/L.

Negative Ions (Chloride, Sulphate, Bicarbonate): Concentrations of all negative ions are low.

Colour: All the natural surface water is coloured, with values consistently exceeding the Canadian Water Quality Guidelines (CWQG) of 15 mg/L (37).

Metals: Levels of all metals are generally low; the highest are iron and aluminum. Concentrations rarely exceed CWQG.

4.2.2 Characteristic Groundwater Quality

The characteristic groundwater in the study area tends to be similar in composition to the surface water, since its constituents are determined by the bedrock composition. The concentrations of dissolved constituents tend to be higher than the corresponding surface water, because the groundwater is less dilute.

The Groundwater Series reports referred to in Section 3 summarize the characteristic groundwater quality as described below. Both reports note a lack of groundwater chemistry data.

Humber Valley: The groundwater in the Humber Valley tends to be a calcium or calcium magnesium bicarbonate water varying from soft to hard. Soft water is found in granite terrain, whereas the hard water is found in the sedimentary strata containing limestone and dolostones. The groundwater from properly installed wells is considered to be of moderately high quality for drinking water supplies.

Local pockets of saline, sulphurous groundwater occur in certain areas underlain by sedimentary strata of the carboniferous age Deer Lake Group, e.g., around Cormack. At present, the full extent and nature of these saline groundwater occurrences is unknown.

Great Northern Peninsula: Due to the lack of data, the Groundwater Series report makes only general comments. Drilled wells in the St. George Group and Table Head formations, although good producers, tend to produce water of questionable aesthetic quality. Elevated concentrations of iron, manganese, and total calcium carbonate have been measured. The report notes that overall, however, calcium, magnesium and total calcium carbonate are generally quite low, considering that limestone and dolomite underly much of the Northern Peninsula.

4.3 Water Quality Assessment

The quality of water sources within the study area was assessed by comparing measured values of water quality parameters with recommended guidelines. The CWQG provides water quality guidelines for the following uses of importance in the study area

- domestic consumption
- livestock/wildlife
- freshwater aquatic life
- fish processing
- recreation.

For all uses except domestic consumption (drinking water), the values given are guidelines, i.e., recommended values to support or maintain a designated use. For drinking water, the values are not simply guidelines; they are the limits adhered to by Health and Welfare Canada.

4.3.1 Domestic Consumption

The guidelines for various uses, including domestic water quality, are presented in Table 4.2. Drinking water that contains substances in concentrations outside these limits may produce adverse health effects or be aesthetically objectionable.

As Table 4.2 shows, the natural waters in the study area typically meet all the maximum acceptable limits for drinking water supplies, with the exception of colour, iron, and pH. Raw water can therefore usually be used for drinking water, with pH adjustment and with disinfection to ensure bacteriological control.

The problem of colour is more difficult and expensive to solve. In Newfoundland it is usually caused by high organic content in the water, sometimes in association with high iron or manganese. Of the 47 communities with surface systems surveyed in the region, about half reported water quality problems. Most of these were related to high organic content. The chief complaints were colour, presence of silt or turbidity, odor, and taste.

The fact that the water sources for many communities in the study area are shallow ponds surrounded by bogs exacerbates the problem. Winds stir up bottom sediments, silt is drawn into the intake when ponds are low and organic materials wash down from the surrounding bogs into the ponds during heavy rains.

The complaints from residents are borne out by analyses of spot samples from community water supply systems; 19 of 32 samples in the community water supply database maintained by DOEL show colour levels above guideline values.

While colour and iron are controlled for aesthetic reasons rather than health, the water may still be quite unpleasant to drink. Water that is coloured or has excess iron may also stain clothes and fixtures. One potential health concern which has recently been expressed is that chlorine and organic materials from coloured water may react to form toxic substances (trihalomethanes). This problem is currently being studied by the Canadian Drinking Water Guidelines Committee.

Table 4.2

Guideline Values for Various Uses

Parameter	Drinking Water Max Acc (mg/L)	Livestock And Wildlife (mg/L)	Aquatic Life (1) (mg/L)	Primary Food Processing (mg/L)	Range of Values in Study Area (2) (mg/L)
Inorganic					
Alkalinity	-	-	-	30-250	<0.1-85.5
Aluminum	-	5.0	0.005	-	0.005-0.340
Arsenic	0.05	0.5	0.05	-	
Bicarbonate	-	-	-	-	
Cadmium	0.005	0.02	0.002	-	0.000-0.001
Calcium	-	1000	-	-	0.6-29.0
Carbonate	-	-	-	-	-
Chloride	250	-	-	-	1.4-10.6
Chromium	0.05	1.0	0.02	-	0.002-0.010
COD	-	-	-	-	
Copper	1	0.5	0.002	-	0.000-0.002
Dissolved Oxygen	-	-	9.5	-	8.2-15.4
Fluoride	1.5	1.0	-	<0.1	0.00-0.02
Iron	0.3	-	0.3	<0.2	0.009-0.400
Lead	0.05	0.1	0.001	-	
Magnesium	-	-	-	-	0.71-5.10
Manganese	0.05	-	-	<0.2	0.001-0.044
Mercury	0.001	0.003	0.0001	-	
Nickel	-	1.0	0.0025	-	
Nitrate	10	-	-	-	0.07-0.33
Nitrite	1	10.0	0.06	-	
N-Ammonia	0.05	-	2.2	-	
pH (pH units)	6.5 - 8.5	-	6.5 - 9.0	-	5.4-8.5 pH
Silica	-	-	-	-	
Sulphate	500	1000	-	-	0.8-6.5
TDS	500	-	-	-	15-203
Zinc	5	50.0	0.03	-	0.000-0.002
Physical					
Color (TCU)	15	-	-	5-10	<5-120
Turbidity (NTU)	5	-	-	1-10	0-3
Temperature (°C)	15	-	-	-	
TSS	-	-	-	-	
Microbiological					
Total Coliforms	10/100ml			<2/100mL	
Faecal Coliforms	0/100ml				

1. Some of these guidelines vary with other parameters. Guideline given is for typical value.

2. Of regularly sampled natural rivers. These values are only presented for general information; analytical methods vary among samples and may also be different from those assumed in the guideline values.

Organic colour can be reduced by coagulation and filtration; iron and manganese, which also cause colour and staining, can be removed by precipitation. Both processes are expensive for small water supply systems (23). Usually the only option for most small communities is to minimize the amount of organic material entering the distribution system by careful location of the intake and by screening. Larger communities may be able to afford filtration.

One other problem occasionally reported is algae growth. This occurs in very shallow stagnant ponds. The water can become so unpleasant to drink that residents will carry water from another source rather than drink the community water. At Port-au-Choix, the algae were eliminated with an application of an algicide. At Pasadena, structural changes to improve the flow rates are expected to alleviate the problem.

Some bacteriological contamination occasionally occurs, often because of problems with chlorinators. The Department of Health monitors these problems and issues boil orders when necessary. Contamination is usually episodic and local; most communities are located on the coast and obtain their water from sources upstream of sewage discharge points.

Communities on the Humber River are exceptions. Some potential for contamination exists from upstream discharge or runoff in the Humber Valley. No major problems have been reported to date, although the Department of Health has had to issue boil orders for Reidville, which takes its water from the lower reaches of the Humber River.

4.3.2 Livestock and Wildlife Watering

As Table 4.2 shows, the natural waters of the study area meet the guidelines for livestock watering, and by extension, wildlife. Parameter values are based on the resistance of the most sensitive farm animal.

Two concerns about the quality of water used by animals may be noted. The first is the possibility of local bacteriological contamination where animals are reared intensively. Careful attention to location of wells or surface sources in relation to pastures, barns and manure piles is required to avoid these problems.

The second is the long range transport of airborne pollutants (LRTAP), which are deposited on natural water bodies and forage lands, and consumed by both domestic and wild animals. No deleterious effects have been observed to date, but scientists with DOEL have noted LRTAP as an important potential source of contamination. This subject is discussed in Section 4.4.

4.3.3 Freshwater Aquatic Life

As Table 4.2 shows, the natural waters of the study area generally meet the guidelines for aquatic life. Guidelines for aquatic ecosystems are difficult to set because of the complex interactions between the aquatic life and the physical and chemical makeup of the water. The authors of the guidelines note that site-specific adjustments may be necessary.

The natural waters are occasionally outside the guidelines for pH. DFO has observed that native species of salmon and trout are relatively tolerant of low pH water, and have recommended the pH tolerance limits shown in Table 4.3 for local species (10).

Table 4.3

Tolerance Limits for Salmonids (pH)

Species	**pH Limit**
Atlantic Salmon and Ouananiche	5.0 - 5.5
Brown trout	5.0
Brook trout	about 4.5 - 5.0

At pH values outside these limits, fish species will decline, cease to reproduce or disappear.

Aluminum also exceeds recommended levels in some rivers of the study area. Aluminum concentrations have been found to be significantly correlated with colour, suggesting that much of the available aluminum is present as organic complexes. The addition of acid to a turbid sample appears to release aluminum from the particles in the sample, resulting in high values. It is likely that at present much of the available aluminum reported from Newfoundland samples forms part of organic complexes, and is nontoxic (33).

Aquatic life is naturally adapted to the local waters, and the guidelines are required when human activity changes the natural quality. The guidelines can be used, for example, as objectives in a rehabilitation program, as standards which a new project must meet, or to monitor the effect of present levels of human activity. Much of the study area is remote from intensive development but such activities as farming or forestry can increase erosion and sediment loads and thereby degrade water quality.

4.3.4 Industrial Water Uses

The two largest industrial water users in the study area are the paper mill at Corner Brook and fish plants at several locations. The paper mill takes its water from Corner Brook, sharing a supply with the City of Corner Brook. The mill provides screening and any treatment required to satisfy its own standards.

Fish plants are the major industrial water users outside of Corner Brook. Their water use and water sources vary considerably. Water uses include fluming, washing equipment, washing fish, making ice, and domestic use for inplant needs. Some plants use both fresh and salt water, others use only fresh. Some have their own supply; others share with the community.

The guidelines listed in Table 4.2 are those applying to food processing in general, where water is not incorporated into the final product. The only guidelines exceeded by natural water are colour and iron. Since most water is used for such purposes as washing and making ice, elevated colour is unlikely to be a concern. If it is, the processor can provide the appropriate inhouse treatment, e.g., coagulation, filtration, precipitation.

DFO inspects fish plants and monitors water to ensure that there is no bacteriological contamination. The standards are set in the Fish Inspection Regulations under the Fish Inspection Act. DFO recommends that all water used in fish plants be chlorinated even if the natural coliform levels are below guideline limits.

4.3.5 Recreational Water Quality

Recreation is a major water use in the study area, and the quality of both the water and the surroundings is essential to maintaining this use. The recreational fresh water quality guidelines are given in Table 4.4. The water quality at all the monitoring stations generally meets the guidelines. The only problem parameter could be colour, which might affect clarity. The Secchi disc test is not performed at the monitored rivers.

4.4 Water Quality Concerns

Human activities can lead to water quality degradation. The degradation occurs from increased loadings of

- sediment or other solids
- micro-organisms
- nutrients
- toxic chemicals
- atmospheric pollutants.

The first two are long standing concerns, and mechanisms are generally in place to control them. Constant attention is required, however, to minimize degradation from these sources. The third, excess nutrients, is not a problem because of the nature of the soils and the low level of agricultural activity. The last two are more recent concerns, and are important because of their ubiquity and possible long term effects. The following sections briefly discuss each of these types of degradation, highlighting potential problems in the study area.

Table 4.4

Guidelines for Recreational Water Quality

Parameter	Guideline
Faecal Coliforms	The geometric mean of not less than 5 samples taken over a 30-day period should be less than 200 faecal coliforms per 100 mL. Resampling should be performed when any sample exceeds 400 faecal coliforms per 100 mL.
Pathogens) Coliphages) Enterococci) E. Coli) P. Aeruginosa) G. Lamblia)	No guidelines set. May be indicators, or monitoring may be required.
Clarity	The water should be sufficiently clear that a Secchi disc is visible at a minimum of 1.2 m.
pH	5.0 - 9.0
Turbidity	The turbidity of water should not be increased more than 5.0 NTU over natural turbidity when this is low (<50 NTU).
Aesthetics	All water should be free from - materials that will settle to form objectionable deposits: - floating debris, oil, scum and other matter; - substances producing objectionable color, odor, taste or turbidity; and - substances and conditions or combinations thereof in concentrations which produce undesirable aquatic life.
Oil and grease	Oil or petrochemicals should not be present in concentrations that - can be detected as a visible film, sheen or discoloration on the surface; - can be detected by odor; or - can form deposits on shorelines and bottom deposits that are detectable by sight and odor.
Aquatic plants	Rooted or floating plants which could entangle bathers should be absent; very dense growths could affect other activities such as boating and fishing.

Source: Canadian Water Quality Guidelines (37)

4.4.1 Sediment

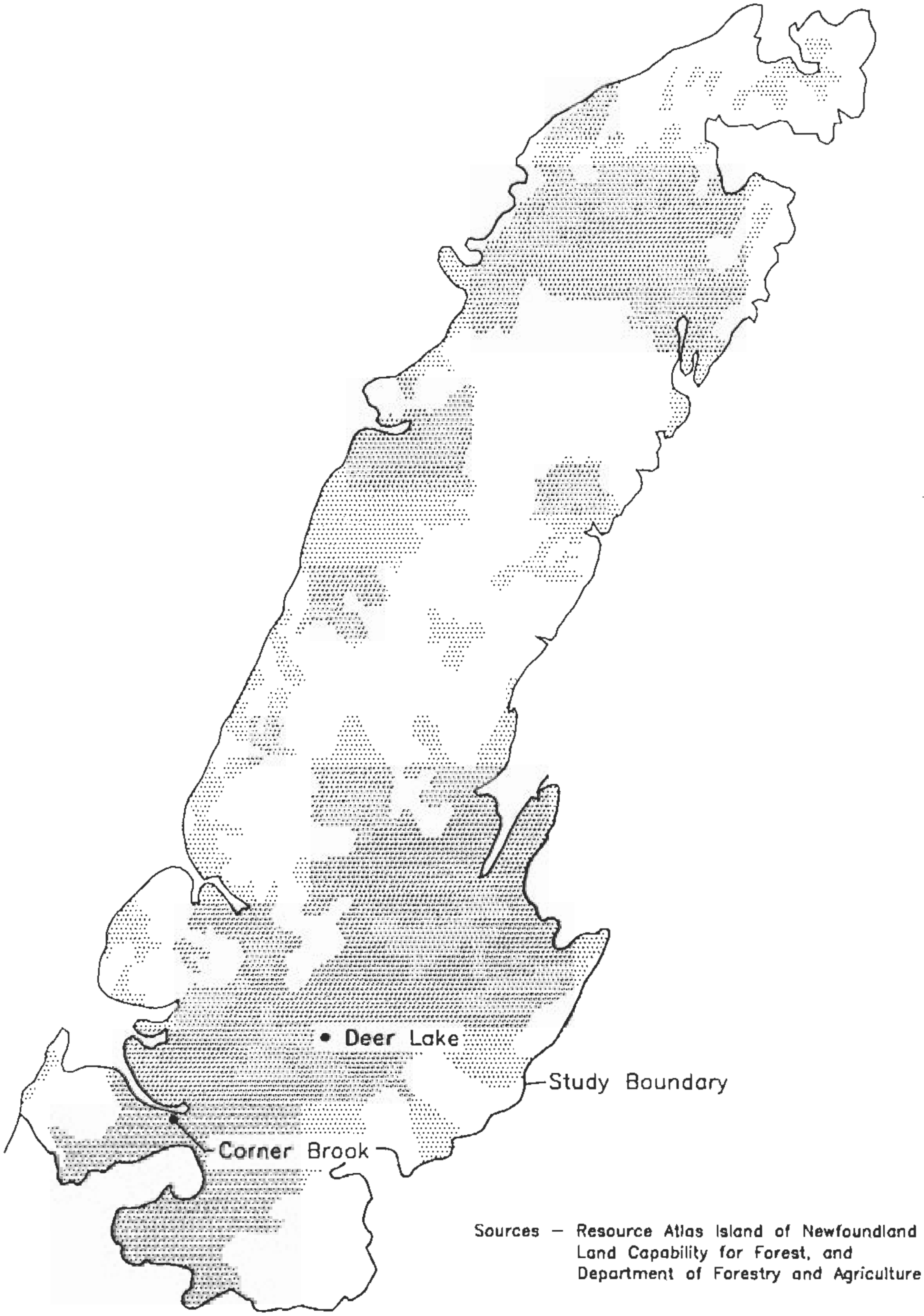
Increased loadings of sediments and other solids generally arise from changed land uses or drainage regimes. Activities such as forestry, construction, road building, quarrying and farming remove protective vegetation and expose soils. Recreational use of all terrain vehicles has a similar harmful effect. Scouring will also often increase when flows are channelled for drainage.

Careless logging operations are probably the most important source of excess sediment loads in the study area. Several studies have been implemented in the last few years in the Corner Brook area to assess the effects of forestry operations on water quality. These studies are ongoing, and the results are not yet available. In general, however, the conclusion of forestry and environmental officials is that careful operations can mitigate many of the worst effects. Simple examples of preferred techniques include aligning skidder roads along contours, rather than perpendicular to them, using winter roads of gravel and snow to minimize bulldozer cuts, and installing sediment traps at strategic locations.

Increased sediment can be a problem because it can enter water supply systems, and because it can degrade fish habitat. An example of the effect of forestry operations on a water supply system occurred in the Corner Brook watershed in 1989. Forestry operations eroded the soil in the watershed, leading to a precautionary shutdown of the city water supply. This event in fact spurred some of the studies referred to above. The forestry practices there are now very well supervised, and can serve as examples elsewhere.

Sediment also has an adverse effect on fish habitat. Salmon and trout both require clean, silt free gravel for spawning. Silt suffocates eggs and young fish, as well as degrading their food supply. Since about two thirds of the study area is productive forest, and either has been or may be logged, there is widespread potential for degradation of fish habitat.

Any of the waters in the productive forest areas shown in the map in Figure 4.1 are at risk, since these areas are either presently being logged, or may be logged in the future.



Department of Environment and Lands
Water Resources Division

Fig. 4.1

Regional Water Resources Study
Humber Valley & Northern Peninsula

Productive Forest Areas

DFO is presently preparing guidelines for protection of fish habitat in forested areas. The provincial Department of Forestry and Agriculture also prepares environmental protection plans for their management units, and DOEL is closely involved in water quality monitoring and protection of watersheds used for water supply.

Staff in these departments are well aware of the problems. They need continuing support for their monitoring and enforcement programs. Although simple measures can often prevent or reduce sediment loads, constant attention is required to ensure that requirements are met and guidelines are followed. Since forestry is a major activity in the Humber Valley, and since forestry practices can greatly increase erosion, forestry operations must be monitored particularly closely.

4.4.2 Microorganisms

Bacteriological contamination is a well known danger when water supplies are located near livestock farming areas or sewage disposal points. Health officials in the province have an established routine for checking domestic and fish plant water supplies, and ensuring that they are free from bacteria.

Although community systems are inspected and are generally well maintained, very small systems are not. Contamination of ponds occurs when people install substandard sewage systems at their cottages; direct discharge into ponds is not uncommon. Although cottages are supposed to have approved septic systems, it is difficult for health officials to check all of them.

Disposal locations and procedures for handling animal wastes (manure spreading, manure lagoons) are occasionally the source of local complaints. The area around Cormack has the highest concentration of dairy farms, and the manure piles can become quite sizeable. DOEL must approve manure disposal practices, however, and no particular problems with water quality have been reported. One case of spreading of poultry manure in a watershed occurred, but the situation was quickly resolved.

Contamination by other microorganisms (viruses and parasites) is becoming a concern in Canada, although no cases have been reported in Newfoundland of infection by these organisms through a drinking water supply. Some parasites (e.g., giardia lamblia) are resistant to chlorine, although other treatments such as coagulation, flocculation and slowrate sand filtration can be effective. Chlorine treatment should generally kill viruses as well as bacteria, but high levels of chlorine in coloured water may lead to the formation of trihalomethanes, as mentioned in Section 4.3.1.

4.4.3 Nutrients

Excess nutrients are not a problem in the study area. The water and soil are lacking in nutrients, and any local excesses are rapidly taken up by plants.

A common source of excess phosphorus and nitrogen is agricultural runoff, but the small amount of farming (less than one per cent of the study area) combined with the natural dearth of nutrients has generally prevented water quality problems. The most intensively farmed area is around Cormack, and the location of the farms also helps prevent water quality problems; the water draining the farms to the Upper Humber River passes through flat boggy land which provides an area for uptake of excess nutrients.

Manure disposal areas must be approved by DOEL, and no problems due to leaching of nutrients have been reported. In fact, the nutrients in the manure piles would be valuable if the manure were applied to land. The main reason that the cattle manure is not used as fertilizer is probably the cost and difficulty of handling. Poultry manure, being easier to handle, is more often used as fertilizer.

4.4.4 Toxic Substances

The use of many new chemical substances is widespread. These have the potential for serious adverse effects on humans and on natural plant and animal life due to their persistence in the environment and their accumulation in living tissues.

Of particular concern in the study area are the pesticides used by the Department of Forestry and Agriculture to control spruce budworm and hemlock looper, and the herbicides used by the utility companies to control growth along rights-of-way. The use of these substances is controlled by the Pesticides Control Branch of DOEL, and Table 4.5 lists the spraying which has been carried out in the study area in the last three years.

In the agricultural sector, the use of formulations containing carbofuran and permethrin is of most concern. The extent of use of these pesticides is not known, but they are particularly toxic to birds and fish.

Water sampling has been done under two government programs to test for toxic chemicals. The programs are ongoing, and results to date do not show any problems in the study area.

The first program is Agriculture Canada's Water Residue Investigation Program. It focuses on farm well water in areas where leaching of agricultural pesticide residues is most likely to occur. Water from four wells near Cormack, one near Pasadena, and one near Reidville was sampled for various carbamates (e.g., aldicarb, carbofuran). No trace of these substances was found. The same sites will be resampled for at least three years (1988, 1989, 1990).

Table 4.5

Areas Sprayed

Year	Active Ingredient	Location (approx)	Area (ha)
1989	Bt	Leg Pond/Castors River	5,362
	Tebuthiuron	Corner Brook	6
	2,4-D/Picloram	Corner Brook	394
1988	Bt	Port au Choix	23,788
	Fenitrothion	Port au Choix	45,138
	Tebuthiuron	Corner Brook	4
	2,4-D/Picloram	Corner Brook	47
1987	Bt	Humber Valley	4,183
	Fenitrothion	Humber Valley	164,412
	Tebuthiuron	Corner Brook	2
	2,4-D/Picloram	Corner Brook	165

Notes:

1. These are estimates only, provided by the Pesticides Control Branch, DOEL.

2. These figures do not include agricultural and/or domestic uses. 2,4-D is found in many agricultural and domestic pesticides over which there is little regulatory control. Given this, estimates for 2,4-D use as indicated are probably very low.

The second program is a toxic chemicals survey by Environment Canada and DOEL. About eight sites in the study area were selected for sampling. Substances tested for included

- arsenic
- cadmium
- chloride
- chromium
- copper
- fluoride
- iron
- sulphate
- lead
- manganese
- mercury
- nitrate and nitrite
- pH
- zinc
- color
- turbidity
- organophosphorus compounds (pesticides)
- chlorophenols (fungicides, e.g., wood perservatives)
- organochlorine compounds (e.g., DDT)
- polychlorinated biphenyls (PCB's)
- chlorinated benzenes
- polyaromatic hydrocarbons (PAH's)
- volatile organic materials (e.g., solvents, thinners).

Concentrations of all substances were below guidelines at sites in the study area, and were often below detection limits, with the exception of pH. Caution is still in order, however, for several reasons.

1. Although trihalomethanes above guidelines were not observed, they are usually present when chlorine is used to disinfect water with a high organic content, as is common in the study area. Chlorine doses and residuals should be closely controlled in the treatment process.

2. Substances not detectable in water samples may be present in tissue, due to bioaccumulation. DDT has been found in fish tissue, for example, although not in water.

3. Atmospheric transport is the principal pathway for contaminants in Newfoundland, and all areas are vulnerable.

4.4.5. Deposition of Atmospheric Pollutants

A fourth type of potential water quality degradation results from the long range atmospheric transport and subsequent deposition of pollutants. Acid rain is the best known, but pollutants other than those causing acid rain can also be deposited.

Acid precipitation is defined as rain, snow, freezing rain, hail and fog with a pH below 5.6 (the pH of normal rain). It is formed in the atmosphere as result of emissions of sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) from the combustion of fossil fuels. These substances can be further oxidized in the atmosphere to form sulfuric and nitric acids.

The effects of acid rain, from experience in Europe and other parts of North America, are the decline and disappearance of fish in freshwater lakes and rivers, and the serious deterioration of forests. These effects are due not only to low pH, but also to the increased mobilization of minerals in soils or rock.

DFO has conducted several major studies to assess the effects of acid rain in Newfoundland. The conclusions of its work to date are that some of the lakes and streams in the study area are extremely sensitive. With current or increasing rates of deposition, they may be on the threshold of acidification. Although chronic acidification is not a widespread problem at present, pH excursions below 5.0 occur, and these are of sufficient magnitude to affect fish. The areas of the west coast and Northern Peninsula containing carbonate rocks (limestone, dolomites) are less vulnerable, because the rocks provide some buffering.

Some very recent work by DFO (unpublished) suggests that levels of sulphate deposition may be decreasing. This appears to be a real decrease (i.e., not simply a result of less total precipitation), but several years of data will be required to confirm the trend.

5 - Instream Uses

5 Instream Uses

5.1 Introduction

The demands for freshwater can be classified as either instream or withdrawal demands. Instream uses do not consume water, although they may alter the physical characteristics or water quality of rivers or lakes. Withdrawal demands, on the other hand, actually extract water.

Three instream uses are important in the study area. These are

- hydropower production
- recreation and tourism
- freshwater fishery.

These are discussed in this chapter. Only minor use is made of rivers for waste disposal (also an instream use). The few instances of this use in the study area are referred to in Chapter 4, Water Quality.

5.1.1 Hydroelectric Power Production

There are three major hydroelectric power plants in the study area, and two smaller installations. Deer Lake Power Company Limited operates a 125 MW plant at Deer Lake and a 9 MW plant at Corner Brook. Newfoundland and Labrador Hydro (NLH) operates a 127 MW plant at Cat Arm and a 75 MW plant at Hinds Lake. In addition, NLH operates a 440 kW minihydro plant at Roddickton.

The drainage areas for these plants are shown in Figure 5.1. Table 5.1 lists the pertinent data for each plant.

Table 5.1 shows that the utilization rate of the water at the three large plants is very high. At Deer Lake, the spill is less than 3 percent of the average annual flow and at Cat Arm it is less than 5 percent. At Hinds Lake there is no spill; the only water not used to produce energy is released for fisheries requirements. Corner Brook spills about 15 percent of the average annual flow. At Roddickton, spill is high, about 25 percent of the average annual flow, because there is no large reservoir.

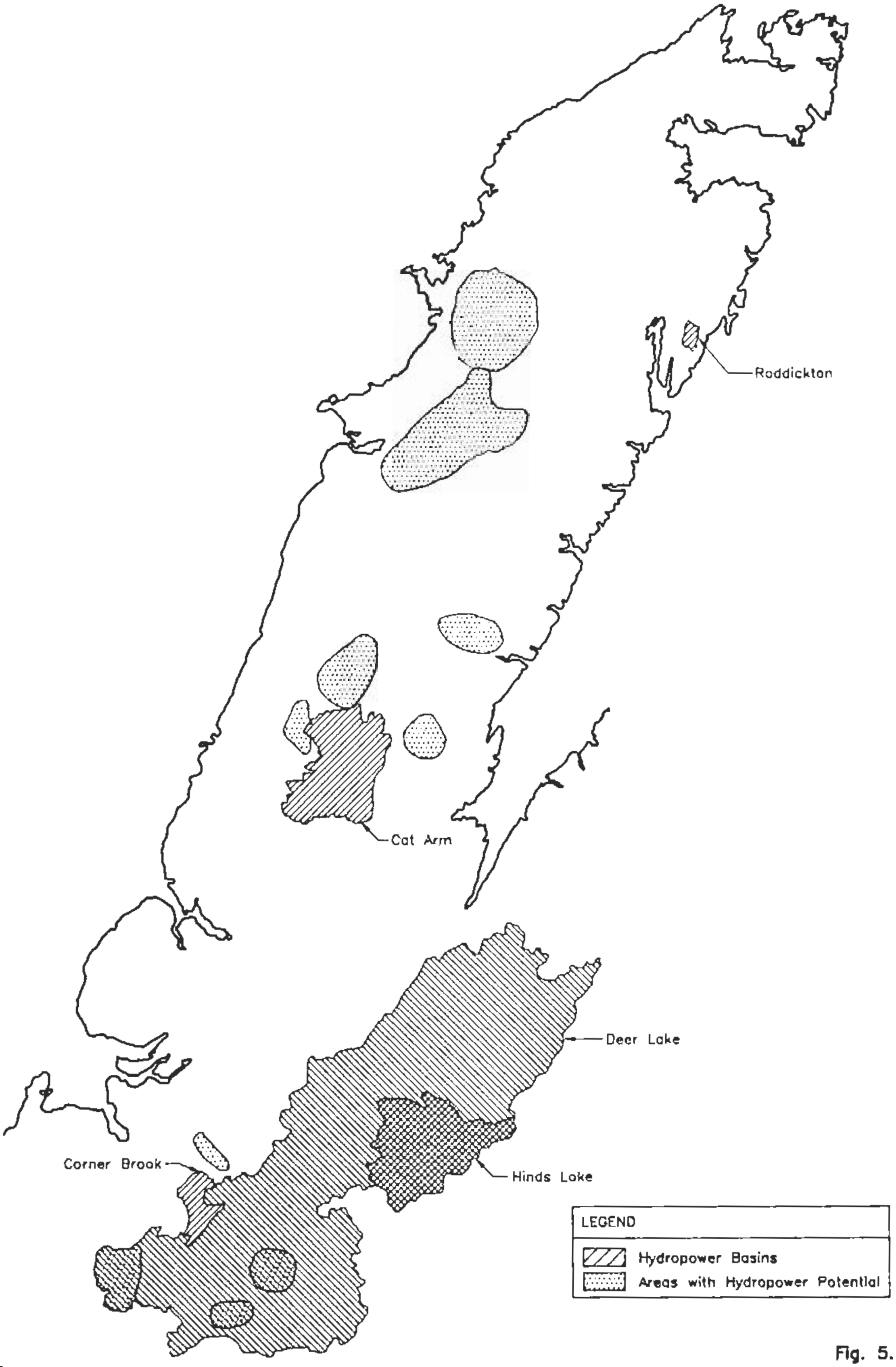


Fig. 5.1

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and Lands
Water Resources Division

Regional Water Resources Study
Northern Peninsula
Hydropower Basins

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Table 5.1

Characteristics of Existing Hydropower Stations

Plant	Deer Lake	Cat Arm	Hinds Lake	Roddickton	Corner Brook
Year Completed	1925	1985	1980	1980	1958
Capacity (MW)	125.	127.	75.	0.44	9.
Drainage Area (km^2)	5030.	632.	651.	23.	130.
Gross Head (m)	80.	390.	220.	46.9	150.
Average Annual Energy (GWh)	790.	745.	342.	1.05	43.
Average Annual Power Flow (m^3/s)	145.	25.6	20.0	0.52	3.64
Average Annual Spill (m^3/s)	3.8	1.2	0.4*	0.18	0.61

* Fisheries Compensation Requirement

5.1.2 Future Developments

Potential for future developments in the region is good because of the mountainous terrain and high amounts of precipitation. The part of the study area from the Upper Humber Valley north to Canada Bay is very well favoured, as is the area around Grand Lake.

The potential for small scale hydro development (1 MW to 20 MW) suitable for interconnection to the island power grid has been studied by NLH, first in an inventory study, then in a follow-up ranking study (27, 28). Sixteen sites in the study area were among the most attractive on the island, and are shown in Figure 5.1. Several other potential projects outside of the terms of reference of these studies have also been noted. These were either too large or too far from transmission lines to have been included in the inventory studies.

Barriers to development of hydropower sites are largely economic. Capital costs of those projects are high relative to annual benefits under present economic conditions. Since the most likely alternative to hydro is thermal generation, these projects will become economical when the cost of oil burning becomes high enough to offset the capital costs of these projects.

There are always environmental concerns with construction of a major project such as a hydropower station. The most likely concerns in the study area include the effects on recreation, fish (especially salmon) and wildlife. The screening study concluded that no project could be precluded because of environmental concerns; with careful design and good construction practices, the projects should be compatible with other uses. Hydropower projects are environmentally more attractive than alternative thermal projects because they do not produce atmospheric pollutants or greenhouse gases.

5.1.3 Value of Water Used to Produce Electricity

The value of water used for hydropower production can be determined from the value of the energy generated. Assuming that the hydro energy produced would be replaced by energy produced by burning Bunker C fuel at a thermal plant, the value of energy is about 3.3¢/KWh. The assumed fuel cost is $20/barrel, and the assumed net energy conversion rate is 600 KWh/barrel. On this basis, the value of water at each of the plants ranges from 0.2¢/m^3 to 4.4¢/m^3, as shown in Table 5.2. The wide range of values is a result of the different heads; the higher the head, the more energy per unit of water. The two extremes are represented by Deer Lake and Cat Arm. They both produce about the same amount of energy, but Deer Lake requires a much larger volume of water because the head is much lower (80 m compared with 390 m at Cat Arm).

Future hydro developments are likely to have values of water within this range, since they are unlikely to have heads lower than that at Deer Lake, nor higher than that at Cat Arm.

5.2 Recreation and Tourism

Newfoundland's recreation and tourism industry to a large extent takes advantage of people's enjoyment of nature. Many people like spending some time away from developed areas, in a relatively unspoiled environment. A key element associated with these unspoiled spaces is clean water.

Although it is difficult to document the use of water for recreation directly, its importance can be inferred from the map in Figure 5.2. It shows parks and other areas presently used for recreation, or identified as having recreational potential in the Canada Land Inventories (20). All of these are near water. Rivers and ponds at these sites provide a main attraction for boating, swimming or fishing, and for enhancing the aesthetic quality of campgrounds, picnic sites and hiking trails.

Table 5.2

Value of Water for Hydropower

Plant	Average Annual Energy (GWh)	Average Annual Power Flow Volume (Mm^3)	Annual Value of Energy ($M)	Annual Value of Water (¢/m^3)
Deer Lake	790.	4570.	26.1	0.57
Cat Arm	745.	810.	24.6	3.0
Hinds Lake	342.	630.	11.2	1.8
Roddickton	1.05	16.4	0.035	0.21
Corner Brook	43.	115.	1.42	1.2

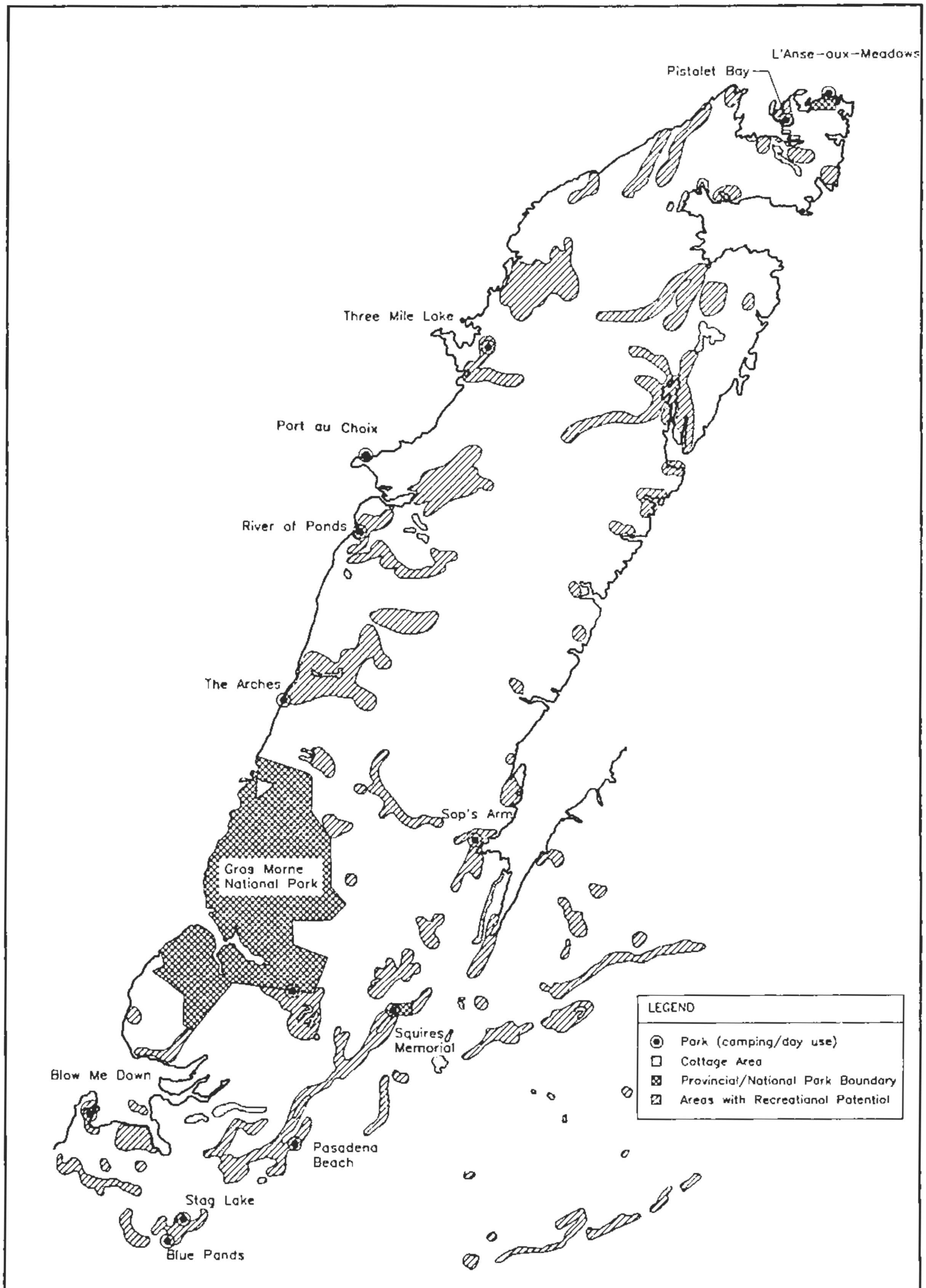

Fig. 5.2

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Regional Water Resources Study
Humber Valley and Northern Peninsula
Recreational Areas

ACRES

Many of these recreational users are residents, but about 20,000 people from outside the province visit the study area as well, according to unpublished statistics from the Department of Development and Tourism.

5.2.1 Gros Morne National Park

Gros Morne National Park is undoubtedly the key recreational attraction in the study area. Nearly 100,000 people visited the park in 1989. Its 1800 km^2 area includes both a coastal plain along the Gulf of St. Lawrence and an alpine plateau, the highlands region of the Long Range mountains. Although it is probably more the geology than the water resources which have given Gros Morne its heritage status, there is no doubt that the ponds, rivers and waterfalls contribute greatly both to its spectacular scenery and biotic richness.

One indicator of the value of the surface water is the popularity of the boat tour on Western Brook Pond. Last year (1989) it attracted nearly 9000 people, despite the fact that visitors had to hike into the pond. The number of people taking the boat tour has increased dramatically since 1982 when fewer than 1000 people took the tour, and boat tours are being planned at other more accessible locations.

5.2.2 Provincial Parks

The 13 provincial parks are also very popular. The first provincial park was established in the area in 1954, Squires Memorial on the Humber River at Big Falls. Through the 1960's, the emphasis was on establishing day use and camping parks near the Trans Canada Highway. In the early 1970's, the trend moved to beach and swimming areas away from the highway, and in the late 1970's, to natural scenic attractions and hiking trails. There are now 77 provincial parks.

In 1960, the total number of visitors to the provincial parks was just under 16,000; in 1988 it was over 400,000 per year.

The provincial parks in the study area and the number of visitors where available are shown in Table 5.3. Over the last five years, the number of visitors to these parks has been increasing by about 2 percent each year. Provincial Parks officials have noted that parks must be located near water in order to attract visitors.

Table 5.3

Provincial Parks

Park Name	Use	Number of Visitors
Pistolet Bay	Camping	12,078
River of Ponds	Camping	30,285
Squires Memorial	Camping	29,619
Sop's Arm	Camping	38,420
Blow Me Down	Camping	21,465
L'Anse Aux Meadows	Historic	-
Port Au Choix	Historic	-
Three Mile Lake	Day Use	-
Pasadena Beach	Day Use	9,680
Stag Lake	Day Use	3,800
The Arches	Scenic Attraction	-
Bottle Cove	Scenic Attraction	-

5.2.3 Water-Related Attractions

Other sources of information confirm the importance of water-related attractions for recreation and tourism. Some statistics extracted from a survey of out-of-province visitors presented in Table 5.4 show that visitors have a strong liking for water based activities, and for water related activities such as sightseeing and touring.

A recent Regional Tourism Study for the Northern Peninsula (north of Deer Lake) identified the anchor attractions, support attractions, and potential attractions in the area (13). The three anchor attractions on the Northern Peninsula are Gros Morne, L'Anse aux Meadows and Port-au-Choix; all three are national or provincial parks, as discussed above.

Table 5.4

Results from Survey of Nonresident Auto Visitors

Waterbased Activities	Percent Liking	Water Related Activities	Percent Liking
Canoeing	44.5	Camping	67.2
Fishing	61.0	Picnic/Lookout	80.9
Sailing/Boating	55.2	Sightseeing	90.8
Go to Beach	74.4	Photograph	85.8
Swimming (Beach)	74.7		

(Data provided by Department of Development and Tourism, Auto Exit Survey)

Among the support and potential attractions identified in the study, many are water-related. These include

- scheduled boat tours, advocated for several locations along the west coast and in the Roddickton-Conche area
- hiking trails
- hunting and fishing operations
- scenic lookouts
- power station at Deer Lake
- fish ladder at Hawkes Bay
- fisheries interpretation centre at Port-au-Choix.

The report concluded that there is a bright future for tourism in the area; clearly the water resources will play an important role in its development.

5.2.4 Value of Water Used for Recreation

It is difficult to quantify the importance of water resources to the recreation and tourism industry in the study area, but the information presented in the previous sections shows that water based activities and the presence of aesthetically pleasing rivers and ponds are attractive to both tourists and residents. The Department of Tourism has estimated that the annual total expenditure by nonresidents visiting the Humber Valley and Northern Peninsula is of the order of $12 million.

The Department of Tourism does not prepare forecasts, but their statistics show that the number of visitors from outside the province to the study area increased by nearly 7 percent per year over the 5 year period from 1983 to 1988. The Regional Tourism Study indicated that good growth can be expected, although because of shifting market trends, it is difficult to quantify.

The rivers, ponds and associated open spaces contribute to the regional economy by attracting visitors as well as encouraging residents to holiday at home. Good quality ponds, rivers and surrounding areas constitute an important economic resource both now and in the future.

5.3 Freshwater Fishery

The freshwater fishery is important for its contribution to recreation and tourism. It is discussed separately here, however, because of the inherent value in preserving natural fish and aquatic life.

The clean waters of the study area, together with good spawning and rearing areas, are well suited to salmon and trout. Species reported include sea-run salmon, sea-run brown and brook trout, resident brook trout and resident (land-locked) salmon, arctic char, ouananiche, stickleback, and others (31). Many of these are favorite sport fish. Their presence in the waters of the study area is important to residents and nonresidents, who derive considerable pleasure from angling, or simply from watching fish. The presence of healthy fish is an indication of good water quality to the public at large.

Table 5.5 lists the rivers of particular interest to DFO, either because they are scheduled salmon rivers, or because they have fishways or research projects (counting fences). But almost any river in the study area can support natural fish species and is therefore important to DFO.

Table 5.5

Rivers of Particular Interest for Fisheries

(Note: Almost all rivers can support natural species of fish and are important; the following list highlights those with particular projects, and identifies scheduled salmon rivers.)

Serpentine River and tributary streams	Scheduled Salmon river (SSR)
Cook's Brook	SSR
Humber River and tributary streams	SSR
Hughes Brook, trib to Hughes Brook	SSR, Counting fence, incubation facility
Goose Arm River	SSR
Trout River	SSR
Lomond Main River (East Arm, Bonne Bay), including East Branch	SSR, Fishway
Deer Arm River	SSR
Western Brook and tributary streams	SSR
Parsons Pond River and tributary streams	SSR
Portland Creek River including Brian's Feeder	SSR
Portland Creek Feeder and tributary streams	SSR
River of Ponds, including Kate's Feeder, Big Feeder Brook, Spring Tilt Brook (below Spring Tilt Pond), and Big Gulch Brook.	SSR
Little Brook Ponds and tributary streams	SSR
East River, Hawke's Bay	SSR
Torrent River and tributary streams	SSR, Fishway
Castor River including South West Feeder	SSR
St. Genevieve River, Ten Mile Lake, Round Lake, and all tributaries to Ten Mile Lake and Round Lake	SSR
West River, St. Barbe	SSR
East River, St. Barbe	SSR

Table 5.5

Rivers of Particular Interest for Fisheries (cont'd)

Big Brook, St. Barbe	SSR
Watson's Brook, St. Barbe Parker River (West Brook), Pistolet Bay	SSR
Bartlett's Brook and tributary streams, Pistolet Bay	SSR
East River, Pistolet Bay	SSR
Upper Brook, Milan Arm, Pistolet Bay	SSR
Pinsent's Brook, Pistolet Bay	SSR
Ariege or Salmon River including Southwest Brook and Rose's Brook, Hare Bay	SSR
Western Brook, Hare Bay	SSR
Northeast Brook and tributary streams, Canada Bay	SSR
Northwest Brook, Canada Bay	SSR
Western or Beaver Brook, Canada Bay	SSR
Easter Brook, Canada Bay	SSR
Cloud River, Canada Bay	SSR
Soufletts River, Harbour Deep	SSR
Little Harbour Deep	SSR
Coney Arm River	SSR
Sop's Arm River, including Main, Doucer's, Natlin's, Corner Brook and all tributary streams.	
Hampden River	SSR
North Brook near Deer Lake	Counting fence, possible enhancement
Bound's Brook near Bellburns	Counting fence, possible enhancement

5.3.1 Value of Water Used for Fisheries

The quantity, flow regime and quality of water and of the surrounding space are all important to the freshwater fishery. The value of the fishery in the study area arises from its economic contribution to tourism and recreation and in the inherent value of preserving natural fish and aquatic life.

A survey by DFO, in association with the provincial Department of Culture, Recreation and Youth, provides some information on sports fishing in Newfoundland (12). On the basis of the survey data, DFO estimates that in 1985 there were about 160,000 active anglers in the province (including children and non-residents). They caught over 12 million fish, weighing nearly 11 million pounds. Since each angler spent an average of 23 days fishing, angling is clearly a major recreational activity.

About 25 percent of the total effort, or about 40,000 anglers, was in the Humber Northeast and Northern Peninsula. Since that area includes the area between the Baie Verte and Eastport Peninsulas, the effort in the study area alone would be somewhat less (perhaps 20,000 to 30,000 anglers). Their estimated expenditure was about $9 million, and about 10 percent of that was by nonresidents.

The responses to the survey questions bear out the importance of the overall environment to fishing as well as to other recreational activities. Perhaps surprisingly, anglers ascribed little importance to catching the desired species or to the size or number of fish caught. They emphasized the importance of the beauty of the surroundings, the quality of the water, and the access to wilderness. They also appreciated the opportunity to fish for wild, not hatchery, fish. (The only hatchery enhancement program in Newfoundland is on the Exploits River.)

5.4 Potential Conflicts Among Instream Users

There are undoubtedly some potential conflicts among instream users, but to date no major problems have been reported. The freshwater fishery is the most sensitive to other uses, and is therefore likely to be the key issue in most conflicts. The potential conflicts are described below.

5.4.1 Fisheries - Hydropower Conflicts

Any hydropower project in the study area will affect fish habitat, since all rivers in the study area can support native species of fish. DFO must approve all projects, and usually requires mitigative measures to ensure that there is no net loss of habitat during and after construction. Some conflicts will remain, especially if large reservoirs are constructed, because these may lead to possible changes in water temperature and accumulation of mercury in fish tissues.

These conflicts are likely to arise in the areas with potential for hydropower development shown on Figure 5.1.

5.4.2 Fisheries - Recreation/Tourism Conflicts

Expenditures on the freshwater fishery are often justified because of the contribution the sports fishery makes to the economy. The environmental conditions desired by anglers are generally in agreement with those necessary to preserve natural fish and aquatic life. The main recreational attractions of the study area for most tourists, cottage owners and other residents are similar - unspoiled nature, clean water and fresh air.

Nevertheless, in their search for a clean environment people can degrade fish habitat, for example, through construction of roads and tourist facilities, and by use of all terrain vehicles. Anglers themselves can also create great pressure on the natural fish species by overfishing. So conflicts can arise between the protection of freshwater fish species and tourism/recreation.

The areas where these conflicts are likely to occur are shown on Figure 5.2, and along access roads to these areas.

Although it is not a competing instream use and thus is not discussed here, the offshore commercial salmon fishery should be noted as a possible large influence on the success of the freshwater sport salmon fishery.

5.4.3 Hydropower and Recreation/Tourism Conflicts

Hydropower and recreation uses are not likely to produce much conflict in the study area. The principal conflicts tend to occur when lakes with cottages are used as storage reservoirs. Lake levels may vary more than usual because of the hydropower operations. Hydropower projects also frequently take water from scenic rapids and waterfalls.

Hydropower projects can benefit recreational uses, by creating and providing access to lakes and areas which were previously inaccessible (e.g., Cat Arm), and by regulation to reduce flooding (e.g., Humber River). Power plants, dams and spillways are themselves often considered interesting attractions worth visiting.

None of the proposed hydropower projects is in a cottage area, so such conflicts are not likely to occur. (Compare Figures 5.1 and 5.2.) Of the existing projects, Grand Lake is the only lake controlled for hydropower that has cottages around it. The lake has been controlled for many years, and no conflicts are reported.

6 - Withdrawal Use: Supply/Demand Analysis by Community

6 Withdrawal Use: Supply/Demand Analysis By Community

This chapter assesses withdrawal uses for each town, incorporated community, and local service district in the study area and calculates a supply/demand ratio for each. The total withdrawal for all uses in the study area is estimated to be about 70 000 m^3/day. About 90 percent is estimated to be from surface sources.

The major withdrawal uses include

- Municipal water supply. An estimated average of about 50 000 m^3/day of water is withdrawn for domestic purposes. About 90 percent is from surface sources. Forty-seven of the towns, incorporated communities and local service districts in the study area have surface water supply systems; the other 18 use groundwater. Most of the remaining unincorporated communities use ground water or mixed systems.

- Industrial water supply. The total industrial demand is estimated to average about 30 000 m^3/day. Over half is from the City of Corner Brook. Almost all of the remainder is from the fish plants. Some fish plants have their own fresh or salt water supply systems or both; others draw from the municipal water supplies. There is considerable variation in consumption through the year because fish processing is not continuous.

- Rural residential supply. Very small communities, isolated homes and summer cottages obtain their water from local groundwater or surface sources. This withdrawal use represents only a very small percent of the total.

Figure 6.1 shows the locations of the towns, incorporated communities and local service districts in the study area. Detailed descriptions of the water supply systems for each of these communities (as well as some other small communities) and maps of the watersheds are provided in the Inventory of Water Supply Systems in Appendix D.

The purpose of this chapter is to compare present and projected demands with the available supply for each community. Slightly different approaches were required for communities with surface water systems than for those with groundwater systems. The methods and assumptions used to obtain the estimates of demand and supply are described in the following sections.

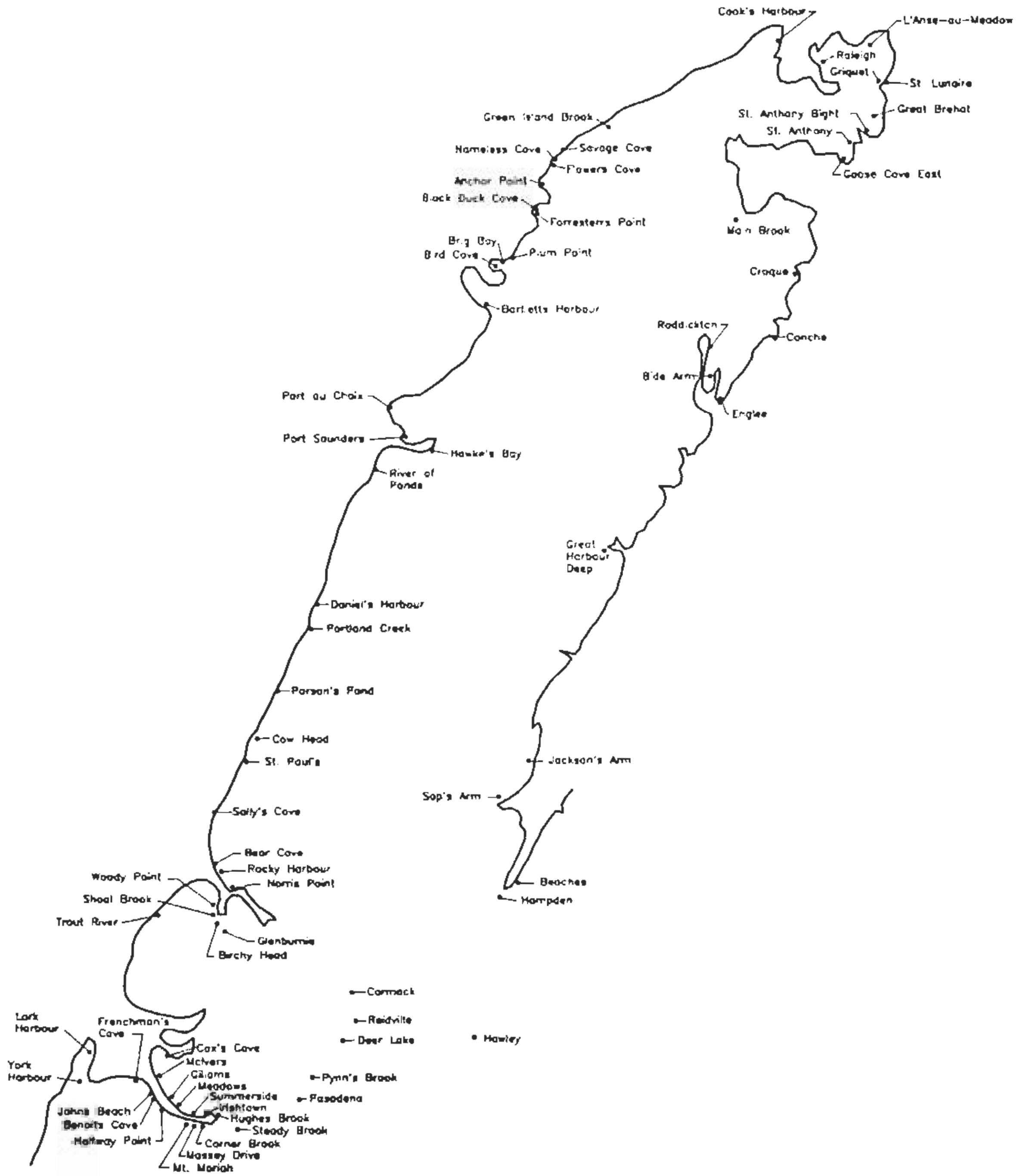

Fig. 6.1

Department of Environment and Lands
Water Resources Division

Regional Water Resources Study
Humber Valley and Northern Peninsula

Locations of Communities

6.1 Demand and Supply Assumptions

6.1.1 Demand

Domestic Demand

Domestic demand was calculated by applying a per capita demand rate to population. The rate chosen was 0.52 m^3/d per capita based on available data for communities in the study area from the Municipal Water Use Data Base (MUD). This rate was increased to 0.82 m^3/d per capita for the larger communities which serve as regional centers, to account for the increased commercial, institutional and small industrial demands.

The demand rate is assumed to remain the same to the end of the 25 year planning period. Any increase in demand (e.g. resulting from a higher standard of living) is assumed to be balanced by improvements in the systems to reduce losses.

These demand rates were applied to 1986 population figures to estimate present demand, and to projected populations in 25 years (2014) for future demand. The population growth rate was calculated from recent trends in each community. These rates range from 4 percent per intercensal period (5 years) for the fastest growing towns to no increase for some small rural communities.

A check was then made on the total projected population to ensure that it matched overall provincial estimates. In the opinion of DMPA officials, the provincial estimates are high; a high estimate is desirable for water supply evaluations to be sure that the supply will be adequate. Table 6.1 shows the past, present and projected populations of the communities in the study area.

Table 6.1
Population

Community	Historic				Projected
	1971	1976	1981	1986	2014
Anchor Point	295	329	368	387	457
Bartlett's Harbour			159	177	209
Beaches			134	124	124
Bear Cove			195	206	243
Bide Arm	278	305	339	341	375
Bird Cove			183	195	230
Black Duck Cove			400	394	394
Brig Bay			183	189	223
Conche	505	431	464	408	408
Cook's Harbour	325	326	388	390	412
Cormack	560	672	788	773	773
Corner Brook	26309	25198	24339	22719	24694
Cow Head	575	650	695	708	785
Cox's Cove	797	1004	980	999	1112
Croque			147	156	184
Daniel's Harbour	415	579	614	566	566
Deer Lake	4421	4546	4248	4233	4995
Englee	1050	989	998	1012	1194
Flower's Cove	372	436	459	417	417
Forrester's Point			268	289	341
Gillams	371	491	488	512	604
Glenburnie and Others			422	368	368
Goose Cove East	349	339	368	373	402
Great Brehat	329	303	120	129	152
Great Harbour Deep	329	303	278	245	245
Green Island Brook			274	309	365
Halfway Point and Others	1912	2144	2214	2182	2182
Hampden	739	780	838	875	1033
Hawke's Bay	462	489	553	547	547
Howley	409	404	456	393	393
Hughes Brook	28	114	128	141	166
Humber Village			62	70	83
Irishtown	502	707	742	798	942
Jackson's Arm			623	652	769
Lark Harbour			66	74	87
L'Anse aux Meadows	590	771	783	829	978
Main Brook	590	551	514	526	599
Massey Drive	370	381	409	415	450
McIvers	671	389	736	738	749
Meadows	516	642	656	671	762

Table 6.1 (con't)
Population

Community	Historic				Projected
	1971	1976	1981	1986	2014
Mount Moriah	639	703	751	692	692
Nameless Cove			110	110	110
Norris Point	986	1065	1033	1010	1010
Parson's Pond	491	544	605	589	589
Pasadena	964	1850	2685	3268	4529
Pidgeon Cove-St. Barbe			170	183	216
Port aux Choix	861	1141	1311	1291	1291
Port Saunders	637	691	769	822	970
Pynn's Brook			104	95	95
Raleigh	292	333	373	390	460
Reidville	253	358	413	504	628
River of Ponds	258	290	304	326	385
Rocky Harbour	982	1267	1273	1268	1268
Roddickton	1239	1234	1142	1223	1443
Sally's Cove	298	188	100	58	58
Savage Cove			326	355	419
Sop's Arm			357	445	525
Spillway			239		239
Steady Brook	288	292	377	386	441
St. Anthony	2593	2987	3107	3182	3637
St. Anthony Bight			214	231	273
St. Lunaire-Griquet	825	921	1010	1013	1030
St. Paul's	347	456	454	497	586
Summerside	603	830	848	798	798
Trout River	689	784	759	771	842
Woody Point	500	529	482	444	444
York Harbour	264	330	346	371	438

Table 6.2
Estimated Reliable Yield for Surface Supplies – Unregulated

Community	Water Source	Pond Area (km²)	Live Stor. Head (m)	Drainage Area (km²)	Stor. Vol. (Mm³)	Mean Annual Runoff (mm)	Mean Annual Q Vol. (Mm³)	Stor. Ratio (2)	Yield ratio (2)	Yield (m³/day)
Anchor Point	Well Cove Pond	0.11	0.70	7.00	0.077	800	5.6	0.01	0.00	656
Brig Bay	Inner Gilmor Pd	0.46	1.00	10.10	0.460	800	8.08	0.06	0.00	947
Beaches	Grassy Pond Brook	0.00	0.00	1.51	0.000	500	0.755	0.00	0.00	88
Corner Brook (1)	Trout Pond	0.05	1.50	113.0	0.075	1100	124.3	0.00	0.00	14565
Corner Brook (1)	Second Pond	0.06	4.00	11.00	0.240	1100	12.1	0.02	0.00	1418
Cox's Cove (Alt 1)	Barachois Brook	0.00	3.50	5.72	0.000	1200	6.864	0.00	0.00	804
Glenburnie & Others	Croucher's Brook	0.00	0.00	2.38	0.000	1300	3.094	0.00	0.00	363
Great Brehat	Little Steady Pond	0.01	0.00	2.34	0.000	800	1.872	0.00	0.00	219
Great Harbour Deep	Bottom & NW Bottom Brook	0.00	0.00	9.47	0.000	800	7.576	0.00	0.00	888
Green Island Brook	Green Island Brook	0.00	0.00	29.80	0.000	800	23.84	0.00	0.00	2794
Halfway Pt & Others	Clark's Brook	0.00	0.70	21.36	0.000	800	17.088	0.00	0.00	2002
Hampden	Elliot Brook	0.00	2.00	6.67	0.000	600	4.002	0.00	0.00	469
Hawke's Bay	Torrent River	0.00	0.00	624.0	0.000	1000	624	0.00	0.00	73120
Irishtown	Irishtown Brook	0.00	0.00	6.31	0.000	1100	6.941	0.00	0.00	813
Jackson's Arm	Lush's Pond & others	0.20	1.00	11.20	0.200	800	8.96	0.02	0.00	1050
McIvers	Feeder Brook	0.00	0.00	3.74	0.000	1100	4.114	0.00	0.00	482
Port Saunders	Tom Taylors Pond	0.44	2.50	31.62	1.100	800	25.296	0.04	0.00	2964
Reidville	Humber River	0.00	0.00	2110	0.000	1000	2110	0.00	0.00	247250
Rocky Harbour	Gull Pond	0.19	3.00	14.90	0.561	800	11.92	0.05	0.00	1397
Roddickton	East Pond	0.97	1.50	40.30	1.455	1000	40.3	0.04	0.00	4722
Sop's Arm (Proposed)	Long Steady	0.09	0.50	11.79	0.045	600	7.074	0.01	0.00	829
Steady Brook	Steady Brook Lake	0.00	1.75	70.50	0.000	1100	77.55	0.00	0.00	9087
St. Lunaire–Griquet	Joe's Pond	0.30	0.80	6.63	0.240	900	5.967	0.04	0.00	699
Trout River	Feeder Brook	0.00	0.00	21.00	0.000	800	16.8	0.00	0.00	1969
Woody Point	Winter House Brook	0.00	1.00	12.30	0.000	800	9.84	0.00	0.00	1153

(1) Trout Pond and Second Pond are intake ponds for the Corner Brook system.
Corner Brook Lake (upsteam) provides regulation – see text.

(2) See Section 6.1.2, for a detailed explanation and sample calculation of storage ratio, see Section 2.5.

Table 6.3
Estimated Reliable Yield for Surface Supplies – Regulated

Community	Water Source	Pond Area (km²)	Live Stor. Head (m)	Drainage Area (km²)	Stor. Vol. (Mm³)	Mean Annual Runoff (mm)	Mean Annual Q Vol. (Mm³)	Stor. Ratio (1)	Yield ratio (1)	Yield (m³/day)
Bartlett's Harbour	Big Pond	3.43	0.70	14.70	2.401	800	11.76	0.20	0.40	12879
Bide Arm	First Clay Pond	0.03	2.50	0.72	0.075	900	0.648	0.12	0.26	458
Bird Cove	Ferrole Marsh Pond	0.34	0.50	1.52	0.170	800	1.216	0.14	0.29	979
Black Duck Cove	Local Pond and GW	0.04	1.10	0.54	0.044	800	0.4344	0.10	0.24	285
Conche (Proposed)	Martins Brk (future)	0.00	0.00	0.86	0.091	800	0.688	0.13	0.29	554
Cow Head	Short Cat Path Pond	0.30	1.00	1.39	0.300	800	1.112	0.27	0.47	1437
Cox's Cove (Alt 2)	Cox's Brook	0.09	3.50	0.48	0.315	1200	0.576	0.55	0.70	1104
Deer Lake	Grand Lake (1)	n/a	n/a	5030	0.000	1000	5030	0.00	0.00	589415
Englee	Island Cove Pond	0.31	2.00	2.01	0.620	800	1.608	0.39	0.58	2571
Flower's Cove	French Island Pond	1.18	1.65	14.80	1.947	800	11.84	0.16	0.34	11151
Forrester's Point	Rudge's Pond	0.16	1.50	1.62	0.240	800	1.296	0.19	0.37	1320
Gillams	Jackie Tapp's Brook	0.04	3.50	1.20	0.123	1200	1.44	0.09	0.21	820
Goose Cove East	Jack's Pond	0.03	3.00	1.24	0.102	800	0.992	0.10	0.24	652
Howley	Sandy Lake (1)	n/a	5.00	5030	0.000	1000	5030	0.00	0.00	589415
Main Brook	Joe Burts Pond	0.36	1.53	3.18	0.551	900	2.862	0.19	0.39	3025
Meadows	Meators Pond	0.07	3.50	2.20	0.245	1200	2.64	0.09	0.22	1619
Norris Point	Neddy Harbour Pond	0.16	2.00	1.30	0.314	800	1.04	0.30	0.50	1481
Pasadena	Blue Gulch Pond	1.67	0.70	11.00	1.169	1000	11	0.11	0.24	7228
Port aux Choix	Winterhouse Pond	0.19	1.00	1.27	0.189	800	1.016	0.19	0.37	1035
River of Ponds	Burnt Head Pond	0.19	1.50	1.44	0.285	800	1.152	0.25	0.45	1413
Sop's Arm (existing)	Existing Supply	0.03	2.50	0.50	0.075	600	0.3	0.25	0.46	378
St. Anthony	St. Anthony Pond	0.34	2.00	4.56	0.680	900	4.104	0.17	0.34	3865
St. Anthony	Frenchman's Pond	0.60	2.00	4.50	1.200	900	4.05	0.30	0.50	5500
St. Anthony Bight	Cat Box Pond	0.02	1.50	0.41	0.030	900	0.369	0.08	0.21	210
St. Paul's	Two Mile Pond	2.14	1.00	5.31	2.140	800	4.248	0.50	0.70	8141

(1) Yield for Grand Lake has been conservatively taken on the natural flow (0.0428 x Qavg)
Estimated reliable yield from Deer Lake Power Co. Ltd. is 12.7 million m³/day.

(2) See Section 6.1.2, for a detailed explanation and sample calculation of storage ratio, see section 2.5.

Table 6.4
Results of Supply Demand Analysis
Communities Served by Surface Water

Community	Population 1986	Population 2014	Demand (m3/d) Domestic 1986	Demand (m3/d) Domestic 2014	Demand (m3/d) Industrial	Total 1986	Total 2014	Supply (m3/d)	Supply/Demand Ratio 1986	Supply/Demand Ratio 2014	
Anchor Point	387	457	201	237		201	237	656	3.3	2.8	
Bartlett's Harbour	177	209	92	109	200	292	309	12879	43	42	
Beaches	124	124	64	64		64	64	88	1.4	1.4	
Bide Arm	341	375	177	195		177	195	458	2.6	2.4	
Bird Cove	195	230	101	120		101	120	979	9.7	8.2	
Black Duck Cove	577	610	300	317		300	317	285	0.9	0.9	*
Brig Bay	189	223	98	116		98	116	947	9.6	8.2	
Corner Brook (1)	23826	25836	19537	21185	11437	30974	32623	242000	7.8	7.4	
Cow Head	708	785	368	408	1000	1368	1408	1437	1.1	1.0	
Cox's Cove, Cox's Brk	999	1112	519	578	71	590	649	1104	1.9	1.7	
Cox's Cove, Barachois Brk	999	1112	519	578	71	590	649	804	1.4	1.2	
Deer Lake (2)	4472	5234	3667	4292	158	3825	4450	589415	154	132	
Englee	1012	1194	526	621	1500	2026	2121	2571	1.3	1.2	
Flower's Cove	417	417	217	217	0	217	217	11151	51	51	
Forrester's Point	289	341	150	177		150	177	1320	8.8	7.4	
Gillams/Meadows	1183	1366	615	710		615	710	2439	4.0	3.5	
Glenburnie	200	200	104	104		104	104	363	3.5	3.5	
Goose Cove East	373	402	194	209		194	209	652	3.4	3.1	
Great Brehat	129	152	67	79		67	79	219	3.3	2.8	
Great Harbour Deep	245	245	127	127	200	327	327	888	2.7	2.7	
Green Island Brook	309	365	161	190	200	361	390	2794	7.7	7.2	
Halfway Pt. and Others	2182	2182	1135	1135	300	1435	1435	2002	1.4	1.4	
Hampden	875	1033	455	537		455	537	469	1.0	0.9	*
Hawke's Bay	647	547	284	284	200	484	484	73120	151	151	
Howley	393	393	204	204		204	204	589415	2884	2884	
Irishtown	798	942	415	490		415	490	813	2.0	1.7	
Jackson's Arm	652	769	339	400	600	939	1000	1050	1.1	1.0	
Main Brook	526	599	274	311	200	474	511	3025	6.4	5.9	
McIvers	738	749	384	390		384	390	482	1.3	1.2	
Norris Point	1010	1010	525	525		525	525	1481	2.8	2.8	
Pasadena	3268	4529	1699	2355	400	2099	2755	7228	3.4	2.6	
Port aux Choix	1291	1291	1058	1058	273	1332	1332	1035	0.78	0.78	
Port Saunders	822	970	427	504		427	504	2964	6.9	5.9	
Reidville	504	628	262	326		262	326	247250	943	757	
River of Ponds	326	385	170	200	200	370	400	1413	3.8	3.5	
Rocky Harbour	1268	1268	659	659	200	859	1240	1397	1.6	1.1	
Roddickton	1223	1443	636	750	200	836	950	4722	5.6	5.0	
St. Anthony	3182	3637	2609	2982	4500	7109	7482	3865	0.5	0.5	*
St. Anthony (with backup)	3182	3637	2609	2982	4500	7109	7482	9365	1.3	1.3	
St. Anthony Bight	231	273	120	142		120	142	210	1.7	1.5	
St. Lunaire–Griquet	1013	1030	527	536		527	536	699	1.3	1.3	
St. Paul's	497	586	258	305		258	305	8141	32	27	
Sop's Arm (existing)	445	525	231	273	200	431	473	378	0.9	0.8	*
Sop's Arm (proposed)	445	525	231	273	200	431	473	829	1.9	1.8	
Steady Brook	386	441	201	229	94	295	323	9087	31	28	
Trout River	771	842	401	438	200	601	638	1969	3.3	3.1	
Woody Point	444	444	231	231	400	631	631	1153	1.8	1.8	

Notes:
- * S/D ratio less than 1.0

(1) Includes Mount Moriah and Massey Drive.

