WATER RESOURCES STUDY

of the

PROVINCE OF NEWFOUNDLAND AND LABRADOR

for

ATLANTIC DEVELOPMENT BOARD

Volume FIVE

COMPARISON OF WATER DEMAND AND SUPPLY

THE SHAWINIGAN ENGINEERING COMPANY LIMITED
JAMES F.MacLAREN LIMITED

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VOLUME FIVE

COMPARISON OF WATER DEMAND AND SUPPLY

OUTLINE OF COMPLETE REPORT

VOLUME FOUR - NON-WITHDRAWAL WATER DEMAND

VOLUME FIVE - COMPARISON OF WATER DEMAND AND SUPPLY

VOLUME SIX A - RIVER BASINS

VOLUME SIX B - RIVER BASINS

VOLUME SEVEN - STUDY AREAS

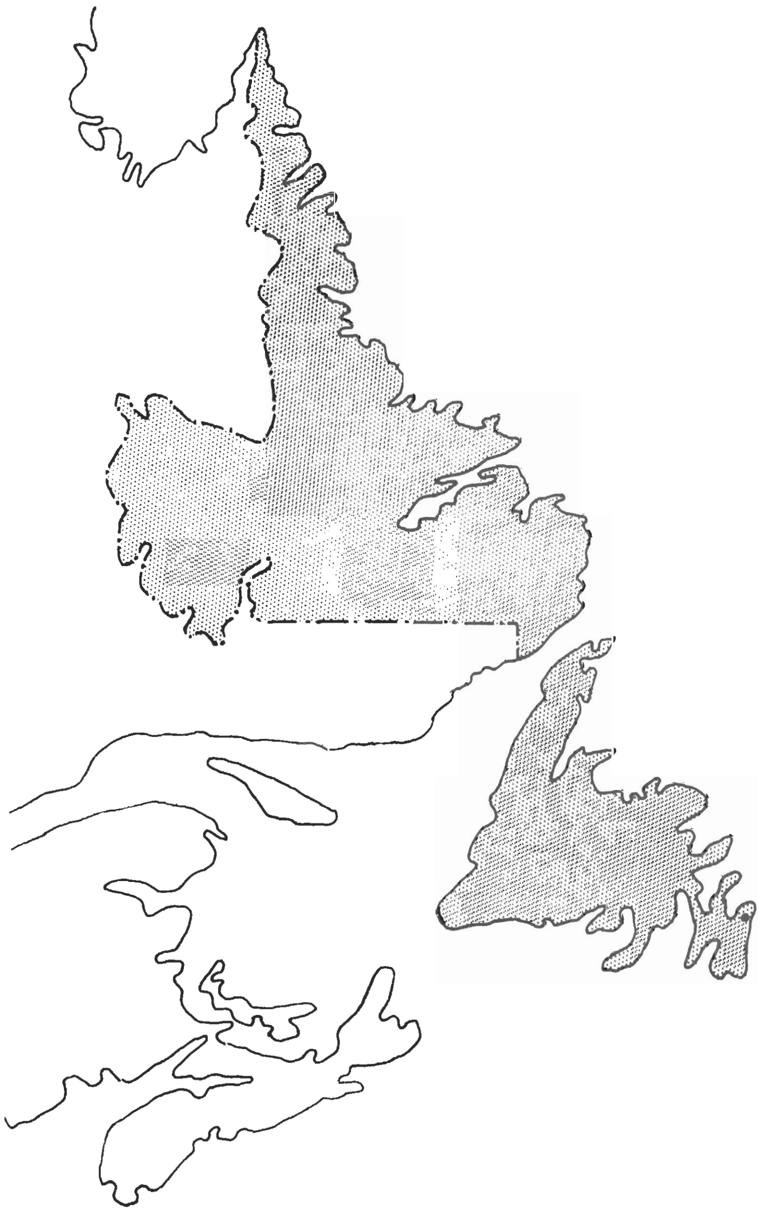
VOLUME EIGHT - APPENDICES

VOLUME FIVE

TABLE OF CONTENTS

PART III - ECONOMIC CONSIDERATIONS

PART IV - GENERAL CONCLUSIONS AND RECOMMENDATIONS



VOLUME FIVE - PART I — SECTIONS 1-3

METHODOLOGY

PART 1 - METHODOLOGY

FOREWORD

This volume is intended to give a general appraisal of the present and forecast conditions of water supply and demand as required in Phase C of the Terms of Reference, (Volume One), and is considered as a general introduction to Volumes Six and Seven which analyze in more detail the same problems by river basins and study areas. The main purposes of this volume are:

a) to give a general picture of the supply-demand conditions in the Province;

b) to identify problems of some significance which are outside the river basins and study areas.

Neither this volume nor Volume Six and Seven are intended to represent a water management analysis; this will form the object of later study. As underlined in the general methodology (Volume One, Section 6-2), this study is limited in scope to the identification of possibilities, priorities, and problem areas in the water resources field. The examination of problems which will enter into water resources management studies has been done only in a very preliminary way, and only for some study areas and river basins for which detailed data were available, with the purpose of clarifying priorities and delineating problem areas.

PART 1 - METHODOLOGY

1 THE REGIONAL APPROACH

In the preliminary stage of an analysis of water supply and demand, the investigation may take place on a regional basis which can enable the delineation of problem areas and areas with abundant water supply, and other elements required in a preliminary determination of the priorities.

1.1 Definitions

The region is considered in this phase of the study as an area where the natural conditions are more or less similar, and which economically or demographically shows a uniform development pattern, or gravitates around one regional center. Ideally it would be desirable to have regions delineated in such a way that, if necessary, a new demand within it could be satisfied either by moving the demand site within the region, or by diverting water from one portion of the region to another. However, this is not always practical since, on one hand the location of an industry is conditioned by many factors and acceptable sites within a region are usually limited; and on the other hand diversions are in many cases not feasible for technical and economic reasons. Since the region does not generally fulfil the above-mentioned conditions, comparisons of supply-demand conditions are frequently only a rough indication of the actual problems in the area.

Water demand was defined in Volume Three, Section 1.1. Water supply is defined here as the amount and quality (including pressure) of water in their time variation which is made available to the user, under certain limiting natural, technical, and economic conditions. As such, water supply should be distinguished from (natural) water availability which pertains to natural conditions only and was analyzed in Volume Two.

Two categories of water supply have to be distinguished:

a) Actual supply which is the water supply as defined above and is available to the user under the presently existing conditions in the analyzed area;

b) Potential supply is the amount and quality of water as defined above and which can be obtained within the limits of acceptable economic conditions. The upper limit of cost is that which the user is willing to pay taking into account all benefits, both tangible and intangible.

1.2 Regional Analysis of Present Day Supply and Demand

An inventory of actual average and minimum water supply and water availability is compared to an inventory of water demand (withdrawal, non-withdrawal) taking into account that the consumptive demand of pollution cannot be satisfied by dilution, and that non-withdrawal demand generally affects the regime of the flow but not the average amount available.

Areas where the minimum actual water supply is larger than the demand can be singled out as areas where development opportunities may exist. Areas where the demand is larger than the minimum supply but not the average actual supply are delineated as areas where additional storage in the existing supply systems is required at the present time. The areas where the demand exceeds the average supply are areas which, even under present-day conditions, require consideration as problem areas, and reconsideration of the supply-demand conditions and readjustments in the frame of water resources management studies are necessary in such cases.

1.3 Regional Analysis of Future Supply and Demand

The inventory of present-day demand obtained in Section 1.2 is supplemented with the inventory of future demand which may be considered in alternative locations. The inventory of actual supply is supplemented with the indications obtained from natural water availability (Volume Two) and cost indices (Volume Eight- Appendix C) for potential water supply (including storage possibilities). Comparisons are made of potential water supply with various alternative forecast demands at different stages in the study period which indicate the areas where abundant water supply can be developed at reasonable costs and areas where shortages and/or conflicts of interest may be anticipated. Preliminary recommendations for ranking of areas according to their priority for detailed development studies can be then made.

Examination of water resources implications of concentrating population or small industry such as fish processing in more favourable locations and of related possible savings is also included in the regional analysis.

2 THE RIVER BASIN APPROACH

This approach was used only for the river basins selected for more detailed study. In the selection of the river basins, consideration was given to the prevailing economic conditions, and only those river basins were selected which could be considered as having a defined economic framework contained therein, or a potential for water resources development which can be considered independently. The river basin analysis represents basically a more detailed analysis than the regional approach. The purpose is to clarify the problems involved in the basins and prepare for the establishment of supply possibilities and priorities.

The steps involved in the river basin analysis are summarized in the General Methodology, (Volume One, Section 3.2, Paragraphs 13-15) and are illustrated in Figure 3-1.

In more detail, these steps consist of:

a) Recognition of the boundary conditions imposed on the water resources of the basin, such as water rights, agreements, etc.

b) Analysis of natural water availability of the area (quantity and quality, surface and ground water) in its geographical and time distribution. For the purpose of this study this is included in Volume Two from which the data required for the individual basins can be obtained.

c) An inventory of water demand in the area (quality and quantity) in its geographical and time distribution. This is included in Volumes Three and Four, from which the data required for the individual basins can be obtained.

d) The development of alternative schemes to satisfy the different types of demand (quantity and quality) including pollution abatement. At this stage, the different schemes are defined only in a broad way (dams, canals, pipes, power plants, fishways, locks, intakes, conveyance systems, treatment plant, distribution systems, sewage systems), and only order of magnitude costing, based on cost indices (See Appendix C, Volume Eight), can be given.

e) A general assessment for each alternative of interaction of different schemes including diversions, to assess possibilities of reducing investment by multipurpose use of developments, existence of conflicts of interests, and possibilities of resolution. The assessment includes an examination of conditions in river basins from which water was or may be diverted to the examined river basin.

f) Preliminary conclusions with indications of areas where because of the natural or economic conditions, water demand exceeds the limits of potential supply, areas where conflicts of interest require reconsideration of planned development, as well as areas where potential supply could be developed at attractive costs. The latter areas can then be considered in examining changes in sites selected for development. The conclusions will also indicate the areas where further investigations are required on different aspects of water resources, and indications for the priority ranking of these investigations. Although the terms of reference require that the economic aspects be used as criteria for priority ranking, it must be recognized that at this stage of the study these criteria will be considered only as a general indication, since costing will be developed on the basis of cost indices and rough estimates of the development characteristics.

It was recognized during the study that for the river basins examined, the water resources picture is dominated mainly by non-withdrawal demand and use.

The river basin water demand-supply analyses are included in Volume Six.

3 THE STUDY AREA APPROACH

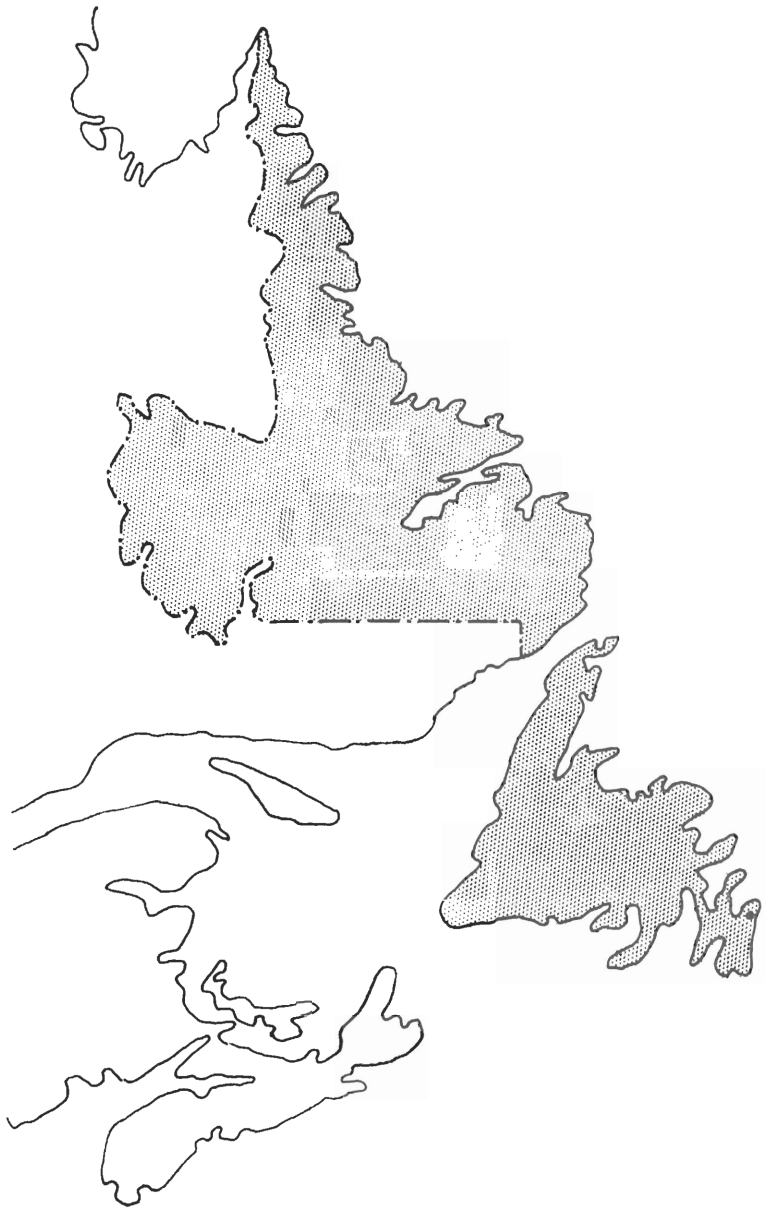
This approach was used whenever the economic pattern of an area was such that it expanded over two or more neighbouring river basins. In these cases, groups of river basins interrelated by a common economic framework were considered. Almost invariably, in the case of study areas, diversions from one river basin to another are planned or will be required, and thus the economic interrelationships of the different basins is reflected by a water resource interrelated pattern.

The methodology used in this case is similar to that of the river basins with two minor differences:

a) Several river basins are considered simultaneously, the link being based on both economic and diversion possibilities;

b) The emphasis, in the specific conditions in the Province, is generally on municipal and industrial water supply and on pollution problems, and not on non-withdrawal water supply as in the case of the river basins.

The study area demand-supply analyses are included in Volume Seven.



VOLUME FIVE - PART II — SECTIONS 4-6

GENERAL APPRAISAL

PART II - GENERAL APPRAISAL

4 ASSESSMENT OF PRESENT SUPPLY CONDITIONS

Present supply conditions differ widely from one group of users to another. While industries such as mining and pulp and paper have no supply problems and generally have ample capacity to provide for emergency conditions and expansion, there are several instances of water quality and quantity problems in the fish processing industry. Seasonal variation and hence a low capacity factor in the fish processing industry places it at somewhat of a disadvantage from the point of view of water supply.

In the case of municipalities, the more prosperous towns have generally adequate supplies, while the less well to do and smaller communities often have difficulties in obtaining the quantity and/or quality of water they need.

There are three main causes which result in inadequate industrial or municipal supply:

- high specific (unit) cost associated with small systems;
- pollution of the potential source;
- lack of adequate planning in the location of new industries in connection with water supply and wastewater disposal.

This section includes a general review of the existing water supply systems with respect to withdrawal water supply. Non-withdrawal water supply is discussed in Volume Four.

4.1 Industries

This subsection deals with those industries in the Province having their own water supplies. Industries relying upon municipal systems for water were not considered separately and have been included under municipal demand in Section 4.2 - Towns and Cities.

4.1.1 Inventory of Supply Systems

Data obtained from the questionnaire program carried out during this study were used to prepare Table 4-1 which shows major water using industries in the Province, except for the fish processing plants which are shown in Volume Three, Table 10-7.

Fish processing plants exceed in number any other classification of industrial firms, followed by mining and concentrating establishments. The two pulp and paper companies have the largest individual water supply systems, having a combined installed water supply capacity of 138 million gpd. The mining industry is next with a total installed capacity of 90 million gpd.

4.1.2 Sources of Supply

Most industries use fresh water only. Exceptions are the Electric Reduction Company plant at Long Harbour and a number of the fish processing plants, which use both fresh and seawater. Two fish processing plants use seawater only. Four of the fish processing plants reported water supply problems because of inadequate quantity.

4.1.3 Quality of Supply

The quality of water is generally satisfactory for industrial purposes, although the low pH and slightly excessive colour are problems for some industrial users. Quality problems relating to bacteriological contamination are encountered mainly in some of the fish processing plants having seawater intakes since these plants, through the discharge of their wastewaters to the sea, often pollute their seawater supply. In recent years a number of fresh water supply systems for fish processing plants have had to be constructed with the financial help of the Atlantic Development Board to permit the continued operation of the fish plants affected by this pollution. No significant problems relating to water turbidity were encountered although some minor problems have come to light at the pulp and paper company at Corner Brook

4.1.4 Physical Condition of the Supply Systems

In general the supply installations serving industry are in good physical condition, most of them having been constructed within the past 10 to 15 years. The installation serving the mining and ore concentrating industries are all less than 10 years old with the exception of portions of the installation serving the American Smelting and Refining Company Limited at Buchans which are 40 years old, but are reportedly in good condition. Those fresh water supplies for the fish processing industry which are of recent construction generally are in satisfactory physical condition.

Water supplies serving the two pulp and paper mills are the oldest industrial installations in the Province, both being in excess of 40 years old. However, continuing maintenance programs by the mills have kept the supply systems in good condition over the years, although leakage problems have been observed at the Price (Nfld) pulp and paper mill.

Out of the 39 fish processing plants, four reported inadequate systems, two related to low pressure and two related to the freezing of hoses connecting them to municipal systems.

4.2 Towns and Cities

This section includes a discussion of the supply conditions in towns and cities having municipal supply systems. The communities which lack such a system are disusssed in Section 4. 3.

4.2.1 Inventory of Supply Systems

Table 4-2 has been prepared from data made available by 67 municipalities in response to the questionnaire program conducted during this study as well as from other sources. Wherever data were available this table includes, by census division, the population served, the source of water supply, the average demand, and other information on the supply system, and data on the sewerage system when applicable and available.

As can be seen from the table there are 49 communities with some form of municipal water supply and sewage disposal systems, 4 with sewage disposal but no water system, 13 with water systems but no sewage systems, and for one community sufficient data were not available to determine its supply and disposal conditions.

Of the 472, 239 people living on the Island, according to Table 4-2, approximately 224, 000 lived in communities of more than 500 which had water distribution systems. It is estimated that, of this population, only 185, 000 were actually served by the municipal systems.

The distribution systems used by most of the communities on the Island are fed by gravity and, as a result, areas or customers above certain elevations cannot be supplied without pumping. At the present time municipalities have not seen fit to incur the additional costs to serve the remaining customers.

Of Labrador's 1966 population of 21,157, approximately 14,285 persons resided in municipalities with a water system, most of whom were connected to the system.

Thus, in 1966 a total of 277,685 persons resided in municipalities and communities of the Province not served with a water distribution system.

4.2.2 Sources of Supply

Most Newfoundland municipalities obtain their water supplies from surface sources. Only St. Lawrence, Wabana, Bishops Falls, Burin, Daniel's Harbour, Lawn, Harbour Breton, and Jerseyside have municipal systems which use groundwater as a source of supply.

Most municipal water works in Newfoundland are gravity systems, which obviates the need for pumping, although adequate service is restricted by site elevation in some areas, as mentioned previously.

4.2.3 Quality of Supply

The quality of the water used for municipal purposes is generally good, and the present practice in the Province is to limit treatment to chlorination, and in the case of the City of St. John's to adjust the pH (to 7.00 from 6.5) by the addition of lime. The surface waters are very low in turbidity (less than 5 J.U.), low in pH (about 6.5), low in dissolved solids (less than 1 ppm), low in hardness (less than 15 ppm), but slightly excessive in colour (in most cases above 20 units). At the present time, no municipal water filtration plants exist in the Province.

Some municipal supply systems have evidenced problems with the quality of water. For example, in St. John's, the water obtained from the Petty Harbour-Long Pond, according to the questionnaire, has an offensive odour and taste during the summer, apparently due to algae bloom.

Stephenville, St. Anthony, Dunville, and Berry's Head draw their water supply from surface sources and have reported a deterioration of the water quality after heavy rains. The deterioration apparently is due to turbidity and increased coliform count indicating respectively erosion and human or animal pollution sources in the drainage basin.

St. Anthony and Berry's Head do not chlorinate their supplies and as a result frequently obtain water of unsatisfactory bacteriological quality. Drinking water must therefore either be obtained from other sources or be boiled before use.

Groundwater used for municipal supplies is generally not as satisfactory in quality as surface water. In the case of St. Lawrence, it is high in fluorides and on occasion has shown indication of salt water intrusion. As discussed in Volume Seven, Part III, Section 16. 3. 4 b), there are some radioactive gases present in the water supply; however, they are not considered to be a health hazard. At Bishops Falls the groundwater appears to contain excessive quantities of iron and/or manganese. In Volume Two, Section 37, there is a detailed discussion of a few special cases where groundwater quality causes municipal water supply problems.

4. 2. 4 Physical Condition of the Supply System

Most municipal supply and distribution systems are less than 25 years old and accordingly should be in good physical condition, although the water supply and distribution systems serving St. John's, Grand Falls, Corner Brook, Harbour Grace, and St. Anthony are exceptions. Facilities intended originally for military purposes at Gander, Argentia, Stephenville, and Goose Bay, constructed during the early 1940's and expanded as required, are reported to be in good physical condition. Part of the Harbour Grace and St. Anthony systems are in the process of being replaced. In view of the magnitude of the major leaks recently discovered in the St. John's distribution system (approximately 20 percent of production), it is likely that the older municipal distribution systems mentioned above also suffer from excessive leakage. Since several municipalities mention corrosion as one of the problems of their water systems, this problem deserves attention in connection with the future design of such systems.

4.2.5 Distribution System Characteristics

Fire flow requirements, because they are so much greater than normal demands, usually determine the sizing of distribution mains in municipalities of less than 50,000 persons, as well as the required volume of water to be available in storage. The National Board of Fire Underwriters recommend for a municipality of 1000 persons a fire flow within the central district of 1.2 million gpd, with a reserve of 0.2 million gallons; for a municipality of 50,000 persons the recommended fire flow is 7.9 million gpd, with a reserve of 3.3 million gallons. By comparison, the usual peak demand for an entire municipality of 1000 would approximate a rate of supply of 0.25 million gpd, and for a municipality of 50,000 persons would approximate a rate of supply of 12.5 million gpd. Accordingly, the size of distribution mains in most Newfoundland municipal systems should be dictated by fire protection requirements and not normal demand. From the available data it is not possible to ascertain the extent to which the older existing distribution systems satisfy the National Board of Fire Underwriters' requirements. The difficulty of supplying certain areas in St. John's and other towns under normal conditions would indicate that some of these older systems do not meet the requirements at least in certain areas.

