GOVERNMENT OF CANADA
DEPARTMENT OF REGIONAL ECONOMIC EXPANSION

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF COMMUNITY AND SOCIAL DEVELOPMENT

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

DREE PROJECT 3.12

PRE-DESIGN STUDY

SEPTEMBER 1972

De Leuw, Cather
ENGINEERS AND PLANNERS

De Leuw, Cather

CONSULTING ENGINEERS

September 21, 1972
Our Ref: 06-149

Mr. Colin Karasek
Director of Implementation
Department of Community & Social Development
Confederation Building
St. John's, Newfoundland

Dear Sir,

In accordance with the terms of our agreement with the Department of Community and Social Development, we are submitting this pre-design study on an industrial water supply system for the Town of St. Georges.

The report summarizes the results of an evaluation of present and future requirements of both industry and the community. The search for a suitable supply source prompted a more extensive subsurface investigation programme than was originally contemplated. In selecting the recommended plan, several alternative schemes were evaluated and are discussed in detail.

We appreciate the cooperation and assistance afforded us by the Government agencies involved and by officials and members of the community of St. Georges.

Yours very truly,

DE LEUW, CATHER & CO. OF CANADA LIMITED

B. D. Henderson

B. D. Henderson, P. Eng., Associate,
Manager, Newfoundland Operations

BDH:ms
encl

DE LEUW, CATHER & COMPANY OF CANADA LTD 272 DUCKWORTH ST., BOX 5549, ST. JOHN'S, NFLD. (A/C709) 726-0282
CABLE DELCAN ST. JOHN'S OFFICES. OTTAWA, MONTREAL, LONDON, EDMONTON — HEAD OFFICE, TORONTO

INDEX

PAGE

INTRODUCTION 1

SUMMARY AND RECOMMENDATIONS 4

CHAPTER 1 - DEMAND 6

CHAPTER 2 - SUPPLY SOURCES 14

- *A. GROUNDWATER* 14
- *B. SURFACE WATER* 21
- *C. SEA WATER* 24

CHAPTER 3 - TREATMENT 27

CHAPTER 4 - DISTRIBUTION SYSTEM 31

CHAPTER 5 - PREFERRED SCHEMES 33

- *"A" - Barachois Brook* 35
- *"B" - Dribble Brook* 37
- *"C" - Flat Bay Brook* 41
- *"D" - Flat Bay Brook (Recommended)* 43

CHAPTER 6 - COSTS 45

CHAPTER 7 - STAGING 50

EXHIBITS

APPENDICES

LIST OF EXHIBITS

EXHIBIT NO. 1 St. Georges - Location Plan

EXHIBIT NO. 2 Population Projections

EXHIBIT NO. 3 Groundwater Sources Investigated

EXHIBIT NO. 4 Surface Watershed Investigated

EXHIBIT NO. 5 Development of Supply - Groundwater Source

EXHIBIT NO. 6 Development of Supply - Surface Water Source

EXHIBIT NO. 7 Scheme "A" - Little Barachois Brook

EXHIBIT NO. 8 SCHEME "B" - Dribble Brook

EXHIBIT NO. 9 SCHEME "C" - Flat Bay Brook

EXHIBIT NO. 10 SCHEME "D" - Flat Bay Brook (Wells)

EXHIBIT NO. 11 to 13 Proposed Water Distribution System

EXHIBIT NO. 14 Hydraulic Gradients of Water Distribution System

EXHIBIT NO. 15 Water Treatment Plant - Schematic Flow Diagram

PHOTOGRAPHS

LIST OF APPENDICES

APPENDIX 1	Fish Inspection Act, Fish Inspection Regulations, PC171-935, Schedule A, Construction and Equipment Requirements for establishments, Part 1, General, Clause 9 (1) and (2), Page 44-26.
APPENDIX 2	Letter from Flintkote Company of Canada Limited regarding water demand.
APPENDIX 3	Letter to Cold Water Fisheries confirming Fish Plant water demand.
APPENDIX 4	Groundwater Feasibility Study - By Nolan, White and Associates Limited.

INTRODUCTION

The St. George's Industrial Water Supply Study is a project under the Agreement between the Province of Newfoundland & Labrador and the Department of Regional Economic Expansion of Canada.

The appointment of consulting engineers was confirmed by telegram dated April 11, 1972 from Mr. C. Karasek, Director of Infrastructure, Department of Community and Social Development.

The objective, requirements and scope of the project were set out in the Terms of Reference which outlined in detail the nature of the investigations to be carried out.

OBJECTIVE

To determine the optimal method of providing fresh water to the industrial area of St. Georges, and to prepare preliminary designs and cost estimates for a fresh water supply to that area.

REQUIREMENTS

(1) The preliminary design shall have sufficient flexibility to allow for the extension of the water supply to the rest of the Town;

(2) The land use and general planning conception must be in accordance with the official 1969 Town Plan;

(3) The quality of the domestic water must meet the standards as established by the Province of Newfoundland and Labrador.

(4) The quality of the water supply for the industrial uses must be adequate and meet the industrial requirements;

(5) Fire Flows must meet the Canadian Fire Underwriters Association standards;

(6) The sources to be investigated shall include Part I, Groundwater Supply and if directed Part II, Surface Water Supply.

This pre-engineering report has been prepared in accordance with these objectives and requirements.

An interim report was submitted to the Federal/Provincial sub-committee in mid May. The findings and conclusions contained therein have been incorporated in this report.

DATA COLLECTION

The following basic data was assembled in the course of preparation of the report:-

1. The 1969 Municipal Plan for the Town of St. Georges forms the basis for future planning. This plan was reviewed with the Provincial Planning Office. Basically no changes were required.

2. Population figures were updated on the basis of preliminary 1971 Statistics Canada figures.

3. A copy of the Sewer and Watermain construction drawings prepared by Gorman Butler Limited for the Town of St. Georges in 1966 was obtained.

4. Mapping of the area was obtained in the form of 1 = 200 ft. topographical plans and 1:50,000 maps.

5. The obvious physical changes to the Town were identified from field inspections. This mainly consisted of noting locations of new buildings erected since the topographic plans were prepared.

6. Aerial photos, geological maps and other information, including reports on wells drilled in the Stephenville area were obtained.

7. The two major industries in the area, The Flintkote Company and Cold Water Fisheries were contacted to determine future water requirements.

8. Regulations covering the quality of water supplies to fish plants were reviewed with Federal Fisheries Department and Newfoundland Fisheries Development Authority.

9. Several reports relating to water supplies to fish plants in other communities were obtained for reference purposes.

10. Rainfall and run-off data for rivers in the St. Georges area was assembled.

11. All surface water sources were sampled. A chemical and physical analysis of each sample was carried out.

12. Mapping of property in the St. Georges area was obtained from Crown Lands and Surveys, Department of Mines and Resources.