(2) Includes population of community of Spillway.

Industrial Demand

Estimates of industrial water demand were required for the industries in Corner Brook and for the fish processing plants.

Industrial water data for the City of Corner Brook were taken from the MUD. Marble Mountain Ski Resort has a private line connected to the Steady Brook water supply for the Town of Steady Brook and officials at the resort provided an estimate of the water use.

There are about 45 fish plants in the study area and about half of them (24) use some fresh water from the municipal supply. Most plants do not use large amounts of fresh water, either because they use salt water, or because their type of process does not need much water (e.g. feeder plant). The exceptions are the two St. Anthony plants, which use large volumes of fresh water. The plants that do not share a fresh water supply with the community usually have their own well for domestic uses.

Information on the fish plants was obtained from several sources. These included MUD (2 plants), a data base provided by DOEL (44 plants, but data incomplete) and a telephone survey (about 25 plants). Water use data were available, or could reasonably be estimated, for 9 plants. Total estimated daily use ranged from about 50 m^3/day to close to 5000 m^3/day on peak days at St. Anthony. Use generally ranged from about 160 m^3/day to perhaps 300 m^3/day.

Water use data were used where available for the supply/demand analysis. Otherwise, the water use was assumed to be the same as that of a plant processing similar species. A figure of 200 m^3/day was usually used for a medium sized plant processing a variety of species, similar to the plants in Benoit's Cove, Corner Brook (2 plants), and Roddickton.

DMPA planners expect little if any growth in the region, so no increase is assumed in industrial water use. If large volumes of fresh water were available, however, some fish plants might switch from salt water to fresh.

Because the estimates are recognized as very approximate at best, the industrial (fish plant) demand has been kept separate from the municipal demand in the analysis. As more fish plant data become available, or if in fact other industries start up, the effects on the supply/demand ratio can readily be identified.

6.1.2 Supply

Surface Systems

The available supply or yield was estimated using the methods developed in Chapter 2. The surface systems fall into one of two categories, unregulated (run of river) or regulated (with storage), although some systems combine run of river with some storage. About half are regulated and half unregulated. The yield for each of the two categories was obtained as follows.

Run of river systems: For run of river systems, with little storage other than natural ponds, the yield was based on the mean of the seven day low flow having a return period of 1:10 years (from Table 2.5). Many of the basins used for water supply are much smaller than the rivers used in the regional low flow analysis, so the regional average was therefore reduced by one standard deviation, i.e., the reliable yield was taken as 4.9 percent of the annual mean flow. Table 6.2 shows the estimated yield from these systems.

Regulated systems: For systems with storage, the storage yield curve presented in Figure 2.10 was used to estimate the reliable yields. If the ratio of storage volume to mean annual flow volume was less than 0.075, the system was assumed to be run of river.

Table 6.3 shows the estimated yield for the systems with storage. The storage volume is calculated from pond area and live storage head. The mean annual flow volume is calculated from the mean annual runoff and drainage area. The storage ratio is the ratio of the two volumes, and the yield ratio is taken from Fig. 2.10. The daily yield is then obtained by multiplying the yield ratio by the mean annual flow volume.

Groundwater Systems

Eighteen of the incorporated communities and local service districts in the study area use groundwater, usually from private wells serving individual homes. A few community wells sometimes serve groups of homes. Spring fed ponds or reservoirs are considered to be groundwater supplies in this chapter.

Information on yields from groundwater supply systems during dry periods is not available, but an indication of reliability can be obtained from reported performance, particularly in the last few years, some of which have been dry. In absence of other information, the reported adequacy of a groundwater system is used here as an indicator of the adequacy of the groundwater source.

6.2 Detailed Supply/Demand Analysis by Community

This section of the report contains an analysis of the present and projected supply/demand situation for each individual community in the study area. Present and projected supply/demand ratios are estimated for each community that draws water from surface supplies. Present and forecast demands are estimated for each community that is supplied by groundwater.

The purpose of this section is to assess whether the water sources can supply an adequate quantity of water. Where other problems occur, e.g., with the distribution systems or with water quality, these may be mentioned here, but the focus is on whether or not a sufficient quantity of water is available. Further general information on the community water supplies and distribution systems can be found in the Inventory in Appendix D.

Table 6.4 summarizes the supply/demand results for the communities with surface water supplies, and Table 6.5 for those with groundwater supplies. Detailed results are presented in the following sections.

Table 6.5
Results of Supply/Demand Analysis
Communities with Groundwater Supplies

Community	Population 1986	Population 2014	Demand (m3/d) Domestic 1986	Demand (m3/d) Domestic 2014	Adequacy
Bear Cove	206	243	107	126	No
Black Duck Cove	577	610	300	317	No
Conche	408	408	212	212	No
Cook's Harbour	390	412	203	214	Yes
Cormack	773	773	402	402	No
Croque	156	184	81	96	No
Daniel's Harbour	566	566	294	294	Yes
Hughes Brook	141	166	73	87	Yes
Lark Harbour	74	87	38	45	No
L'Anse aux Meadows	829	978	431	509	Yes
Nameless Cove	110	110	57	57	No
Parson's Pond	589	589	306	306	Yes
Pynn's Brook	95	95	49	49	No
Raleigh	390	460	203	239	Yes
Sally's Cove	58	58	30	30	Yes
Savage Cove	355	419	185	218	No
Summerside	798	798	415	415	No
York Harbour	371	438	193	228	Yes

Note: Groundwater supplies include spring-fed reservoirs.
Some systems indicated as inadequate are presently being upgraded. See text.

6.2.1 Anchor Point

The Community of Anchor Point is served by water pumped from a surface supply at Well Cove Pond. The fish plant in the community obtains fresh water from a private supply. Present and future demand and reliable yield are estimated as follows.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	387	201	---	201	656	3.3
2014	457	237	---	237	656	2.8

Although the quantity of water should be sufficient, the present supply is not adequate because the pond is shallow and freezes to the bottom in winter. There are also leaks in the distribution piping. DMPA indicates that the freezing problem can be alleviated by construction of a proposed dam with a higher crest. Replacement of the distribution piping will reduce leaks.

6.2.2 Bartlett's Harbour

The Local Service District of Bartlett's Harbour obtains water from a surface supply pumped from Big Pond. The watershed is small, the quality is poor and the dam leaks. A joint supply (with the fish plant) from Doctor's Pond has been proposed. The estimates of present and future demand and reliable yield in the following table show that the supply would be abundant.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	177	92	200	292	12 879	44
2014	209	109	200	309	12 879	42

At present, the local fish plant uses salt water, and fresh water from a private groundwater supply.

6.2.3 The Beaches

The Local Service District of The Beaches draws its water from a small reservoir created by a small dam near the mouth of Grassy Brook. The supply is sufficient, as shown in the table below.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	124	64	---	64	88	1.4
2014	124	64	---	64	88	1.4

6.2.4 Bear Cove

The Local Service District of Bear Cove is served by groundwater from private wells. The present supply is not adequate. The following table shows the present and projected community demand.

Year	Population	Demand (m^3/d)
1986	206	107
2014	243	126

Two wells were drilled early in 1990 and are expected to rectify the water shortage; each well will serve about half the community.

6.2.5 Bide Arm

The Community of Bide Arm draws its water from a surface supply at First Clay Pond, which is locally known as Drinking Pond. First Clay Pond is supplied from Second Clay Pond. The supply is adequate, as shown in the table below, but water must be pumped to the community in winter from a deeper part of the pond because the pond freezes.

Year	Pop'n	Demand Municipal (m³/d)	Ind. (m³/d)	Total (m³/d)	Yield (m³/d)	S/D Ratio
1986	341	177	---	177	458	2.6
2014	375	195	---	195	458	2.4

The community plans to divert water from Second Clay Pond to ensure security of supply, and to eliminate pumping. There are also plans for dam improvements.

6.2.6 Bird Cove

The water source for the Community of Bird Cove is Ferolle Marsh Pond. Present and future demand and reliable yield are estimated as follows.

Year	Pop'n	Demand Municipal (m³/d)	Ind. (m³/d)	Total (m³/d)	Yield (m³/d)	S/D Ratio
1986	195	101	---	101	979	9.7
2014	230	120	---	120	979	8.2

Despite the high supply/demand ratio, community residents at the end of the water line experience shortages because the existing line is too small, and the pump capacity is inadequate. DMPA has recommended improvements to the pumping and distribution systems.

6.2.7 Black Duck Cove and Pidgeon Cove-St. Barbe

The Local Service District of Black Duck Cove draws its water from two community groundwater wells and a spring fed surface water supply shared with the Community of Pidgeon Cove-St. Barbe. The fish plant in Black Duck Cove draws water from a private artesian well.

The supply is inadequate for the entire community. Leaks in the system and freezing of the pond in winter reduce the supply as well.

Black Duck Cove, Forresters Point and Pidgeon Cove-St. Barbe applied for funding in May 1988 for a regional supply using Rudges Pond which presently supplies Forresters Point. The estimated demand from Black Duck Cove and Pidgeon Cove-St. Barbe is shown in the following table. This joint supply would be adequate for all three communities (see Forresters Point).

Year	Pop'n	Demand (m^3/d)
1986	577	300
2014	610	317

6.2.8 Brig Bay

The Local Service District of Brig Bay obtains its water from Inner Gilmor Pond, a large but shallow pond north of the community. The supply is adequate, as shown in the following table.

		Demand				Yield
Year	Pop'n	Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	(m^3/d)	S/D Ratio
1986	189	98	---	98	947	9.7
2014	223	116	---	116	947	8.2

6.2.9 Conche

Residents of the Community of Conche are presently served by groundwater from shallow private wells and community artesian wells. There are three community wells in Conche, as well as one in nearby Crouse. The local fish plant has its own fresh water well. Water quality is poor, and a water supply study is presently being carried out. One suggested water source is Martin's Brook (reported yield 674 m^3/day). This supply should be sufficient to service Conche and southwest Crouse.

Present and future domestic demand estimates for a new water supply system are given below.

Year	Population	Demand (m^3/d)
1986	408	212
2014	408	212

6.2.10 Cook's Harbour

The Town of Cook's Harbour is served by groundwater; a "boiling hole" feeds a reservoir. The present and projected community populations and their associated water demands are tabulated below.

Year	Population	Demand (m^3/d)
1986	390	203
2014	412	214

The quantity of water appears to be adequate, but in winter the reservoir freezes over. Town officials solve the problem by pumping from below the ice during the winter. There are also leaks in the distribution system and in the dam. The fish plant places the greatest demand on the supply during the three months of the year that it is in operation.

The town's five year plan proposes a permanent intake at Saltwater Pond Spring (a second boiling hole) with a line running under Salt Pond to connect with the southern end of the community's distribution system.

6.2.11 Cormack

Residents in the Community of Cormack obtain their water from private shallow and artesian wells some of which occasionally run dry. Cormack would be expensive to service because it is spread out along the road. The present and projected populations and associated demands on a community-wide service would be as follows.

Year	Population	Demand (m^3/d)
1986	773	402
2014	773	402

6.2.12 Corner Brook

The main water source for the City of Corner Brook is Trout Pond, with Three Mile Pond and Burnt Pond serving as a backup. The Corner Brook system serves the Towns of Massey Drive and Mount Moriah. A second system from Second Pond, Third Pond and Burnt Pond serves Curling, O'Connell Drive, Country Road Industrial Park and Sunnyslope Drive.

A large degree of regulation is provided by Corner Brook Lake, operated by Deer Lake Power Co. Ltd. Deer Lake Power estimates the reliable yield at 2.8 m^3/s, or about 242,000 m^3/s. This supply is ample for the town, as shown in the following table.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	23 826	19 537	11 437	30 974	242 000	7.8
2014	25 836	21 185	11 437	32 623	242 000	7.4

6.2.13 Cow Head

The Town of Cow Head is served by a surface water system which consists of a gravity supply from an intake behind a dam on Short Cat Path Pond. These are two fish plants in the town; one uses water from the municipal supply, the other is primarily a salt water user.

The present water supply system is just adequate for present domestic and industrial water requirements as shown in the table below.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	708	368	1000	1368	1437	1.1
2014	785	408	1000	1408	1437	1.0

According to the Inventory of Water Supply Systems, low pressures and small pipe sizes limit the potential for industrial expansion. The municipality's five year plan proposes a new supply from Big Pond.

6.2.14 Cox's Cove

The present sources of water for the Community of Cox's Cove are groundwater from two community wells and surface water from a reservoir known as Rocky Bog, which was formed by damming a local brook. The supply is inadequate even when the local fish plant, which draws some of its water from the municipal supply, is closed.

Two proposals are being considered by the town to improve the local water supply. The first is a gravity system from Barachois Brook to supplement the existing system and the second is a gravity system on Cox's Brook, which drains Frenchman's Pond. There is some conflict because of existing cabins on Frenchman's Pond. Either of these schemes would provide an adequate supply of water, although Cox's Brook would provide a more secure supply. Present and future demand and reliable yield for each proposal are estimated as follows.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)
1986	999	519	71	590
2014	1112	578	71	649

Barschois Brook			Cox's Brook	
Year	Estimated Yield	S/D Ratio	Estimated Yield	S/D Ratio
1986	804	1.4	1104	1.9
2014	804	1.2	1104	1.7

6.2.15 Croque

The Local Service District of Croque has no municipal water supply system. DMPA recommends constructing a community well. The present and future demands are estimated in the following table.

Year	Population	Demand (m^3/d)
1986	156	81
2014	184	96

6.2.16 Daniel's Harbour

Originally, the water system for the Community of Daniel's Harbour water system consisted of water drawn from a small stream fed by a large bog and two small ponds. In the early 1980's, the community developed a new spring fed source approximately 0.5 km from the original intake. Both of these systems are used for the community supply, with the older system supplementing the spring fed supply.

The supply is reported to adequate, and with no growth expected, the systems should continue to be sufficient for community demands.

Year	Population	Demand (m^3/d)
1986	566	294
2014	566	294

6.2.17 Deer Lake

The Town of Deer Lake obtains its water from Grand Lake, which serves as a reservoir for Deer Lake Power Company Limited. Due to the large size of the watershed and the high degree of regulation for hydroelectric operation, there is ample water for the town as shown in the first table below. This supply has been proposed for neighboring communities such as Reidville and St. Jude's. The second table below shows that the supply can accommodate these communities.

		Demand (Deer Lake and Spillway)			**Yield**	
Year	**Pop'n**	**Municipal** (m^3/d)	**Ind.** (m^3/d)	**Total** (m^3/d)	(m^3/d)	**S/D Ratio**
1986	4472	3667	158	3825	589 415	154
2014	5234	4292	158	4450	589 415	132

	Demand (Deer Lake, Spillway, Reidville and St. Jude's)					
Year	**Pop'n**	**Municipal** (m^3/d)	**Ind.** (m^3/d)	**Total** (m^3/d)	**Yield** (m^3/d)	**S/D Ratio**
1986	5176	4244	158	4402	589 415	134
2014	6062	4971	158	5129	589 415	115

6.2.18 Englee

The fresh water supply for the Community of Englee is a gravity system from Island Cove Pond which also serves the local fish plant. There is sufficient water to meet the municipal and industrial demands of the community, as shown in the table below.

		Demand			**Yield**	
Year	**Pop'n**	**Municipal** (m^3/d)	**Ind.** (m^3/d)	**Total** (m^3/d)	(m^3/d)	**S/D Ratio**
1986	1012	526	1500	2026	2571	1.3
2014	1194	621	1500	2121	2571	1.2

6.2.19 Flower's Cove

Residents of the Town of Flower's Cove obtain water pumped from French Island Pond. The water supply is adequate as shown in the table below. Nameless Cove is to be connected to this system. There will be ample water for both communities, as shown in the table below.

Year	Pop'n	Demand (with Nameless Cove) Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield S/D (m^3/d)	Ratio
1986	527	274	---	274	11 151	41
2014	527	274	---	274	11 151	41

6.2.20 Forrester's Point

The Local Service District of Forrester's Point is served by a surface water supply pumped from Rudges Pond. The supply is ample, as the table below shows, but there have been problems with freezing of lines in winter.

Year	Pop'n	Demand (Forrester's Point only) Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	289	150	---	150	1320	8.8
2014	341	177	---	177	1320	7.4

Forrester's Point has applied for a joint regional supply with Black Duck Cove and Pidgeon Cove-St. Barbe. The supply should be adequate to supply all three communities, according to the following table.

Year	Pop'n	Demand (Forrester's Point, Black Duck Cove and Pidgeon Cove-St.Barbe) Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	577	300	---	300	1320	4.4
2014	610	317	---	317	1320	4.2

6.2.21 Gillams and Meadows

The Communities of Gillams and Meadows are served by interconnected systems from Jackie Tapps Brook, Meator's Pond and Meadows Pond. There are no reported problems with the water supplies, as shown in the following table for the combined systems.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	1183	615	---	615	2439	4.0
1014	1366	710	---	710	2439	3.5

6.2.22 Glenburnie, Birchy Head and Shoal Brook

Glenburnie's water is supplied by a small reservoir behind a dam on Croucher's Brook. This reservoir is supplied by two water sources, a brook and a spring. Shoal Brook and Birchy Head are served by community wells.

The groundwater supply for Shoal Brook and Birchy Head is reported to be good. The surface water supply is inadequate due to leaks in the dam. The table below shows that the supply is sufficient for Glenburnie if the leaks are controlled.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	200*	104	---	191	363	3.5
2014	200	104	---	191	363	3.5

* Estimated population of Glenburnie only.

6.2.23 Goose Cove East

Residents of the Community of Goose Cove East receive their water from a system from Jack's Pond. The water supply to the community is adequate, as shown below.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	373	194	---	194	652	3.4
2014	402	209	---	209	652	3.1

6.2.24 Great Brehat

The Local Service District of Great Brehat is served by a gravity feed system from Little Steady Pond. There is sufficient water, as shown in the table below, but residents run their water in the winter to prevent freezing, resulting in reduced water availability to homes at higher levels. Residents are also concerned about water quality due to the proximity of the pond to the road.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	129	67	---	67	219	3.3
2014	152	79	---	79	219	2.8

The Community is requesting funding for a complete new system that will supply water from Big Steady Pond.

6.2.25 Great Harbour Deep

The sources of water for the Community of Great Harbour Deep are Bottom Brook and Northwest Bottom Brook. According to the table below, the supply should be adequate, but the community ran short in the summer of 1989 for the first time. A possible explanation for the discrepancy is leaks in the old timber dam.

The community frequently runs short of water during the winter due to distribution problems. Lines from both water sources have frozen and burst in the winter leaving the community without water. The town wants a new distribution system and a new dam, which should solve their problems.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	245	127	200	327	888	2.7
2014	245	127	200	327	888	2.7

6.2.26 Green Island Brook

Water is pumped from Green Island Brook to the Local Service District of Green Island Brook. There is sufficient water for the community as shown in the table below.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	309	161	200	361	2794	7.7
2014	365	190	200	390	2794	7.2

6.2.27 Halfway Point-Benoit's Cove-John's Beach-Frenchman's Cove

The fresh water sources for the Town are a number of ponds and brooks in the area, including John's Brook and a brook running into Frenchman's Cove. Over the last few years (since 1987) the Town has undertaken a water and sewer project which will serve all parts of the Town. Residents report that the present supply is insufficient.

A new supply is under construction from Clark's Brook, which will just be adequate to serve all the community, as shown in the following table.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	2182	1135	300	1435	2002	1.4
2014	2182	1135	300	1435	2002	1.4

An alternative to extending the distribution line all the way to Frenchman's Cove would be to upgrade the present Frenchman's Cove system to supply that part of the town. More water would then be available for all the community.

6.2.28 Hampden

The Community of Hampden is served by a surface water system from Elliot Brook.

The water supply can barely meet present requirements, and will not be sufficient for projected growth. The system ran dry during the summer of 1989, and the outlet of Elliot Lake was cleared to allow access to otherwise dead storage.

The following table shows estimated present and future water demand of the community. The estimated yield does not include the storage acquired by clearing the outlet, since this may not provide permanent additional storage. A control structure at the outlet of Elliot Lake could provide more reliable storage.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	875	455	---	455	469	1.03
2014	1033	537	---	537	469	0.87

6.2.29 Hawke's Bay

The Town of Hawke's Bay is supplied from Torrent River. The municipal supply also provides fresh water to the local fish plant. There is an ample supply of water for the Town as shown below.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	547	284	200	484	73 120	151
2014	547	284	200	484	73 120	151

6.2.30 Howley

Water for Town of Howley is pumped from Sandy Lake. The water supply is abundant, as shown in the table below, because Sandy Lake is connected to Grand Lake. (See also Deer Lake.)

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	393	204	---	204	589 415	2884
2014	393	204	---	204	589 415	2884

6.2.31 Hughes Brook

The Community of Hughes Brook is presently served by groundwater from a spring. Community officials report that the quantity of water has never been a problem. With low growth expected, no future supply problems are anticipated. The present and projected community demand is as follows.

Year	Population	Demand (m^3/d)
1986	141	73
2014	166	87

6.2.32 Irishtown

Irishtown residents are supplied with water through one of three means. Most families are served by one system in which water is pumped from Irishtown Brook. Other families have private supplies from this brook. The remaining households have private wells.

With a planned new dam and intake and improvements to the distribution system all the residents will have sufficient water from the surface supply, as shown in the table below.

Year	Pop'n	Demand			Yield	
		Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	(m^3/d)	S/D Ratio
1986	798	415	---	415	813	2.0
2014	943	490	---	490	813	1.7

6.2.33 Jackson's Arm

The Community of Jackson's Arm is served both by groundwater and surface water supplies. Lush's Pond supplies some homes, but most are supplied by Godfather Cove Pond or Little Pond. A few families and a health clinic have private wells.

The system is adequate at present, because only about 30 to 40 homes are served from Lush's Pond. Lush's Pond has been proposed as the source for the entire community, but the following table shows that the supply of water from Lush's Pond may be barely adequate for the entire community. A detailed evaluation of the Lush's Pond source, in particular the amount of storage available, should be undertaken.

		Demand			Yield	
Year	Pop'n	Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	(m^3/d)	S/D Ratio
1986	652	339	600	939	1050	1.1
2014	769	400	600	1000	1050	1.0

6.2.34 Lark Harbour

There is no municipal water system in the Community of Lark Harbour. Residents obtain their water from small individual shallow wells or private surface supplies. A few residents are connected to a small supply that services the local fish plant.

The supply adequacy is variable. Some residents report an adequate supply of water throughout the year, while others report recurring problems of insufficient supplies during dry periods of the year.

Two possible new surface supplies have been identified. The first is a gravity system at Gravelly Brook (yield approximately 680 m^3/day). The second is a pumped system from Lark Harbour Brook (yield approximately 2720 m^3/day). The community has applied for funds to develop the latter system. The community demands for a surface water system are given below; either system should be adequate.

Year	Population	Demand (m^3/d)
1986	74	38
2014	87	45

6.2.35 Main Brook

Water is pumped to the Town of Main Brook from Joe Burt's Pond. There are losses in the system due to leaks in the lines, but the community has replaced about half of these lines to date. The local fish plant also draws water from the municipal supply. There is an adequate volume of water available to the community, as shown in the table below.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	526	274	200	474	3025	6.4
2014	599	311	200	511	3025	5.9

6.2.36 Massey Drive

See Corner Brook.

6.2.37 McIvers

The Community of McIvers is presently served by a surface water system from Feeder Brook, a branch of McIvers Brook. The table shown below indicates that the supply is just adequate; the supply briefly ran low during the summer of 1989, perhaps because there is some leakage in the gabion dam.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	738	384	---	384	482	1.3
2014	749	390	---	390	482	1.2

6.2.38 Meadows

See Gillams/Meadows.

6.2.39 Mount Moriah

See Corner Brook.

6.2.40 Nameless Cove

There is no municipal water supply in the Local Service District of Nameless Cove. All homes use private wells.

The supply is reported to be inadequate, and the community has applied to be connected to the system at Flower's Cove. The potential increase in demand to the Flower's Cove supply is shown below. The Flower's Cove system has ample water for both communities (see Flower's Cove).

Year	Population	Demand (m^3/d)
1986	110	57
2014	110	57

6.2.41 Norris Point

The Community of Norris Point is supplied by surface water from Neddy Harbour Pond. A new dam was constructed in 1987, and since that time community officials report that the supply has been adequate, as shown in the table below.

Year	Pop'n	Demand Municipal (m^3/d)	Demand Ind. (m^3/d)	Demand Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	1010	525	---	525	1481	2.8
2014	1010	525	---	525	1481	2.8

6.2.42 Parson's Pond

The Community of Parsons Pond obtains its water from a spring fed reservoir near the community. The supply is adequate. There are no records of the community running out of water.

Because of water quality problems, a surface water supply from Otter Brook has been proposed. Identifying and remedying if possible the water quality problems, which may lie in the distribution fines, may solve the problem. The forecast demand on a surface supply would be as follows.

Year	Population	Demand (m^3/d)
1986	589	306
2014	589	306

6.2.43 Pasadena

The Town of Pasadena has two gravity feed water supplies as a result of amalgamation with South Brook in 1986. The primary system consists of a dam and reservoir on Blue Gulch Brook. The second system serves South Brook and consists of a dam and intake on Transmission Brook. Three local fish plants also draw some fresh water from the municipal supply.

The supply at Blue Gulch Pond is adequate, but Transmission Brook dries up in the summer. As the table below shows, the Blue Gulch system is adequate to supply the whole town.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	3268	1699	400	2099	7228	3.4
2014	4529	2355	400	2755	7228	2.6

6.2.44 Pidgeon Cove-St. Barbe

See Black Duck Cove.

6.2.45 Port aux Choix

The Town of Port aux Choix is served by a surface water supply at Winterhouse Pond. Three groundwater sources have also been developed since 1982, and supply about ten percent of the community water. The local fish plant draws fresh water from the municipal supply.

The supply barely adequate as shown in the table below. Winterhouse Pond often dries up in winter. If the fish plant is not operating, the supply can provide just enough water to serve the community.

The Town Council has applied several times to develop a new supply from Tom Taylor's Pond, the water supply for Port Saunders. Tom Taylor's Pond is capable of meeting water requirements of Port aux Choix and Port Saunders in the short and long term (see Port Saunders).

		Demand			Yield	
Year	Pop'n	Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	(m^3/d)	S/D Ratio
1986	1291	1059	273	1332	1035	0.78
2014	1291	1059	273	1332	1035	0.78

6.2.46 Port Saunders

The Town of Port Saunders obtains its water from Tom Taylor's Pond. The supply is ample.

The following table shows the combined present and projected water demand of the Towns of Port Saunders and Port aux Choix. There is sufficient water for both towns.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	2113	1485	273	1758	2964	1.7
2014	2261	1562	273	1925	2964	1.5

6.2.47 Pynn's Brook

There is no municipal supply in the Local Service District of Pynn's Brook. Residents receive water from private surface and groundwater sources. The wells are reported to run dry.

Town officials are investigating the possibility of installing a surface system for the community. The estimated demand is as follows.

Year	Population (m^3/d)	Demand
1986	95	49
2014	95	49

6.2.48 Raleigh

The Community of Raleigh is served by one community well. Very few homes in the community are served by the well, but tenders are being called for more drilled wells.

Upon completion of the second and third wells, community officials expect that the entire community will be served. Present and future estimated domestic demand are shown in the following table.

Year	Population	Demand (m^3/d)
1986	390	203
2014	460	239

6.2.49 Reidville

The Community of Reidville is served by a surface water system that was installed in 1989. A small number of farms use the same water source, but have their own pumps, and are not connected to municipal lines. There is an abundant supply of water, as shown in the following table.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	504	262	---	262	247 250	943
2014	628	326	---	326	247 250	757

6.2.50 River of Ponds

The Community of River of Ponds obtains its water from Burnt Head Pond. The local fish plant is served by the municipal supply, but is seeking approval to install its own water line from the same source.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	326	170	200	370	1413	3.8
2014	385	200	200	400	1413	3.5

6.2.51 Rocky Harbour

The Community of Rocky Harbour is served by Gull Pond, which is augmented by Grand Rocky Harbour Pond. The table below shows the estimated supply and demand. The supply (yield) estimate is conservative because it does not include the uncontrolled storage in Grand Rocky Harbour Pond. Although the population is not increasing, municipal demand is shown as increasing because of commercial and recreational growth. The system will be at capacity by the end of the planning period.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	1268	659	200	859	1397	1.6
2014	1268	1040	200	1240	1397	1.1

6.2.52 Roddickton

The Town of Roddickton is served by a surface water system from East Pond. The supply is more than adequate, as shown in the table below.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	1223	636	200	836	4722	5.6
2014	1443	750	200	950	4722	5.0

6.2.53 St. Anthony

The water source for the Town of St. Anthony is St. Anthony Pond. Water is diverted from Western Long Pond and Eastern Long Pond into St. Anthony Pond to augment the supply. A supply pumped from Frenchman's Pond, which was the main supply until 1967, is still connected to the existing system.

The supply is reported to be adequate, as reflected in the table below, which combines the yields from the two systems. When the fish plant is in peak production, some houses on higher ground experience low pressures and a reduced supply. The town has experienced several leaks and blockages in the water system over the last few years.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	3182	2609	4500	7109	9365	1.3
2014	3637	2982	4500	7482	9365	1.3

The local airport is supplied by a private groundwater supply.

6.2.54 St. Anthony Bight

The Local Service District of St. Anthony Bight obtains its water from a surface water system at Cat Box Pond. Part of the dam recently washed out, so the community has experienced shortages since then. With the dam at full height, the supply is adequate, as the table below shows.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	231	120	---	120	210	1.7
2014	273	142	---	142	210	1.5

6.2.55 St. Lunaire-Griquet

The Community of St. Lunaire-Griquet is served by water pumped from Joe's Pond. The supply is reported to be sufficient as reflected in the following table.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	1013	527	---	527	699	1.3
2014	1030	536	---	536	699	1.3

6.2.56 St. Paul's

The water supply for the Community of St. Paul's is taken from Two Mile Pond. Water is pumped from the pond to an underground storage reservoir and then gravity fed from the reservoir to the community. There is an abundant supply of water as shown in the following table, but the quality is reported to be poor.

Year	Pop'n	Demand Municipal (m^3/d)	Demand Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	497	258	---	258	8141	32
2014	586	305	---	305	8141	27

6.2.57 Sally's Cove

Residents of the Community of Sally's Cove are served by private wells. Community officials report that the water supply is adequate, having never run out. With only low growth expected, the groundwater sources should be adequate for the future as well.

Year	Population	Demand (m^3/d)
1986	355	185
2014	419	218

6.2.58 Savage Cove

There is no municipal water supply in the Local Service District of Savage Cove. Residents are served by private groundwater supplies. The local fish plant also has a private supply.

The supply is reported to be presently inadequate, but the Department of Municipal Affairs is scheduled to drill one exploratory well in the winter of 1990. The estimated demand is shown in the following table.

Year	Population	Demand (m^3/d)
1986	355	185
2014	419	218

6.2.59 Sop's Arm

The Local Service District of Sop's Arm is presently served by a surface water supply at a small pond just south of Long Steady. The present system is not adequate when the fish plant is operating, as shown in the following table.

Year	Pop'n	Demand Municipal (m^3/d)	Demand Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	445	231	200	431	378	0.9
2014	525	273	200	473	378	0.8

The community would like to move the intake to Little Tickle Pond and divert water from Long Steady into the Little Tickle Pond watershed across a bog. The extra storage in Little Tickle Pond, and the increased drainage area would result in an adequate supply, as shown below.

Year	Pop'n	Demand Municipal (m^3/d)	Demand Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	445	231	200	431	829	1.9
2014	525	273	200	473	829	1.8

6.2.60 Spillway

See Deer Lake.

6.2.61 Steady Brook

The Community of Steady Brook is served by a surface water supply from Steady Brook Lake. The community shares this supply with the Marble Mountain Ski Resort. The supply is sufficient, as shown in the following table.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	386	201	94	295	9087	31
2014	441	229	94	323	9087	28

6.2.62 Summerside

The Community of Summerside is served by private surface and groundwater supplies. The surface supplies yield ample water, but the artesian wells often run dry. The community water supply system is scheduled to be changed to a surface supply from Pynn's Pond, which should be adequate. The estimated demand on such a system is shown below.

Year	Population	Demand (m^3/d)
1986	798	415
2014	798	415

6.2.63 Trout River

Water for the Community of Trout River is obtained by pumping from Feeder Brook to a concrete reservoir. The local fish plant also draws water from the community supply. The supply is adequate, as shown in the following table.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	771	401	200	601	1969	3.3
2014	842	438	200	638	1969	3.1

6.2.64 Woody Point

The Community of Woody Point is served by water pumped from Winterhouse Brook. Two fish plants draw fresh water from the community supply. Community officials state that there has always been ample water in the reservoir as long as the pumps have been in operation. These statements are supported by data in the following table.

Year	Pop'n	Demand Municipal (m^3/d)	Ind. (m^3/d)	Total (m^3/d)	Yield (m^3/d)	S/D Ratio
1986	444	231	400	631	1153	1.8
2014	444	231	400	631	1153	1.8

6.2.65 York Harbour

The Community of York Harbour obtains its water from private groundwater and surface supplies. There is usually sufficient water in the community, but some residents' wells went dry for the first time in twenty-five years in the summer of 1989. The community demand is shown in the following table.

Year	Population	Demand (m^3/d)
1986	371	193
2014	438	228

6.3 Value of Surface Water Systems

The values of the municipal water systems are presented in Table 6.6. Two columns of figures are shown; one is the amount spent by DMPA on the system since 1984; the other is an estimate based on an average value of approximately $18,000 per service connection. DMPA engineers recommend the latter estimate, since communities could have obtained funds from others, or prior to 1984.

The number of service connections in each community was estimated by community officials, or by assuming one connection for every four persons in the community served by the municipal water system.

Table 6.6
Value of Municipal Water Systems

Community	Cost Since 1984	Approximate No. of Connections	Approximate Value
Anchor Point	$105,000	115	$2,070,000
Bartlett's Harbour	$0	40	$720,000
The Beaches	$83,000	19	$337,500
Bide Arm	$0	60	$1,080,000
Bird Cove	$10,000	85	$1,530,000
Black Duck Cove	$35,500	55	$990,000
Brig Bay	$0	20	$360,000
Corner Brook	$1,435,000	6550	$117,900,000
Cow Head	$400,000	225	$4,050,000
Cox's Cove	$822,000	250	$4,500,000
Deer Lake	$2,929,000	2000	$36,000,000
Englee	$15,000	250	$4,500,000
Flower's Cove	$143,000	130	$2,340,000
Forrester's Point	$0	70	$1,260,000
Gillams	$455,000	190	$3,420,000
Glenburnie and others	$0	50	$900,000
Goose Cove East	$0	15	$270,000
Great Brehat	$0	35	$630,000
Great Harbour Deep	$0	70	$1,251,000
Green Island Brook	$40,200	65	$1,170,000
Halfway Point and others	$1,150,000	550	$9,900,000
Hampden	$333,000	225	$4,050,000
Hawke's Bay	$655,000	160	$2,880,000
Howley	$145,000	150	$2,700,000
Irishtown	$1,900,000	200	$3,600,000
Jackson's Arm	$1,303,000	150	$2,700,000
Main Brook	$1,200,000	150	$2,700,000
McIvers	$195,000	185	$3,330,000
Meadows	$325,000	280	$5,040,000
Norris Point	$50,000	325	$5,850,000
Pasadena	$2,950,000	1025	$18,450,000
Port aux Choix	$450,000	425	$7,650,000
Port Saunders	$145,000	275	$4,950,000
Reidville	$300,000	150	$2,700,000
River of Ponds	$0	80	$1,440,000
Rocky Harbour	$0	400	$7,200,000
Roddickton	$64,000	530	$9,540,000
Sop's Arm	$24,000	115	$2,070,000
Steady Brook	$0	140	$2,520,000
St. Anthony	$271,000	1200	$21,600,000
St. Anthony Bight	$0	50	$900,000
St. Lunaire-Griquet	$128,000	260	$4,680,000
St. Paul's	$13,000	125	$2,250,000
Trout River	$48,000	120	$2,160,000
Woody Point	$160,000	110	$1,980,000

7 - Overall Water Resource Assessment

7 Overall Water Resource Assessment

The previous chapters described the water resource in terms of the availability of water (Chapters 2 and 3), quality of water (Chapter 4), instream uses (Chapter 5) and the supply and demand situation for communities and industries (Chapter 6). This chapter provides an overall assessment of the water resource, considering all those separate components.

The study area was broken down into four subareas or regions following geographical and hydrological boundaries as shown in Figure 7.1. The regions are

Gulf/Northern - The west and north coasts of the Great Northern Peninsula, from the southern boundary of Gros Morne National Park to Englee in Canada Bay.

White Bay - All the land draining into White Bay, from Canada Bay on the west side to The Beaches on the east side.

Upper Humber/ Grand Lake - The Upper Humber and Grand Lake watersheds, to (and including) the town of Deer Lake.

Bay of Islands - All the area surrounding the Bay of Islands north to the southern boundary of Gros Morne Park, east to (but not including) the town of Deer Lake, and south to the study boundary.

7.1 Ranking Categories

Each region was ranked in order of relative pressure on the water resource, in four categories, as follows

1. Abundance - The area with the least abundant supply is considered to have the most pressure on its resource in this category, and is ranked #1.

2. Water supply/demand conditions - whether present and projected supplies are sufficient, or whether shortages are or may be experienced. The region with the most shortages is considered to have the most pressure on its water resources and is ranked #1.

3. Conflicts among instream uses - The land area required by various instream uses, and the types of uses, are taken as indicators of the existing or potential conflicts. The region with the most potential conflicts is ranked #1.

Fig. 7.1

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Regional Boundaries

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4. Land Uses Affecting Quality/Quantity - considers uses such as agriculture, forestry, mining, urban development, wastewater dilution, and recreation. The region with the most uses likely to affect the water resource is ranked #1.

These relative rankings provide a scheme to identify the regions with the most pressure on their water resources, and highlight some of the major issues in each region. Detailed discussion is provided in previous chapters of the report.

Table 7.1 presents a summary of the relative ranking for each region and Table 7.2 provides a summary of the data used to make these rankings. The assignment of the rankings is discussed separately for each region in the remainder of this chapter. Not unexpectedly, because of its relatively large population and small land area, the Bay of Islands region has the most pressure on its water resource, and the White Bay region has the least.

Table 7.1

Relative Rankings

Category	Gulf/Northern	White Bay	UH/GL	Bay of Islands
Abundance	4	3	2	1
Supply/Demand	1	3	4	2
Instream Use Conflicts	3	4	1	2
Land Use Conflicts	3	4	2	1
Total	11	14	9	6

7.1.1 Category 1 - Abundance

As shown in Chapter 2, the study area is abundantly supplied with water, with an average runoff volume of about 25,000 Mm^3 per year, and an average specific runoff (i.e. average per unit area) of 0.035 m^3/s per km^2.

Table 7.2

	Regional Data			
	Bay of Islands	Gulf/Northern	Humber V./ Grand Lake	White Bay
Specific runoff m^3/s per km^2	0.0319	0.0378	0.0316	0.0393
Population (1)	34800	22600	6140	2340
Total Supply (1) (m^3/day)	265 000	149 000	837 000	2870
Total Demand (1) (m^3/day)	37500	22800	4690	2160
Overall (1) S/D ratio	7.1	6.8	180	1.3
No. of communities with inadequate supplies	2	6 (2)	1	1 (3)
Instream Uses – Level of conflict	Moderate to high – fishery, recreation	Moderate – fishery, hydro, recreation	High – hydro, fishery, recreation	Low – fishery, hydro
Land Uses – Level	High – forestry	Moderate – forestry	High – forestry	Moderate – forestry

Notes:

(1) – Data for cities, towns, incorporated communities and local service districts.
(2) – Several other incorporated communities (perhaps half-a-dozen) also experience shortages.
(3) – Sop's Arm – Existing system is nearly adequate; proposed new system will rectify shortages.

Within the study area, the Gulf/Northern region has the most abundant supply; the specific runoff is the highest of the four regions, at 0.0378 $m^3/s/km^2$, and the total mean annual runoff volume is over 10 000 Mm^3. Withdrawal demands are of the order of 7 Mm^3 per year, so there is clearly a surplus available for development.

The White Bay region is second in abundance, with a specific runoff of 0.0343, close to the average for the whole study area. With an average annual runoff volume of about 4800 Mm^3, and an estimated withdrawal demand of the order of 0.5 Mm^3 per year, there is a surplus of water in this region as well.

The Bay of Islands and Upper Humber/Grand Lake regions have very similar specific runoffs, 0.0319 and 0.0316 respectively. The Upper Humber/Grand Lake region has a much more reliable supply, however. To the south, Grand Lake regulates the flow. To the north, the Upper Humber River provides a more convenient and reliable supply because of its size than the small, flashy basins in the Bay of Islands region, even though it is not regulated.

The Upper Humber/Grand Lake region also has less pressure on its water resources; the total withdrawal demand is about 1.5 Mm^3 per year, compared with about 14 Mm^3 per year for the Bay of Islands region. The Bay of Islands region was therefore considered to have the least abundant amount of water available for development, and was ranked #1.

7.1.2 Category 2 - Supply/Demand

The Gulf/Northern region was judged to be the region with the greatest supply/-demand problems. Although there is abundant water in the region, more communities experience shortages here than in any of the other regions. The location of the communities on the narrow coastal strip means that they cannot economically access large drainage areas or ponds, or the more productive aquifers. Hawkes Bay, which takes its water from Torrent River, is the only exception.

Industries wishing to take advantage of the natural abundance of freshwater in the region should locate their sources inland to ensure an adequate and reliable supply. An alternative chosen by most fishplants is to use salt water.

A few communities in the Bay of Islands region also experience shortages (e.g., Cox's Cove, Halfway Point). Each of these communities has proposed new water supplies as discussed in Chapter 6 and in the Inventory of Water Supply Systems in Appendix D, and shortages should soon be rectified.

Because of the occasional shortages, and because of the large amount of water withdrawn relative to the total supply, Bay of Islands was ranked #2. (Table 7.2 gives a somewhat distorted view of total supply and demand since about 90% is from the Corner Brook Lake system.)

Communities in the Upper Humber/Grand Lake and the White Bay regions rarely experience shortages. Based on the higher overall nation of supply to demand, the Upper Humber/Grand Lake region was ranked #4, indicating that it has the fewest supply/demand problems.

7.1.3 Category 3 - Conflicts Among Instream Users

As discussed in Chapter 5, the major instream uses are the freshwater fishery, hydropower, and recreation. No major conflicts are reported among these water uses.

The Upper Humber/Grand Lake area was considered to have the most potential for conflicts. The area is already over 60 percent developed for hydropower, and additional projects are possible. As is true throughout the study area, all the rivers are suitable for the freshwater fishery, in particular the Humber River, which is one of the largest salmon rivers in the world. The Humber itself as well as its tributaries offers good recreational opportunities. Conflicts might therefore occur among hydropower, fisheries and recreational interests.

The region with the second highest potential for conflicts among instream users is Bay of Islands, mostly because of possible conflicts between recreational users and the freshwater fishery. All the brooks around the Bay of Islands support native fish such as trout, ouananiche, sea trout and Atlantic Salmon. At the same time, about one-third of the land area offers good recreational opportunities, and there is more pressure for recreational land in this region because it has the largest population.

The Gulf/Northern and White Bay regions are very similar to each other. They both are important fish production regions and they both have good hydropower potential. One major project, Cat Arm, has already been developed in the White Bay region. The Gulf/Northern peninsula was judged to have slightly more potential for conflict than the White Bay region because of its greater recreational potential.

7.1.4 Category 4 - Land Uses Affecting Water Quality/Quantity

The regions are all very similar in this category. The only major land use in any region is forestry, and they are therefore ranked in the order in which they are presently or potentially affected by forestry. The Bay of Islands has the most forestry potential and conflicts have already arisen as described in Chapter 4. The Upper Humber/Grand Lake region is also very heavily forested, and is therefore ranked #2. The Gulf/Northern White Bay regions have much less potential for forestry and are ranked #3 and #4.

Other activities such as mining, urban development, and agriculture are very minor. Planners with DMPA see little if any growth in these activities anywhere in the study area.

The only region with any significant amount of agricultural activity is Upper Humber/Grand Lake, but even there less than one percent of the total land area is used for agriculture.

All regions have some mineral occurrences and some gold exploration has taken place near Jackson's Arm, but substantial mine development affecting water quality and quantity seems unlikely.

8 - Conclusions and Recommendations

8 Conclusions and Recommendations

The principal conclusion of this study is that the natural waters of the study area are an abundant resource which should be managed to maximize benefits to the province. In a region lacking many other natural resources, both the abundant quantity and the relatively good quality of the surface waters offer substantial economic and other benefits including

- plentiful sources for water supply projects, with little treatment required, as well as inexpensive groundwater nearly everywhere in the area for rural homes and agriculture;

- hydro energy production, averaging about 1900 GWh per year and valued at nearly $100 million per year, with opportunities for additional generation;

- recreational opportunities providing activities for tourists and encouraging residents to vacation locally rather than out of the province;

- streams capable of supporting populations of favorite sports fish, even in populated areas if properly maintained.

The areas with the most potential for water resource development are the Great Northern Peninsula and White Bay region. The area with the most pressure on its water resources is the Bay of Islands.

The principal conclusion of this study is that comprehensive planning and positive management are required to ensure that the benefits of the water resources are maximized. The specific conclusions and recommendations arising from each part of the study are presented below.

8.1 Availability

Availability: Conclusions

The average annual runoff in the study area is high, at about 1100 mm. Low flow periods occur in late winter (especially in colder areas) and in summer. Natural dependable flows for water supplies are low, and a large drainage basin is required to satisfy water supply requirements during these low flow periods. Reliable flows can readily be increased by relatively modest storage in many cases, however. Estimates of mean annual runoff and low flows would be improved with additional data and analyses.

Groundwater availability is variable. The evaluation of the groundwater resource relied on earlier studies by others; these found that well yields were generally low. High producing units are located inland, and therefore are not accessible to coastal communities looking for water supply sources.

Availability: Recommendations

1. The regional low flow analysis presently underway for the Island of Newfoundland should be completed, and updated every few years to take advantage of additional data. The present study indicates that data from more gauges must be included in the analysis in order improve the low flow prediction equations.

2. A data collection and analysis program should be instigated to improve the estimates of runoff from rainfall. Several precipitation gauges should be located at higher elevations, near the centroids of basins which have streamflow gauges if possible. The present plan to establish climate stations at WSC gauge locations is commendable, but does not remedy the dearth of precipitation data at higher elevations. The program should evaluate methods of estimating evapotranspiration from climatological data in Newfoundland conditions.

3. More data should be collected for small coastal watersheds, which are frequently used for water supply. Existing supplies should be metered, and good continuous records should be kept. A joint effort by DMPA and the Water Resources Branch of DOEL is probably the most effective approach to setting up a metering and record-keeping system. Alternatively, hydrometic stations could be established in small coastal basins.

4. The groundwater potential near communities with shortages should be systematically investigated, particularly where a good surface water supply is not available within an economic distance (e.g., New Ferolle Peninsula and the tip of the Northern Peninsula). A collaborative effort among DMPA, the Groundwater Branch of DOEL, and the Department of Mines and Energy is suggested.

8.2 Water Quality

Quality: Conclusions

Water chemistry results show that the quality of the natural waters of the study area is generally good. Levels of color, turbidity, iron and manganese are sometimes higher than desirable. In some areas, the natural water tends to be corrosive because of its softness and low pH, with potential dissolution of lead and copper in plumbing systems. In other areas underlain by limestone formations, e.g., on much of the Northern Peninsula, the water tends to be hard.

Local problems occur which are not identified in standard test results. In particular, the organic content of the water varies seasonally, and sometimes is high enough to make water unpleasant for drinking. This problem may not be detected in water chemistry analysis, or may not be considered serious because taste and odor are aesthetic parameters. Some concern is warranted not only because the water is unpalatable for at least part of the year in many communities, but also because toxic products may be formed when water with high organic content comes into contact with chlorine.

Other water quality concerns identified in this study include degradation of water quality due to anthropogenic activities, particularly forest operations including application of pesticides, and long range transport of airborne pollutants.

Quality: Recommendations

1. The Government should strengthen the ability of its Departments to monitor activities which may affect water quality and to enforce the provisions of their regulations.

   The departments which require strong support are those responsible for environment and lands, fisheries, forestry and agriculture. Sufficient staff and budget should be provided

   - to ensure that no one is engaging in activities requiring a permit without holding one;
   - to ensure that those holding permits and licenses are adhering to the terms and conditions under which they were issued;
   - to enforce the provisions of their legislation.

2. The water quality data base should be improved by continued and expanded monitoring. In particular, programs to monitor parameters likely to be affected by anthropogenic activities should be expanded to identify problem areas and to detect trends. These programs relate to
   - long range transport of airborne pollutants;
   - nonpoint pollution from agricultural and brush control chemicals;
   - nonpoint pollution from insecticides to control forest pests;
   - the formation of toxic substances when organics come in contact with chlorine, in water supply systems.

3. Water quality at the end of the distribution system (i.e., at the tap) should be analyzed for metals, particularly in locations with low alkalinity and pH. Depending on the results some treatment may be required.

4. The development and evaluation of inexpensive processes to improve the aesthetic quality of water in very small systems should be encouraged.

5. The effect of land uses on water quality should be a fundamental consideration in any land use planning, not only in protected watersheds. The water resource management authority should have a strong voice in interdepartmental land use planning.

6. A public education program should be instituted to increase the public's recognition of the value of its water resources, and of its role in maintaining water quality.

8.3 Water Supply

Supply: Conclusions

Water supply sources are sufficient to meet demand in most of the communities in the study area. Some experience shortages; these include

Bartlett's Harbour	Lark Harbour
Bear Cove	Nameless Cove
Black Duck Cove	Pidgeon Cove-St. Barbe
Conche	Port au Choix
Cormack	Pynn's Brook
Cow Head	Savage Cove
Cox's Cove	Sop's Arm
Croque	Summerside

Improvements are underway at some of these communities. At others, improvements are planned but have not been funded.

Most of the remaining communities have an adequate supply of water; only a few have large surpluses. Those with large surpluses are Hawke's Bay, Reidville, Deer Lake and Howley. Deer Lake and Howley both obtain their water from Grand Lake, which is regulated for hydroelectric generation.

Of the communities served by groundwater, about half report shortages of water. Most of these communities are located along the coast of the Great Northern Peninsula.

Supply: Recommendations

1. Most communities with water supply shortages have plans for improvements. A consistent approach should be developed towards reviewing these plans, to ensure that all communities meet the same engineering standards, including a reliable yield criterion. If the plans meet the standards, they should be funded. A coordinated effort among communities, working with DMPA, might provide better solutions to water supply problems than individual community initiatives. Areas which could benefit from a regional supply include the New Ferolle Peninsula and the Forrester's Point area.

2. The Province should maintain its own inventories of municipal and industrial water use. The information should be obtained by the most reliable methods available, e.g., metering or monitoring of reservoir drawdown and inflow. Fish plant use in particular should be surveyed and documented.

3. Watersheds serving the following communities should be reviewed to determine whether protection is required for existing or planned supplies.

- Anchor Point
- Bartlett's Harbour
- Black Duck Cove
- Bird Cove
- Brig Bay
- Englee
- Forresters Point
- Great Brehat
- Great Harbour Deep
- Green Island Brook
- Hawke's Bay
- Howley
- Humber Village
- Jackson's Arm
- L'Anse aux Meadows
- Main Brook
- McIvers
- Pidgeon Cove-St. Barbe
- Port Saunders
- River of Ponds
- St. Anthony Bight
- St. Lunaire-Griquet
- Trout River
- Woody Point

8.4 Instream Uses

The principal instream uses in the study area are hydropower, tourism and recreation, and fisheries/wildlife conservation. These all bring economic and other benefits to the study area. Conflicts seldom occur at present because these uses are widely dispersed.

Instream Uses: Recommendations

1. The effect on instream uses should always enter into the evaluation of any proposed development for land or water use.

2. Development trends in small scale hydropower projects and legislation elsewhere should be watched. Because of the abundant water and hilly topography of the study area, there are numerous sites suitable for small hydro projects. At present, they are not economically viable because alternative sources of power are relatively cheap, but that situation may change. The Government should be prepared with appropriate policies.

3. A study should be undertaken to estimate the value of water quantity and quality for recreation, tourism, and fisheries and wildlife uses. A study with a broad scope would provide needed information to the authority making water management decisions.

4. As with water quality, the abilities of responsible departments to monitor and enforce their regulations should be strengthened.

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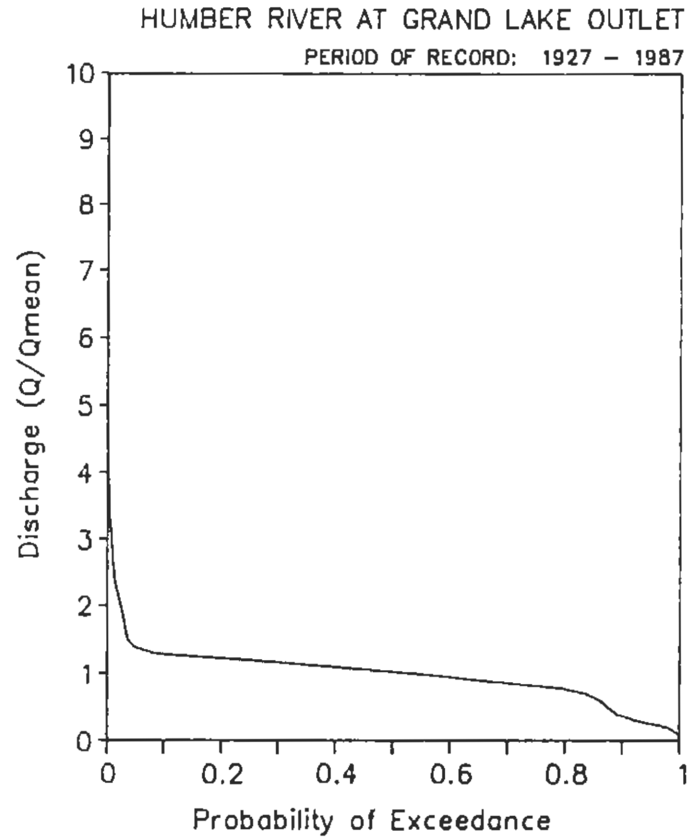
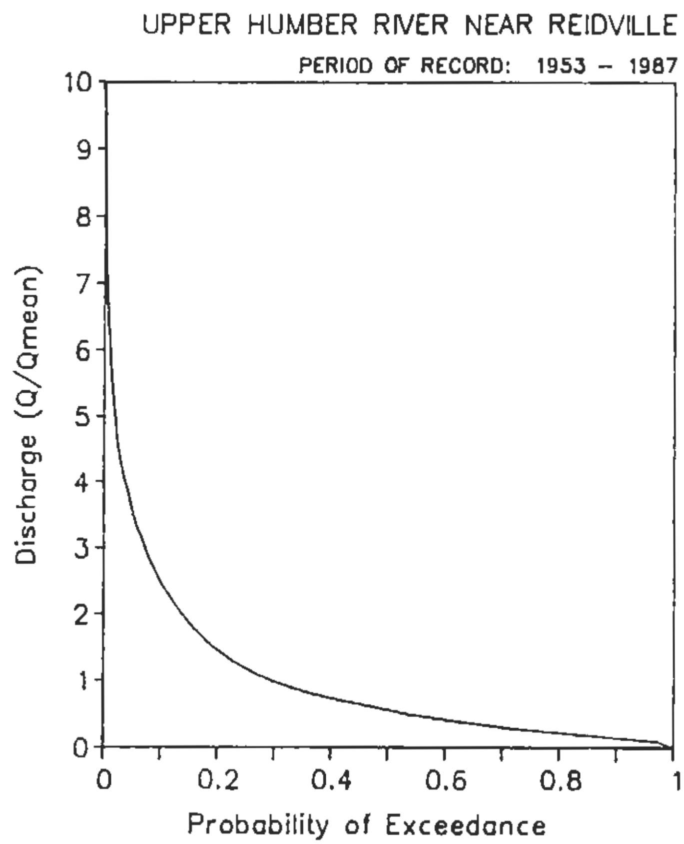
Appendix A

Flow Duration Curves





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Regional Water Resources Study
Northern Peninsula

Flow Duration Curves

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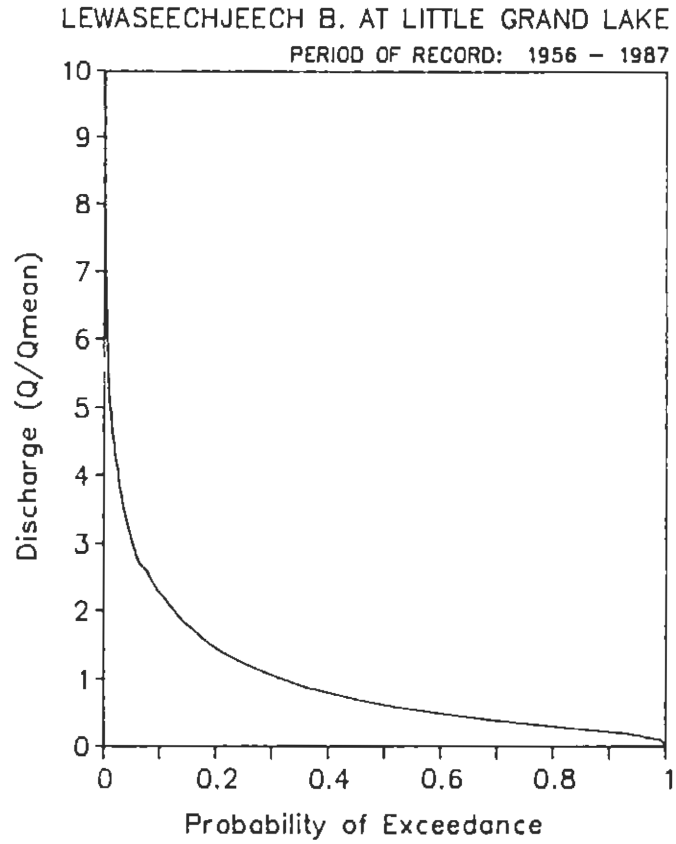

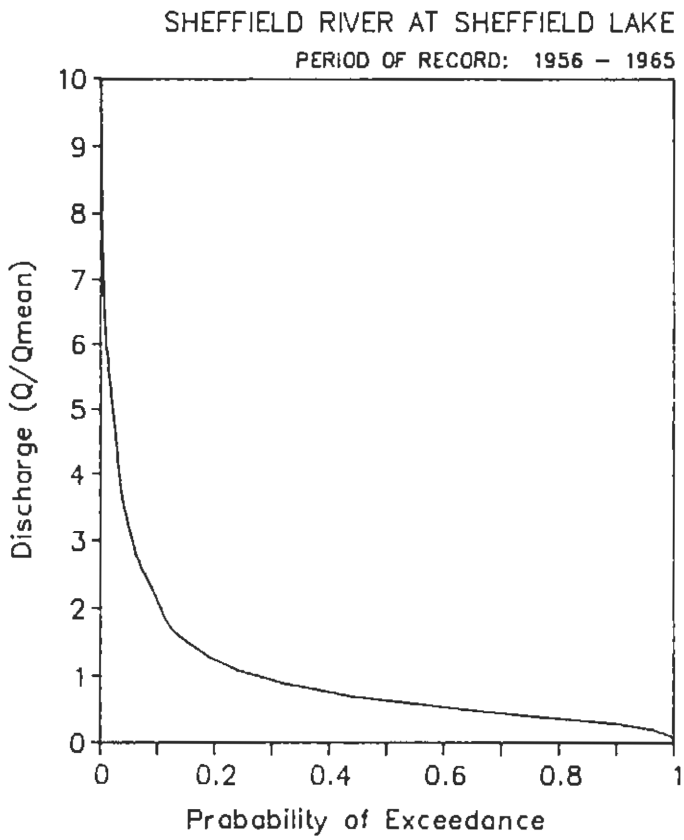

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Flow Duration Curves

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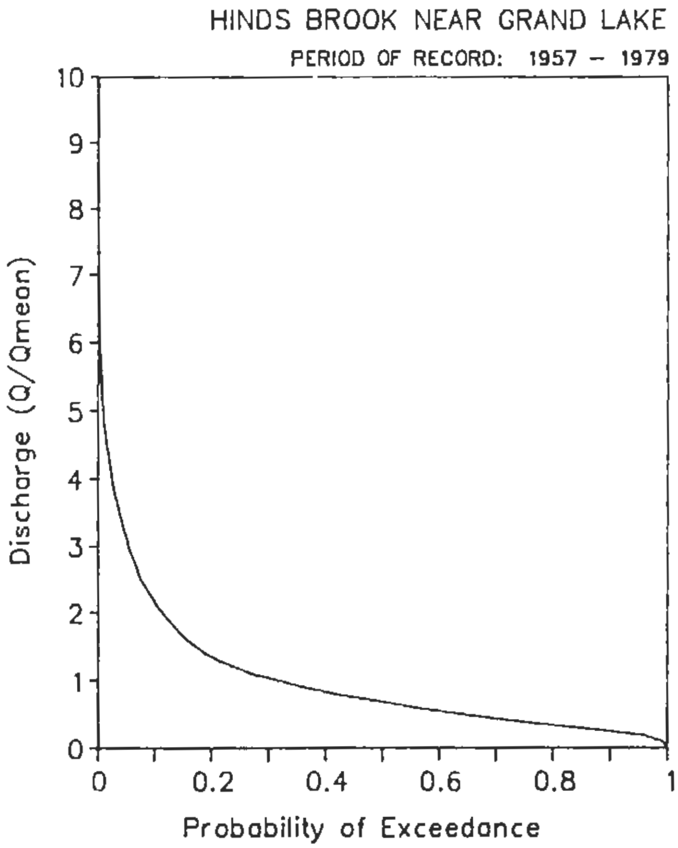

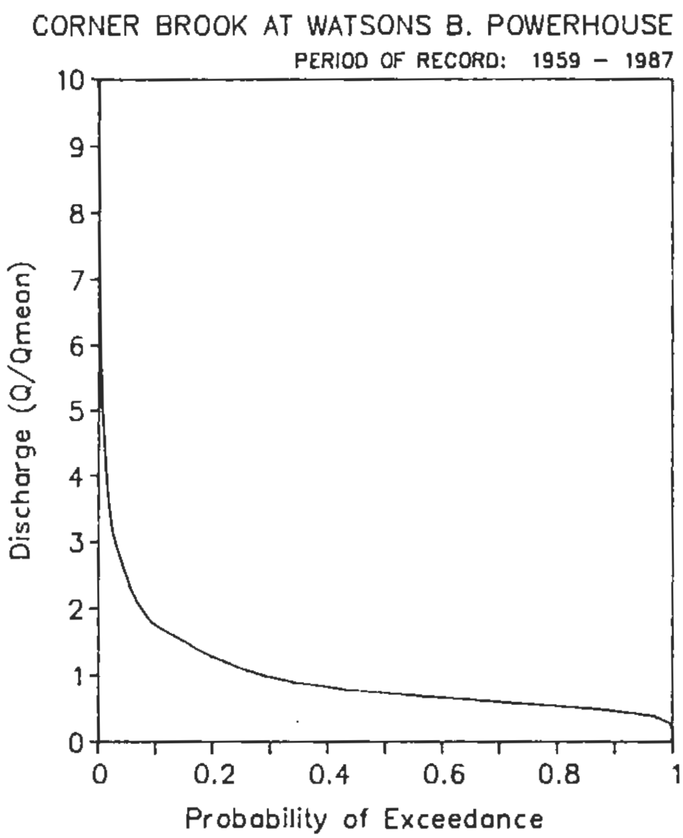

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Regional Water Resources Study
Northern Peninsula
Flow Duration Curves

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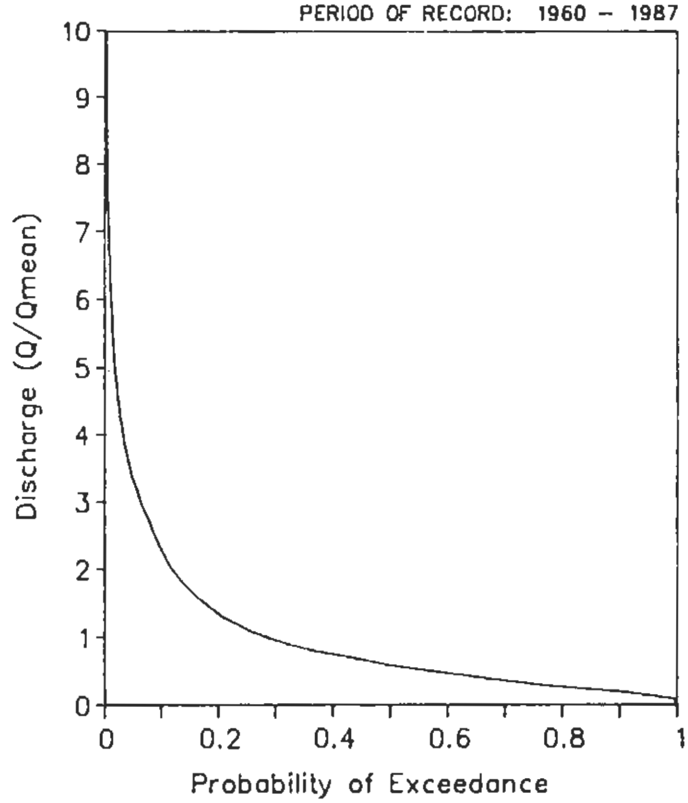
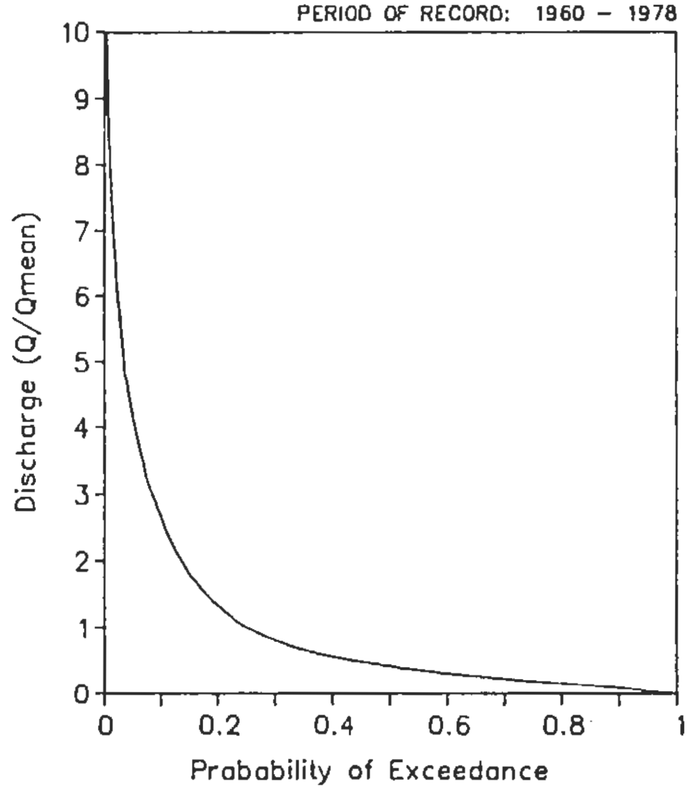
TORRENT RIVER AT BRISTOLS POOL