4.2.6 Communities Without Central Water Supply Systems

The following table shows the distribution of communities in the Province without water supply systems where residents rely on individually-owned facilities, usually shallow dug wells:

Size of Municipality or Community	Approximate Number	Approximate 1966 Population
less than 100 persons	-	24,953
100- 500	474	113,293
501-1000	99	68,269
1001-1500	16	21,871
1501-2000	3	4,887
2001-3000	2	4,072
3001-5000	5	17,983
Population without central water supplies		255,328

Dug wells are normally constructed by the houseowner and probably cost about $150 inclusive of labour. The main disadvantages of these wells, apart from operating inconvenience, are lack of quality control and difficulty in ensuring that the well pumping unit is set to draw from below the groundwater horizon through all its variations. //

In a few communities where surficial materials do not yield groundwater in sufficient quantity, drilled bedrock wells are utilitzed. Such wells, however, cost approximately $7.50 to $12.00 per lineal foot of well installed and average about 150 lineal feet in depth, thus making the cost of a drilled well about $1500, which is quite beyond the ability of the average houseowner to pay.

Where surficial materials permit, such as in the area near Stephenville Crossing, well points are installed to obtain groundwater. In some areas of the Province where groundwater is not readily available, surface waters are utilized for non-municipal domestic supplies, generally through serving a small group of houses by piping from a nearby stream.

The chemical quality of the water used in the individual consumer supplies of the small and isolated communities is good with the possible exception of high fluorides in a number of the surficial wells in the St. Lawrence area. However, bacteriologically much of the surficial groundwater used in these communities is polluted due to improper sealing and local contamination as discussed in Volume Two, Section 36.

NO.	ESTABLISHMENT	LOCATION	CENSUS DIVISION	PRODUCTS	DAILY DEMAND 1966 MGD	WATER SUPPLY: SOURCE TYPE	WATER SUPPLY: SOURCE CAPACITY MGD	WATER SUPPLY: TREATMENT CAPACITY OF PLANT MGD	WATER SUPPLY: TREATMENT COMMENTS	WASTE DISPOSAL: RECEIVING WATER BODY	WASTE DISPOSAL: COMMENTS
1	BAVARIAN BREWING CO LTD	ST-JOHN'S	1	BEER	0.150	MUNICIPAL		0.150	CHARCOAL FILTERS	MUNICIPAL SEWER	WASTES CONTAIN YEAST-SUSPENDED SOLIDS
2	BENNETT BREWING CO. LTD	ST-JOHN'S	1	BEER	0.130	MUNICIPAL			CHLORINATION	MUNICIPAL SEWER	
3	BROOKFIELD ICE CREAM	ST-JOHN'S	1	ICE CREAM	0.07	MUNICIPAL				MUNICIPAL SEWER	
4	BROWNING HARVEY LTD	ST-JOHN'S	1	SOFT DRINKS	0.05	MUNICIPAL			CHLORINATED TO 8 ppm	MUNICIPAL SEWER	WASTES CONTAIN CAUSTIC SODA FROM BOTTLE WASHING
5	CANADIAN LIQUID AIR LTD	ST-JOHN'S	1	INDUSTRIAL GASES	0.005	MUNICIPAL				MUNICIPAL SEWER	
6	CHALKER AND CO.	ST-JOHN'S	1	SMOKED MEATS		MUNICIPAL				MUNICIPAL SEWER	GREASE TRAPS ON SEWER OUTLETS
7	CONCRETE PRODUCTS	ST-JOHN'S	1	READY MIX CONCRETE BLOCKS, PIPES	0.03	PRIVATE-WELLS				SEPTIC SYSTEM	
8	DAWES NAIL AND HARDWARE LTD.	BAY ROBERTS	1	NAILS, BOLTS & OTHER STEEL PRODUCTS		PRIVATE-WELL				MUNICIPAL SEWER	
9	EAST END BAKERY	ST-JOHN'S	1	BREAD, CAKES	0.01	MUNICIPAL				MUNICIPAL SEWER	
10	ERCO	LONG HARBOUR	1	PHOSPHOROUS		PRIVATE	FRESH WATER 12.0 SEA WATER PUMPING CAPACITY 10.0			LONG HARBOUR	
11	GADENS LTD	ST-JOHN'S	1	SOFT DRINKS, SYRUP	0.12	MUNICIPAL (BOOSTER PUMP REQUIRED)		0.03	FERROUS SULPHATES, SODA ASH, CHLORINATION	MUNICIPAL SEWER	
12	GOLDEN EAGLE REFINERY	HOLYROOD	1	REFINED PETROLEUM	FRESH 0.4 SALT 2.6	PRIVATE WELLS, POND, SEA			FRESH WATER pH. TO 6-7	HOLYROOD BAY	LAGOONING
13	LUNDRIGAN CONCRETE (EAST) LTD	ST-JOHN'S	1	READY MIX CONCRETE BLOCKS, PIPES	0.02	MUNICIPAL				ROBIN HOOD BAY	
14	HAMMY'S BAKERY	ST-JOHN'S	1	BREAD, CAKES	0.01	MUNICIPAL					
15	NEWFOUNDLAND BREWERY LTD	ST-JOHN'S	1	BEER	0.08	MUNICIPAL					
16	NEWFOUNDLAND MARGARINE CO.	ST-JOHN'S	1	MARGARINE	0.06	MUNICIPAL			FILTER	MUNICIPAL SEWER	
17	NEWFOUNDLAND STEEL CO.	ST-JOHN'S	1	MERCHANT BAR & GRINDING BALLS	8.4	PRIVATE-WELL, POND			DRINKING WATER CHLORINATED		
18	PURITY FACTORIES LTD	ST-JOHN'S	1	BISCUITS, JAMS, SOFT DRINKS	0.03	MUNICIPAL		0.008	CHLORINATION, FILTER	MUNICIPAL SEWER	
19	RUSSWOOD POULTRY LTD	CONCEPTION BAY	1	EGGS, BROILERS, HOGS		PRIVATE-POND			CHLORINATION	MUNICIPAL SEWER	
20	SEVEN-UP EASTERN LTD	ST-JOHN'S	1	SOFT DRINKS	0.025	MUNICIPAL (BOOSTER PUMP REQUIRED)			FILTER SYSTEM FOR 12% OF INTAKE	MUNICIPAL SEWER	
21	STANDARD MANUFACTURING CO. LTD	ST-JOHN'S	1	NAILS, BOLTS AND OTHER STEEL PRODUCTS		PRIVATE-WELL					
22	UNITED NAIL AND FOUNDRY CO.	ST-JOHN'S	1	FOUNDRERS AND MANUFACTURERS	0.025	MUNICIPAL					
23	U.S. NAVAL BASE	ARGENTIA	1	MILITARY	1.5	POND					
24	WALSH'S BAKERY LTD	ST-JOHN'S	1	BREAD, CAKES	0.005	MUNICIPAL			NOT TREATED	MUNICIPAL SEWER	
25	NEWFOUNDLAND FLUORSPAR LTD	ST-LAWRENCE	2	FLUORSPAR	1.5	PRIVATE-POND				TO SEA	SMALL SETTLING PONDS
26	NEWFOUNDLAND MARINE WORKS LTD	MARYSTOWN	2	SHIPYARD	0.05	PRIVATE-POND	1.5				
27	ATLANTIC BREWING CO. LTD	PORT HARMON	4	BEER		PRIVATE-POND					
28	FLINTKOTE CO. OF CANADA LTD	FLAT BAY	4	RAW GYPSUM		PRIVATE-WELL	0.036				
29	ATLANTIC GYPSUM LTD	CORNER BROOK	5	WALLBOARD, LATHE, CRUSHED ROCK	0.02						
30	BOWATERS NEWFOUNDLAND LTD	CORNER BROOK	5	PULP AND PAPER	33.0	PRIVATE (1½% FROM MUNICIPAL)	43.0	0.60	*	HUMBER ARM	*BOILER FEED FROM MUNICIPAL SOURCE TREATED BY SODIUM ZEOLITE SYSTEM FOR SOFTENING AND DEALKALIZING. WATER FOR OTHER USES CHLORINATED.
31	BROWNING HARVEY LTD	CORNER BROOK	5	SOFT DRINKS							
32	LUNDRIGAN LTD	CORNER BROOK	5	CEMENT							
33	NORTH STAR CEMENT LTD	CORNER BROOK EAST	5	PORTLAND CEMENT	0.3	MUNICIPAL					
34	WEST COAST BAKERY LTD	CURLING	5	BREAD						MUNICIPAL SEWER	
35	AMERICAN SMELTING AND REFINING CO.	BUCHANS	6	BASE METALS	2.2	PRIVATE-LAKE	3.2		CHLORINATED DOMESTIC SUPPLY	RED INDIAN LAKE	IMPOUNDMENT
36	CENTRAL DAIRIES LTD	GANDER	6	MILK	0.002						
37	DEPARTMENT OF TRANSPORT	GANDER	6	TRANSPORTATION		LAKE					
38	GADEN'S (CENTRAL) LTD	BISHOP'S FALLS	6	SOFT DRINKS	0.035	MUNICIPAL		0.007	LIME, FERROUS SULPHATE, CHLORINE		SLIGHT CAUSTIC CONTENT, NO TREATMENT
39	GANDER BAKERY	GANDER	6	BREAD							
40	GULLBRIDGE MINES LTD	GULL POND	6	BASE METALS	2.0	PRIVATE-POND	2.4	2.4	CHLORINATED		
41	PRICE BROTHERS	GRAND FALLS	6	PULP AND PAPER	43.2	PRIVATE-EXPLOITS RIVER	80.0**			EXPLOITS RIVER	** PART OF THIS CAPACITY IS USED FOR INTERMITTENT WOOD HANDLING
42	CORONATION BAKERY	CATALINA	7	BREAD	0.0002	PRIVATE-WELL			CHLORINATION		
43	ADVOCATE MINES	BAIE VERTE	8	ASBESTOS		PRIVATE-POND	1.8	0.2	CHLORINATED		
44	BRITISH NFLD. EXPLORATION LTD	WHALESBACK	8	BASE METALS	1.0	PRIVATE-LAKE	1.0		UNTREATED	TO SEA	SETTLEMENT IN OLD LAKE BED
45	NOTRE DAME BAKERIES	LEWISPORTE	8	BREAD							
46	DEPARTMENT OF TRANSPORT	GOOSE BAY	10	TRANSPORTATION		RIVER					
47	IRON ORE COMPANY OF CANADA	LABRADOR CITY	10	IRON ORE	24.0	PRIVATE-LAKE	47.5			WABUSH LAKE	
48	SCULLY MINE	WABUSH	10	IRON ORE	10.0	PRIVATE-LAKE	16.0			FLORA LAKE	
49	USAF	GOOSE BAY	10	MILITARY		LAKE					

NOTE: DATA ON WATER DEMAND OF EXISTING FISH PROCESSING PLANTS IS CONTAINED IN VOLUME 3, TABLE 10-7

SOURCE: SECO MACLAREN QUESTIONNAIRES

NEWFOUNDLAND AND LABRADOR
SUMMARY OF INDUSTRIAL WATER SUPPLY AND DISPOSAL DATA, EXCLUDING FISH PROCESSING

TABLE 4-1

5 REGIONAL ASSESSMENT OF DEMAND AND SUPPLY

This section discusses the present and forecast conditions of water use (availability, demand, supply, and wastewater disposal) for the Province in order to assess in broad terms the existence of water resources problems, their nature and possible significance. A graphical comparison between water availability and water demand for the Province is shown on Figure 5-1.

Although in the course of the study climatic and hydrologic regions have been suggested (Volume Two, Sections 8.8 and 21), this discussion is based on geographic-economic regions delineated by census division. This was done because statistical data based on such divisions were readily available, and their delineation broadly coincides with the climatic and hydrologic regions. The regions used are as follows:

- Avalon Peninsula
- Burin Peninsula
- South Coast
- West Coast
- Northern Peninsula
- Central
- Labrador

This broad regional analysis facilitates the selection of certain river basins and study areas for more detailed studies and ensures that general problems not included in those studies are not overlooked.

5.1 Avalon Peninsula Region

The region includes the isthmus separating Placentia and Trinity Bays and coincides with the DBS census division number 1.

Water usage at present is largely municipal and industrial due to the relatively large population concentration (about 200,000 or nearly 40 percent of the Island's population). There is a small non-withdrawal demand for hydro power, and for recreation, tourism, and fisheries.

5.1.1 Withdrawal Demand

The total municipal demand in the region is currently estimated at about 22 million gpd of which 10 million gpd is for the City of St. John's. Only about half the demand is met by central supply systems (Table 4-2), the remainder of the population or about 97,000 being supplied by isolated wells and small surface intakes.

By 1981 the population of the region is estimated to reach 242,000 resulting in an estimated additional municipal demand of about 10 million gpd, allowing for increased per capita demand. Present industrial demand supplied by privately-owned systems is estimated at 40 million gpd, of which 23 million gpd is for fresh water and the balance for sea water. Included is approximately 0.3 million gpd of fresh water for agricultural use.

Major increases in industrial demand during the forecast period will be for the industrial complex at Come By Chance in the order of 16.5 million gpd of fresh water; and the thermal station at Duffs near Holyrood requiring 1.5 million gpd of fresh water plus sea water for station service and condenser cooling amounting to 15 million gpd and 200 million gpd respectively.

The potential establishment of two major fish processing operations in the region would result in a withdrawal demand of 2.0 to 3.0 million gpd. The total additional withdrawal demand in the Avalon Peninsula region by 1981 is therefore estimated at 30 million gpd of fresh water plus 215 million gpd of sea water.

From the viewpoint of the average available flow this municipal and industrial demand represents no problem, but the large variation of this flow throughout the year and the small size of the drainage areas in this region requires the provision of storage or diversions to ensure meeting the demand. The supply of water from dug wells in this region is often insufficient because of the small amount of water stored in the surficial layers.

From the viewpoint of quality, the water corresponds generally to the requirements for industrial and municipal uses, with some exceptions. The most notable exception is that related to bacteriological quality and is caused by the occasional improper disposal of domestic wastewaters as discussed in Section 5.1.4. Problems of odour and taste in the sources of municipal water are also noted in the region (the Petty Harbour Long Pond supply for St. John's). Several instances of poor quality of groundwater in the region can be related to local salt water intrusion.

5.1.2 Non-Withdrawal Demand

Non-withdrawal water demand in this region is primarily for the generation of hydro-electric power and recreation. Few significant salmon streams exist, except for the Salmonier River, although all streams do support other fish in good quantity. Because of population concentration, the demand for recreation and sport is quite active. Navigation and log driving exert no demand.

There are many parks in the area with relatively high attendance (Volume Four, Section 5, Figure 5-2). This use is definitely impeded by the hydro-electric demands and water quality reduction through the disposal of residential wastewaters without treatment. If no corrective measures are taken, this could become a significant problem in the near future.

Because of significant anticipated increase in both population and per capita disposable income during the forecast period, there are reasons to believe that the use of the available water resources for recreation, sport fishing, and related water activities will greatly increase.

The Newfoundland Light and Power Company Limited owns all the 13 small generating stations in the region listed in Volume Four, Table 1-8. Their flow capacity often exceeds the average available flow by several times, and in the present stage of the electric energy system these stations are used intermittently for peaking. Because of this type of operation involving the storage of the available flow for considerable periods, the minimum flows downstream of these plants is often reduced to zero, and this conflicts with the use of these rivers for other purposes, mainly fisheries and water supply.

No increase in the use of water for hydro-electric power is anticipated in the region; in fact it is likely that many of the 13 small generating stations in the region will be retired from service by 1981.

5.1.3 "Negative" Demand

"Negative" water demand in the Avalon Peninsula region is primarily associated with bogland reclamation. In the region approximately 1650 acres of bogland has been reclaimed, mostly for community pastures or experimental purposes, out of a total of 3893 acres reclaimed by 1967 throughout the entire Province.

It is anticipated that there will be some increase in the amount of bogland reclaimed during the forecast period, but this should not affect the fresh water resource.

5.1.4 Wastewater Disposal

Industrial wastewaters in the region are generally discharged untreated either directly to the sea, or through the municipal sewerage systems (see Table 4-1). Exceptions are the Newfoundland Steel Company Limited which discharges its cooling water to Rock Pond and from there to Octogon Pond, thus recirculating it, and the Eagle Refinery which discharges its effluent to a lagoon before disposal.

Residential and commercial wastewaters are discharged untreated either directly to the sea, to the municipal sewerage systems (Table 4-2), to septic tanks and cesspools, and/or occasionally to surface ponds and rivers.

Degradation of sea water is occurring locally as a result of all the untreated industrial wastes most of which are discharged without due consideration to oceanographic conditions. Similar conditions apply to the municipal wastewaters of coastal communities. About 5000 persons living in the interior of the Peninsula create raw wastes which affect both the surface water and groundwater.

The effect of the industrial wastewaters on the quality of sea water is not known, but there is some evidence that pollution may be occurring in the St. John's-Conception Bay area. The amount of polluting wastes for each of the more significant industries in the area are given in Volume Three, Sections 7 to 13, and 16.

The discharge of untreated residential wastes from municipal systems or individual outfalls in the sea is producing bacteriological contamination which is more significant here than in any other area of the Province. The discharge of residential wastes to improperly designed septic tanks and cesspools or surface water bodies produces groundwater and surface water bacteriological contamination, which has already been detected in several areas of the region. It is also likely, but not yet proven, that eutrophication of the fresh water lakes is accelerating due to the effect of these wastes.

Pollution of the inland waters of the region has resulted in:

a) Health hazards due to the use of untreated water for drinking or swimming.

b) Reduction of the value of water for recreation and sport.

c) Difficulties in using fresh water for process water in industries requiring high bacteriological quality, such as the fish processing, dairy, and soft drink industries.

The identifiable consequences of sea water pollution in the region are:

i) Difficulties of using sea water in fish processing industries.

ii) Migratory water fowl kills.

There may be further consequences of sea pollution related to inshore or offshore fisheries but the data available so far are inconclusive.

The increase in population in this region will be mainly in the urban coastal areas, so that quality degradation of the municipal demand should not affect the fresh water resource except for local groundwater pollution which could result from inadequately operated and maintained septic tanks. Industrial wastewaters from the expanded fish processing plants as well as the complex at Come By Chance will be discharged to the sea and as such will not affect the fresh water resource. However, in the Come By Chance area both industries and municipalities will produce sea water pollution and the problem of the adequate dispersion of these wastes needs careful investigation.

5. 1. 5 Selection of Areas and Basins for More Detailed Studies

The examination of present conditions in the region led to the conclusion that more detailed studies were required in the St. John's area and its immediate environs, as well as the area around Conception Bay. This is the area where the most acute problems of municipal water supply, sea and fresh water pollution, and recreational demands are concentrated and where significant conflicts of interest already exist or may develop in the near future. This is also an area where there is a large number of people lacking proper water supply and sewage facilities. The delineation of this study area is shown in Volume Seven, Figure 8-1.

Considerable industrial development will take place in the Come By Chance-Argentia area in the future, and this area, together with the rivers flowing into it, was selected for more detailed study. This area is dealt with in some detail in Volume Seven.

In addition, because the hydrologic conditions in the region indicated that any new development involving the use of a flow of some significance would involve the provision of additional storage, a separate study of storage possibilities in the Avalon Peninsula area was made, as described in Section 5. 8. 1.

5.2 Burin Peninsula Region

The Burin Peninsula region coincides with DBS census division number 2. The use of water resources here is also dominated by the industrial and municipal demand but at a much smaller scale than in the Avalon Peninsula.

Future changes in the pattern of water use are anticipated in relation to the rationalization of the fish processing industry and as a result of the connection of the Burin Peninsula to the provincial power grid, which will change the pattern of use of the existing power plants.

5.2.1 Withdrawal Demand

The major industrial water demand in this region, being met at the present time from privately-owned systems, is shown on Table 4-1 and estimated at approximately 3.2 million gpd, of which 0.8 million gpd is salt water.

Although the existing potential municipal water demand in the region cannot be determined exactly, it is estimated to amount to about 2 million gpd. Only about 10,000 of the 26,000 persons residing in the area are currently supplied with water from municipal systems, and about one-half of the capacity of the existing municipal supply is directed to servicing industry.

Agricultural water demand in the region is limited to the watering of livestock and is estimated to be only 30,000 gallons per day.

Thus, the present fresh water withdrawal demand of the Burin Peninsula is 4.4 million gpd of the total demand of 5.2 million gpd.

Increased industrial demand anticipated in the Burin Peninsula is related to the fish processing industry and the new shipyard at Marystown. At the present time existing capacity appears adequate to meet these demands.

Because of the small size of the drainage basins and resulting river flow variability, the water supplies for industries and municipalities cannot meet a consistent demand without storage. Individual well supplies cannot sustain a demand without being deepened to ensure pumping from below the groundwater horizon.

The regional population is estimated to increase to 33,000 persons by 1981, an increase of 7000. Most of these persons are expected to reside in urban areas and the additional municipal demand in 1981 is estimated to be 1.0 million gpd.

No increase in other withdrawal demand is anticipated during the study period, unless new fluorspar mines are opened up.

Thus the total additional withdrawal for water in the Burin Peninsula region to 1981 is estimated to be 1.0 million gpd.

5.2.2 Non-withdrawal Demand

Non-withdrawal water demand in this region is primarily for the generation of hydro-electric power. However, demand for recreation and related sport fishing exists, although on a small scale. There are no significant salmon streams in the region. Logging and navigation do not exert any demands on the water resource.

The Newfoundland Light and Power Company Limited owns three small hydro generating stations in the region. These stations are listed in Volume Four, Table 1-8. No data on the actual operation regime are available; but, since the area is not yet connected to the Provincial power network, it may be assumed that these stations are operated continuously with some hourly variation, and that they do not therefore produce conflicts of interest with other uses.

Non-withdrawal uses will be reduced if the small generating stations in the area are closed down when the Provincial power network is connected to the region and power is provided more economically by the Newfoundland and Labrador Power Commission. This may well occur during the study period and, in this case, the storages used for hydro-electric power may become available for other uses.

5.2.3 "Negative" Demand

Negative water demand in the Burin Peninsula region is related to bogland reclamation, soil erosion problems, and mine dewatering. At Winterland, an area of 1211 acres has been reclaimed for use as a community pasture. This is the largest single area reclaimed to date and represents over 30 percent of all land reclaimed in the Province.

Siltation effects are evident in some of the small harbours (Grand Bank and Fortune). The causes are not yet established, but they may be related to soil erosion resulting from past forest fires.

The main problem related to mine dewatering is that at the St. Lawrence mine where the drainage water contains radioactive gases and other toxic substances.

Some minor flooding problems have also been recorded in the region.

5.2.4 Wastewater Disposal

Fresh water degradation due to wastewater discharges is not significant in the Burin Peninsula region since practically all industrial and municipal wastewaters are discharged directly into the sea. However, people living in areas where distance makes direct disposal to the sea impractical may cause localized bacteriologic pollution of the fresh water resource, particularly the groundwater. An example is the situation at Lawn where comprehensive analysis has shown that 27 out of 40 wells were bacteriologically unsafe.

Fish plant and municipal discharges of wastewater to the ocean cause visible pollution effect from time to time in embayments and inlets.

Additional wastewater disposal problems may arise from increased activity in the fish processing industry and the possible opening of new fluorspar mines.