SUMMARY AND RECOMMENDATIONS

The essential data, conclusions and recommendations which have evolved from this Study are summarized below:

- The report incorporates the findings of an interim report submitted to the sub-committee in May 1972.
- An assessment has been made of the existing and future water requirements of the two main industries in St. Georges - The Flintkote Company and the Cold Water Fisheries Plant. Of these, the fish plant is and will be the major industrial user.
- The 1969 St. George's Municipal Plan has been used as a basic guideline in the establishment of design population figures. Based on the plan, a 20 year population projection of 3,160 persons has been used in determining community water needs and in sizing the facilities.
- The Terms of Reference specifically excluded any extensive subsurface investigations for groundwater. Early in the Study however, it was established that several zones near the Town might provide a good supply and it was recommended that a limited subsurface testing programme be carried out. The investigation in fact showed that there appears to be no groundwater source close to the Town capable of meeting the industrial or community requirements.
- An existing drilled well close to the Town was pump tested. This appears to be a good well capable of producing about 40 gallons per minute.

- The water in several local streams was tested and found to be of high quality with the exception that all samples showed fairly high colour concentrations, indicating that surface water would require treatment. Surface water supply to the Town from Barachois Brook, Dribble Brook and Flat Bay Brook formed the basis for three separate schemes.

  A groundwater supply, from granular deposits adjacent to Flat Bay Brook forms the basis of a fourth system.

- The recommended scheme (Scheme "D") is based on a groundwater supply from a source close to Flat Bay Brook where it is crossed by the Trans-Canada Highway - about three miles from St. Georges. It is unlikely that treatment of the water would be required. Cost of this system, including supply, transmission, storage and distribution to the industrial areas is estimated at $795,000.00* Some further study will be required to determine the most economical method of extracting water from this zone and the extent to which colour improvement can be realized.

- A section is included which describes distribution systems for the industrial area and future extensions to meet community needs. The system is basically the same as that shown in the plans prepared by Gorman Butler Limited. Sizing and location of the watermains are illustrated.

- Development restrictions should be imposed on the zone near Flat Bay Brook from which the water supply would be drawn.

- The provision of a temporary supply to the Town from the existing well is not recommended. Additional expense would be incurred and such a temporary system would not be adequate for the requirements of either the existing industry or present community.

---

*Includes 10% engineering.

CHAPTER 1 - WATER DEMAND

A. INDUSTRIAL DEMAND

The two major industries in St. Georges which were considered for an industrial water supply are the Flintkote Company and the Cold Water Fisheries plant.

(i) Flintkote

This company's operation in St. Georges consists of loading facilities for shipping gypsum and anhydrite. There is a large stockpile of gypsum at Turf Point from which the material is loaded onto ships. The gypsum is transported to the stockpile by an overhead cableway and in large trucks.

There is no present or planned industrial process at Turf Point requiring the use of fresh water. Some damping down of the stockpile is done with water pumped from a well on the site which delivers approximately 10 gpm. The only other normal requirement would be for domestic water (toilets, washrooms) for the small labour force.

A letter accompanying this report (Appendix #3) suggests that ships may take on water while loading. The occasional demand of 20,000 gallons is relatively insignificant. In assessing future demand it has been assumed this demand could occur several times in one month.

Fresh water demands will be minimal even assuming that the stockpile watering will eventually come from the municipal supply and that ships will take on water if it is available. For the purpose of this study Flintkote Company's requirements are assumed to be in an average of 10,000 to 20,000 gallons per day.

(ii) Cold Water Fisheries

Regulations being introduced by the Federal Department of Fisheries governing operating standards for fish plants (Appendix No. 1) will require that water used in any fish plant comes from approved sources.

The water used in the fish plant at St. Georges is drawn directly from Flat Bay close to the plant and would not meet the new standards. The provision of an acceptable supply to the plant is therefore a matter of some urgency.

Salt water may be used in the processing of fish provided it meets the requirements. A supply of fresh water must be available however for use in washrooms and certain processes such as ice making and skinning machines.

The plant processes 30 to 50 tons of herring per day at present and facilities can be expanded to handle 100 tons per day. It is hoped that 50,000 lbs. of ground fish per day will be processed here in the near future and that facilities will be improved eventually to handle 250,000 lbs. of this type of fish per day.

Based on volumes used in modern fish plants the maximum daily total water requirements at present would be (100,000 lbs. per day x 2 1/2 gals. per lb) 250,000 gallons per day. On the same basis the future requirements could be as high as 625,000 gallons per day which would possibly be required over a 10-hour period (Appendix #4).

It is not known when the demand for the higher figure will occur, but one of the purposes of this study is to determine how any such future demand can be met, if and when it arises.

(iii) New Industry

It is difficult to forecast what new industries might locate in the St. Georges industrial area once a water supply is made available.

It would be desireable, therefore, to have a source capable of being expanded or further developed to meet a substantial future demand.

B. DOMESTIC DEMAND

The domestic water supply demand evolved in this report has resulted from a study of the existing community together with the planning recommendations contained in the 1969 St. George's Municipal Plan.

The Municipal Plan has set out land use and development plans for the area. The only updating of this plan was in the population figures which have taken into consideration the 1971 Statistics Canada preliminary Census.

A design period of 20 years has been selected for the purposes of determining future domestic needs.

According to the 1969 Municipal Plan, the outmigration of the work force due to the closure of the Harmon Base in Stephenville was assumed to have ceased in 1968. Since that time opportunities in the industrial expansion at Stephenville have apparently become available, since the present population of St. Georges surpasses the pre-Harmon Base figures. The Municipal Plan states that *"as industrial expansion in the Stephenville area progresses, increasing employment opportunities will become available to the work force in St. Georges."* Further expansion of the Town population will be brought about by an inflow of people employed in local or regional industry who will be qualified for the employment available.

An average annual growth rate of about 2% was the trend until 1966, and it is reasonable to assume that this trend will be again experienced. This is represented graphically on Exhibit No. 2.

Population history and projected growth is summarized as follows:

Year		Population	Percent Annual Increase
1961		1,874	
			+ 1.75%
1966		2,046	
			- 9.0%
1968		1,696	
			+ 7.1%
1971		2,085	
			+ 2.0%
1972	Projected	2,127	
			+ 2.0%
1992	Projected	3,160	

C. CALCULATION OF DEMANDS

(a) Industrial

		Fish Plant	Flintkote	Total
Present				
Daily demand	(gals)	250,000	7,000	257,000
Daily demand rate	(gpm.)	175	5	180
Future				
Projected 1992 yearly demand	(gals)	84,000,000	6,000,000	90,000,000
Avg. daily demand rate	(gals)	230,000	16,000	246,000
Yearly ave. demand rate	(gpm.)	160	10	170
Maximum daily demand	(gals)	625,000	30,000	655,000
Maximum daily demand rate	(gpm.)	440	20	460
Peak Hourly demand	(gpm.)	62,500	5,000	67,500
Maximum Hourly demand rate	(gpm.)	1,040	80	80

The figures given for the fish plant represent a total demand, i.e. including fresh water and possible salt water. If salt water of the required quality were obtained it could make up about 90% of the figures shown for the fish plant. About 6,000,000 gallons per year of fresh water would be required in any case.