PERIOD OF RECORD: 1960 – 1987



BEAVER BROOK NEAR RODDICKTON

PERIOD OF RECORD: 1960 – 1978



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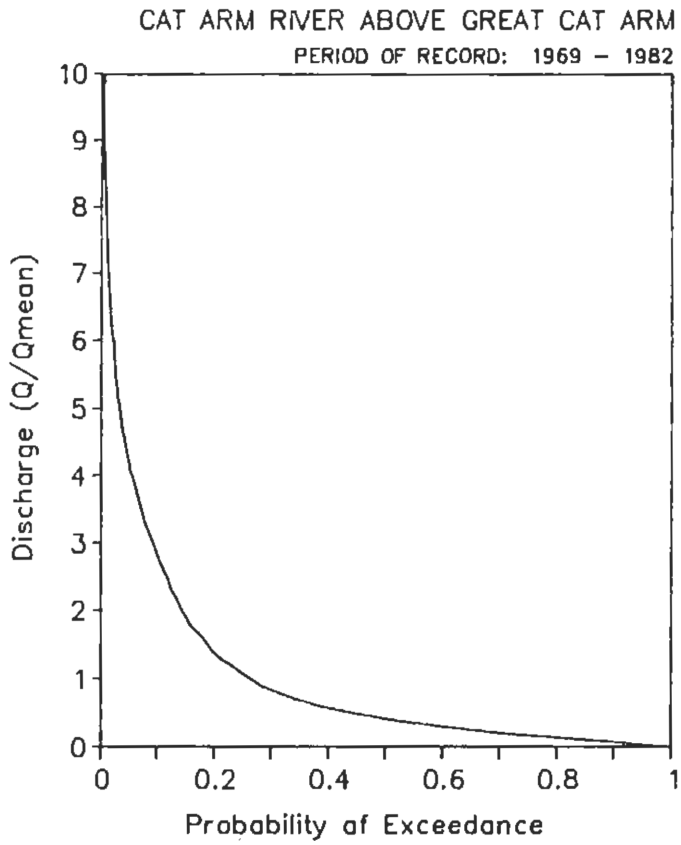
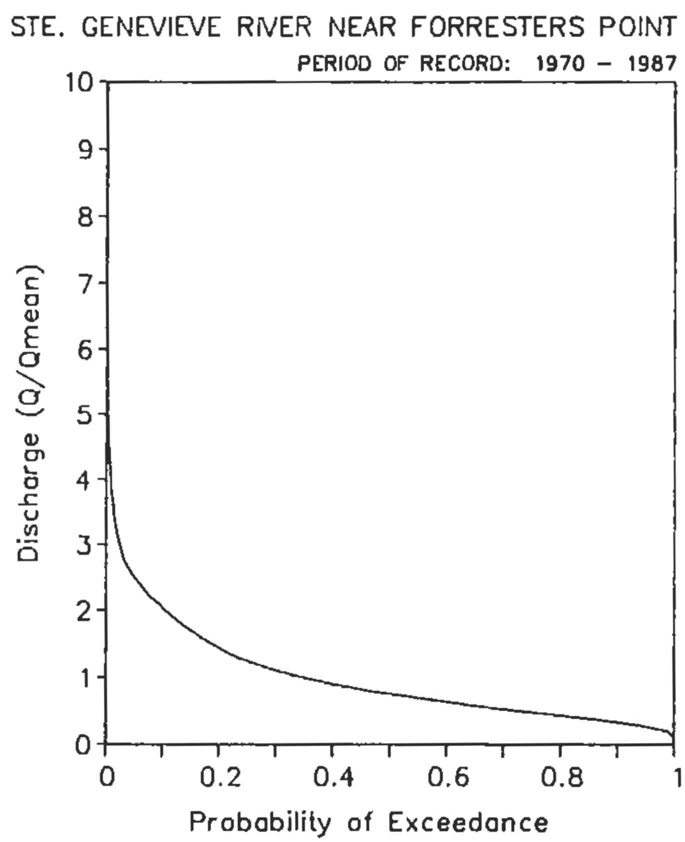
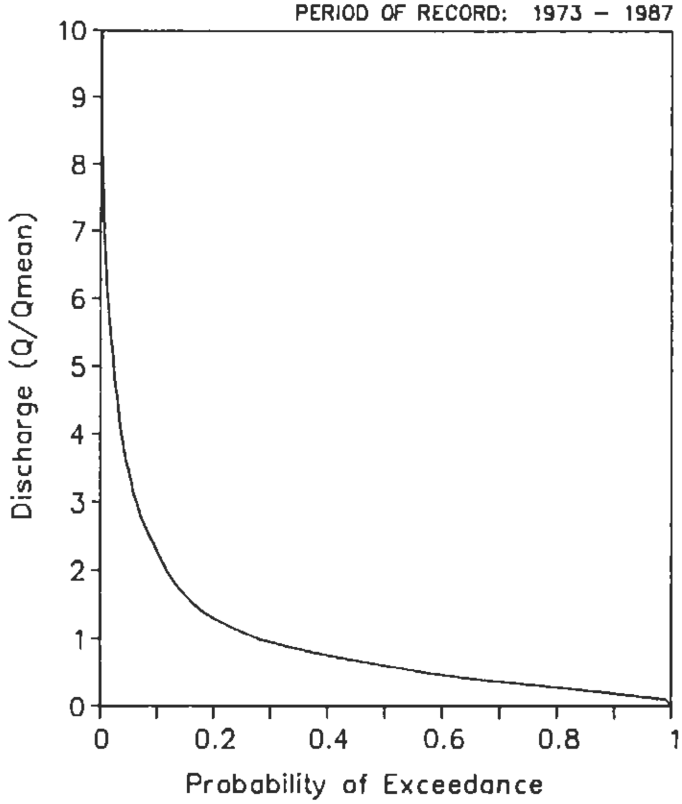

CAT ARM RIVER ABOVE GREAT CAT ARM
PERIOD OF RECORD: 1969 – 1982
Discharge (Q/Qmean)
Probability of Exceedance
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
6
7
8
9
10


STE. GENEVIEVE RIVER NEAR FORRESTERS POINT
PERIOD OF RECORD: 1970 – 1987
Discharge (Q/Qmean)
Probability of Exceedance
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
6
7
8
9
10

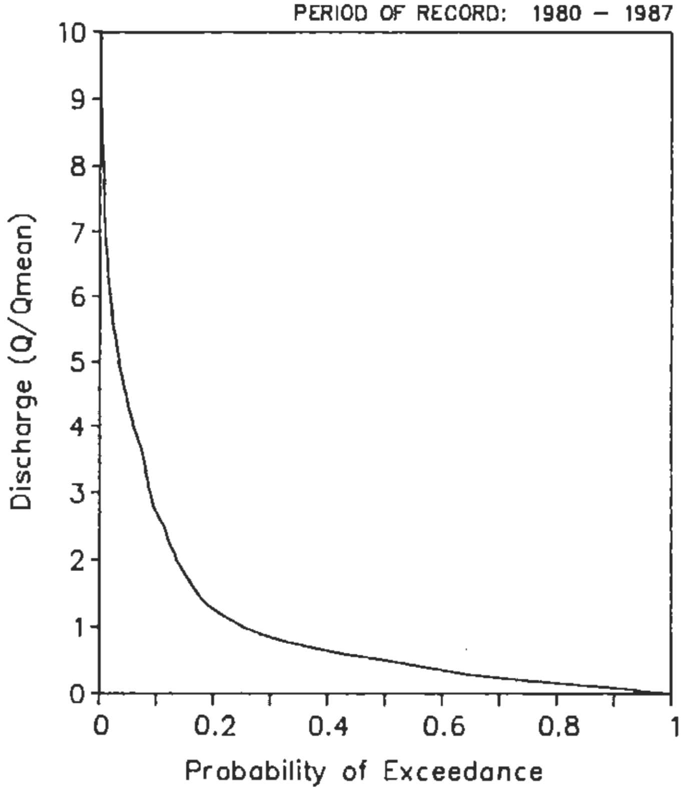
SHEFFIELD BROOK NEAR TRANS CANADA HIGHWAY

PERIOD OF RECORD: 1973 – 1987



NORTHEAST BROOK NEAR RODDICKTON

PERIOD OF RECORD: 1980 – 1987



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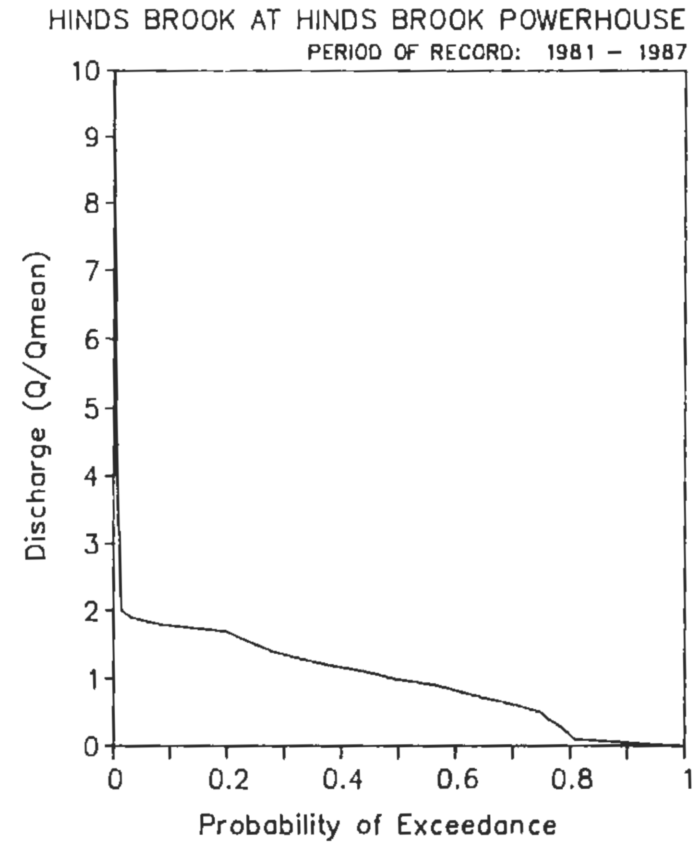
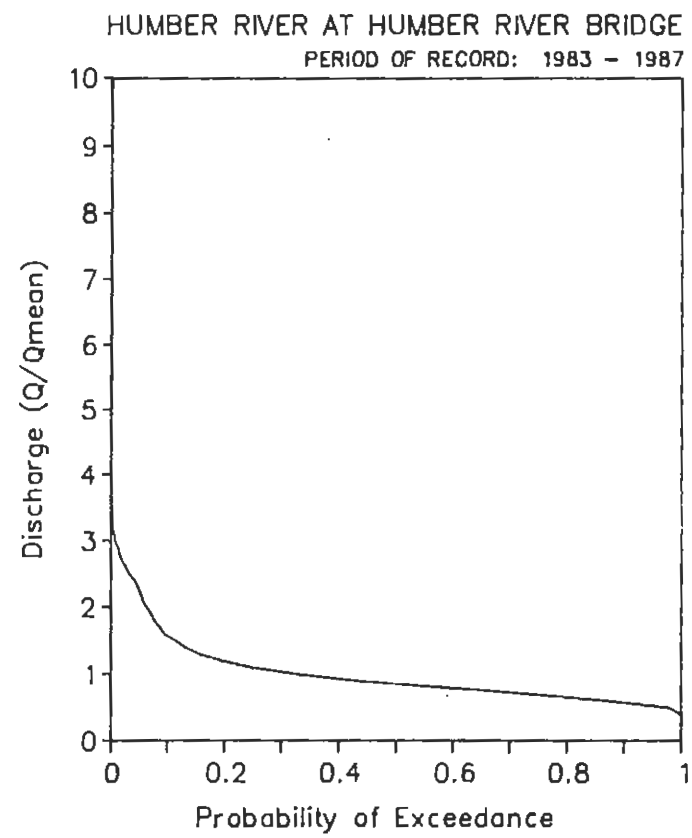
Flow Duration Curves

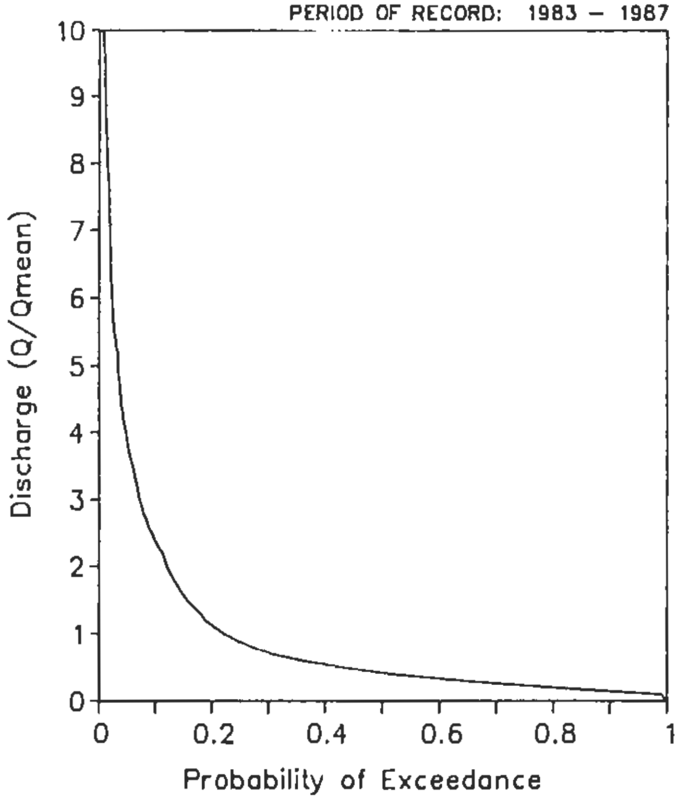
ACRES


HINDS BROOK AT HINDS BROOK POWERHOUSE
PERIOD OF RECORD: 1981 – 1987
Discharge (Q/Qmean)
0
1
2
3
4
5
6
7
8
9
10
0
0.2
0.4
0.6
0.8
1
Probability of Exceedance


HUMBER RIVER AT HUMBER RIVER BRIDGE
PERIOD OF RECORD: 1983 – 1987
Discharge (Q/Qmean)
0
1
2
3
4
5
6
7
8
9
10
0
0.2
0.4
0.6
0.8
1
Probability of Exceedance

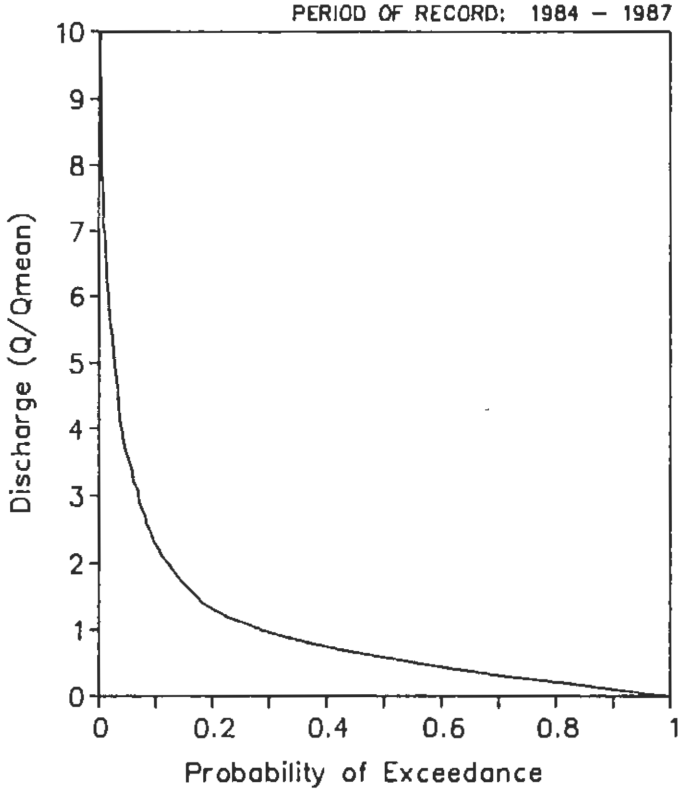
SOUTH BROOK AT PASADENA

PERIOD OF RECORD: 1983 – 1987



GREAVETT BROOK ABOVE PORTLAND CREEK POND

PERIOD OF RECORD: 1984 – 1987



Department of Environment and Lands
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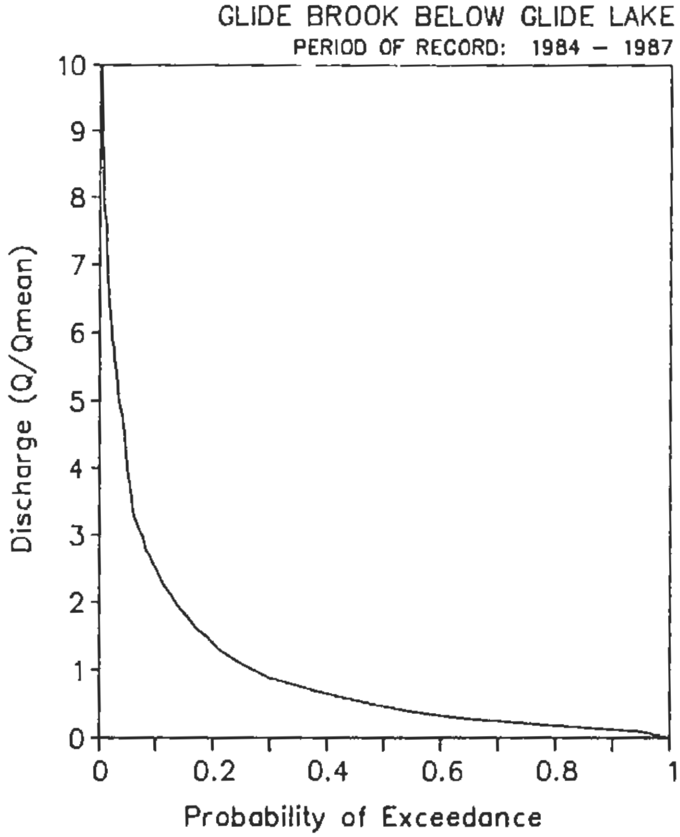
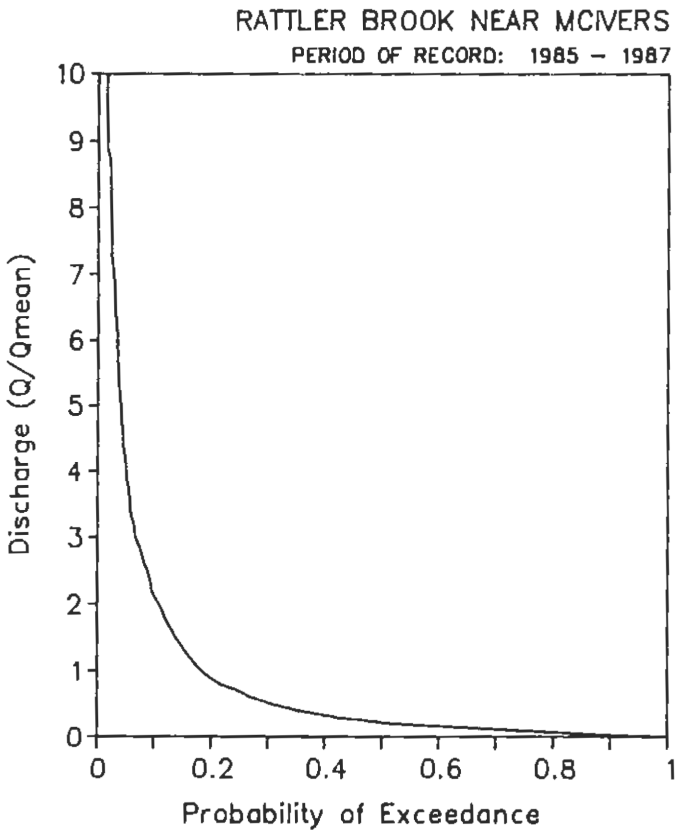
Regional Water Resources Study
Northern Peninsula
Flow Duration Curves

ACRES

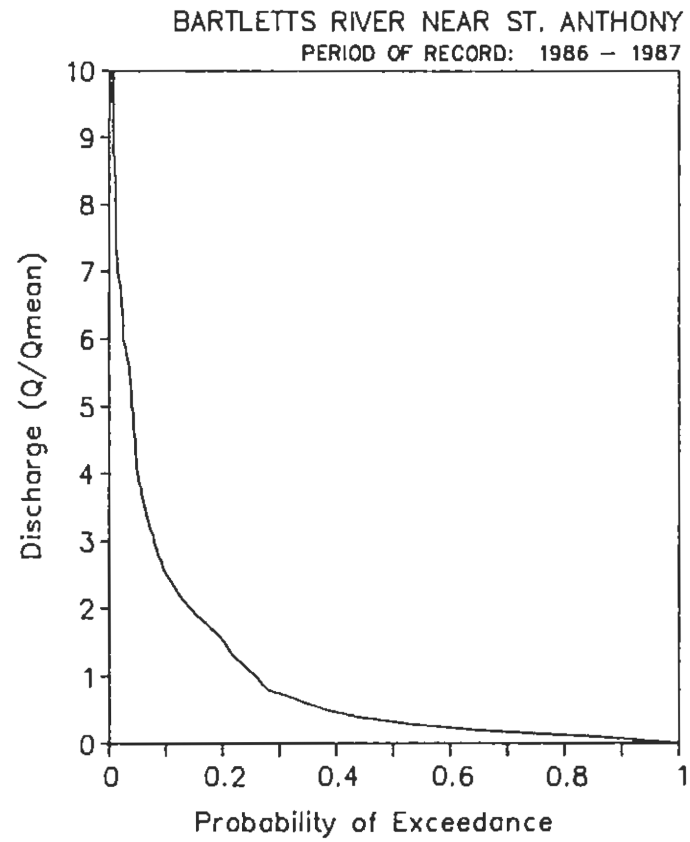


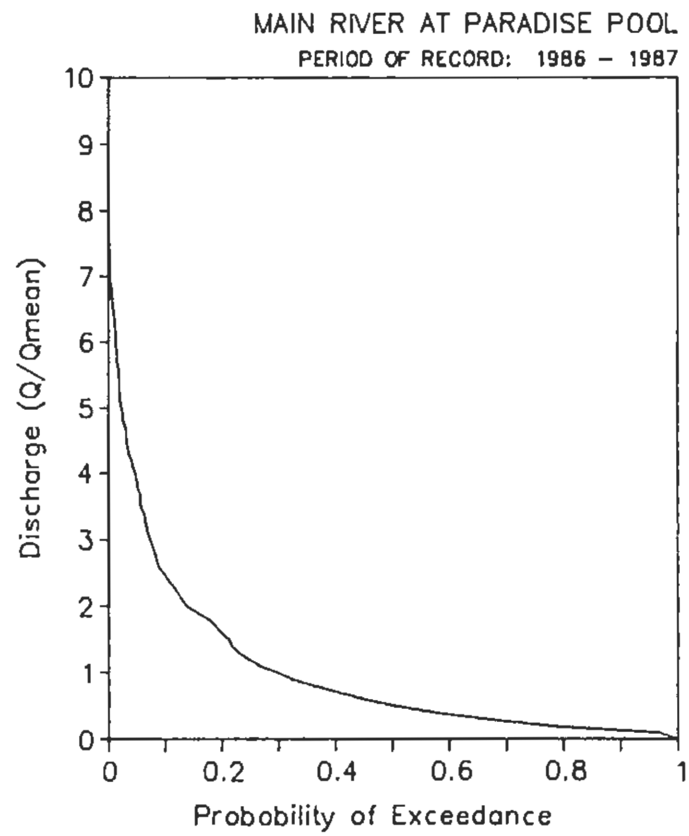


Department of Environment
and Lands
Water Resources Division

Regional Water Resources Study
Northern Peninsula
Flow Duration Curves

ACRES





Department of Environment
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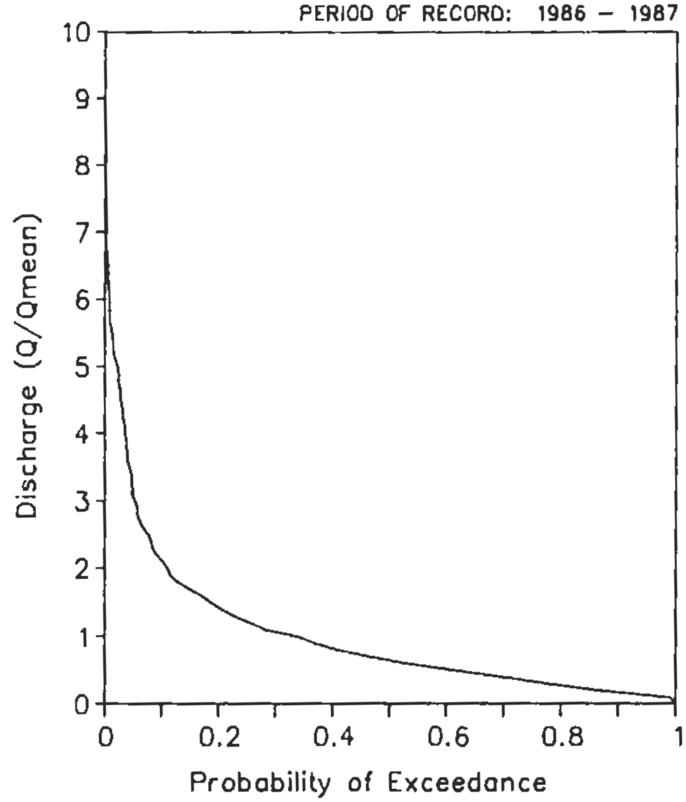
Water Resources Division

Regional Water Resources Study
Northern Peninsula
Flow Duration Curves

ACRES

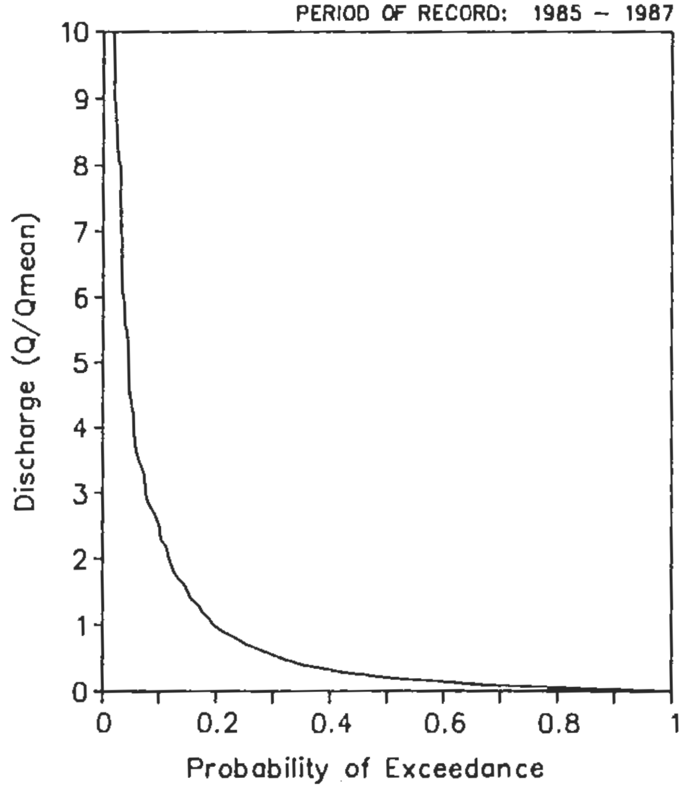
BOTTOM CREEK NEAR ROCKY HARBOUR

PERIOD OF RECORD: 1986 – 1987



BOOT BROOK AT TRANS CANADA HIGHWAY

PERIOD OF RECORD: 1985 – 1987



Appendix B

LOFLOW Results

LEWASEECHJEECH BROOK AT LITTLE GRAND LAKE 02YK002

1 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
9	1953	4.5000	1.0300	1	2.05	48.67
9	1954	2.7200	1.1200	2	5.48	18.25
3	1955	3.3400	1.1300	3	8.90	11.23
11	1956	2.5200	1.7600	4	12.33	8.11
8	1957	4.1600	2.0000	5	15.75	6.35
4	1958	6.3700	2.1100	6	19.18	5.21
8	1959	3.0900	2.1200	7	22.60	4.42
8	1960	1.1300	2.1700	8	26.03	3.84
2	1961	1.7600	2.4000	9	29.45	3.40
9	1962	3.0300	2.5200	10	32.88	3.04
8	1963	3.4800	2.5200	11	36.30	2.75
1	1964	3.2600	2.6300	12	39.73	2.52
2	1965	2.1700	2.7000	13	43.15	2.32
7	1966	2.6300	2.7200	14	46.58	2.15
2	1973	3.0600	2.7800	15	50.00	2.00
2	1974	2.7800	3.0300	16	53.42	1.87
2	1975	2.1200	3.0600	17	56.85	1.76
8	1976	2.1100	3.0900	18	60.27	1.66
3	1977	4.2800	3.2600	19	63.70	1.57
9	1978	1.0300	3.3300	20	67.12	1.49
7	1979	3.3800	3.3400	21	70.55	1.42
3	1980	2.5200	3.3800	22	73.97	1.35
3	1982	3.8000	3.4000	23	77.40	1.29
7	1983	2.0000	3.4800	24	80.82	1.24
8	1984	3.3300	3.8000	25	84.25	1.19
2	1985	2.4000	4.1600	26	87.67	1.14
3	1986	2.7000	4.2800	27	91.10	1.10
8	1987	1.1200	4.5000	28	94.52	1.06
1	1988	3.4000	6.3700	29	97.95	1.02

LEWASEECHJEECH BROOK AT LITTLE GRAND LAKE 02YK002

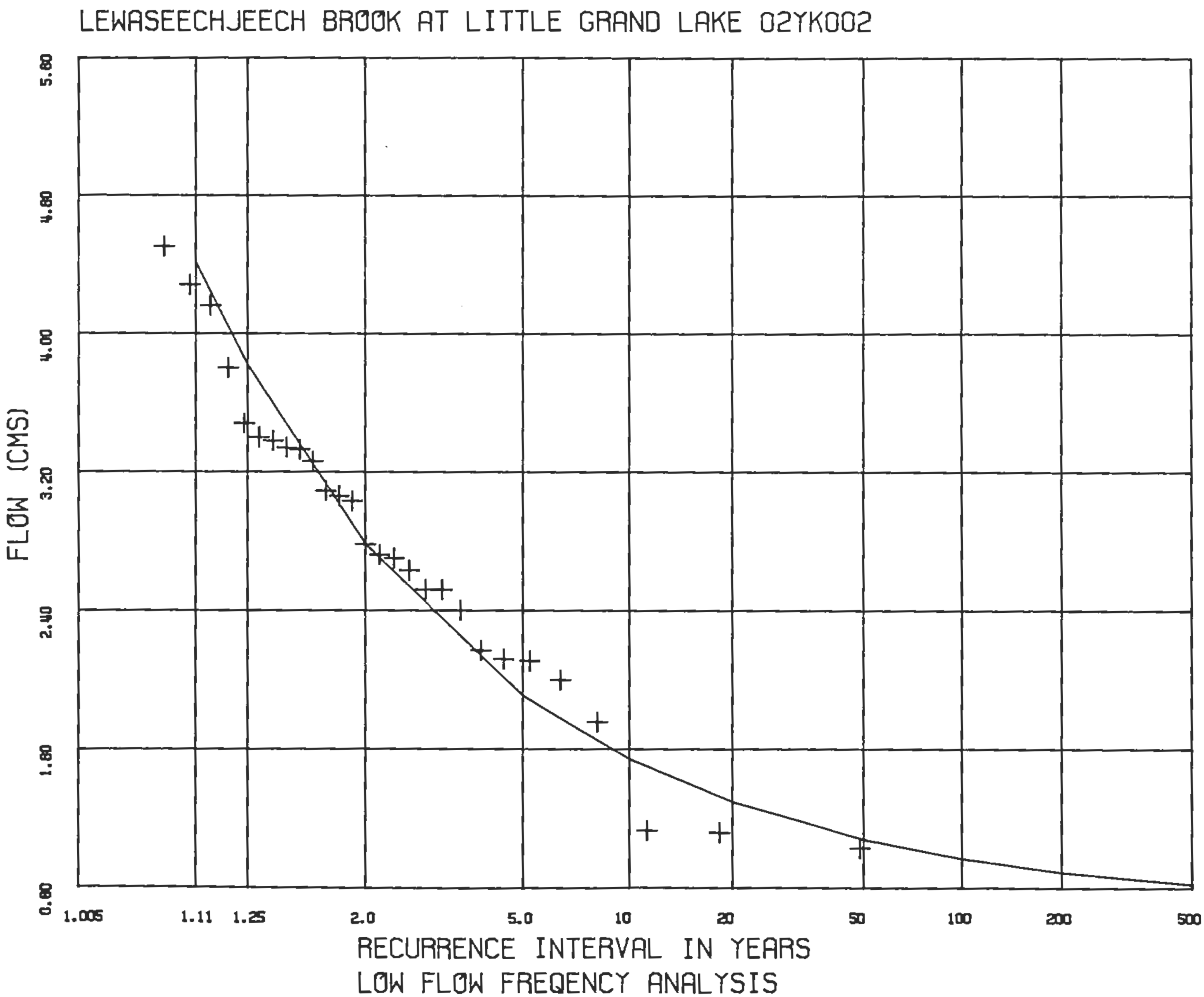
MEAN= 2.90 S.D.= 1.1129 SKEW= 0.8351 C.V.= 0.3833

N= 29 XMIN= 1.03

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 2.09397 E= 0.6906 U= 3.1812

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	6.215
1.010	5.861
1.110	4.407
1.250	3.817
2.000	2.781
5.000	1.907
10.000	1.541
20.000	1.294
50.000	1.077
100.000	0.9674
200.000	0.8892
500.000	0.8187


LEWASEECHJEECH BROOK AT LITTLE GRAND LAKE 02YK002
FLOW (CMS)
5.80
4.80
4.00
3.20
2.40
1.80
0.80
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LOW FLOW FREQENCY ANALYSIS

LEWASEECHJEECH BROOK AT LITTLE GRAND LAKE (02YK002)

7 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	7 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
10	1956	2.7603	1.1748	1	2.29	43.67
8	1957	4.8077	1.1748	2	6.11	16.37
4	1958	6.6887	1.1937	3	9.92	10.08
7	1959	3.3917	1.8294	4	13.74	7.28
9	1960	1.1937	2.1756	5	17.56	5.70
2	1961	1.8294	2.2290	6	21.37	4.68
9	1962	3.1489	2.2652	7	25.19	3.97
8	1963	3.7208	2.3306	8	29.01	3.45
1	1964	3.6140	2.5167	9	32.82	3.05
2	1965	2.2652	2.5907	10	36.64	2.73
7	1966	3.1351	2.7603	11	40.46	2.47
1	1973	3.4865	2.9284	12	44.27	2.26
2	1974	2.9284	2.9284	13	48.09	2.08
2	1975	2.1756	3.1351	14	51.91	1.93
8	1976	2.2290	3.1489	15	55.73	1.79
3	1977	4.3771	3.3917	16	59.54	1.68
9	1978	1.1748	3.4865	17	63.36	1.58
6	1979	3.5640	3.5640	18	67.18	1.49
2	1980	2.5907	3.6140	19	70.99	1.41
3	1982	4.1359	3.6200	20	74.81	1.34
7	1983	2.3306	3.7208	21	78.63	1.27
8	1984	4.0842	4.0842	22	82.44	1.21
2	1985	2.5167	4.1359	23	86.26	1.16
8	1986	2.9284	4.3771	24	90.08	1.11
8	1987	1.1748	4.8077	25	93.89	1.07
1	1988	3.6200	6.6887	26	97.71	1.02

LEWASEECHJEECH BROOK AT LITTLE GRAND LAKE (02YK002)

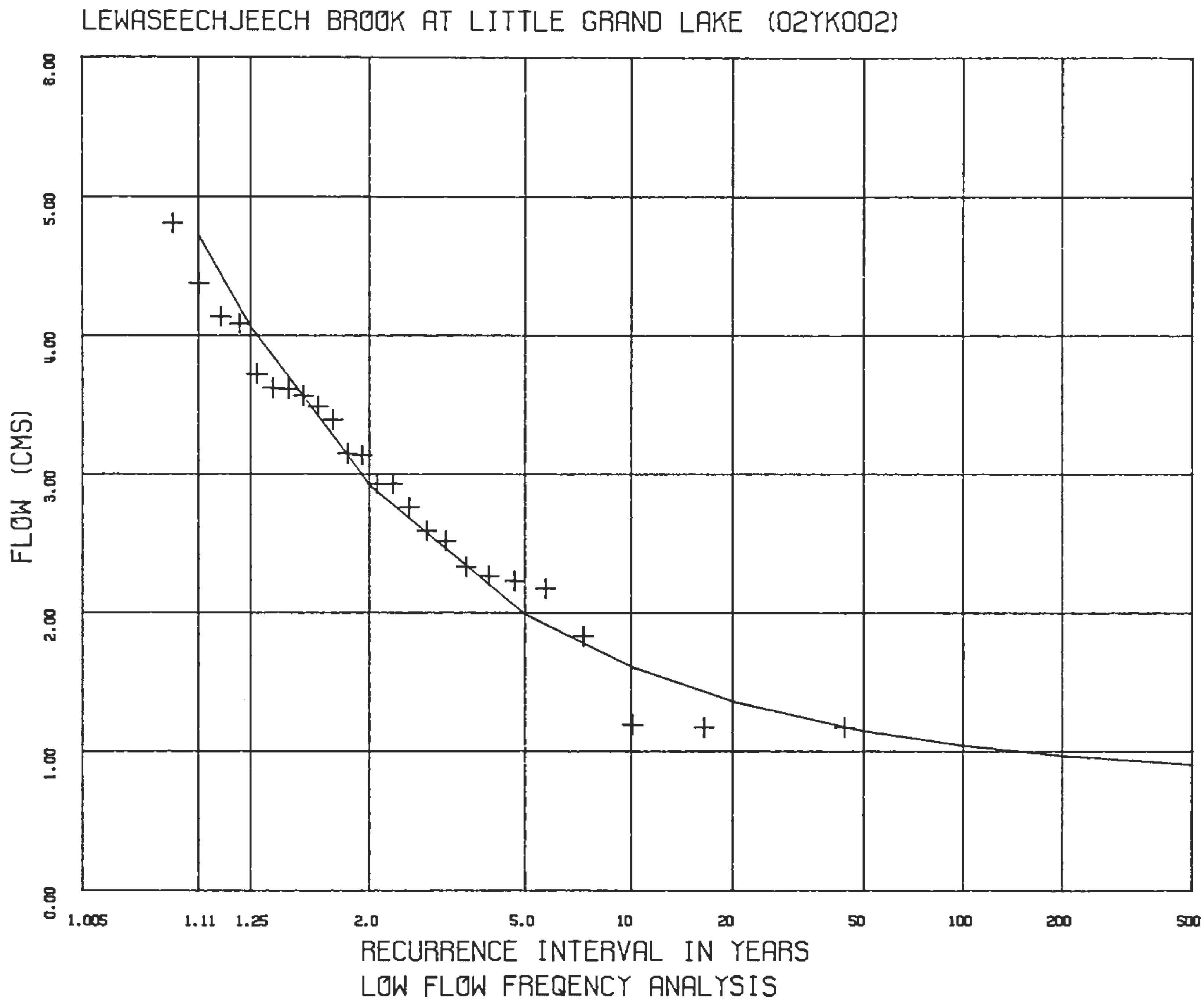
MEAN= 3.07 S.D.= 1.2191 SKEW= 0.7903 C.V.= 0.3969

N= 26 XMIN= 1.17

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 1.95731 E= 0.7975 U= 3.3553

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	6.796
1.010	6.385
1.110	4.722
1.250	4.059
2.000	2.919
5.000	1.986
10.000	1.608
20.000	1.358
50.000	1.146
100.000	1.041
200.000	0.9684
500.000	0.9044


LEWASEECHJEECH BRØØK AT LITTLE GRAND LAKE (02YK002)
FLØW (CMS)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LØW FLØW FREQENCY ANALYSIS

UPPER HUMBER @ REIDVILLE (02YL001)

1 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
9	1954	7.6700	3.4300	1	1.70	58.67
7	1955	4.8700	3.9000	2	4.55	22.00
3	1956	7.1400	4.3700	3	7.39	13.54
3	1957	8.5000	4.8400	4	10.23	9.78
2	1958	8.5000	4.8400	5	13.07	7.65
3	1959	5.4400	4.8700	6	15.91	6.29
8	1960	3.4300	4.9300	7	18.75	5.33
2	1961	6.5400	5.4400	8	21.59	4.63
9	1962	7.4200	5.6600	9	24.43	4.09
3	1963	9.7100	5.9100	10	27.27	3.67
3	1964	9.0000	5.9700	11	30.11	3.32
2	1965	9.0000	6.1700	12	32.95	3.03
7	1966	8.1800	6.4300	13	35.80	2.79
8	1967	4.8400	6.5400	14	38.64	2.59
8	1968	5.9700	7.0200	15	41.48	2.41
7	1969	9.4900	7.1400	16	44.32	2.26
8	1970	6.1700	7.3300	17	47.16	2.12
8	1971	7.0200	7.4200	18	50.00	2.00
8	1972	11.9000	7.6700	19	52.84	1.89
2	1973	9.9100	8.1800	20	55.68	1.80
2	1974	8.2100	8.2100	21	58.52	1.71
3	1975	4.9300	8.5000	22	61.36	1.63
7	1976	4.8400	8.5000	23	64.20	1.56
3	1977	14.2300	8.5000	24	67.05	1.49
8	1978	7.3300	9.0000	25	69.89	1.43
6	1979	11.6000	9.0000	26	72.73	1.37
3	1980	5.6600	9.3100	27	75.57	1.32
9	1981	9.3600	9.3600	28	78.41	1.28
3	1982	8.5000	9.4900	29	81.25	1.23
7	1983	6.4300	9.7100	30	84.09	1.19
8	1984	10.2000	9.9100	31	86.93	1.15
8	1985	5.9100	10.2000	32	89.77	1.11
8	1986	3.9000	11.6000	33	92.61	1.08
8	1987	4.3700	11.9000	34	95.45	1.05
8	1988	9.3100	14.2300	35	98.30	1.02

UPPER HUMBER @ REIDVILLE (02YL001)

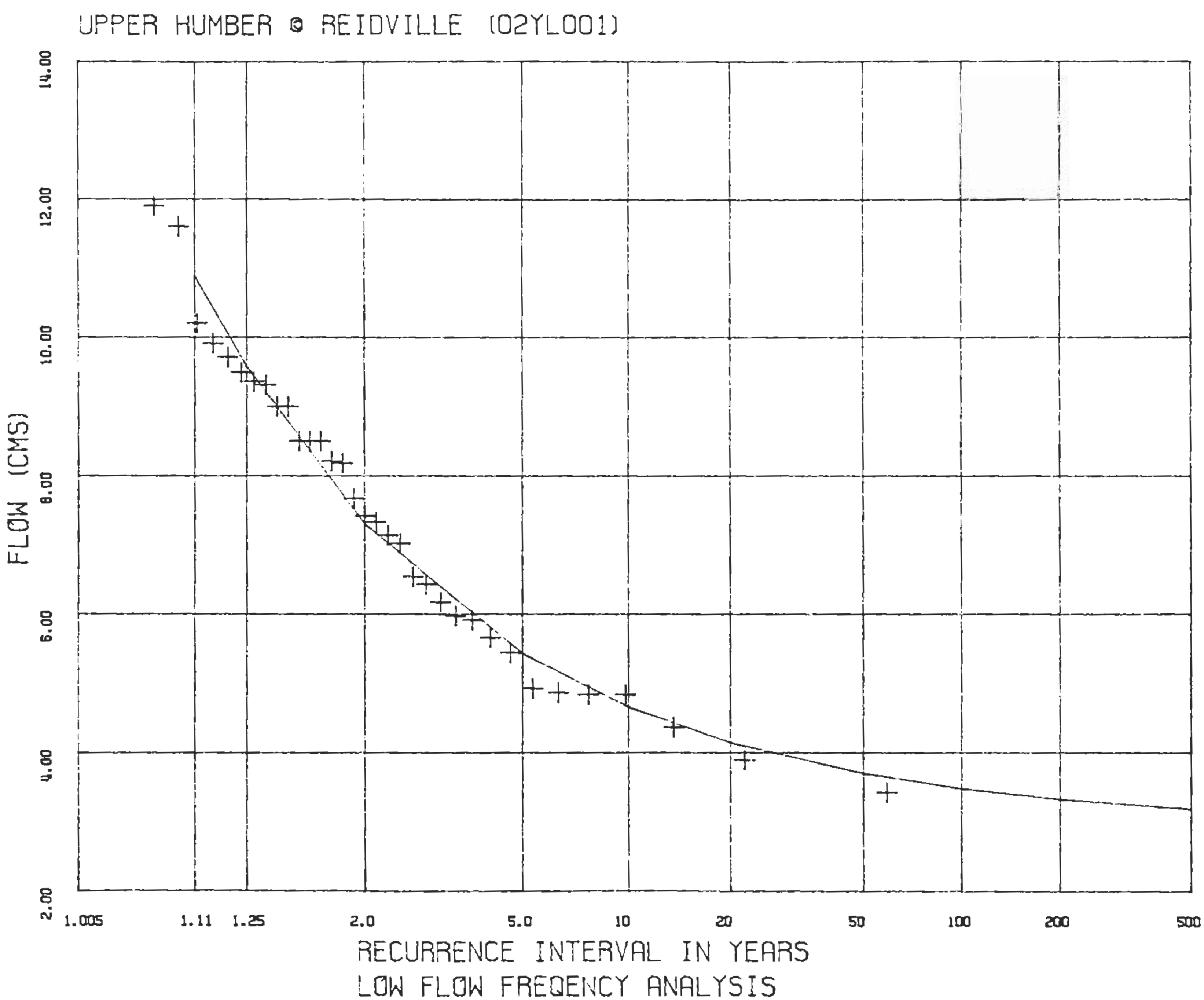
MEAN= 7.59 S.D.= 2.4381 SKEW= 0.5116 C.V.= 0.3214

N= 35 XMIN= 3.43

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 2.01137 E= 2.9441 U= 8.1764

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	14.94
1.010	14.14
1.110	10.88
1.250	9.573
2.000	7.305
5.000	5.426
10.000	4.653
20.000	4.139
50.000	3.696
100.000	3.475
200.000	3.320
500.000	3.182


UPPER HUMBER @ REIDVILLE (02YL001)
FLOW (CMS)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LOW FLOW FREQENCY ANALYSIS

UPPER HUMBER @ REIDVILLE (02YL001)

7 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	7 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
9	1954	8.2200	3.5300	1	1.70	58.67
7	1955	6.7200	4.5200	2	4.55	22.00
3	1956	9.4300	4.6500	3	7.39	13.54
3	1957	9.7600	5.0100	4	10.23	9.78
2	1958	9.0000	5.4300	5	13.07	7.65
3	1959	6.5600	5.4600	6	15.91	6.29
8	1960	3.5300	5.9000	7	18.75	5.33
2	1961	6.6400	6.3700	8	21.59	4.63
9	1962	7.9400	6.5600	9	24.43	4.09
3	1963	10.2300	6.6400	10	27.27	3.67
3	1964	10.4800	6.7200	11	30.11	3.32
2	1965	9.3500	6.8900	12	32.95	3.03
7	1966	11.5700	7.0200	13	35.80	2.79
8	1967	5.4600	7.7300	14	38.64	2.59
8	1968	6.3700	7.8300	15	41.48	2.41
7	1969	10.4900	7.9400	16	44.32	2.26
8	1970	7.0200	8.2200	17	47.16	2.12
2	1971	7.7300	8.4800	18	50.00	2.00
8	1972	13.3400	8.7500	19	52.84	1.89
2	1973	10.6100	8.9600	20	55.68	1.80
2	1974	8.7500	9.0000	21	58.52	1.71
3	1975	5.0100	9.3500	22	61.36	1.63
7	1976	5.4300	9.4300	23	64.20	1.56
3	1977	15.8300	9.7600	24	67.05	1.49
8	1978	8.4800	10.2000	25	69.89	1.43
6	1979	12.2000	10.2000	26	72.73	1.37
3	1980	5.9000	10.2300	27	75.57	1.32
9	1981	10.2000	10.4800	28	78.41	1.28
3	1982	8.9600	10.4900	29	81.25	1.23
7	1983	7.8300	10.6100	30	84.09	1.19
8	1984	11.3000	11.3000	31	86.93	1.15
8	1985	6.8900	11.5700	32	89.77	1.11
8	1986	4.6500	12.2000	33	92.61	1.08
8	1987	4.5200	13.3400	34	95.45	1.05
8	1988	10.2000	15.8300	35	98.30	1.02

UPPER HUMBER @ REIDVILLE (02YL001)

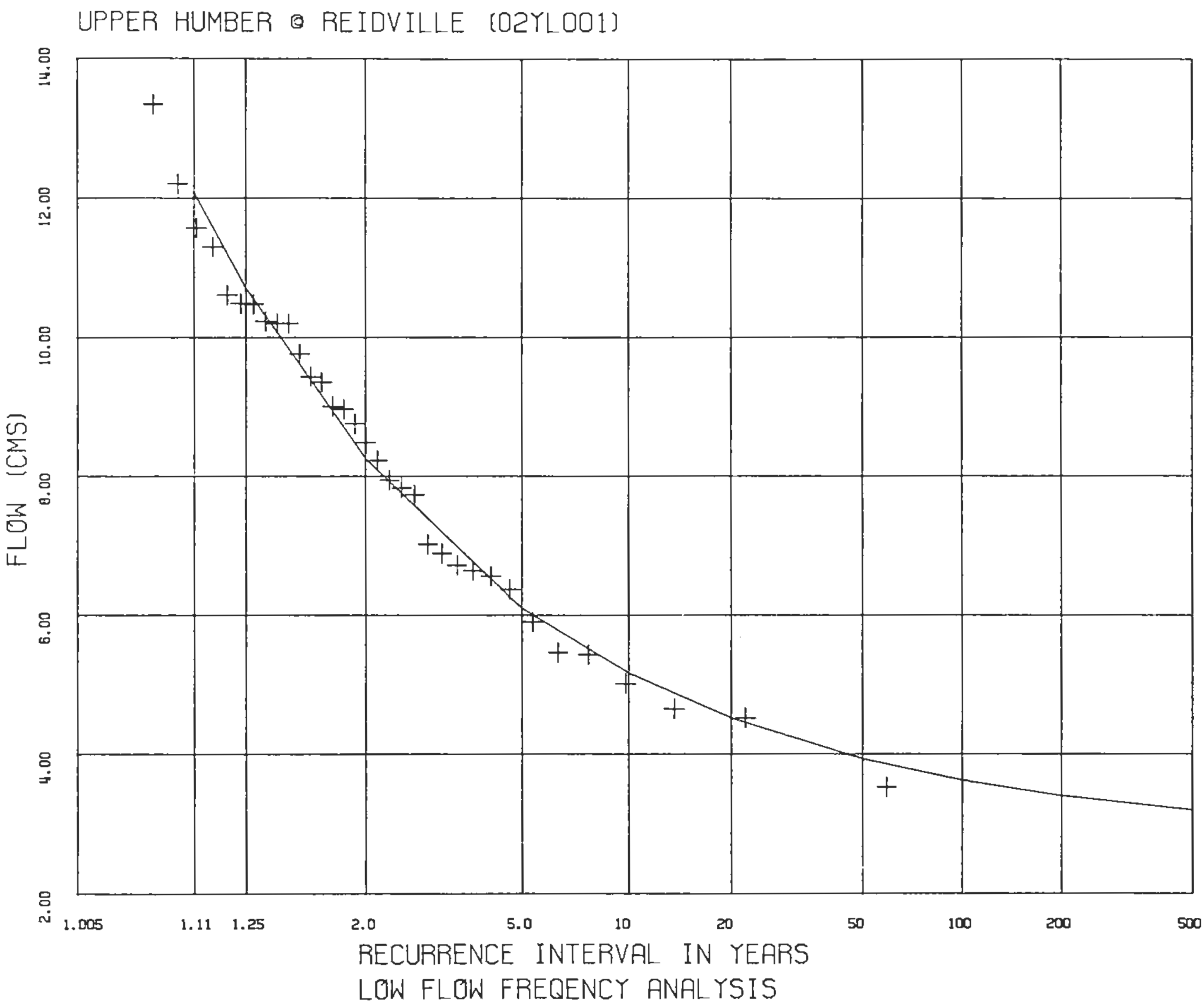
MEAN= 8.47 S.D.= 2.6953 SKEW= 0.4367 C.V.= 0.3181

N= 35 XMIN= 3.53

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 2.26649 E= 2.7782 U= 9.2046

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	16.19
1.010	15.40
1.110	12.08
1.250	10.71
2.000	8.245
5.000	6.094
10.000	5.159
20.000	4.511
50.000	3.927
100.000	3.623
200.000	3.399
500.000	3.193



UPPER HUMBER @ REIDVILLE (02YL001)
FLOW (CMS)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LOW FLOW FREQENCY ANALYSIS

W STATION NO. : 02YF001 VERSION: 0 N-DAY MEAN DURATION: 1
WSC STATION NAME: CAT ARM RIVER ABOVE GREAT CAT ARM
W TER SEASON (MONTH/DAY) FROM JAN 1 TO DEC 31

SEQ.NO.	YEAR	MON	FLOW
1	1969	9	3.280
2	1970	8	0.852
3	1971	3	1.460
4	1972	2	2.140
5	1973	1	1.710
6	1974	3	0.991
7	1975	2	1.050
8	1976	8	0.770
9	1977	3	2.440
10	1978	4	0.680
11	1979	6	2.180
12	1980	3	1.300
13	1981	7	2.240
14	1982	3	1.020

F001 0 1 CAT ARM RIVER ABOVE GREAT CAT ARM
1 DAY LOW FLOW MEAN DISCHARGE IN PERIOD JAN 1 TO DEC 31

TARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
					(%)	(YEARS)
9	1969	3.2800	0.6800	1	4.23	23.67
8	1970	0.8520	0.7700	2	11.27	8.87
3	1971	1.4600	0.8520	3	18.31	5.46
2	1972	2.1400	0.9910	4	25.35	3.94
1	1973	1.7100	1.0200	5	32.39	3.09
3	1974	0.9910	1.0500	6	39.44	2.54
2	1975	1.0500	1.3000	7	46.48	2.15
8	1976	0.7700	1.4600	8	53.52	1.87
3	1977	2.4400	1.7100	9	60.56	1.65
4	1978	0.6800	2.1400	10	67.61	1.48
6	1979	2.1800	2.1800	11	74.65	1.34
3	1980	1.3000	2.2400	12	81.69	1.22
7	1981	2.2400	2.4400	13	88.73	1.13
3	1982	1.0200	3.2800	14	95.77	1.04

C,)01 0 1 CAT ARM RIVER ABOVE GREAT CAT ARM
1 DAY LOW FLOW MEAN DISCHARGE IN PERIOD JAN 1 TO DEC 31
ᵏ AN = 1.58 S.D. = 0.7739 SKEW = 0.7829 C.V. = 0.4900

GUMBEL III DISTRIBUTION - PARAMETERS BY SMALLEST OBSERVED DROUGHT
N = 14 XMIN = 0.680 A = 1.38079 E = 0.5239 U = 1.6795

RETURN PERIOD (YRS)	DROUGHT ESTIMATE
1.005	4.392
1.010	4.022
1.110	2.644
1.250	2.155
2.000	1.410
5.000	0.9140
10.000	0.7500
20.000	0.6580
50.000	0.5920
100.000	0.5650
200.000	0.5490
500.000	0.5370

CAT ARM RIVER (02YF001)

1 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

TARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
9	1969	3.3500	0.6960	1	4.23	23.67
8	1970	0.9300	0.9220	2	11.27	8.87
3	1971	1.6100	0.9300	3	18.31	5.46
2	1972	2.2200	1.0300	4	25.35	3.94
1	1973	1.9200	1.1000	5	32.39	3.09
2	1974	1.0300	1.1900	6	39.44	2.54
2	1975	1.1000	1.3700	7	46.48	2.15
3	1976	0.9220	1.6100	8	53.52	1.87
3	1977	2.4900	1.9200	9	60.56	1.65
4	1978	0.6960	2.2200	10	67.61	1.48
2	1979	2.5900	2.4800	11	74.65	1.34
3	1980	1.3700	2.4900	12	81.69	1.22
9	1981	2.4800	2.5900	13	88.73	1.13
3	1982	1.1900	3.3500	14	95.77	1.04

CAT ARM RIVER (02YF001)

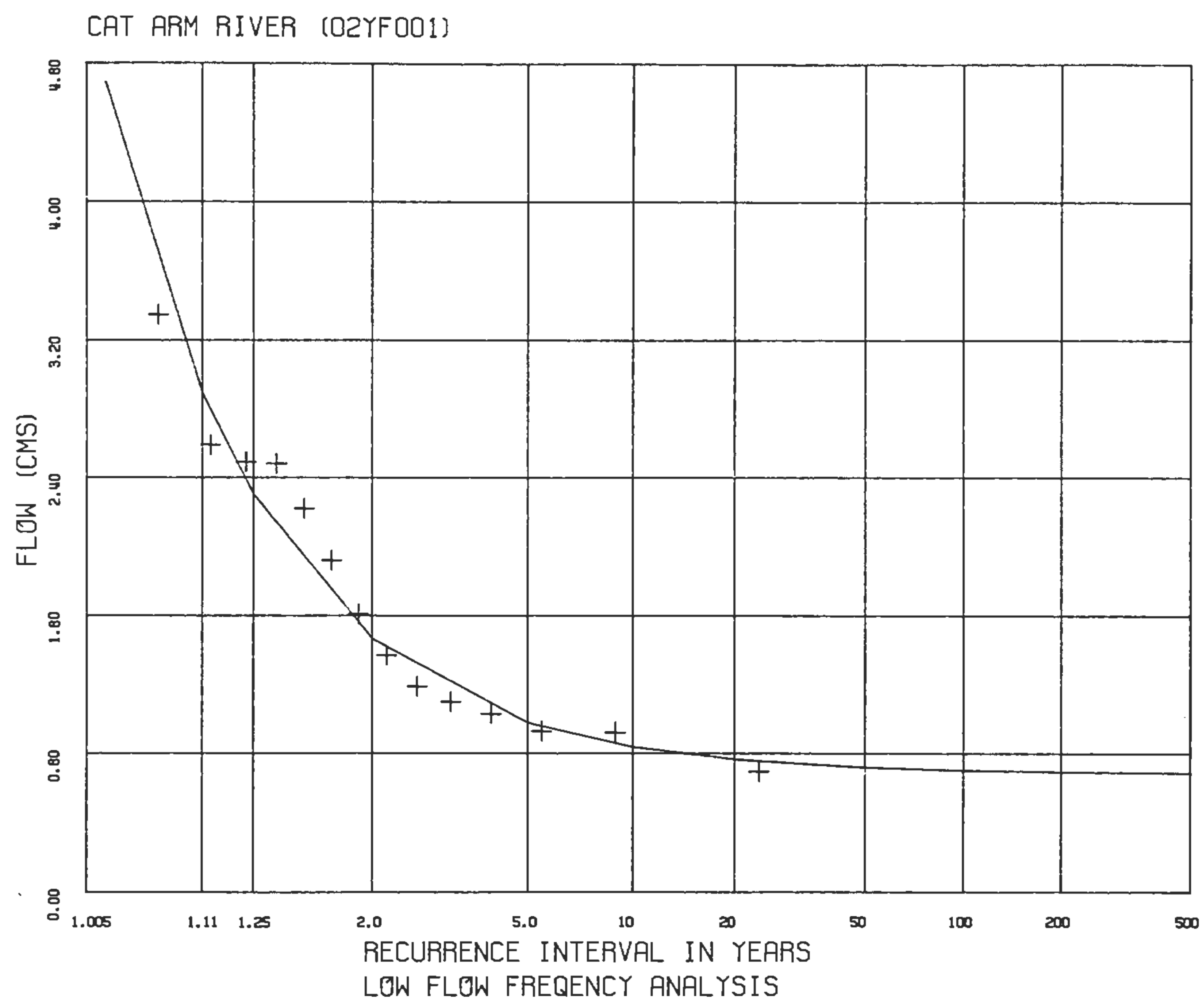
MEAN= 1.71 S.D.= 0.8066 SKEW= 0.6008 C.V.= 0.4725

N= 14 XMIN= 0.70

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 1.16235 E= 0.6808 U= 1.7563

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	5.199
1.010	4.690
1.110	2.892
1.250	2.300
2.000	1.465
5.000	0.9767
10.000	0.8359
20.000	0.7643
50.000	0.7182
100.000	0.7013
200.000	0.6921
500.000	0.6859


CAT ARM RIVER (02YF001)
FLØW (CMS)
0.00
0.80
1.60
2.40
3.20
4.00
4.80
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LØW FLØW FREQENCY ANALYSIS

Hinds Brook 02YK002

1 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
11	1956	3.9100	1.4000	1	2.83	35.33
9	1957	3.3400	1.9400	2	7.55	13.25
3	1958	4.2500	2.0900	3	12.26	8.15
3	1959	3.0600	2.1100	4	16.98	5.89
9	1960	1.4000	2.1500	5	21.70	4.61
9	1961	1.9400	2.2400	6	26.42	3.79
2	1962	2.2400	2.3500	7	31.13	3.21
3	1963	4.0800	2.9700	8	35.85	2.79
3	1964	5.1800	3.0300	9	40.57	2.47
9	1965	2.1100	3.0600	10	45.28	2.21
3	1966	2.3500	3.2600	11	50.00	2.00
8	1969	2.9700	3.3400	12	54.72	1.83
2	1970	4.6700	3.7900	13	59.43	1.68
8	1971	4.4200	3.9100	14	64.15	1.56
9	1972	3.2600	4.0800	15	68.87	1.45
2	1973	4.4700	4.2500	16	73.58	1.36
9	1974	3.0300	4.4200	17	78.30	1.28
2	1975	2.1500	4.4700	18	83.02	1.20
8	1976	2.0900	4.6700	19	87.74	1.14
3	1977	4.9800	4.9800	20	92.45	1.08
1	1979	3.7900	5.1800	21	97.17	1.03

Hinds Brook 02YK002

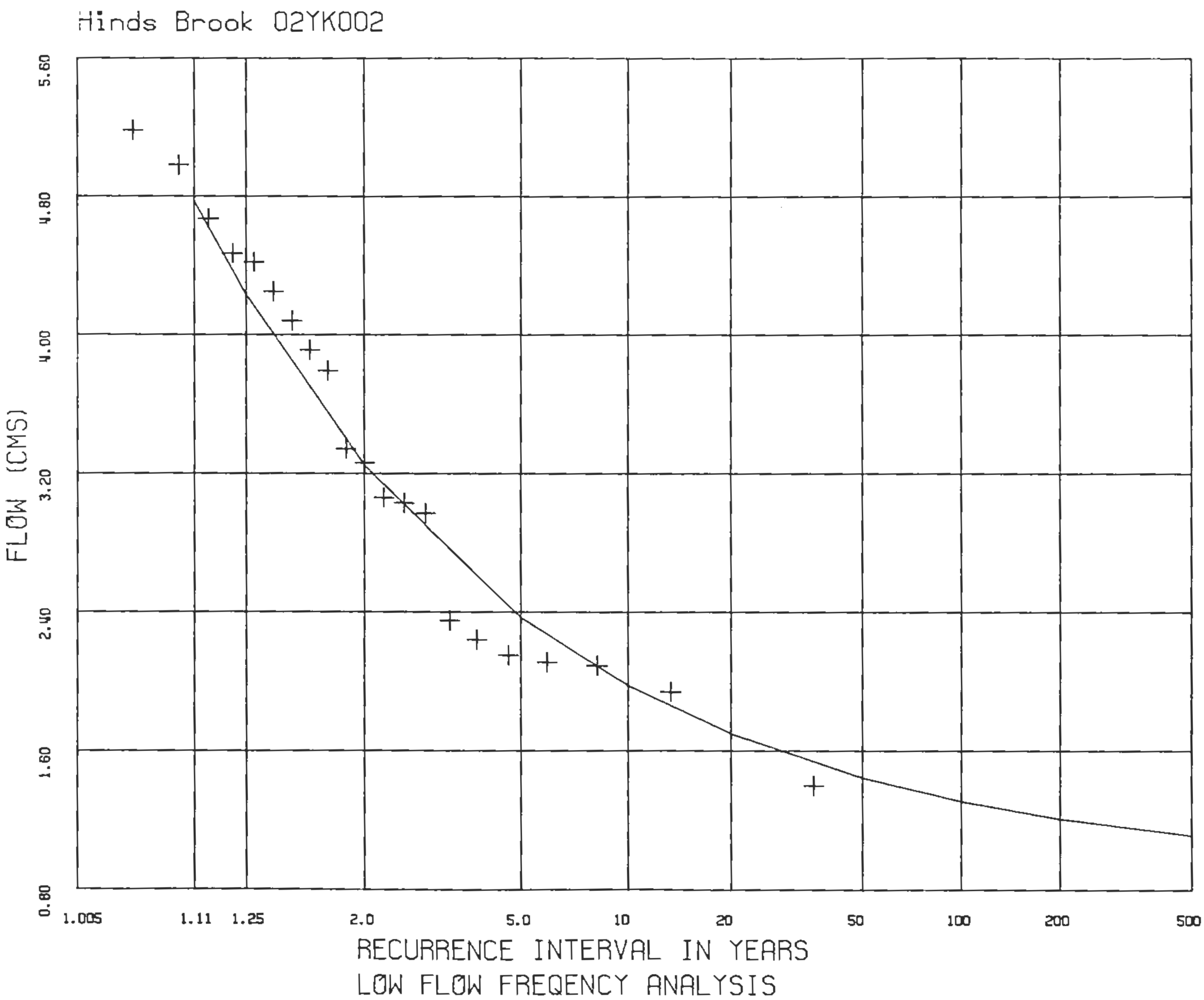
MEAN= 3.32 S.D.= 1.1159 SKEW= 0.0312 C.V.= 0.3363

N= 21 XMIN= 1.40

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 2.40170 E= 0.9074 U= 3.6321

RETURN PERIOD -------- (YRS)	DROUGHT ESTIMATE ---------- (CMS)
1.005	6.365
1.010	6.058
1.110	4.770
1.250	4.229
2.000	3.246
5.000	2.366
10.000	1.975
20.000	1.698
50.000	1.444
100.000	1.309
200.000	1.208
500.000	1.112


Hinds Brook 02YK002
FLØW (CMS)
5.60
4.80
4.00
3.20
2.40
1.60
0.80
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LØW FLØW FREQENCY ANALYSIS

HINDS BROOK NEAR GRAND LAKE (02YK004)

7 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	7 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
9	1957	3.5900	1.4900	1	2.97	33.67
3	1958	4.7600	1.9800	2	7.92	12.63
3	1959	3.2500	2.1400	3	12.87	7.77
9	1960	1.4900	2.2300	4	17.82	5.61
9	1961	1.9800	2.4200	5	22.77	4.39
2	1962	2.5800	2.5800	6	27.72	3.61
3	1963	4.1600	3.2200	7	32.67	3.06
3	1964	5.4600	3.2500	8	37.62	2.66
8	1965	7.8200	3.2900	9	42.57	2.35
3	1966	2.4200	3.3600	10	47.52	2.10
8	1969	3.2200	3.5900	11	52.48	1.91
2	1970	5.2600	4.1200	12	57.43	1.74
8	1971	5.0000	4.1600	13	62.38	1.60
9	1972	3.3600	4.6900	14	67.33	1.49
2	1973	4.6900	4.7600	15	72.28	1.38
9	1974	3.2900	5.0000	16	77.23	1.29
2	1975	2.2300	5.2600	17	82.18	1.22
8	1976	2.1400	5.3300	18	87.13	1.15
3	1977	5.3300	5.4600	19	92.08	1.09
8	1979	4.1200	7.8200	20	97.03	1.03

HINDS BROOK NEAR GRAND LAKE (02YK004)