5.2.5 Selection of Areas and Basins for More Detailed Studies

The southern portion of the Burin Peninsula was selected as a study area. The selection was based on the consideration of its relatively large population concentration and of the variety of water uses and problems, including those related to negative demand. All significant new developments and changes in water usage patterns in the region will probably take place inside this area.

As mentioned in Section 5.2, storage will be necessary to supply water to any new industries requiring a significant amount of water; hence, a separate study was made of storage possibilities and is discussed in Section 5.8.

5.3 South Coast Region

The South Coast region as discussed in this section coincides with the DBS census division number 3 and extends from Port aux Basques in the west to the Burin Peninsula in the east. The water resources situation in this area is dominated by the Bay D'Espoir hydro-electric station which is still under development.

Changs in the pattern of water use are considered possible during the study period because of the opportunities afforded by the Bay D'Espoir development. These changes will result from increased recreation and tourism and related water resources activities, and possibly increased industrial usage.

5.3.1 Withdrawal Demand

Privately-owned independent industrial water systems in this region supply four fish processing plants. Although no data were available for these plants, it was estimated that their total demand for fresh water exceeds 0.5 million gpd.

There is a total potential municipal water demand in the region at the present time of about 2 million gpd. Of the total regional population of 26,000 persons, only 7000, or 27 percent, reside in municipalities with a water supply and distribution system (Table 4-2).

Agricultural water demand is practically non-existent in the South Coast region.

Thus the total potential withdrawal water demand in the region is estimated to be 2.5 million gpd of fresh water with an additional salt water demand at fish processing plants of 0.5 million gpd. The actual supply at present is substantially less than this due to an inadequate supply for residential uses.

The availability of power, harbour facilities, and a large regulated flow of water (over 6000 cfs) at the tailrace of the Bay D'Espoir development may attract industrial establishments to this area. In fact this area is considered to be one of the alternative sites for an aluminum smelter which would require up to 60 million gpd of which approximately 8 million gpd would be fresh water.

If a smelter does locate in this area, it is estimated that the net inward population movement could reach 14,000 which would result in an additional municipal demand of approximately 1.5 million gpd.

Some increase in water usage for fish processing plants is also possible.

5.3.2 Non-withdrawal Demand

Non-withdrawal demand in this region is significant, but consists almost entirely of water required for hydro-electric power generation at the Bay D'Espoir station and fisheries. At the present time the flow of the Salmon and Upper Grey rivers is diverted for use at Bay D'Espoir. With the completion of Stage II of the development, the flows of two other rivers, the Upper White Bear and the Victoria (one of the headwater rivers of the Exploits River flowing to the north coast) will also be diverted to the Bay D'Espoir development. These diversions will cause a series of new conflicts of interest or emphasize already existing ones in the basins affected.

A number of the rivers in the South Coast region, particularly the Grey and Conne rivers, are excellent salmon streams and all rivers in the region support good populations of fish. These rivers have good potential for recreation and sport fishing development which will be reduced following the diversions. On the other hand, the system of canals and structures forming part of the Bay D'Espoir development may become tourist attractions and open up new recreational areas. In addition, the controlled lakes and reservoirs included in the development represent opportunities for the development of inland fresh water fisheries.

Hydro-electric development at other sites in the area (Upper Salmon development) does not appear likely during the forecast period. However, successive increases in the capacity of the Bay D'Espoir development for obtaining peaking power are planned which will introduce flow and level fluctuations in the Bay D'Espoir tailrace.

5.3.3 "Negative Demand

"Negative" demand problems in the region are related to soil erosion due to forest fires especially in the Pipers Hole River basin, and to possible bog reclamation.

5.3.4 Wastewater Disposal

The quality reduction of the fresh water resource due to municipal and industrial use is negligible due to the limited interior development. Also the low level of activity in this area even along the coast creates only limited deterioration of sea water quality.

The introduction of an aluminum smelter with the resulting concentration of population might introduce wastewater problems in the Bay D'Espoir estuary.

5.3.5 Selection of Study Areas and River Basins

The rivers included in this region diverted to the Bay D'Espoir development (Salmon, Grey, and White Bear) were selected for more detailed studies because of the changes, new possibilities, and conflicts of interest induced by these diversions. The Conne River was added to this group because of its fishery potential which may be put to increased use in relation to the increased population in the Bay D'Espoir area and increased tourism attraction in the South Coast region. Finally, the Pipers Hole River basin was also included among the river basins to undergo some further analysis because of the extensive forest fires in the area and related hydrologic and soil erosion problems. These basins are dealt with in some detail in Volume Six.

The possibility of selecting the Bay D'Espoir area as the site for the planned aluminum smelter indicated that this area should be selected for more detailed studies. Consequently, the analysis of the group of rivers of the South Coast region has been expanded to include the Bay D'Espoir area. Since withdrawal water supply can be readily obtained from the regulated flow at Bay D'Espoir, it was not considered necessary to carry out a special investigation of additional storage possibilities for the region.

5.4 West Coast Region

The West Coast region extends from Cape Ray to the Humber Arm and includes Deer Lake. The region corresponds to DBS census divisions 4 and 5. The water resources demand in this area is presently dominated by the Bowater Pulp and Paper Mill at Corner Brook and the related population concentration.

Some areas of the West Coast may undergo significant industrial development, while others may be rapidly developed for recreation and tourism. The potential for pumped storage hydro-electric development in the area may be of interest towards the end of the study period.

5.4.1 <u>Withdrawal Demand</u>

Industrial water demand in this region being met at the present time from privately-owned systems totals 33.3 million gpd. The Bowater mill represents 97 percent of this demand, and at present there is an excess capacity at the Bowater pulp and paper mill of 10 million gpd. There are a number of small industrial enterprises connected to municipal systems with a demand estimated at 0.7 million gpd.

Of the total regional population of 67,000, about 40,000 reside in municipalities with water supply and distribution systems. There is therefore a potential municipal demand of about 8 million gpd.

Agricultural water demand in the West Coast region is for watering of livestock and on the basis of approximate livestock data, it is estimated to be only about 60,000 gallons per day.

There is, therefore, a total potential withdrawal water demand in the West Coast region at the present time of approximately 43 million gpd, with the actual supply being only moderately less than this figure. Withdrawal of this total amount of water from the Humber River, which is the largest in the region, would be simple, and the existing storage could ensure the required amount of water at all times. However, because of historical and topographical conditions and some deterioration of the Humber River water quality due to logging and domestic waste-water, all of the water used is supplied by small brooks in the region. Therefore, in spite of larger minimum flows than in other areas of the Island, significant storage is required to satisfy the demand. It should also be noted that the region includes the area with the largest ground-water potential in the Island (Volume Two, Figure 5-1).

Future industrial water demand is primarily associated with the proposed development in the Stephenville area. This is considered as the selected site for a linerboard mill and one of two possible sites for an aluminum smelter. A water supply scheme of 100 million gpd capacity involving storage and diversions in the Harrys River has been proposed to serve this develpment, and it is unlikely that the industrial demand will exceed that capacity during the study period. Industries scheduled to be served by this water supply include the linerboard mill at 40 to 60 million gpd, an aluminum smelter with an estimated demand of 60 million gpd of which 8 million gpd would be for fresh water, with the balance being made up by miscellaneous industrial and municipal requirements. The pulp and paper mill at Corner Brook is likely to have a requirement for an additional 10 million gpd by the end of the study period to meet increased production requirements. The possible establishment of a large fish processing plant to process the potential pelagic catch would require 1 to 2 million gpd.

By 1981 the population of this region is expected to increase by 16,000 to a total population of 83,000. Most of these persons are expected to reside in urban areas, and the total additional municipal demand in 1981 is estimated to be about 2.5 million gpd.

Thus the total additional withdrawal demand for water in the West Coast region to 1981 is estimated to be in the order of 90 million gpd.

5.4.2 Non-withdrawal Demand

Non-withdrawal water demand in the region is significant. The Humber and Harry's rivers, Southwest Brook, and numerous other streams support excellent populations of salmon and other sport fish. The Humber River is used extensively for log driving and is utilized for the generation of hydro-electric energy.

Hydro-electric generating stations in the region are listed in Volume Four, Table 1-8. The Deer Lake and Corner Brook hydro-electric plants are generally operated for base load and have a regulating effect on the flows downstream.

Logging activity has decreased in the region, but is still practised on an extensive scale. This results in rapid flow variation on the smaller rivers and tributaries where logging is practised and some deterioration of water quality for fisheries.

Many of the rivers in the area have an important fresh water fishery potential and a few of them currently provide a significant sport fishing base. There are several conflicts of interest with other water users affecting the use of water for fisheries in the area. Considerable wildlife exists in the region, which has potential for recreation and tourism, especially in the Humber River basin.

The future increase in both population and income will probably result in the development of water based recreational and sport activities.

The use of the Harrys River for industrial and municipal water supply may conflict with the fisheries and recreational uses of this river, and this should be carefully considered before development proceeds.

5.4.3 "Negative" Demand

Negative water demand in the West Coast region is associated primarily with soil erosion, flooding, and bogland reclamation.

Soil erosion and sedimentation has been observed mainly in the Corner Brook basin and is affecting the withdrawal water supply in the area.

Flooding occurs occasionally on many smaller streams, because of their flashy nature, and has local effects on roads, culverts and bridges, and occasionally other installations and developments.

Bogland reclamation takes place on a small scale only, and is not of major importance.

5.4.4 Wastewater Disposal

Some reduction of fresh water quality occurs due to logging and the interior population's wastes disposal,as in the case of Noel's Pond and Bell's Brook, but normally all major wastes are discharged to the sea. Quality degradation of the sea water in the Humber Arm was the subject of a preliminary investigation by the Department of Fisheries of Canada during 1968.

As in other populated areas, the supply of water from individually dug wells is not satisfacoty due to variation of the ground water level relative to the well pumping level and due to bacteriological contamination related to improper residential waste disposal (St. George's).

Since the bulk of the additional population will reside in coastal municipalities, no significant effect of their wastewaters on the fresh water resource is expected. This is also true with respect to future industrial wastewaters which will probably all be discharged to the sea.

Nevertheless, attention must be given to the possible pollution of sea water in the disposal area, particularly in the case of the new industrial developments at Stephenville.

5.4.5 Selection of River Basins and Study Areas

The Humber River basin has been selected for detailed analysis since it is the largest in the region, and includes most of the industrial activity and non-withdrawal uses. The Corner Brook-Deer Lake area, where the population and industry is mainly concentrated, was selected for further analysis as a study area and is included in the detailed discussion of the river basin in Volume Six.

Because of the problems and conflicts of interest which may arise in connection with the industrial and residential development in the Stephenville area and the suggested supply source, Harrys River, Southwest River and Bottom Brook basins, which are partially included within the area, were selected for more detailed studies. Storage investigations have been carried out for the Atlantic Development Board on the Harrys River basin for the Stephenville industrial-municipal supply, and on behalf of the Bowater Power Company for a study of possible increases in storage for the Deer Lake power plant. The results of these studies are reported in Volume Seven, Part IV and Volume Six, Part II.

Because of limestone formations in the area, the problem of storage is more difficult to assess without complete geologic data. It should be mentioned that a small reservoir at Port au Port in this area had to be lined with clay to stop excessive leakage.

Only one area of significant population concentration in the region was not selected for further study at this time, namely, the Codroy River basin and adjacent communities. However, it is considered that this area should be studied later when full benefit could be obtained from a series of studies already initiated in the area, especially those by the Fisheries Research Board of Canada.

5.5 Northern Peninsula Region

The Northern Peninsula coincides with DBS census division number 9 covering that portion of the Island lying north of a line between Bay of Islands and White Bay. This region is basically undeveloped.

Future development will probably be limited to forest exploitation, hydro-electric energy, and some increase in the fish processing activity. The proposed DC infeed from Labrador will run the length of the Peninsula and will have some effect on the economic activity of the area. However, it is not expected to have a significant effect on the fresh water resource.

5.5.1 Withdrawal Demand

The only industrial demand being met at the present time from non-municipal sources is for three fish processing plants. Although no data on water usage were available from these plants, considering the seasonal nature of their operation, their combined average demand is probably between 300,000 and 650,000 gpd during the season.

The estimated municipal demand in the region at the present time is about 1 million gpd.

St. Anthony has the only municipal water supply and distribution system (Table 4-2) in the region and serves approximately 10 percent of the total population of 24,000. Several water quality problems (corrosiveness, bacteriological contamination) have plagued this water supply system but the situation has been partially corrected.

There is no significant agricultural water demand in the region.

The total potential withdrawal water demand in the Northern Peninsula region is estimated to be 1.7 to 3.0 million gpd, of which the present municipal supply represents only a portion.

In addition to the residential demand, future withdrawal demand may result from developments of primary and secondary forest and fisheries industries. Forestry requirements would result from possible pipeline transportation of woodchips and the establishment of a chip mill. These requirements would be of the order of 10 million gpd. A large fish processing plant could require up to 3 million gpd. These requirements combined with the expected residential demand would result in a regional water withdrawal demand of 16 million gpd by the end of the forecast period.

5.5.2 Non-withdrawal Demand

Non-withdrawal water demand in the region is minimal at the present time. There is no hydro-electric generation, although significant hydro-electric potential exists, particularly in the Cat Arm River basin where development might be considered during the study period. The area also includes interesting possibilities for pumped storage hydro-electric schemes.

The extensive forest resource is not exploited at the present time. However, its expected development during the forecast period could result in the use of some rivers for log driving. Although no significant sports fishing occurs in the region, the streams do support a good fishery, development of which could conflict with an active log driving program.

5.5.3 "Negative" Demand

There is no significant negative demand except that occasioned by flooding of roads and bridges. However, because of the regional topography, increased forestry exploitation could result in soil erosion problems. Some negative demand would arise from the Cat Arm development which involves the flooding of some forested areas and from construction activities associated with the areas' development.

5.5.4 Wastewater Disposal

Because the population is located primarily on the coast, most wastewaters are disposed to the sea where pollution is negligible. There is no known fresh water degradation due to municipal or industrial wastewater discharges.

5.5.5 Selection of Areas and Basins for More Detailed Studies

The water resources problems of the region are very local and it was decided not to select areas or river basins for more detailed study.

Hydrologic conditions are such that minimum flows of river basins with drainage areas of 100 to 200 square miles could satisfy the potential withdrawal demand using natural storage. Therefore, no special study of storage possibilities was carried out for this region. However, because of its significant hydro-electric potential, the Cat Arm basin was selected for special study (Volume Six, Part VI).

5.6 Central Region

The Central region corresponds to DBS census divisions 6, 7, and 8 which include the northern portion of the Island from Deer Lake to Trinity Bay. The water resources pattern is complex, being dominated by the Price Newfoundland Pulp and Paper Mill at Grand Falls, and includes significant withdrawal demand for mining and residential use, and extensive non-withdrawal uses including fishery needs.

In the future, the pattern of water use will be further complicated by the increasing demands of the service industries and the developing tourist and recreational activities.

5.6.1 Withdrawal Demand

The total withdrawal demand of this region is estimated to be in the order of 110 million gpd.

Total municipal demand excluding the water using industries discussed separately is estimated to be 9 million gpd. This figure includes service industry requirements and some small industrial enterprises which are supplied by the municipal systems.

Of the total regional population of 131,000, approximately 55,000 live in municipalities with water supply and distribution systems, and the remaining 76,000 obtain their water from private sources. Thus, there is a potential municipal demand in the order of 15 million gpd.

By 1981 the population of the region is estimated to be 153,000, an increase over the 1966 population of 22,000. Since most of these persons will reside in urban areas, the estimated additional municipal water demand by 1981 is 3.0 million gpd.

The largest industrial water user in the region is the Price Newfoundland pulp and paper mill which represents over 80 percent of the region's withdrawal demand. Since the supply source for this user is the Exploits River, at a point where the natural and controlled storages are large, the continuous supply for water use by the paper mill is not a problem. Although some expansion in production capacity is expected, it is unlikely that any significant increase in water usage will occur.

Although their needs are much smaller, the other users must rely heavily on storage to obtain the required supply because they use much smaller basins. Table 4-1 shows the water usage and capacity data available from the industrial establishments in this region. The water usage of fish processing plants is shown on Table 10-7 of Volume Three.

The withdrawal demand of the mines is estimated to be 5 million gpd. Because of their operating requirements there is a general excess water capacity in the industry in terms of their average daily demand. While the location of the mining activity may shift geographically during the study period, no major change of withdrawal demand is anticipated.

Future industrial water demand in the central region to be met from non-municipal sources during the study period is estimated at 1.0 million gpd for fish processing.

Agricultural water demand is primarily related to that required for watering livestock, although irrigation is also practiced (one farm). On the basis of data on livestock population and irrigated area, the estimated agricultural water demand during the irrigation period amounts to about 0.2 million gpd.

Thus, the total additional withdrawal demand for water in the Central region by 1981 is estimated to be a maximum of 15 million gpd.

5.6.2 Non-withdrawal Uses

Non-withdrawal water uses in this region are of great significance and include log driving, fisheries, and hydro-electric power generation. The Exploits River and its tributaries are currently used for driving logs to the mill at Grand Falls; the Gander and Terra Nova rivers were used extensively for log driving, but this activity has ceased. The Exploits, Gander, and Terra Nova rivers are also major salmon rivers and, with the many smaller rivers, support a large fishery, the Atlantic salmon being of particular importance to the area. Hydro power generation was one key to the economic development of the region. The largest plants, on the Exploits, are used as base plants and contribute to flow regulation. The smaller stations are used according to local variable needs and may occasionally produce larger flow variations than would occur under natural conditions. The stations in the region are listed in Volume Four, Table 8-1. Active use is made of the water resource for recreation and tourism which also supports a significant wildlife population.

Various important non-withdrawal uses arising from the fisheries, logging and hydro power activities have led to a number of serious conflicts of interest especially in the Exploits River. Because of the diversion of the headwaters of the Exploits River (Victoria and possibly Lloyds rivers) to the Bay D'Espoir development, these conflicts will be intensified during the forecast period.

An increased use of the Exploits, Gander, and Terra Nova rivers and other smaller rivers for the rearing of Atlantic salmon is the major additional non-withdrawal use anticipated during the study period.

Changes in the pattern of hydro power production and in the intensity and geographic location of logging operations may also be expected. For example, a significant hydro-electric potential exists in the Terra Nova River basin and its development may come under consideration within the study period.

Increased use of water resources for recreation and tourism can also be expected.

5.6.3 "Negative" Demand

Negative water demand problems in the central region are primarily related to soil erosion in the Bonavista North Peninsula and the Miguel Hill area which has followed severe forest fires. Some reclamation of bogland has been carried out but only of small plots. Dewatering is a problem at practically all of the mines.

Instances of flooding appear infrequent, except for the Exploits River where damage has been reported at the Price mill by flooding due to ice jams below the powerhouse. There are also negative demand problems related to the creation of new storage reservoirs for the diversion of the Victoria River to the Bay D'Espoir development.

During the study period three types of negative demand may result from activities in the primary industries and development of the hydro-electric potential. The development of the Terra Nova River power potential will probably involve the flooding of some forested areas. There may be additional bogland reclamation projects in the region and the possible development of new mine sites will incur the type of dewatering problems already encountered.

5.6.4 Wastewater Disposal

Use of the fresh water resource for the disposal of untreated or partially treated wastewater is of considerable significance since approximately 35,000 persons in the region reside in inland municipalities. Although treatment by impoundment of the mine wastewater and treatment of municipal sewage from Gander, Glenwood, and Badger are practised, the situation on the whole is not satisfactory. The waters from the Grand Falls pulp and paper mill are discharged untreated into the Exploits River and the wastewater of all the inland communities except for those mentioned above are discharged untreated into the various rivers of the area. The efficiency of the treatment of mine wastewaters by impoundment may not be adequate from the viewpoint of the downstream users since Fisheries Department indicate considerable concentrations of copper which might be detrimental to fish. Dissolved oxygen levels also have become dangerously low due to organic pollution from municipal wastes.

Table 4-1 gives a list of the industries having their own waste disposal facilities. The copper mines which are near the sea coast and discharge treated wastewater into minor streams a short distance upstream present fewer problems from the viewpoint of fresh water. However, on the whole, fresh water degradation is serious in this area and improvement is required. Mine wastewater discharges to the sea may also cause problems for the inshore fisheries.

The growth in population projected over the study period will increase the potential pollution of the region's fresh waters. The need to treat municipal wastewater will increase and only treatment will maintain the quality of the water in the region's development basins.

Increased production by the pulp and paper mill at Grand Falls is expected to create severe quality conditions in the Exploits River unless treatment of the industrial wastewater is provided. Should copper mining operations expand, quality reduction of the fresh water resource may be excessive and reach toxic proportions if wastewater treatment is not included. The problem may be further complicated by diversion of flow from the Exploits River (now under construction) and the development of new mine sites. Under these conditions it is clear that pollution control must soon be instituted if serious economic loss is to be avoided.

5.6.5 Selection of Areas and Basins for More Detailed Studies

The examination of the conditions in the Central region leads to the obvious conclusion that more detailed studies are required in the Exploits River basin where there are numerous uses and conflicts of interest. Within this basin the Badger-Botwood area was given more attention because it is here that most of the population is concentrated.

Although the Gander River basin does not have the magnitude and the number of problems of the Exploits River, it was considered appropriate to include this basin for detailed study. It is the third largest on the Island, and has a fairly large population and a very active service industry.

The Terra Nova River received special study because of its significant hydro-electric potential and because of conflicts of interest between forestry, fisheries, and recreation and tourism (Volume Six, Part IV).

The western tip of the Bonavista Peninsula was selected for special study as an example of an area with little apparent economic potential which might benefit from a study of water resources. In addition to the general water resources analysis of the area, an investigation of the storage possibilities was carried out. This was prompted by the geographic and hydrologic conditions which do not favour the development of any river of significant size. Water requirement in excess of 1 million gpd would necessitate the development of artificial storage.

Supplementary storage may also be required in the Exploits River basin because of the changes resulting from the diversion of the Victoria River (and possibly the Lloyds River). The results of a preliminary investigation on this subject are included in Volume Six.

5.7 Labrador Region

This region includes all of Labrador and corresponds to DBS census division number 10. The water withdrawal pattern is dominated by the iron mining requirements and the non-withdrawal use by the huge hydro-electric development now under construction.

The pattern of water use will undergo major changes during the study period as a result of the hydro-electric development of the Churchill River and possibly other rivers, the beginning of intensive forest exploitation, and possibly the development of water related recreation and tourism. Further expansion of the mining industries and related water demand may also be expected.

5.7.1 Withdrawal Demand

The total potential municipal water demand in Labrador is estimated to be about 3 million gpd. All municipalities with a population larger than 1000 (totalling about 14,000 from a total population of about 21,000) have water supply and central distribution systems, and the present municipal demand is probably of the order of 2 million gpd.

Industrial withdrawal demand is satisfied from privately-owned sources and is dominated by the mining and beneficiation activities of the iron mining industry. The mining demand is estimated at 38 million gpd, and is drawn from systems with combined capacity of about 100 million gpd.

Labrador's total withdrawal demand is estimated to be 40 million gpd, a figure significantly below the estimated capacity.