The controlling demand for the design of a water supply to the industrial area is considered to be the daily fish plant demand since 4 - 5 consecutive days of continuous full operation must be considered a possibility both at present and in the future.

(b) Community Domestic Demand

1.	1971 Population	2,085
2.	Projected 1992 population (20 year period)	3,160
3.	Per capita consumption (all uses)	75 gpcpd
4.	Average daily consumption	237,000 gals.
5.	Total yearly consumption	86,505,000 gals.
6.	Yearly average consumption rate	165 gpm.
7.	Maximum daily demand factor	2.25
8.	Maximum daily consumption rate	370 gpm.
9.	Peak hourly demand factor	4.0
10.	Peak Hourly domestic demand	660 gpm.

(c) Fire Demand

1. Canadian Underwriters Association Formula:

   $Q = 850 \sqrt{P} (1 - 0.01 \sqrt{P})$

   $P = 3.16$ (3,160 population)

   $Q = 1,480$ gpm.

2. Minimum of 4 std. Fire Streams desireable to supply any location 175 U.S. gpm. (low risk).

3. Hydrant Residual Pressure:

   20 p.s.i. - if pumper used

   50-75 p.s.i. - if no pumper

4. Fire flow duration - 3 1/2 hours.

D. SUMMARY OF CONTROLLING DEMANDS

1. Demands for distribution system sizing (1992)

(a) Absolute Peak 1 hour demand

. Industrial	1,120	
. Community	660	
		.... 1,780 gpm.

It is assumed that the industrial supply would not be maintained for the duration of a major fire in which case absolute peak hour demand would be

. Industrial	0	
. Community	660	
. Fire	1,480	
		.... 2,140 gpm.

(b) Minimum design demand

. Industrial	(max. day)	460	
. Community	(max. day)	370	
			.... 830 gpm.

(c) Design Demand

. Community	(max. day)	370	
. Fire		1,480	
			.... 1,850 gpm.

2. Water Supply Demands

. Present industrial demand	180 gpm.
. Present industrial demand + present community demand (Average Yearly) 180 + 110	290 gpm.
. Future industrial + present community demand 460 + 110	570 gpm.
. Future industrial + future community demand (Yearly average) 460 + 165	625 gpm.
. Future industrial + future community demand (daily maximum) 460 + 370	830 gpm.

The maximum rate of demand to be provided from the source of supply will be 1,850 gpm. for a duration of 3 1/2 hours. This is in accordance with the Canadian Underwriters Association requirement for communities of 3,000 to 4,000 persons.

The per capita daily consumption of 75 gallons (90 U.S. gal.) is considered appropriate for this community. Per capita consumption will vary in accordance with many factors, including the size of the community, presence of sewers, quality of the water and whether or not the water supply to the household is metered.

The maximum daily water supply demands will range from the present industrial requirement for a 180 gpm. continuous supply up to a maximum of 830 gpm. in the design year considering an expanded fish processing industry and a larger community. This is represented diagramatically on Exhibits #4 and #6.

It would be possible to supply part of the demand, from 160 gpm. at the present up to 390 gpm. in 1992 from an acceptable salt water source. This is discussed in the following chapter of this report.

CHAPTER 2 - WATER SUPPLY SOURCES

SUMMARY

The Terms of Reference require that the first step carried out be an evaluation of the groundwater potential in the St. Georges area. The possibility of utilizing sea water was also to be considered.

The geology of the area together with field observations of exposed soils indicated that the groundwater potential was good. This was not borne out, however, by the subsurface investigation subsequently carried out in the immediate vicinity of the Town.

A comprehensive study of the surface water potential was then undertaken.

Further testing proved the existance of a good groundwater aquifer near Flat Bay Brook.

The investigations and conclusions reached are described in this chapter. Descriptions of the field tests are also contained in the report by Nolan, White Associates (Appendix #4).

A. GROUNDWATER

The following evaluation of groundwater potential was made in the initial stages of the Study:

> ### *SUMMARY*
>
> *Much of the Stephenville/St. Georges area is underlain by the vast outwash deposits of sand and gravel of glacial origin which represent what is possibly the best groundwater source on the Island of Newfoundland.*

The St. Georges area specifically is near the southern extremity of these deposits and has therefore groundwater potential which, although good, is less clearly defined.

WELL HISTORY

Both deep (bedrock) and shallow drilled wells have been utilized on many occasions by residents of this area. They have been fairly successful, but demand has generally been low and the wells have seldom been adequately tested. Some producing drilled wells achieve their production through the open end of a piece of casing, drilling having terminated in the sand and gravel material. Others have been cased to bedrock with additional penetration in rock ultimately being rewarded when water bearing fractures are intersected. Many dug wells have been successful, especially those in low areas. Construction of dug wells in clean sand and gravel below the water table is difficult and the wells may go dry during prolonged periods of low precipitation. Sand points have been used rarely since coarse gravel and boulders seem to occur frequently enough to discourage their use.

The highest producing wells in Newfoundland were developed in Stephenville by the U.S. Army Corps of Engineers. One of the test wells which was properly screened and developed had been put down to a depth of approximately 100 feet. This well produced 980 USGPM with a drawdown of 19 feet. Other similar wells in the same area yielded roughly 300 to 600 USGPM.

SURFICIAL DEPOSIT GEOLOGY

During Pleistocene time the ice which moved from the interior of the Island out into St. Georges Bay was *directly responsible for the emplacement of vast deposits of sand and gravel. Beds of silt and clayey silt are also found within the assemblage of unconsolidated material. The granular materials have been reworked and washed to the extent that much of it is highly pervious. It is for this reason that some zones in these deposits make excellent aquifers.*

The access highway from the Trans-Canada Highway to the community of St. Georges can be considered as representing the southern extremity of large deposits of sand and gravel. Excellent deposits do occur adjacent to Flat Bay Brook but these fluvial sediments differ in origin from the broader deltaic deposits of the region.

Fine-grained material becomes more prevalent toward the west end of the Town.

BEDROCK GEOLOGY

The Community and vicinity is underlain by relatively young sedimentary rocks of the "Codroy Group" which have not been highly lithified. These are comprised of sandstones primarily with some limestone, but are best known for the commercial gypsum deposits they contain. The sandstones may contain some good aquifer horizons but in any event would probably require the use of well screens to properly develop these zones as is the case with the above-mentioned sand and gravel deposits.

There has been no attempt as yet made in Newfoundland to properly assess the groundwater potential in these rock types. Most wells in western Newfoundland which penetrate these rocks probably yield less than 10 gpm.

The bedrock in and around the community of St. Georges is infrequently exposed. This is especially true at least of T.C.H. Access Road. At Turf Point near Indian Cove rock is near surface. It is exposed near the shoreline just east of Long Point. The inclination of bedding planes vary considerably from one exposure to another but the strike is generally northeast.