MEAN= 3.81 S.D.= 1.5419 SKEW= 0.7463 C.V.= 0.4050

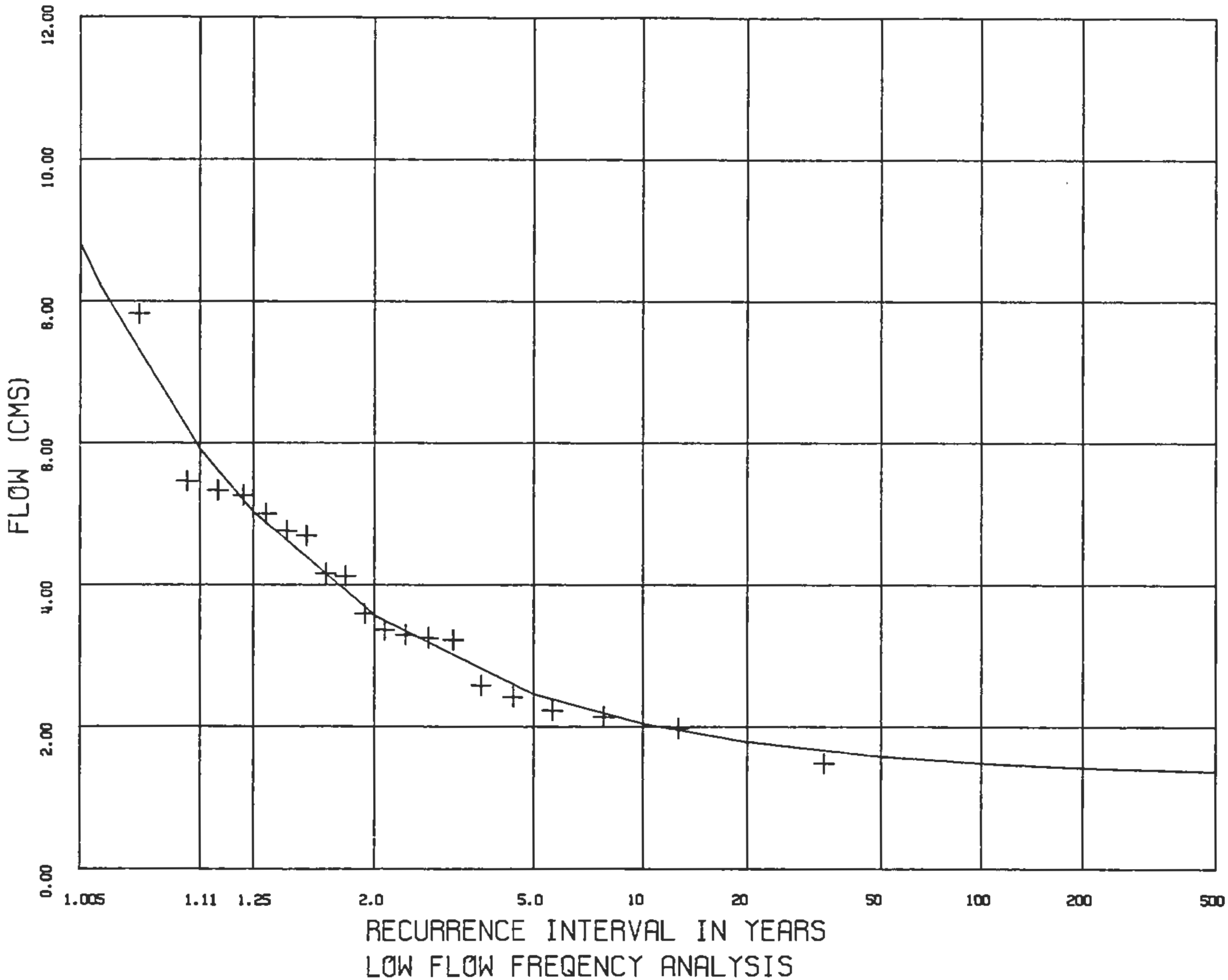
N= 20 XMIN= 1.49

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 1.69154 E= 1.2967 U= 4.1036

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	8.823
1.010	8.229
1.110	5.903
1.250	5.016
2.000	3.557
5.000	2.453
10.000	2.039
20.000	1.782
50.000	1.576
100.000	1.482
200.000	1.419
500.000	1.368

HINDS BRØØK NEAR GRAND LAKE (02YK004)



;C STATION NO. : 02YK005 VERSION: 0 N-DAY MEAN DURATION: 1
v STATION NAME: SHEFFIELD BROOK NEAR TCH
WAiER SEASON (MONTH/DAY) FROM JAN 1 TO DEC 31

SEQ.NO.	YEAR	MON	FLOW
1	1973	2	1.220
2	1974	2	1.710
3	1975	8	1.370
4	1976	8	1.460
5	1977	9	2.920
6	1978	9	1.030
7	1979	8	2.090
8	1980	3	1.190
9	1981	8	2.710
10	1982	3	2.350
11	1983	2	3.050
12	1984	2	1.420
13	1985	3	1.360
14	1986	3	2.000
15	1987	8	0.524
16	1988	9	1.770

?YK005 0 1 SHEFFIELD BROOK NEAR TCH

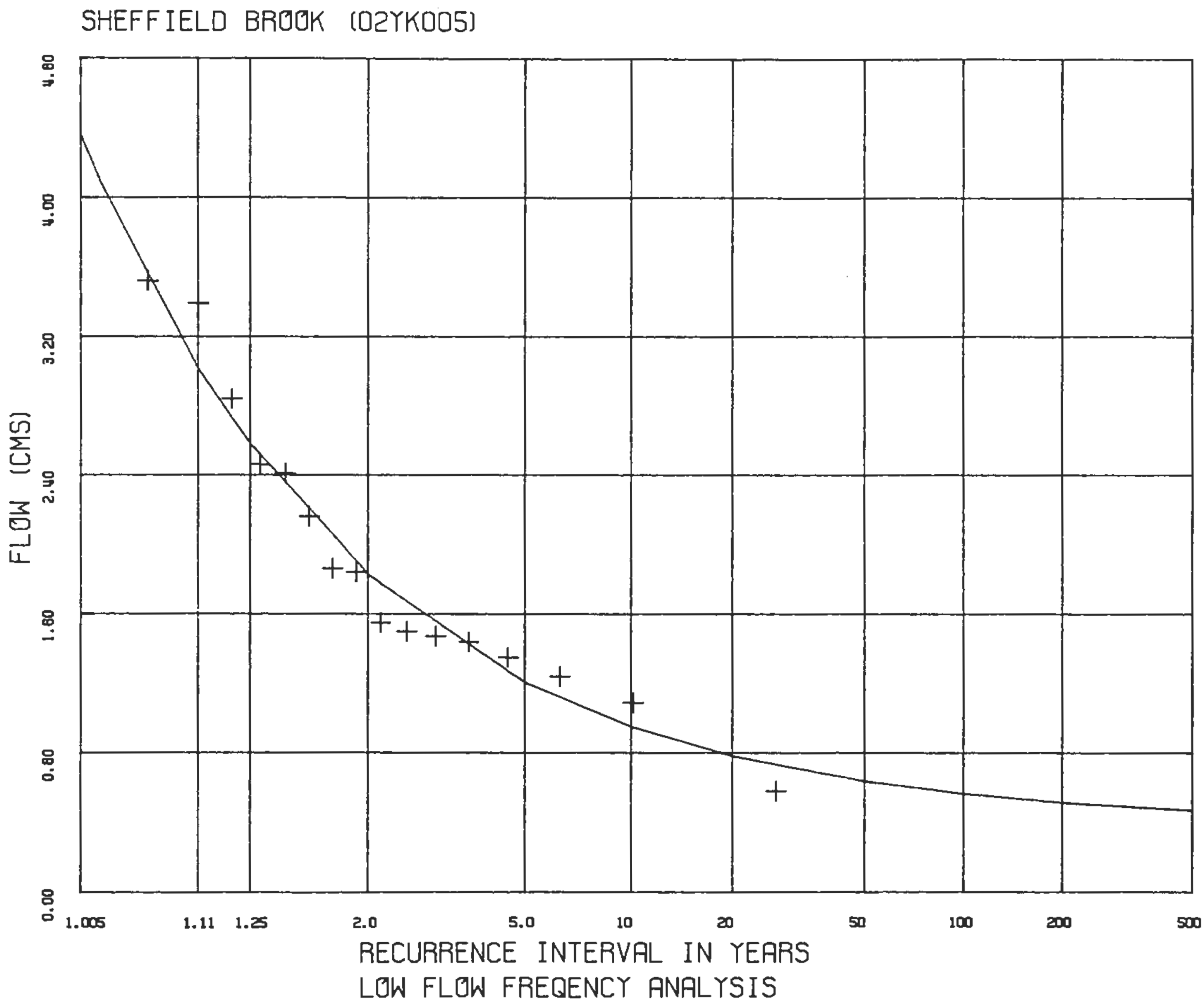
1 DAY LOW FLOW MEAN DISCHARGE IN PERIOD JAN 1 TO DEC 31

TARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
					(%)	(YEARS)
2	1973	1.2200	0.5240	1	3.70	27.00
2	1974	1.7100	1.0300	2	9.88	10.12
8	1975	1.3700	1.1900	3	16.05	6.23
8	1976	1.4600	1.2200	4	22.22	4.50
9	1977	2.9200	1.3600	5	28.40	3.52
9	1978	1.0300	1.3700	6	34.57	2.89
8	1979	2.0900	1.4200	7	40.74	2.45
3	1980	1.1900	1.4600	8	46.91	2.13
8	1981	2.7100	1.7100	9	53.09	1.88
3	1982	2.3500	1.7700	10	59.26	1.69
2	1983	3.0500	2.0000	11	65.43	1.53
2	1984	1.4200	2.0900	12	71.60	1.40
3	1985	1.3600	2.3500	13	77.78	1.29
3	1986	2.0000	2.7100	14	83.95	1.19
8	1987	0.5240	2.9200	15	90.12	1.11
9	1988	1.7700	3.0500	16	96.30	1.04

02YK005 0 1 SHEFFIELD BROOK NEAR TCH
1 DAY LOW FLOW MEAN DISCHARGE IN PERIOD JAN 1 TO DEC 31
. N = 1.76 S.D. = 0.7129 SKEW = 0.4185 C.V. = 0.4049

GUMBEL III DISTRIBUTION - PARAMETERS BY MAXIMUM LIKELIHOOD
N = 16 XMIN = 0.524 A = 2.29866 E = 0.2658 U = 1.9533

RETURN PERIOD (YRS)	DROUGHT ESTIMATE
1.005	3.753
1.010	3.548
1.110	2.696
1.250	2.341
2.000	1.705
5.000	1.145
10.000	0.9000
20.000	0.7290
50.000	0.5750
100.000	0.4940
200.000	0.4340
500.000	0.3790



SHEFFIELD BROØK (02YK005)
FLØW (CMS)
0.00
0.80
1.60
2.40
3.20
4.00
4.80
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LØW FLØW FREQENCY ANALYSIS

WSC STATION NO. : 02YC001   VERSION: 0   N-DAY MEAN DURATION: 1
WSC STATION NAME: TORRENT RIVER AT BRISTOL'S POOL
\TER SEASON (MONTH/DAY) FROM JAN 1 TO DEC 31

SEQ.NO.	YEAR	MON	FLOW
1	1960	4	4.810
2	1961	3	1.980
3	1962	2	3.680
4	1963	3	3.400
5	1964	3	2.440
6	1965	2	4.190
7	1966	3	4.810
8	1967	3	3.090
9	1968	8	3.400
10	1969	4	7.280
11	1970	8	5.860
12	1971	3	4.670
13	1972	3	3.650
14	1973	4	4.980
15	1974	4	3.370
16	1975	3	2.550
17	1976	3	4.760
18	1977	3	4.530
19	1978	3	4.130
20	1979	3	6.000
21	1980	4	3.620
22	1981	2	4.650
23	1982	4	4.380
24	1983	3	3.800
25	1984	3	3.920
26	1985	4	2.860
27	1986	3	3.150
28	1987	3	2.090
29	1988	3	4.600

02YC001 0 1 TORRENT RIVER AT BRISTOL'S POOL

1 DAY LOW FLOW MEAN DISCHARGE IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL. (%)	RETURN PERIOD (YEARS)
4	1960	4.8100	1.9800	1	2.05	48.67
3	1961	1.9800	2.0900	2	5.48	18.25
2	1962	3.6800	2.4400	3	8.90	11.23
3	1963	3.4000	2.5500	4	12.33	8.11
3	1964	2.4400	2.8600	5	15.75	6.35
2	1965	4.1900	3.0900	6	19.18	5.21
3	1966	4.8100	3.1500	7	22.60	4.42
3	1967	3.0900	3.3700	8	26.03	3.84
8	1968	3.4000	3.4000	9	29.45	3.40
4	1969	7.2800	3.4000	10	32.88	3.04
8	1970	5.8600	3.6200	11	36.30	2.75
3	1971	4.6700	3.6500	12	39.73	2.52
3	1972	3.6500	3.6800	13	43.15	2.32
4	1973	4.9800	3.8000	14	46.58	2.15
4	1974	3.3700	3.9200	15	50.00	2.00
3	1975	2.5500	4.1300	16	53.42	1.87
3	1976	4.7600	4.1900	17	56.85	1.76
3	1977	4.5300	4.3800	18	60.27	1.66
3	1978	4.1300	4.5300	19	63.70	1.57
3	1979	6.0000	4.6000	20	67.12	1.49
4	1980	3.6200	4.6500	21	70.55	1.42
2	1981	4.6500	4.6700	22	73.97	1.35
4	1982	4.3800	4.7600	23	77.40	1.29
3	1983	3.8000	4.8100	24	80.82	1.24
3	1984	3.9200	4.8100	25	84.25	1.19
4	1985	2.8600	4.9800	26	87.67	1.14
3	1986	3.1500	5.8600	27	91.10	1.10
3	1987	2.0900	6.0000	28	94.52	1.06
3	1988	4.6000	7.2800	29	97.95	1.02

02YC001 0 1 TORRENT RIVER AT BRISTOL'S POOL
1 DAY LOW FLOW MEAN DISCHARGE IN PERIOD JAN 1 TO DEC 31
EAN = 4.02 S.D. = 1.1864 SKEW = 0.5696 C.V. = 0.2949

GUMBEL III DISTRIBUTION - PARAMETERS BY MAXIMUM LIKELIHOOD
N = 29 XMIN = 1.980 A = 2.15499 E = 1.6197 U = 4.3282

RETURN PERIOD (YRS)	DROUGHT ESTIMATE
1.005	7.494
1.010	7.127
1.110	5.615
1.250	4.998
2.000	3.905
5.000	2.970
10.000	2.573
20.000	2.302
50.000	2.063
100.000	1.940
200.000	1.852
500.000	1.771

TORRENT RIVER (02YC001)

7 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	7 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
4	1960	5.0200	2.1100	1	2.05	48.67
3	1961	2.1100	2.1100	2	5.48	18.25
2	1962	4.4000	2.5000	3	8.90	11.23
3	1963	3.5400	2.5900	4	12.33	8.11
3	1964	2.5000	2.9300	5	15.75	6.35
2	1965	4.3300	3.1300	6	19.18	5.21
3	1966	4.9500	3.3700	7	22.60	4.42
3	1967	3.1300	3.5400	8	26.03	3.84
8	1968	3.6500	3.6500	9	29.45	3.40
4	1969	7.3700	3.6600	10	32.88	3.04
8	1970	6.0400	3.7100	11	36.30	2.75
3	1971	4.8100	3.7400	12	39.73	2.52
3	1972	3.7400	4.0100	13	43.15	2.32
4	1973	5.1400	4.2700	14	46.58	2.15
3	1974	3.6600	4.3300	15	50.00	2.00
3	1975	2.5900	4.3600	16	53.42	1.87
3	1976	4.9100	4.4000	17	56.85	1.76
3	1977	4.6400	4.4400	18	60.27	1.66
3	1978	4.2700	4.6400	19	63.70	1.57
3	1979	6.4800	4.7200	20	67.12	1.49
4	1980	3.7100	4.8000	21	70.55	1.42
2	1981	4.8000	4.8100	22	73.97	1.35
2	1982	4.4400	4.9100	23	77.40	1.29
3	1983	4.3600	4.9500	24	80.82	1.24
3	1984	4.0100	5.0200	25	84.25	1.19
4	1985	2.9300	5.1400	26	87.67	1.14
3	1986	3.3700	6.0400	27	91.10	1.10
3	1987	2.1100	6.4800	28	94.52	1.06
2	1988	4.7200	7.3700	29	97.95	1.02

TORRENT RIVER (02YC001)

MEAN= 4.20 S.D.= 1.2215 SKEW= 0.4436 C.V.= 0.2910

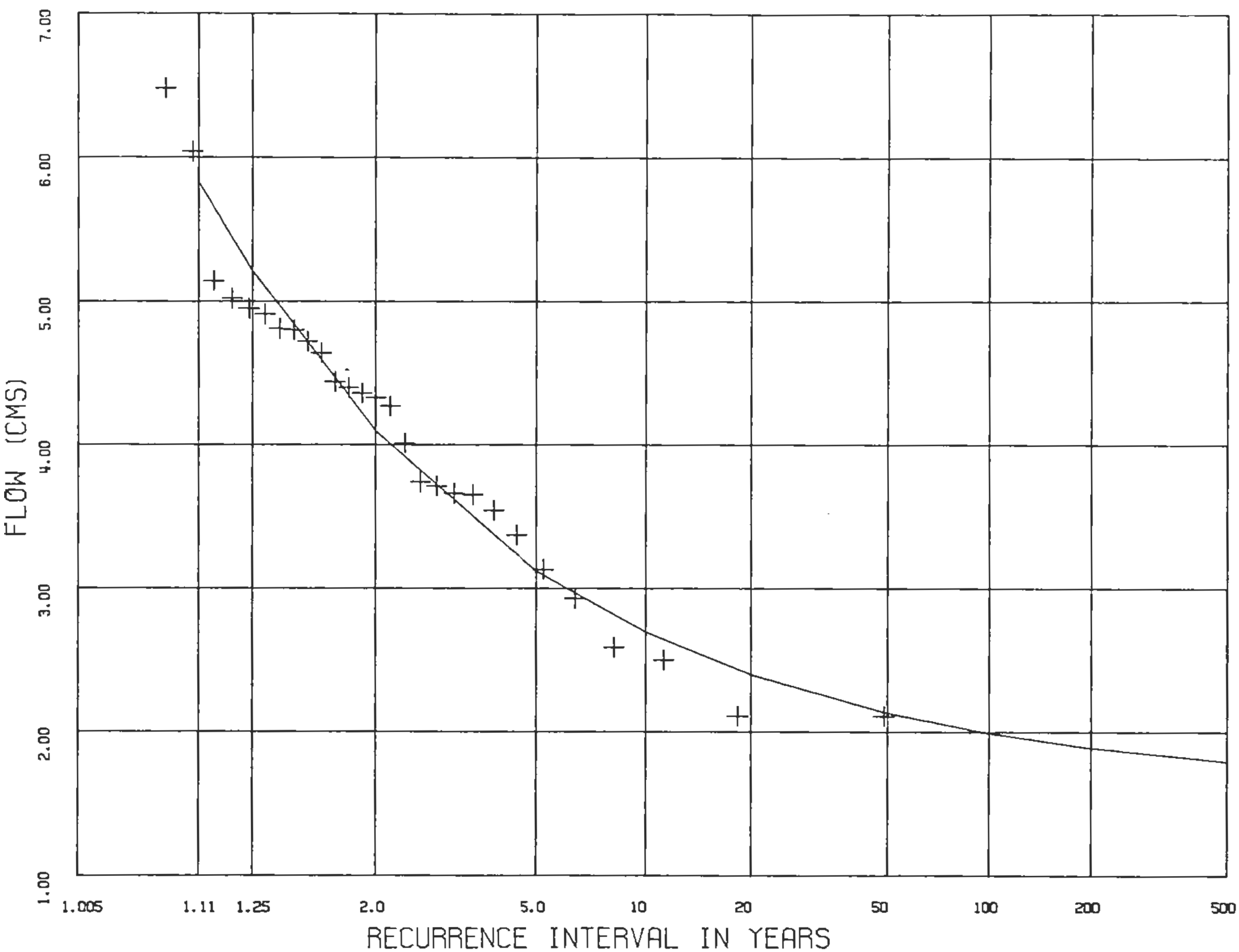
N= 29 XMIN= 2.11

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 2.28053 E= 1.6004 U= 4.5280

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	7.685
1.010	7.325
1.110	5.828
1.250	5.207
2.000	4.093
5.000	3.117
10.000	2.692
20.000	2.396
50.000	2.129
100.000	1.990
200.000	1.887
500.000	1.792

TORRENT RIVER (02YC001)



LOW FLOW FREQENCY ANALYSIS

WSC STATION NO. : 02YD001   VERSION: 0   N-DAY MEAN DURATION: 1
WSC STATION NAME: BEAVER BROOK NEAR RODDICKTON
JATER SEASON (MONTH/DAY) FROM JAN 1 TO DEC 31

SEQ.NO.	YEAR	MON	FLOW
1	1960	8	0.300
2	1961	3	0.425
3	1962	2	0.685
4	1963	3	0.864
5	1964	3	0.569
6	1965	9	1.060
7	1966	3	0.657
8	1967	4	0.708
9	1968	8	0.725
10	1969	9	1.550
11	1970	3	0.161
12	1971	3	1.420
13	1972	3	0.385
14	1973	2	0.399
15	1974	2	0.218
16	1975	2	0.425
17	1976	3	0.283
18	1977	3	0.651
19	1978	4	0.456

02YD001 0 1 BEAVER BROOK NEAR RODDICKTON
1 DAY LOW FLOW MEAN DISCHARGE IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL. (%)	RETURN PERIOD (YEARS)
8	1960	0.3000	0.1610	1	3.12	32.00
3	1961	0.4250	0.2180	2	8.33	12.00
2	1962	0.6850	0.2830	3	13.54	7.38
3	1963	0.8640	0.3000	4	18.75	5.33
3	1964	0.5690	0.3850	5	23.96	4.17
9	1965	1.0600	0.3990	6	29.17	3.43
3	1966	0.6570	0.4250	7	34.37	2.91
4	1967	0.7080	0.4250	8	39.58	2.53
8	1968	0.7250	0.4560	9	44.79	2.23
9	1969	1.5500	0.5690	10	50.00	2.00
3	1970	0.1610	0.6510	11	55.21	1.81
3	1971	1.4200	0.6570	12	60.42	1.66
3	1972	0.3850	0.6850	13	65.62	1.52
2	1973	0.3990	0.7080	14	70.83	1.41
2	1974	0.2180	0.7250	15	76.04	1.32
2	1975	0.4250	0.8640	16	81.25	1.23
3	1976	0.2830	1.0600	17	86.46	1.16
3	1977	0.6510	1.4200	18	91.67	1.09
4	1978	0.4560	1.5500	19	96.87	1.03

02YD001 0 1 BEAVER BROOK NEAR RODDICKTON
1 DAY LOW FLOW MEAN DISCHARGE IN PERIOD JAN 1 TO DEC 31
MEAN = 0.63 S.D. = 0.3786 SKEW = 1.2322 C.V. = 0.6024

GUMBEL III DISTRIBUTION - PARAMETERS BY MAXIMUM LIKELIHOOD
N = 19 XMIN = 0.161 A = 1.25882 E = 0.1512 U = 0.6628

RETURN PERIOD (YRS)	DROUGHT ESTIMATE
1.005	2.077
1.010	1.875
1.110	1.147
1.250	0.8980
2.000	0.5340
5.000	0.3070
10.000	0.2370
20.000	0.1990
50.000	0.1740
100.000	0.1640
200.000	0.1590
500.000	0.1550

BEAVER BROOK (02YD001)

7 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	7 DAY MEAN FLOW (CMS)	ASCENDING ORDER (CMS)	RANK	CUMULAT. PROBABIL. (%)	RETURN PERIOD (YEARS)
8	1960	0.3370	0.1920	1	3.12	32.00
3	1961	0.4430	0.2290	2	8.33	12.00
2	1962	0.7850	0.3000	3	13.54	7.38
3	1963	0.9210	0.3370	4	18.75	5.33
2	1964	0.7250	0.4000	5	23.96	4.17
9	1965	1.1370	0.4360	6	29.17	3.43
3	1966	0.6990	0.4430	7	34.37	2.91
4	1967	0.7180	0.4470	8	39.58	2.53
8	1968	0.8150	0.4640	9	44.79	2.23
9	1969	1.6200	0.6770	10	50.00	2.00
3	1970	0.1920	0.6990	11	55.21	1.81
3	1971	1.4400	0.7180	12	60.42	1.66
3	1972	0.4000	0.7250	13	65.62	1.52
2	1973	0.4470	0.7850	14	70.83	1.41
2	1974	0.2290	0.8150	15	76.04	1.32
2	1975	0.4360	0.9210	16	81.25	1.23
3	1976	0.3000	1.1370	17	86.46	1.16
3	1977	0.6770	1.4400	18	91.67	1.09
4	1978	0.4640	1.6200	19	96.87	1.03

BEAVER BROOK (02YD001)

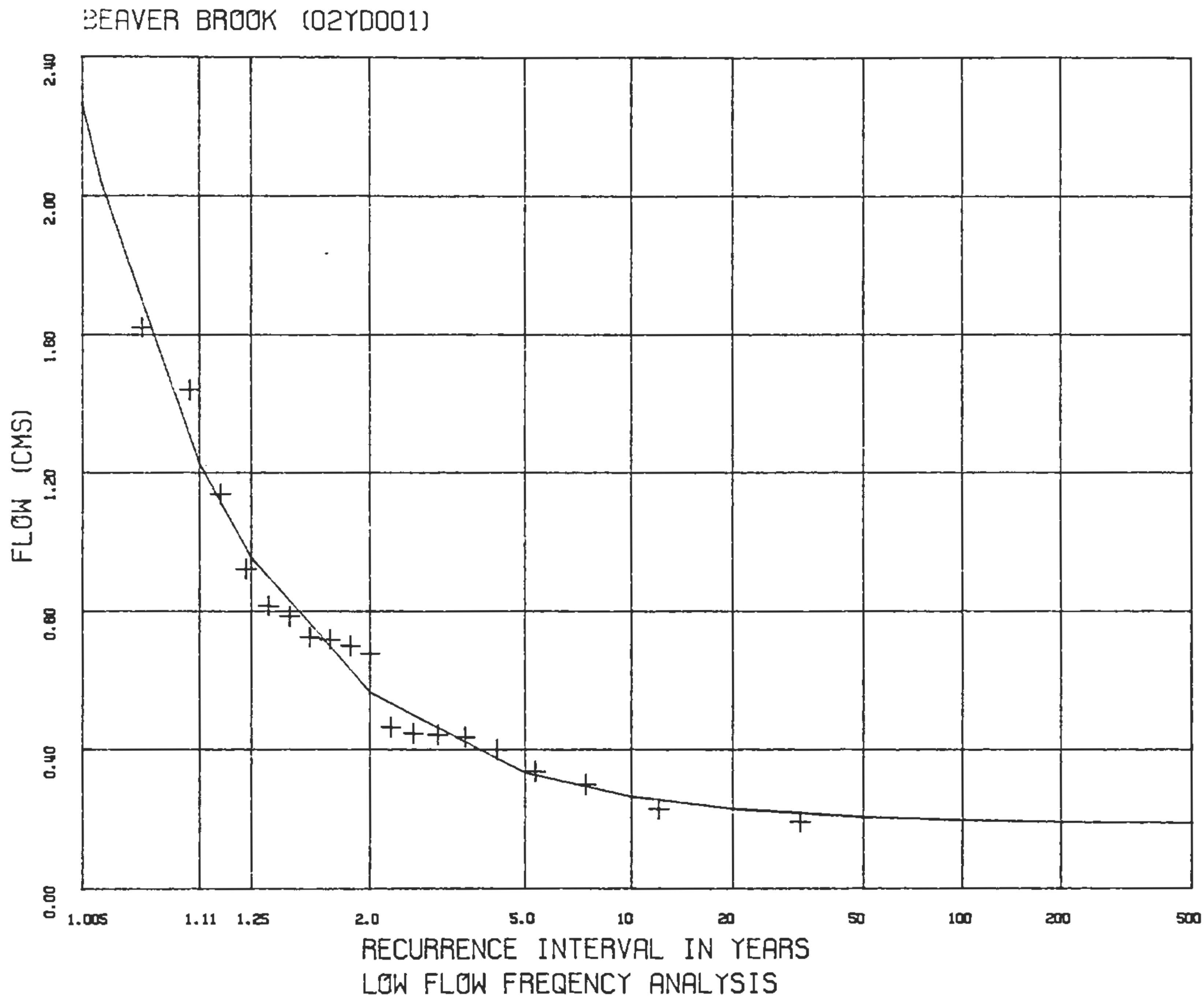
MEAN= 0.67 S.D.= 0.3915 SKEW= 1.1029 C.V.= 0.5818

N= 19 XMIN= 0.19

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 1.19778 E= 0.1845 U= 0.7011

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	2.264
1.010	2.037
1.110	1.224
1.250	0.9531
2.000	0.5649
5.000	0.3322
10.000	0.2635
20.000	0.2278
50.000	0.2044
100.000	0.1956
200.000	0.1907
500.000	0.1874


BEAVER BROOK (02YD001)
FLOW (CMS)
0.00
0.40
0.80
1.20
1.60
2.00
2.40
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LOW FLOW FREQENCY ANALYSIS

ST. GENEVIEVE RIVER (02YA001)

1 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	1 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
10	1970	4.5600	1.1900	1	3.12	32.00
3	1971	4.1100	1.3500	2	8.33	12.00
2	1972	1.1900	1.5700	3	13.54	7.38
10	1973	2.5600	1.7400	4	18.75	5.33
3	1974	1.9800	1.9800	5	23.96	4.17
3	1975	2.4900	2.0900	6	29.17	3.43
8	1976	3.0900	2.2900	7	34.37	2.91
3	1977	3.6800	2.3700	8	39.58	2.53
4	1978	3.2600	2.4900	9	44.79	2.23
7	1979	5.3500	2.5600	10	50.00	2.00
4	1980	3.0900	2.7900	11	55.21	1.81
9	1981	2.2900	3.0900	12	60.42	1.66
3	1982	3.1200	3.0900	13	65.62	1.52
3	1983	2.3700	3.1200	14	70.83	1.41
10	1984	2.0900	3.2600	15	76.04	1.32
2	1985	1.7400	3.6800	16	81.25	1.23
8	1986	1.5700	4.1100	17	86.46	1.16
2	1987	1.3500	4.5600	18	91.67	1.09
9	1988	2.7900	5.3500	19	96.87	1.03

ST. GENEVIEVE RIVER (02YA001)

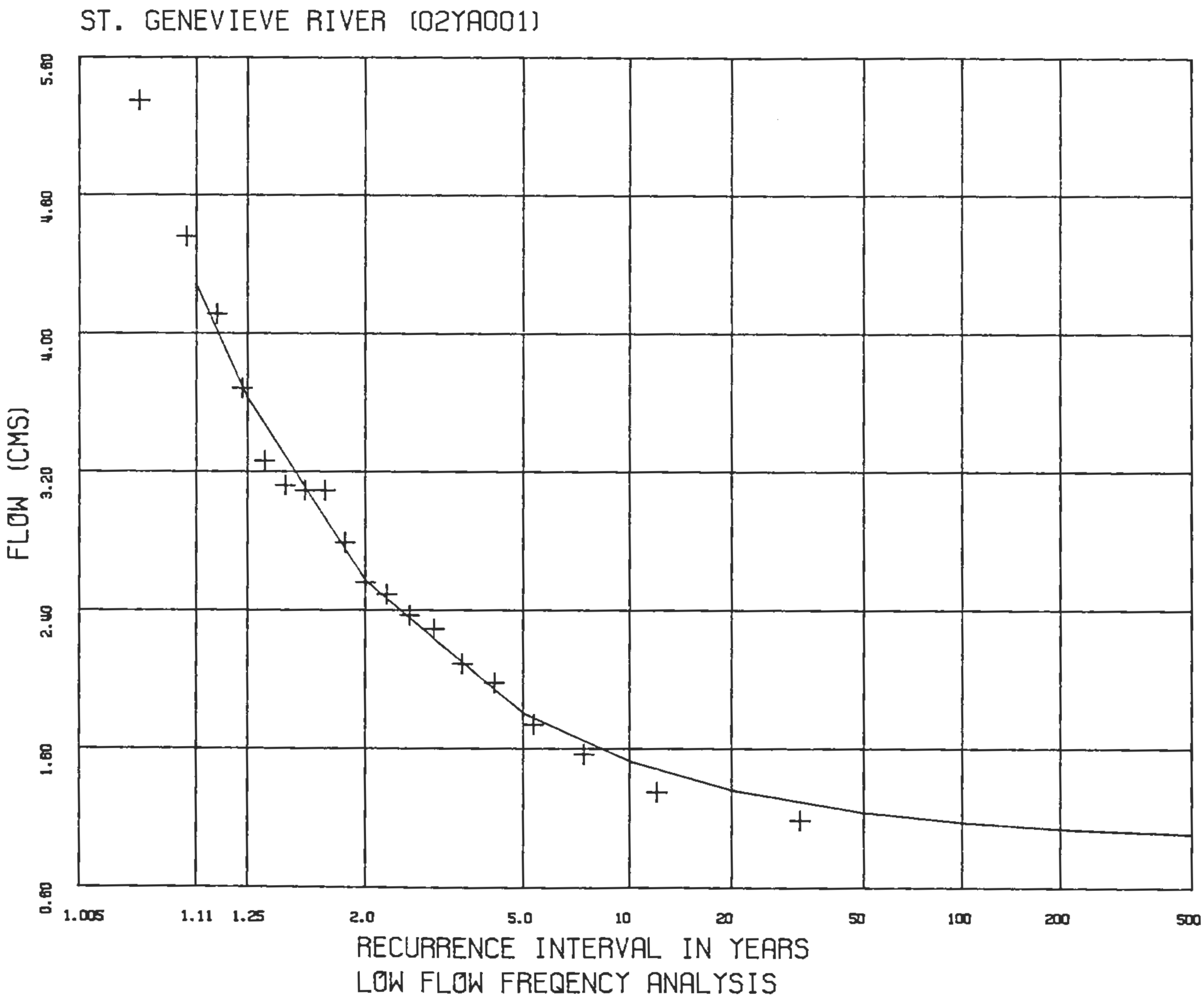
MEAN= 2.77 S.D.= 1.0971 SKEW= 0.7280 C.V.= 0.3957

N= 19 XMIN= 1.19

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 1.58236 E= 1.0714 U= 2.9602

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	6.492
1.010	6.036
1.110	4.279
1.250	3.623
2.000	2.570
5.000	1.803
10.000	1.527
20.000	1.360
50.000	1.232
100.000	1.175
200.000	1.138
500.000	1.109


ST. GENEVIEVE RIVER (02YA001)
FLØW (CMS)
5.60
4.80
4.00
3.20
2.40
1.60
0.80
1.005
1.11
1.25
2.0
5.0
10
20
50
100
200
500
RECURRENCE INTERVAL IN YEARS
LØW FLØW FREQENCY ANALYSIS

ST. GENEVIEVE RIVER (02YA001)

7 DAY LOW FLOW MEAN DISCH. IN PERIOD JAN 1 TO DEC 31

STARTING MONTH	YEAR	7 DAY MEAN FLOW	ASCENDING ORDER	RANK	CUMULAT. PROBABIL.	RETURN PERIOD
		(CMS)	(CMS)		(%)	(YEARS)
10	1970	4.8720	1.2190	1	3.12	32.00
3	1971	4.1530	1.3840	2	8.33	12.00
2	1972	1.2190	1.6730	3	13.54	7.38
10	1973	3.2640	1.7890	4	18.75	5.33
3	1974	2.0370	2.0370	5	23.96	4.17
3	1975	2.5480	2.1834	6	29.17	3.43
8	1976	3.2480	2.4420	7	34.37	2.91
3	1977	3.8470	2.5480	8	39.58	2.53
4	1978	3.2800	2.7000	9	44.79	2.23
7	1979	5.5980	3.1600	10	50.00	2.00
4	1980	3.1860	3.1860	11	55.21	1.81
9	1981	2.7000	3.2160	12	60.42	1.66
3	1982	3.2160	3.2480	13	65.62	1.52
3	1983	2.4420	3.2640	14	70.83	1.41
10	1984	2.1834	3.2800	15	76.04	1.32
2	1985	1.7890	3.8470	16	81.25	1.23
8	1986	1.6730	4.1530	17	86.46	1.16
2	1987	1.3840	4.8720	18	91.67	1.09
9	1988	3.1600	5.5980	19	96.87	1.03

ST. GENEVIEVE RIVER (02YA001)

MEAN= 2.94 S.D.= 1.1487 SKEW= 0.6188 C.V.= 0.3911

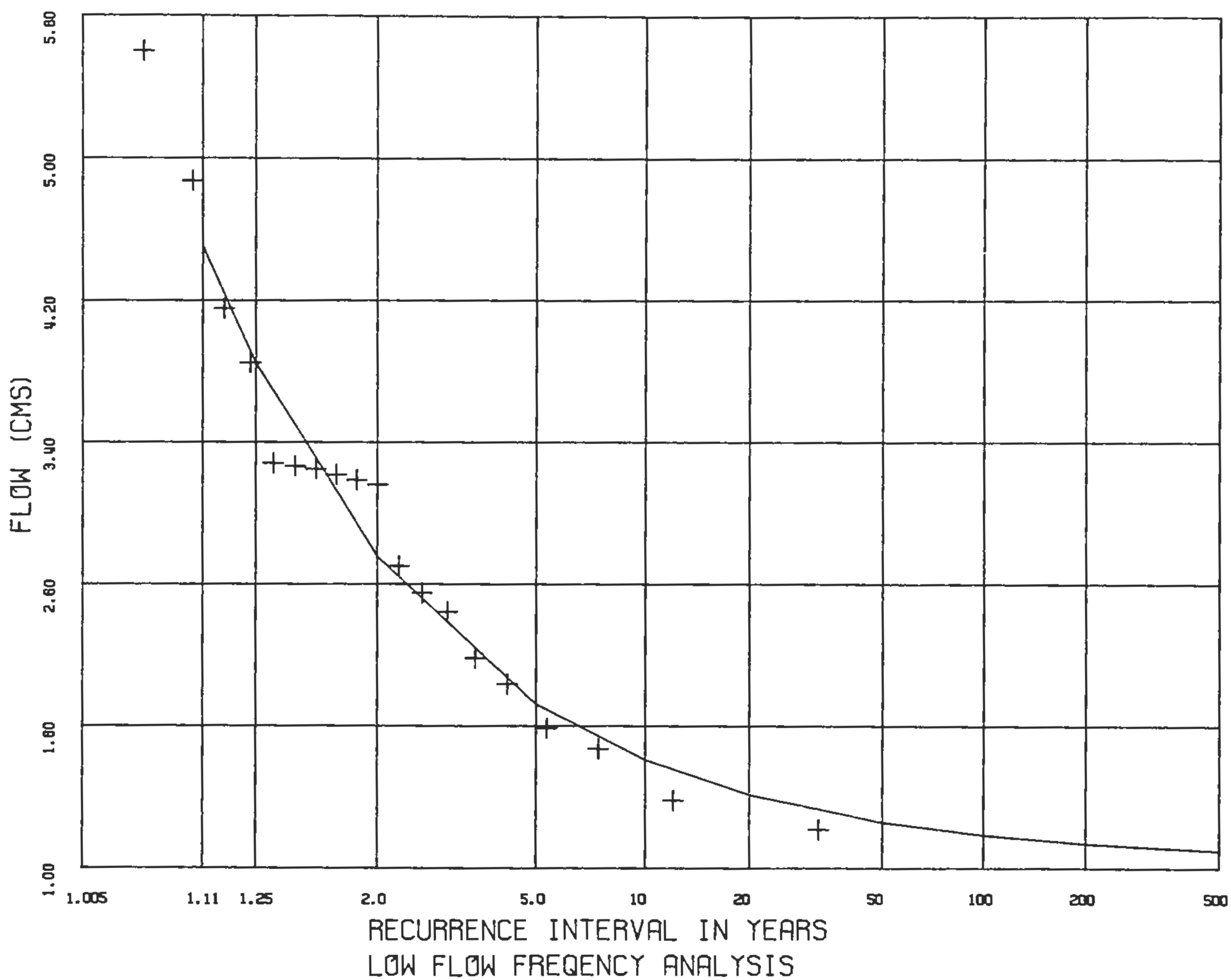
N= 19 XMIN= 1.22

PARAMETERS BY MAXIMUM LIKELIHOOD

A= 1.70703 E= 1.0409 U= 3.1599

RETURN PERIOD (YRS)	DROUGHT ESTIMATE (CMS)
1.005	6.672
1.010	6.231
1.110	4.503
1.250	3.841
2.000	2.750
5.000	1.921
10.000	1.608
20.000	1.413
50.000	1.256
100.000	1.184
200.000	1.136
500.000	1.097

ST. GENEVIEVE RIVER (02YA001)



Appendix C

Detailed Comparison of Low Flow Prediction Methods

Appendix C

Detailed Comparison of Low Flow Prediction Methods

Table C-1 gives the detailed results of the low flow prediction methods, including the parameters calculated when each basin was withheld in turn, and PRESS and ordinary residuals. The notation $Q\hat{}_{i,-i}$ is used to refer to the predicted value when the observation for basin i was withheld.

None of the three equations is very good, however, as the plots of the predicted values and the standardized residuals in Figures C-1 and C-3 show.

Table C1
Comparison of Predictive Models (Equations)

Data Set	Gauge Name	Mean Annual Flow (m3/s)	Dep Var 1:10(7) Qlow (m3/s)	Ratio Qlow/ Qavg	Independent Variables DA (km2)	FLSAR	L & S
1	Lew Brk	17.3	1.608	*****	470	0.16	75.52
2	Upp Humb	80.7	5.159	*****	2110	0.11	242.2
3	Cat Arm	25.7	0.836	*****	611	0.13	80.3
4	Hinds Brk	16.4	2.039	*****	529	0.36	187.9
5	Sheff Brk	11.1	0.949	*****	391	0.17	67.06
6	Torrent R	25.5	2.692	*****	624	0.17	104.3
7	Beaver B	8.87	0.264	*****	237	0.08	19.49
8	Ste Gen R	8.83	1.608	*****	306	0.35	108.4
			1.89	*****			
			1.42	*****			

Model 1: Qlow = a * Qavg, where a = mean Qlow/Qavg

Gauge dropped from analysis i	Constants a	Q^i,-i	Q^i (from 0)	Qlow	Residuals Press	rdinar	Residuals squared (Q^i,-i -Qlow)^2	(Q^i - low)^2
All in	0.0896	-						
LB	0.0891	1.541	1.550	1.608	-0.067	*****	0.005	0.003
UH	0.0932	7.522	7.231	5.159	2.363	2.072	5.586	4.292
CA	0.0977	2.511	2.303	0.836	1.675	1.467	2.804	2.151
HB	0.0846	1.387	1.469	2.039	-0.652	*****	0.425	0.324
SR	0.0901	1.000	0.995	0.949	0.051	0.046	0.003	0.002
TR	0.0873	2.225	2.285	2.692	-0.467	*****	0.218	0.166
BB	0.0981	0.870	0.795	0.264	0.606	0.531	0.367	0.282
StG	0.0763	0.674	0.791	1.608	-0.934	*****	0.872	0.667
				Sum |AB	6.815			
					Press statistic ->		10.28	7.89
			Mean	1.89		s.e.=S	1.31	1.15
				1.42		Resid^2/(n-2)		

Table C1 (cont'd)
Comparison of Predictive Models

Model 2: Qlow = a * DA^b1

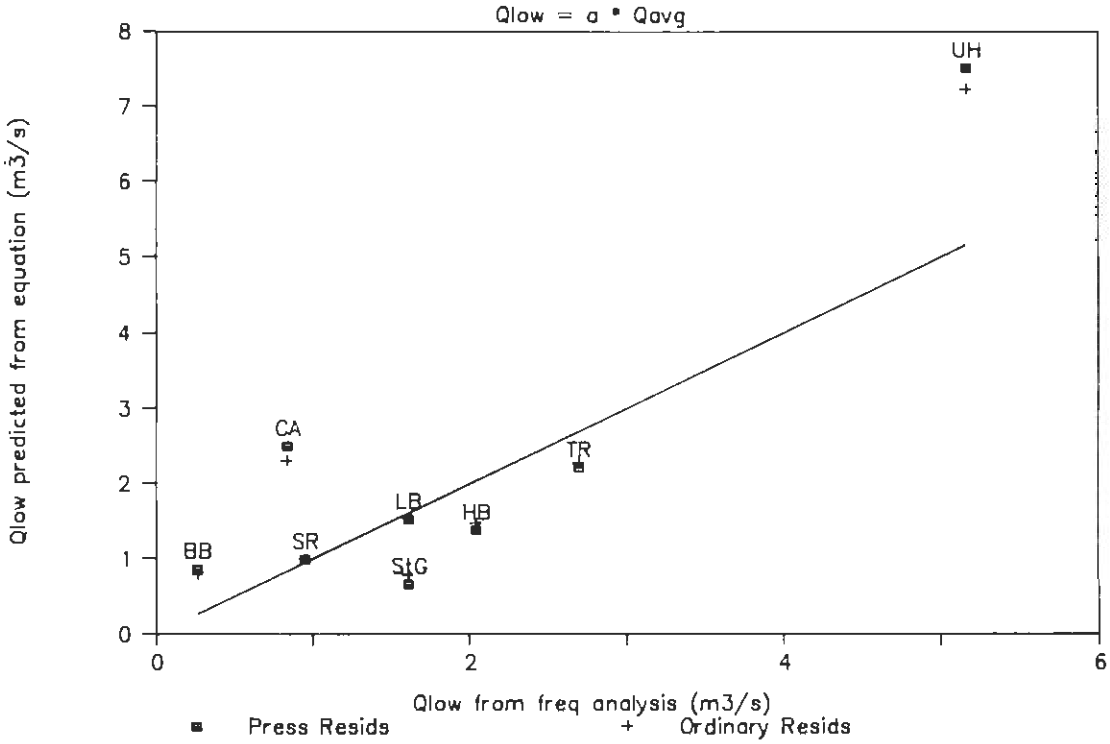
Gauge dropped from analysis							Residuals		Residuals squared	
	Constants						Press	Ordinar	Press	Ordinary
i	ln(a)	a	b1	Q^i,-i	Q^i (from all)	Qlow	(Q^i,-i -Qlow)	(Q^i - Qlow)	(Q^i,-i -Qlow)^2	(Q^i - Qlow)^2
All in	-6.320	0.00180	1.064	-						
LB	-6.420	0.00163	1.074	1.207	1.253	1.608	-0.401	-0.355	0.161	0.126
UH	-8.520	0.00020	1.431	11.399	6.194	5.159	6.240	1.035	38.935	1.071
CA	-6.470	0.00155	1.104	1.845	1.657	0.836	1.009	0.821	1.017	0.674
HB	-6.360	0.00173	1.063	1.358	1.421	2.039	-0.681	-0.618	0.464	0.381
SR	-6.250	0.00193	1.054	1.042	1.031	0.949	0.093	0.082	0.009	0.007
TR	-6.190	0.00205	1.033	1.582	1.695	2.692	-1.110	-0.997	1.233	0.995
BB	-4.110	0.01641	0.736	0.918	0.605	0.264	0.654	0.341	0.428	0.116
StG	-7.450	0.00058	1.226	0.649	0.794	1.608	-0.959	-0.814	0.920	0.663

		Sum |	11.147		
		Press statistic ->		43.17	4.03 SSR
Mean	1.89		s.e.=SQ	2.68	0.82
Std dev	1.42		Resid^2/(n-2)		

Model : Qlow = a * DA^b1 * L&S^b2

Gauge dropped from analysis								Residuals		Residuals squared	
	Constants							Press	Ordinary	Press	Ordinary
i	ln(a)	a	b1	b2	Q^i,-1	Q^i (from all)	Qlow	(Q^i,-i -Qlow)	(Q^i - Qlow)	(Q^i,-i -Qlow)^2	(Q^i - Qlow)^2
All in	-5.469	0.00422	0.279	0.905	-						
LB	-5.582	0.00376	0.279	0.920	1.116	1.172	1.608	-0.492	-0.436	0.242	0.190
UH	-5.335	0.00482	0.252	0.910	4.924	5.110	5.159	-0.235	-0.049	0.055	0.002
CA	-5.649	0.00352	0.373	0.829	1.461	1.332	0.836	0.625	0.496	0.391	0.246
HB	-5.207	0.00548	0.090	1.124	3.468	2.763	2.039	1.429	0.724	2.041	0.524
SR	-5.425	0.00441	0.274	0.904	1.009	1.000	0.949	0.060	0.051	0.004	0.003
TR	-5.342	0.00478	0.248	0.904	1.580	1.698	2.692	-1.112	-0.994	1.236	0.987
BB	-5.110	0.00604	0.317	0.779	0.346	0.284	0.264	0.082	0.020	0.007	0.000
StG	-5.793	0.00305	0.381	0.829	1.312	1.442	1.608	-0.296	-0.166	0.088	0.028

		Sum |ABS	4.330		
		Press statistic ->		4.06	1.98
Mean	1.89		s.e.=SQR	0.82	0.63
Std de	1.42		Resid^2/(n-3)		



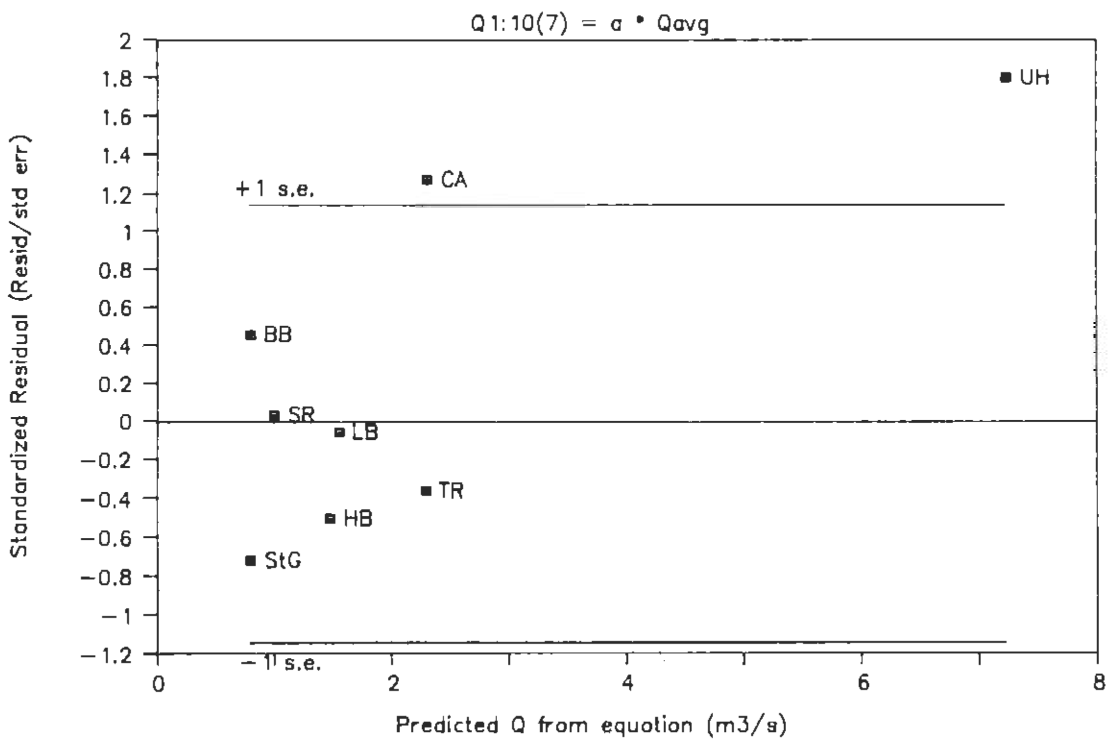


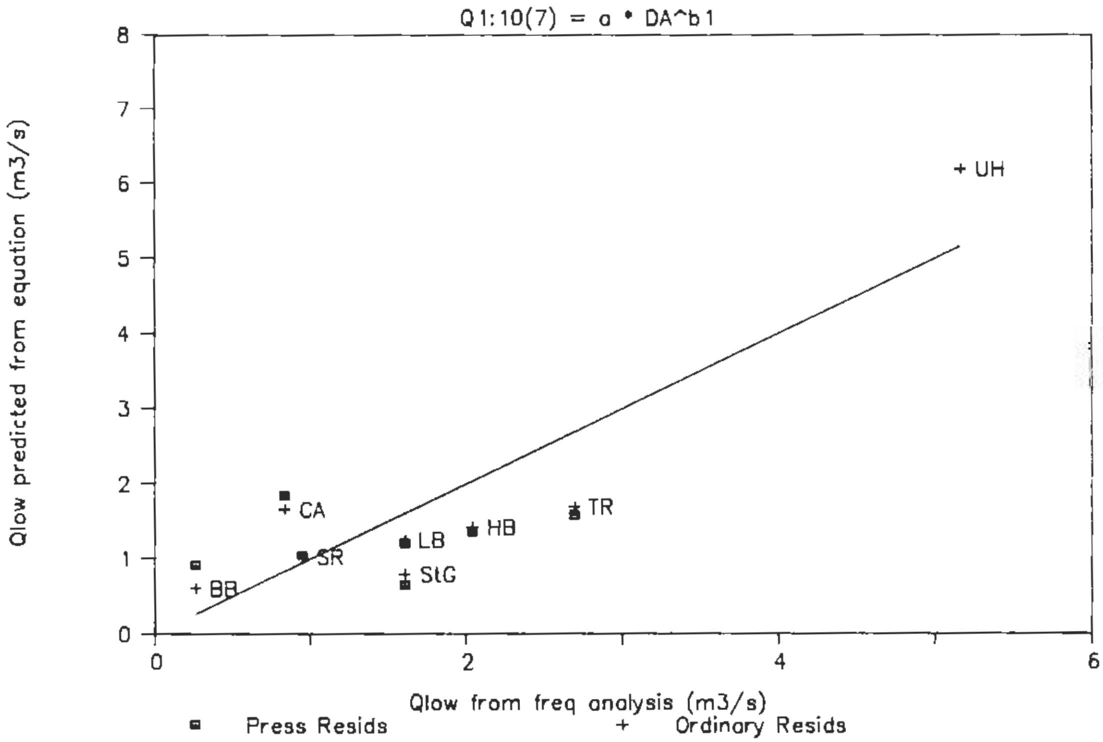
Fig. C–1

Department of Environment and Lands
Water Resources Division

Regional Water Resources Study
Humber Valley and Northern Penninsula

Predicted Values & Residuals, Equation 1

ACRES



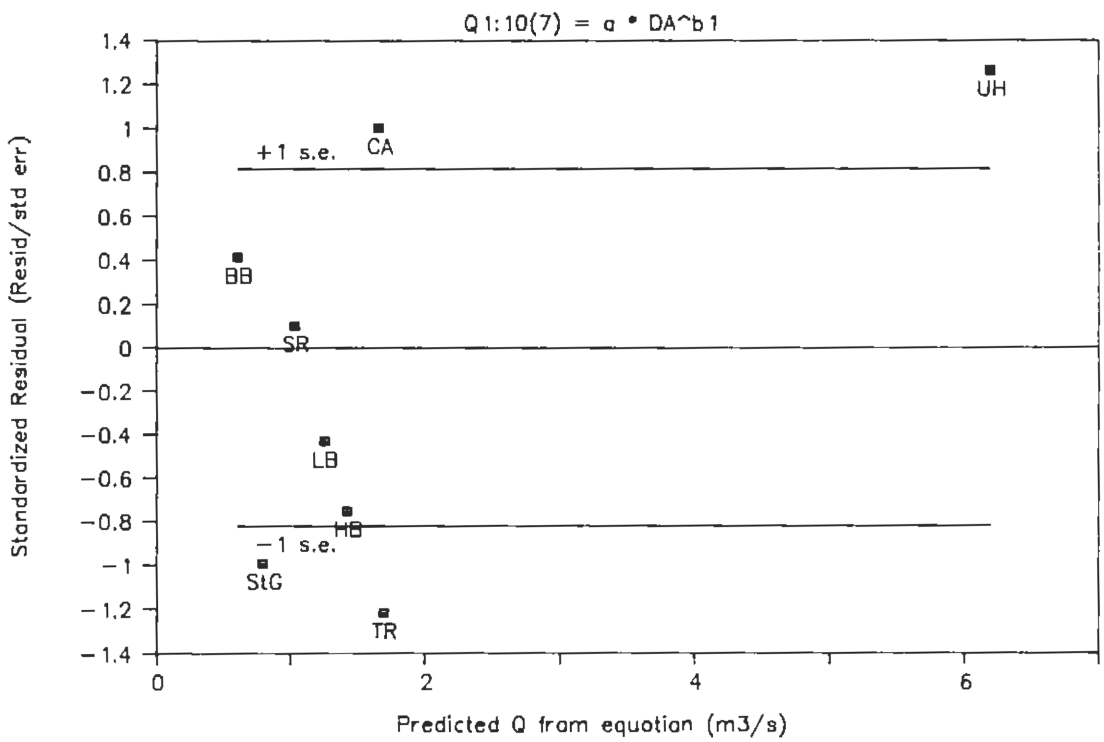


Fig. C-2

Department of Environment
and Lands
Water Resources Division

Regional Water Resources Study
Humber Valley and Northern Penninsula

Predicted Values & Residuals, Equation 2

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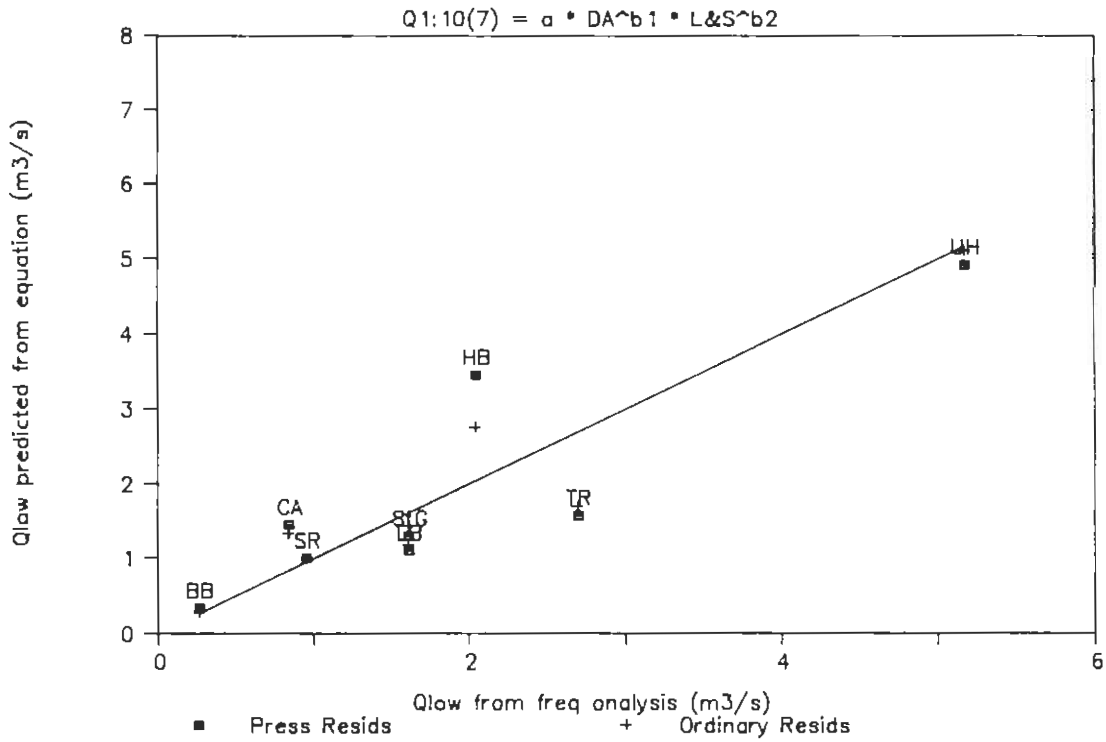

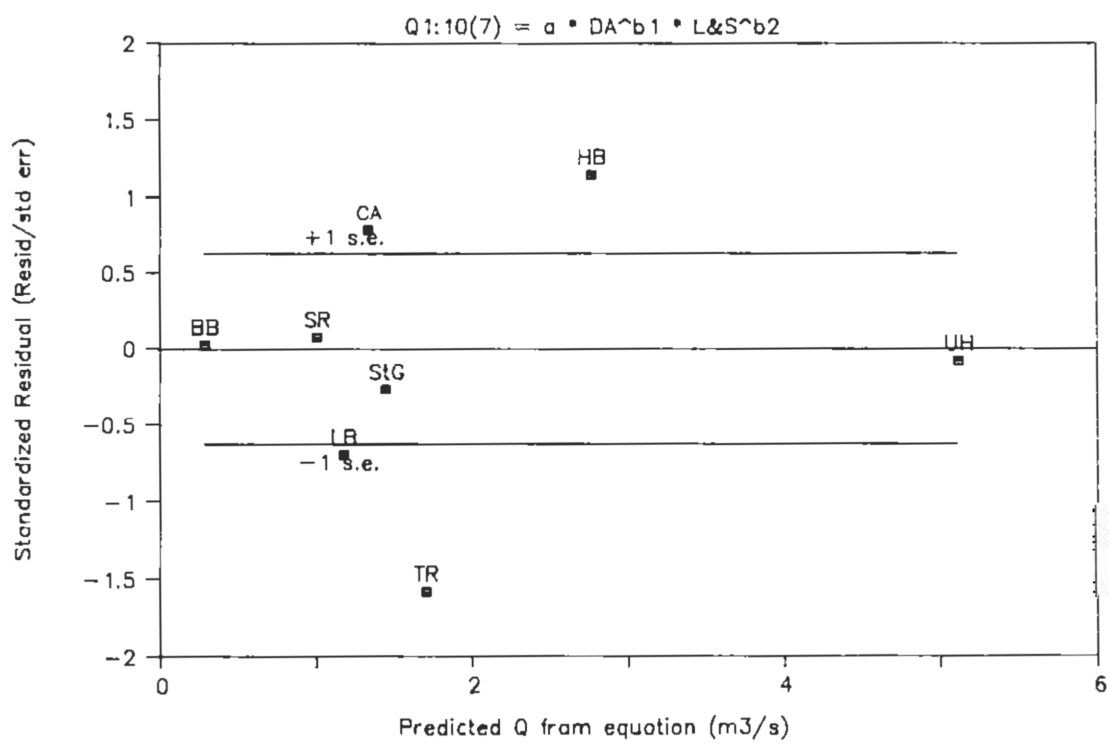

Fig. C-3

Department of Environment and Lands
Water Resources Division

Regional Water Resources Study
Humber Valley and Northern Penninsula

Predicted Values & Residuals, Equation 3

ACRES

Appendix D

Inventory of Water Supply Systems

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Department of Environment and Lands
St. John's, Newfoundland

Regional Water Resources Study of The Northern Peninsula and Humber Valley

Inventory of Water Supply Systems
Appendix D

June, 1990

Acres International Limited
St. John's, Newfoundland

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Table of Contents

1.0 Introduction

This inventory is Appendix D to the Regional Water Resources Study of the Humber Valley and Northern Peninsula carried out by Acres International Limited. The Water Resources Study provides information to assist in the planning and management of the water resources of the Northern Peninsula and Humber Valley.

The inventory of surface water supply systems acts as a data source for the Water Resources Study. The inventory therefore concentrates on detailed water resources data for each community, particularly available storage, locations of major structures and reported performance of the existing system. Other information was obtained verbally on municipal demand, water quality and transmission/distribution systems, sometimes backed up by drawings or reports.

Figure D-1 shows the locations of all the communities included in this inventory.

1.1 Approach

A standard report format by community was developed. The information contained in the inventory is discussed below.

Status: From Department of Municipal and Provincial Affairs (DMPA) 1986 Municipal Directory, and Local Service Directory.

Population: Statistics Canada census data.

Information Sources: Sources of data. Where government departments are named, more than one person in the department may have contributed.

Existing Water Supply: Information on ponds, dams, intakes, spillways from various sources, including reports, drawings, residents, engineers, visual inspection, DMPA technicians, community officials.

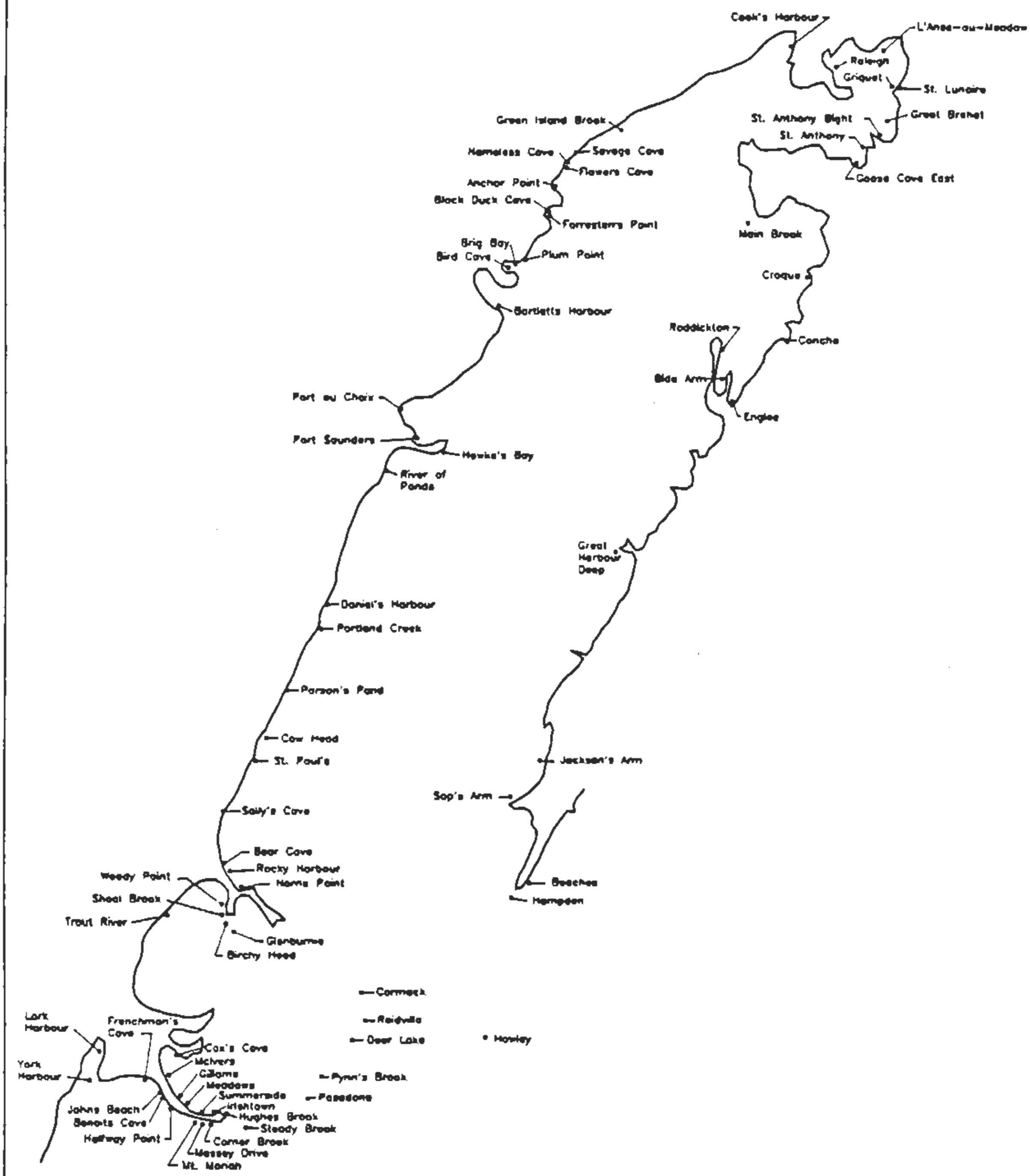

Fig. D.1

Department of Environment
and Lands
Water Resources Division

Regional Water Resources Study
Humber Valley and Northern Peninsula

Locations of Communities

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Status of Watershed Protection: Watershed protection is established under Section 25 of the Department of Environment Act. The reference document is the "Inventory of Domestic; Industrial and Fish Plant Water Supplies within the Province of Newfoundland, Eastern Region", Land Management Division of Forests, dated February 1986. The watershed officer in Corner Brook provided an up-to-date list.

Pond Area/Drainage Area: Occasionally available in a report, but usually taken from 1:50,000 scale mapping.

Reported Adequacy of Supply: DMPA and community officials were asked about the performance of the system in the past. If a system was reported to be inadequate, the problems could be low yield (drainage area or storage too small), leaks from the storage pond or distribution system, or pressure problems (usually undersized pipes).

Generally if there were leaks or pressure problems, community representatives or DMPA representatives were aware of the cause. Otherwise the inadequacy was assumed to be insufficient yield from the watershed. Very few communities had estimates of yield, so this question was addressed in the main report using the techniques developed in Chapter 2.

If a system was reported to be inadequate, with no leakage or distribution problems the supply/demand analysis usually confirmed that more storage or a larger drainage area was required to meet the demand. Since these results arise from the analysis, not from the inventory, they are presented in Chapter 6 of the main report.

Potential for Increased Storage: A function of topography.

Reported Demand: Information on domestic and industrial water use was obtained to supplement other data obtained as part of the supply/demand analysis in Chapter 6. Information on the number of connections was obtained if possible, for use in the main report to estimate the value of water supply systems.

Water Quality: Information on the method of treatment was obtained from DOEL and community officials. Information on water quality problems was obtained from community officials/residents. They are aware of bacteriological problems because Department of Health staff advise them of these. They are also the best judges of problems such as poor taste, silt, or algae, which are not tested for by Department of Health.

Future Plans Affecting Supply/Demand: DMPA officials provided data on future plans, since requests for funding come to them. Community officials were also asked what water supply proposals were in their plans.

Maps: Reproductions of 1:50,000 scale topographic maps are provided for surface supply systems, showing the location of the community, the drainage area, and other features of the system.

It should be noted that this inventory is for study purposes only. The information is not suitable for engineering design. Dimensions are frequently estimates, or approximate conversions from Imperial units.