Expected expansion of the Iron Ore Company of Canada Limited includes an estimated demand for an additional 26 million gpd, and it is expected that Wabush Mines Limited will increase their water demand by 10 million gpd during the study period. However, the existing capacity of both mines could possibly satisfy this increased demand. The opening of new mines in the region is a possibility and would require new systems. The installation of a chip mill at Happy Vally will create a substantial demand for water; the size is unknown but is estimated to be 20 to 40 million gpd, which allows for the installation of hydraulic wood handling facilities.

A substantial increase in population in the region is expected during the study period and by 1981 the population may reach 63,000. Most of these persons will reside in urban areas and will create an additional municipal demand by 1981 of about 6 million gpd.

The total additional withdrawal demand in the Labrador region by 1981 is therefore estimated to be 60 to 75 million gpd.

5.7.2 Non-withdrawal Demand

Non-withdrawal water demand is primarily for the generation of hydro-electric power although all rivers in the region, particularly the Eagle and Forteau Rivers, support excellent populations of salmon and other fish. These together with the wildlife and scenery conditions create good development possibilities for recreation and tourism.

There now are two hydro-electric plants operating in the region (Volume Four, Table 1-8. These are base load plants and have a regulating effect on the flows. Another very large development is under construction on the Churchill River at Churchill Falls, and involves the diversion of the flow of a large neighbouring basin - the Naskaupi. This will also be operated as a base plant.

The harvesting of pulpwood during the study period will create a further non-withdrawal demand on the water resource since it is expected that extensive use will be made of the Churchill River and its major tributaries (downstream of Churchill Falls) for log driving.

The reservoirs and lakes in the area offer possibilities for resident fish development on a commercial basis.

The opening of roads and the provision of transportation for the industrial development will result in increased use of the region for tourism and recreation.

5.7.3 "Negative" Demand

Known negative demand problems are limited to mine dewatering and those related to the Churchill River development which will cause the flooding of a very large area.

5.7.4 Wastewater Disposal

Because wastewater treatment is provided in the municipalities of this area, fresh water degradation caused by municipal use is negligible. The disposal of a significant amount of tailings in the Wabush and Flora Lakes has created a major reduction in water quality of these lakes and possibly of the rivers fed by them which even heavy dilution following moderate treatment cannot effectively correct.

Continued municipal wastewater treatment should ensure that the municipal demand of the resource does not create secondary problems. Industrial wastewaters will greatly reduce the possibility of using sectors of the resource for other purposes, and serious consideration should be given to the wisdom of continuing this policy, especially in relation to the expansion of the mining activity and the recreation and tourism potential offered by the basin.

5.7.5 Selection of Areas and Basins for More Detailed Studies

The development of Labrador has been concentrated in the Churchill River basin. Because of the existing development and the activity which will take place over the study period, the basin was selected for further study with the Labrador City area, where most of the population and industrial activity is concentrated. The hydrologic conditions are such that it is not difficult to ensure the required withdrawal flows from several rivers in the region by proper development of natural storage, and therefore a special investigation for storage sites was not carried out for this region, nor was it considered necessary to select other basins for special study. However, the study of the whole area with respect to hydro-electric potential appears justified.

5.8 Regional Storage Possibilities

In certain study areas, because of hydrologic conditions, it was found that a significant increase in demand could not be met without the provision of storage, and storage possibilities to meet known or assumed requirements were investigated.

The potential storage sites were located using the 1:50,000 scale 50-foot contour maps. Generally, the maximum drawdown was limited to ten feet since it was expected that the storage sites would be developed by simple structures such as wood-crib or low fill dams. The study was limited to storage sites in basins that appeared to be able to provide a regulated flow of at least 10 million gpd. This demand is generally not difficult to satisfy on the Island with relatively small storage reservoirs, and is sufficient for a reasonably-sized water-using industry.

5.8.1 Conception Bay and St. John's Area

Figure 5-2 shows the drainage basins investigated for storage possibilities in this study area. The study area itself is described in Volume Seven, Part I, and includes the City of St. John's which has recently encountered water quantity problems. The problem has been under detailed study on behalf of the City and the first stage of the recommendations by consulting engineers for the increase of available storage has been implemented. This study has been reviewed and is discussed in Volume Seven, Part I.

The remainder of the study area drains into Conception Bay. Eight storage sites were located in this area of which three are existing hydro developments. The storage possibilities are listed in Table 5-1. As shown, five sites are capable of providing a regulated flow greater than 20 million gpd, and the remaining three provide a regulated flow greater than 10 million gpd. Figure 5-2 indicates the location of these storage sites.

5.8.2 Argentia-Come By Chance Area

Figure 5-3 shows the drainage basins investigated for storage possibilities in the Argentia-Come By Chance study area described in detail in Volume Seven, Part II. This area contains the site of the proposed Come By Chance mill, for which an investigation was carried out by The Shawinigan Engineering Company Limited for the Atlantic Development Board in 1965 for the supply of 50 million US gpd. A supplementary study was recently carried out for the Board by ShawMont Newfoundland Limited to determine the facilities required to produce a flow of 20 million US gpd.

Due to the small drainage basins in this study area, only three storage sites which could supply a regulated flow of 20 million gpd or more have been located. These are outlined in Table 5-2 and shown in Figure 5-3, and include the storage site investigations mentioned above.

5.8.3 Burin Peninsula

Figure 5-4 shows the drainage basins investigated for storage possibilities on the Burin Peninsula, and the results of the investigation are outlined in Table 5-3.

The study area itself is dealt with in detail in Volume Seven, Part III. Of the eight schemes investigated, five provide a regulated flow greater than 20 million gpd and the remaining three provide more than 10 million gpd regulated flow.

As in the other regions discussed, the storage available at existing hydro plants are included since it may be possible to:

a) Utilize the regulated outflows downstream from the plants for industrial use, and/or

b) Utilize part or all of the facilities for use other than hydro power.

In other parts of the Island such conditions have materialized, especially because of the expansion of the provincial power grid. An example of case a) occurs at the Corner Brook hydro plant where the flow is utilized downstream of the hydro plant for the Bowater paper mill at Corner Brook. As an example of case b), the water supply system presently used for the 150 hp Clarenville hydro development may be used exclusively for water supply for Clarenville, and the generating facilities abandoned.

5.8.4 Bonavista Area

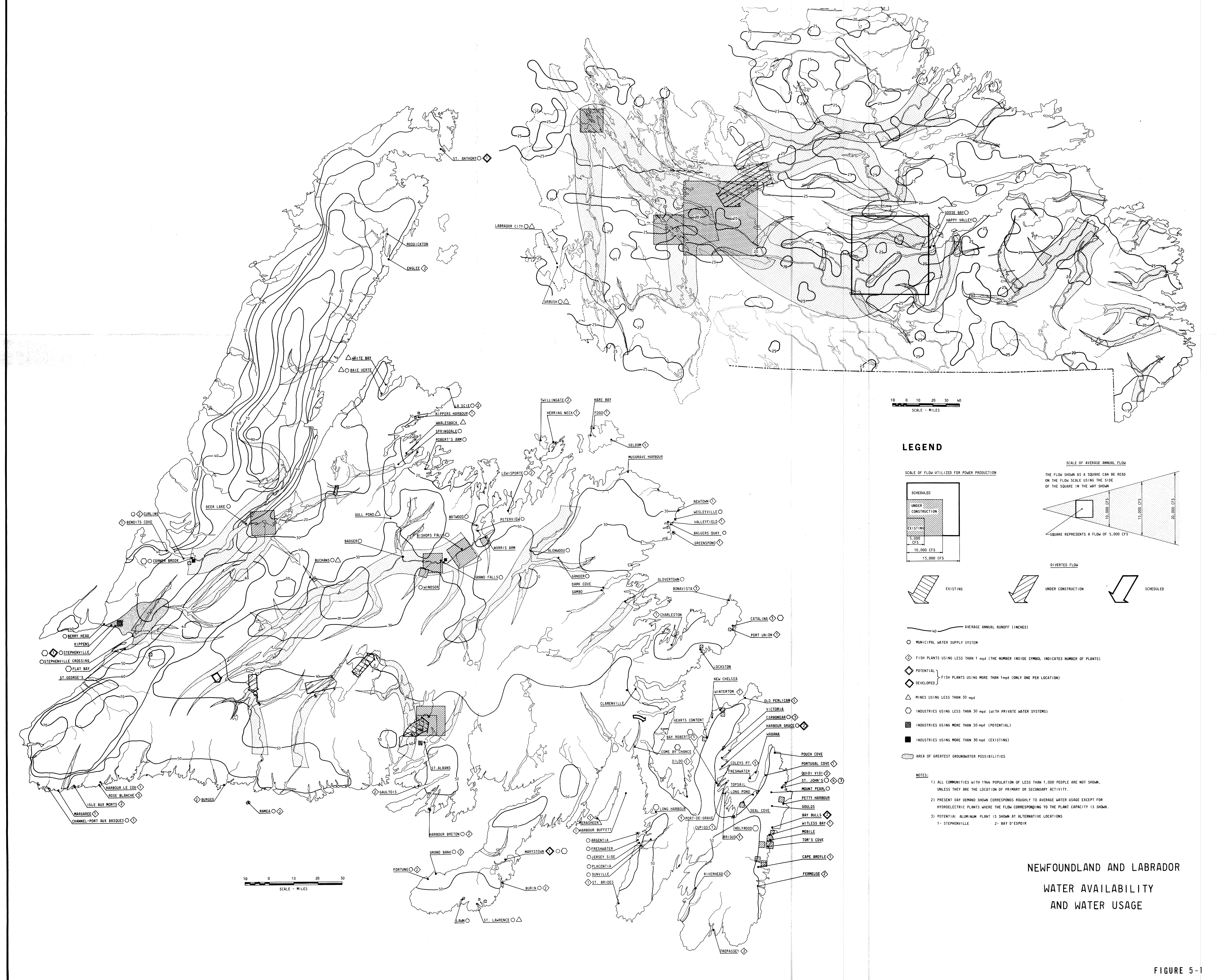
Figure 5-5 shows the area near the town of Bonavista on the east coast of the Island which was investigated for storage possibilities. The storage volumes available at two existing hydro plants in these basins were determined and three additional storage sites were located in the area. Results of the storage investigations are shown in Table 5-4.

5.8.5 Upper Exploits Basin

As mentioned in Section 5.6, storage facilities may be required in this area as a partial solution to the conflict of interests in the basin which will be intensified by the planned diversion of the Victoria River. As a preliminary assessment of the storage potential in the Upper Exploits basin, the following reservoir sites shown on Figure 5-6 were located and order of magnitude storage volumes calculated.

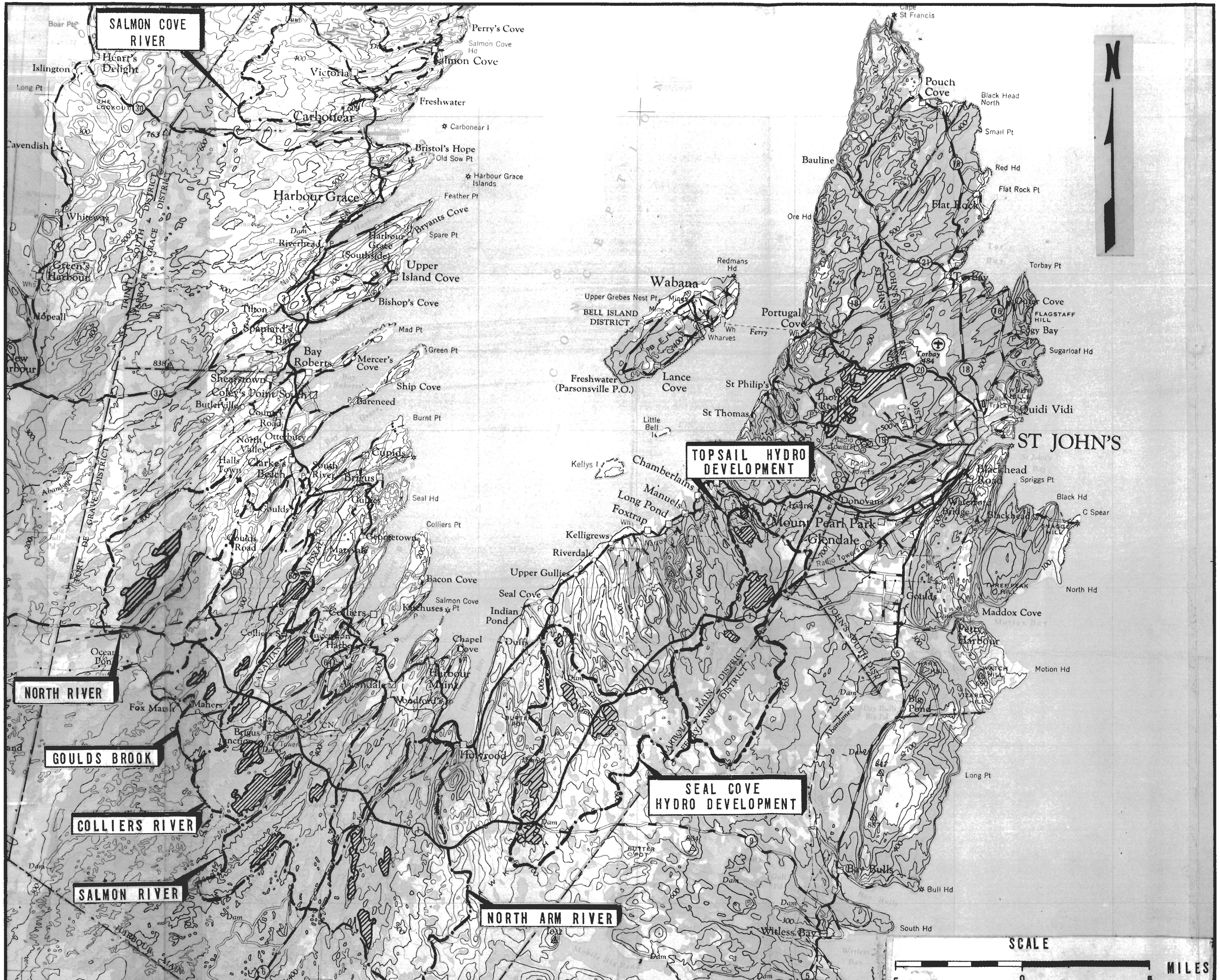
No.	Reservoir Site	Drawdown feet	Storage Volume acre-feet	Comments
1	South Twin Lake	13.5	123,000	Abandoned logging reservoir
2	North Twin Lake	7.5	70,400	Abandoned logging reservoir
3	Mary Ann Lake	8.0	31,100	Abandoned logging reservoir
4	Star Lake	15.0	98,000	Undeveloped reservoir
5	Red Indian Lake	1.0	45,000	Existing reservoir
6	Long Lake	10.0	51,500	Existing logging reservoir
7	Sandy Lake	-	30,800	Existing reservoir

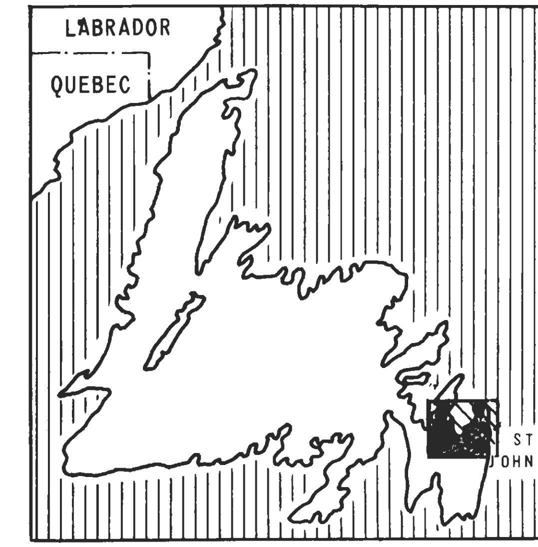
Detailed studies are needed to determine the most effective storage locations in this basin as discussed in Volume Six, Part I.