AREAS FOR INVESTIGATION

There are four zones in the St. Georges area which have groundwater potential. These are shown on Exhibit #4.

Zone No. 1 has the highest potential, but is situated at considerable distance from the existing community. It lies along the Flat Bay Brook Valley and is represented by extensive river terrace deposits of sand and gravel. This material is relatively coarse and well-graded with size ranging from fine sand to cobbles and boulders. The installation of screened wells in terraces adjacent to the river would probably result in high production being achieved, e.g. greater than 200 gpm. per well. The main factors to be determined are (a) quality of material beneath water table, (b) depth of producing horizons below water table. In other words, adequate drawdown must be assured from a zone of suitable (high transmissibility) material. The deposits in this area would lend themselves to a lineal system of development which could be expanded with comparative ease.

Zone No. 2 is located between the railway and Highway No. 47 just to the northeast of St. Georges. This large *deltaic deposit consists of bedded sand and gravel the quality of which appears best toward Barachois Brook. The surface of this deposit is probably 50 feet or so above the main water table. The possibility of intersecting bedrock at too high an elevation is a concern in this area as well as the proximity to the salt water shoreline. The possibility of insufficient groundwater recharge may also be a limiting factor. However, the nearby deposits along Barachois Brook Valley, which are really an easterly extension of Zone No. 2 are more favourably located with respect to their potential but are further distant from the Town. Therefore, Zone No. 2 and "Zone No. 2 Extension" must be compared according to: (a) magnitude of production required, (b) distance from community and industry, and (c) economic significance of (a) and (b).*

Zone No. 3 is in the Dribble Brook Watershed. The sand and gravel deposits in this river valley are less impressive than Zones Nos. 1 and 2 but are worth consideration. The watershed of Dribble Brook is small, compared to either Flat Bay or Barachois Brooks, which in itself is a disadvantage when considering high demands.

Zone No. 4 was chosen because of its location relative to elevation and community layout but would appear to be less favourable than the other zones selected. It would seem that sand and gravel deposits do not underlie this area. Bedrock is thought to be within 50 feet of surface and the overburden is presumably high in fines.

Zone 4 - Pump test on existing drilled well

Three wells were drilled into bedrock about four years ago for the Town of St. Georges. One of these (see Exhibit No. 4) reached a depth of 254 feet and is thought to be the well which is located on Sullivan's Lane. The other two wells are located in a field a few hundred feet south of Francis Alexander's property. These are believed to be 180 feet and 110 feet in depth with 60 and 50 feet of casing respectively. One of these was drilled as an observation hole for the other.

Well No. 1 (see Exhibit No. 4) was pump tested for a period of 24 hours. The static water level at the beginning of the test was 0 feet (elevation of surface is approximately 95 feet above sea level). Pumping at the rate of 27.5 gpm. resulted in a drawdown of 59 feet in 24 hours. It would appear that this well would have a yield of approximately 40 - 45 gpm.

This well is relatively good compared to most deep wells in Newfoundland. The location, however, is not in the most favourable area with respect to groundwater potential; this is especially true when considering the magnitude of the required demand.

It was not possible to use Well No. 2 as an observation well nor to pump test as it was found to be uncapped and choked with debris.

While this well is adequate for supply to a small number of dwellings, it cannot be considered suitable for a community and/or industrial supply. The bedrock underlying this part of the community is not known to be highly fractured (no indications of fault zones, etc.) but may contain a moderate aquifer.

Zones 2 and 3 - Field Drilling Programme

A programme of subsurface investigation was recommended to and approved by the sub-committee upon presentation of the interim report. It was felt that it was important to prove conclusively if Zones 2 or 3 could supply the industrial and community needs.

Descriptions of the boreholes and logs of materials encountered are contained in Appendix #4 of this report. The boreholes indicated that Zones 2 and 3 were not suitable for well development.

Zone 1 - Field Tests

This zone along Flat Bay Brook was initially considered to be too far from the Town to constitute an economic supply source. Cost comparisons with the surface water schemes showed that if groundwater extraction could remove the coloration from the otherwise good water, a scheme based on this source would be less costly.

A field testing programme was undertaken to determine if there was in fact an aquifer in this area capable of delivering the required volume of water. The results show that the aquifer has a high production capability.

The granular materials excavated in the test pits are well graded and it is highly likely that the coloration found in the water from Flat Bay Brook would be reduced to an acceptable level. Treatment would not then be required.

Further testing should be carried out in the design phase of this project to determine

(a) The extent of colour improvement
(b) The most economical method of extraction.

The water table in the area tested is high so that extraction could be by means of

Infiltration galleries
Well Points
Shallow or deep wells

An important advantage of utilizing a groundwater source is that it can be developed or expanded on an incremental basis depending on development of demand.

B. SURFACE WATER SUPPLY

SUMMARY

An investigation to determine the feasibility and costs of developing surface water sources was carried out. Studies of the available topographic mapping and aerial photography were made and a supplementary field reconnaissance programme to locate suitable natural reservoirs or intake locations or streams reasonably close to the community (Exhibit No. 4). Run-off data for the area is tabulated and water treatment is discussed in this chapter.

The streams considered for water supply are:

(i) Little Barachois Brook
(ii) Dribble Brook
(iii) Flat Bay Brook

RUN-OFF DATA

Run-off data has been recorded since 1968 for Harry's River which is about seven miles north of St. Georges. General topography and vegetation are similar to the Little Barachois Brook, Dribble Brook and Flat Bay Brook catchment areas. A summary of this data appears in Fig. No. 1.

Further data was obtained in the form of recorded electricity generated at a small power station located on a tributary of Flat Bay Brook some twelve miles from St. Georges. Records for five years of operation were examined. This data indirectly confirms that the Harry's River flows are representative of those found in Flat Bay Brook.

Harry's River has a watershed area of 245 square miles. The minimum daily flow recorded was 54.6 cfs on June 21, 1971; the second lowest 57.9 cfs on June 26, 1971, and the third lowest 66.7 cfs on June 25, 1971. The minimum daily rate of run-off from this watershed using the June 21, 1971 figures was 54.6/245.0 = 0.2228 cfs. per square mile. A similar rate of run-off is expected from the Little Barachois Brook, Dribble Brook and Flat Bay Brook watersheds as follows:

Watershed	Area	Minimum Daily Run-off Area x 0.2228 cfs/sq.mi.
Little Barachois Brook	135 sq. mi.	30.08 cfs (11,262 gpm)
Dribble Brook	9 sq. mi.	2.01 cfs (753 gpm)
Flat Bay Brook	222 sq. mi.	49.46 cfs (18,518 gpm)

<u>Factor of Safety</u> - The ratio of minimum daily run-off available to maximum daily usage is considered as the normal Factor of Safety governing design. The future maximum daily consumption will be