The purpose of this inventory was to assemble data. Conclusions and recommendations on adequacy of the systems are presented as part of the main report.

2.0 Community Descriptions

Anchor Point

Status: Community

Population: 387 (1986 census)

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

"Water System Improvements", Terpstra Engineering. March 1979.

"Community of Anchor Point Water System Assessment", BAE Group. November 1987.

Existing Water Supply

Water Source(s):

Existing surface supply consists of dam and reservoir on brook from Well Cove Pond. Pumped supply.

Pond Area: 0.11 km^2

Drainage Area: 7 km^2

Live Storage Head: 0.7 m (assumed)

Existing Structures:

Concrete, approximately 4 m high at centerline. Crest el 12.5 m. New dam proposed with crest elevation 14-15 m.

Delivery System:

Water delivered to community by way of a 200 mm ductile iron transmission main which runs from the reservoir on Well Cove River to the existing well/distribution house. From here, water distributed by three main loops and one branch line. Waterlines 50 mm diameter, series 100 polyethylene pipe, adapted from old well system. 50 mm lines shallow buried.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply:

Pond froze to bottom February/March 1989. Adequate if water level is raised to account for ice, as proposed.

Potential for Increased Storage:

Not very good because of flat country.

Other Observations/Reported Problems:

Deficiency in storage mainly due to excessive demands placed on system as a result of leaks in the distribution piping (BAE Group report). Flow rates recorded at main pumphouse indicated excessive readings for community size of Anchor Point. Also problems with freezing.

Reported Demand

Domestic:

System servicing approximately 115 houses and number of small businesses.

Industrial:

Fish plant (12.6 litres/second maximum water demand) run by Peninsula Seafoods (fresh and frozen product). Has fresh and salt water supply, in plant chlorinator. Just opened shrimp operation which is very fresh water intensive.

Metering:

Meter at main pumphouse, but no data available.

Losses/Wastage:

Excessive losses reported due to leakage in distribution piping.

Water Quality

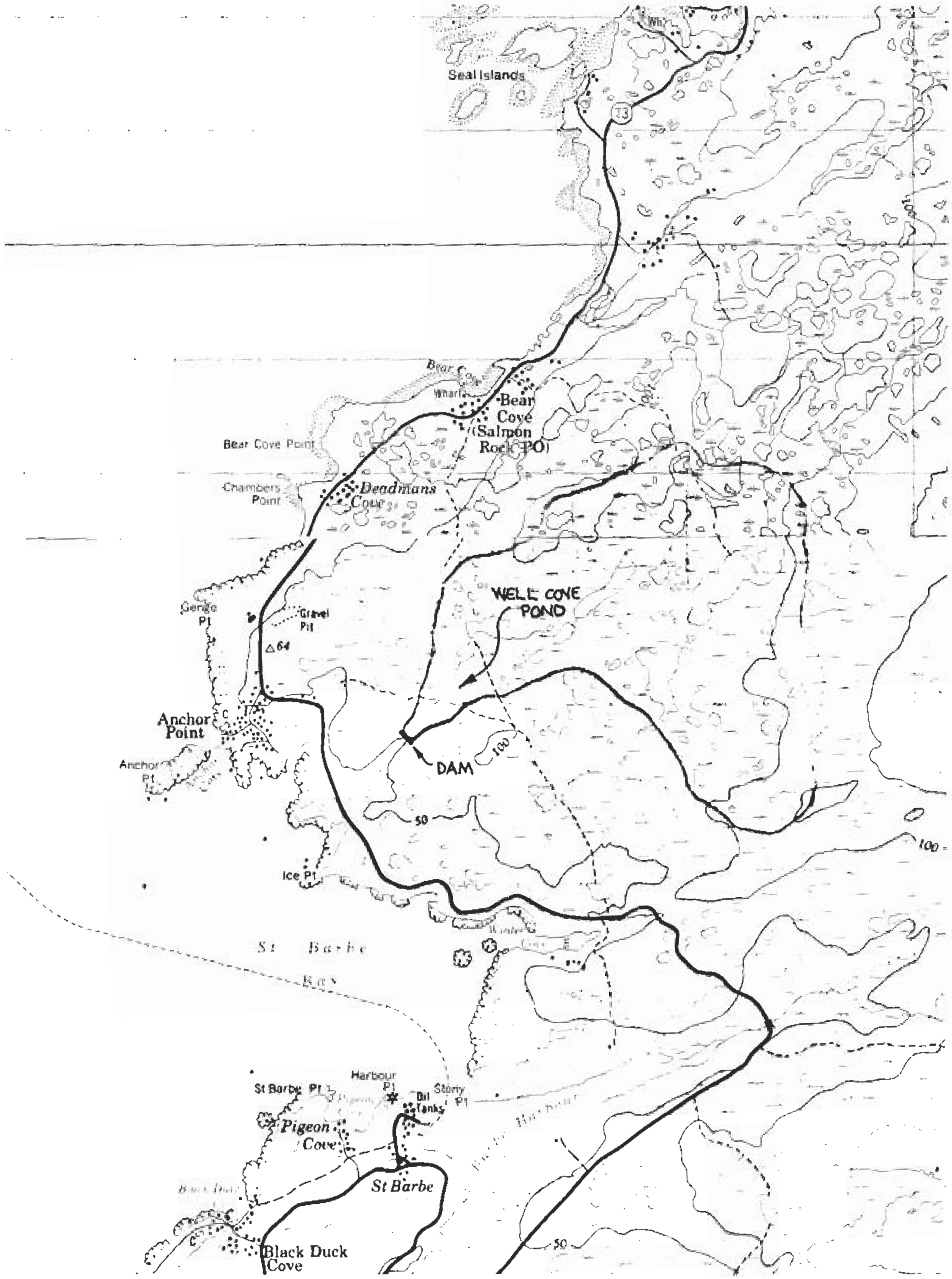
Method of Treatment: Chlorine gas.

Reported Observations/Problems:

Department of Health tests satisfactory. Wells near the ocean in this area can turn salty, but Anchor Point has a surface supply.

Future Plans Affecting Supply/Demand

Budget to repair leaks has been approved ($25,000). Municipal and Provincial 5-year plan includes replacement of existing lines. Wells farther inland could be an alternative solution to the new dam, but there are no plans for these.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ANCHOR POINT

ACRES

Bartlett's Harbour

Status: Local Service District

Population: 180

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Existing surface supply taken from Big Pond, east of town. Old system consisting of small dam on pond with intake into pond. Water pumped via 1.5 HP pump. Proposed system from Doctor's Pond (joint supply with fish plant.)

Pond Area: 3.43 km^2 (Doctor's Pond)

Drainage Area: 14.7 km^2 (Doctor's Pond)

Live Storage Head: 0.7 m (assumed)

Existing Structures: Wooden dam is in poor condition and leaks badly.

Delivery System: 75 mm and 37 mm diameter poly pipes.

Status of Watershed Protection: Neither Big Pond nor Doctor's Pond watersheds are protected.

Reported Adequacy of Supply: Doctor's Pond would be adequate but quality is dubious because of proximity to highway.

Potential for Increased Storage: Poor.

Reported Demand

Domestic: Approximately 40 homes connected to system.

Industrial:

Fish plant. Peninsula Seafoods - salt and fresh water supply (municipal). Fresh product only.

Metering: No metering on system.

Losses/Wastage: Dam leaks.

Water Quality

Method of Treatment: Chlorine compound.

Reported Observations/Problems:

Have had problems in past with bacteria/organic material. Probable cause is sewage effluent from houses getting into supply.

Future Plans Affecting Supply/Demand

Study has been completed for alternate supply for fish plant (Doctor's Pond). LSD has applied for funding. Wells farther inland might be a possibility if quality of Doctor's Pond is not suitable.

DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ACRES

BARTLETTS HARBOUR

Beaches

Status: Local Service District

Population: 75

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

A small dam near the mouth of Grassy Pond Brook provides a small reservoir for the intake.

Pond Area: No pond.

Drainage Area: 1.51 km^2

Live Storage Head: No storage.

Existing Structures: Small dam, intake, chlorinator.

Delivery System:

A 50 mm diameter main brings the water to the chlorinator plant near the highway at the south of the community.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Adequate.

Potential for Increased Storage:

Not required but possible with control structure at upstream pond.

Reported Demand

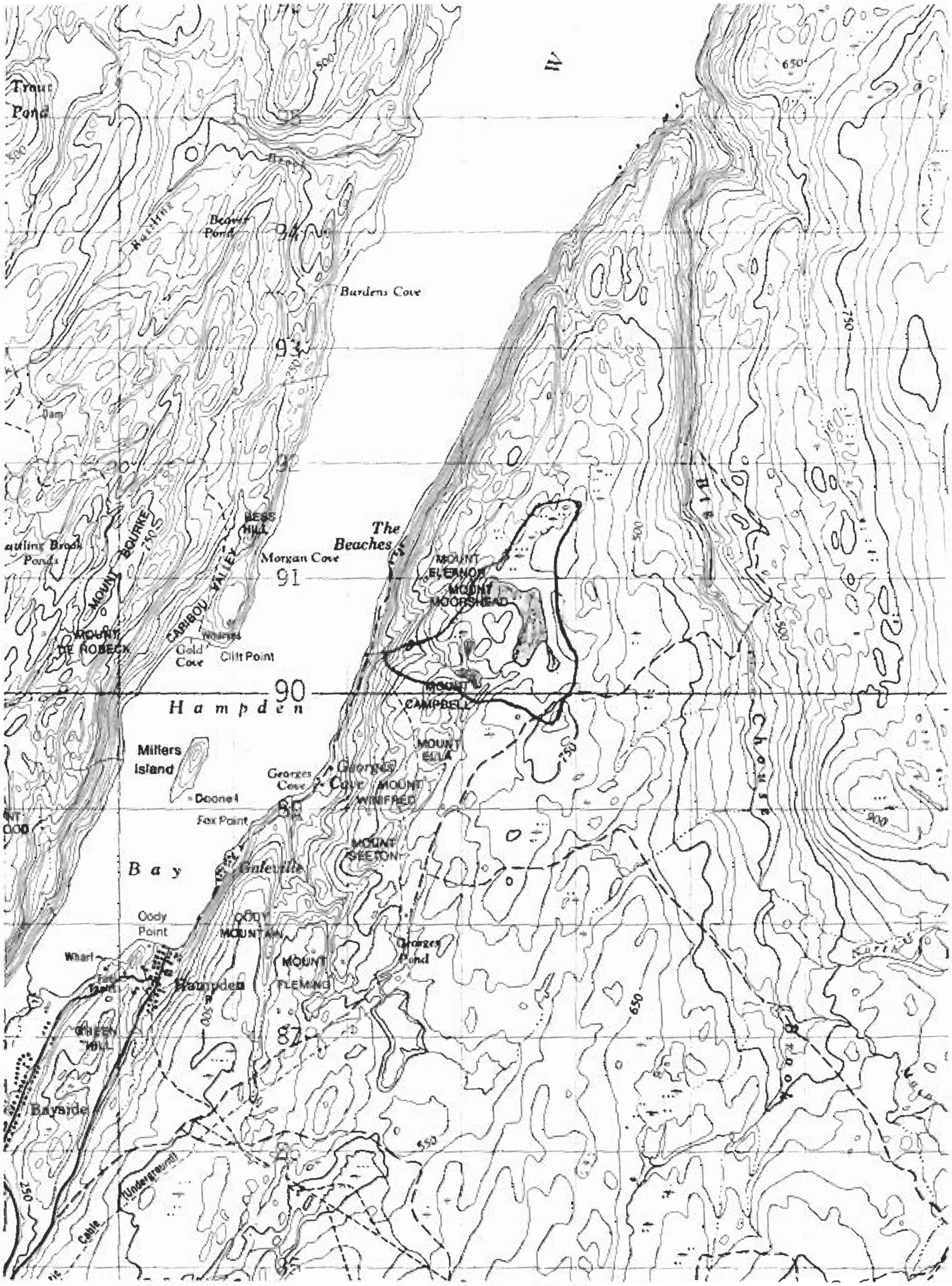
Domestic: All community served.

Industrial: None.

Water Quality

Method of Treatment: Chlorinated.

Reported Observations/Problems: None.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

THE BEACHES

ACRES

Bear Cove

Status: Local Service District

Population: 202

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

No municipal system. All private.

Delivery System: None.

Reported Adequacy of Supply: Not adequate. Two wells were drilled in the winter of 1990, one to supply each half of the community.

Reported Demand

Domestic: No municipal supply.

Industrial:

Fish plant - Conner Brothers (salt water supply). Very small plant - fresh and frozen product, salt fish.

Water Quality

Method of Treatment: None.

Bide Arm

Status: Community

Population: 341 (1986 census)

Information Sources:

Ms. Jean Rendell - Town Clerk.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

First Clay Pond (locally called Drinking Pond), supplied from Second Clay Pond. (Third Clay Pond is not in the same drainage area.)

Pond Area: 0.03 km^2

Drainage Area: 0.72 km^2

Live Storage Head: Depth of pond about 3 m (storage accessed by pumping).

Existing Structures: Concrete dam, about 180 m long, 1 m high. Pipe from intake has recently been replaced.

Delivery System: 200 mm diameter PVC water main.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Adequate, but storage must be accessed by pumping in the winter.

Potential for Increased Storage: Not required. Best potential is from upstream pond(s).

Other Observations/Reported Problems:

The community used to have shortages in winter, but since they have installed a submersible pump in the pond, they have increased the accessible storage.

Reported Demand

Domestic: About 60 houses.

Industrial: Peninsula Seafoods (no meter data).

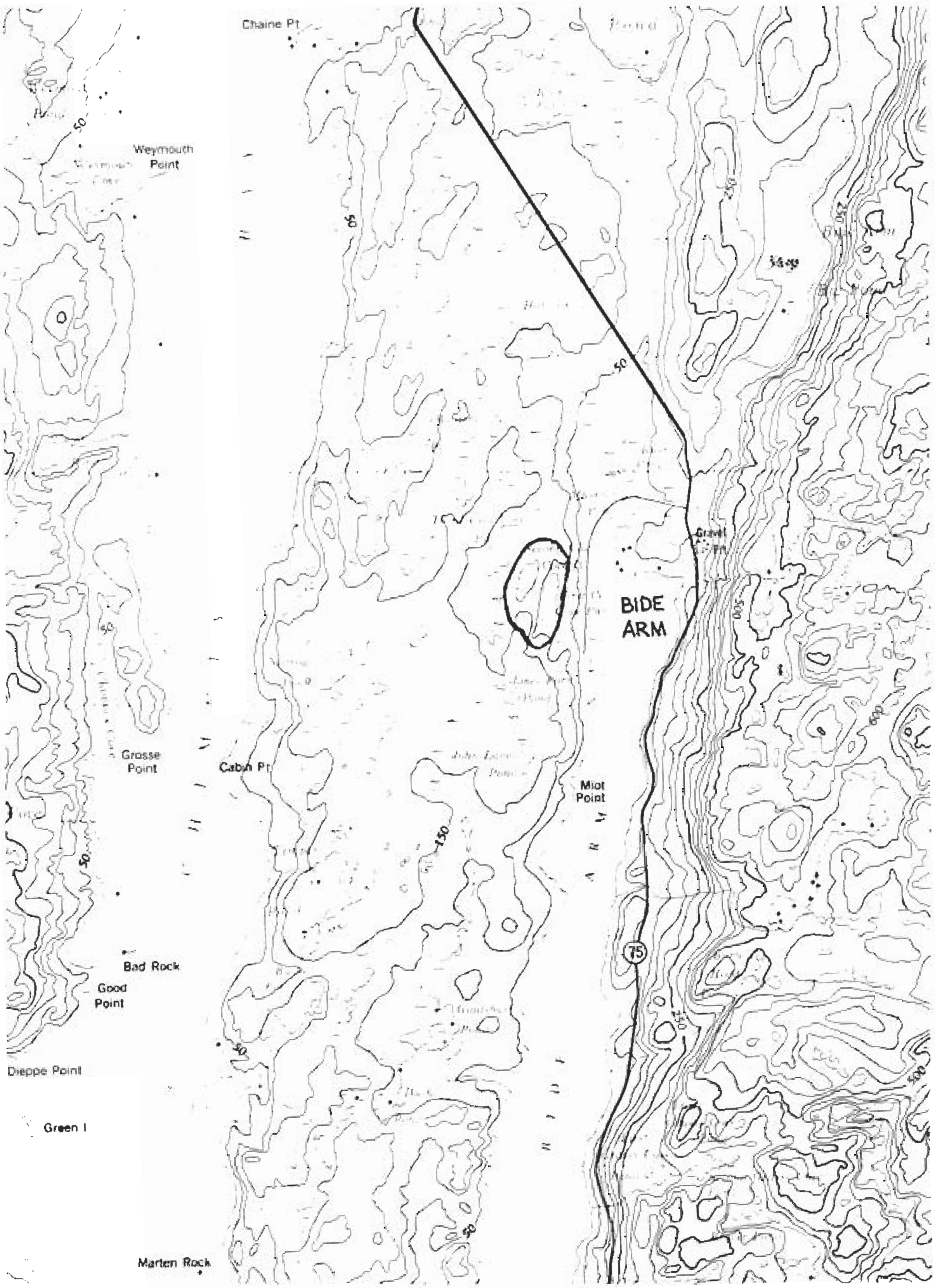
Water Quality

Method of Treatment: Chlorination.

Reported Observations/Problems: None.

Future Plans Affecting Supply/Demand

The town plans to divert Second Clay Pond to augment First Clay Pond and thus ensure security of supply. The five year plan includes some dam improvements.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

BIDE ARM

Bird Cove

Status: Community

Population: 394 (1986 census)

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

"Community of Bird Cove Investigation of Water Supply Problems."

Department of Municipal and Provincial Affairs, June 1984.

Mrs. Annette Myers (Town Clerk).

Existing Water Supply

Water Source(s):

Existing surface supply consists of pump in a concrete wet well, supplied from Ferolle Marsh Pond. Old system had intake in Long Pond but water quality problems due to the proximity of Long Pond to the community led to new system.

Pond Area: 0.34 km^2

Drainage Area: 1.52 km^2

Live Storage Head: About 0.6 m.

Existing Structures: No dam or spillway.

Delivery System: 50 mm diameter polyethylene pipe.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Adequate, but distribution problems reported.

Potential for Increased Storage: Poor, but not required.

Other Observations/Reported Problems:

Residents at the end of the line experience shortages because the line is too small (50 mm) and pump capacity is inadequate.

Reported Demand

Domestic: About 85 houses connected.

Industrial: None.

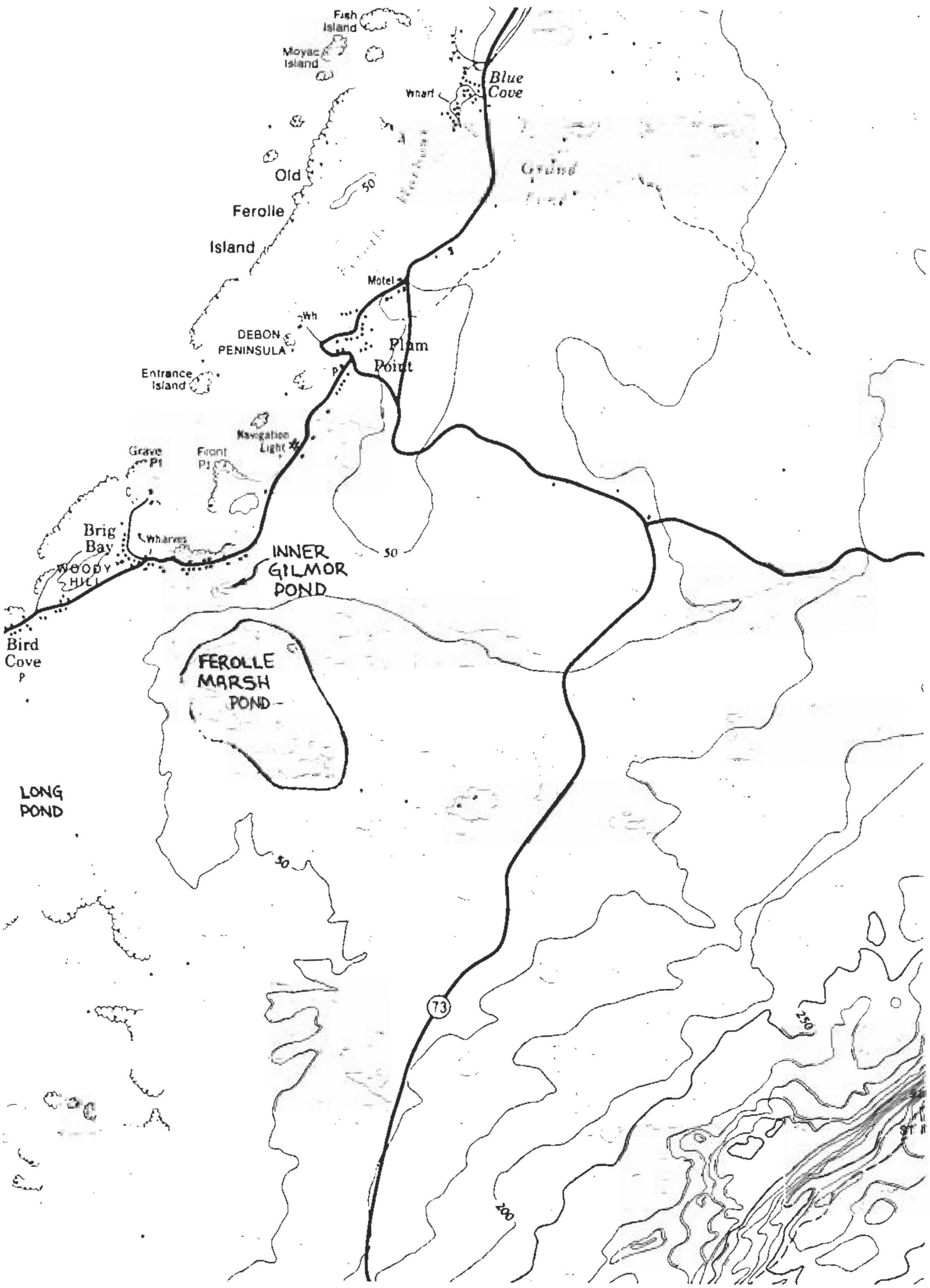
Water Quality

Method of Treatment: Chlorination.

Reported Observations/Problems: None reported.

Future Plans Affecting Supply/Demand

Municipal and Provincial Affairs report in 1984 recommended construction of a new water supply with intake at Ferolle Marsh Pond and new pumphouse and chlorination system. Also recommended that ties and joints in existing distribution system be replaced. Clerk reports that they didn't get enough money to finish the work.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

BIRD COVE, BRIG BAY

ACRES

Black Duck Cove

Status: Local Service District

Population: 181

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Existing Water Supply

Water Source(s):

Surface - Gravity feed system off small pond near community, fed from underground springs. Intake for surface supply is 100 mm PVC directly into pond. Surface supply constructed in 1971 by local forces.

Groundwater

Well #1 - owned by fish plant

Well #2 - community well

Well #3 - community well

Well #4 - abandoned

Well #5 - abandoned

Well #6 - private.

Pond Area: 0.043 km^2

Drainage Area: 0.55 km^2

Live Storage Head: 1.1 m (reduced due to ice in winter)

Existing Structures: No dam or spillway.

Delivery System:

180 m of 100 mm PVC across bog at 1.8 m depth. Pipe reduces to 50 mm polyethylene pipe for distribution to town. Out of 45 homes, 10-15 homes connected to this system.

Status of Watershed Protection: Unprotected.

Black Duck Cove

Reported Adequacy of Supply: Not adequate.

Pressures are low in higher areas of community, and sediment appears in water. Freezing of pond in winter results in partial or complete loss of flow. Also numerous leaks in system.

Potential for Increased Storage: Poor, flat country.

Reported Demand

Domestic:

Ten to fifteen houses connected to surface supply.

Well #2 - well serves 10 families

Well #3 - well serves 9 families

Well #6 - well serves 6 families.

Industrial: Well #1 - well services fish plant.

Metering: No metering.

Losses/Wastage: Numerous leaks in system.

Water Quality

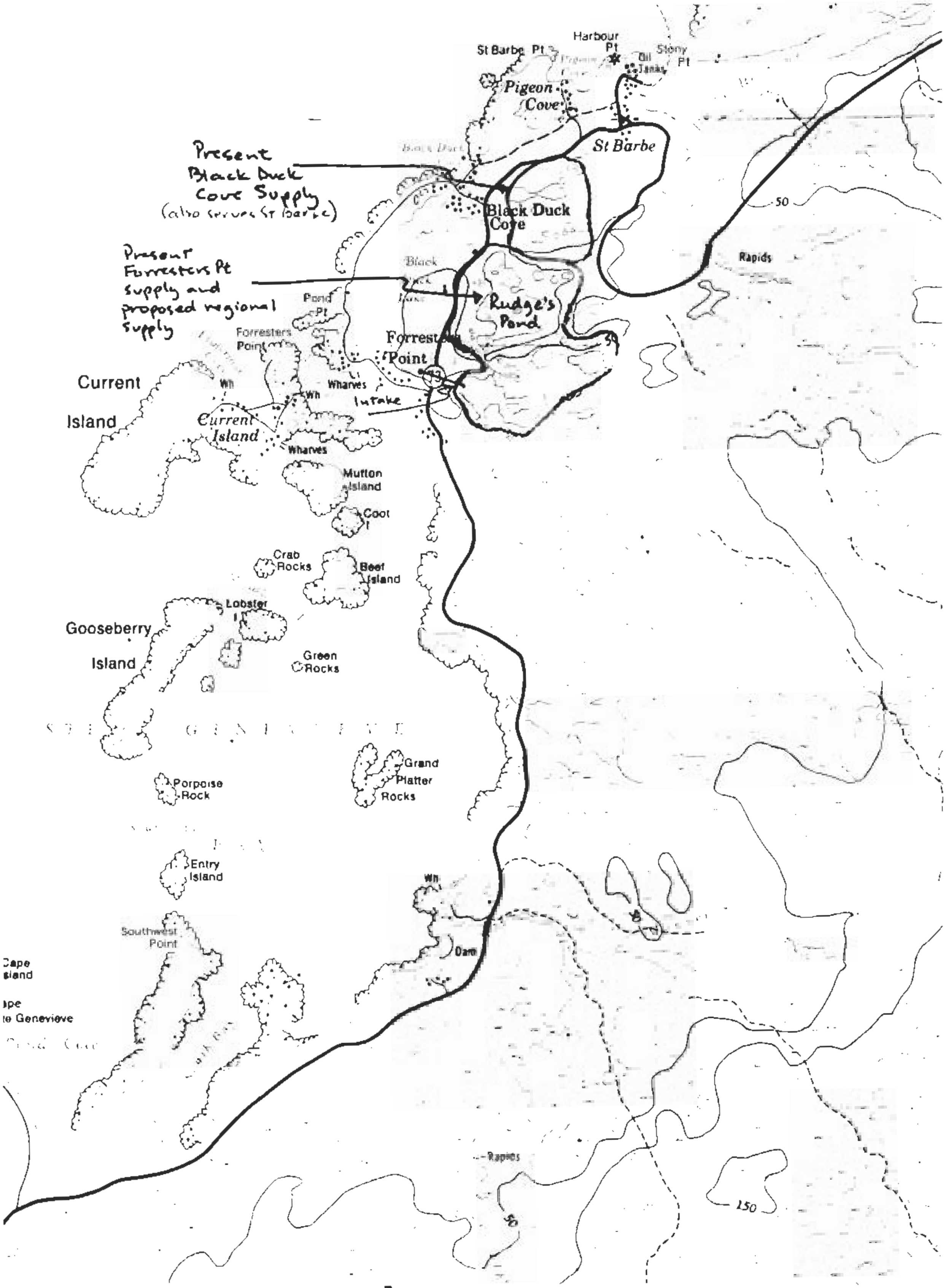
Method of Treatment: None.

Reported Observations/Problems:

Residents report high sediment content in water. Number one well is reported to be salty, #4 and #5 abandoned because of foul odor, high salt content. Other wells good (farther inland).

Future Plans Affecting Supply/Demand

The present system has degenerated to the point where it must undergo major repairs or be replaced. Black Duck Cove/Forresters Point/Pidgeon Cove/St. Barbe applied for funding in May 1988 for a regional supply using Rudges Pond (presently supplying Forresters Point). Funding has not yet been approved so Black Duck Cove is using federal funds for interim improvements (a pumphouse and pump).



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ACRES

BLACK DUCK CV., PIGEON CV. – ST. BARBE, FORRESTER'S PT.

Brig Bay

Status: Local Service District

Population: 169

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Inner Gilmor Pond, just to the north of Ferolle Marsh Pond, 100 m from road. Pond is shallow, rock bottom. About 1 m of ice cover last year. (See map for Bird Cove.)

Pond Area: 0.46 km^2

Drainage Area: 10.1 km^2

Live Storage Head: 1 m

Existing Structures:

No dam or spillway - intake only. A study is presently underway on the intake, location of pumps.

Delivery System:

50 mm line running behind the houses, buried in the bay.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply:

Pond is large. Except for ice, should have no problems with supply.

Potential for Increased Storage: Poor since land very flat all around.

Reported Demand

Domestic: About 60% of population served.

Industrial: Fish plant - Great Northern Seafoods (new plant ownership).

Water Quality

Method of Treatment: Chlorinated.

Reported Observations/Problems: None reported.

Future Plans Affecting Supply/Demand

Brig Bay could share supply with Bird Cove or perhaps better, with Plum Point (since Bird Cove's supply pond, Ferolle Marsh Pond, is shallow and bottom is easily stirred up). Plum Point has a surface water system from Plum Point Lake, about 7-8 km^2 in area. The intake is located where the brook leaves the pond. Water is pumped to the main lines, and Brig Bay could be connected. The water is somewhat hard, and occasionally has a slight odour.

SEE BIRD COVE MAP

DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY
BRIG BAY

ACRES

Conche

Status: Community

Population: 700

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

"Water and Sewage Study for Community of Conche", Island Engineering Co. Ltd. February 1980.

Existing Water Supply

Water Source(s):

Water obtained from private shallow wells or community artesian wells. One community well in Crouse and three in Conche, approximate depth of wells 40 m - 90 m. Hand pumps on wells. Fish plant, post office and school have own wells.

Yield:

Community wells: 15-25 litres/min

Fish plant: 30 litres/min

Post Office: 15 litres/min

School: 20 litres/min.

Reported Adequacy of Supply: Not adequate (some wells contaminated).

Reported Demand

Domestic: Mixed private and community wells.

Industrial: Fish plant.

Water Quality

Method of Treatment: Not treated.

Reported Observations/Problems:

Water is milky, has a pungent odor, and stains. Levels of manganese and hydrogen sulfide reported high.

Future Plans Affecting Supply/Demand

Study carried out by Island Eng. recommended surface supply be developed at Sailor Jack's Pond in Martin's Brook watershed (reported reliable yield 468 litres/min.) Martin's Brook = D.A. 0.86 km^2 with six small ponds in watershed. Live storage 9,000 m^3 (20,000,000 gal). This supply would service both Conche and Southwest Crouse.

EDM Consultants of Deer Lake are currently carrying out study for water supply.

Present water usage by fish plant 230 - 450 L/min (50-100 gal/min) depending on ability to use salt water for fluming and processing. Flow of 900 L/min (200 gal/min) would meet further requirements.

Cook's Harbour

Status: Town

Population: 390 (1986 census)

Information Sources:

"Town of Cook's Harbour Water and Sewer System Investigative Report". Atlantic Engineering Consultants. May 1989.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Small pond adjacent to community. Water pumped from reservoir to nearby 227 m^3 steel standpipe via two 3 hp pumps. Pumphouse located at the shoreline contains a wet well, fed by 450 mm diameter C.M.P. intake. Entire water supply for town supplied from this source.

Pond Area: 0.0105 km^2.

Drainage Area: Fed from groundwater springs ("boiling hole").

Live Storage Head: 1.37 m above intake.
3-4 feet deep (approximate intake depth of portable pump).

Approximate Storage: 54,800 m^3 (from report).

Existing Structures:

Rockfill wood crib dam, spillway. Inspection by Atlantic Engineering reports dam in good condition although not watertight.

Delivery System:

Intake is a 450 mm pipe. Water supplied to town through a system of 100 mm diameter and 150 mm diameter ductile iron water lines.

Status of Watershed Protection: Not protected.

Cook's Harbour

Reported Adequacy of Supply:

Town has experienced winters when the pond has had a thick ice cover and little water is available at the intake. This problem has been solved by putting a pump in the middle of the pond below the ice in winter.

Potential for Increased Storage:

Dam could be raised approximately 0.5 m above existing elevation to provide additional storage, or a second groundwater source ("boiling hole") could be used.

Other Observations/Reported Problems:

Ice on reservoir during winter results in a loss of approximately 48,000 m^3 of storage. Ice over 1 m thick has been measured, leaving very little useable water in reservoir. The Town also has problems with freezing of water line in winter and leaks in distribution system.

Reported Demand

Domestic: 105 houses plus a number of small businesses and stores.

Industrial:

Three fish plants in community. Two process lumpfish roe and only operate 6-8 weeks a year. FPI owns other plant. Open three months of year. Fish plants are largest single user and place greatest demand on system. All connected to municipal supply.

Metering: No metering.

Losses/Wastage: Leaks in distribution system and in dam.

Water Quality

Method of Treatment: Chlorine compound.

Cook's Harbour

Reported Observations/Problems:

Problems have been experienced with chlorinator in the past and all water pumped through town's system may not be chlorinated.

Future Plans Affecting Supply/Demand

The town's five year plan proposes a permanent intake at Saltwater Pond Spring, a second boiling hole, with a line running under Salt Pond to connect with the southern end of the community's distribution system.

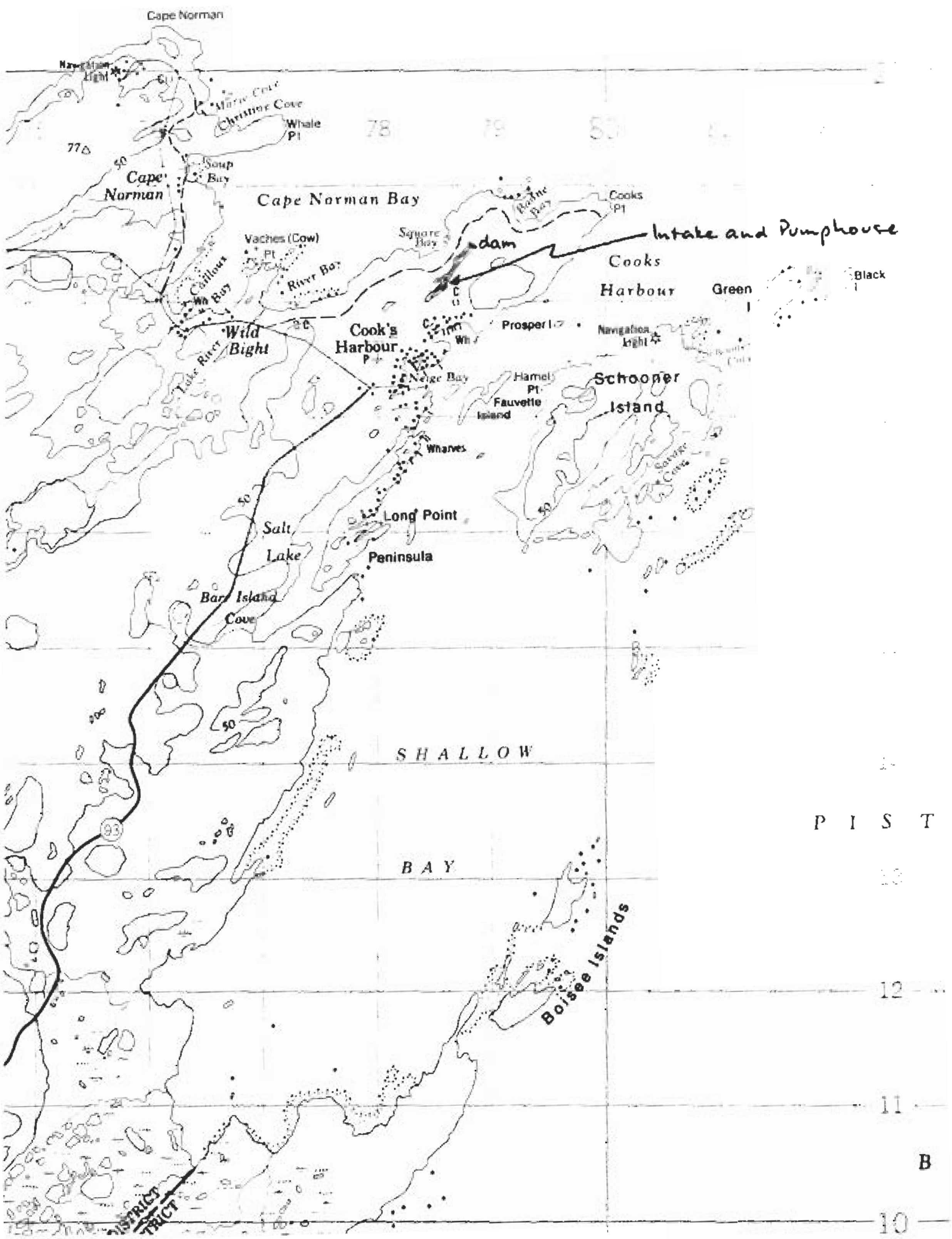
Notes

Atlantic Engineering report made several recommendations regarding water supply system:

- Repair existing system, including elimination of leaks, insulating water lines, raising reservoir levels by 0.5 m to provide additional storage, new chlorination system and additional fire hydrants.

- Supplement water supply by means of additional deep well and pump.

- Install sewer system.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

COOK'S HARBOUR

ACRES

Cormack

Status: Community

Population: 773 (1986 census)

Information Sources:

Cynthia Fry, Town Clerk.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

No community water supply. Private shallow and artisan wells.

Reported Adequacy of Supply:

Have had problems getting enough water from wells during dry summers and during some winters as well.

Reported Demand

Domestic:

Approximately 210 homes in community as well as a number of farms.

Industrial: No major industry.

Water Quality

Method of Treatment: None.

Reported Observations/Problems: Water quality reported good.

Future Plans Affecting Supply/Demand

Cormack is spread out over 48 km of road and would be expensive to service with water and sewer. Council is considering putting in subdivision but can't sell unless serviced.

Corner Brook

Status: City

Population: 22,719

Information Sources:

W. Ryan, Engineer

W. Brown, Superintendent

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

The main supply is from Trout Pond, with Three Mile Pond as a backup. This system serves about 90% of the demand including Massey Drive and Mount Moriah. A second system from Second Pond, Third Pond and Burnt Pond serves Curling, O'Connell Drive, Country Road Industrial Park and Sunnyslope Drive. Burnt Pond also provides backup to the main system. (See schematics and maps).

Pond Area: Trout Pond 0.05 km^2
Second Pond 0.06 km^2

Drainage Area: Above Trout Pond 113 km^2
Above Second Pond 11 km^2

Live Storage Head: Trout Pond - about 2 1/2 m
Second Pond - about 4 m

Existing Structures:

All structures on main system were built in the last 10 years, and are in good condition.

The dam on Corner Brook Lake was rebuilt in 1975 by Corner Brook Pulp and Paper. It is an earthfill structure of 10.7 m maximum height with a live storage of 28.7 Mm^3 and a drawdown of 4.3 m between full supply level and low supply level. A reinforced concrete sluiceway is incorporated into the dam.

Delivery System: See schematic.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Adequate - designed for expansion.

Potential for Increased Storage: Some potential but not required.

Reported Demand

Domestic: All population served plus Mount Moriah and Massey Drive. The Curling System demand is about 6800 m^3/day, and the Corner Brook system demand is about 30,000 m^3/day.

Industrial: North Start Cement, Atlantic Gypsum, Newfoundland Farm Products, Barry's Fisheries, Lundrigan's, CNR, Corner Brook Garage, Western Memorial Hospital, Monaghan Hall.

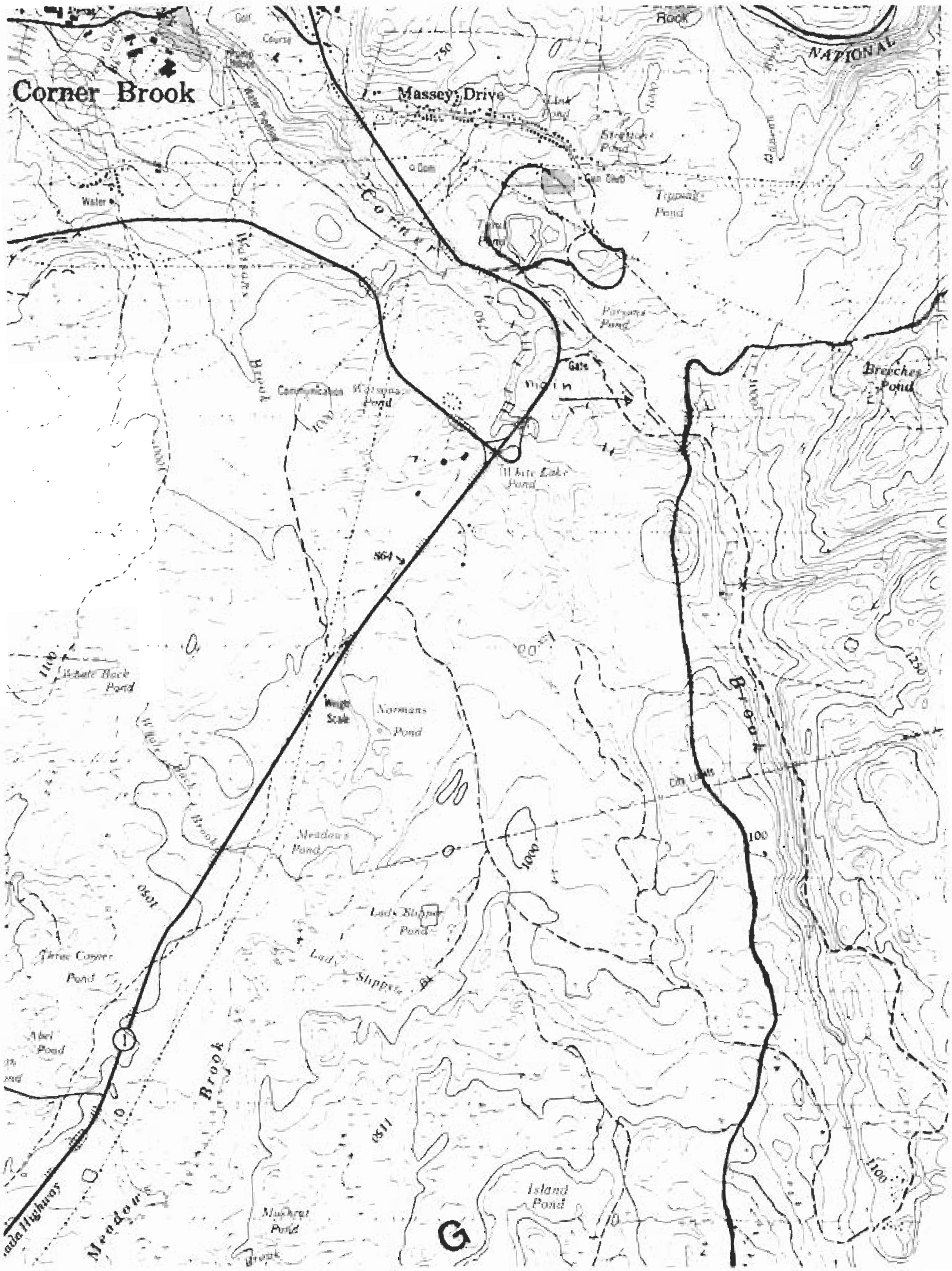
Metering: Most industries metered. Accounts are kept by the City. Total peak industrial demand is estimated at bout 11,500 m^3/day.

Variations in Demand: Peaks at noon and 5-6 p.m. Fish plant load also varies.

Water Quality

Method of Treatment: Chlorinated, fluoridated, and pH adjusted.

Reported Observations/Problems: None reported.

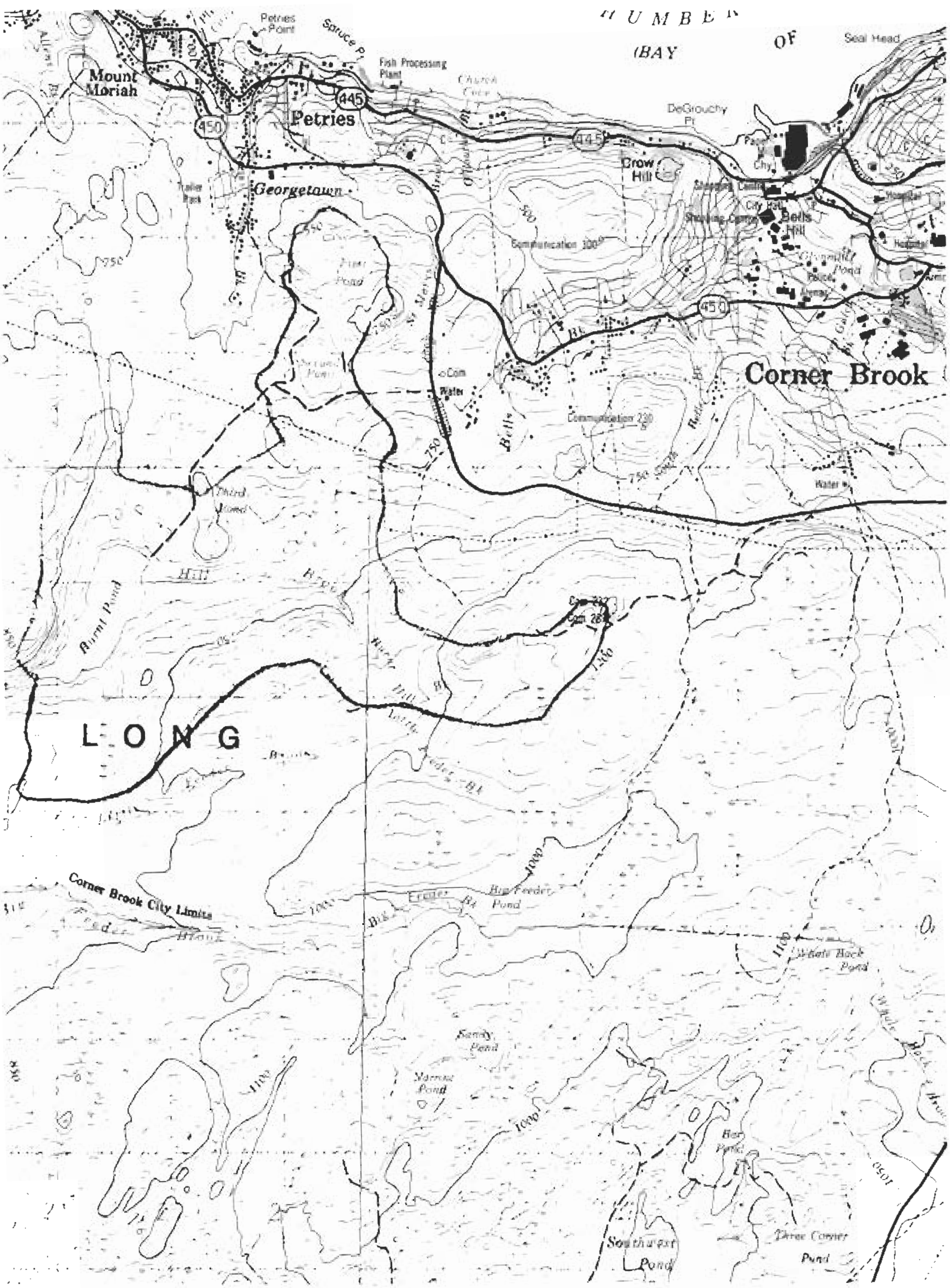


DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

CORNER BROOK

ACRES



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

CORNER BROOK

AGRES

Cow Head

Status: Town

Population: 708 (1986 census)

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

"Town of Cow Head Water Supply System Study". Newplan Consultants Ltd., March 1980.

Existing Water Supply

Water Source(s):

Existing system consists of gravity supply from intake behind a dam on Short Cat Path Pond. Water fed to concrete stilling basin, then to chlorination building.

Pond Area: 0.3 km^2

Drainage Area: 1.39 km^2

Live Storage Head: 1 m

Existing Structures: Wet well, pumphouse, chlorinator.

Delivery System:

200 mm diameter feeder main. 75 mm diameter plastic pipe installed by fish plant from town's supply.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Adequate.

Potential for Increased Storage: Little potential at existing pond because land is flat.

Cow Head

Other Observations/Reported Problems:

In summer of 1989, pond was low when fish plant was operating but they have never run out of water.

Reported Demand

Domestic:

Two hundred houses serviced by existing system, plus a number of small businesses. Present domestic demand estimated at average 330 m^3/day, peak 1320 m^3/day (Newplan report). Projected to year 2000, demand estimated to average 594 m^3/day, peak 2376 m^3/day.

Industrial:

H.H. Hopkins; - Small fish plant - pickled and salt fish supplied by municipal system. Present demand estimated as:

Average annual demand:	70,000 m^3
Maximum June/July demand:	49,000 m^3
Maximum monthly demand (June):	28,000 m^3
Average daily demand (June):	1850 m^3/d.

Metering: No metering.

Water Quality

Method of Treatment: Chlorine gas.

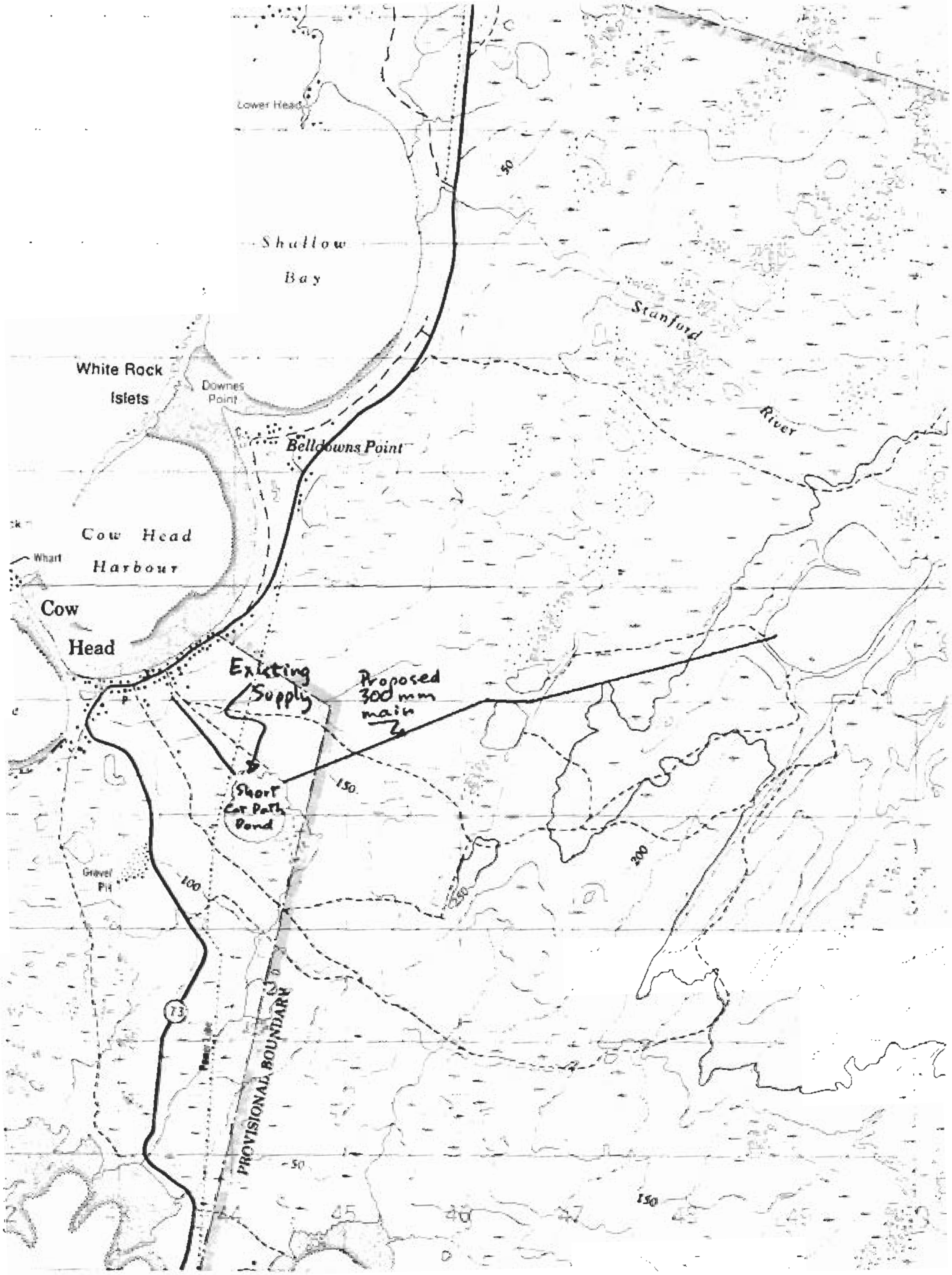
Reported Observations/Problems:

Residents complain about the boggy taste of the water and discoloration in fixtures. Unsatisfactory bacteria counts also led to the installation of a chlorinator, and residents note that the large amounts of chlorine required by Department of Health leads to poor taste. Slight turbidity in high winds because muddy bottom is stirred up by waves.

Future Plans Affecting Supply/Demand

Existing water supply and distribution system marginally adequate for present domestic and industrial water requirements. Because of low pressures in system and high friction losses at higher rates of flow, system not adequate to meet fire flow requirements through town and does not have capacity to fully meet projected industrial requirements for either short or long term (Newplan report).

The town's five year plan proposes a new supply from Big Pond, which has excellent water quality. This supply might be adequate to supply St. Pauls and Parsons Pond as well as Cow Head.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

COW HEAD

ACRES

Cox's Cove

Status: Community

Population: 999 (1986 census)

Information Sources:

Tony Oxford - Mayor

"Report on Alternate Water System for Cox's Cove". Island Engineering Co. Ltd. June 1987.

"Report on Need for Additional Fresh Water at Fish Plant". Island Engineering Co. Ltd. May 1987.

"Community of Cox's Cove - Alternate Water Supply Feasibility Study". Atlantic Engineering Consultants. February 1989.

Department of Municipal and Provincial Affairs, Corner Brook Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Dam on brook (known locally as Rocky Bog) north of town. Also two wells: Well #1 deep well drilled in 1980, located adjacent to chlorination house (estimated yield 109 L/min.); Well #2 deep well drilled in 1981 (estimated yield 150 LPM).

Pond Area: No pond.

Drainage Area: 1.1 km^2

Live Storage Head: 3.6 m

Elevation of spillway 69.8 ft.

Elevation/Location of Intake: 66.2 ft. (3.6 ft. below top of dam).

Approximate storage: About 3400 m^3

Existing Structures: Dam (reinforced concrete) and spillway in good condition.

Delivery System: 75 mm (6 ") water line from dam.

Status of Watershed Protection: Protected.

Cox's Cove

Reported Adequacy of Supply:

Reported not adequate. Have been occasions when fish plant not operating, still not enough water to satisfy domestic demand. In June 1989, all houses on town supply had little or no water. Estimated reliable yield 386 L/min from existing surface supply (from consultants); actually reliable yeild estimated by methods of main report is probably less than half that amount.

The winter 1986/87 fishery could not be taken advantage of because community reservoir was almost dry and supply to fish plant had to be turned off. Town estimates approximately $300,000 lost in salaries alone.

Potential for Increased Storage: Poor at existing location.

Reported Demand

Domestic:

Approximately 200 homes on existing surface supply, 20 homes on community artisan well. Forty to fifty homes still to be connected.

Industrial:

T.& H. Fisheries have own salt water supply as well as using municipal supply. Estimated demand 200 million litres = 22,800 litres/hr.

Fresh, frozen, pickled product.

Metering:

No metering. Fish plant pays a flat rate to town for water usage. Looking at getting a meter for plant.

Losses/Wastage:

Some problems with leaks in waterlines. Repairs average six per year.

Variations in Demand:

Fish plant has largest impact on demand and distribution. When fish plant is operating, houses in higher areas lose pressure.

Water Quality

Method of Treatment: Chlorine compound.

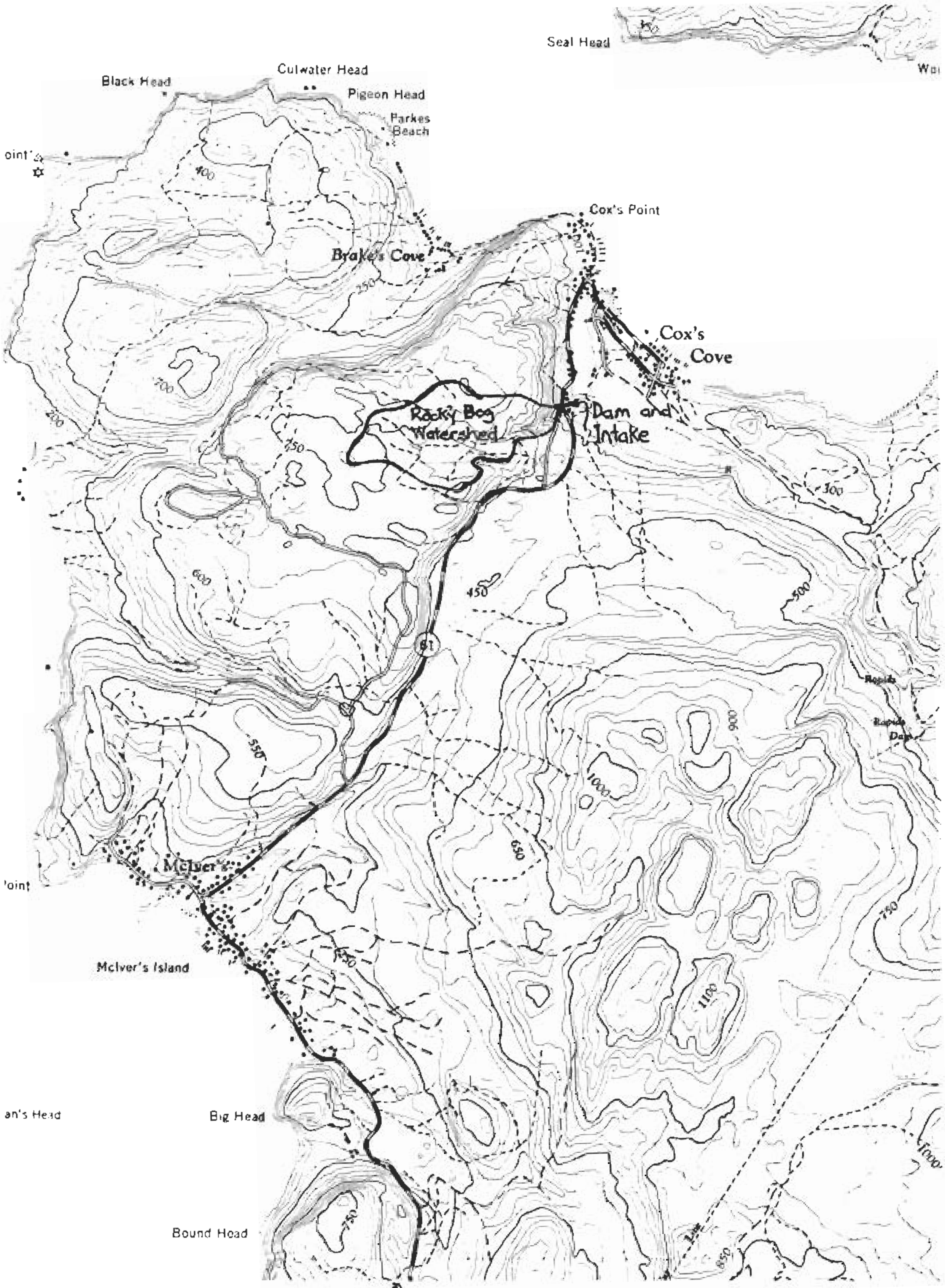
Reported Observations/Problems: Have had unsatisfactory reports for colour.

Future Plans Affecting Supply/Demand

Fish plant has applied for shrimp processing license. Shrimp processing very labour and fresh water intensive. Town expects that lack of dependable water supply may affect capital investment in plant.

Island Eng. 1977 report recommended construction of a gravity system from Barachois Brook to supplement existing system. Atlantic Engineering 1989 report recommended gravity system be developed on Cox's Brook, which drains Frenchman's Pond (total drainage area approximately 52 km^2).

Town favours development of Cox's Brook system which will supply town's needs over next 50 years. Have committed funding from government sources. A watershed protection plan has been drafted for Frenchman's Pond; there is still some conflict because of cabins on the pond.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

COX'S COVE

ACRES

Croque

Status: Local Service District

Population: 120

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

No municipal water supply system.

Reported Adequacy of Supply: Not adequate. People carry water by skidoos in winter.

Reported Demand

Domestic: No municipal system.

Water Quality

Method of Treatment: None.

Future Plans Affecting Supply/Demand

DMPA recommends a well.

Daniel's Harbour

Status: Community

Population: 566 (1986 census)

Information Sources:

E. Perry, Town Clerk

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

"Community of Daniel's Harbour Water and Sewer System Review", Newplan Consultants Ltd. October 1980.

Existing Water Supply

Water Source(s):

Old system consists of water drawn from a small stream south of town fed by a large bog and two small ponds. Water is pumped at constant pressure to distribution network. In early 1980's, community developed a new intake and surface storage basin at a spring fed source approximately 0.5 km from existing intake. Both systems are used for town supply, with older system supplementing spring fed supply.

Pond Area: No pond.

Drainage Area: About 0.75 km^2 (old system)

Live Storage Head: N/A.

Approximate Storage:

New system - Reported capacity of surface basin 2700 m^3. Old storage 22,000 m^3 in ponds and brook at depth 0.22 m.

Existing Structures: Dam on old system.

Delivery System:

Distribution system consists of 150 mm diameter ductile iron mains reducing to 50 mm diameter PVC lines at outer parts of serviced area. A watermain leads from the spring to the pumphouse at the intake of the older supply.

Daniel's Harbour

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Adequate with backup from old system in winter.

Potential for Increased Storage: Poor but not required.

Other Observations/Reported Problems: None.

Reported Demand

Domestic: 150 houses

Industrial: None

Water Quality

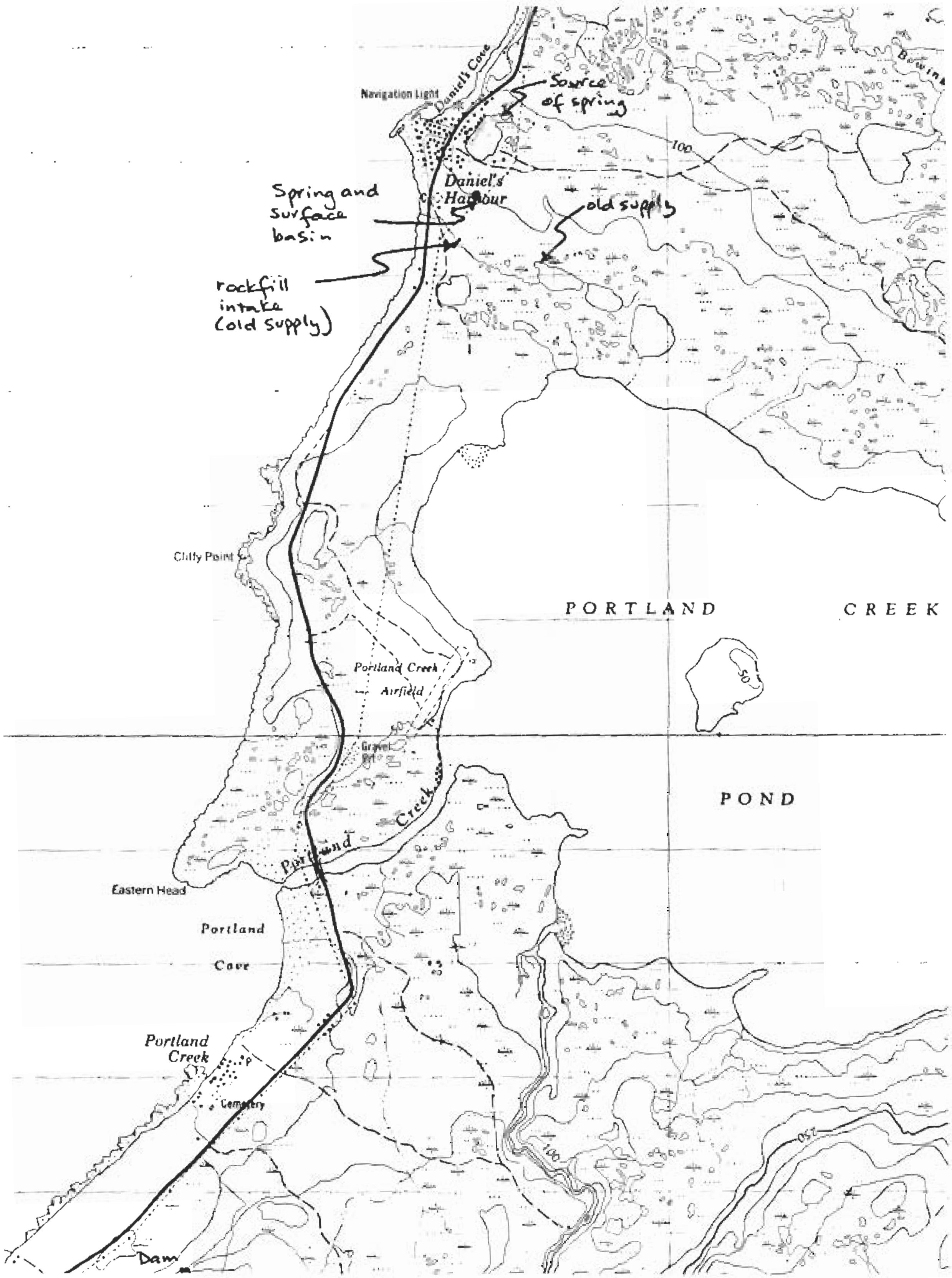
Method of Treatment: Chlorine compound.

Reported Observations/Problems:

Water from the spring is reported to be good and clear. Water from the old system is sometimes coloured. Concern has been expressed about contamination of supply stream from developing areas in community. Department of Health reports are satisfactory.

Future Plans Affecting Supply/Demand

Council has no plans for water supply in its five year plan; they want to continue improving the sewer system.



DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY
DANIEL'S HARBOUR
ACRES

Deer Lake

Status: Municipality

Population: 4233 (1986 census)

Information Sources:

- Walter Dominie - Town Manager, Phone 635-2451
- "Town of Deer Lake Report on Municipal Water Supply System", Procter and Redfern, June 1983.
- Carl Stratton, Deer Lake Power.

Existing Water Supply

Water Source(s):

Town uses gravity feed supply from Deer Lake Power (intake at penstock). Grand Lake supplies water to Deer Lake Power Co. Ltd. through 11.0 km long sidehill canal. This reservoir with a surface area of 492 km^2 is the largest on the island. (See section on hydropower in main report.)

Pond Area: Grand Lake

Drainage Area: 5030 km^2

Existing Structures: Deer Lake power canal, dam, spillway, intake, penstocks.

Delivery System:

150 mm and 300 mm ductile iron mains to Deer Lake. This year, a 300 mm line was extended to Nicholsville to connect those residents to Deer Lake supply.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Supply more than adequate.

Potential for Increased Storage: Not required.

Deer Lake

Other Observations/Reported Problems:

Have a pressure problem in some of the higher areas. Small booster pump installed.

Reported Demand

Domestic:

About 1500 - 2000 connections, including two motels, 18 restaurants/lounges, takeouts, two parks, two waterslides, as well as retail stores and schools.

Metering: No metering.

Losses/Wastage:

Some leakages. Infiltration into sewer system but cause is being investigated.

Variations in Demand:

No large industries so demand fairly constant. Nicholsville loses pressure when demand is high in Deer Lake.

Water Quality

Method of Treatment: Chlorine gas.