NEWFOUNDLAND AND LABRADOR
WATER AVAILABILITY
AND WATER USAGE

FIGURE 5-1





NEWFOUNDLAND - KEY PLAN

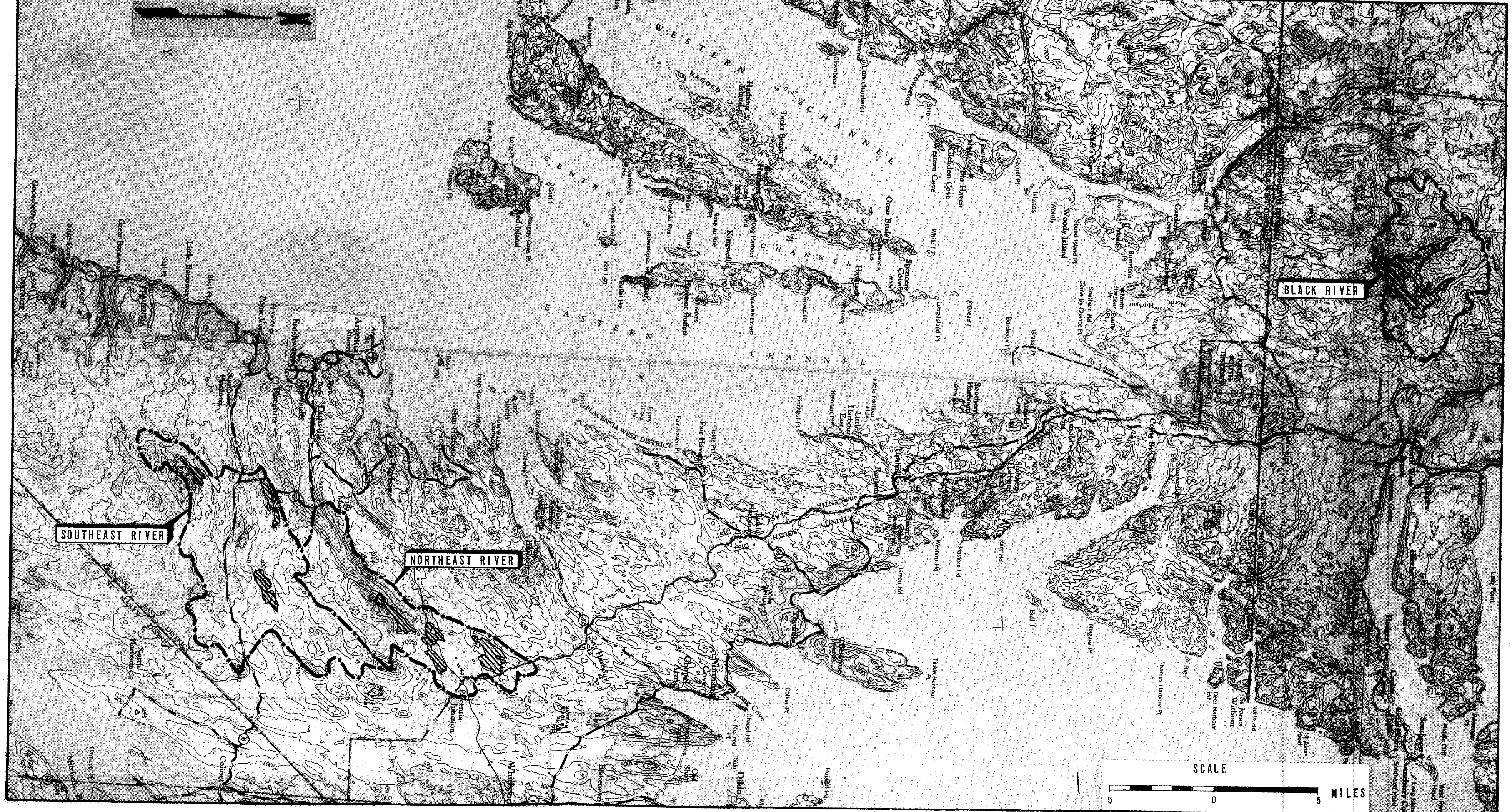
LEGEND

DRAINAGE BASIN OUTLINE

STORAGE SITE

CONCEPTION BAY-ST. JOHN'S AREA
STORAGE POSSIBILITIES

FIGURE 5-2



NEWFOUNDLAND - KEY PLAN

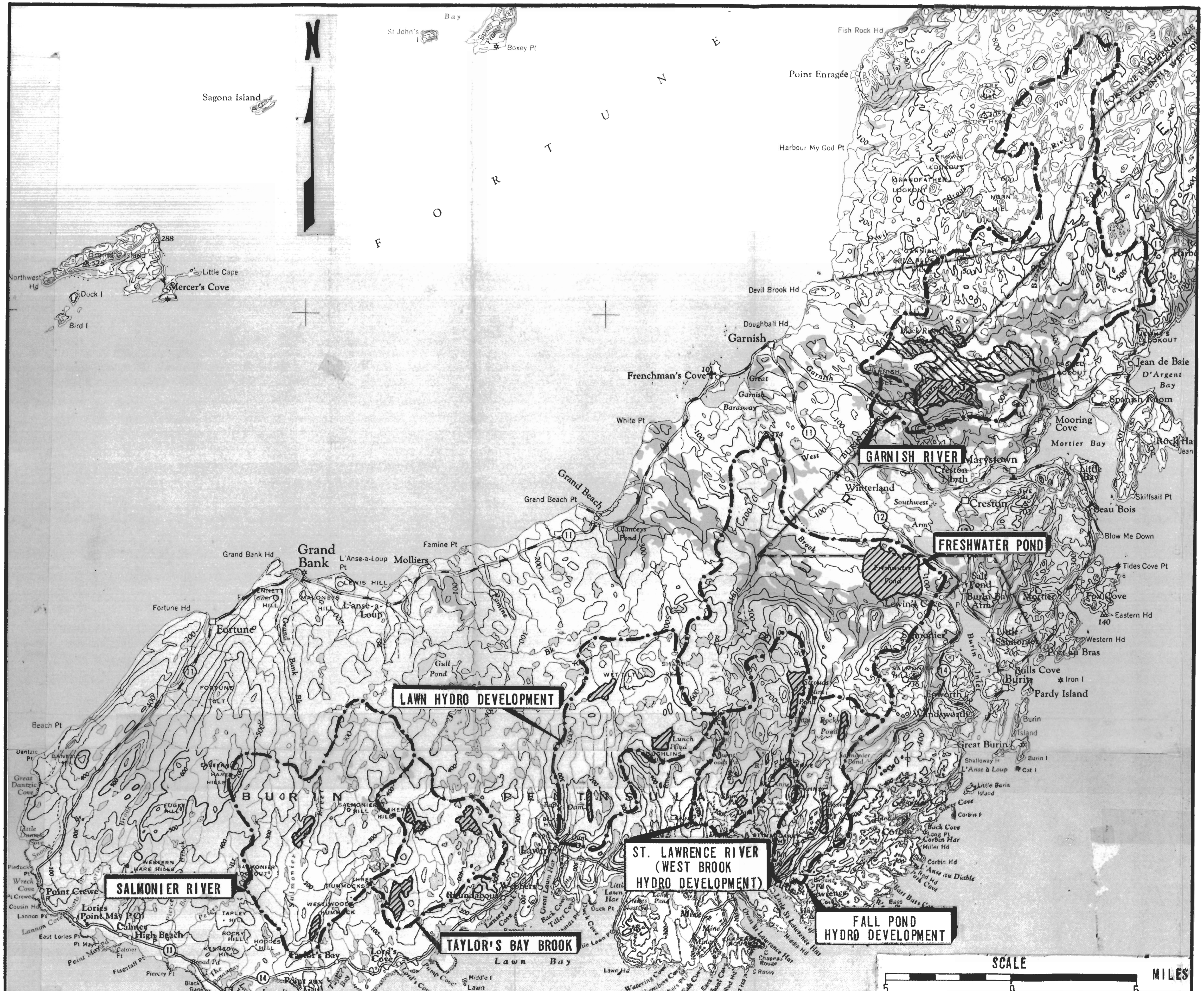
LEGEND

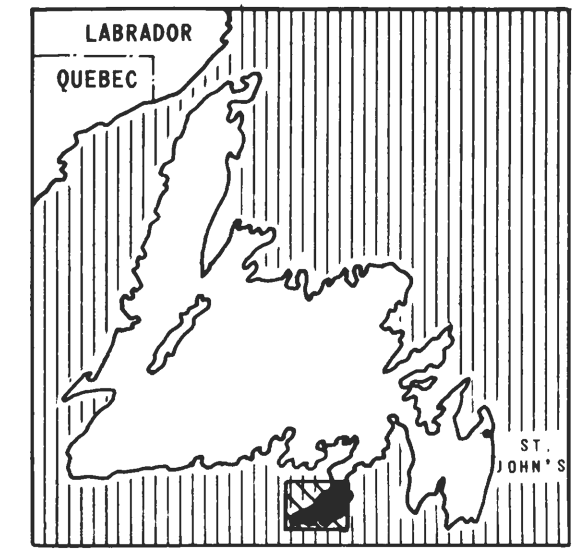
DRAINAGE BASIN OUTLINE

STORAGE SITE

ARGENTIA-COME BY CHANCE AREA
STORAGE POSSIBILITIES

FIGURE 5-3





NEWFOUNDLAND - KEY PLAN

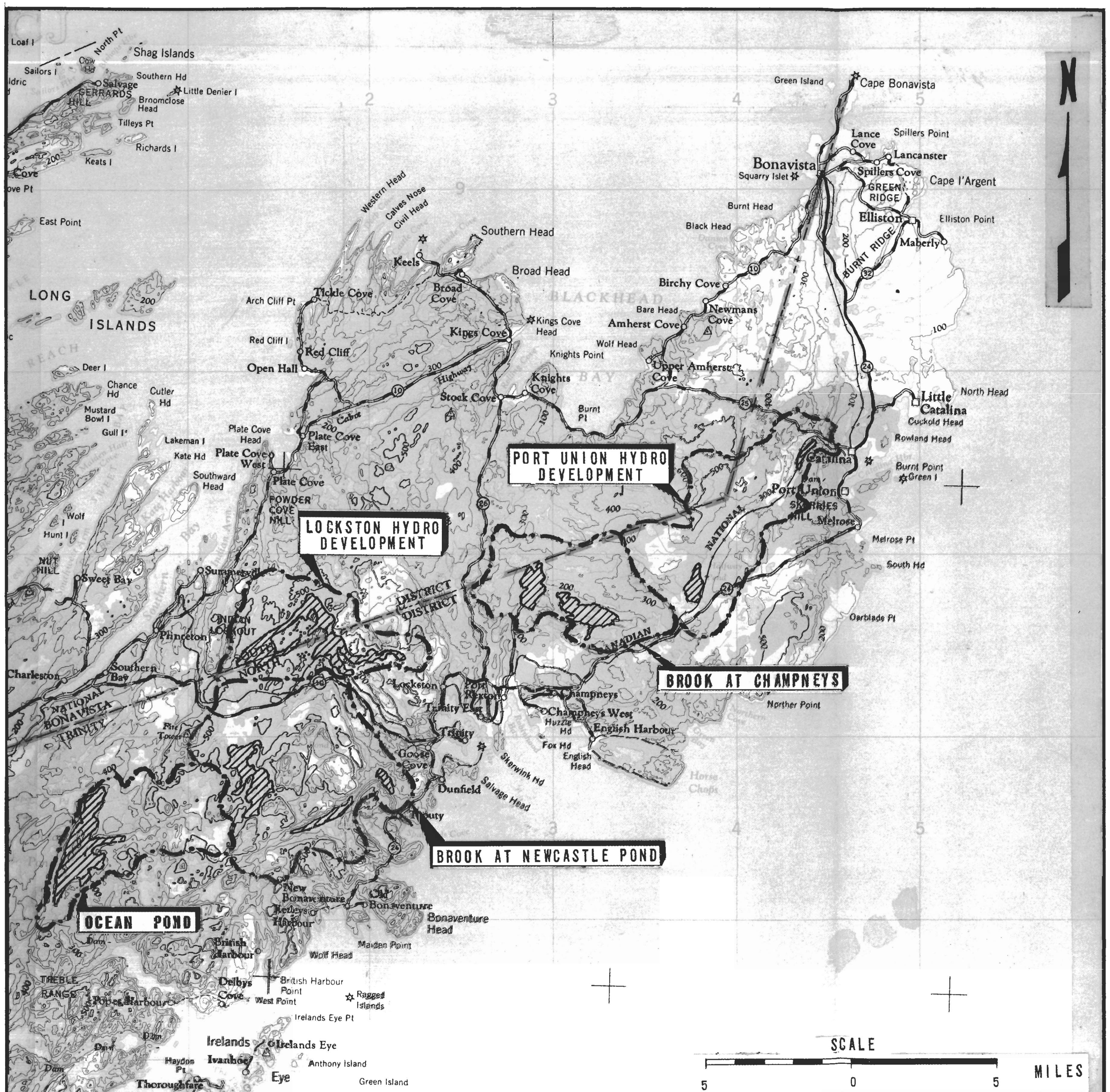
LEGEND

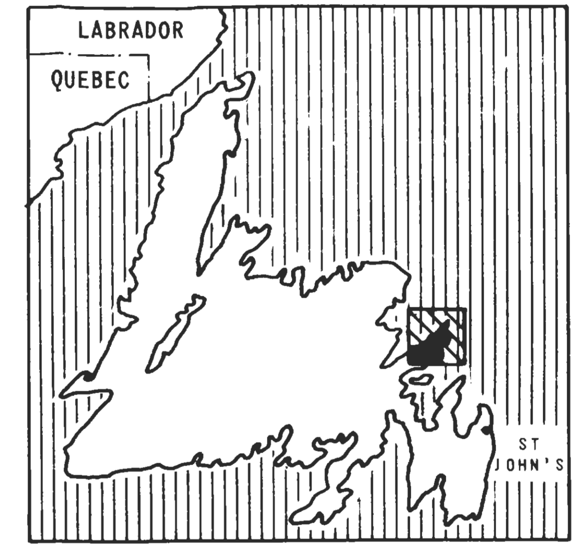
DRAINAGE BASIN OUTLINE

STORAGE SITE

BURIN PENINSULA
STORAGE POSSIBILITIES

FIGURE 5-4





NEWFOUNDLAND - KEY PLAN

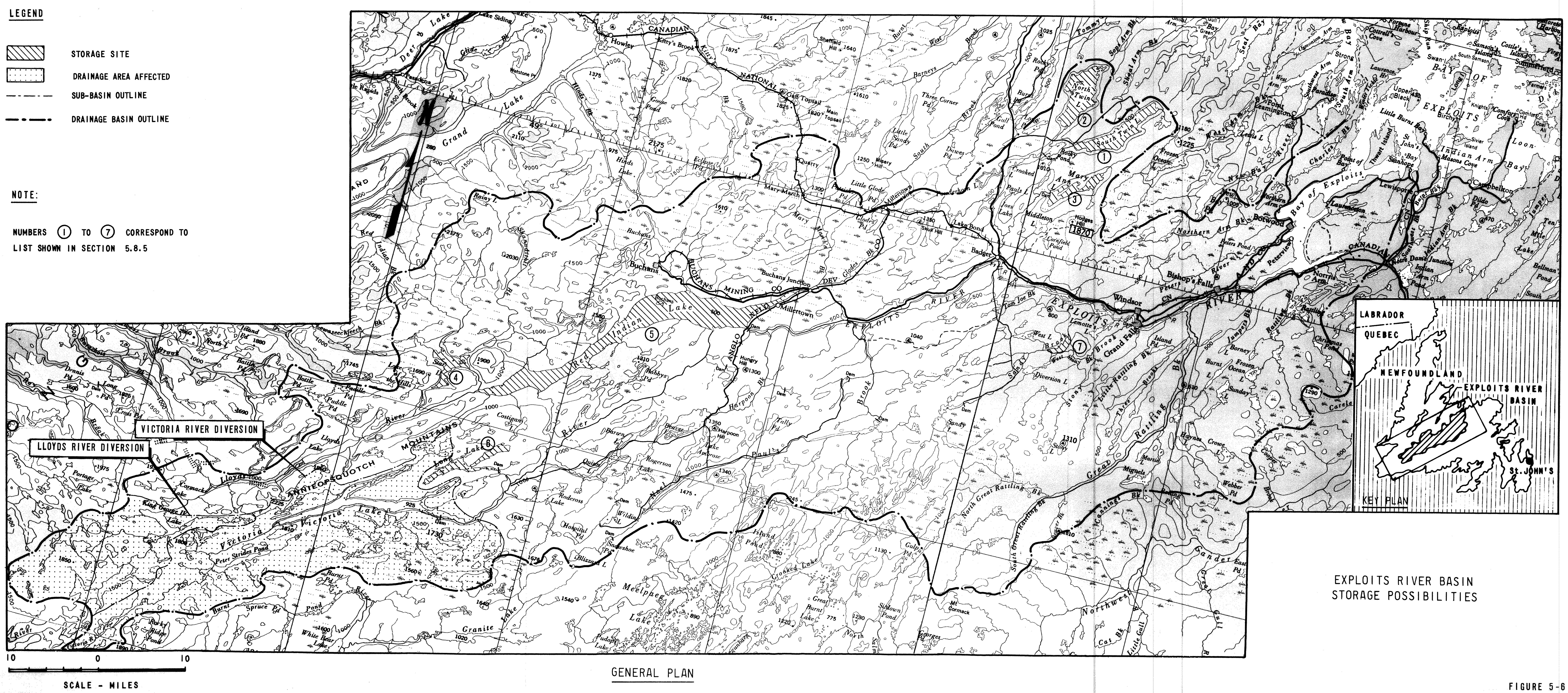
LEGEND

DRAINAGE BASIN OUTLINE

STORAGE SITE

BONAVISTA AREA
STORAGE POSSIBILITIES

FIGURE 5-5



EXPLOITS RIVER BASIN
STORAGE POSSIBILITIES

GENERAL PLAN

FIGURE 5-6

LOCATION OF DOWNSTREAM STRUCTURES		ABOVE TIDEWATER	ABOVE TIDEWATER	ABOVE TIDEWATER	ABOVE TIDEWATER	ABOVE TIDEWATER	ABOVE TIDEWATER	TOPSAIL HYDRO DEVELOPMENT	SEAL COVE HYDRO DEVELOPMENT
DRAINAGE AREAS DEVELOPED		NORTH RIVER	GOULDS BROOK	COLLIERS RIVER	SALMON RIVER LEONARDS WATERS LOCKYERS WATERS	NORTH ARM RIVER DANIELS BROOK	SALMON COVE RIVER VICTORIA HYDRO DEVELOPMENT (1)	FORE BAY POND UPPER MANUELS RIVER	SEAL COVE RIVER
TOTAL DRAINAGE AREA	SQ. MILES	18.3	24.0	24.0	23.5	33.2	24.0	23.1	30.0
REGULATED FLOW	CFS	43	30	60	24	45	24	38	45
	MGD	23	16	33	13	24	13	21	24
STORAGE REQUIRED	CFS-MONTHS	201	102	289	73	161	74	150	168
STORAGE DRAWDOWN	FEET	10.0	10.0	9.2	10.0	10.0	13 *	Varies	Varies
ELEVATION OF LOWER RESERVOIR	FEET	20	20	20	20	20	20	360	190
STORAGE RESERVOIRS DEVELOPED		SNOWS POND POND NEAR TIDEWATER	GOULDS BIG POND CUPID LONG POND GOLDEN GULLIES POND UNNAMED POND POND NEAR TIDEWATER	MIDDLE GULL POND COLLIERS BIG POND NINE ISLAND POND THIRD JUNCTION POND POND NEAR TIDEWATER	AVONDALE POND NINE ISLAND POND POND NEAR TIDEWATER	SPLIT ROCK POND SOUTH PEAK POND LITTLE TRIANGLE POND OLD SEA POND	ROCK POND * SALMON COVE POND	FOREBAY POND THREE ISLAND POND PADDY POND MANUELS POND	KELLY POND, SOLDIERS POND ROUND POND GULL POND FOREBAY POND BIG OTTER POND FENELONS POND
EXISTING HYDRO CAPACITY	HP.	NIL	NIL	NIL	NIL	NIL	750	1500	4500

* EXISTING STORAGE
(1) INTAKE FACILITIES DOWNSTREAM OF HYDRO DEVELOPMENT

CONCEPTION BAY AND ST. JOHN'S AREA

- STORAGE POSSIBILITIES

TABLE 5-1

ARGENTIA - COME BY CHANCE AREA

STORAGE POSSIBILITIES

LOCATION OF DOWNSTREAM STRUCTURES		ABOVE TIDEWATER	ABOVE TIDEWATER	OUTLET OF BLACK RIVER POND
DRAINAGE AREAS DEVELOPED		SOUTHEAST RIVER	NORTHEAST RIVER	BLACK RIVER
TOTAL DRAINAGE AREA	SQ. MILES	55	20	35
REGULATED FLOW	CFS	55	49	87
	MGD	30	26	47
STORAGE REQUIRED	CFS - MONTHS	171	236	422
STORAGE DRAWDOWN	FEET	10.0	8.0	10.0
ELEV. AT LOWER STORAGE RESERVOIRS	FEET	150	375	580
STORAGE RESERVOIRS DEVELOPED	1 2 3	POND NO. 1 POND NO. 2 POND NO. 3	POND NO. 1 POND NO. 2 POND NO. 3	BLACK RIVER POND

NOTE: -
DEPT. OF MUNICIPAL AFFAIRS PRESENTLY SURVEYING AND DESIGNING A WATER SYSTEM FOR THE TOWN OF PLACENTIA USING THE SOUTHEAST RIVER AS A SOURCE OF SUPPLY

TABLE 5-2

LOCATION OF DOWNSTREAM STRUCTURES		OUTLET OF GARNISH POND	OUTLET OF FRESHWATER POND	DOWNSTREAM OF GARNISH POND	ABOVE TIDEWATER	3 MILES UPSTREAM OF TIDEWATER	LAWN HYDRO DEVELOPMENT	FALL POND HYDRO DEVELOPMENT	WEST BROOK HYDRO DEVELOPMENT
DRAINAGE AREAS DEVELOPED		GARNISH RIVER	MAIN BROOK SHEARSTICK BROOK FRESHWATER POND OUTLET	GARNISH RIVER	SALMONIER RIVER	TAYLORS BAY BROOK	UNNAMED BROOK	WATER FALL BROOK	ST. LAWRENCE RIVER
TOTAL DRAINAGE AREA	SQ. MILES	76.6	57.8	78.6	44.7	20.7	30.3	13.1	17.8
REGULATED FLOW	CFS	65	110	196	34	41	40	23	20
	MGD	35	59	106	18	22	22	12	11
STORAGE REQUIRED	CFS-MONTHS	153	387	787	75	154	115	74	56
STORAGE DRAWDOWN	FEET	9.8	9.9	8.7	10.0	10.0	10.0	10.0	10.0
ELEVATION OF LOWER RESERVOIR	FEET	80	30	90	20	160	80	50	160
STORAGE RESERVOIRS DEVELOPED		GARNISH POND	FRESHWATER POND	GARNISH POND	NORTH BRANCH POND EAST BRANCH POND DAM AT TIDEWATER	POND NO. 1 POND NO. 2 POND NO. 3	STORAGE POND * SAW POND * LAWN FOREBAY * LUNCH POND WET TILT HILL POND	FALL POND * LUNDIGRANS POND * BEAVER POND ROCK POND	STRANDS HILL * CLAM POND * WEST FOREBAY *
EXISTING HYDRO CAPACITY	HP	NIL	NIL	NIL	NIL	NIL	500	500	1,000

* EXISTING STORAGE

BURIN PENINSULA

STORAGE POSSIBILITIES

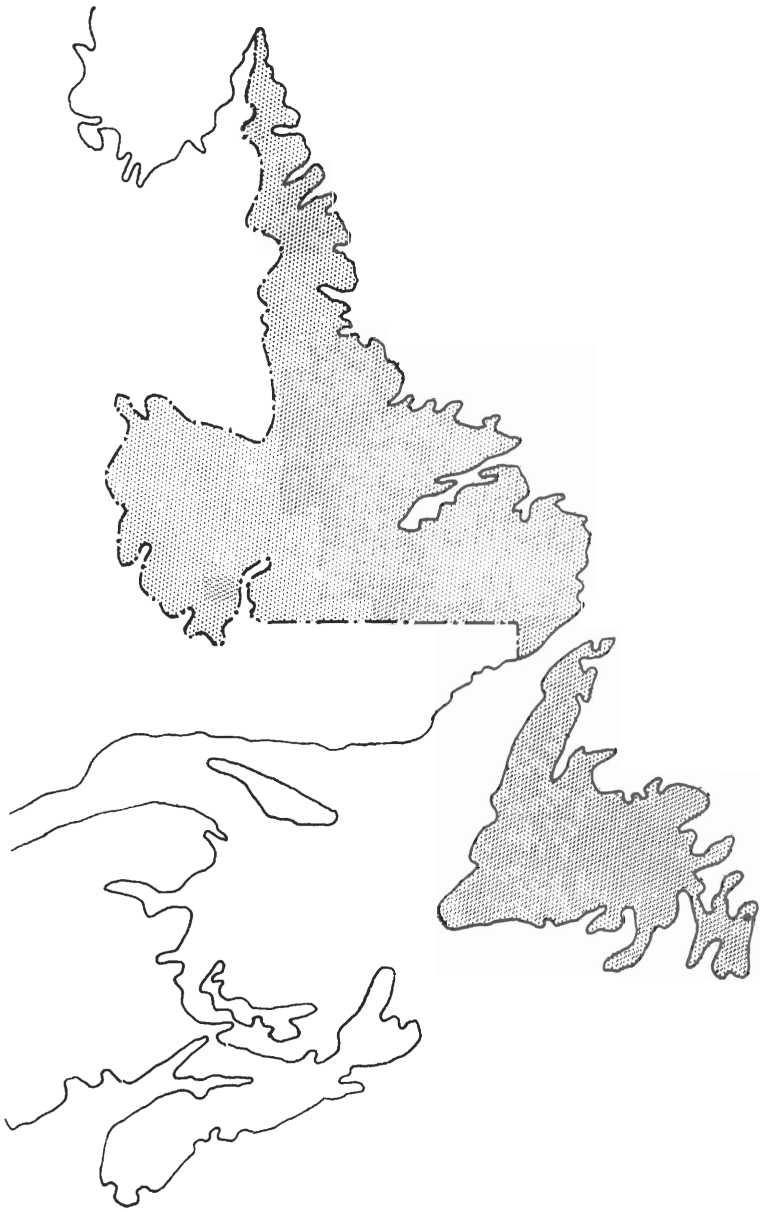
TABLE 5-3

BONAVISTA AREA
STORAGE POSSIBILITIES

LOCATION OF DOWNSTREAM STRUCTURES		OUTLET OF OCEAN POND	OUTLET OF POND UPSTREAM OF CHAMPNEYS VILLAGE	OUTLET OF NEWCASTLE POND	LOCKSTON HYDRO DEVELOPMENT	PORT UNION HYDRO DEVELOPMENT
DRAINAGE AREAS DEVELOPED		OCEAN POND	UNNAMED BROOK	UNNAMED BROOK	TRINITY POND	UNNAMED BROOK
TOTAL DRAINAGE AREA	SQ. MILES	18.6	19.7	33.7	15.5	28.9
REGULATED FLOW	CFS	46	44	58	48	33
	MGD	25	24	31	26	18
STORAGE REQUIRED	CFS-MONTHS	224	207	239	255	111
STORAGE DRAWDOWN	FEET	8.3	10.2	10.1	16.3	10.3 (Av.)
ELEVATION OF LOWER RESERVOIR						
	FEET	275	140	100	338	70
STORAGE RESERVOIRS DEVELOPED		OCEAN POND	POND #1 POND #2	NEWCASTLE POND TROUTY POND SADDLE BACK POND BLUE GULL POND	TRINITY POND*	HALFWAY POND* LONG POND * WELLS POND * ISLAND POND * WHIRL POND *
EXISTING HYDRO CAPACITY	HP	NIL	NIL	NIL	2,000	900

* EXISTING STORAGE RESERVOIRS

TABLE 5-4



VOLUME FIVE - PART III — SECTIONS 7 & 8

ECONOMIC CONSIDERATIONS

6 TECHNICAL CONSIDERATIONS - FUTURE DEVELOPMENT

In Section 5, it was indicated that future development in water resources will include various types of projects, from simple wells to complex hydro-electric or industrial waste treatment plants.

While it is very difficult to comment at a general level on projects such as hydro-electric plants which have unique characteristics, some broad consideration of the development of municipal and industrial water and wastewater systems appears warranted at this point.

Numerous studies have been carried out for water supply and sewer systems in the Province, and they are listed in Table 6-1 with some of their technical and economic characteristics. A comparative appraisal of these projects was not possible because of the variations in assumptions, in economic criteria, and in the accuracy of the basic information. It was considered more appropriate to give general technical comments on projects of this type in the Province or policies that should be employed in regard to them.

6.1 Municipal Water Supply

Previous sections have indicated that many municipalities in Newfoundland do not have a municipal water supply and distribution system; the residents thereof generally rely upon individually-owned wells for water. For most of Newfoundland's smaller communities (less than 500), this situation is not likely to change during the study period because, for reasons of geography, topography, and/or layout, central water supplies and distribution systems will be prohibitive in cost.

For these communities with populations of less than 500, the use of individually-owned wells capable of meeting the demand should be acceptable provided that the construction of the wells meets minimum standards to ensure that they cannot become contaminated from surface drainage and provided that these wells are properly located away from potential sources of pollution. Instruction should be given under Provincial initiative to correct existing deficiencies in well construction techniques and all new construction should be adequately regulated by the appropriate Provincial authority.

In the long term, a desirable minimum objective should be the provision of a municipal water supply and central distribution system for all communities with a population of 500 or more, and current subsidies offered to municipalities by the Provincial Government in creating these systems have established the necessary incentive to make this goal realistic.

For municipalities with a population of between 500 and 2000 the possibilities of meeting potable water requirements of a municipal supply from groundwater should always be thoroughly investigated. It is reasonable to assume that many municipalities of this size might be able to meet their requirements from groundwater at considerably less cost than that required for development of a surface supply.