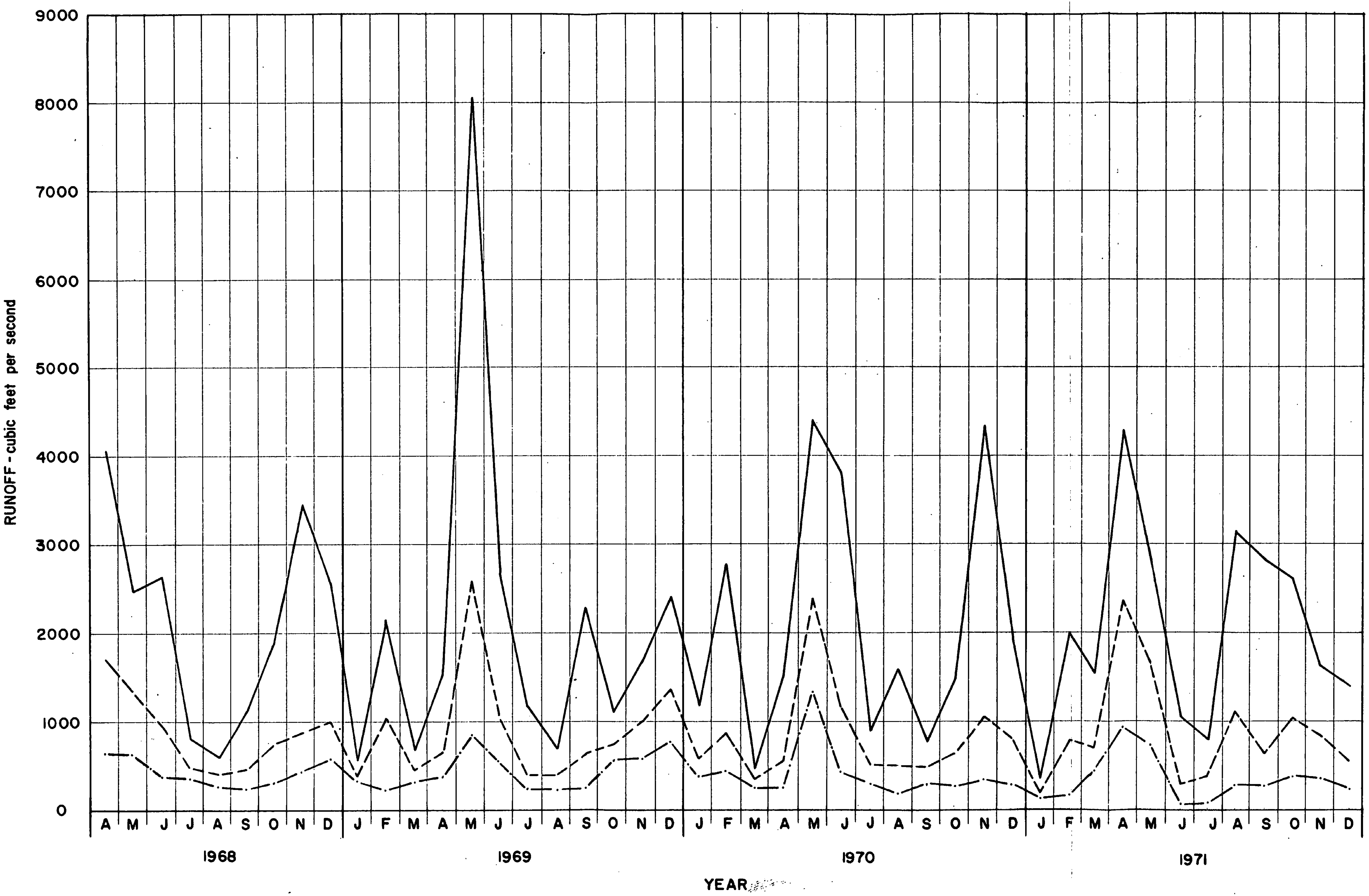
. Industrial	460 gpm
. Community	370 gpm
	830 gpm

i.e. 2.22 cfs.

			Factor of Safety
. Little Barachois Brook	30.08/2.22	=	13.55:1
. Dribble Brook	2.01/2.22	=	0.91:1
. Flat Bay Brook	49.46/2.22	=	22.20:1

Little Barachois Brook and Flat Bay Brook at minimum recorded flow contain sufficient water to supply the future industrial and community needs through a river intake. Dribble Brook cannot sustain the flow required for the future water supply but it could be developed by constructing a dam and impounding reservoir.

FIGURE Nº 1



HARRYS RIVER

DAILY DISCHARGES

(GAUGED BELOW HIGHWAY BRIDGE)