Reported Observations/Problems:

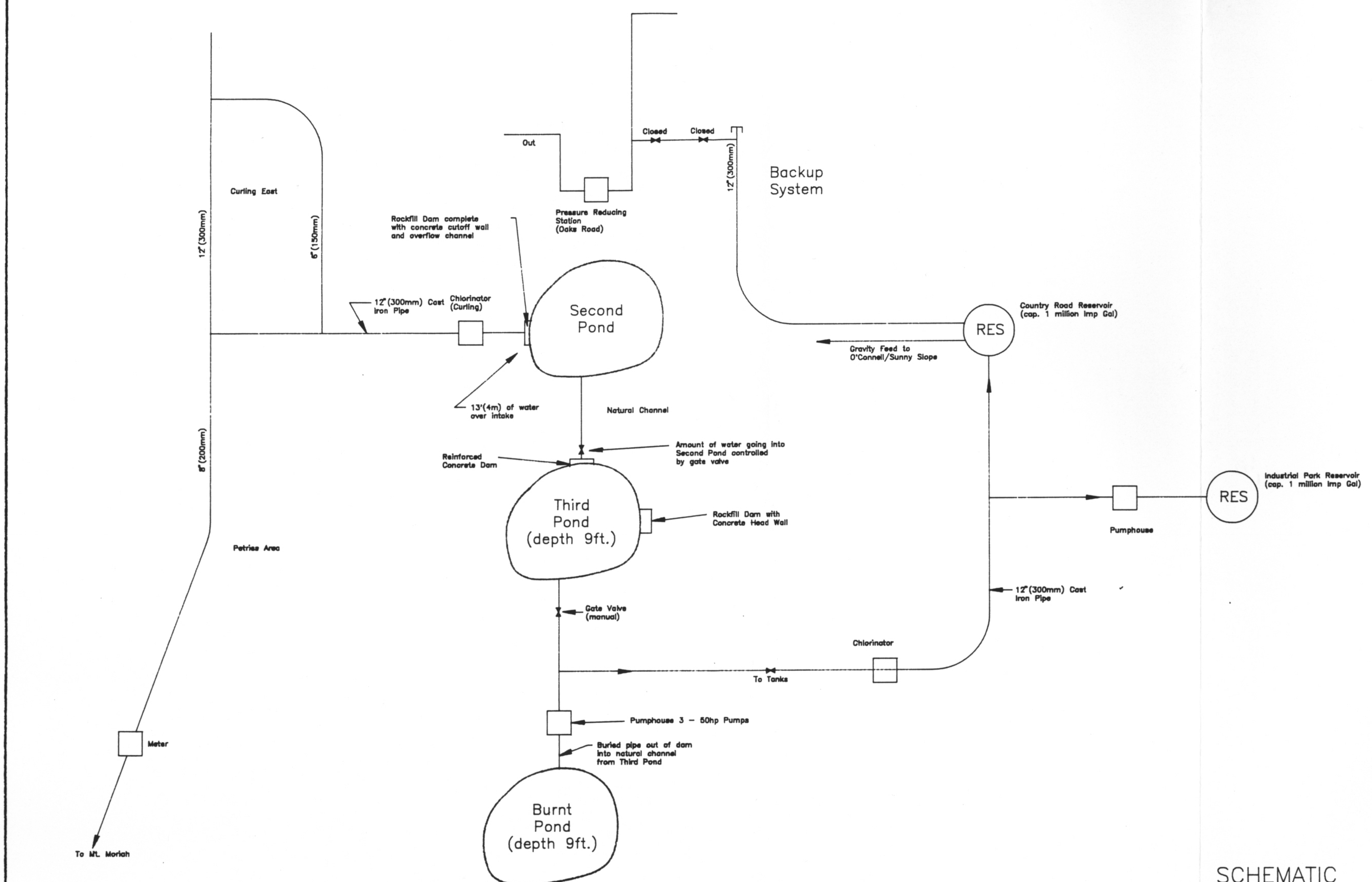
None, although town is concerned about cabin development on Sandy Lake and the possible effects on downstream water quality.

Future Plans Affecting Supply/Demand

Regional water system for area has been proposed which would see Reidville and St. Judes serviced by Deer Lake. As part of this regional system, a new intake and treatment plant will be installed along with 600 mm mains.

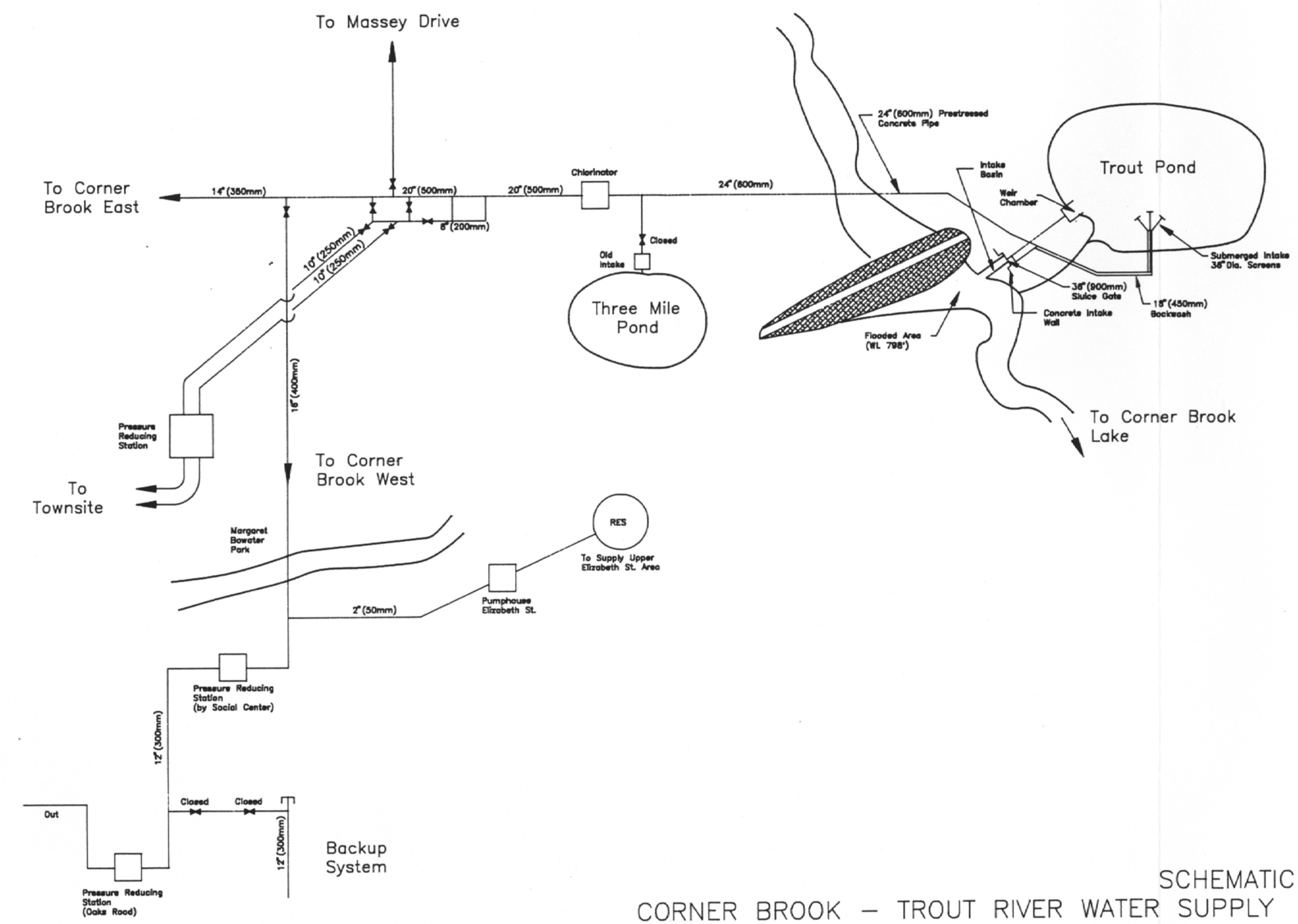
Deer Lake

Existing industrial park is being expanded and the population is expected to increase. Plans are to upgrade intake and install two major waterlines to tie into industrial area. The abundant and dependable supply of water is being promoted by the town to attract industries.

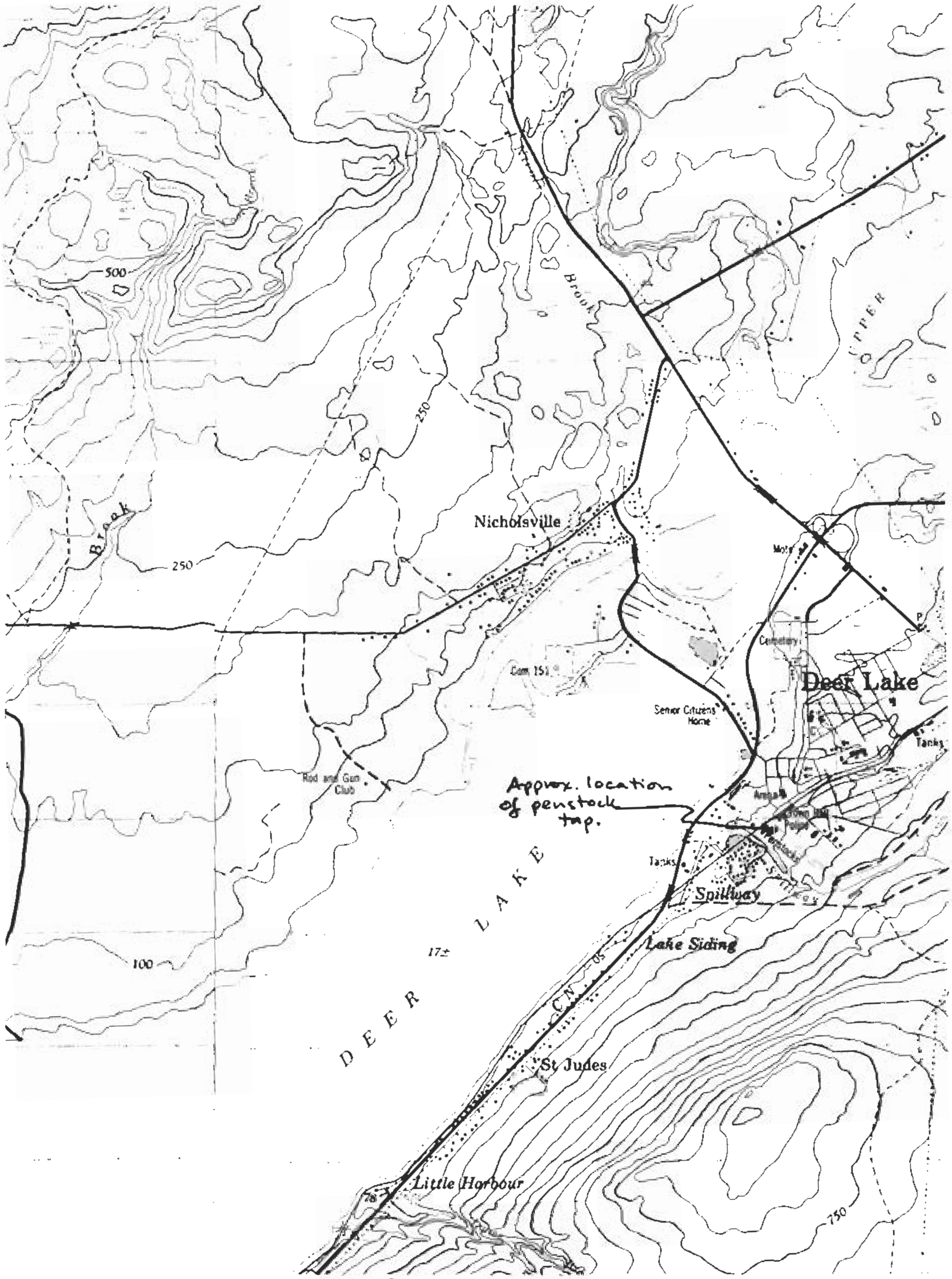


SCHEMATIC

CURLING SUPPLY AND CORNER BROOK BACKUP SYSTEM



SCHEMATIC
CORNER BROOK – TROUT RIVER WATER SUPPLY



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

DEER LAKE

ACRES

Englee

Status: Community

Population: 1012 (1986 census)

Information Sources:

Doris Randell - Town Clerk.

"Engineering Report on Fresh Water System Englee", Provincial Consultants Ltd., October 1980.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Fresh water supply is a gravity system constructed by fish plant in 1968, which also serves town. The system consists of a water intake at Island Cove Pond and an underground supply pipe to community. Pond has been dammed in several places to provide large volume. A screen house is located a short distance from the intake structure near Island Cove Pond and a chlorination building is located on the outskirts of the community before the distribution system.

Pond Area: 0.31 km^2

Drainage Area: 2.01 km^2

Live Storage Head: 2 m

Existing Structures:

Two concrete dams, 9.1 m and 8.2 m long. Crest 0.6 m wide at el 122.7 m. Side slopes 1:1. Concrete overflow spillway (crest el 122 m) approximately 36.6 m long. Stoplog control at el 122 m. Both dam and spillway in good condition.

Delivery System: 200 mm main.

Status of Watershed Protection: Not protected.

Englee

Reported Adequacy of Supply: Good.

Potential for Increased Storage: Not required.

Other Observations/Reported Problems: Freezing last winter.

Reported Demand

Domestic:

Approximately 250 houses and small businesses, one school, demand reported to be about 1 m^3/min.

Industrial:

Peninsula Seafoods shares supply with town. Meter readings indicate approximate usage of 1.4 m^3/min. Saltfish Corporation also uses town supply.

Metering:

Metering at Peninsula Sea Foods fish plant and at chlorination building. Saltfish Corporation not metered.

Water Quality

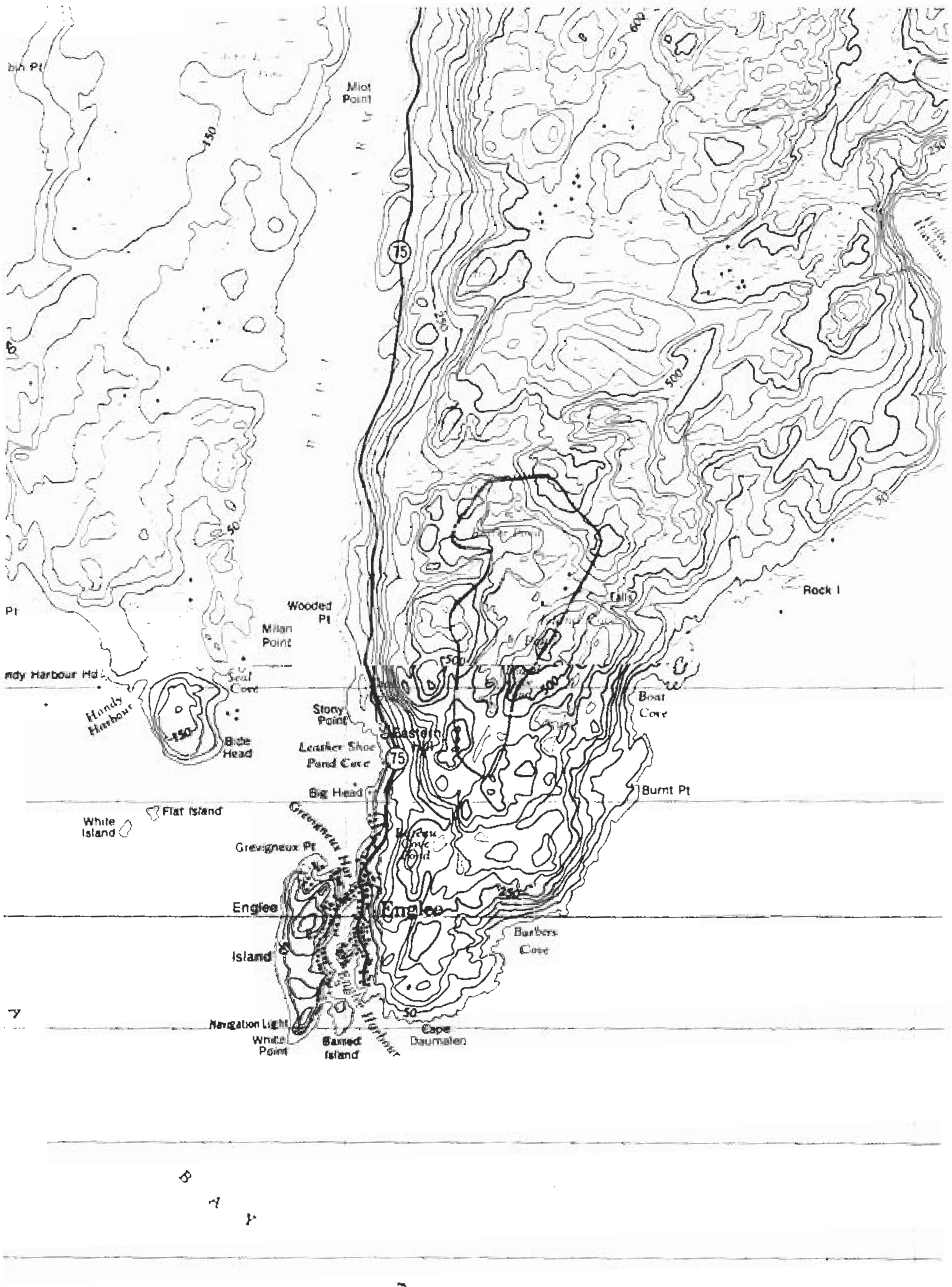
Method of Treatment: Chlorine gas.

Reported Observations/Problems:

Water quality was poor for a while last summer, due to a high bacteria count. The chlorine count was stepped up to improve the situation. Problems with silt are also reported. The screens will be changed to filters.

Future Plans Affecting Supply/Demand

None reported.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ENGLEE

ACRES

Flower's Cove

Status: Town

Population: 417 (1986)

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): French Island Pond.

Pond Area: 1.18 km^2

Drainage Area: 14.8 km^2

Live Storage Head: 1.65 m.

Existing Structures: No dam. New pumping system recently installed.

Delivery System:

Town is in process of replacing present lines, extending system to new subdivisions.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Good.

Potential for Increased Storage: Poor, but not required.

Reported Demand

Domestic: About 130 houses connected.

Water Quality

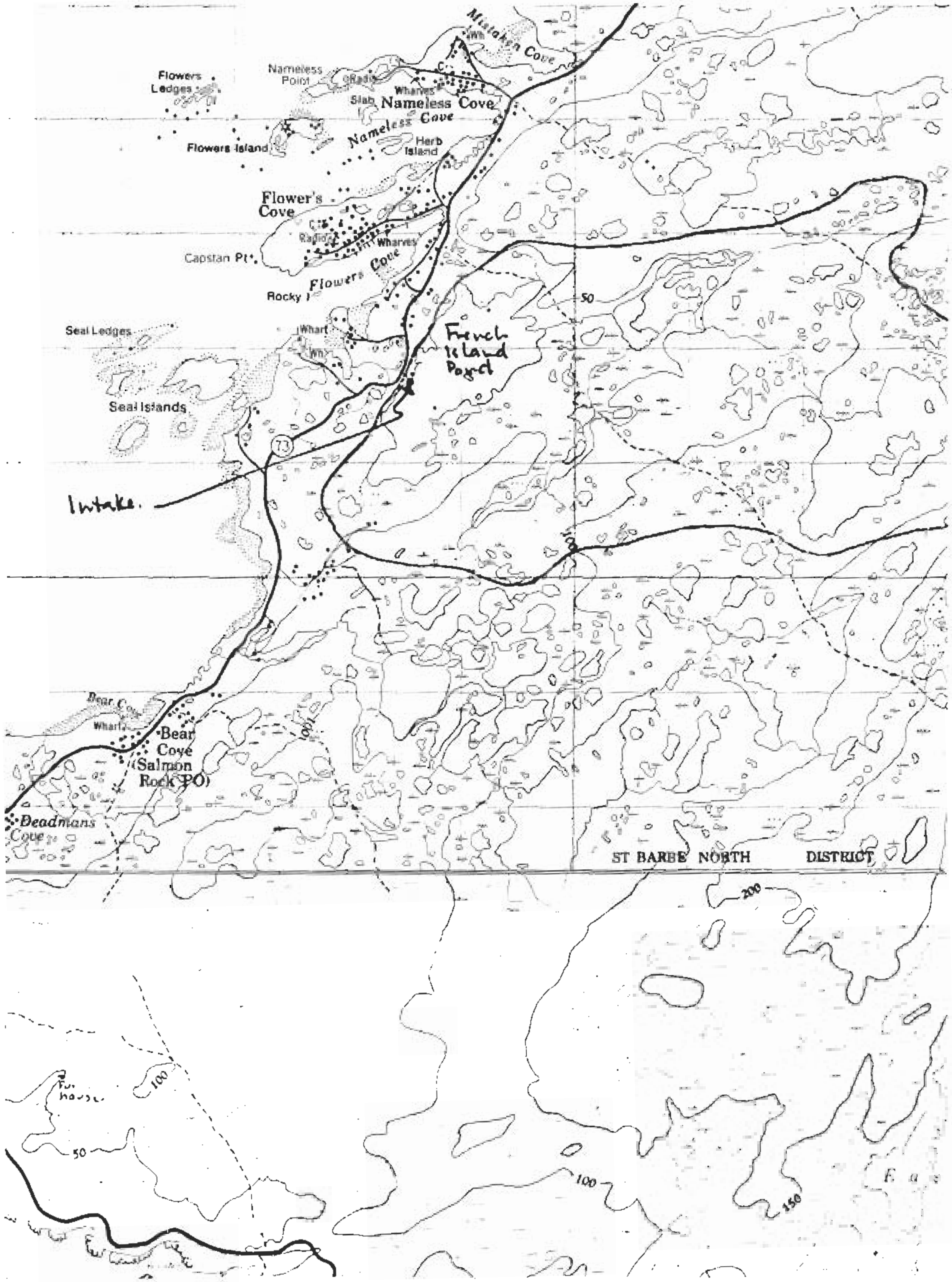
Method of Treatment: Chlorinated.

Reported Observations/Problems:

Water quality reported to be good. Department of Health Reports satisfactory. Occasionally silty when wind stirs up pond.

Future Plans Affecting Supply/Demand

Improvements to distribution system underway.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

FLOWER'S COVE

ACRES

Forresters Point

Status: Local Service District

Population: 263

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Surface supply pumped from Rudge's Pond. (See Black Duck Cove map).

Pond Area: 0.307 km^2

Drainage Area: 0.811 km^2

Live Storage Head: 1.5 m

Existing Structures: Concrete reservoir.

Delivery System: Plastic 50 mm supply line from a concrete reservoir.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply: Adequate.

Potential for Increased Storage: Poor - flat country.

Other Observations/Reported Problems:

Better system than Black Duck Cove, but have had problems with freezing of lines. Need new intake and pumphouse.

Water Quality

Method of Treatment: Chlorination.

Reported Observations/Problems: None reported.

Future Plans Affecting Supply/Demand

Application has been made for regional supply with Black Duck Cove, Pidgeon Cove-St. Barbe.

SEE BLACK DUCK COVE MAP

DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

FORRESTER'S POINT

AGRES

Gillams

Status: Municipality

Population: 512 (1986 census)

Information Sources:

Mrs. Blanchard - Town Clerk.

"Feasibility Study Gillams Gravity Water Supply System". Island Engineering Co. Ltd. January 1986.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Jackie Tapps Brook. Gravity flow system constructed in 1986. Previous system consisted of pumped groundwater supply. Jackie Tapps Brook and Meadows Pond (Meadow's water source) are both part of the same watershed. Control structure on Jackie Tapps Pond.

Pond Area: 0.035 km^2

Drainage Area: 1.2 km^2

Approximate storage: 454,600 L reservoir capacity. Assumed live storage head in pond 3.5 m, similar to adjacent Meator's Pond.

Existing Structures:

Dam: 60 m long x 4 m high concrete dam, in excellent condition (constructed in 1980).
Small locally constructed control dam on Jackie Tapps Pond.

Delivery System:

1500 m of 200 mm (8 in.) diameter PVC waterline joined into existing waterline.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Good.

Potential for Increased Storage: Not required.

Reported Demand

Domestic:

Approximately 180 homes connected to system. Some homes in community cannot be serviced because of distance and pressure problems. High school (550 students plus staff) and some small businesses are serviced.

Industrial: No major industry.

Metering: None.

Losses/Wastage: None reported.

Water Quality

Method of Treatment: Chlorine compound.

Reported Observations/Problems: None required.

Future Plans Affecting Supply/Demand

Municipal and Provincial Affairs had recommended a joint system with Meadows.

DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUOY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

GILLAMS, MEADOWS

ACRES

Glenburnie/Birchy Head/Shoal Brook

Status: Community

Population: 368 (1986 census)

Information Sources:

N. Goosney, Water Committee, Glenburnie.

I. Strickland, Town Clerk.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Glenburnie served by small reservoir behind dam on Croucher's Brook. Dam supplied with two sources of water a brook and a spring. Shoal Brook and Birchy Head served by wells.

Pond Area: No pond.

Drainage Area: 2.38 km^2

Existing Structures:

Dam: Timber crib 20.5 m long, approximately 2.5 m high at centerline, crest 600 mm wide. Dam reported to leak approximately 18 L/min.

Spillway: Wood sheathing, 2.5 m wide with three stoplogs for control. Screened intake on upstream face of dam approximately 2 m from top of spillway.

Delivery System:

50 mm line from dam (with pressure reducing stations); 100 mm through community.

Status of Watershed Protection: Protected.

Glenburnie

Reported Adequacy of Supply:

1) Surface water (Glenburnie). Leak in dam resulted in reduced supply in summer of 1989 - only enough water to service approximately 30% of community. Water committee reports that it is the first time they have run out.

2) Groundwater (Shoal Brook, Birchy Head). Good. (Wells in Glenburnie used to run dry before the surface system was installed).

Potential for Increased Storage: Good but new dam would probably be required. Existing dam already leaks and needs repairs.

Reported Demand

Domestic:

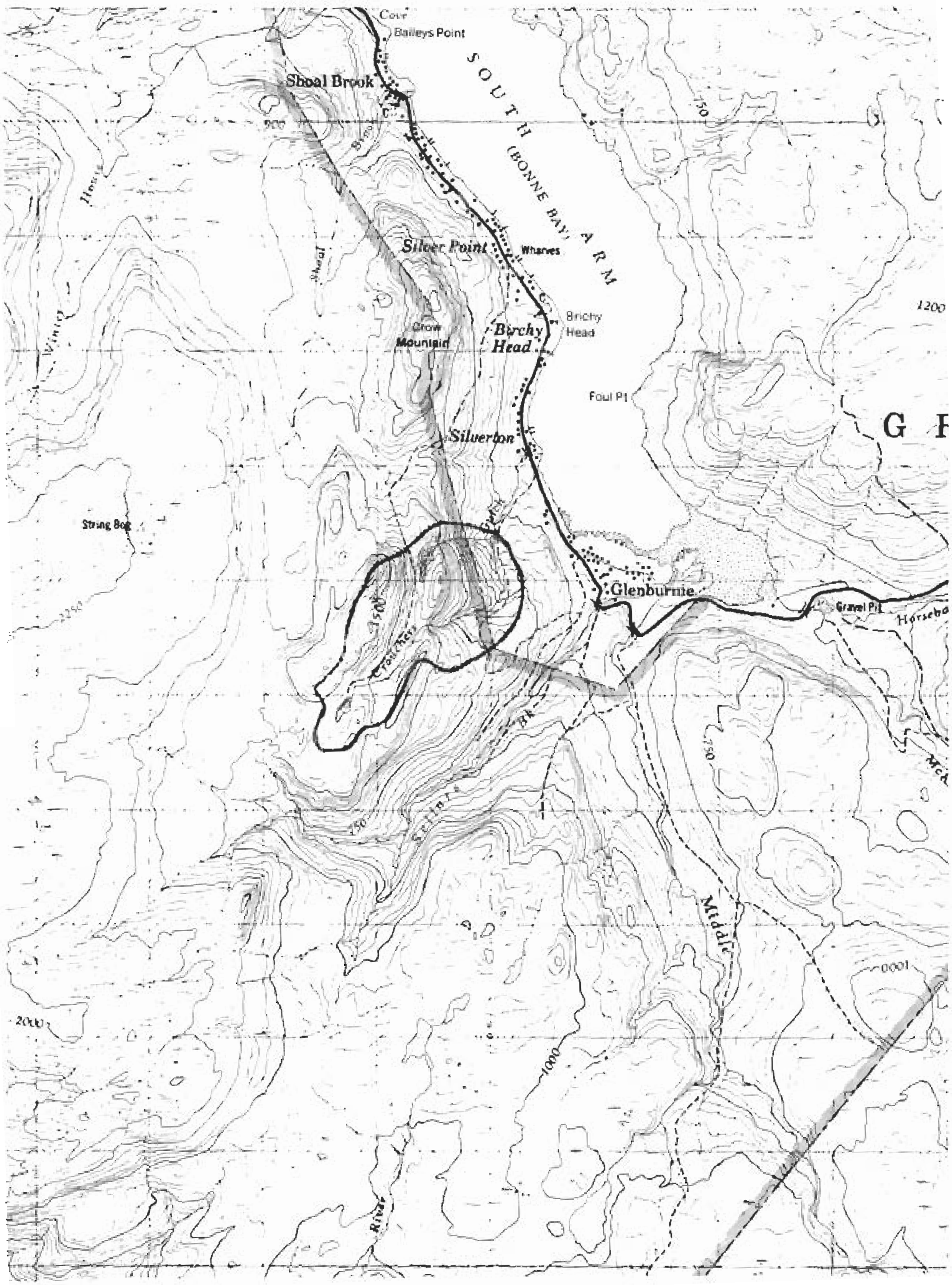
About 40 houses in Shoal Brook and Birchy Head served by wells. About 50 houses in Glenburnie serviced by surface water system.

Water Quality

Method of Treatment: Chlorine compound.

Reported Observations/Problems:

Groundwater quality good. Surface water quality good. All reports from Department of Health satisfactory. Occasionally water is coloured after rain; water committee is considering a filter.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

GLENBURINE – BIRCHY HEAD – SHOAL BROOK

ACRES

Goose Cove East

Status: Community

Population: 373 (1986 census)

Information Sources:

Mrs. Troy, Town Clerk.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

"Goose Cove East Water Quality Study", Terpstra Municipal Engineering Associates Ltd. January 1980.

Existing Water Supply

Water Source(s):

Gravity flow system from Jack's Pond. After initial system completed, reservoir went dry and in fall of 1975 the dam was raised to flood large boggy area around pond. No supply problems since.

Pond Area: 0.034 km^2

Drainage Area: 1.24 km^2

Live Storage Head: 2-3 m

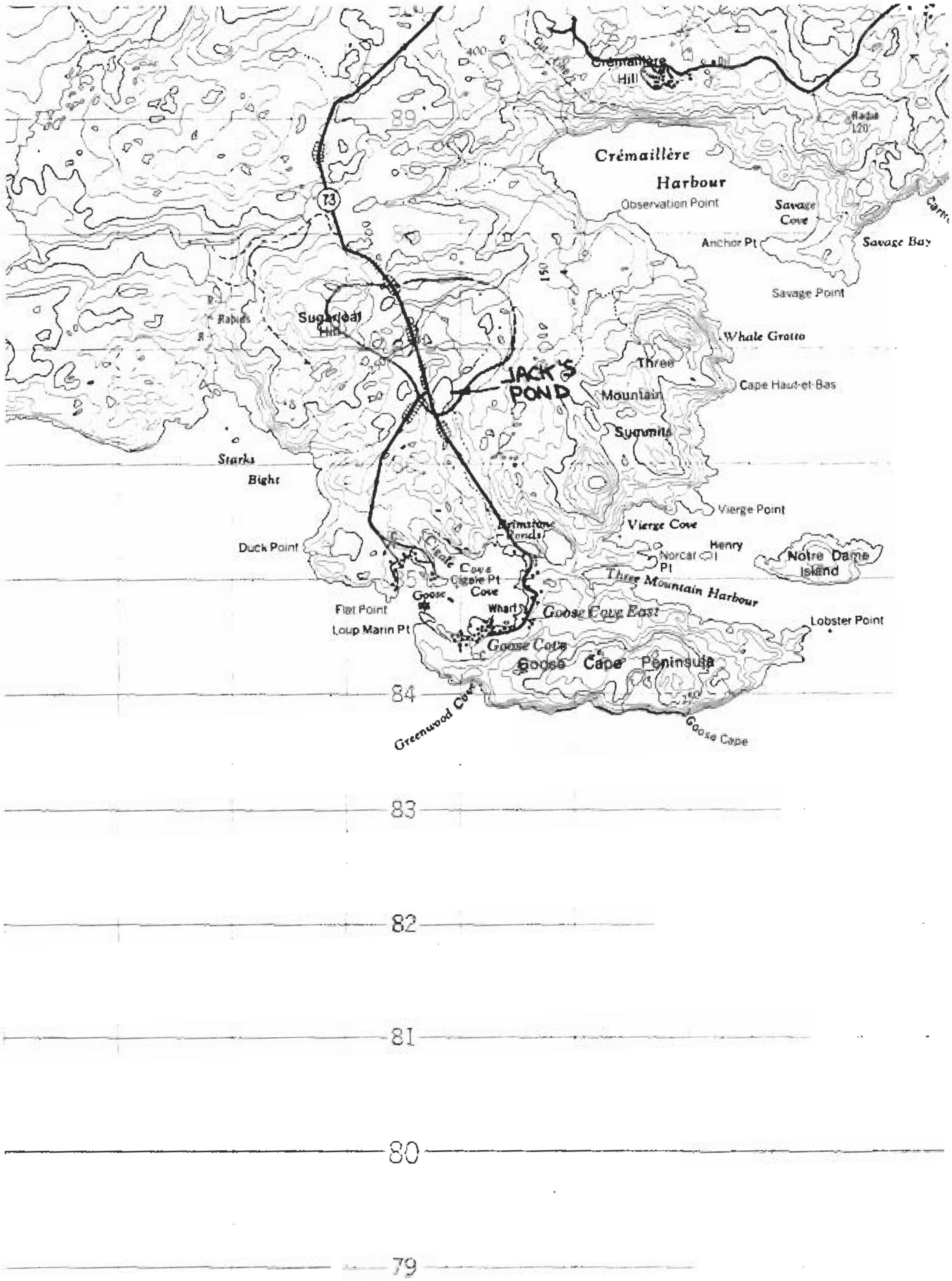
Existing Structures: Dam, Chlorinator Building.

Delivery System: Satisfactory.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Good.

Potential for Increased Storage: Not required.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

GOOSE COVE EAST

ACRES

Goose Cove East

Reported Demand

Domestic:

Fifteen houses connected; a few additional new houses connected each year.

Industrial: Water supplied to fish wharf for washing.

Water Quality

Method of Treatment: Chlorine compound.

Reported Observations/Problems:

Department of Health reports satisfactory. Occasional dirt in pipes, flushed out. They have had problems with odour and colour; an aerator was installed to alleviate this problem.

Future Plans Affecting Supply/Demand

No water supply changes in five year plan.

Great Brehat

Status: Local Service District

Population: 150

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Present water system consists of 50 mm polyethylene pipe running from Little Steady Pond, which is approximately 10-15 m from the road. System installed in 1977.

Pond Area: 0.0089 km^2

Drainage Area: 2.34 km^2

Live Storage Head: Not known.

Existing Structures: No dam or spillway.

Delivery System: 50 mm polyethylene pipe.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Adequate.

Other Observations/Reported Problems:

Lines have very little cover in places, because the terrain is 100% rock, and the residents run their water in the winter to prevent freezing. Results in little or no water pressure in homes at higher levels.

Great Brehat

Reported Demand

Domestic: Approximately 35 homes.

Water Quality

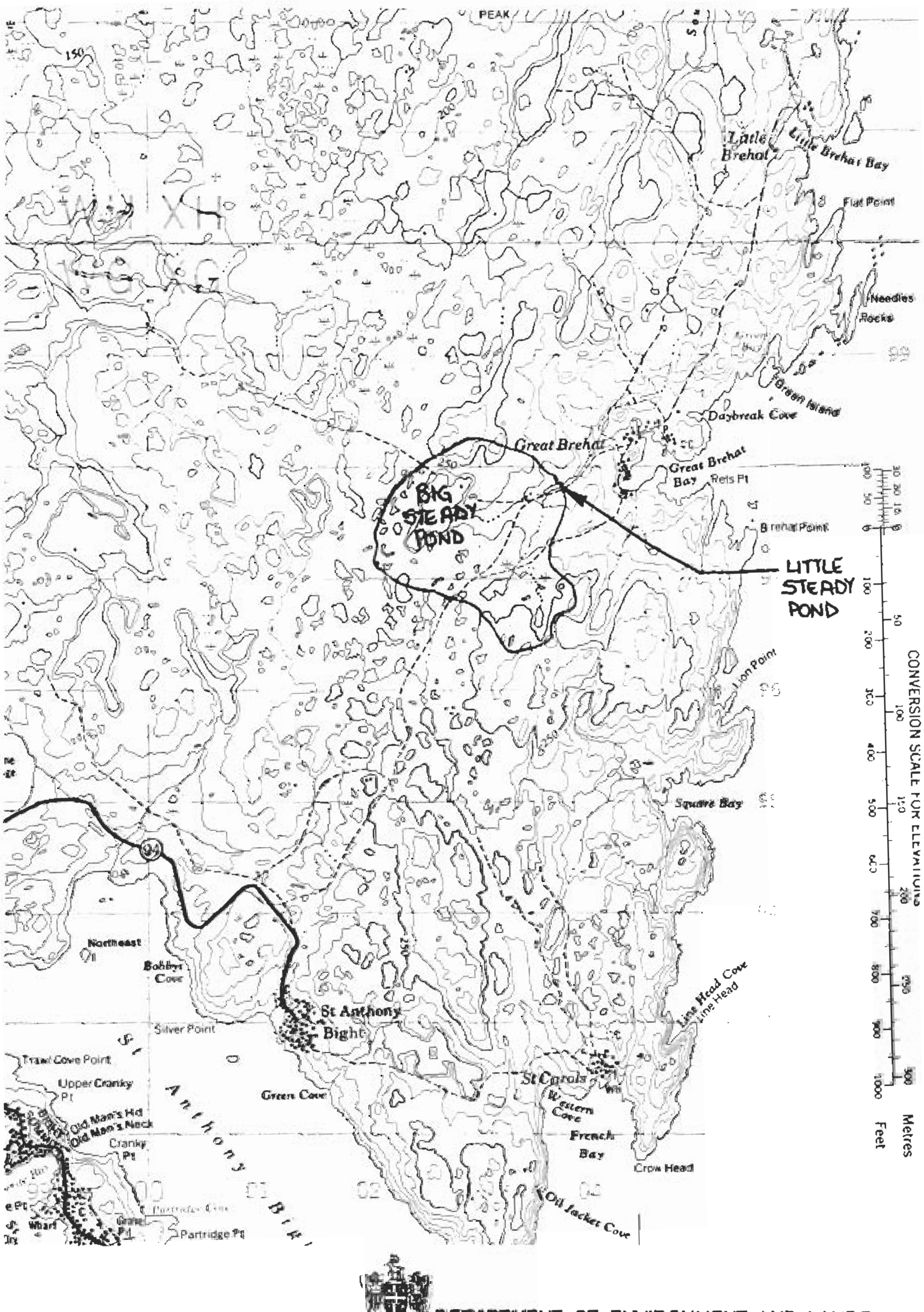
Method of Treatment: Chlorinated.

Reported Observations/Problems:

September 1989, poor physical quality due to sediment and color. Town very concerned about pollution of system due to close proximity to road.

Future Plans Affecting Supply/Demand

Town is requesting funding for a complete new system consisting of 100 mm diameter mains, supplied from Big Steady Pond which is approximately 400 m from main road.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

GREAT BREHAT

ACRES

Great Harbour Deep

Status: Community

Population: 278 (1981 census), 245 (1986 census)

Information Sources:

Mr. Pittman - Manager of fish plant.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Bottom Brook, Northwest Bottom Brook.

Drainage Area 1: 0.78 km^2

Drainage Area 2: 8.7 km^2

Live Storage Head: None.

Existing Structures:

Timber dam is 15-20 year old; reported to be in need of improvements or replacement (e.g., with a concrete dam).

Delivery System:

The lines from the two sources meet in the community. The community has had problems with freezing and bursting of lines.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply:

Ran short last summer for the first time. Fish plant can switch to salt water if supply is low. Frequently run short in winter due to distribution problems.

Potential for Increased Storage: Good.

Reported Demand

Domestic: All population served.

Industrial: Fish plant.

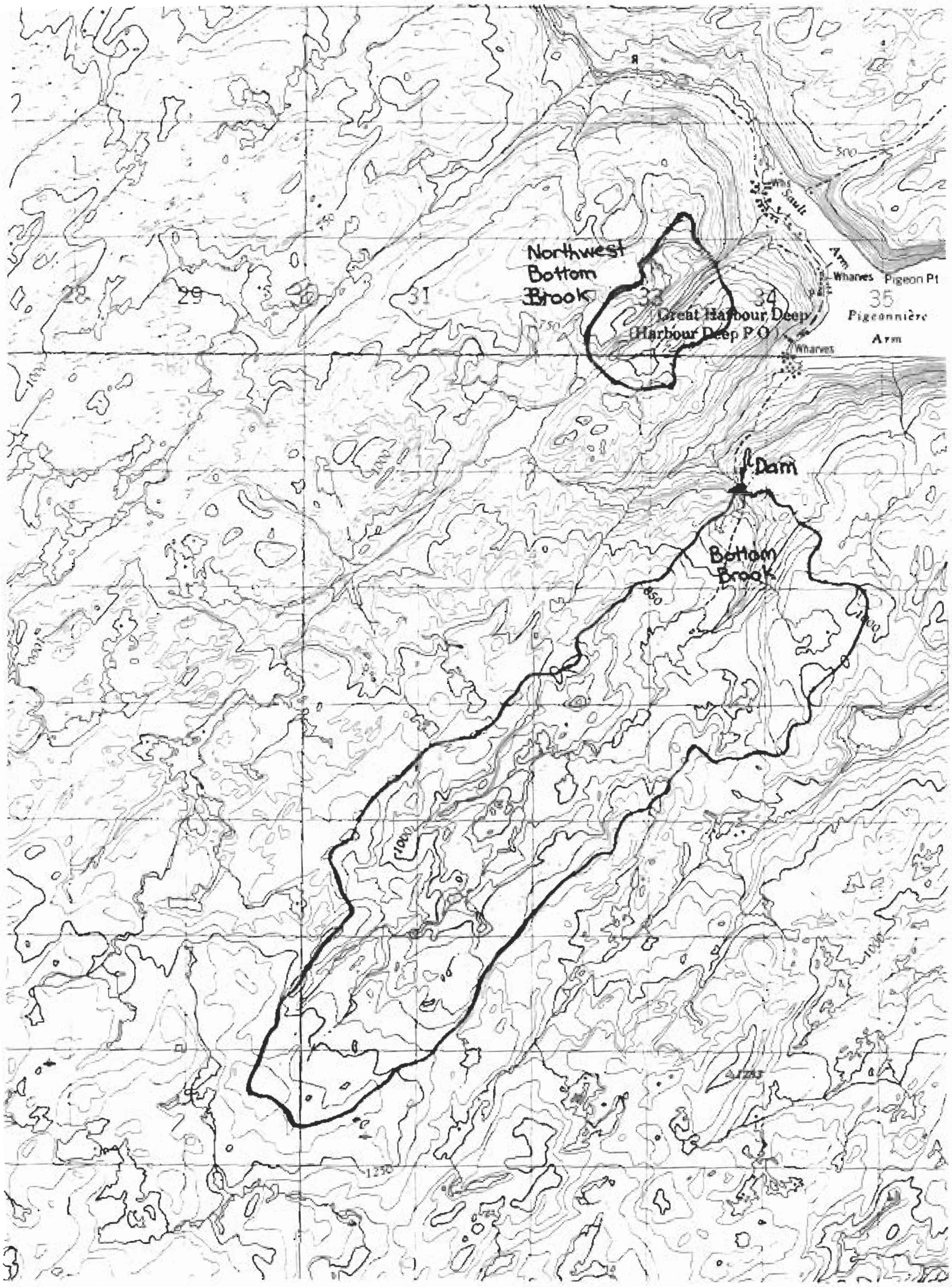
Water Quality

Method of Treatment: Chlorinated.

Reported Observations/Problems: No complaints about water quality.

Future Plans Affecting Supply/Demand

Town wants a new distribution system and new dam.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

GREAT HARBOUR DEEP

ACRES

Green Island Brook

Status: Local Service District

Population: 302

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Infiltration gallery in Green Island Brook with water pumped to community.

Pond Area: 0.75 km^2

Drainage Area: 29.8 km^2

Live Storage Head: None

Existing Structures: No dam or spillway. The intake is in the river.

Delivery System: 100 mm main line.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Reported to be good supply with no problems.

Potential for Increased Storage: Poor - flat country.

Reported Demand

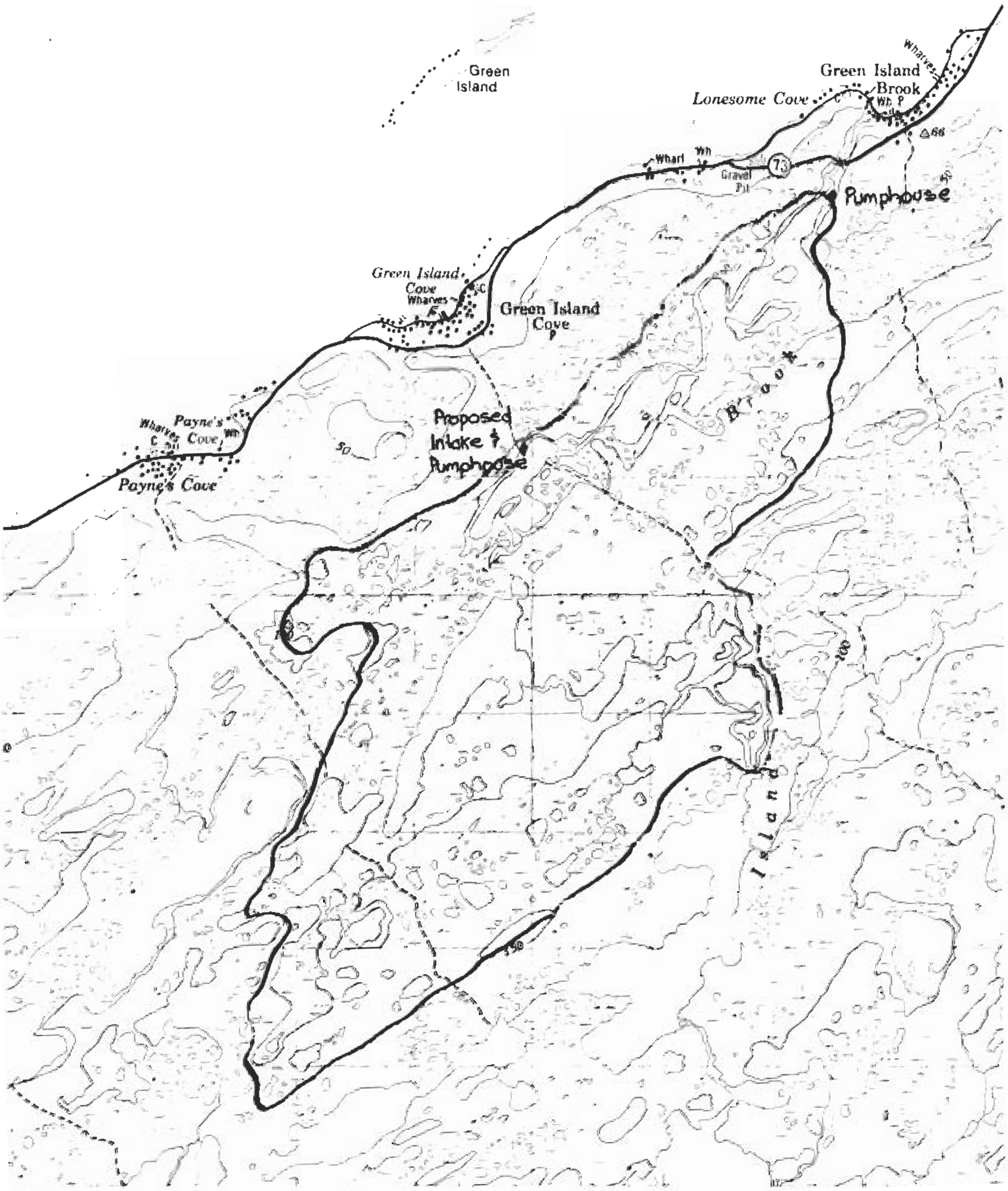
Domestic: About 250 people serviced.

Industrial:

Fish plant run by Southside Fisheries Division (Canadian Saltfish Corp.).

Water Quality

Method of Treatment: Chlorine.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

GREEN ISLAND BROOK, GREEN ISLAND COVE

ACRES

Green Island Cove

Status: Local Service District

Population: 234

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Private wells. Artesian well for fish plant.

Existing Structures: None.

Delivery System: None.

Potential for Increased Storage: Poor - flat country.

Reported Demand

Domestic: About 50 people serviced (of 234).

Industrial: McClean Fisheries Ltd. (salt and fish product). Artesian well.

Water Quality

Method of Treatment: Chlorine.

Future Plans Affecting Supply/Demand

Proposed intake and pumphouse on Green Island Brook (see map for Green Island Brook).

SEE GREEN ISLAND BROOK MAP

DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY
GREEN ISLAND COVE

AGRES

Halfway Point-Benoits Cove-Johns Beach-Frenchman's Cove

Status: Town

Population: 2114 (1981 census), 2182 (1986 census)

Information Sources:

Town Clerk

Walter Anderson, Atlantic Engineering

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Various ponds and brooks. New system under construction from Clark's Brook.

Pond Area: None.

Drainage Area: 2.14 (Clark's Brook)

Live Storage Head: No storage

Existing Structures: Intake and cribwork dam on John's Brook, and on Frenchman's Cove system.

Status of Watershed Protection: Watershed protection in process.

Reported Adequacy of Supply: Inadequate.

Potential for Increased Storage: Not very good - no large ponds.

Reported Demand

Domestic: All population will be served.

Industrial: Fish plant at Benoit's Cove

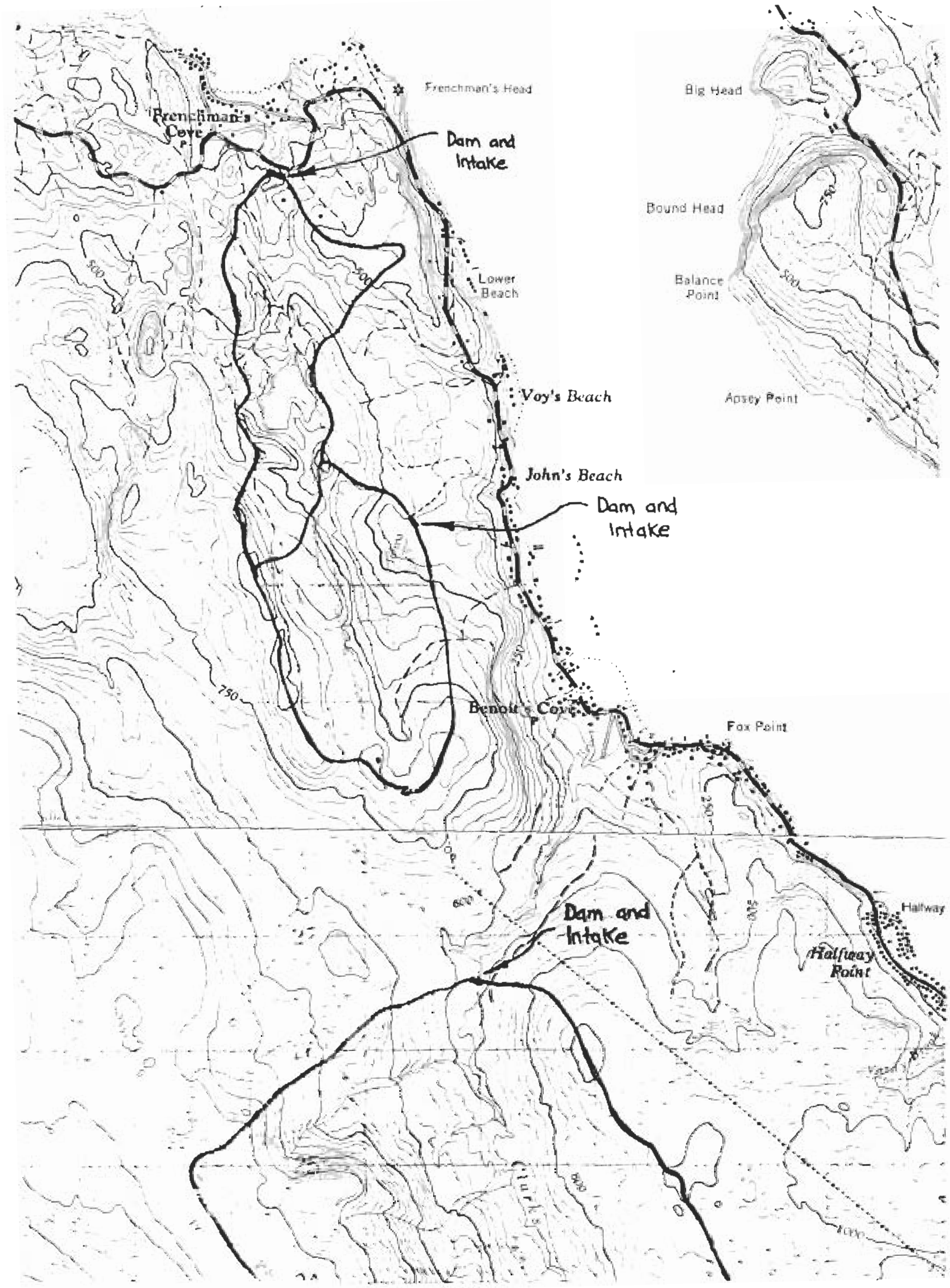
Water Quality

Method of Treatment: Chlorination

Reported Observations/Problems: None reported.

Future Plans Affecting Supply/Demand

John's Beach, Benoits Cove, Halfway Point will all be served by new system. Present plans show the lines being extended to Frenchman's Cove (Phase VIII), but the economics of improving the existing system at Frenchman's Cove rather than extending the lines from Clark's Brook should be examined.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

HALFWAY PT.– BENOIT'S CV.– JOHN'S BEACH – FRENCHMAN'S CV.

ACRES

Hampden

Status: Community

Population: 875 (1986 census)

Information Sources:

Mr. Prescott, Maintenance Dept.

R. Jenkins, Town Clerk.

Walter Anderson, Atlantic Engineering

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Elliot Brook. Intake is located in a small reservoir formed by a dam. Water flows by gravity to a pumphouse in Bayside, and is pumped through Bayside and Hampden.

Pond Area: None (Very small pond to provide cover for intake).

Drainage Area: 6.67 km^2

Live Storage Head: About 2 m above intake.

Existing Structures:

Concrete (about 3.7 m high) and spillway in good condition. (Built about five years ago).

Delivery System:

Good - 150 mm line throughout community. Services school and arena.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply:

Reservoir behind dam ran dry last summer; maintenance staff cleared the outlet of Elliot Lake to allow access to otherwise dead storage.

Potential for Increased Storage: Good if required, by providing a control structure on the lake.

Reported Demand

Domestic: All population serviced.

Industrial: None.

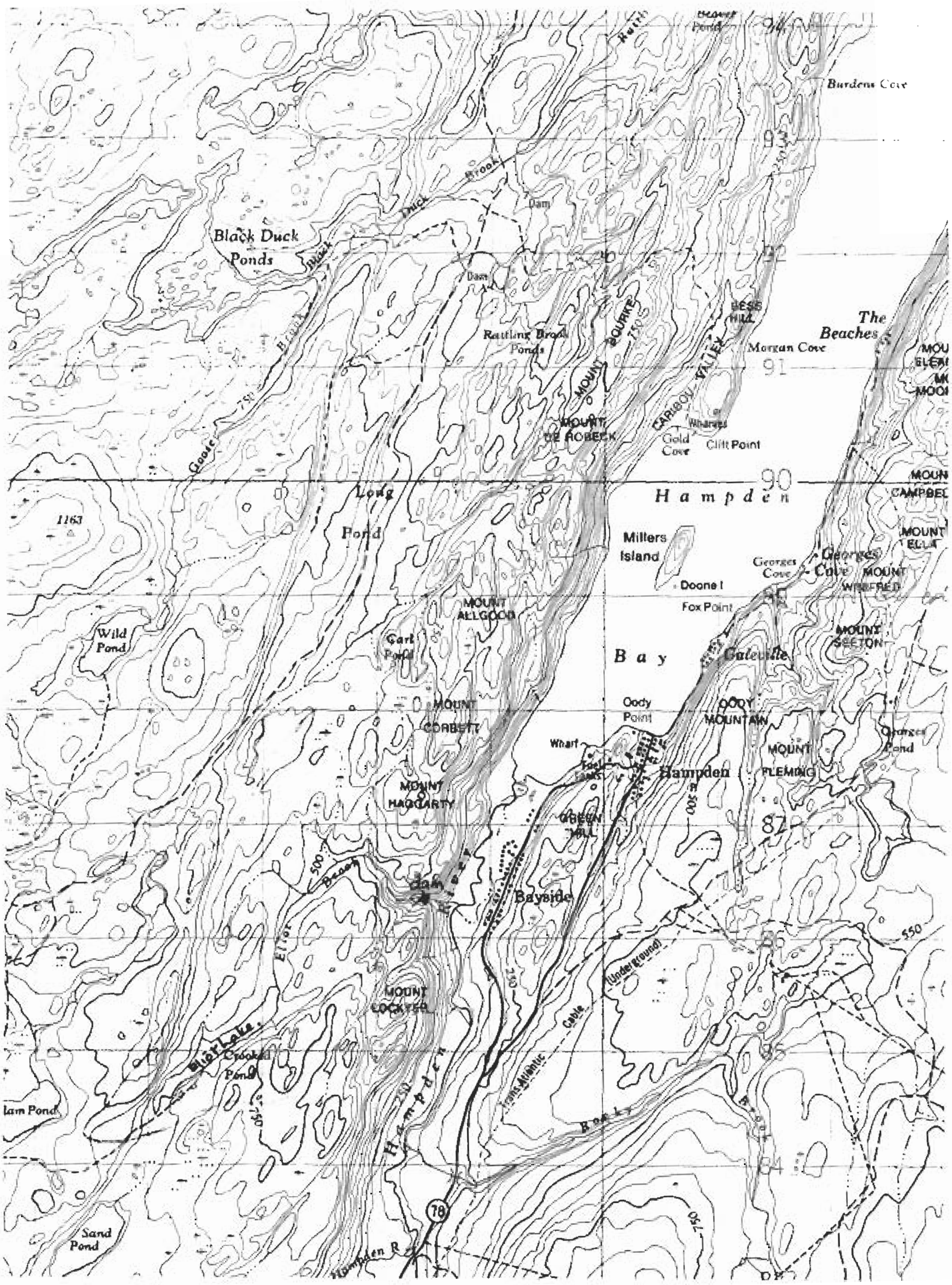
Water Quality

Method of Treatment: Chlorinated.

Reported Observations/Problems: No problems. Occasional colour after rain.

Future Plans Affecting Supply/Demand

No plans other than to hook up any new houses.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

HAMPDEN

Hawkes Bay

Status: Town

Population: 547 (1986 census)

Information Sources:

Y. House, Town Clerk

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Water is pumped from Torrent River to a tower (about 38 m high).

Pond Area: None.

Drainage Area: 624 km^2

Live Storage Head: Water level is about 0.6 m above intake in the river.

Existing Structures: Small dam, intake, pumphouse, steel tower reservoir.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Excellent.

Potential for Increased Storage: Not required.

Other Observations/Reported Problems: None.

Reported Demand

Domestic: About 160 houses serviced.

Industrial: Torrent Fisheries, supplied with fresh water from municipal system. Pickled and fresh product.

Water Quality

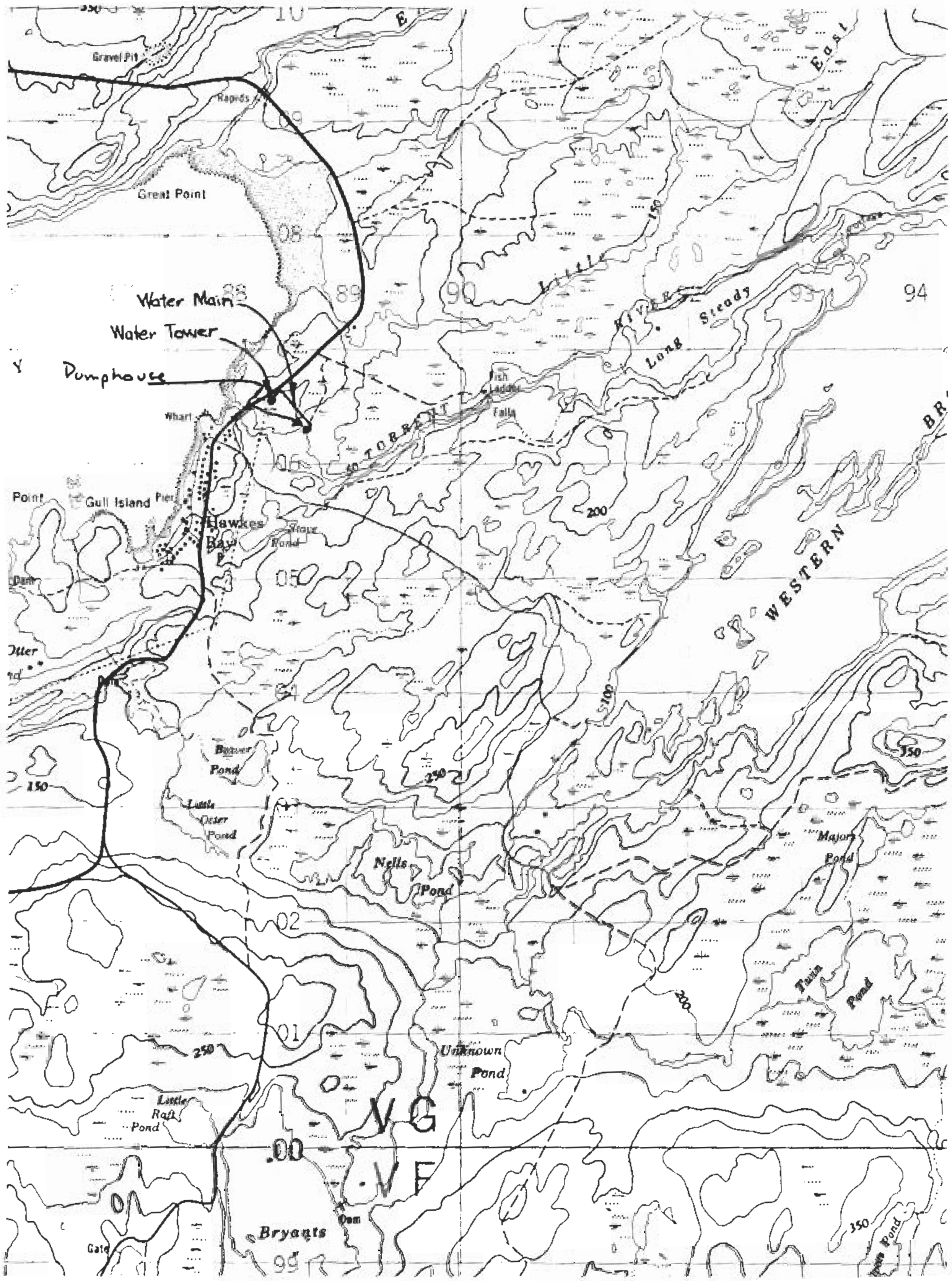
Method of Treatment: Chlorinated.

Reported Observations/Problems:

None - some slight colour during spring runoff but not a real problem. All reports from Department of Health satisfactory.

Future Plans Affecting Supply/Demand

Town is presently improving and extending water and sewer lines to service new lots and upgrade some existing connections.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

HAWKE'S BAY

ACRES

Howley

Status: Town

Population: 393 (1986 census)

Information Sources:

Town Clerk

"Town of Howley Report on Water Supply System", Department of Municipal and Provincial Affairs, Corner Brook. April 1983.

Tom Kendell, H.T. Kendell and Associates.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Water for town pumped from Sandy Lake, immediately adjacent to town, to vertical steel tank on the opposite side of town. Some services are supplied from the water main that fills the tank. System approximately 15 years old. Construction of a new intake at about 6 m depth and about 100 m out into Sandy Lake has started. This system will have an automatic strainer.

Pond Area: Grand Lake.

Drainage Area: 7860 km^2

Live Storage Head: About 5 m (in Grand/Sandy Lakes).

Existing Structures:

Intake: 100 mm galvanized steel suction pipe with a foot valve and strainer in lake.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Good (Grand and Sandy Lakes).

Potential for Increased Storage: Difficult because change in levels of Grand and Sandy Lakes would be necessary. Not required.

Reported Demand

Domestic:

One hundred and twenty homes, broiler farms (four, only two connected to municipal system), small stores.

Water Quality

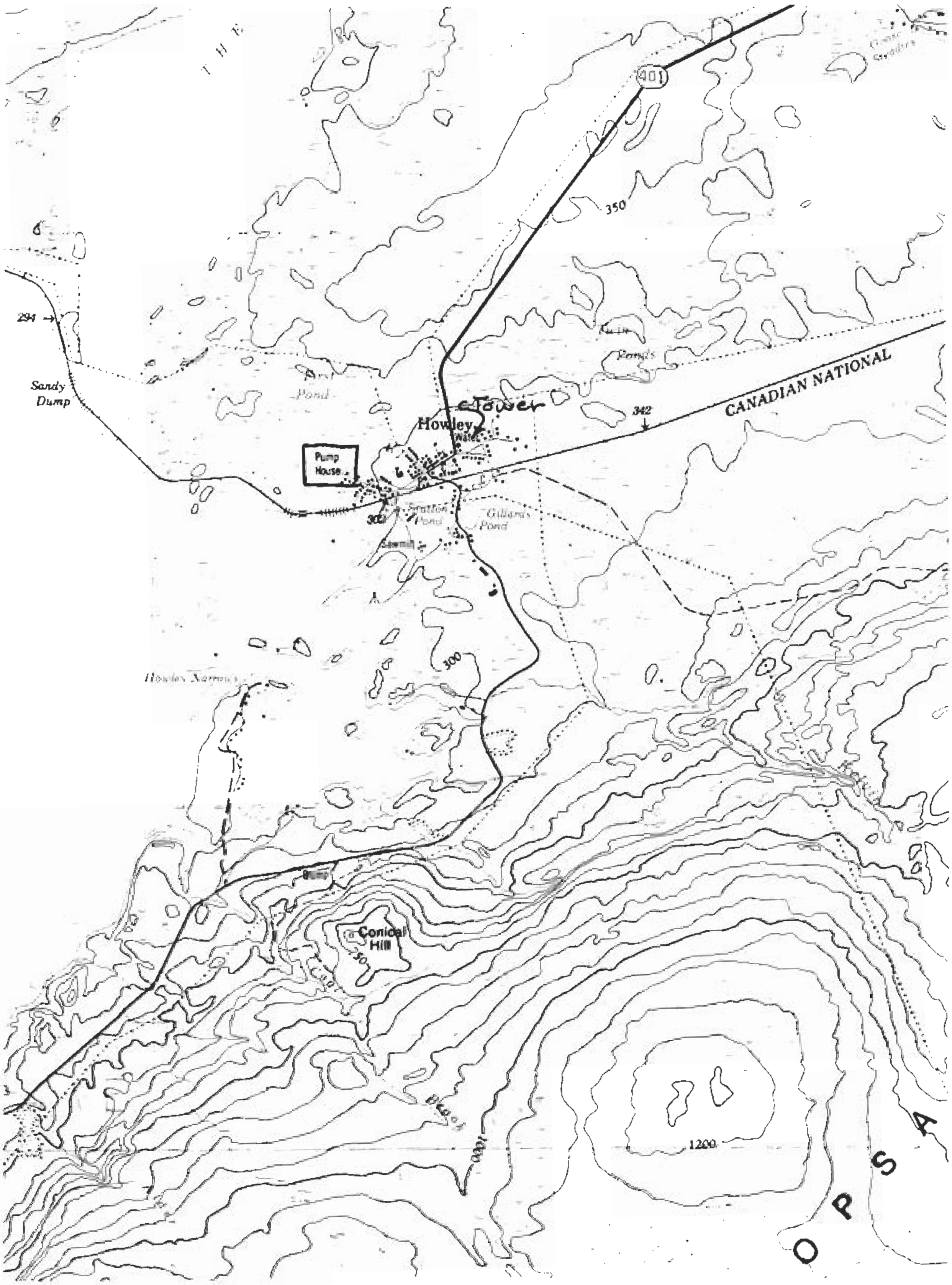
Method of Treatment: Chlorine liquid.

Reported Observations/Problems:

Department of Health reports have been unsatisfactory because of low chlorine count. Town now has two chlorinators, one at the pumphouse and one at the town. Had problems with silt and colour. The silt and colour result from the high organic content (bark) on the bottom due to logging, coupled with high inlet velocities due to a small pipe. The extended inlet plus the automatic strainer should alleviate the water quality problem.

Future Plans Affecting Supply/Demand

None.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

HOWLEY

ACRES

Hughes Brook

Status: Community

Population: 128 (1981), 141 (1986)

Information Sources:

D. Suley, Town Clerk

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Groundwater from a spring in the side of a mountain.

Existing Structures: Small reinforced concrete dam with spillway to provide intake pond.

Delivery System: 150 mm diameter main. New in 1986.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Good.

Reported Demand

Domestic: About 40 to 45 houses connected.