For those municipalities with a population of more than 2000 as well as smaller municipalities unable to meet water requirements from groundwater sources, surface water is the generally most feasible alternative. Desalination of sea water in Newfoundland is not a practical solution for obtaining potable water during the study period because of its relatively high cost.

The advantage of developing regional water supplies at a low unit cost to supply water to a group of small municipalities should not be overlooked. Similarly, pressure to move citizens from small villages to larger municipalities will make it possible to serve more of the populace at lesser unit cost and to thereby improve protection of the public health.

It should be noted in relation to controlling municipal demand that total metering of a municipal supply is a sound policy and a reasonable ultimate objective for any utility. Metering provides for a more equitable basis of charging for the service and generally decreases the annual average usage of water. On the other hand, metering is costly to install ($40 per residential consumer), and peak hourly or maximum demands which control the system capacity are not generally reduced. The low pH and consequently the corrosion problem in Newfoundland's waters will also increase meter maintenance and, in view of the relatively low pressure for alternate use of most water supply sources at this time, the objective of full metering should be given a low priority for the study period.

6.1.1 Municipal Water Supply Protection

At the present time most municipal surface supplies are developed on the basis of an impounded supply receiving only chlorination since the water quality is otherwise normally acceptable. The advantage and economy inherent in such a situation should not be lost by future quality degradation of the resource.

Newfoundland and Labrador have ample supplies of clean surface water in the form of lakes and rivers which could be used for recreational activities without imposing on those reserved for water supply purposes. This being the case, prohibition of the use of water supply reservoirs and their drainage basins for any form of activity which might endanger maintenance of the requisite high standard of water quality should be enforced as long as practicable for the protection of the public health.

Eventually in areas of relatively dense development, such as St. John's, pressures may develop on the water supply authority to permit use of such water supply reservoirs, particularly relatively large lakes, for other purposes including recreation and the cutting of trees. It would seem that in Newfoundland and Labrador, a suitable watershed management policy should be developed now in order to make provision for regulated use-sharing in these limited instances.

6.1.2 Protection of Sources of Potable Water Supply

The following are indications of basic measures to be considered in a water resources management plan for the protection of potable water sources of supply.

a) Control of forestation in the area consisting of planting where necessary for erosion control; controlled cutting of mature trees where these have become a useful product; provision of fire lanes throughout the forested area (since such fires can result in a gross deterioration of water quality); and, where cutting of trees is permitted, a careful control of the location of logging roads, in order to prevent erosion which could be a source of sediment in reservoirs.

b) Permission of restricted recreational activities in the watershed and the reservoir, including fishing, (with artificial lures and flies only) with designated areas being provided for fish cleaning; hunting, where such activity conforms with existing game laws and where cleaning of the animals is again restricted to designated areas; boating (restricted to row boats and boats with electrically powered motors); rambling, birdwatching, and picnicking in restricted areas where adequate sanitary facilities have been provided, that is, garbage receptacles and toilets.

Because of the public health aspects involved in the maintenance of adequate water quality standards, the permission to carry out the above activities must be strictly enforced by an adequate policing of the reservoir and its watershed. In order to assist in this regard, the use of the area should be confined to those with special permits. The cost of such permits would be applied against the cost of policing and the provision and maintenance of the facilities required.

None of the above-noted recreational activities should be permitted in the intake area which may be defined as the area having its center on the intake, and with a radius sufficient to provide a storage period of thirty days. No permanent residences or cottages should be permitted in the immediate area of the reservoir itself and any residences in the upstream areas of the watershed should be provided with adequate septic tank systems with tile beds discharging in safe areas. Cottages or residences existing in the area of the lake at the time of its take-over as a water supply reservoir should be purchased outright or relocated. Bathing, boating, ice boating, and skating in and on the reservoir should be strictly prohibited. Because of the difficulties involved in the control of the activities of large groups of people, no camping should be permitted in the watershed.

In view of the acceptability of chlorination as adequate treatment for most of the waters of Newfoundland as indicated elsewhere in this section, it is essential that a water quality surveillance program be maintained by public health authorities wherever recreational or other activities are permitted in reservoirs and/or their watersheds.

It should be noted that a lack of control of the use of reservoirs and their watersheds could necessitate very substantial increases in cost since the cost of any treatment beyond chlorination is relatively high. Indeed in the more complex situations, the cost of treatment should be an ultimate consideration in any benefit-cost analysis considering multi-purpose use.

6.1.3 Municipal Water Treatment

With the exception of some lime addition for pH control in a few municipalities, water treatment on the Island is currently limited to chlorination for disinfection.

Barring unforeseen developments and given water with characteristics typical of the Province, there is no reason to suppose that continuation of this practice will not be effective or adequate for the study period. With the populations of many major urban centres in North America still being served with chlorinated raw water, it is unlikely that the requirement for further treatment will become necessary in Newfoundland in the foreseeable future.

The installation of facilities for the removal of colour from drinking water seems to be an unwarranted expense at this period of the Province's development. From a potable water consideration, colour per se is not harmful and its removal is usually recommended more on the basis of aesthetics than of public health. Where people have become accustomed to drinking the coloured waters of Newfoundland, it would not seem unreasonable to accept these conditions until public demand requires a supply with less colour.

Accordingly, as a general policy for treatment of potable water, the continued use of chlorination is recommended with the addition of filtration only where turbidity or coliform counts exceed established limits (USPHS or other standard).

Where chlorination equipment has been installed on existing water supply systems in the past, a problem of equipment maintenance has developed. It is only in very recent months that a manufacturer's representative has been resident on the Island to facilitate servicing of any malfunctioning chlorination equipment. In the past, this difficulty has been compounded by the absence of responsible and trained personnel in the municipalities to check the operation of the equipment, which has been done only when representatives of the Department of Health have taken samples of the water for bacteriological examination. Under this arrangement, there could be a considerable time lag between the breakdown of the chlorination equipment and its repair. In view of this, it is recommended that all chlorination installations be made in duplicate and regularly inspected and maintained by properly-trained personnel.

6.2 Municipal Wastewater Treatment

At the present time, treatment of municipal sewerage is limited to the municipalities of Deer Lake, Badger, Gander, and Glenwood on the Island, and Wabush and Labrador City in Labrador. Industrial wastewaters in the Province are invariably discharged to the nearest receiving body without treatment, the single exception being the ore concentrating industries which treat their wastewaters by impoundment.

Ultimately all municipal, industrial, and private wastewaters will require varying degrees of treatment prior to disposal whether such disposal is to fresh water bodies or to the sea. The degree of treatment required will depend upon the uses to be made of the receiving body and its ability to absorb the wastewaters discharged into it, and must therefore meet the requirements determined by the appropriate provincial authority.

For the smaller municipalities of Newfoundland and Labrador, waste treatment must be considered as a long term objective. A safe and potable water supply must come first for the sake of the public health and practicable benefit/cost relationships should be utilized to establish the appropriate date on which municipal wastewater collection and treatment will be required.

In assessing possible treatment of municipal and domestic wastewaters during the study period, two main factors must be considered:

a) The most appropriate system, i.e., individual collection and treatment by means of septic tanks or cesspools, or a municipal collection system with centralized treatment and/or disposal.

b) The degree of degradation caused by the waste discharge on the receiving waters and the extent of conflict with other uses.

The comments on the problem of wastewater disposal which follow are related to the above factors.

6.2.1 Small Communities

For many of Newfoundland's smaller communities, anything more elaborate than individual septic tanks, in the near future at least, will be prohibitive in cost. There can be no valid objections to the use of septic tanks provided that:

a) Required standards of design and maintenance of the septic tank and tile disposal bed are applied.

b) The use of such a system for wastewater disposal is considered in the size of building lots permitted in the area.

c) The permeability of the soil is such that disposal of wastewaters by means of a tile disposal bed is feasible.

d) There is adequate control over the location of the septic tank systems relative to shallow water supply wells or surface water used for purposes incompatible with bacteriologic pollution and/or eutrophication.

Disregard of the above considerations has resulted in instances throughout the Province of improperly constructed septic tank systems operating in an ineffective manner, causing needless pollution of nearby wells.

Further growth of these small communities forced to rely upon septic tanks and individual wells should not be encouraged until such time as it is feasible to provide them with suitable water supplies and adequate systems of sewers for disposal of wastewaters; indeed, individual septic tanks and wells in these small communities should be considered only as interim solutions to a problem whose ultimate solution must be community services which includes sewage treatment facilities.

6.2.2 Coastal Municipalities with Sewage Collection Systems

For the majority of the Island's municipalities which are located on the coast, disposal to the sea of domestic wastewaters without treatment has been the established practice to date.

Although treatment of these wastewaters should be the ultimate objective, there would seem to be little objection to the continuation of such practice for at least the short term if other related conditions are carefully considered.

Many of the problems encountered in the disposal of wastewaters to the sea have resulted because outfalls were not designed with due regard to local conditions or measures necessary to obtain a proper dispersal and dilution of the wastes.

It is recommended that where such outfalls are to be installed or relocated in the future, they be so positioned that tides and ocean currents will remove wastes from populated and/or shore areas, and that the outfalls be provided with properly designed diffusers located at sufficient depth to ensure adequate dilution and dispersal of the wastewaters. The institution of such a policy would avoid problems which have occurred in the past at a number of fish processing plants which have had to relocate sea water intakes due to pollution, or even develop fresh water sources of supply in order to obtain process water of suitable quality.

In relation to ultimate objectives, all systems should be designed so that future treatment can be reasonably incorporated.

6.2.3 Inland Municipalities with Sewage Collection Systems

For those communities whose sewerage system discharge into fresh water, some degree of treatment will be necessary. Taking into consideration the existing condition of the waters of Newfoundland and the existing state of development of its communities, the required treatment facilities would vary in degree of complexity from simple screening to secondary treatment.

A minimum requirement should be the removal of all floating materials and any other readily visible evidence of pollution from surface observation. Beyond that point, it would seem desirable to base the determination of the required additional treatment on:

a) The nature of the pollutants and capacity of the receiving body of water to absorb the pollution discharged to it.

b) All uses to be made of the water downstream of the community under consideration.

c) The distance which downstream users are located from the community under consideration.

d) The long term cumulative effects of pollution in different zones of the receiving water body.

Such an approach would require the determination by the appropriate authority of the multiple uses to which the waters in each river system are to be put and having determined these uses, it would be necessary to set up water quality objectives which would permit the use of the receiving body for these purposes.

Highly complicated and automated systems of pollution control should be avoided wherever possible due to the difficulty of readily obtaining parts and service personnel in the widely scattered communities of the Province. Oxidation ponds should be given every consideration as an acceptable treatment method.

6.3 Industrial Water Supply and Wastewater Treatment

Much of what has been stated in relation to municipal supply and pollution control applies to industry but there are certain specific situations that should be considered.

Where industry can develop its water supply from a local municipal system, that alternative should be favoured in view of the financial savings it represents. Additionally the discharge of its wastes to a municipal sewerage system provides for further economy and permits industry to participate with the municipality in federal grants relating to pollution control.

In the case of industries requiring relatively large water supplies whose volumes far exceed the capacity of the municipal systems, the foregoing alternative is not a practicable one and separate industrial systems need be developed.

These systems should in future however be developed with more thought to water conservation and re-use so as to avoid wastage of a valuable resource. Moderate expenditure on holding ponds can often permit re-cycling of a large portion of the supply, thus conserving the source for other valuable purposes.

Wastewaters from industries located inland will require varying degrees of treatment prior to discharge into inland waters. The complexity of the required treatment facilities would be determined in a manner similar to that recommended with respect to municipal wastewaters in order to meet quality objectives consistent with pre-determined multiple uses of the receiving waters.

For those industries located on the sea coast, disposal to the sea of wastewaters without treatment appears to be feasible in most cases provided such a practice takes into account other uses of the sea and the outfall is located so that the wastewaters are rapidly dispersed.

A different approach must be considered when the discharge is into an estuary, as for example the pulp and paper mill wastes currently being discharged into the Humber Arm by the Bowaters Newfoundland Limited pulp and paper mill at Corner Brook. In such cases, the wastes tend to accumulate and might require treatment; similarly, treatment of the wastewaters from the industrial complex currently under construction at Come By Chance could be necessary depending upon the exact nature of the wastes produced and the location of the waste discharge point.

Community	Census Division	Object of Project	D.B.S. Population 1966	Design Population	Source of Water	System Capacity Existing	System Capacity Added	Capital Cost $	Notes
Arnold's Cove	1	Domestic Water Supply	435	2,000	Eastern Brook	0	324 US gpm	312,000	No industry*
		Domestic Water Supply, Chlorination, Fire Protection					1500 US gpm	434,000	
		Sewer System						57,600	
Bellburns	2	Water System	158		Well System		25,000 gpd	38,000	No industry*
Berry Head	4	Water Improvements and Chlorination	408		Dam	Av. 24,000 gpd Max. dem. - 36,000 gpd	0	109,150	
Carbonear	1	Chlorination	4,584					33,000	
		Water & Sewer (New Area)						511,600	
Catalina	7	Water System	1,089	3,000	Look out Pond	0	1,000 gph	511,095	No industry*
		Water System			Look out Pond		40×10^6 gal/yr 2.5×10^6 gal/yr	551,066	2 fish plants
		Sewer System						240,059	No industry*
		Sewer System						671,550	2 fish plants
Channel - Port Aux Basques	3	Water Treatment Plant	5,692		System of Ponds		700,000 gpd (treatment cap.)	170,000	CNR 2.3×10^6 gal/month West Coast Power 1.75×10^6 gal/month
Daniel's Harbour	9	Water System	412		Drilled wells, pumps		4.4×10^6 gal/yr	120,000	No industry*
Fogo	8	Water System without house service	1,150	1,500	Freemans Pond	0	127,500 gpd	372,767	No industry*
		Water System with house service						570,951	
		Water & Sewer System						873,312	
Fox Harbour	1	Water System: Main, Dam	765	1,000	Pond		36.5×10^6 gal/yr	215,000	No industry*
		Water Distribution and Sewer System						271,520	
Hare Bay	6	Water and Sewer System	1,410	3,000	Hare Bay Pond	0	285,000 gpd	558,000	No industry*
Hearts Content	1	Water System Replacements for old system	592				55 gpm Dom. 1250 gpm fire	206,000	Very little industry
		Sewer System						61,000	
Hants Harbour	1	Water System	482	700	Church Pond	0	74,000 gpd	337,345	No industry*
		Sewer System						87,000	

NOTE: Author and date of study shown in Table 3-22 of the Administrative Study-Water Resources Prepared by P.C. Leger for the Board.

* No industry signifies no large water consuming industry is connected to the system.

NEWFOUNDLAND

CONSULTANT REPORTS ON MUNICIPAL WATER AND SEWER SYSTEMS

Community	Census Division	Object of Project	D.B.S. Population 1966	Design Population	Source of Water	System Capacity Existing	System Capacity Added	Capital Cost $	Notes
Isle Aux Morts	3	Water and Sewer System for community and fish plant	1,064	1,200	Pond		Town - 120,000 gpd Fish Plant 2100 US gpm	560,000	Fish Plant
Kellingrews, Upper Gullies, Seal Cove	1	Water: Gravity System in Storage Water: Pumped System in Storage	2,455	5,000	Lower Gullies River	0	750,000 gpd	430,000 365,000	
Little Bay	8	Water System for Town Tapped from Atlantic Coast Copper Mines Line	319		Creek Above Little Bay	0	50 gpm	83,000	Atlantic Coast Copper
Main Brook, Hare Bay	9	Water and Sewer System	677	1,500	Georges Pond	0	1,438 gpm	549,750	No industry*
Middle Brook South	6	Water and Sewer System	399		Dark Cove Pond	0	840 gpm	189,000	No industry*
Musgrave Harbour Doting Cove	8	Water System	1,183	2,500	Big Rock Pond	0	Domestic: 250,000 gpd Fire: 576,000 gpd	465,000	No industry*
		Sewer System						209,000	
North West River (Labrador)	10	Water and Sewer System			Drilled Wells	0	217,500 gpd	680,000	
Old Perlican	1	Water and Sewer System	648	1,500	Big Bell Pond	0	Domestic: 54.8×10^6 gal/yr Fish Plant: 45.00×10^6 gal/yr Hospital: 9.2×10^6 gal/yr	246,207	Fish Plant & Hospital
Pasadena - Midland	5	Water and Sewer System	685	1,500	Blue Gulch Brook	0	56.2×10^6 gal/yr	623,000	
Petty Harbour	1	Dam, Intake, Water Mains	932	2,000	Ponds North of Petty Harbour		210 gpm	87,800	No industry*
		Sewer Treatment Plant						132,000	
Placentia	1	Sewer System	1,847					627,000	
Placentia, Jerseyside, Freshwater	1	Water System	4,110				7.65×10^6 gal/yr	1,200,000	No industry*
Ramea	3	Water System for Community and Fish Plant Boilers, and Fish Plant Domestic Use	1,160	1,900		0	200,000 gpd	380,000	Fish Plant
Roddicton	9	Water and Sewer System	1,227	2,000	East Brook	0	1000 gmp fire f. 208 gpm domestic	743,140	
Rushoon	2	Water and Sewer System	396	600	Lily Pond	0	21.9×10^6 gal/yr (no fire fighting)	184,853	No industry*
		Water System Only						35,860	
Sandy Cove	9	Water System	225	350	Bare Apple Pond			127,130	

Community	Census Division	Object of Project	D.B.S. Population 1966	Design Population	Source of Water	System Capacity Existing	System Capacity Added	Capital Cost	Notes
St. Anthony (East Side)	9	Water System			Frenchmans Pond	0	125 gpm	150,000	No industry*
St. Anthony Bight	9	Water System	175		Pond	0	10,000 gpm fire f.	101,000	No industry*
St. John's		Water System	79,884					4,094,000	
St. Lawrence		Water System	2,130					153,500	
South Brook	5	Water System	396	800	Brook	0	56 gpm	134,000	
Spaniards Bay	1	Water System Sewer System	773		From Bay Roberts System (Pond)	0	1,050 gpm	572,300 284,200	No industry*
Stephenville	4	Water System Community, Paper Mill, and other planned industries	5,910				100,000,000 gpd	4,967,000	
Trepassey	1	Water System Water & Sewer System	670	1,000		0	95 x 10^6 gal/yr	430,000 600,000	No industry*
Trout River-Bonne Bay	9	Water System Sewer System	655	815	Feederbrook	0		324,400 176,900	No industry*
Twillingate	8	Water and Sewer System	1,374	2,500	Stuckley and Wild Ponds		9.6 x 10^6 gal/yr (Including fire f.)	1,700,000	Fish plant, not included $200,00 works in progress
Upper Island Cove	1	Water System Sewer System	1,790	2,900	Boyails Cove Pond	0	320,000 gpd	552,300 425,300	No industry*
Woody Point, Bonne Bay	9	Water System	542		Dammed Brook		95,000 Domestic 350,000 Fish Plant 120,000 Fire F. 565,000 gpd	373,200	Community and Fish Plant

NEWFOUNDLAND

CONSULTANT REPORTS ON MUNICIPAL WATER AND SEWER SYSTEMS

PART III - ECONOMIC CONSIDERATIONS

7 FUTURE DEVELOPMENT

In this section an effort has been made to assess in a general way the cost of future demand and pollution control developments which appear reasonable for initiation during the study period. The costs are order of magnitude estimates and for municipal projects were derived from the estimating criteria, Appendix C, Volume Eight. Estimates of the water development projects for industry were taken from reports of specific engineering studies carried out by others or provided by the industries themselves, while the values for industrial wastewater control schemes were developed from broad assumptions for the minimum control system considered applicable in each instance.

Costs of hydro-electric schemes were developed from studies carried out by ShawMont Newfoundland Limited, or were specifically estimated in the light of the Consultant's knowledge of the area. The cost criteria contained in Appendix C relating to hydro-electric schemes were derived from the results of these studies.

In Appendix C, Section 3.1, it is recommended that several interest rates be used to compare alternatives. Volume Five is to show the magnitude of costs and, as agreed with the Board, annual fixed costs are computed for interest rates of 7 and 9 percent to give the probable range of annual costs. The service lives used are as listed in Appendix C.

7.1 Municipal Water Supply

As indicated in Section 6 of this volume, the provision of municipal water supplies should be considered during the study period for all municipalities exceeding 500 or more in population. In addition existing municipal waterworks systems should be expanded to serve the areas not now served and to provide service to increasing populations. This specific withdrawal demand will be substantial and will require a considerable investment.

It is customary to design most facilities to have some capacity for the future and to be capable of expansion. In this instance, therefore, all works have been estimated on the basis of providing capacity for the estimated 1981 population with the assumption that most could be built prior to that date.

7.1.1 Municipal Water Supply - Unserviced Communities

In this situation, the costs of providing water supply schemes have been determined individually for those towns with populations exceeding 2000 persons and collectively for unserviced towns having a population less than 2000. Two collective groups have been established, one for municipalities whose population will range between 1000 and 2000 and the other for municipalities whose population will range from 500 to 1000.

The basic water demand for 1981 (Table 7-1) has been computed from a formula that relates water demand to income and is set out in Section 21, Volume Three. This demand is exclusive of industrial and commercial usage and a factor of 1.6 is therefore applied to make provision for these uses. To this again a factor of 1.75 is applied to establish peak day capacity over average day demand.

Having established these figures, it was possible to develop estimated expenditures for water supply on a capital and annual basis for the unserviced municipalities whose population exceeds 500 and these figures are set out in Table 7-2.

The unit costs of water derived from that table have been used to develop Figure 7-1 which indicates that the cost of water supply varies from more than 60 cents per 1000 gallons in the smallest communities to just over 15 cents per 1000 gallons in the larger municipalities considered. This is a clear demonstration of the value of relocating population to large centres insofar as reducing water-works costs are concerned.

It should be pointed out that if the supplies for municipalities of 2000 or less could be developed from groundwater as suggested in Section 6 of this volume, some significant reductions would result in the capital costs of supply set out for many of the municipalities in Table 7-2.

In Table 7-3 an effort has been made to develop the estimated expenditures for providing the distribution systems including the house connection in these unserviced communities. This represents an annual per capita cost of $19.50 to $24.50 depending on the financing used and assuming a constant density of 15 persons per gross acre. This latter figure is high in relation to most of the group of smaller municipalities considered and in these cases the per capita costs will be even higher than shown.

The relation of water consumption to disposable income may tend to unnecessarily inflate derived figures of future consumption. Other variables are involved as well. However it is considered to be a most useful tool and reference to Table 7-2 shows that, even if the consumption is in error by 100 percent, the cost does not change by more than 30 percent.

7.1.2 Municipal Water Supply - Extensions to Serviced Communities

Before 1981, numerous municipalities currently serviced with a municipal supply must increase their supply and extend their distribution systems to not only serve their increasing populations, but also those citizens not yet served. Estimates of the probable cost of providing these extensions have been prepared using the following assumptions:

a) That the total increase in population in the 1966-1981 period will gravitate to the larger centres. Consequently, the total increase in supply will be based on the expected increase in population less the increases detailed for presently unserviced municipalities in Section 7.1.1 and on Table 7-2.

b) That the per capita cost for extending the water supply system will be $35. A review of consultants' estimates for various projects on the Island gave per capita costs ranging from $25 to $60 with $35 being a reasonable mean.

c) That the per capita cost of extending the distribution costs will approximate $200. This per capita cost presumes that the basic trunk water supply system already exists and that the per capita costs can therefore be somewhat less than for a new system.