LEGEND

——— MAXIMUM DAILY DISCHARGE

– – – – MEAN DAILY DISCHARGE

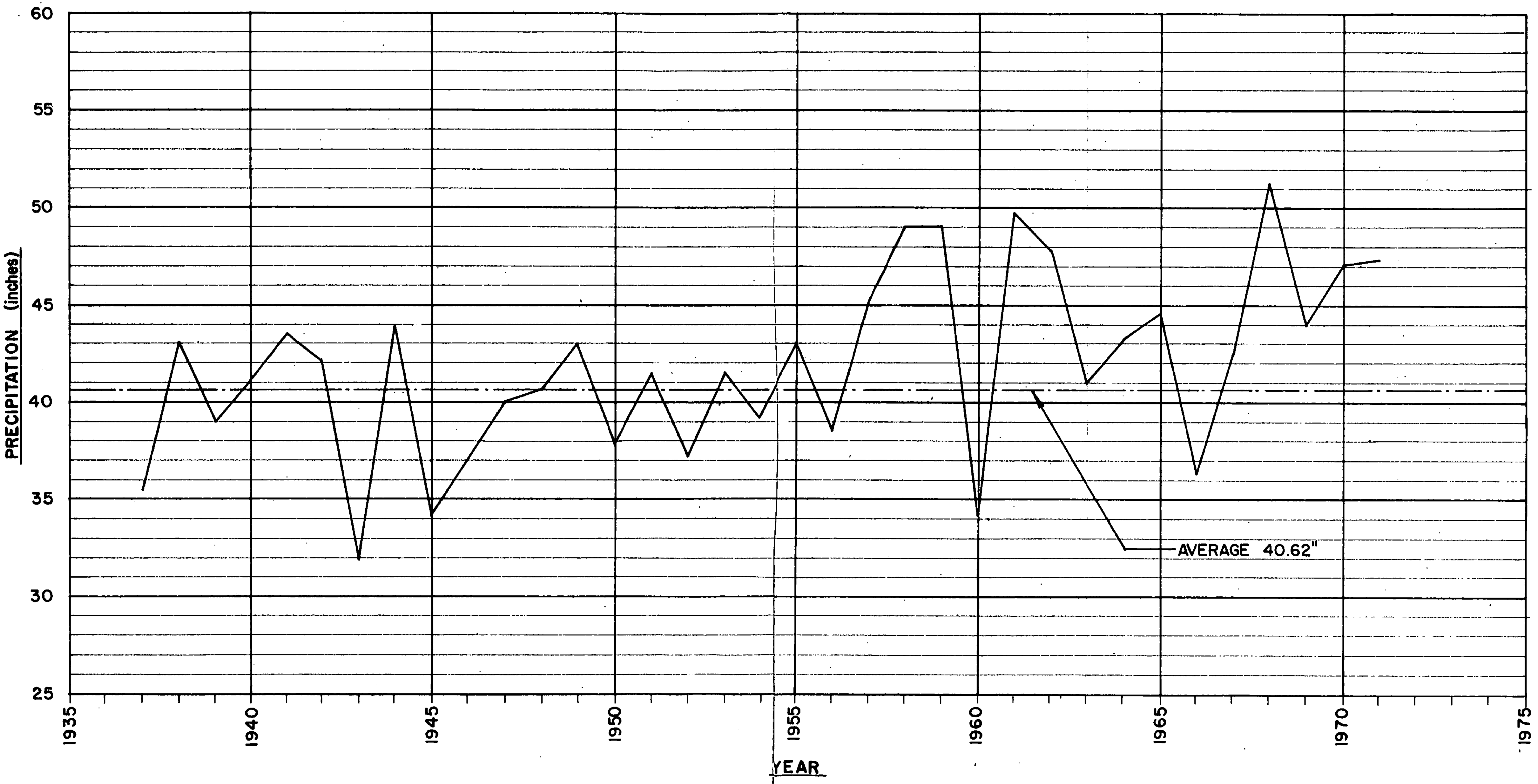
–·–·– MINIMUM DAILY DISCHARGE

MAXIMUM DAILY FLOW
8050 cfs
MAY 21, 1969

MINIMUM DAILY FLOW
54.6 cfs
JUNE 21, 1971

De Leuw, Cather
consulting engineers

FIGURE Nº 2



ANNUAL PRECIPITATION RECORD – ST. GEORGE'S 1937-1942
STEPHENVILLE 1943-1971

De Leuw, Cather
consulting engineers

DESCRIPTION OF STREAMS

Little Barachois Brook - Little Barachois Brook flows into St. Georges Bay at the eastern limits of the Town. There are no natural ponds or reservoirs on this river within nine miles of the community. Since it is a designated salmon stream, any structures blocking the river such as dams, must incorporate fish ladders to permit free movement of the fish. A properly designed water intake in the stream could provide an adequate water supply. This intake should be located far enough upstream of the Canadian National Railway Bridge to avoid the intrusion of salt water into the system. Little Barachois Brook is the surface source closest to the Town (1.8 miles) and a system based on it (Scheme "A") has been developed.

Dribble Brook - Dribble Brook is a tributary of the Flat Bay Brook watershed. The effective 9.0 square mile watershed cannot directly provide the demand flows on a daily basis at certain times of the year. In the absence of any natural ponds near the Town, it would be necessary to construct a dam and storage reservoir to utilize this source.

The flat marshy topography of this watershed east and west of the Trans-Canada Highway precludes the construction of a dam close to the Town. From an examination of the aerial photographs followed by field reconnaissance, a dam location was selected about 2.2 miles from the Town. The foundation conditions at the dam site are not exactly known but the generally extensive sand and gravel deposits in the area will almost certainly necessitate sealing to prevent leakage from the reservoir. This development would be very costly and would only be practicable if no other suitable source could be found. Scheme "B" is based on this source.

Flat Bay Brook - Flat Bay Brook flows south of the Town and drains a large catchment area of about 222 square miles. There is a substantial flow in this stream throughout the year. Flat Bay Brook is somewhat further removed (2.5 miles at the closest point) from St. Georges than the other streams and the cost of a transmission main would be somewhat higher. Scheme "C" is based on a surface supply from this river.

Samples taken from these streams confirm that treatment will be required. This is discussed in the following chapter.

C. SEA WATER SUPPLY

Existing regulations permit the use of "acceptable" sea water in the processing of filleted fish. (Appendix 1). It is probable that similar regulations will be introduced in the near future to cover processing of herring. At the present time herring is unloaded from boats using sea water drawn directly from Flat Bay immediately adjacent to the fish plant. The new regulations will require that the herring be unloaded from boats or otherwise handled using "acceptable" water. "Acceptable" water can be provided in two forms:

(a) Untreated Water - Sea water may be used without treatment provided that it is sufficiently low in bacteria and other detrimental elements so that it can meet Federal Fisheries Department standards for untreated water. Chlorination would be required in any case.

There are two methods of supplying such water

- Offshore intake - Location of an intake at some point in the bay where "acceptable" water is found. Determination of a suitable location would require fairly extensive sampling and testing at various locations as well as a study of tidal flushing action and currents in the bay. A superficial examination suggests that since Flat Bay is almost enclosed by Sandy Point, flushing action may be minimal. Since a considerable amount of raw sewage from the community flows directly into Flat Bay, the contamination levels would almost certainly be high. An intake then, would have to be located at a considerable distance off shore.

- Salt Water Wells - Provided that subsurface conditions were suitable, wells could be developed close to the shoreline. Indications are, however, that in the vicinity of the plant soils conditions would not favour this approach.

  Water from wells would, in any case, have to either be available in sufficient quantity to meet the maximum demand directly, or storage facilities from well supplied salt water would have to be provided. Furthermore, several wells would probably be required.

(b) Treated Water - Sea water could be pumped directly from the bay at an intake close to the plant and put through a water treatment process which would include chlorination.

Considerable expense would be involved in providing "acceptable" sea water by any of the methods described, and in all probability the only user for such a supply would be the Fish Plant.

The chlorination process would be a duplication of that required for the fresh water supply to the Municipality. A salt water treatment plant for processing the volumes of water required would be very costly.

In view of the limited number of potential sea water users it is suggested that efforts should be concentrated on developing a fresh water source rather than on providing acceptable sea water.

CHAPTER 3 - TREATMENT

Water samples taken during the course of this study indicated that treatment would be necessary before surface water could be used in a municipal water system.

Water Quality

Samples were taken from Barachois Brook, Dribble Brook and Flat Bay Brook on June 4th. 1972 and again on August 1st. 1972.

The first set of samples was analysed for physical and chemical characteristics by the Water Laboratory, Department of the Environment, Moncton, N.B. A similar analysis was carried out on the second set of samples by the Water Laboratory at Memorial University in St. John's.

The sample results were compared with criteria proposed by the Clean Air, Water and Soil Authority. While these standards have not yet been adopted by the Authority, they are a useful yardstick for water quality and are furthermore comparable with standards accepted elsewhere.

It can be seen that the samples are generally well within the criteria for high quality water with the exception that in all cases the colour readings were above the acceptable limits.

There is, furthermore, some concern that the turbidity could be unacceptably high at certain times of the year.

Bacteriological testing was not carried out but some contamination would be anticipated in all streams.

On the basis of the test results, it is recommended that any surface source be treated before being used in a municipal water system.