Water Quality

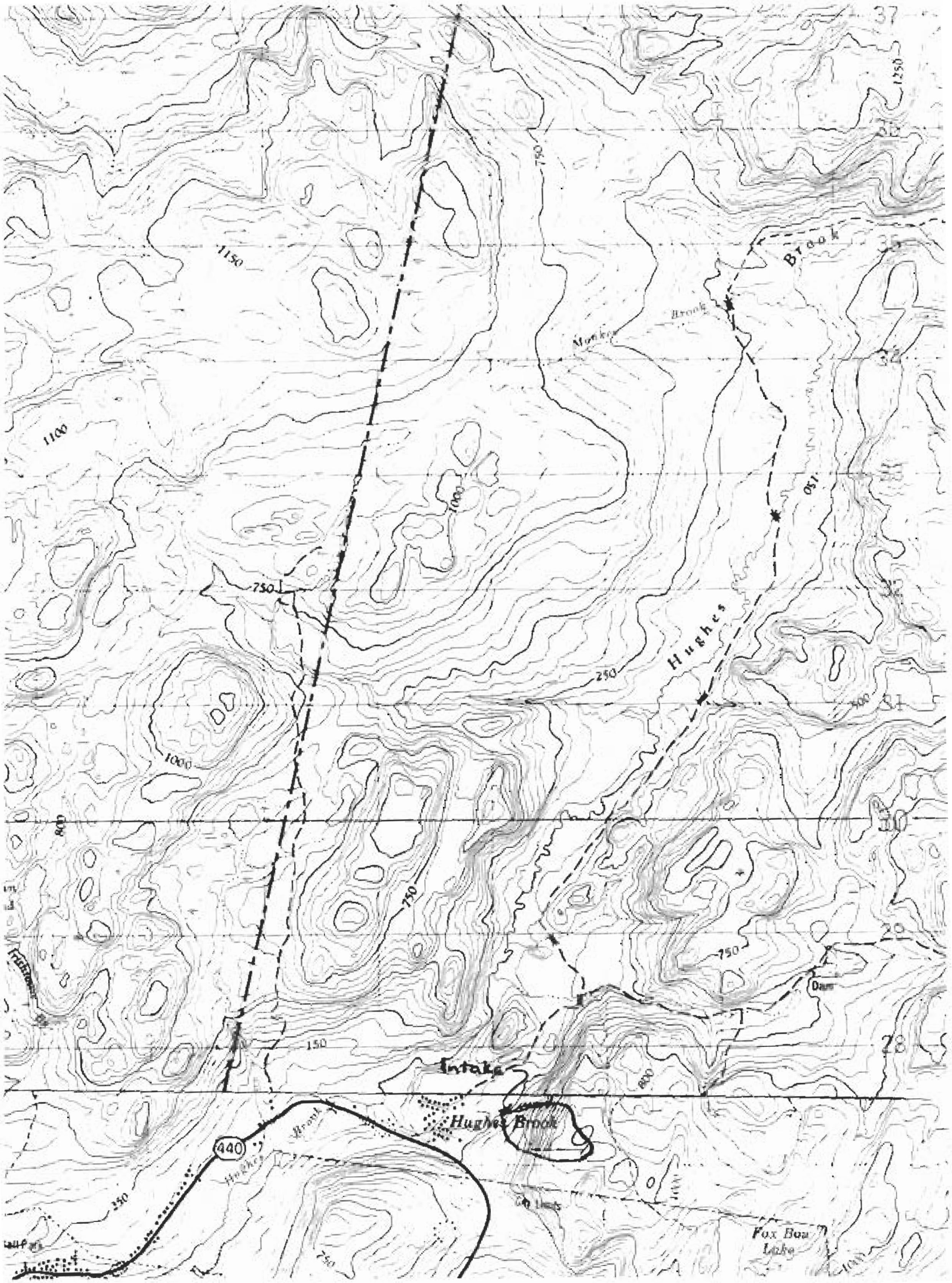
Method of Treatment: Chlorination.

Reported Observations/Problems: Water quality reported to be excellent.

Hughes Brook

Future Plans Affecting Supply/Demand

Delivery system is being expanded to serve 10 or 11 new homes. Continuing expansion will require an additional well or other source.



DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

HUGHES BROOK

ACRES

Irishtown

Status: Community

Population: 742 (1981), 798 (1986)

Information Sources:

A. Penney, Deputy Mayor

C. Burden, Burden Management

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Irishtown Brook. A temporary system was installed in 1975, consisting of a 75 mm plastic pipe and a small pumphouse. About 65 families are served by this system. About 20 other families have private supplies from this brook. The remaining households have private wells.

Pond Area: 0.08 km^2

Drainage Area: 6.87 km^2

Live Storage Head: Approximate storage: About 4500 m^3 at reservoir. About 27,000 m^3 in Irishtown Pond.

Existing Structures: Small temporary pumphouse.

Delivery System:

Town has been installing water and sewer pipes since 1978. When the new dam and intake are built, about 150 houses will be connected leaving about 45 to be serviced.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Should be adequate when new system is complete.

Potential for Increased Storage: Good with new system.

Reported Demand

Domestic: Total proposed connections about 200 households.

Industrial: None.

Water Quality

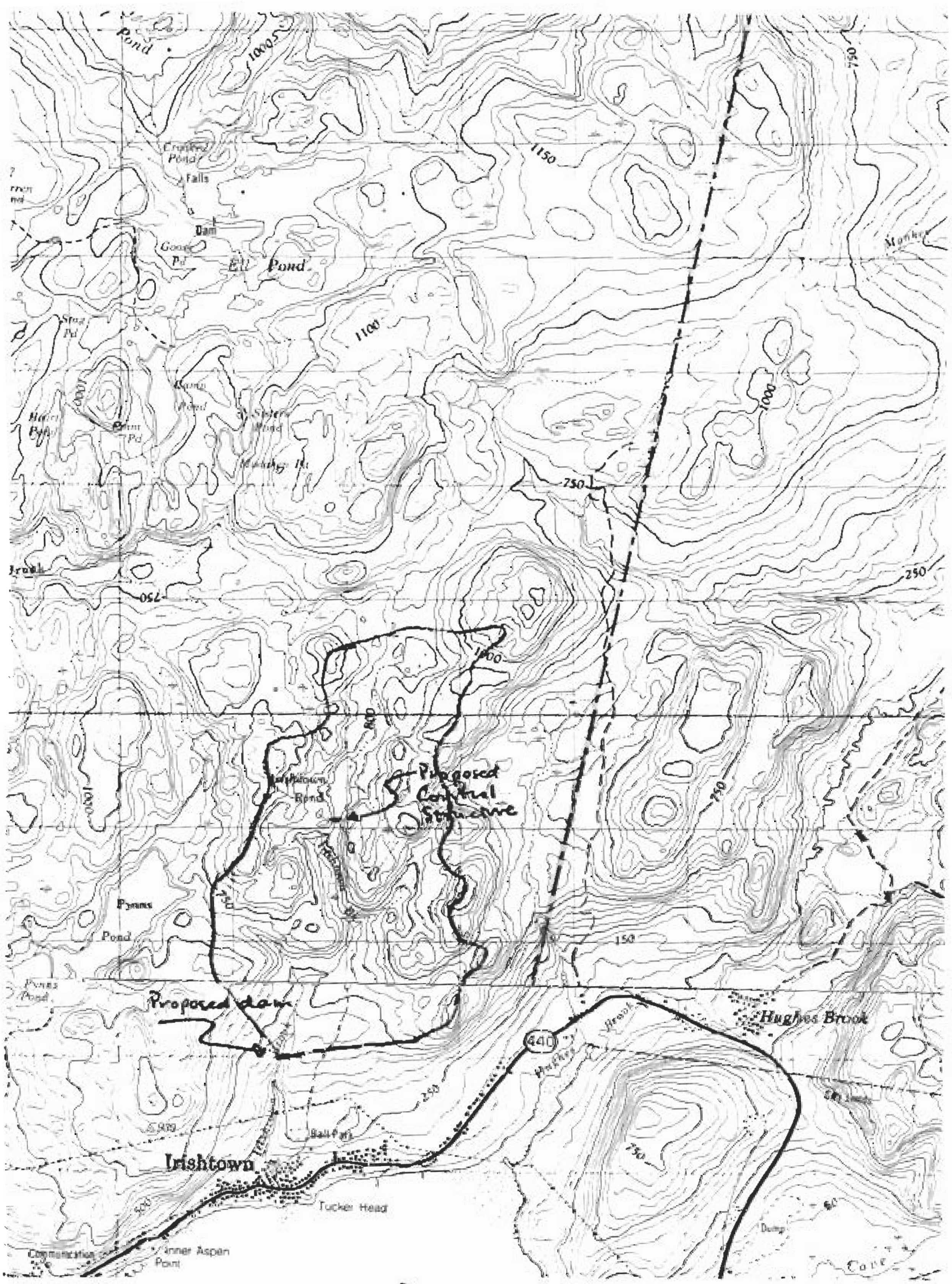
Method of Treatment: Chlorination.

Reported Observations/Problems:

Department of Health reports satisfactory. Silt during rainfall and colour in present system; silt problem should be resolved with new system.

Future Plans Affecting Supply/Demand

With construction of new dam and control structure and connection to mains, water system should be complete.



DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY
IRISHTOWN
ACRES

Jackson's Arm

Status: Community

Population: 652

Information Sources:

E. Davis, Town Clerk

Department of Municipal and Provincial Affairs, Corner Brook

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Lush's Pond (Long Pond, Long Steady - upstream ponds) services about 30-40 homes at present. It is the proposed supply for the whole community. Clay Cove system from Little Pond serves about 65 homes, and the Godfather Cove system serves about 60. A few families and the Health Clinic have wells.

Pond Area: 0.2 km^2

Drainage Area: 11.2 km^2

Live Storage Head: No storage in pond - 3.3 m depth of water above intake behind dam. 1 m assumed available.

Existing Structures:

A concrete dam and spillway just downstream of the old highway bridge are in good condition.

Delivery System:

900 mm diameter intake, 250 mm diameter main. New lines are being installed; about half the system is in place.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Good - never reported to run out.

Potential for Increased Storage:

Not required. Shallow pond with reedy bottom, not suitable for much storage.

Reported Demand

Domestic: 150 houses.

Water Quality

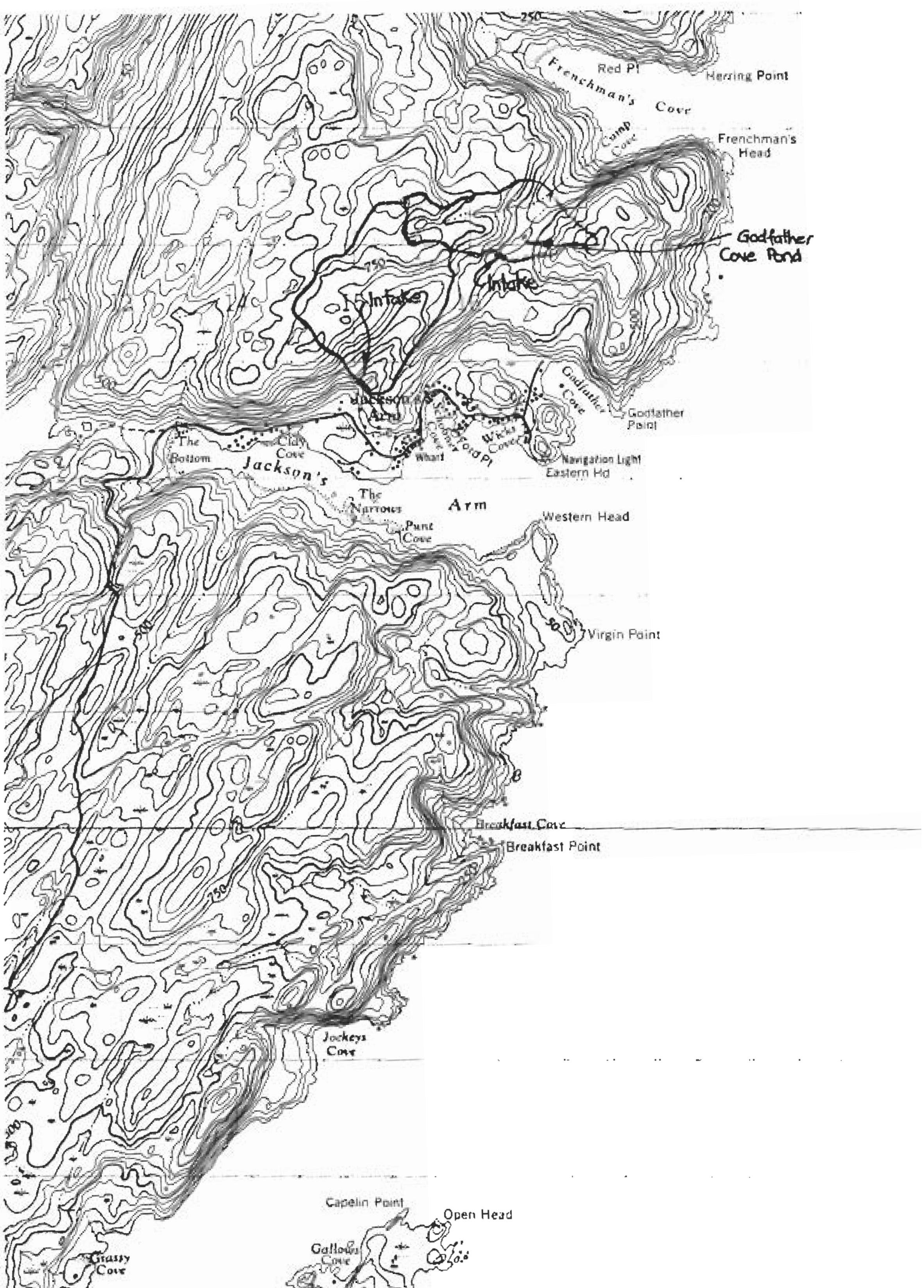
Method of Treatment: Chlorine.

Reported Observations/Problems:

Department of Health reports satisfactory, but occasionally in the spring and summer there is noticeable taste, colour and silt.

Future Plans Affecting Supply/Demand

Community will continue extending distribution system until entire community is served.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

JACKSON'S ARM

ACRES

Lark Harbour

Status: Community

Population: 828 (1986 census)

Information Sources:

"Pre-Engineering Investigation Water and Sewer System for Community of Lark Harbour", Atlantic Engineering Consultants Ltd. October 1987.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

No municipal system. Existing water supply consists of small individual shallow wells or private surface supplies. A few residents are connected to a small private supply servicing fish plant.

Existing Structures: Fish plant has a dam (unnamed source).

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply:

Adequacy variable. Some residents report an adequate supply of water throughout the year while others report recurring problems of insufficient supplies during dry periods of the year.

Other Observations/Reported Problems:

Town has no fire flow capability and no sewer system (individual septic tanks or outfalls to the sea or roadside ditches).

Reported Demand

Domestic: No municipal system.

Industrial:

Fish plant supplies own water from small dam above plant. Owned by National Sea Products (pickled, fresh and frozen).

Water Quality

Method of Treatment: Fish plant supply chlorinated.

Future Plans Affecting Supply/Demand

Consultants report identified two possible surface supplies - a gravity system at Gravelly Brook (storage approximately 250,000 m^3) or a pumped system from Lark Harbour Brook (storage approximately 2,000,000 m^3).

L'Anse Aux Meadows

Status: Local Service District

Population: 74

Information Sources:

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): None. Small system for park buildings.

Reported Demand

Domestic: No municipal system.

Main Brook

Status: Town

Population: 314

Information Sources:

M. Metcalfe, Mayor

Department of Environment and Lands, Corner Brook.

Department of Municipal and Provincial Affairs, Corner Brook.

Existing Water Supply

Water Source(s): Water is pumped from Joe Burts Pond.

Pond Area: 0.36 km^2

Drainage Area: 3.18 km^2

Live Storage Head: 1.5 m

Existing Structures: Intake, storage tank, pumphouse.

Delivery System:

Old system poor, cannot take pressure; suffers breaks and leaks. Council has installed about half of a new system.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Good - town reports that they have never run out.

Potential for Increased Storage: Poor but not required. Flat country.

Reported Demand

Domestic: About 150 houses will eventually be connected.

Industrial:

Fish plant - owned by Fisherman's Committee, leased last year to Doyle Fisheries. Fish plant use has never affected town's supply.

Water Quality

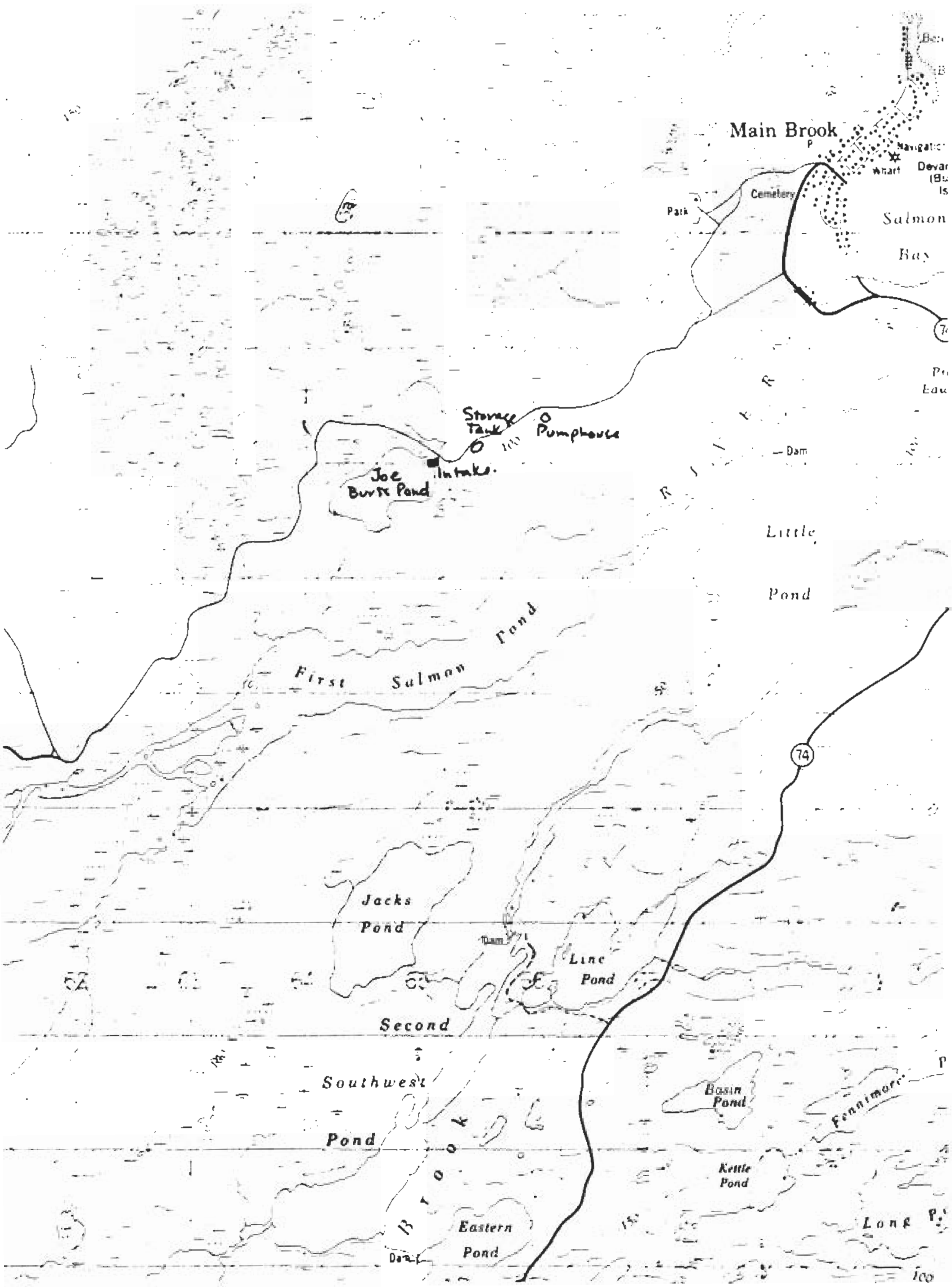
Method of Treatment: Chlorinated.

Reported Observations/Problems:

Good quality water. Department of Health reports satisfactory. In the winter, the town reports some colour and/or silt, presumably as a result of drawdown.

Future Plans Affecting Supply/Demand

Town plans to continue replacing its old distribution system.



DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY
MAIN BROOK
ACRES

Massey Drive

Status: Town

Population: 409 (1981 census), 415 (1986 census)

Existing Water Supply

Water Source(s): Supplied by Corner Brook. See Corner Brook description and map.

McIvers

Status: Community

Population: 738 (1986)

Information Sources:

Wade Parsons, Mayor

Nolan Davis Drawings 1976. Phase I w/s system.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Feeder Brook (branch of McIvers Brook).

Pond Area: No pond. Brook running down into town is about 0.3 m deep.

Drainage Area: 3.74 km^2

Live Storage Head: None.

Existing Structures:

Intake down about 1 m in gravel at bottom of brook; 150 mm diameter slotted screen. Very small gabion dam (some leakage); spill is over dam.

Delivery System: 150 mm PVC.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply:

Barely adequate. Ran low one day last summer (early August); council turned off the water overnight, it rained shortly afterwards and the system recovered.

Potential for Increased Storage: No pond.

McIvers

Reported Demand

Domestic: About 160 houses are connected with about 25 left to be hooked up.

Industrial: None.

Water Quality

Method of Treatment:

Chlorinator (not required in cool months.)

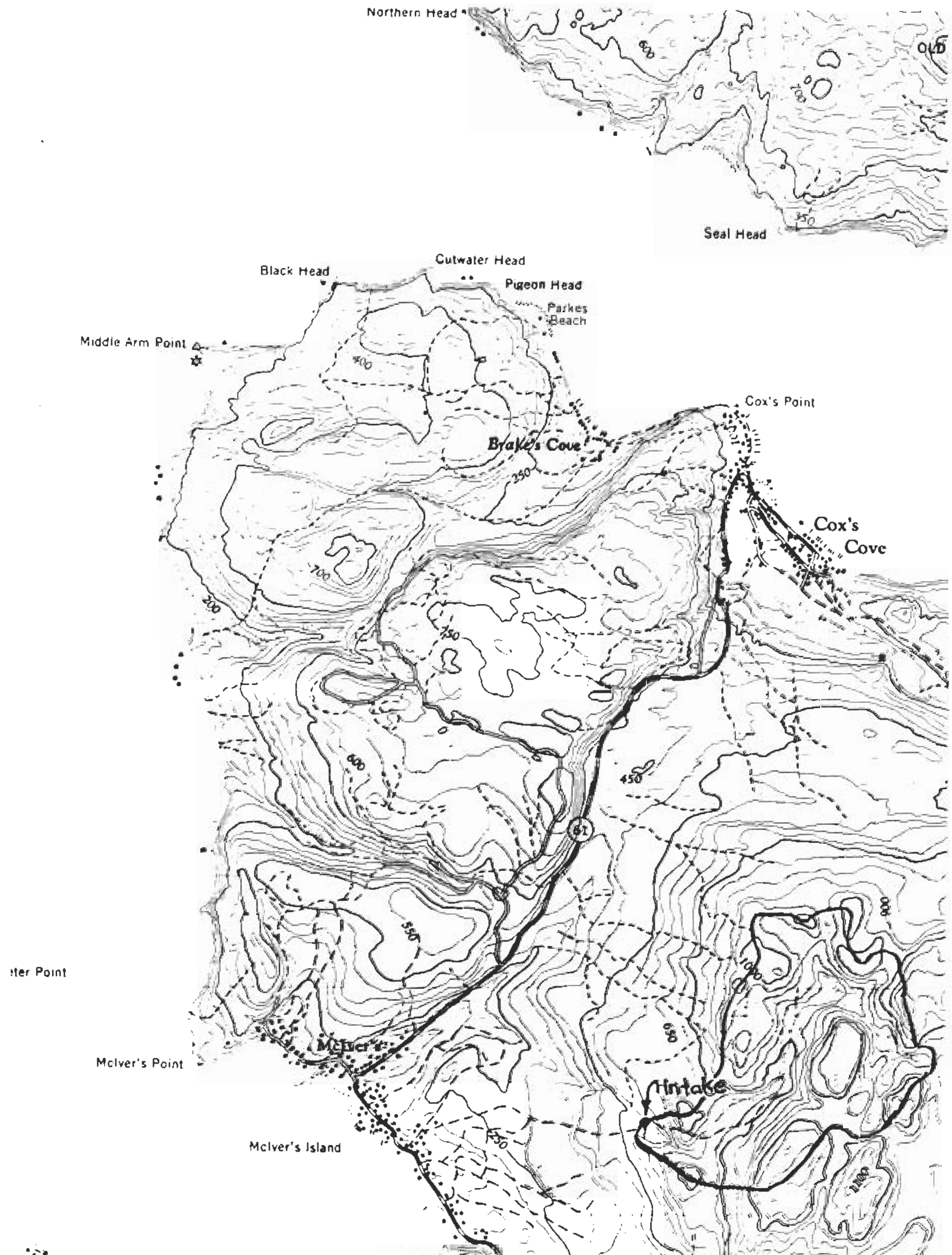
Reported Observations/Problems:

Reports from Department of Health in the summer are unsatisfactory due to a high coliform count if chlorinator is not on. Some slight colour after rain.

The watershed is not protected, and a pasture near the intake location has resulted in some conflict presently under consideration by the responsible provincial agricultural and environmental officials.

Future Plans Affecting Supply/Demand

Plan to hook up remaining houses. No other plans for the near future.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

McIVERS

Meadows

Status: Community

Population: 671 (1986 census)

Information Sources:

Jim Brake - Town Superintendent

Phyllis Brake - Town Clerk

"Feasibility Study on Engineering Aspects of Installing a Water and Sewer System in Meadows". Burden Management and Design. May 1977.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Meator's Pond, drained by McCarthy's Brook which runs through the community. Meadows Pond also feeds Meator's Pond through a canal or two pipes which are normally closed, but can be manually opened if backup supply necessary. A canal from Meadows Pond feeds Jackie Tapps Pond (presently Gillams supply). See Gillam's map.

Pond Area: 0.070 km^2

Drainage Area: 2.2 km^2

Live Storage Head: 3.5 m

Existing Structures:

Rockfill dam with 2:1 side slopes constructed in 1980. Concrete core. Crest 3 m wide. Top of dam at el. 76.8 m, intake at el. 73.2 m. Spillway: Overflow pipe on dam. Both dam and spillway in excellent condition.

Delivery System: 200 mm Sclairpipe.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply:

Supply reported to be more than adequate. Have never had any problems with supply.

Potential for Increased Storage:

Not very good. Pond is near top of watershed; already supplemented from adjacent ponds.

Reported Demand

Domestic:

Approximately 230 homes connected. Thirty five homes in Summerside tentatively scheduled for connection to Meadows supply next year. Also school (450 students plus staff), several small businesses, church and medical clinic.

Industrial: No major industries.

Water Quality

Method of Treatment: Chlorine gas.

Reported Observations/Problems: None.

Future Plans Affecting Supply/Demand

Summerside will be connected to supply next year (approximately 35 homes).

SEE GILLIAMS MAP

DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

MEADOWS

ACRES

Mount Moriah

Status: Town

Population: 692 (1986)

<u>Existing Water Supply</u>

Water Source(s): Served by Corner Brook. See Corner Brook description and map.

Nameless Cove

Status: Local Service District

Population: 103

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): None. Private wells. Could connect to Flowers Cove System.

Reported Adequacy of Supply: Not adequate.

Reported Demand

Domestic: No municipal supply.

Future Plans Affecting Supply/Demand

Nameless Cove LSD would like to obtain water from the Flowers Cove supply.

New Ferolle (Ferolle Harbour)

Status: Unincorporated

Population: 111

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Private groundwater and surface supplies. Some residents carry drinking water year round, and water for all purposes in winter if private supplies freeze up. Kettles Hill Brook, formerly used as a source, is now poor quality, and residents carry water from Castor River, Doctor's Brook or other local ponds. (See Reefs Harbour map.)

Delivery System: No municipal supply.

Reported Adequacy of Supply: Inadequate.

Reported Demand

Domestic: No municipal supply.

Industrial: None.

SEE REEF'S HARBOUR MAP

DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY
NEW FEROLLE

ACRES

Norris Point

Status: Community

Population: 1010 (1986 census)

Information Sources:

Oscar Hatcher, Maintenance Foreman.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Existing water supply taken from Neddy Harbour Pond, just north of community. Gravity flow with small dam and intake located directly in pond.

Pond Area: 0.157 km^2

Drainage Area: 1.30 km^2

Live Storage Head: 2.3 m

Existing Structures:

Small earthfill dam 1.5 m and 20-30 m long. No spillway. Dam is in very good condition, constructed two years ago.

Delivery System:

Main from intake 460 mm, plus a short segment of 300 mm, 200 mm main from screen chamber, 200 mm and 150 mm lines in town.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply:

Until dam was constructed two years ago, had problems with running out of water in winter. Since then, have had more than adequate supply.

Potential for Increased Storage:

Dam could easily be raised 0.5 m if low spot on opposite end of pond was dammed (approximately 15-20 m length).

Reported Demand

Domestic:

Approximately 300 homes connected to system, two schools, cottage hospital (20 beds), plus a number of small stores/businesses.

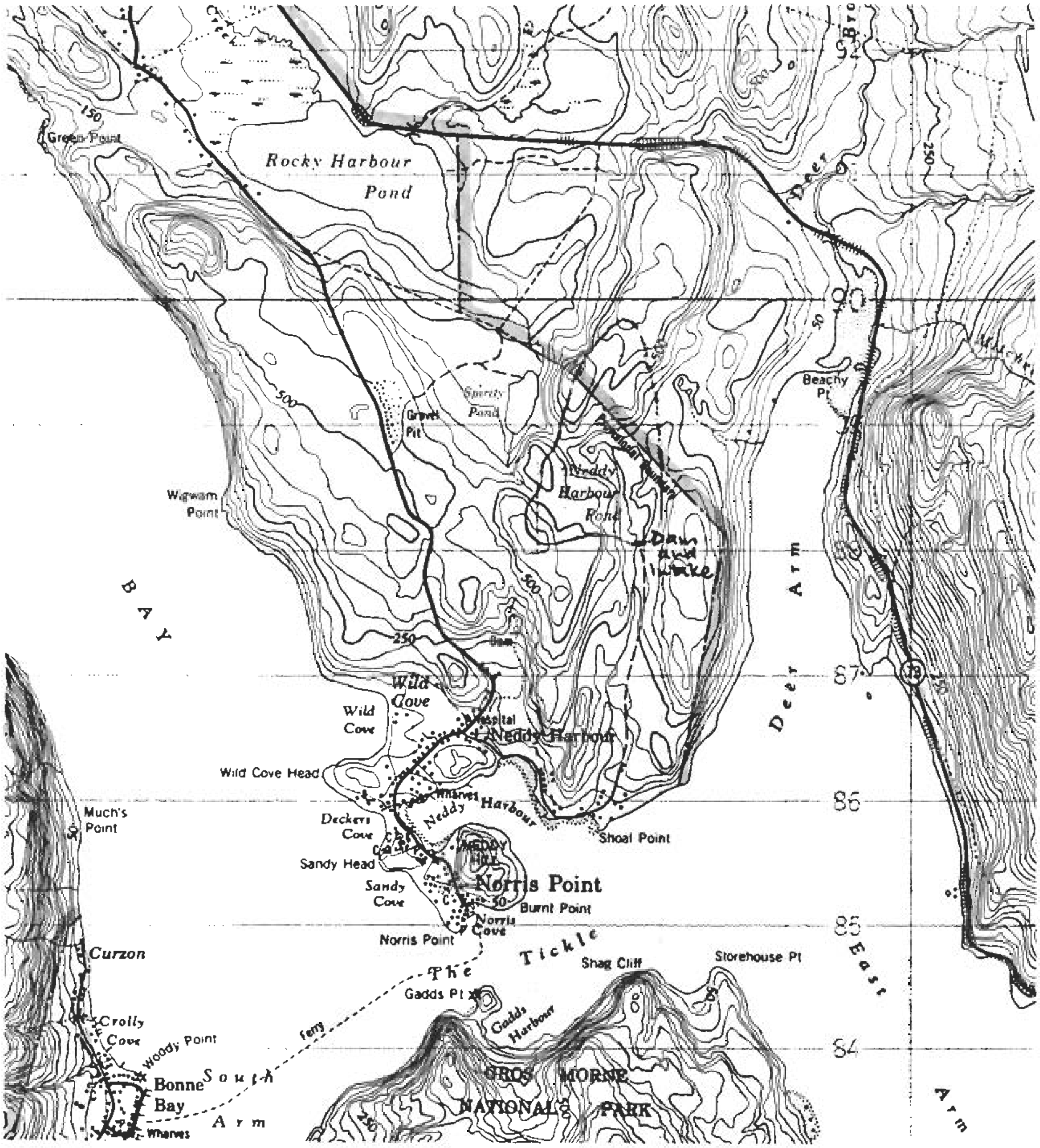
Industrial: No major industries.

Water Quality

Method of Treatment: Chlorine gas.

Future Plans Affecting Supply/Demand

Town is looking at constructing a new ice rink. Surveying is being completed now. Would be located in higher area of town and may need a pump to give adequate water pressure.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

NORRIS POINT

ACRES

Parson's Pond

Status: Community

Population: 589

Information Sources:

A. Payne - Mayor

J. Parsons - Clerk

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Spring-fed reservoir about 2 km north of Parson's Pond (near new subdivision).

Existing Structures: Small plywood faced timber crib dam at intake.

Delivery System: 50-150 mm lines in older parts of community; 100-150 mm in new subdivision.

Reported Adequacy of Supply: Never run out.

Potential for Increased Storage: No ponds, but not required.

Reported Demand

Domestic: All community served.

Industrial: Parsons Pond Seafoods, connected to municipal supply.

Water Quality

Method of Treatment: Chlorination.

Reported Observations/Problems:

Many complaints. Town often has boil orders in the summer. Possible causes include proximity of spring to dump, and intake too shallow. Neighboring communities are getting an incinerator, and dump will be closed, but this may not solve problem.

DOEL staff attribute the quality problem not to the dump but to the old distribution system. The pipes cannot be properly flushed and disinfected, and therefore contain sediment and heavy bacterial growth.

The shoreline of the reservoir is very flat, and the resulting shallow areas are conducive to algae growth.

Future Plans Affecting Supply/Demand

- Improve quality by deepening and possibly covering intake.
- Upgrade distribution system.
- Construct a proposed supply from Otter Brook (adjoins present spring).

Pasadena

Status: Town

Population: 3268 (1986 census)

Information Sources:

Ian Freemantle - Town Manager

Gerald Wight - Town Superintendent

"Pasadena and South Brook Water and Sewer Study", BAE Group. November 1983.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Town has two gravity feed water supplies as a result of amalgamation with South Brook in 1986. The primary system consists of a dam and reservoir on Blue Gulch Brook, 2 km southeast of the town. The intake is installed in a brook draining Blue Gulch Pond. A small structure with stoplogs on the outlet of Blue Gulch Pond allows the pond level to be controlled.

Pond Area:	1.67 km^2
Drainage Area	
above Pond:	11.0 km^2
below Pond:	0.835 km^2
Live Storage Head:	0.7 m

The second system serves South Brook and consists of a dam and intake on Transmission Brook. The intake is located in the bottom of the brook.

Existing Structures:

The dam on Blue Gulch Brook is earthfill with a wood face; the dam on Blue Gulch Pond is a small wood/rockfill cofferdam. The spillway in Blue Gulch Brook is a concrete overflow spillway. The dams on Blue Gulch system are in need of structural repairs - wood is rotted out. The spillway has had considerable structural problems and repairs undertaken to prevent further damage.

Delivery System: 250 mm PVC from dam.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply:

Blue Gulch Pond adequate. At Transmission Brook, brook dries up in summer, and problems with silting up of intake in spring are reported.

Potential for Increased Storage: Dams can be raised about 0.3 m at Blue Gulch Pond.

Other Observations/Reported Problems:

Have some pressure problems with town spreading out over higher ground. Town is going to connect both supplies so that if one has to be shut down, rest of area can still be serviced.

Reported Demand

Domestic:

Approximately 870 homes connected to Blue Gulch system; 135 connected to Transmission Brook system.

Industrial: Bayside Seafoods.

Water Quality

Method of Treatment:

Chlorine gas on Blue Gulch system, chlorine liquid on Transmission Brook system. New chlorinator installed for Pasadena West last year, new chlorinator for Pasadena East planned.

Reported Observations/Problems:

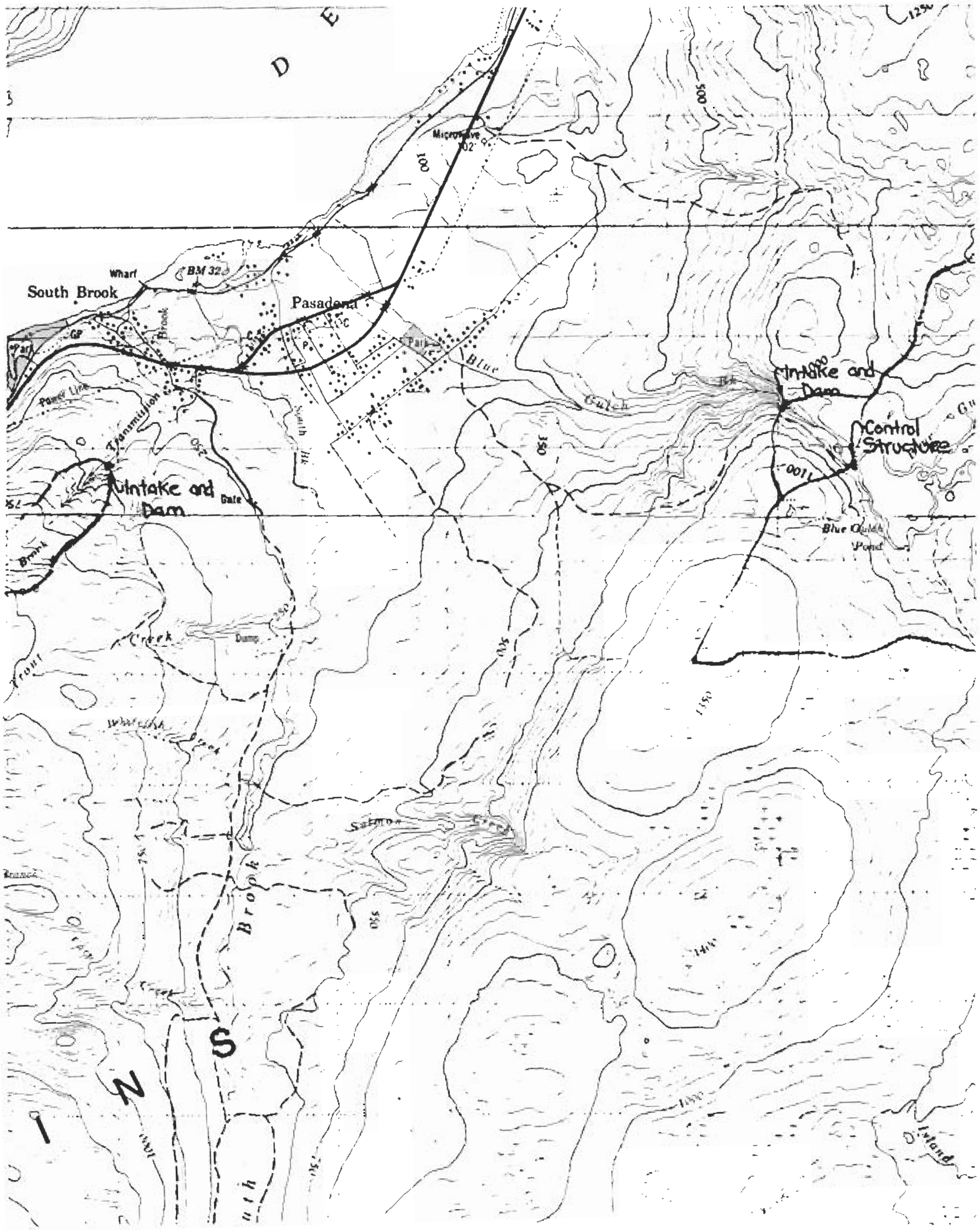
During warm dry summers, algae growth in Blue Gulch Pond causes very bad odor in water. The shallow water at the edges of the pond is conducive to algae growth.

Future Plans Affecting Supply/Demand

Town has requested funding for engineering study to investigate improvements to existing system, including structural repairs to existing dams and solutions to deal with the algae problem. Have to spend $5000 - $10,000 this year for temporary repairs to dam.

Town is expanding rapidly - there are 33 new housing starts already this year compared to 19 starts for all of 1988.

There is a concern by the town that the proposed route of the new Trans Canada Highway will affect accessibility and distribution of water to the town.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

PASADENA

ACRES

Pidgeon Cove - St. Barbe

Status: Local Service District

Population: 155

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Local pond, shared with Black Duck Cove (see Black Duck Cove). The delivery system is a 50 mm insulated polypipe.

Reported Adequacy of Supply: Ran out of water last winter (pond froze).

Potential for Increased Storage: Poor because of flat country.

Reported Demand

Domestic: All community is served.

Water Quality

Method of Treatment: Chlorinated.

Future Plans Affecting Supply/Demand

Rudge's Pond, presently serving Forrester's Point, has been suggested as a regional supply for Forrester's Point, Pidgeon Cove and St. Barbe.

SEE BLACK DUCK COVE MAP

DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY
PIGEON COVE – ST. BARBE

ACRES

Plum Point

Status: Unincorporated

Population: 196

See Brig Bay

Port au Choix

Status: Town

Population: 1311 (1986 census)

Information Sources:

M. Kelly, Town Manager

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

"Town of Port au Choix Water and Sewer Systems Study". Newplan Consultants Ltd. October 1987, revised February 1988.

Existing Water Supply

Water Source(s):

Surface water supply taken from Winterhouse Pond located just west of town. Water pumped to an elevated storage tank near the pond and from here is distributed to most of the town. System installed in 1973. Fish plant also has salt water supply from Gargamelle Cove, consists of intake and pumphouse.

Groundwater sources developed since 1982 supply about 10% of the water. They include well #1 near existing pumphouse, well #2 (not connected), well #3 drilled under emergency grant in 1987.

Pond Area: 0.0067 km^2

Drainage Area: 1.66 km^2

Live Storage Head: About 1.2 m

Existing Structures:

Earthfill dam with reinforced concrete core wall, 150 m long, crest width 2.4 m with a 1.2 m diameter corrugated metal pipe overflow spillway, 14 m long. There is also another small earthfill dam and a small steel dam.

Delivery System:

Ductile iron water mains of 100 mm to 250 mm diameter (7.5 km of water main). Water pressure determined by water elevation in storage tank. Town is satisfied with distribution system.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply:

Supply reported not adequate. Pond often dries up in winter. If fish plant is not operating, town can sometimes just get by.

Potential for Increased Storage:

Poor due to flat topography. Drainage area insufficient even with additional storage.

Reported Demand

Domestic: About 400 homes plus small businesses and stores.

Industrial:

FPI plant - fresh frozen, shrimp. Fresh water (municipal) and salt water.

Metering:

Five meters (5 in-line turbine type flow meters) record consumption for town and freshwater for fish plant at the following locations:

Meter Location	Flow Measured
Pumphouse	From Winterhouse Pond
Pumphouse	From Well #1
Well #2	From Well #2
Well #3	From Well #3
Fish Plant	From town system to fish plant.

Meter records available for 1975-1986. Show yearly average of 288,000 m^3 domestic consumption and 46,000 m^3 for fish plant, with freshwater use by fish plant varying from 8.8% to 23.2% of total consumption for the year.

Water Quality

Method of Treatment: Chlorine gas.

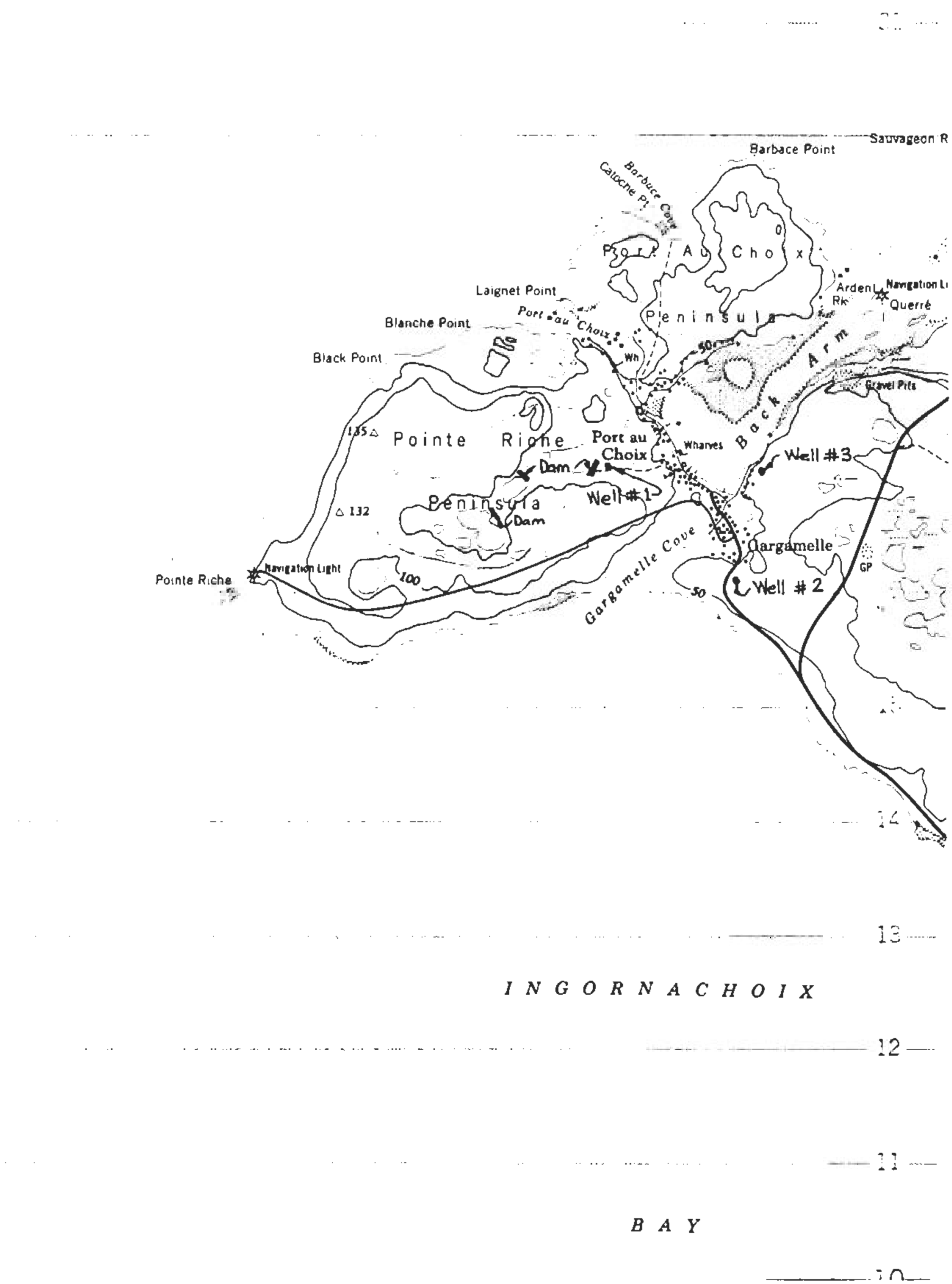
Reported Observations/Problems:

Residents report that pond is stagnant and consequently has an unpleasant taste and odor, although reports from Department of Health are satisfactory.

Future Plans Affecting Supply/Demand

Excerpt from report on water system performance in February 1988 - "Water level in Beaverhouse Pond, the water intake pond, continued to drop. Water depth in wet well at pumphouse was 6 ft., 11 in. (49 in over intake pipe). Level fallen since December to 28 in over intake pipe in January, 1988. Water levels in two backup ponds too low to provide any additional water to system before spring runoff." (Note: direct quote, therefore units not converted.)

Town has applied several times to develop new supply from Tom Taylor's Pond, which is currently source for Port Saunders. A 6.4 km long 300 m diameter line would be required. Report concludes that pond is capable of meeting water requirements of Port aux Choix and Port Saunders in short and long term. Town is hopeful that funding will be approved this fall (1989).



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

PORT AUX CHOIX

ACRES

Port Saunders

Status: Town

Population: 822 (1986 census)

Information Sources:

Peter Kennedy, Maintenance Foreman

"Town of Port Saunders Water and Sewer System Master Plan". EDM Consultants. December 1988.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Intake in Tom Taylor's Pond. Gravity flow into wet well, then pumped to concrete underground reservoir (400 m^3 capacity), gravity flow to town.

Pond Area: 0.44 km^2

Drainage Area: 11.56 km^2 (plus upstream bog).

Live Storage Head: About 2.4 m

Existing Structures: No dam or spillway.

Delivery System:

Eight inch ductile iron main from intake, various sizes of PVC main through town (50-150 mm)

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply:

Adequat[illegible]n under dry conditions.

Potential for Increased Storage: Not required.

Other Observations/Reported Problems:

Town has had problems in past with sludge buildup in intake because not protected by berm. Tenders are to be called this year for Phase 1 of water supply upgrading (see Future Plans).

Reported Demand

Domestic:

In 1988, 264 connections were made to system, including 20 bed hospital (estimated consumption 0.21 litres/sec), school, RCMP building, and a number of small stores/-takeouts.

Industrial:

Fish processing plant. Maximum discharge from hose 0.49 litres/sec. Marine Service Center - three ice making machines making 15 tons/day each results in estimated consumption of 0.42 litres/sec water.

Losses/Wastage:

Had leaks in system last year and two pumps were required to keep reservoir filled. Leaks repaired and only one pump operating now.

Variations in Demand:

Houses at higher level (approximately same el as water supply) lose water in winter when other people keep taps running to prevent freezing.

Water Quality

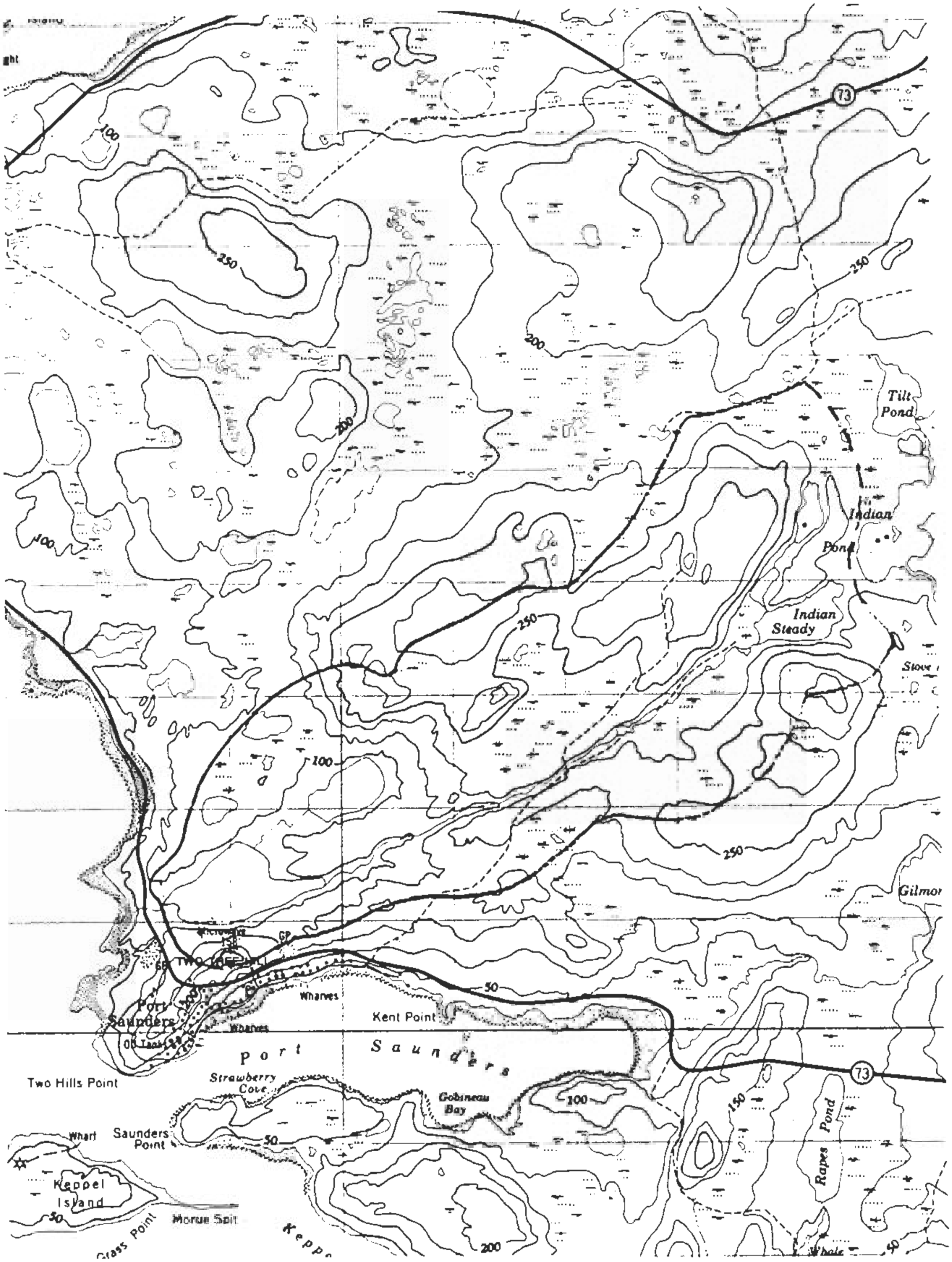
Method of Treatment: Chlorine gas.

Reported Observations/Problems: None reported.

Future Plans Affecting Supply/Demand

New subdivision opened up. Six homes being constructed this year.

Upgrading will include replacing intake, constructing a protecting berm, upgrading of pumphouse and chlorination system, and replacement of supply lines where necessary. Sewer system planned for 1990-1993.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

PORT SAUNDERS

Portland Creek

Status: Local Service District

Population: 150

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

A small dam was built to form a reservoir collecting water from a spring in the side of a hill. Gravity supply.

Existing Structures: Small dam.

Delivery System: 50 mm pipe.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply: Just adequate.

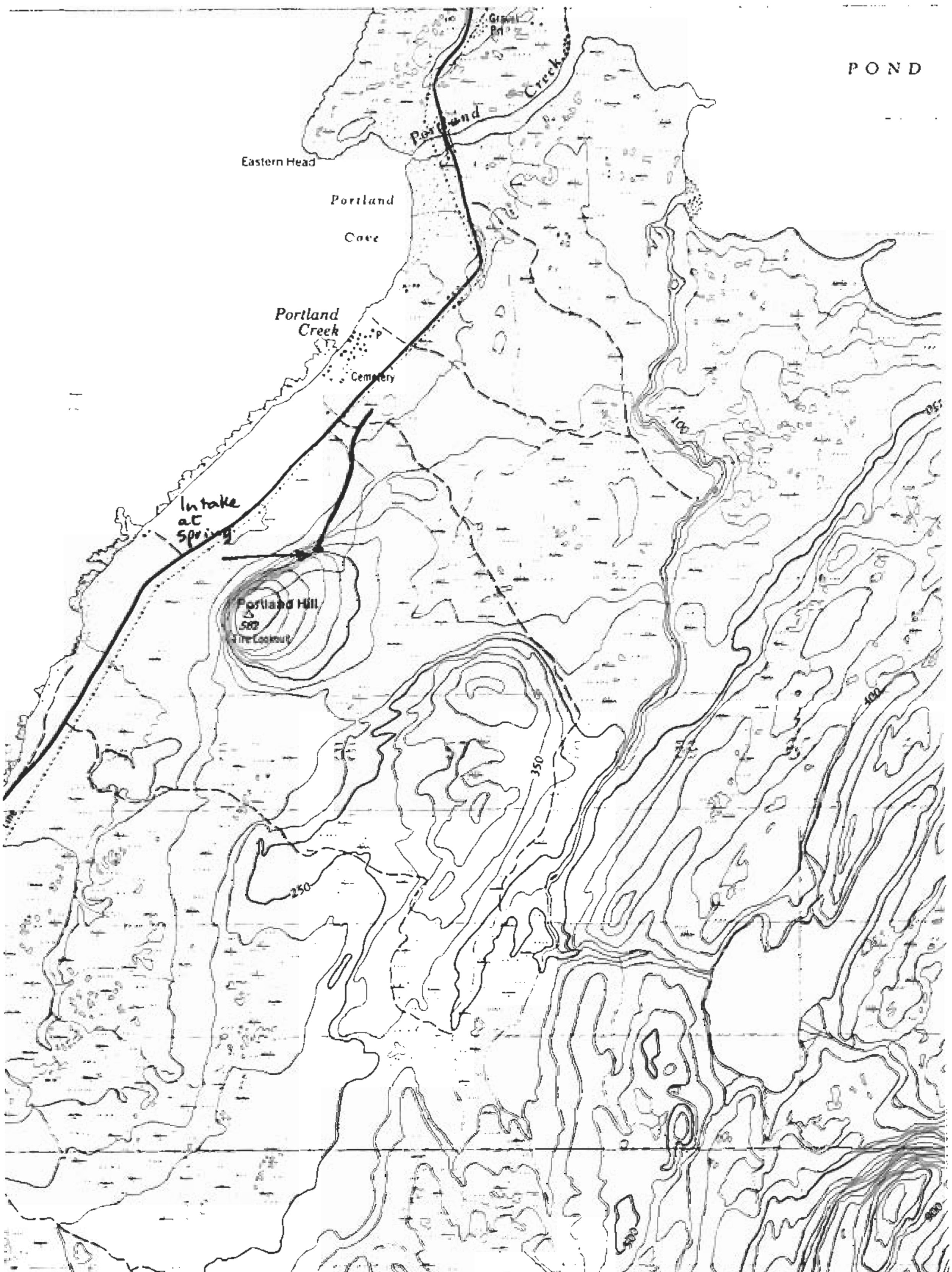
Potential for Increased Storage: No pond.

Reported Demand

Domestic: All community served.

Water Quality

Method of Treatment: Chlorinated.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

PORTLAND CREEK

ACRES

Pynns Brook

Status: Local Service District

Population: 90

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Private groundwater and surface supplies.

Reported Adequacy of Supply: Some wells run dry.

Reported Demand

Domestic: No municipal supply.

Water Quality

Method of Treatment: None.

Reported Observations/Problems: Drilled wells are reported to have a high sodium content.

Future Plans Affecting Supply/Demand

A new system has been started (Phase I in fall of 1989) from Pynn's Brook. An earthfill dam will form a small membrane-lined reservoir. The transmission main will be 270 m of 100 mm PVC,I from the intake and then 1130 m of 50 mm to the chlorination building.

Quirpon

Status: Unincorporated

Population: 95

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Private groundwater supplies.

Reported Adequacy of Supply: No reports to the Department of Municipal and Provincial Affairs; assumed adequate.

Reported Demand

Domestic: No municipal system.

Raleigh

Status: Community

Population: 373

Information Sources:

C. Taylor, Mayor

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Groundwater. One drilled community well serves about 10 houses. Tenders have been called for two more drilled wells to serve the rest of the community.

Reported Adequacy of Supply: No reported shortages from drilled wells in the area.

Reported Demand

Domestic:

Present community system serves 10 houses. Total expected domestic connections about 130 houses.

Industrial:

Fish plant owned by Fishermen's Committee, leased to Doyles, will be supplied by municipal system. (Presently private system.)

Water Quality

Method of Treatment: Chlorination.

Raleigh

Reported Observations/Problems:

Water quality is reported to be very good from drilled and dug wells, but poor from artesian wells. People carry drinking water from community well in winter.

Future Plans Affecting Supply/Demand

The community expects that the three drilled wells, with possibly a fourth for peak demand, will serve the entire community. Council is proceeding in phases towards this goal.

Reef's Harbour

Status: Unincorporated

Population: 106

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Mixed private groundwater and surface systems. The school and the fish plant have drilled wells, and the fish plant also has a surface system. People in the community use the fish plant line in summer, carry water in winter.

Status of Watershed Protection: Fish plant supply is unprotected.

Reported Adequacy of Supply: Inadequate

Reported Demand

Domestic: No municipal supply.

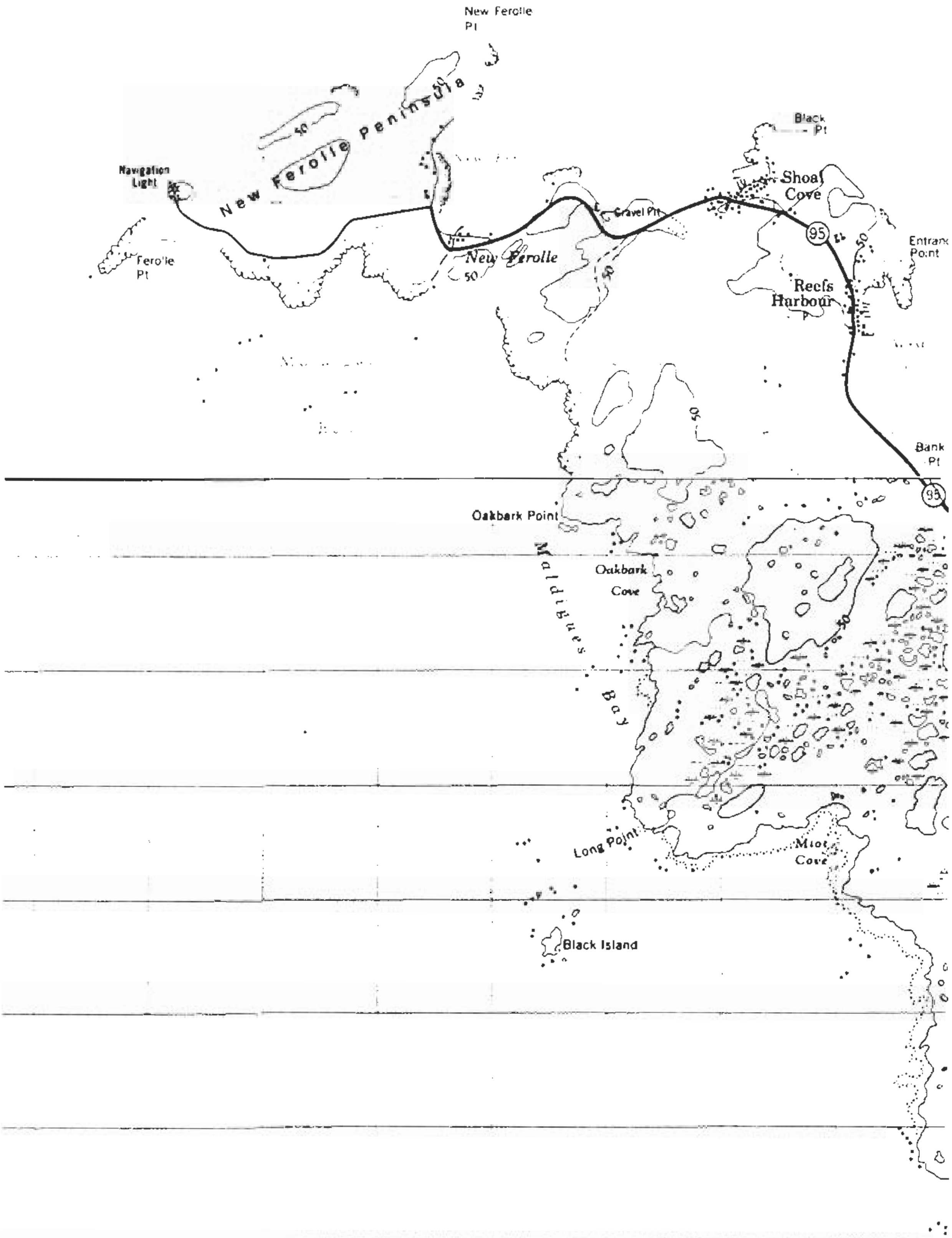
Industrial: Fish plant.

Water Quality

Method of Treatment: Fish plant supply is chlorinated.

Future Plans Affecting Supply/Demand

A large lake near the community is used for water, but it is very shallow. Consequently, it is dirty in the summer and freezes in the winter.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

REEF'S HARBOUR, NEW FEROLLE, SHOAL COVE WEST

AGRES

Reidville

Status: Community

Population: 504 (1986 census)

Information Sources:

Gail King - Town Clerk

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Humber River. Supply consists of wet wells with intake directly into river. Pumped supply. New system installed in 1989.

Pond Area: No pond.

Drainage Area: 2110 km^2

Delivery System: 150 mm diameter pipe.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Good.

Potential for Increased Storage:

Not required - would require damming of Upper Humber or upstream pond.

Other Observations/Reported Problems:

Had problems in past with slob in winter and debris and silting of intake in winter. New system not tested yet.

Reported Demand

Domestic:

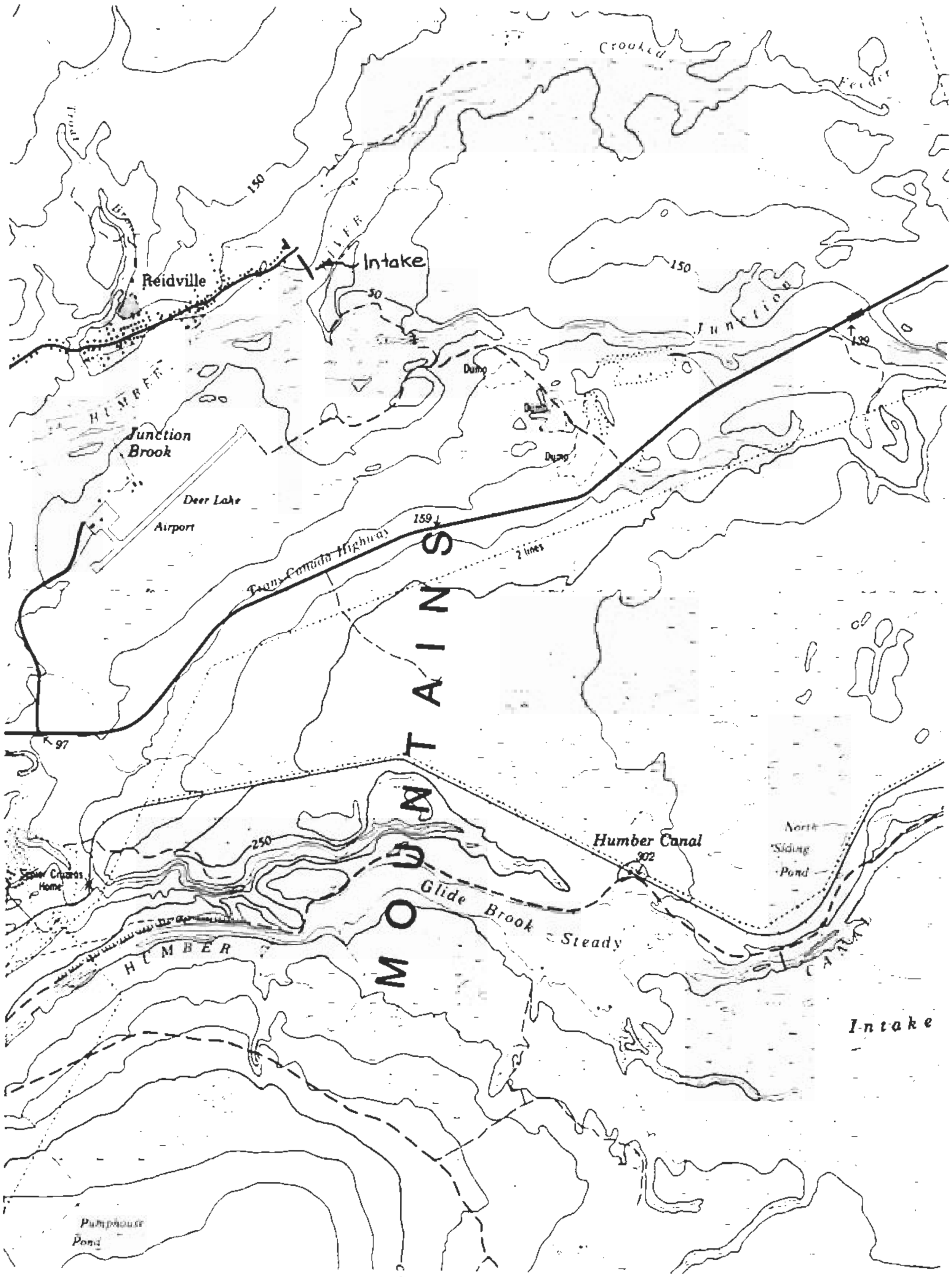
Approximately 150 homes connected to system, 10 homes not serviced. Some farms in area use same water source but have own pumps - not on municipal supply.

Water Quality

Method of Treatment: No treatment yet. Chlorine treatment scheduled for installation.

Reported Observations/Problems:

The Department of Health has issued boil orders.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

REIDVILLE

ACRES

River of Ponds

Status: Community

Population: 326 (1986 census)

Information Sources:

Town Clerk.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Gravity from Burnt Head Pond.

Pond Area: 0.19 km^2

Drainage Area: 1.44 km^2

Live Storage Head: About 1.5 m

Existing Structures:

Small rockfill dam at back of pond to prevent outflow. In good condition. Raised about 5-6 years ago.

Delivery System:

75 mm line coming from 150 mm main. Inadequate delivery to some homes when fish plant is operating.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply: Good.

Potential for Increased Storage: Little further potential.

Reported Demand

Domestic: About 75-80 houses.

Industrial: Fish plant (Gould's Fisheries).