The total estimated cost of extending serviced areas in the period 1966-1981 amounts to $28,400,000 as detailed below:

Estimated Cost of Extending Existing Water Supply Systems

Estimated Population Increase		1966-1981	136,000
Estimated Population Increase in unserviced municipalities		1966-1981	
Bonavista	-	250	
Bay Roberts	-	4,590	
St. Georges	-	1,410	
1000-2000	-	8,620	
500-1000	-	0	14,870
			121,130

Estimated Cost of System Expansions 1966-1981

Water Supply	- 121,130 x $35	4,200,000
Water Distribution	- 121,130 x $200	= 24,200,000
		$28,400,000

7. 1. 3 Municipal Water Supply - Commentary

From the following summary based on subsections 7. 1. 1 and 7. 1. 2, it is evident that the cost of providing waterworks in currently unserved municipalities and extending existing systems could be as much as $95, 000, 000 in the period 1969 to 1981, which would be made up as follows:

Provision of Water Supply to Unserved Areas (Table 7-2)	$31,360,000
Provision of Water Distribution to Unserved Areas (Table 7-3)	32,630,000
Extensions of Existing Systems	28,400,000
Total	$92,390,000

This represents a very significant investment so that all possible means should be utilized to select schemes and methods which will permit some reduction in these costs. Development of groundwater and the concentration of population in larger centres are two obvious areas in which savings can be effected.

The probable annual cost of providing this waterworks service to a family residing in a community of 2000 can be estimated using the same assumptions as used to derive the total Island costs:

Supply to four persons using 50 gpd at 40 ¢ per 1000 gallons	$ 29.20
Distribution to four persons at $25 per capita	100.00
	$ 129.20

This amount should be within the capability of the family to pay by 1981 as the disposable income of such a family has been estimated to be $8,000 per year by that time. The International Bank for Reconstruction and Development considers a water utility likely to be viable if the annual revenue does not exceed 2 percent of the average disposable income. For a Newfoundland family the limiting figure would be $160 per year at that time.

The probable annual cost of water supply and the ability to pay, on the basis of the IBRD criteria, will come close to each other within the study period, which stresses the necessity for careful planning and economy in waterworks design and construction.

7.2 Municipal Sewage Treatment

The capital costs of providing sewage treatment at the primary level, either through a primary type mechanical plant or an oxidation pond, have been derived for a number of Island communities as shown on Table 7-4. The communities selected have populations exceeding 1000 and are located in potential pollution problem areas. The costs of providing adequate treatment have been derived from Appendix C, Figures C-4 and C-5 and the annual costs have been computed for a service life of 35 years.

These costs do not include the cost of collector or intercepting sewers. Experience has shown that where these facilities are required they could double or triple the cost of establishing pollution control.

The results developed in Table 7-4 have been plotted on Figure 7-2 to relate the unit cost of providing primary sewage treatment to the design population. This curve can then be employed to give the order of magnitude cost for providing primary treatment for any given population.

These results again show the desirability of concentrating the population in larger communities to reduce the total investment since the unit cost rises sharply when the population falls below 10,000.

Although the foregoing would appear to be the more obvious treatment requirements over the next 15 years, there are additional costs related to sewerage installation and extension in other municipalities including outfall improvement in relation to coastal systems.

These costs, however, are not chargeable to the consumptive use of the fresh water withdrawal demand, that is water quality degradation, and are not estimated.

7.3 Industrial Water Supply and Wastewater Disposal

As indicated in Appendix B of this report, the water demands for industry, the waste concentrations in the wastewaters resulting from these demands, and their composition vary widely with industry type.

7.3.1 Industrial Water Supply

From the river basin studies and the study area investigations set out in Volumes Six and Seven, an effort has been made to evaluate the more important industrial schemes which it would appear necessary to develop over the next fifteen years.

Costs obtained from the river basin and study area investigations are summarized on Table 7-5. The table shows that the total cost of industrial water supply could reach $10,200,000 and that the unit cost of water would be of the order of 3 cents per 1000 gallons provided the scheme is of reasonable capacity and that the distance between the source and the consumer is not extreme.

Because of the importance of the fishing industry to Newfoundland, it has been selected to demonstrate some of the economies that could be effected by combining municipal and industrial facilities in respect of water supply and wastewater treatment.

With the move from inshore to offshore fishing and the use of larger boats, it is possible to concentrate fish processing in fewer but larger plants. Plants with input capacities of 100 million pounds or more per year have been proposed and the costs of water supply and waste disposal facilities for these plants may be determined from Appendices B and C.

Assuming a water demand of about 3.5 gallons per pound of fish input, the required capacity of the 100 million pound plant is about 1 million gpd. The capital cost of a water supply scheme to meet this demand would amount to about $500,000 from Figure 1 of Appendix C.

If this demand could be combined with a municipal demand for a community with a population of 2000 the scheme cost would rise to $550,000. The cost of a separate scheme for a population of 2,000 has been estimated herein as $200,000. The savings from constructing a combined scheme therefore amounts to about $150,000.

7.3.2 Industrial Wastewater Treatment

Estimated costs for providing wastewater treatment are discussed in the report sections describing the river basin and study area investigations. Table 7-6 lists the probable projects liable to be required between 1966 and 1981 and indicates the annual costs. The total investment of these selected schemes represents an expenditure of $18,500,000 with the unit cost based on annual fixed and operating charges varying from 5 cents per 1000 gallons to 28 cents per 1000 gallons, or on the basis of tons of wastewater from about 1 cent per ton to about 5.5 cents per ton.

As with water supply there can be a significant saving in combining municipal wastewater treatment with industrial wastewater treatment, as well as in conservation and recycling to reduce the withdrawal demand.

7.4 Non-Withdrawal (Non-Consumptive) Developments

Non-withdrawal demands on the resource develop only if alternative means of satisfying the requirement are more expensive. The demands considered under this heading are the use of water for the generation of hydro power since costs relating to the use of water for fisheries, logging, navigation, and recreation have not been established with any degree of accuracy.

7.4.1 Hydro-Electric Power

Estimated capital and firm energy costs of eleven selected hydro-electric schemes not previously investigated have been reported in Volume Four, Section 1. The capital costs of these schemes at 50 per cent CF capacity factor vary from $632 to $160 per installed kilowatt and the firm energy costs from 19.8 to 5.4 mills per kilowatt hour at the busbars for a 6 percent interest rate (See Volume Four, Section 1.1.4).

Figure 7-3 compares the unit cost of the hydro electric schemes examined in Volume Four with the incremental unit cost of producing the equivalent power with an additional 150 Mw unit at the Holyrood station now under construction.

Computations have been made for interest rates of 7 and 9 percent and for a range of capacity factors (Tables 7-7 and 7-8). For the hydro alternatives the costs were adjusted from the 6.0 percent interest rate and the one capacity factor used for economic ranking of the schemes in Volume Four. No allowance is included for transmission, it being assumed that all schemes could be interconnected to the provincial grid without excessive transmission costs.

The comparison indicates that the Cat Arm scheme is the most economically viable scheme for interest rates up to 9 percent, and is therefore worthy of more detailed study.

NEWFOUNDLAND
ESTIMATED UNIT COST OF WATER SUPPLY OPERATING AT DESIGN CAPACITY

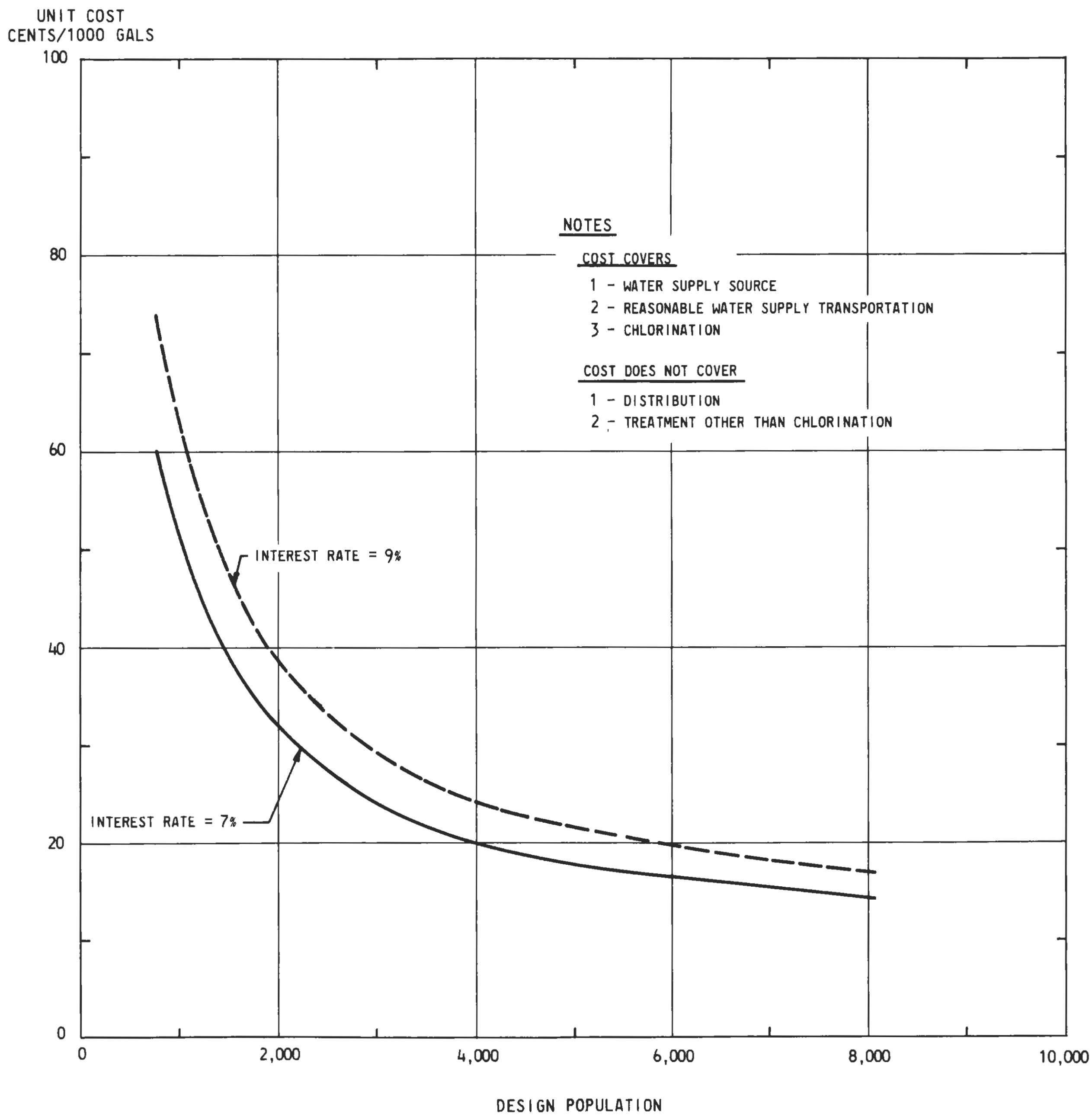


FIGURE 7-1

NEWFOUNDLAND
ESTIMATED UNIT COST OF PRIMARY SEWAGE TREATMENT OPERATING AT DESIGN CAPACITY

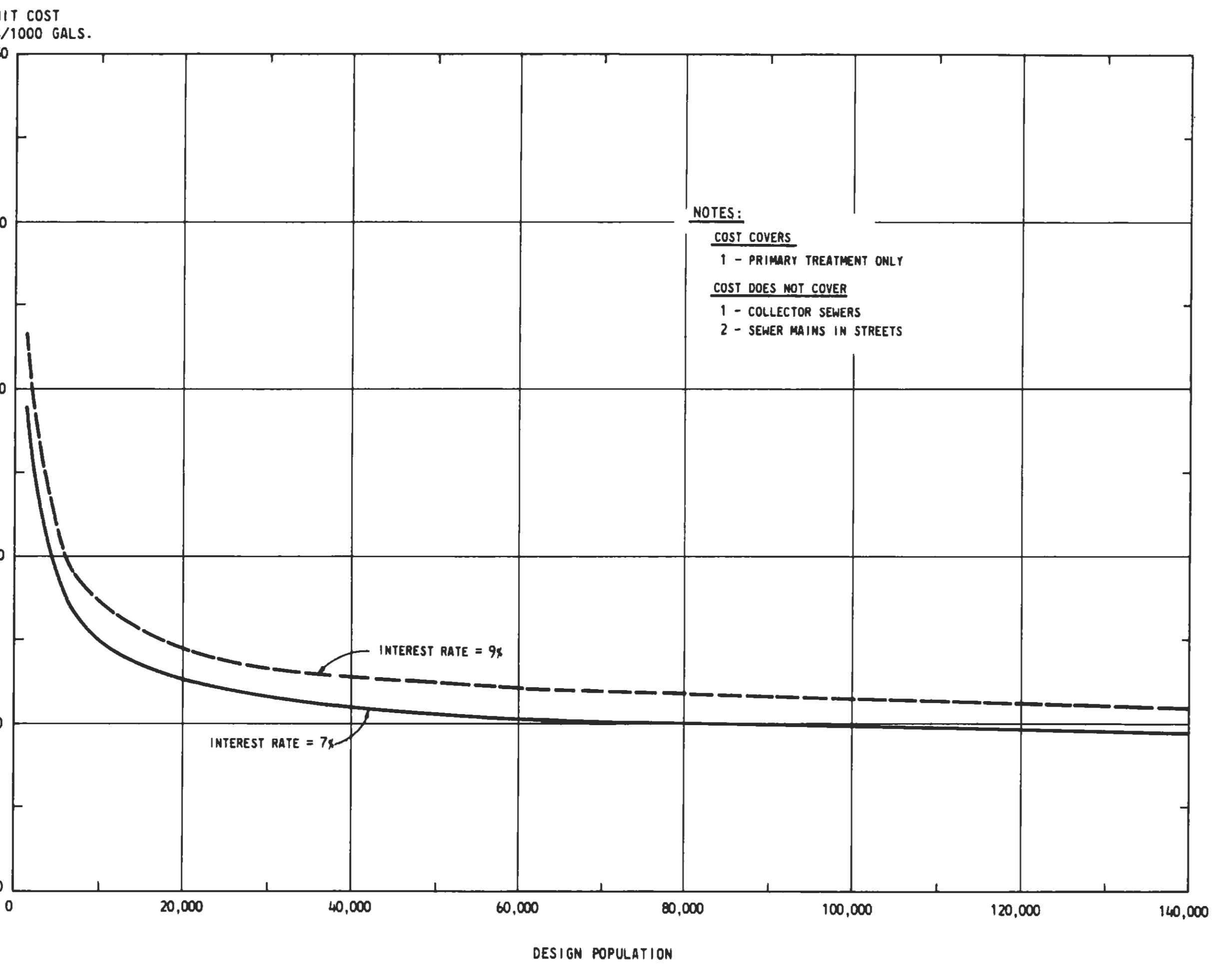
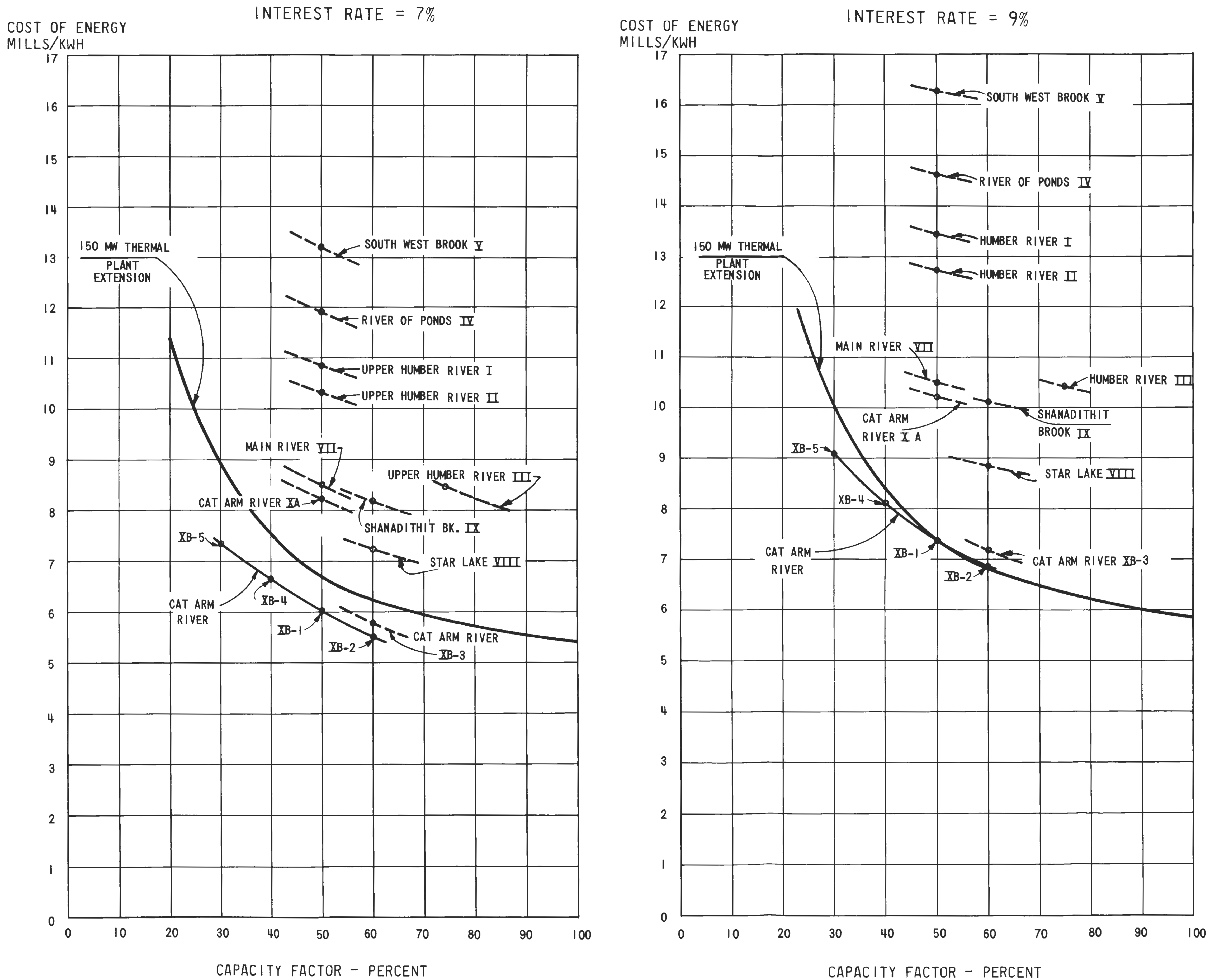


FIGURE 7-2



COMPARISON OF COSTS
HYDRO ELECTRIC POWER
AND
THERMAL ELECTRIC POWER

FIGURE 7 - 3

NEWFOUNDLAND

MUNICIPAL WATER SUPPLY AND WASTEWATER TREATMENT
BASIC DATA FOR DETERMINING WATER DEMAND

Community	Population 1966	Population 1981	Per Capita Disposable Income - 1965 $ 1966	Per Capita Disposable Income - 1965 $ 1981	Basic Water Demand Gal/Cap/Day 1966	Basic Water Demand Gal/Cap/Day 1981
St. John's	101,200	134,000	$1,200	$2,200	61	124
Corner Brook	30,220	37,700	1,500	2,500	80	143
Grand Falls - Windsor	14,700	21,200	1,700	2,500	92	143
Bishops Falls	4,290	5,100	1,700	2,500	81	125
Botwood	5,730	6,300	1,700	2,500	81	125
Buchans	2,540	2,500	1,700	2,500	81	125
Norris Arm	2,830	1,450	1,700	2,500	81	125
Dunville	1,630	2,850	1,200	2,200	53	108
Bonavista	4,190	4,440	900	2,000	36	97
Bay Roberts Area	3,440	8,030	1,200	2,200	53	108
St. Georges	2,050	3,460	1,100	2,200	47	108
1000 - 2000	1,500	1,875	-	-	43	80
500 - 1000	750	750	-	-	39	78

TABLE 7-1

Name or Size of Community	Number	Design (1) Usage Mgd.	Design (2) Capacity Mgd.	Estimated Capital Cost	Annual Capital (3) Charge 7%	Annual Capital (3) Charge 9%	Unit Fixed Charges Cents/1000 Gals. 7%	Unit Fixed Charges Cents/1000 Gals. 9%	Operation (4) & Maintenance Cents/1000 Gals.	Total Unit Cost Cents per 1000 Gal. Int. 7% Cents/1000 Gals.	Total Unit Cost Cents per 1000 Gal. Int. 9% Cents/1000 Gals.
Bonavista	1	0.69	1.20	$ 540,000	$ 39,700	$ 49,800	16	20	3	19	23
Bay Roberts Area	1	1.38	2.40	720,000	53,000	66,300	11	13	3	14	16
St. Georges	1	0.60	1.05	500,000	36,800	46,200	17	21	3	20	24
1000 - 2000	18	0.24	0.42	6,200,000	455,000	572,000	29	36	4	33	40
500 - 1000	97	0.09	0.16	23,400,000	$1,720,000	$2,150,000	54	68	6	60	74
	118			$31,360,000							

(1) Design Usage = 1.6 x 1981 Basic municipal water demand (Table 7-1)

(2) Design Capacity = 1.75 x design Usage.

(3) Carrying Charges -

Interest	7.00%	9.00%
Depreciation (50 Yrs.)	.25	.12
Interim Replacement	.10	.10
Insurance	-	-
	7.35%	9.22%

(4) Based on design Usage.

NEWFOUNDLAND

MUNICIPAL WATER SUPPLY - ESTIMATED COST TO PROVIDE WATER TO ALL COMMUNITIES IN EXCESS OF 500 PRESENTLY WITHOUT CENTRALIZED WATER SUPPLY

TABLE 7-2

NEWFOUNDLAND

MUNICIPAL WATER SUPPLY
ESTIMATED COST OF WATER MAINS FOR
ALL COMMUNITIES IN EXCESS OF 500
PRESENTLY WITHOUT CENTRALIZED WATER SUPPLY

Name or Size of Community	Number	Estimated (1) Capital Cost	Annual Capital (2) Charge		Per Capita (3) Fixed Charges	
			7%	9%	7%	9%
Bonavista	1	$ 1,180,000	$ 87,000	$ 109,000	$19.6	$24.5
Bay Roberts Area	1	2,130,000	156,000	196,000	$19.5	$24.4
St. Georges	1	920,000	68,000	85,000	$19.7	$24.6
1000 - 2000	18	9,000,000	660,000	830,000	$19.5	$24.6
500 - 1000	97	19,400,000	$1,420,000	$1,800,000	$19.5	$24.5
	118	$32,630,000				

(1) Assumes population density of 15 persons per acre.
Assumes 80% rock, 20% earth.

(2) Carrying Charges:

Interest	7.00	9.00
Depreciation (50 Yrs.)	.25	.12
Interim Replacement	.10	.10
Insurance	-	-
	7.35%	9.22%

(3) Based on design population.