ST. GEORGES

WATER SAMPLE ANALYSES

SAMPLES	FLAT BAY BROOK		DRIBBLE BROOK	BARACHOIS BROOK		STANDARDS	
	June 4/72	Aug. 1/72	June 4/72	June 4/72	Aug 1/72	DESIRABLE	UPPER LIMIT
Turbidity	0.20 JVT	0.15	0.25	0.31	0.20	Less than 1	5
Colour	*40	20	60	40	30	" " 5	15
Chloride	5.1 ppm		8.2	5.3		" " 250	
Iron (Extractable)	0.105	0.177	0.12	0.14	0.000	" " .1	3
Magnesium (dissolved)	0.46	0.855	0.80	0.60	1.033	" " 50	
Manganese (extractable)	0.005	0.000	0.005	0.005	0.000	" " .05	
Specific Conductance	32.3	67.4	70.1	32.5	72.0	" " 50	150
Hardness	6.9	13.73	18.5	6.7	7.51	" " 120	
Calcium	2.0	3.96	6.1	1.7	1.303	" " 75	
Sulphate	2.9		9.1	1.9		" " 250	
Residue	No test when Turbidity is less than 3.0						

* parts per million

Samples taken from streams in St. Georges area, June 4, 1972 and August 1, 1972

Analysis of samples taken June 4, 1972 by Water Laboratory, Department of the Environment, Moncton, N.B.

Analysis of Samples taken August 1, 1972 by Water Laboratory, Memorial University of Newfoundland, St. John's, Nfld.

DESCRIPTION OF FACILITIES

- *Intake and Low-Lift Pumping Station* - An underwater intake structure and conduit would be constructed at a suitable location and depth on the proposed source. This intake would lead directly to the receiving well of the low-lift pumping station, to be built adjacent to the river. Two vertical submersible pumps would be installed with space provided for a third (future) pump. Each pump would be sized to provide maximum daily capacity to the treatment plant. The intake and low-lift pumping station would be sized for the ultimate plant capacity.

- *Water Treatment Plant* - Coagulation followed by filtration is the process most widely used to remove substances producing turbidity and colour in water. Chlorination is normally included in any treatment process.

  A package type plant would probably be most economical to construct and to maintain. A "solids contact" unit would be suitable since it could incorporate in a single unified structure the process of mixing, coagulation and flocculation, floc conditioning, liquid-solids separation and sludge removal.

  The plant would be sized initially to meet demands anticipated for the first few years. For example, a standard type plant processing 460 Igpm should meet the anticipated demand up to 19. Facilities would be designed so as to permit expansion of the plant by means of the addition of a further 460 Igpm. processing unit which would accommodate demands projected to 1992. Schematic layout of plant is shown on Exhibit #15.

- *Clear Well and High-Lift Pumping Station* - Associated with the treatment plant would be a treated-water storage well (clear well) with a sufficient storage for backwashing, and a high lift pumping station. Storage for peak periods and fire requirements would be provided in the municipal storage reservoir described in the chapter on the Distribution system.

  It is proposed that initially three high-lift pumps be provided, each rated at about 230 gpm. One of the three would act as a standby unit for the other two, which together would provide maximum daily demand flow to the storage reservoir in the initial stage. Further pumps would be added whenever the treatment plant is expanded.

- *Standby Power* - A diesel-electric generator standby power unit would be installed at the water treatment plant. This facility would be capable of operating two high-lift pumps, one low-lift pump, together with other small motors associated with the treatment plant.

A schematic diagram of the surface-water treatment plant is shown on Exhibit No. 14..

These facilities are common to Schemes "A", "B", and "C".

CHAPTER 4 - DISTRIBUTION SYSTEM

The industrial distribution system serves initially to provide water to the two main industries in the Town.

This system of conduits will constitute the "core" of the distribution system for residential users.

Some minor alterations to pipe sizing shown on the existing plans prepared by Gorman Butler Limited were required. These were mainly due to the location of connection points to the water supply system.

Pipe sizing has been determined by the fire flow requirements which exceed all other projected peak flows. The fire provisions are in accordance with the requirements of the Canadian Underwriters Association.

Pipes will be installed within road or street right-of-ways. Details of locations and sizing are shown on Exhibits 11, 12 and 13.

Industrial

The industrial system is made up of 10" diameter and 8" diameter pipes through the central section of the Town. The fish plant and adjacent industrial land is served by an 8" diameter main.

The main industrial area, between Main Street East and the Harbour would be serviced from the 8" diameter main on Main Street East which extends around the industrial area to the Flintkote Loading Dock area.

Community Distribution System

The residential distribution system will be an extension to the industrial system on which capped tees would be installed at appropriate locations.

The system has main distribution lines of 8" and 6" diameter. Feeder mains to minor streets would be 4" diameter pipe.

Fire Protection

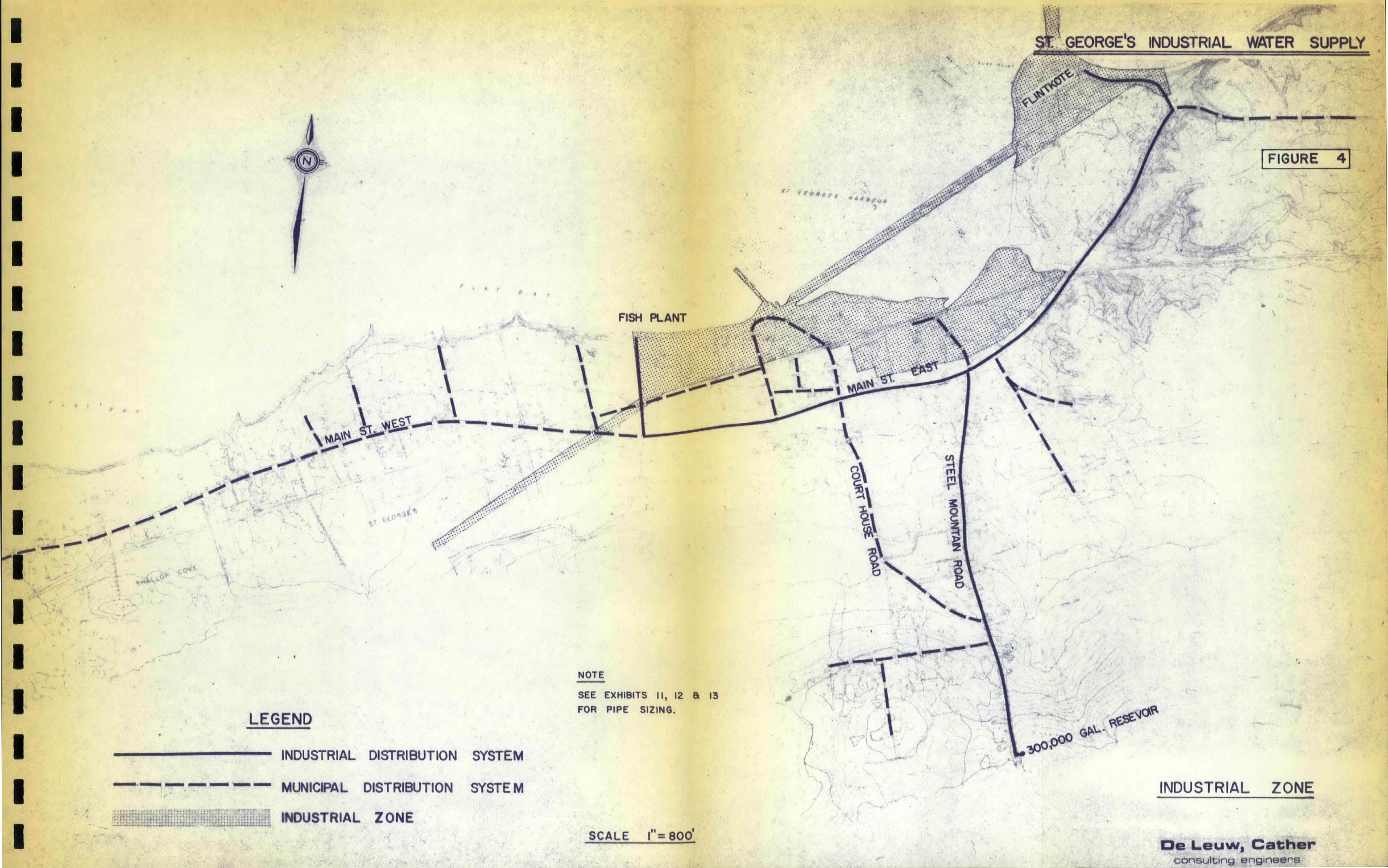
Storage - In order to provide proper fire protection for a community of this size, a 400,000 imperial gallon storage reservoir should be provided. This would be located at approximately elevation 280 near Steel Mountain Road (Schemes "A", "B", and "D") or on high ground approximately one mile south of the Town (Scheme "C").