Water Quality

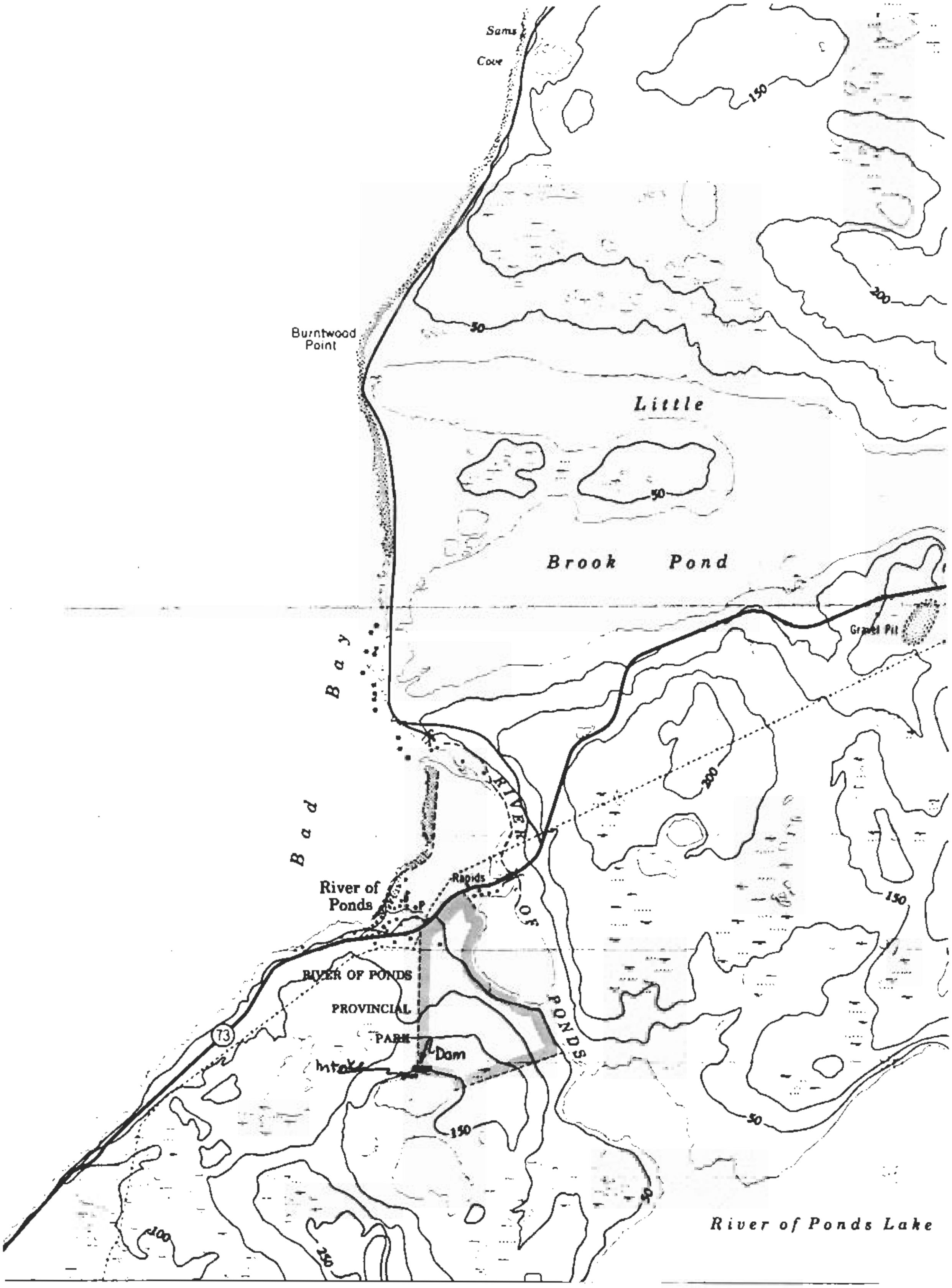
Method of Treatment: Chlorinated.

Reported Observations/Problems:

Reported to be very good. Rarely, when water levels are low, bottom silt can get into water.

Future Plans Affecting Supply/Demand

Fish plant is seeking approval to install its own 75 mm line. Council is supporting this application, to alleviate distribution problems.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

RIVER OF PONDS

ACRES

Rocky Harbour

Status: Community

Population: 1268 (1986 census)

Information Sources:

Glen Pittman, Town Manager

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Existing water supply consists of intake into Gull Pond, to the northeast of town. Gravity system installed in 1975-76. Gull Pond fed by Grand Rocky Harbour Pond. Intake extends 60 m into pond.

Pond Area: 0.187 km^2

Drainage Area: 14.9 km^2

Live Storage Head: 3 m

Existing Structures: No control structure.

Delivery System:

400 mm line from intake, separates into two 300 mm lines going into community. All in good condition.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Good.

Potential for Increased Storage: Not required, but could be provided.

Rocky Harbour

Reported Demand

Domestic:

Approximately 350 homes now connected to supply. Also, one hotel, one motel, campground (Juniper Park), one school, recreation facility with ice rink, Parks Canada Administration Center and large visitors center. Two extensions to supply planned for next two years which would connect another 27 homes connected to system.

Industrial: Harbour Seafoods fish plant uses municipal water supply.

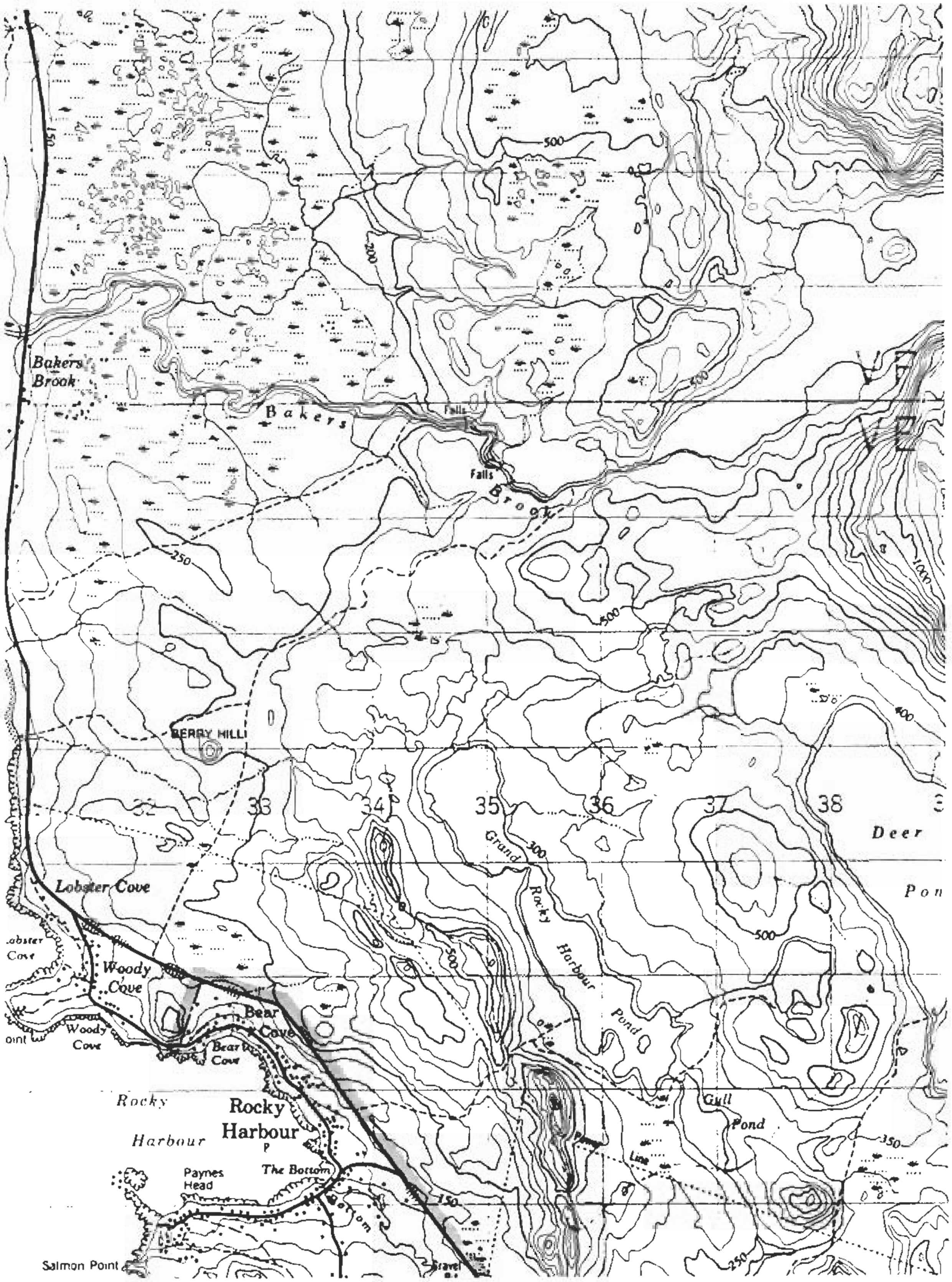
One 38 mm line is run all year at the government wharf used by people washing cars and fishermen. Helps prevent freezing of lines.

Water Quality

Method of Treatment: Chlorine gas.

Future Plans Affecting Supply/Demand

Parks Canada is completing construction of large recreation complex just outside town which will be connected to town's supply. Facilities will include large swimming pool and two large whirlpool baths which will put demand on system. Also have a large fire pump with a 200 mm line that is connected to system, which is tested once a week. Town feels that there will be problems with water pressure in the town next year when complex opens.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ROCKY HARBOUR

ACRES

Roddickton

Status: Town

Population: 1223

Information Sources:

Art Locke, Town Manager.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

East Pond (also called Eastern Pond Brook). Intake in pond, pumphouse on concrete wet well about .5 m from shore.

Pond Area: 0.97 km^2

Drainage Area: 40.3 km^2

Live Storage Head: About 1.5 m

Existing Structures: No dam or spillway.

Delivery System:

Good distribution system. (250 mm main, 150 mm lines) but small header relative to size of pipes causes loss of pressure. Also lack of pumping capacity.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Excellent.

Potential for Increased Storage: Good but not required.

Roddickton

Reported Demand

Domestic:

About 500 houses presently connected; funding for an additional expansion to 25-30 houses has been approved. Town is also opening up a new subdivision.

Industrial: Crab plant is a large water uses when operating.

Water Quality

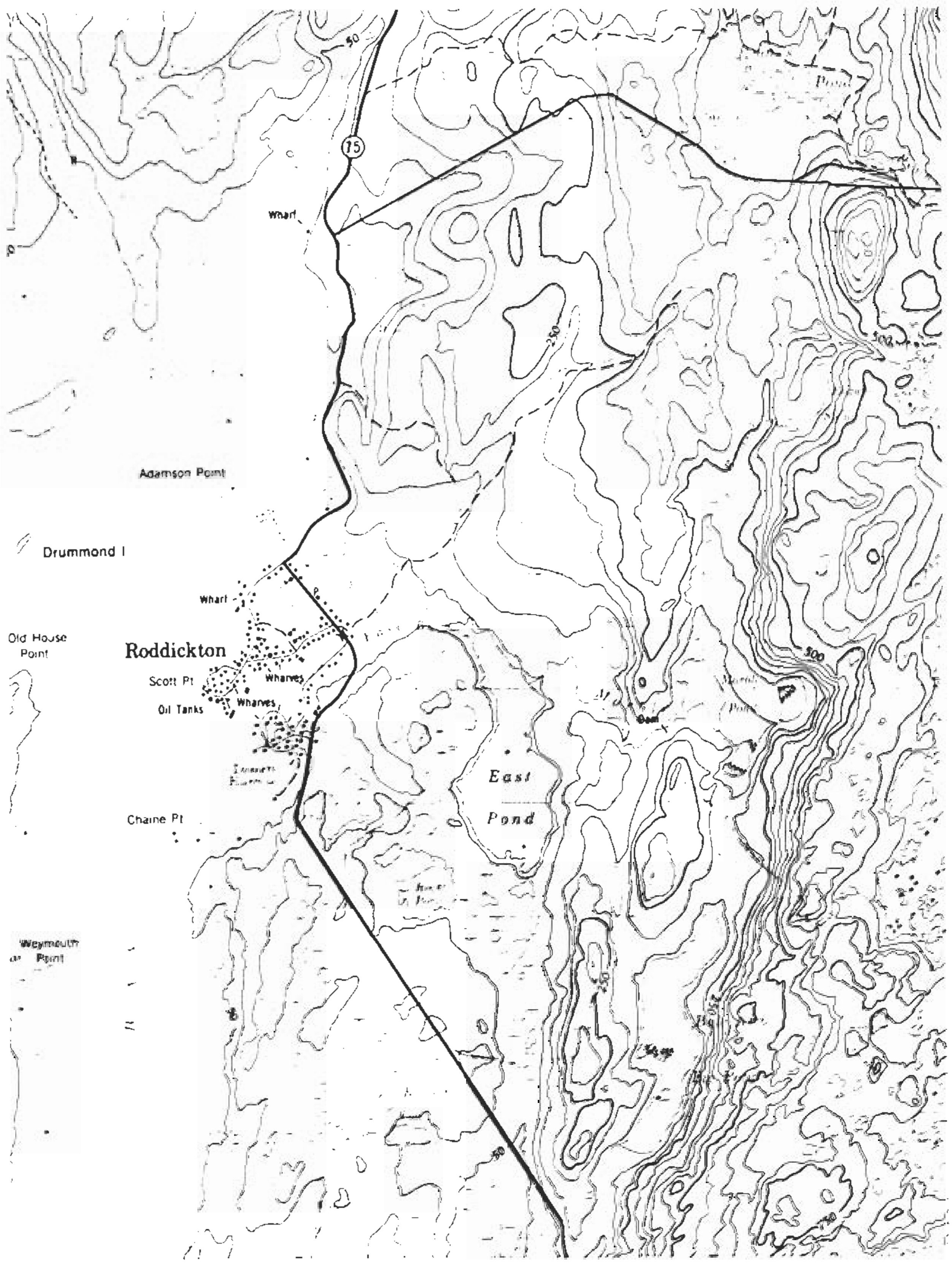
Method of Treatment: Chlorinated.

Reported Observations/Problems:

Water quality excellent. All reports from Department of Health satisfactory. Once in 15 years when the pond was low, the limestone bottom in conjunction with the stagnant low water was reported to have caused poor taste.

Future Plans Affecting Supply/Demand

Modifications to pumping station and additional pumps should improve delivery. Town may install submersible pump as a temporary measure this winter.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

RODDICKTON

ACRES

St. Anthony

Status: Town

Population: 3182 (1986 census)

Information Sources:

Pat Troy, Town Clerk.

"Town of St. Anthony Report on Water Supply and Sewerage Systems", Procter and Redfern Group. August 1980.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Water supply presently obtained by gravity from St. Anthony Pond, which is located 2 km west of town. System developed in 1967. Old supply pumped from Frenchman's Ponds, still connected to existing system as a backup. Culvert (378 m, 450 mm diameter) and open channel diversion diverts water from Western Long Pond into St. Anthony Pond to augment supply. Also underground pipe to Eastern Long Pond to augment supply.

Pond Area:	St. Anthony Pond	0.34 km^2
	Western Long Pond	0.52 km^2
Drainage Area:	St. Anthony Pond	1.84 km^2
	Western Long Pond	4.56 km^2
Live Storage Head:	About 2.3 m	

Existing Structures:

Reinforced concrete dam on St. Anthony Pond, approximately 7.6 m long and 2.7 m high, with 0.6 m wide crest. Also earthfill dam with impermeable core located between intake and screen house. Reinforced concrete overflow spillway 3.7 m wide.

The dam on Frenchman's Pond is in poor condition.

St. Anthony

Delivery System:

Watermain has deteriorated due to severe oxidation. Funding of $15,000 approved for 1990/91 to investigate deterioration and provide recommendations to town.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Adequate.

Potential for Increased Storage: Some potential but not required.

Other Observations/Reported Problems:

When fish plant in peak production, approximately 12 houses on higher ground, get low pressure and reduced water supply.

Reported Demand

Domestic:

Approximately 1200 homes connected to system as well as hospital (180 beds), two schools, mall, two hotels, and a number of small restaurants and businesses. From water meter records, average winter demand for consumption 4000 m^3/day and average summer demand 3300 m^3/day.

Industrial: FPI plant (fish and meal plant), demand 3100 m^3/day.

Metering:

Meters at fish plant and meal plant. Records show total use of 2.5 Mm^3 for August of this year (slightly higher than average; $16,000 compared with an average of $10,000). Annual use is $70,000, at a rate of 35¢ per day 4550 L (1,000 gallons).

Losses/Wastage:

Town has experienced several leaks and blockages in both water and service systems over last number of years.

Water Quality

Method of Treatment:

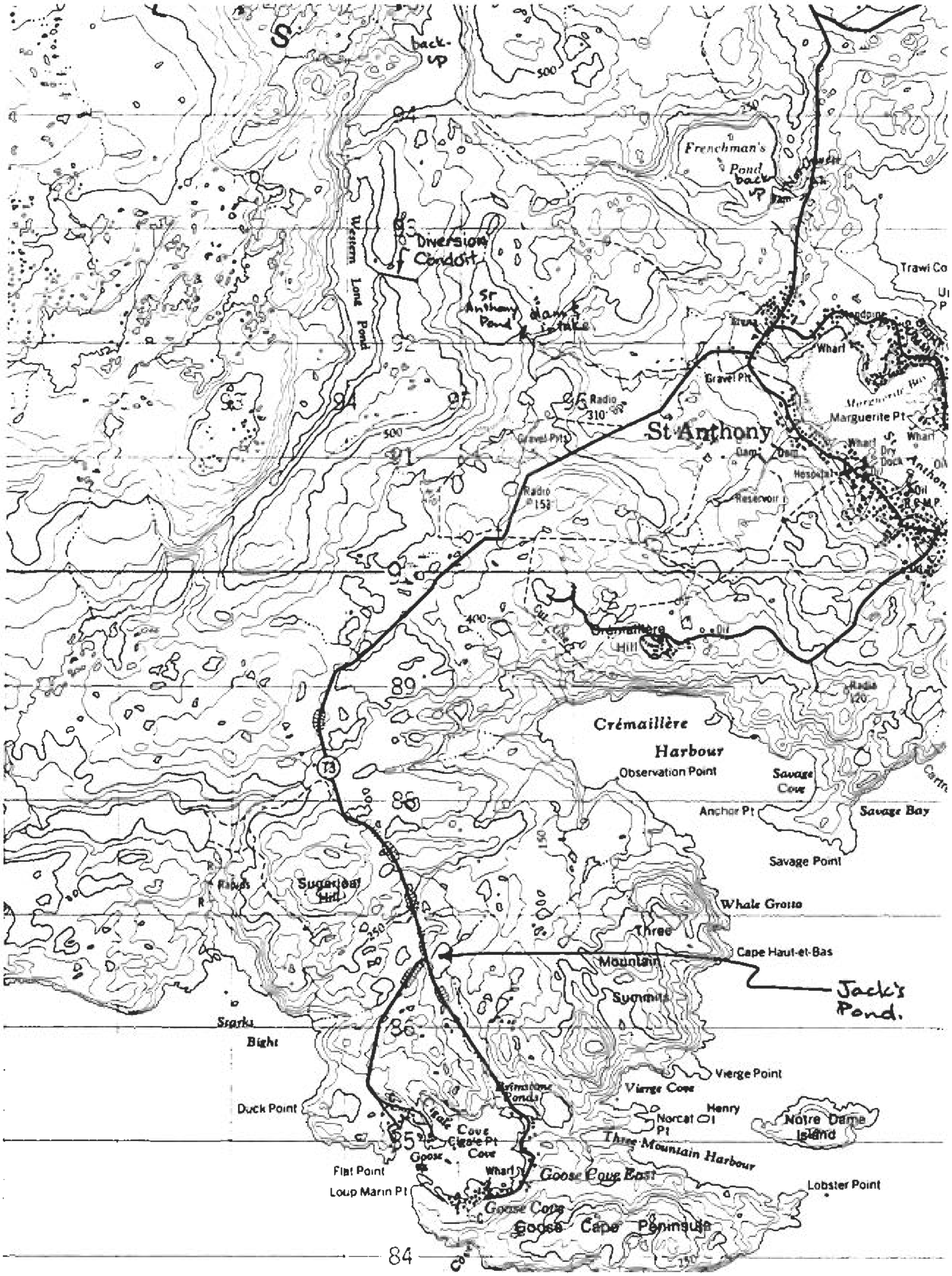
New chlorinator being installed this year. Should be operational by end of 1989.

Future Plans Affecting Supply/Demand

Future activity at fish plant unknown. Depends on state of inshore fishery and on quota reduction.

Notes

St. Anthony Airport is supplied by groundwater.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ST. ANTHONY

ACRES

St. Anthony Bight

Status: Local Service District

Population: 190

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Cat Box Pond.

Pond Area: 0.02 km^2

Drainage Area: 0.41 km^2

Live Storage Head: About 1.5 m

Existing Structures:

Timber crib dam is about 45 m long, 2-2 1/2 m high. About 10 years old. Dam washed out last year; about 5 m broke off on the south side where it wasn't tied in to cliff.

Delivery System: 100 mm line from intake.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply:

Adequate until dam washed out. No funding was received for repairs this year.

Potential for Increased Storage: Low potential - pond is at top of watershed.

Reported Demand

Domestic: All community served.

Industrial:

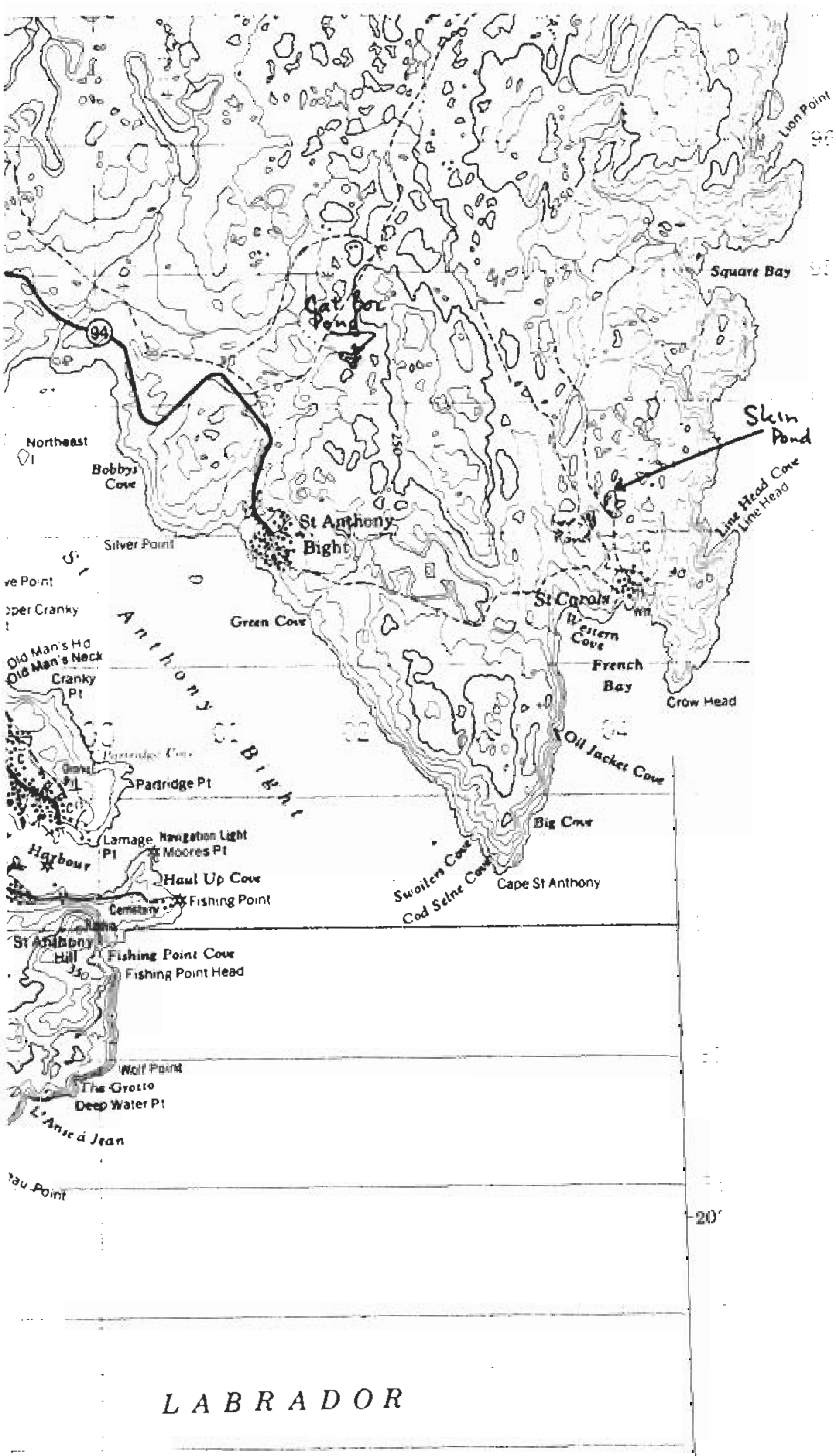
Water Quality

Method of Treatment: Chlorinated.

Reported Observations/Problems: Chlorinator often reported not in service. Pond right by gravel road, collects dust.

Future Plans Affecting Supply/Demand

Dam requires repair.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ST. ANTHONY BIGHT, ST. CAROL'S

ACRES

St. Carol's

Status: Unincorporated

Population: 150

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Ives Pond supplies 19 houses. Four wells also supply 12 houses at 6.8 L/min per well. Skin Pond has been proposed as a new supply. (See map for St. Anthony Bight.) The ponds is very small, and the drainage areas cannot be delineated on 1:50,000 scale mapping.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply: Surface supply freezes in winter.

Potential for Increased Storage: Possible but preferable to go to a larger supply.

Reported Demand

Domestic: Present mixed groundwater/surface system serves 31 houses.

Industrial: None.

Water Quality

Method of Treatment: None.

St. Lunaire-Griquet

Status: Community

Population: 1013

Information Sources:

Ms. Glenda Patey, Town Clerk.

"Feasibility Study for Existing Water Distribution System Improvements and Proposed Sanitary Sewer System for St. Lunaire-Griquet", Burden Management and Design Ltd. August 1983.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Existing water supply taken from Joe's Pond, just west of community. Pumped supply installed in 1971. (Burden reports yield of 9740 1/min).

Pond Area: 0.3 km^2

Drainage Area: Approximately 6 km^2

Live Storage Head: About 0.8 m.

Existing Structures: No dam.

Delivery System:

From intake, 150 mm PVC pipe, through town network of PVC pipe in various sizes.

Status of Watershed Protection: Not protected.

Reported Adequacy of Supply: Good.

Potential for Increased Storage:

Not required. Storage could perhaps be increased with dam and spillway, but land is rather flat.

St. Lunaire-Griquet

Reported Demand

Domestic:

There are now 205 homes connected to the system. Approximately 50 homes left to service. Sewer system almost complete. Two schools (one using municipal supply).

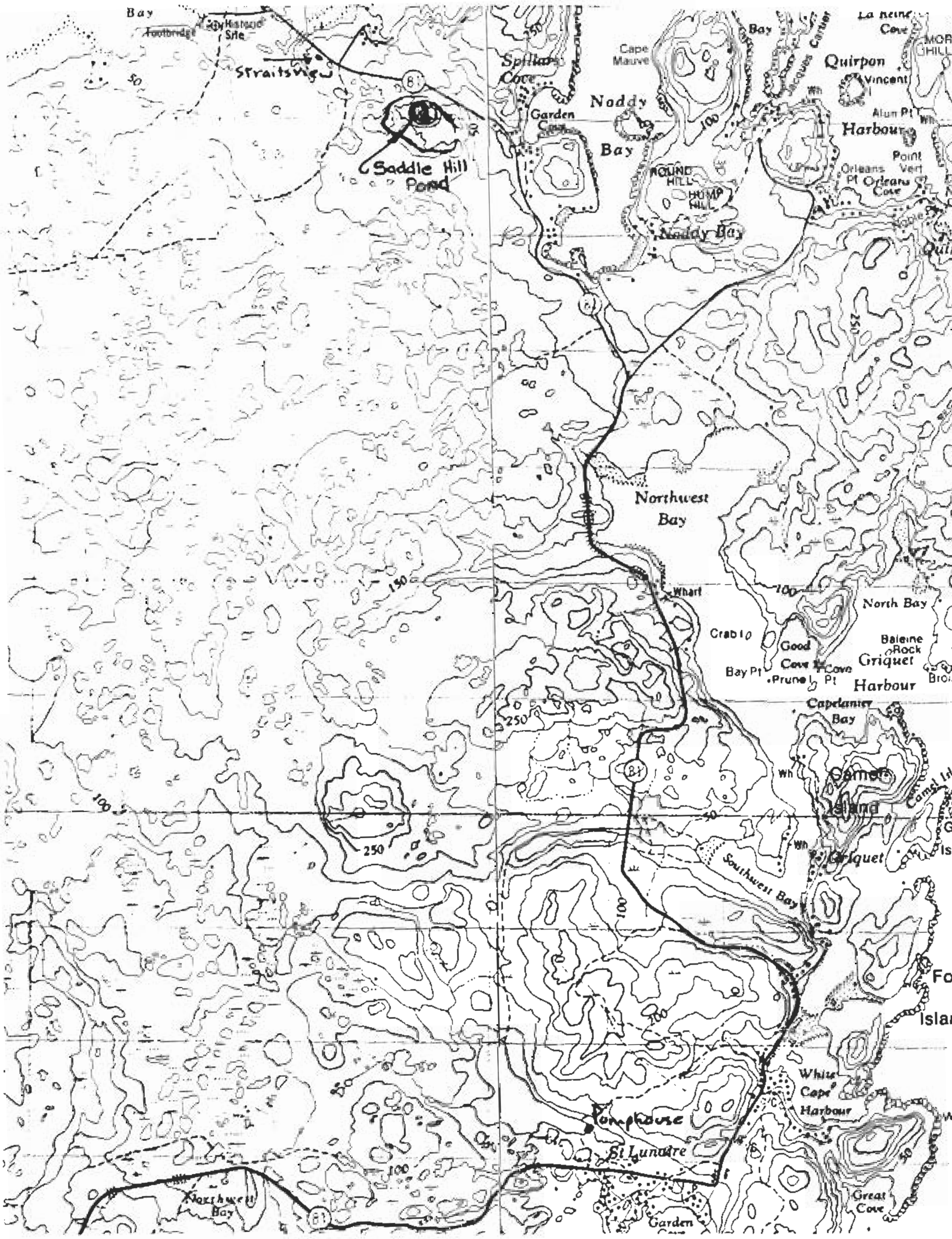
Water Quality

Method of Treatment: Chlorine gas.

Reported Observations/Problems:

Had problems with chlorinator in the past - being repaired now. Had a boil order issued last year by the Department of Health.

The well in Camel Island portion of the community was contaminated by salt (probably salt water intrusion). They requested a connection to the existing distribution system.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ST. LUNAIRE – GRIQUET, STRAITSVIEW

ACRES

St. Paul's

Status: Community

Population: 497 (1986 census)

Information Sources:

Ms. Velma Pittman, Town Clerk.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Existing water supply taken from Two Mile Pond, just south of town. Water is pumped from pond to underground storage reservoir and then gravity fed from reservoir to town. System installed in 1977.

Pond Area: 2.14 km^2

Drainage Area: 5.31 km^2

Live Storage Head: 9.5 m

About 1.5 m (normal W.L. 9.5 m, top of intake 7.6 m). Underground storage reservoir capacity 270 m^3. (1 m drawdown assumed in pond.)

Existing Structures: No dam or spillway.

Delivery System: 250 mm diameter supply main from intake.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Good.

Potential for Increased Storage: Little potential. Land very flat all around pond.

Reported Demand

Domestic:

There are now 110 homes connected to the water service, with 7 homes left to connect. Full sewer system. Two schools and restaurants.

Industrial: None.

Water Quality

Method of Treatment: Chlorine liquid.

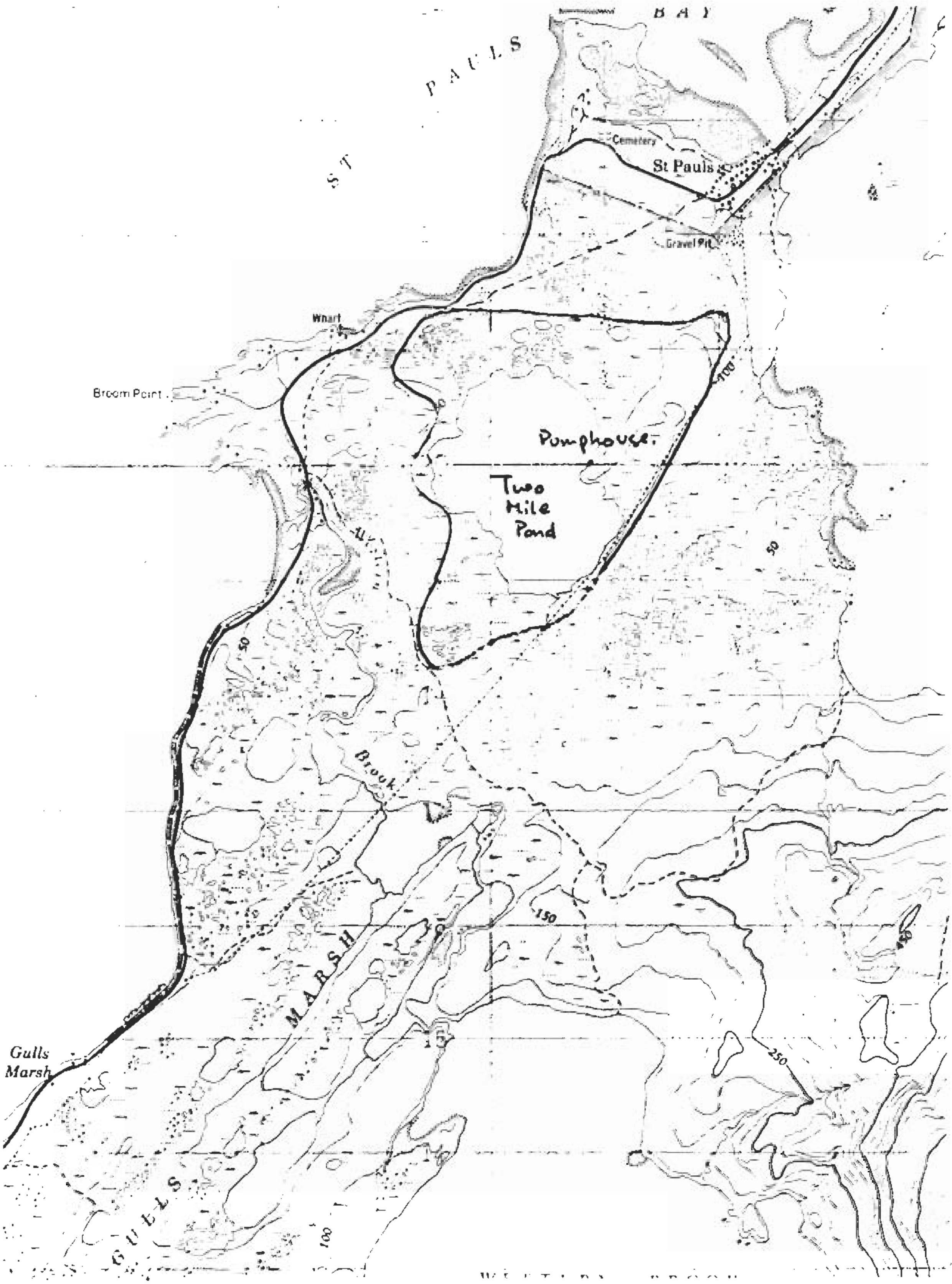
Reported Observations/Problems:

Town often gets complaints regarding odor and color of water. Few people in town actually drink water because of odor but instead carry spring water for drinking. Water also colors and stains clothes. Reports to Department of Health have resulted in testing, but water found to be satisfactory.

The organic (bog) particles appear to be stirred up by wave action. The community is attempting to screen them out at the wet well.

Future Plans Affecting Supply/Demand

According to the town clerk, the population of St. Paul's has decreased substantially in last few years with many people leaving to find work.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

ST. PAUL'S

ACRES

Sally's Cove

Status: Community

Population: 100

Information Sources:

Dawson Roberts, Mayor.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Private groundwater (mostly dug wells supplied by a spring).

Reported Adequacy of Supply: Never run out.

Reported Demand

Domestic: No municipal supply.

Water Quality

Reported Observations/Problems: Water quality reported to be good.

Savage Cove

Status: Local Service District

Population: 372

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Private groundwater supplies, including a spring; fish plant has private surface supply, uses both fresh and salt water. New well drilled early in 1990.

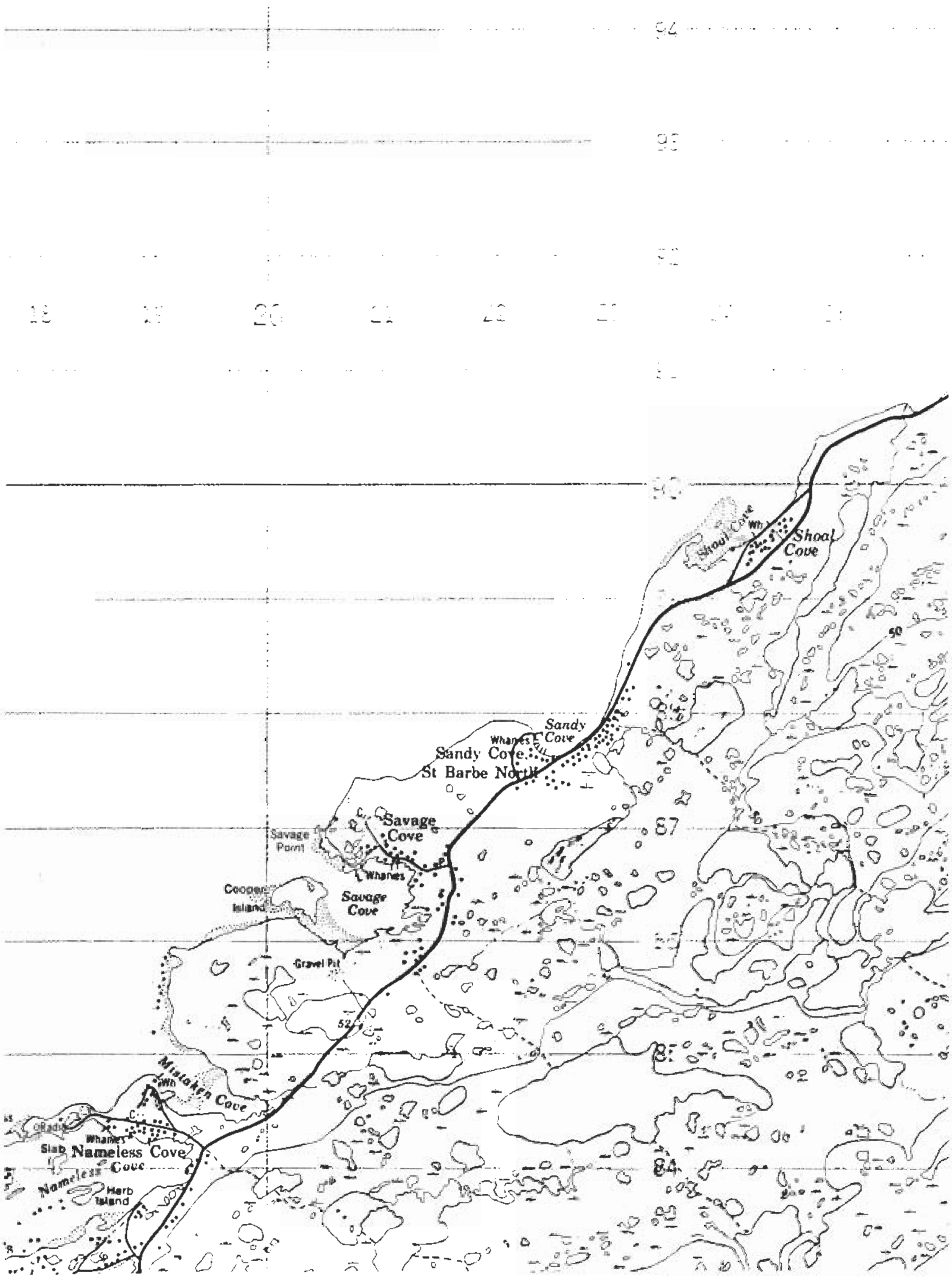
Status of Watershed Protection: Fish plant supply unprotected.

Reported Adequacy of Supply: Presently inadequate (i.e., before new well).

Reported Demand

Domestic: No municipal supply.

Industrial: Cole's Fisheries. Fresh and frozen products.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

SAVAGE COVE

ACRES

Ship Cove/Onion Cove

Status: Unicorporated

Population: 80

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):	Private groundwater and supplies.
Delivery System:	None.
Reported Adequacy of Supply:	Some supply problems have been reported.

Future Plans Affecting Supply/Demand

1974 design for groundwater supply and community distribution system never approved.

Shoal Cove West

Status: Unincorporated

Population: 243

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

No municipal system. Private groundwater or surface supplies. Residents carry water (see Reef's Harbour). Surface supply to fish plant.

Delivery System: None.

Status of Watershed Protection: Fish plant supply unprotected.

Reported Adequacy of Supply: Inadequate.

Sops Arm

Status: Local Service District

Population: 460

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Long Steady. Proposed supply from Little Tickle Pond.

Pond Area: 0.087 km^2

Drainage Area: 2 km^2 (Little Tickle Pond)

10.8 km^2 (Long Steady)

Live Storage Head: Depth of pond about 2.5 - 3 m

Existing Structures: Long old concrete dam; needs improvements.

Delivery System: Existing lines are 50 mm and 75 mm. New line under construction.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply:

Frequently run out (without water for three weeks last winter). Should be adequate with new system.

Potential for Increased Storage: Poor at Long Steady (too high and too isolated for a control structure to be maintained); good at Little Tickle Pond. Long Steady can be readily diverted towards Little Tickle Pond.

Reported Demand

Domestic: All community served.

Industrial: Fish plant.

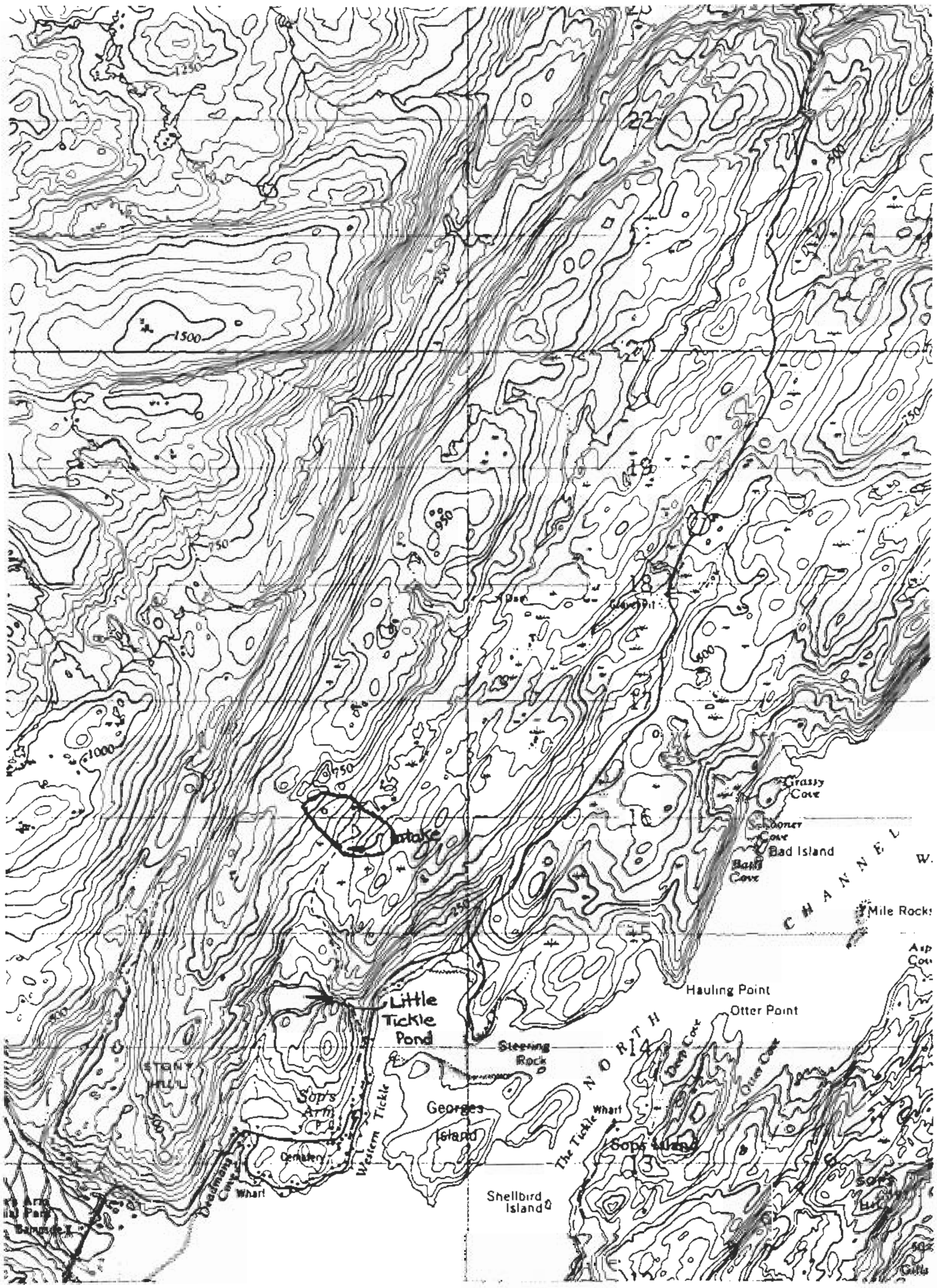
Water Quality

Method of Treatment: Chlorinated.

Reported Observations/Problems: Dirty when pond is low, otherwise good.

Future Plans Affecting Supply/Demand

Proposed supply from Little Tickle Pond (hasn't been funded). Long Steady is separated from Little Tickle Pond basin by about 100 m of bog underlain by bedrock. A canal about 2 m deep through this bog would channel water from Long Steady towards Little Tickle Pond. A new dam should also be built to replace the present leaking dam at the northeast end of Long Steady.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

SOP'S ARM

ACRES

Spillway

Status: Local Service District

Population: 250

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): Spillway is connected to Deer Lake supply. (See Deer Lake).

Steady Brook

Status: Community

Population: 386 (1986 census)

Information Sources:

Town Administrator, Al Gidge.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Marble Mountain and Steady Brook share an intake installed in 1988 in Steady Brook.

Pond Area: None

Drainage Area: 70.5 km^2

Live Storage Head: No dam or control structure. Normal depth of water 1.75 m.

Existing Structures: New system.

Delivery System:

Complete. Good pressure throughout town. 710 mm diameter intake.

Status of Watershed Protection: Protected.

Reported Adequacy of Supply: Never run out.

Potential for Increased Storage:

Not required but potential is good. (Bowaters used to have a dam on Steady Brook Lake).

Steady Brook

Reported Demand

Domestic: About 140 houses connected (all town is served).

Industrial: Marble Mountain ski resort.

Metering: Town of Steady Brook has recently started metering.

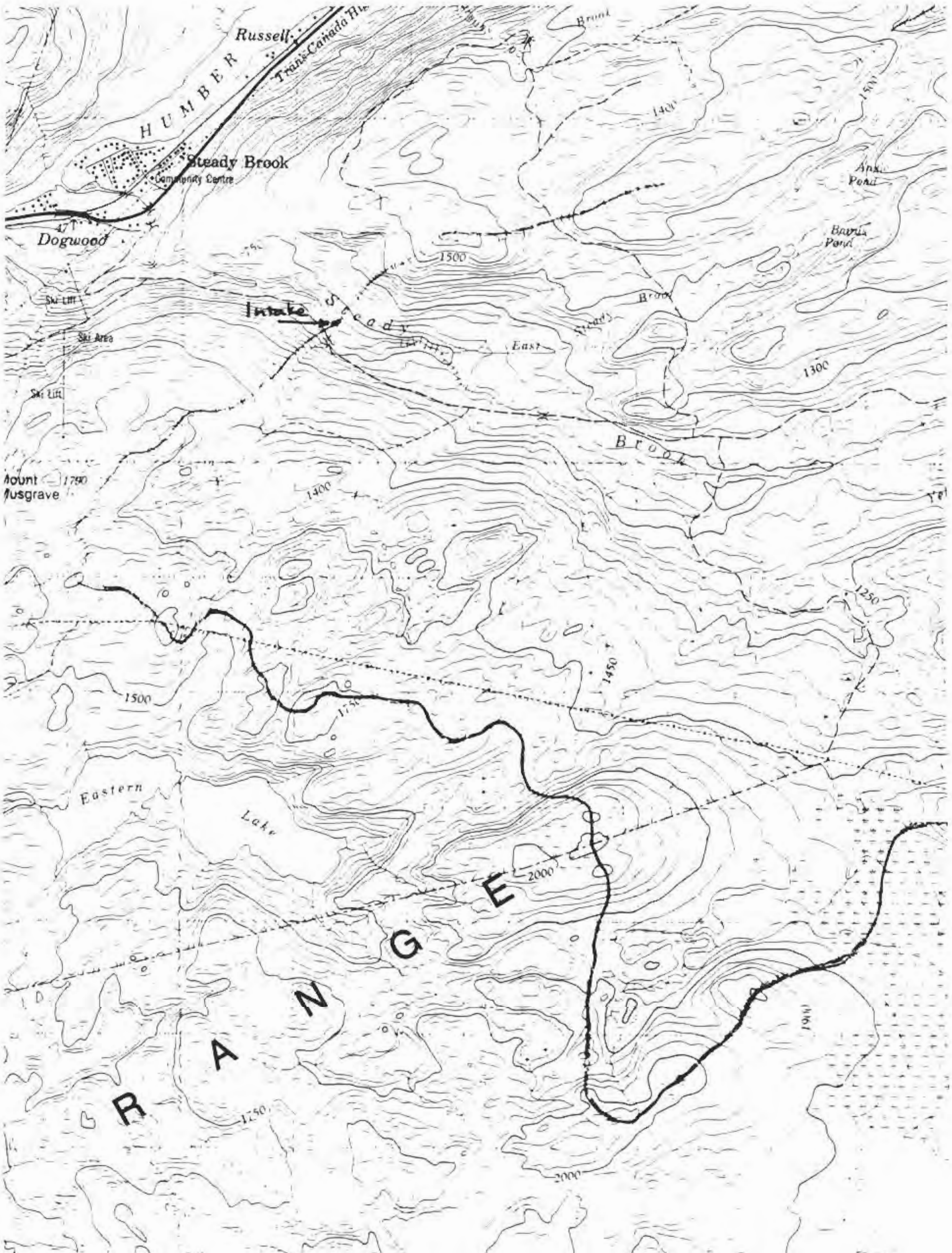
Water Quality

Method of Treatment: Chlorinated.

Reported Observations/Problems: Water quality reported to be excellent.

Future Plans Affecting Supply/Demand

Supply and distribution system complete. Further development may take place at Marble Mountain resort (e.g. water slides).



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

STEADY BROOK

AGRES

Straitsview

Status: Unincorporated

Population: 152

Information Sources:

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Existing water supply from a small pond known as Saddle Hill Pond located about 600 m northwest of Garden Cove. Gravity feed supply through intake pipe extending about 40 m into pond. (See map for St. Lunaire/Griquet).

Pond Area: 0.03 km^2

Drainage Area: 0.4 km^2

Live Storage Head: Average depth 1.2 m, maximum depth 1.8 m.

Existing Structures: No dam or spillway.

Delivery System:

800 m of 100 mm diameter PVC water main from pond, 75 mm diameter polyethylene distribution lines throughout community. Service lines 19 mm diameter polyethylene with curbstop.

Status of Watershed Protection: Unprotected.

Other Observations/Reported Problems:

Problems identified report included silting in area of open intake pipe requiring cleaning semi-annually. Also, silt picked up by screen required cleaning of screen every second day.

Reported Demand

Domestic:

Thirty six homes and a few small stores.

Industrial: No major industry.

Water Quality

Method of Treatment: Chlorine liquid.

Reported Observations/Problems:

High levels of bacteria and suspended solids identified by Department of Health.

Notes

Consultants report stated silting and quality problems caused by supply source - shallow depth and surrounding peat bog. In absence of alternative supply source, recommended installing of intake screen complete with the rock berm to provide protection of intake pipe. Berm would retain movement of silt on the pond bottom outside the intake.

SEE ST. LUNAIRE – GRIQUET MAP

DEPARTMENT OF ENVIRONMENT AND LANDS
REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY
STRAITSVIEW
ACRES

Summerside

Status: Community

Population: 798 (1986 census)

Information Sources:

Feasibility of the Extension of the Summerside Water System to supply the community of Irishtown.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Existing - Private surface and groundwater supplies. Under construction - new supply from Pynn's Pond. Reported average daily flow rate 12.6 m^3/min; minimum runoff 5 m^3/min (1440 m^3/day). Connected to 60 houses this fall (1989).

Pond Area: 0.6 km^2

Drainage Area: 5.2 km^2

Storage: Reported storage potential about 45,500 m^3. 2.4 m drawdown.

Existing Structures: New concrete dam/spillway.

Delivery System: Presently private. New lines being installed in phases.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply:

Presently private artisan wells often run dry. Supply should be good with new system.

Potential for Increased Storage: Possible but not required.

Reported Demand

Domestic: About 230 homes will eventually be connected.

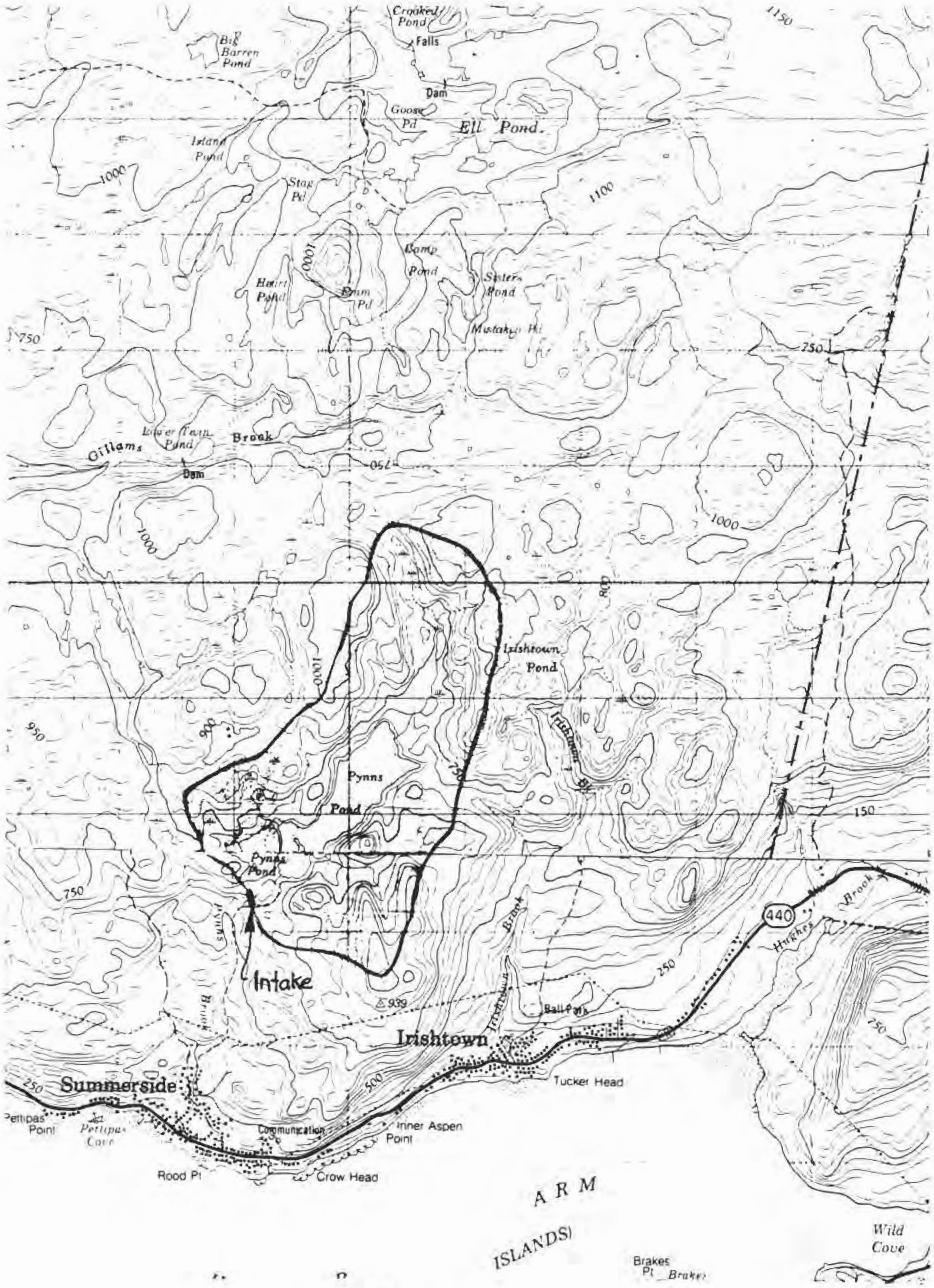
Industrial: None.

Water Quality

Method of Treatment: Chlorination with new system.

Reported Observations/Problems:

Water quality from new system expected to be good. People using private surface supply report good quality.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

SUMMERSIDE

ACRES

Trout River

Status: Community

Population: 771 (1986 census)

Information Sources:

H. Crocker, Mayor

Mrs. Aubert, Town Clerk

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s): A pump on Feeder Brook pumps water to a concrete reservoir.

Pond Area: No pond.

Drainage Area: 21 km^2

Live Storage Head: No storage.

Existing Structures: Pumphouse about 15 years old. No dam or spillway.

Delivery System:

150 mm line is adequate but additional pump capacity is required to improve pressure and to provide fine flow.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply:

Generally adequate. Ran low one year, but council can dig down into brook to augment supply.

Potential for Increased Storage: Little potential. Any dams upstream would require the approval of Parks Canada.

Reported Demand

Domestic:

About 110-120 houses connected. A few people on the other side of the river are not served.

Industrial:

Fish plant. J.W. Hiscock Ltd. Producers, fresh, pickled and salt product. Uses fresh water from municipal supply.

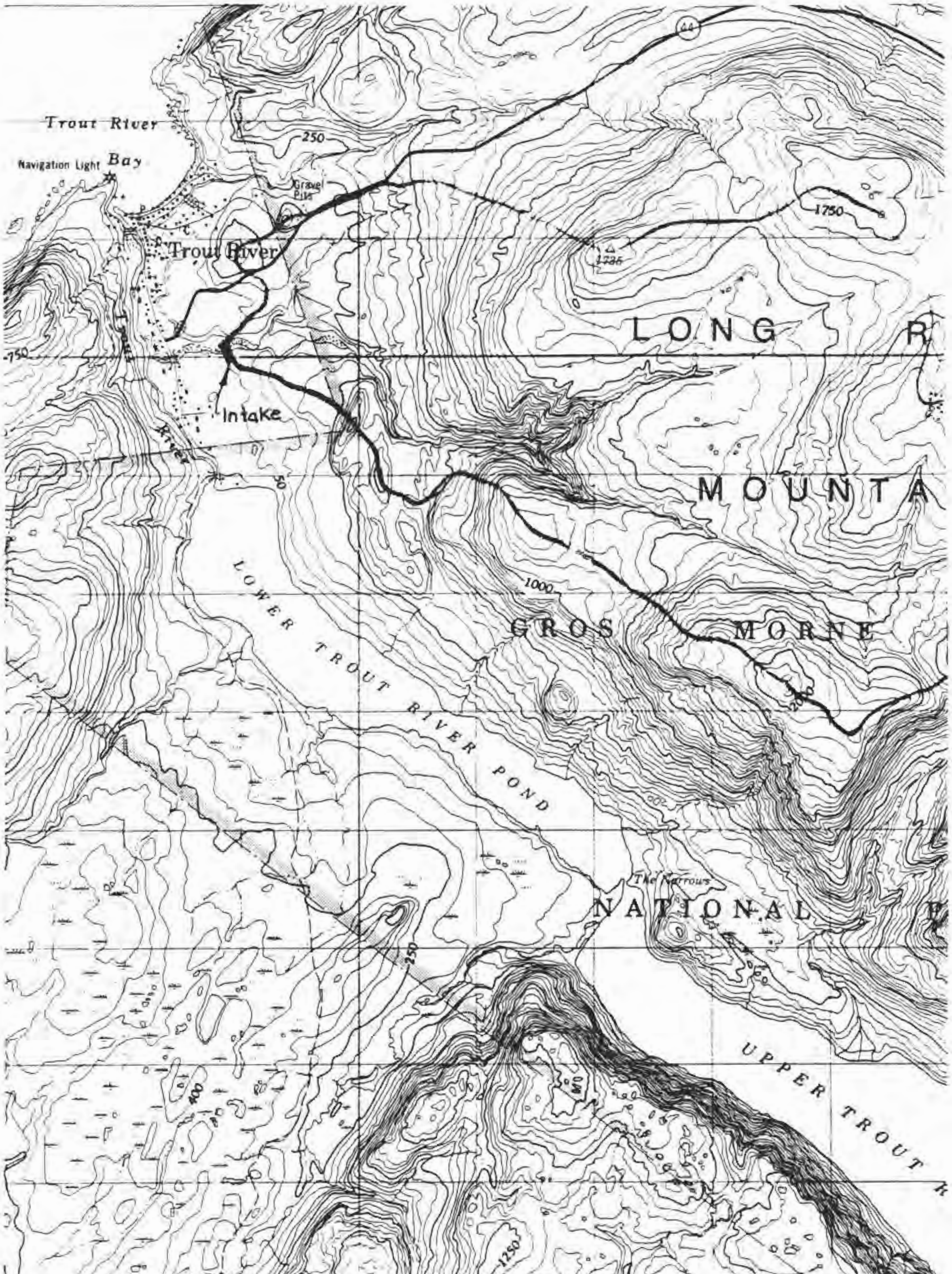
Water Quality

Method of Treatment: Chlorinated.

Reported Observations/Problems: None. Sometimes a bit of colour after a rain.

Future Plans Affecting Supply/Demand

Council will probably include improvements to pumping capacity in its five year plan (not yet prepared). A better scheme including pumping to a higher concrete reservoir to provide gravity flow to the plateau area can probably be devised.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

TROUT RIVER

ACRES

Woody Point

Status: Community

Population: 444 (1986 census)

Information Sources:

Ms. Judy Goosney, Town Clerk.

"Report on Community of Woody Point Water Supply Improvements". Newfoundland Design Associates Ltd. March 1981.

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Reservoir and dam at Winterhouse Brook. Pumped system with water pumped from el of 12.2 m at brook through distribution lines to 25 m^3 steel storage tank at el 48.7 m. From tank, water gravity fed to town.

Pond Area: Small pond formed behind dam on brook.

Drainage Area: 12.3 km^2

Live Storage Head: Very little storage - about 1 m cover over intake.

Existing Structures:

Dam is reinforced concrete, 90 m long, including wingwalls and spillway. Spillway is a concrete overflow structure 20 m long located in center of dam.

Delivery System:

Watermains from intake to pumphouse and storage tank consist of 305 m of 300 mm diameter, 1830 m of 200 mm diameter, and 488 m of 150 mm diameter ductile iron pipe.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply: Adequate.

Potential for Increased Storage: Possible but not required.

Other Observations/Reported Problems:

This past summer (1989), town had problems with pump and when both fish plants were operating, could not keep storage tank filled. Should be alleviated when pump repaired.

Reported Demand

Domestic:

All homes in community serviced by water (approximately 100 homes), partial sewer system. Also two schools, fire hall, one motel, one hospitality home.

Industrial:

Two fish plants - 3 T's Company Ltd. (uses municipal fresh water supply) and Bonne Bay Seafoods (uses mostly salt water for processing, fresh water for cleaning, and domestic uses, but not as much as other plant). Both plants started up in 1989 and operated on and off during the months from April to December.

Metering:

No metering on plants. Both pay flat rate to town for use of municipal water (town is considering installing a meter).

Losses/Wastage:

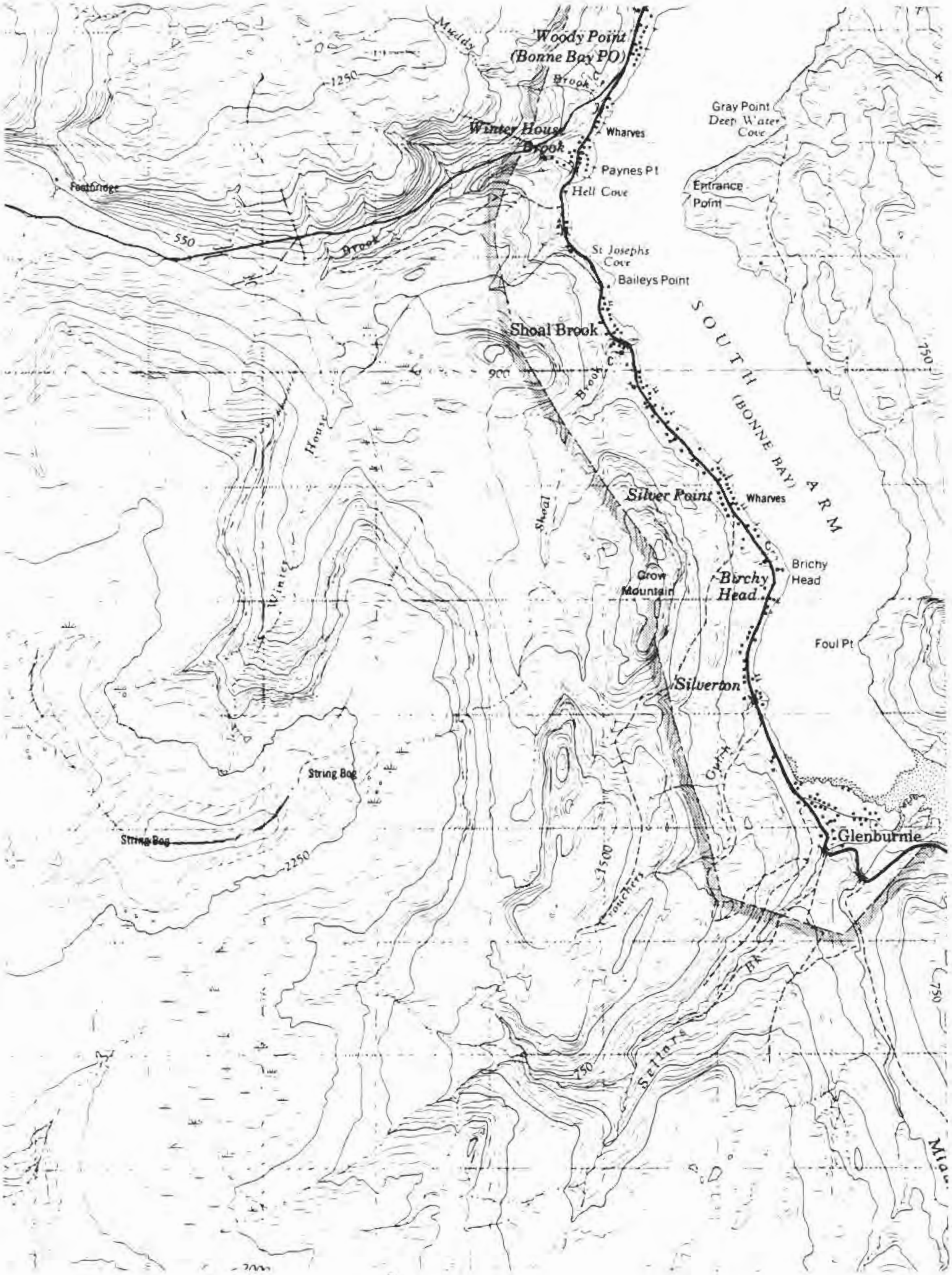
Except for leakage due to problems with pump seals this past year, no other losses reported.

Water Quality

Method of Treatment: Chlorine gas.

Future Plans Affecting Supply/Demand

The community is checking into the possibility of obtaining gravity flow.



DEPARTMENT OF ENVIRONMENT AND LANDS

REGIONAL WATER RESOURCES STUDY OF THE NORTHERN PENINSULA AND HUMBER VALLEY

WOODY POINT

ACRES

York Harbour

Status: Community

Population: 371 (1986 census)

Information Sources:

V. Robinson, Clerk

Department of Municipal and Provincial Affairs, Corner Brook.

Department of Environment and Lands, Corner Brook.

Existing Water Supply

Water Source(s):

Private groundwater and surface supplies. One small shared supply for 20 houses.

Status of Watershed Protection: Unprotected.

Reported Adequacy of Supply:

Generally good. Some people ran dry last summer for the first time in 25 years. Carried water from springs or spring-fed brooks.

Water Quality

Method of Treatment: None.

Reported Observations/Problems:

Water quality generally reported to be good. Comes from mountains. All Department of Health reports satisfactory.

Future Plans Affecting Supply/Demand

No major growth expected; a few people come to retire.