TABLE 7-3

NEWFOUNDLAND

MUNICIPAL WATER SUPPLY
ESTIMATED COST OF PRIMARY SEWAGE TREATMENT COSTS
FOR COMMUNITIES HAVING A POPULATION OF 1000 OR MORE
AND HAVING A POTENTIAL POLLUTION PROBLEM

Community	Design (1) Plant Capacity MGD	Estimated Capital Cost	Annual Capital (2) Charges 7%	Annual Capital (2) Charges 9%	Unit Fixed Charges Cents/1000 Gals. 7%	Unit Fixed Charges Cents/1000 Gals. 9%	Operation (3) & Maintenance Cents/1000 Gals.	Total Unit Cost Cents/1000 Gals. 7%	Total Unit Cost Cents/1000 Gals. 9%
St. John's	26.7	$8,000,000	$638,000	$777,000	6.5	8.0	3.0	9.5	11.0
Corner Brook	8.6	2,930,000	234,000	284,000	7.5	9.1	3.7	11.2	12.8
Grand Falls - Windsor	4.8	1,860,000	148,000	181,000	8.4	10.3	4.0	12.4	14.3
Bishops Falls	1.0	625,000	49,800	60,700	13.6	16.6	6.0	19.6	22.6
Botwood	1.3	718,000	57,200	69,700	12.1	14.7	5.0	17.1	19.7
Buchans	0.5	390,000	31,100	37,900	17.0	20.8	7.4	24.4	28.2
Norris Arm	0.3	275,000	21,900	26,700	20.0	24.3	9.0	29.0	33.3
Dunville	0.5	390,000	31,100	37,900	17.0	20.8	7.4	24.4	28.2

(1) Design capacity = 1.6 x basic water usage.

(2) Carrying Charges

		7%	9%
	Interest	7.00	9.00
	Depreciation (35 Yrs.)	0.72	0.46
	Interim Replacement	0.25	0.25
	Insurance	-	-
		7.97%	9.71%

(3) Based on design plant capacity.

Basin or Study Area	Industry	Water Type	Design Capacity	Estimated Cost	Annual Capital (3) Cost 7%	Annual Capital (3) Cost 9%	Operating Cost	Total Annual Cost 7%	Total Annual Cost 9%	Total Unit Cost (4) Cents/1000 Gallons 7%	Total Unit Cost (4) Cents/1000 Gallons 9%
Exploits	Price Nfld. (Pulp & Paper)	Raw	5.0 Mgd.	$500,000(1)	$ 36,800	$ 46,200	$ 18,200(1)	$ 55,000	$ 64,400	3.0	3.5
Humber	Bowaters Nfld. (Pulp & Paper)	Raw	15.0 Mgd.	1,500,000(1)	110,200	138,000	5,000(1)	115,200	143,000	2.7	2.9
Come By Chance	Industrial Complex	Raw	16.5 Mgd.	3,205,000(2)	235,600	295,000	60,000(2)	295,600	355,000	4.9	5.9
Stephenville	Industrial Complex	Raw	100.0 Mgd.	4,967,000(2)	365,000	457,000	576,000(2)	941,000	1,033,000	2.6	2.8
				$10,172,000							

(1) From discussions with personnel of industry.

(2) Estimated by consultants.

(3) Carrying Charges:

	7%	9%
Interest	7.00%	9.00%
Depreciation (50 Yrs.)	.25	.12
Interim Replacement	.10	.10
Insurance	-	-
	7.35%	9.22%

(4) Based on design capacity.

NEWFOUNDLAND

INDUSTRIAL WATER SUPPLY - ESTIMATED COST OF WATER SUPPLY REQUIRED BY INDUSTRIAL DEVELOPMENT

TABLE 7-5

Basin or Study Area	Industry	Treatment	Design Capacity	Estimated (2) Cost	Annual Capital (1) Charges 7%	9%	Operating (2) Cost	Total Annual Cost 7%	9%	Unit Cost Cents/ton 7%	9%
Exploits	ASAR Co. (Base Metals)	Primary	2.0 Mgd.	$ 1,700,000	135,000	165,000	$ 35,000	$170,000	$200,000	4.66	5.48
	Price Nfld. (Pulp & paper)	Primary	20.0 Mgd.	3,000,000	239,000	291,000	$219,000	458,000	510,000	1.25	1.40
Humber	Bowaters (Pulp & paper)	Primary	25.0 Mgd.	1,500,000	120,000	146,000	$[illegible]75,0[illegible]	395,000	421,000	0.87	0.92
Churchill	Wabush Mines (Ore Concentration)	Primary	10.0 Mgd.	3,000,000	239,000	291,000	$[illegible]10,0[illegible]	349,000	401,000	1.91	2.20
	Iron Ore (Ore Concentration)	Primary	40.0 Mgd.	8,000,000	638,000	777,000	$290,000	928,000	1,067,000	1.27	1.46
Burin	Nfld. Fluorspar (Mining)	Primary	3.0 Mgd.	1,300,000	104,000	126,000	$ 43,000	147,000	169,000	2.69	3.09
				$18,500,000							

(1) Carrying Charges:

	7%	9%
Interest	7.00%	9.00%
Depreciation (35 Yrs.)	0.72	0.46
Interim Replacement	0.25	0.25
Insurance	-	-
	7.97%	9.71%

(2) Estimated by the Consultant.

PROBABLE INDUSTRIAL WASTEWATER TREATMENT PROJECTS

TABLE 7-6

NEWFOUNDLAND

ANNUAL OPERATING COSTS AND UNIT COSTS OF ENERGY FOR A TYPICAL 150 MW THERMAL PLANT EXTENSION

	INTEREST RATE = 7%					INTEREST RATE = 9%				
	COST OF 1 x 150 MW UNIT = $22.53 x 10⁶*					COST OF 1 x 150 MW UNIT = $23.2 x 10⁶**				
CAPACITY FACTOR	20%	40%	60%	80%	100%	20%	40%	60%	80%	100%
ANNUAL ENERGY gwh	285	570	855	1040	1250	285	570	855	1040	1250
ANNUAL FUEL COST ($ x 10^6)	0.970	1.940	2.910	3.540	4.250	0.970	1.940	2.910	3.540	4.250
VARIABLE O & M "	0.054	0.108	0.163	0.198	0.238	0.054	0.108	0.163	0.198	0.238
FUEL INVENTORY "	0.017	0.034	0.051	0.062	0.074	0.022	0.044	0.065	0.080	0.096
FIXED COSTS "	2.213	2.213	2.213	2.213	2.213	2.668	2.668	2.668	2.668	2.668
TOTAL ANNUAL OPERATING COST (MILLIONS OF DOLLARS)	3.254	4.295	5.337	6.013	6.775	3.714	4.760	5.806	6.486	7.252
UNIT COST OF ENERGY (MILLS/KWH)	11.40	7.55	6.24	5.78	5.42	13.00	8.36	6.79	6.24	5.80

BASIS OF COST COMPUTATIONS:

INTEREST RATE	=	7.000%	INTEREST RATE	=	9.000%
AMORTIZATION	=	1.059%	AMORTIZATION	=	0.733%
SERVICE LIFE	=	30 Yrs.	SERVICE LIFE	=	30 Yrs.
INTERIM REPLACEMENT	AT	0.35% CAPITAL COST	INTERIM REPLACEMENT	AT	0.35% CAPITAL COST
INSURANCE	AT	0.25% - DO -	INSURANCE	AT	0.25% - DO -
FIXED O & M	AT	$1.40/kw	FIXED O & M	AT	$1.40/kw
OVERHEAD	AT	25% FIXED O & M	OVERHEAD	AT	25% FIXED O & M
UNIT COST OF FUEL	AT	3.4 MILLS/KWH	UNIT COST OF FUEL	AT	3.4 MILLS/KWH
VARIABLE O & M	AT	0.19 MILLS/KWH	VARIABLE O & M	AT	0.19 MILLS/KWH
FUEL INVENTORY	AT	1.75% ANNUAL FUEL COST	FUEL INVENTORY	AT	2.25% ANNUAL FUEL COST

* INCLUDES INTEREST DURING CONSTRUCTION AT 7%

** INCLUDES INTEREST DURING CONSTRUCTION AT 9%

TABLE 7-7

DEVELOPMENT NO.	INSTALLED CAPACITY (HP x 1000)	FIRM ENERGY (gwh)	CAPACITY FACTOR (%)	INTEREST RATE = 7%: INTEREST & AMORTIZATION ($ x 1,000)	INTEREST RATE = 7%: OPERATION & MAINTENANCE ($ x 1,000)	INTEREST RATE = 7%: TOTAL ANNUAL COST ($ x 1,000)	INTEREST RATE = 7%: COST OF FIRM ENERGY * (Mills/kwh)	INTEREST RATE = 9%: INTEREST & AMORTIZATION ($ x 1,000)	INTEREST RATE = 9%: OPERATION & MAINTENANCE ($ x 1,000)	INTEREST RATE = 9%: TOTAL ANNUAL COST ($ x 1,000)	INTEREST RATE = 9%: COST OF FIRM ENERGY * (Mills/kwh)
Upper Humber River I	100	287	50	2940	165	3105	10.8	3670	165	3835	13.4
Upper Humber River II	30	89	50	845	75	920	10.3	1057	75	1132	12.7
Upper Humber River III	65	283	75	2320	88	2408	8.5	2880	88	2968	10.5
River of Ponds IV	35	97	50	1068	84	1152	11.9	1335	84	1419	14.6
South West Brook V	30	86	50	1060	75	1135	13.2	1328	75	1403	16.3
Gt. Rattling Bk. VI	15	45	50	957	36	993	22.1	1200	36	1236	27.3
Main River VII	150	448	50	3610	217	3827	8.5	4510	217	4727	10.5
Star Lake VIII	35	127	60	834	84	918	7.2	1040	84	1124	8.9
Shanadithit Bk. IX	50	167	60	1261	108	1369	8.2	1575	108	1683	10.1
Cat Arm River X A	100	299	50	2320	164	2484	8.3	2900	164	3064	10.2
Cat Arm River X B-1	190	554	50	3060	265	3325	6.0	3830	265	4095	7.4
Cat Arm River X B-2	160	554	60	2830	224	3054	5.5	3530	224	3754	6.8
Cat Arm River X B-3	160	560	60	3010	224	3234	5.8	3770	224	3994	7.1
Cat Arm River X B-4	250	554	40	3360	313	3673	6.6	4200	313	4513	8.2
Cat Arm River X B-5	325	554	30	3700	407	4107	7.4	4630	409	5039	9.1

NOTE: Interest Rate = 7.000%
Amortization = 0.246%
Insurance = 0.100%
Interim Replacement = 0.200%
Service Life = 50 Years

NOTE: Interest Rate = 9.000%
Amortization = 0.123%
Insurance = 0.100%
Interim Replacement = 0.200%
Service Life = 50 Years

* At Plant Busbar.

NEWFOUNDLAND

TECHNICAL AND ECONOMIC DATA FOR POSSIBLE HYDRO-ELECTRIC DEVELOPMENTS

TABLE 7-8

8 FUTURE POLICY

It is evident that, although the level of demand on the available supply is not currently of a high order, areas of conflict do exist and significant sums will have to be spent to resolve them as well as to provide for the increasing demand.

It would appear that this is a most appropriate time for the Province to institute a water resources management policy so that it can fully and practically control the use of its water resources in accordance with the terms of The Water Resources and Pollution Control Act, 1966-67.

All of the foregoing technical considerations and future development programs could best be instituted and preserved under such a plan and it would also provide an appropriate means for maintaining a full accounting of the use of the resource and its condition at any time.

One of the important considerations in such a policy would be the maintenance of water quality. Significant areas of degradation of water quality have already occurred and no cost for eventual control, let alone correction of these situations, has been recognized. It is not prudent that future development should continue to ignore these costs whether pollution control is instituted now or much later.

In addition it is becoming obvious through the actions in more developed areas such as the states of Maryland and Pennsylvania, and the province of Ontario, that eventually the state or the province will be required to build and operate pollution control facilities for municipalities and industries alike and to charge directly for this service as they would for electric power service.

Pollution control is becoming far too complex to be handled otherwise and the efficiency of operation of these major schemes representing many millions of dollars in investment must be maintained by skilled operators uniformly trained, whom neither municipal or industrial programs can provide. This is especially true in Newfoundland where scattered communities of small size would find it most difficult to finance and provide trained staff at the local level as well as provide a major servicing capability.

Essentially, then, a policy should soon be formulated in relation to water quality control and a program established for the Province to assume a new role, at least in respect to water quality degradation in line with the aforementioned act. This policy should be established on the basis of maintaining predetermined standards of stream quality for various classifications of streams and not the treatment per se of wastewaters in order to maintain effluent quality. A policy based upon effluent quality does not give adequate weight to the receiving streams' ability to absorb pollution nor the uses to which the streams will be put; it is therefore uneconomical and not in the best interests of the Province.

Furthermore, it should be recognized that water is a resource belonging to the Province as a whole, and all its uses must be authorized and controlled by the Province with particular attention placed upon degradation of water through such use. The Province as previously mentioned should then accept the responsibility for all pollution and treat all wastewaters, both municipal and industrial, to the degree necessary to maintain the required standard of quality; monies to finance the necessary treatment facilities could be covered by degradation charges assessed against all water users in accordance with the degree of degradation resulting from their specific use of the water together with the volume of water so used.

Implementation of such a policy would be through the issuance of a withdrawal license by the Authority (the Newfoundland and Labrador Water Authority). Such license would represent permission for any person or corporation to utilize the provincially-owned water resources at a charge set by the Authority. Exceptions might be made for domestic or agricultural use when the average use rate is less than 500 gallons per property or per acre respectively per day, in which case the charge would be waived.

The basis of charge would be subject to review and re-assessment by the Authority annually, and the overall basic rate for withdrawal would be subject to change by the Authority at its discretion but with two years' prior notice to all users.

At the time of granting the withdrawal license, the authority would determine the average degree of degradation that could result to the quality of the receiving water through the specific use and charge additionally on the originally measured quantity for the loss occasioned thereby as follows:

Dilution	0.25 cent/ton (or some comparable appropriate charge)	-	where the maximum withdrawal rate exceeds 2% of the flow rate of a stream or the daily use exceeds 0.01% of the volume of a lake or aquifer
Physical	0.25 cent/ton (or some comparable appropriate charge)	-	where the quality of the receiving water within 1000 lineal feet in any any direction following discharge is altered by more than 0.1% with respect to either colour (increase), turbidity, (increase), temperature, (increase), or dissolved oxygen, (decrease)
Chemical	0.5 cent/ton (or some comparable appropriate charge)	-	where the quality of the receiving water within 1000 lineal feet in any direction following discharge is altered by more than 0.1% with respect to any original chemical constituents as well as pH or where any new chemicals may be introduced through the use so as to result in a concentration following dilution in excess of 1 milligram/litre
Biological	0.5 cent/ton (or some comparable appropriate charge)	-	where the quality of the receiving water within 1000 lineal feet in any direction following discharge is altered by more than 0.1% with respect to BOD (5-day), COD, or E. Coli

The maximum charge for degradation would therefore be 1.5 cents per ton and would be subject to review annually as would the withdrawal charge; similarly, the basic rate for degradation could be altered by the Authority at its discretion but with two years' prior notice to all permit holders.

The degradation charge would represent the loss in resource experienced by the Province as a whole as a result of the degradation of the water withdrawn. Should the Authority determine that the degradation of the resource could not be tolerated, it would then install and operate at its own expense the necessary improvement facilities and would require the license holder to provide all necessary co-operation to make this possible.

The Authority might as an alternative declare the license holder as its agent in this regard and require the agent to build and operate to the satisfaction of, but at the expense of, the Authority the necessary remedial works to improve the used water prior to discharge so as to prevent some or all aspects of degradation of the receiving waters.

All existing water users would be affected by the foregoing but at a rate of 0.1 of the stated rates per annum increasing by a similar amount each year until full rate was established.

Flexibility, especially in economic effect, remains with the license holder who by in-plant or process changes can substantially alter the effect of his wastes on the receiving water and thus greatly reduce his degradation charge.

Also, with such a policy the Authority can decide on its own wisdom when it will permit degradation for a period of time or when it must immediately effect pollution control. The charges, however, are levied from the time the use commences, and the money accumulates for the eventual pollution control facility so that the consumptive use and its related cost is recognized from the beginning.

VOLUME FIVE - PART IV — SECTIONS 9 & 10

GENERAL CONCLUSIONS AND RECOMMENDATIONS

PART IV - GENERAL CONCLUSIONS AND RECOMMENDATIONS

The preliminary regional comparison of water availability, demand and supply in the Province has been carried out only for the purpose of revealing general problems. Consequently the conclusions and recommendations of this volume are general in character with more specific and local problems in the river basins and study areas being discussed in Volumes Six and Seven.

9 CONCLUSIONS

a) The comparison of water availability - water demand shows that there is no shortage of water at the present time and no such shortage can be foreseen during the study period.

b) The comparison of water supply - water demand and wastewater disposal conditions indicates numerous problems which are basically related to:

- i) Lack of understanding of the relationship between various water uses.
- ii) Inadequate design, operation, and maintenance of some of the works.
- iii) Lack of data on the water resources, especially groundwater.
- iv) Economic restrictions fostering inefficient spending.

c) The provision of water supply facilities (including distribution systems) for all communities of over 500 would represent an estimated capital cost of $100,000,000 and an estimated annual expenditure for debt retirement, even on the most favourable terms, of $7,500,000.

d) The capital and total annual costs of water supply and waste treatment on a unit basis increase rapidly when the community size falls below 2000 persons. Relocation of the populace to larger municipalities could result in significant savings in waterworks and pollution control investment. Some of this saving could be achieved by combining municipal and industrial schemes to reduce unit costs.

e) The costs of water supply for most of the smaller communities could be decreased if more groundwater sources were developed and on a more efficient basis than has been done to date.

f) Even for the larger municipalities, it is apparent that the current cost of providing a complete waterworks system will result in a charge to the consumer which is close to the limit of his ability to pay for the service.

g) Lack of proper water supply and wastewater disposal facilities for about half the population is contributing to a level of living incompatible with present day standards in other parts of Canada, and causes definite hazards to the public health.

h) The total cost for providing municipal wastewater treatment for those communities where pollution problems appear severe would be $15,000,000, excluding any requirement for collection sewers. Again population relocation to larger centres and combination with industry would substantially reduce unit costs and total expenditure.

i) For those communities whose size remains at 500 or less, it is obvious that a municipal water supply system cannot be economically justified. Substantial health hazards will continue in relation to pollution of the individual well supplies however, unless the installation of these systems is placed under more rigid control and inspection.

j) Further threat to the public health could develop if municipalities with surface supplies from impoundments do not better control the tributary watersheds as well as ensure adequate chlorination of the supply.

k) Based on present economic forecasts and assumptions, the cost of water supply for planned industries on the Island is estimated at $10,200,000, and water can be delivered to the industries for as little as 3 cents per 1000 gallons. This expenditure can be most efficiently made when the utilization factor for supply is developed to its maximum in the shortest possible time.

l) An expenditure of more than $18,500,000 would be required to effect even a minimum level of pollution control to major areas of industrial waste discharge in the Province. Quality degradation of the resource has not been recognized to date. A definite ultimate cost is being incurred with no provision for its eventual financing having been arranged.

m) The lack of pollution control enforcement has permitted industries to ignore in certain instances the economies that could be achieved from water re-use and conservation.

n) For the present assumption regarding electrical energy demand in the Island, further development of hydroelectric power will probably be limited to one or two conventional schemes at low capacity factors and possibly later to some pumped storage schemes. Many of the smaller, old plants will be discontinued during the forecast period and some changes in the operation of existing plants will occur when base load is supplied on the Island by the Churchill Falls infeed or alternatively thermal developments. Hydro-electric development in Labrador will continue both for export and for servicing the developing economy of the area (mining and forest products).

o) It is to be expected that both for internal and external reasons, increased use of available resources in the Province for recreation and tourism will be made, and this could be accelerated by the careful development of anadromous and other fresh water fisheries and adequate protection of wildlife. The pattern of the present non-withdrawal uses for hydro-electric power and log driving may change slightly because of this.

10 RECOMMENDATIONS

a) It is essential that the Province soon adopt a strong water resource management policy that is conceived on the basis of obtaining optimum economic effects and maximum intangible benefits for all users and the preservation of the resource for future generations. The interdependence of the uses of water should be recognized and analyzed, and measures taken as warranted by the significance of the problem. The current legislation of The Water Resources and Pollution Control Act, 1966-67, would appear to provide the Newfoundland Water Authority the broad powers to adopt such a policy, which should be fully comprehensive in its outlook and designed to permit development of a viable operating program for the future. It is recognized that this program could be administered in specific watersheds by Basin Commissions as recommended for the Exploits, Humber and Churchill Rivers in Volume Six. However, the major policy aspects must be declared and decided at the Provincial level.

b) Under this policy, a program of initiating the provision of safe water supplies and distribution systems should be embarked upon to service as rapidly as economically feasible those municipalities whose populations exceed 500 and those areas of existing municipalities where the systems serve only a portion of the population.

No scheme should be embarked upon however which cannot be accomplished at a cost within the financial means of the consumer and the priority of proceeding with schemes should be based on rating them in relation to their unit costs. Maximum attention should be paid to groundwater supplies, regional supplies, concentration of population in larger centres, and combination with industry and fire protection alternatives to ensure optimum service for least cost.

A study should be undertaken in support of this program to establish appropriate regulations for standards of service, materials and rates to ensure uniformity and economy in the program.

c) Also under this policy, a plan to establish withdrawal and degradation licenses and charges should be developed so that all users larger than individual property owners are charged for water use and its degradation at some cost which is comparable to their effect on the resource. The provincial Authority should arrange to set these payments aside and when sufficient degradation in the water quality of the resource occurs should utilize these funds to build and operate wastewater control schemes for its license holders.

As in the case with water supply, these eventual schemes should be designed to effect maximum economy through consideration of combined or regional schemes, water re-use and reclamation, and discharge to tidal waters where adequate dispersal can be achieved.

d) To provide direction to its pollution control program, the Provincial Authority should establish a system of water quality standards under its overall resource management plan and for this initiate a priority of spending to control wastes to permit the established quality standards to be maintained.

e) In all planning, consideration should be given to effective grouping of industries where practicable and the adoption of processes and methods calculated to conserve the fresh water resource, including, for coastal establishments, the utilization of sea water.

f) It is recommended that consideration be given to alternative uses of storages at existing small hydro-electric stations (less than 5000 hp) bearing in mind the escalation of operating and maintenance costs and the planned expansion of the Province-wide electrical network by the Newfoundland and Labrador Power Commission.

g) A study of the undeveloped hydro-electric potential of Labrador should be initiated in the near future, particularly in the southern region, so that the availability of adequate power sources can be properly considered in the location of sites for new industries.

h) A quantitative study of the actual and potential significance of the tourism-recreation industry for the Province's economy should be carried out.

i) The development of fish and wildlife conservation should be encouraged and included in all projects related to water resources, both on the Island and in Labrador.