Residual Pressures - Exhibit #14 sets out schematically the hydraulic gradients to be expected during a major fire at various locations in the Town.

There would be a minimum residual pressure of 26 pounds per square inch at the western extremity of the system.

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

FIGURE 4



NOTE

SEE EXHIBITS 11, 12 & 13
FOR PIPE SIZING.

SCALE 1" = 800'

INDUSTRIAL ZONE

De Leuw, Cather
consulting engineers

CHAPTER 5 - PREFERRED SCHEMES

The water requirements of the Town and the available sources of supply have been discussed in the foregoing chapters.

Four schemes have been developed for a water supply system;

Scheme "A"	-	Barachois Brook	-	Surface Water	
Scheme "B"	-	Dribble Brook	-	Surface Water	
Scheme "C"	-	Flat Bay Brook	-	Surface Water	
Scheme "D"	-	Flat Bay Brook	-	Groundwater	(Recommended)

GENERAL

Soils - The soil conditions at sites of structures (Storage reservoir and treatment plants) for all schemes appear to be generally similar in nature. The underlying materials would probably be boulder clay or sandy silt deposits which appear to be fairly widely distributed.

Scheme "B" envisages the use of a dam near the Trans-Canada Highway. If this scheme were selected, an extensive soils investigation of both the damsite proper and the reservoir basin should be undertaken.

Installation of some sections of the cross-country transmission lines would be in swampy ground. No rock excavation is anticipated as bedrock appears to be well below the surface in the St. Georges area.

Land Ownership - The several schemes discussed in this chapter have been overlaid on plans obtained from Crown Lands and Surveys.

The cross-country transmission mains (Schemes "B", "C" and "D") cross land that is owned by the Reid Newfoundland Company. The dam and reservoir site for Scheme "C" also lies on property owned by this company.

Easements across private property in the Town will be required to connect the mains with the distribution system. The exact route, however, would not be determined until the design stage.

Distribution mains and feeders would be installed within road or street allowances. The transmission line for Scheme "A" would be installed in the right-of-way of the road to Stephenville Crossing.

The groundwater aquifer in Scheme "D" is located on Crown land.

At this point it does not seem that land ownership should be a major factor in determining a suitable water supply system.

SCHEME "A" - BARACHOIS BROOK

This system would supply water to the Town from an intake located in Barachois Brook, upstream of the Canadian National Railway Bridge.

Holding Pond - A small holding pond would be excavated in the river approximately 500 ft. upstream of the bridge. The pond would serve as a reservoir for low-lift pumps supplying the treatment plant. The intake would be properly screened to keep out fish and debris.

Low-Lift Pumps - The low-lift pumping area would house a screen and two low-lift pumps each of 500 gpm capacity. The pumps would deliver raw water to the treatment plant.

Treatment Plant and High-Lift Pumps - The type of treatment plant and high-lift pumping system which would be used are described in Chapter 3. These facilities would be housed in one building.

Transmission Main - The transmission main, 10" diameter, would be installed in the right-of-way of the St. Georges - Stephenville Crossing road. Services to residential development along the road could eventually be tapped directly off this line.

Storage Tank - The storage tank would be located on Steel Mountain Road. This tank would then supply the system through a 12" diameter main.

COST ESTIMATE

	Treatment, pumping and transmission		
1.	Treatment plant, complete	$ 345,000.	
2.	10" transmission main - treatment plant to distribution system (9,500')	155,000.	
	Sub-total		$ 500,000.
	Storage		
3.	Reservoir (400,000 gals)	100,000.	
4.	12" diameter supply main, reservoir to Distribution system	92,000.	
	Sub-Total		192,000.
	Industrial Distribution System		
5.	Main Street West - Steel Mountain Road to Fish Plant Road (3,300')	69,300.	
6.	Main Street East - Steel Mountain Road to Flintkote (4,350')	82,700	
7.	Fish Plant Road - Main Street West to Fish Plant (1,000')	19,000	
	Sub-total		171,000.
	WATER SUPPLY AND DISTRIBUTION		$ 863,000.
	10% Engineering		86,000.
	TOTAL		$ 949,000.

SCHEME "B" - DRIBBLE BROOK

This scheme is based on the use of the Dribble Brook watershed which has a catchment area of 9.0 square miles (5,400 acres). Run-off from this watershed is not adequate during periods of low flow to supply the industrial and community needs from a stream intake similar to Scheme "A".

A dam and storage reservoir would be needed to maintain the water supply during dry periods. This scheme is shown on Exhibit No. 8.

Precipitation and Run-off Data - The information needed to determine the required capacity of an impounding or storage reservoir includes a hydrograph of the outlet stream for the longest and driest period known or predicted and water demand data during that dry period. Since no hydrographic data exist for this catchment, the amounts of run-off available and the required reservoir storage capacities have been determined from existing regional precipitation records for the minimum year on record, (Chapter 2, Figure No. 2) in conjunction with the run-off data for the neary Harry's River, (Chapter 2, Figure No. 1).

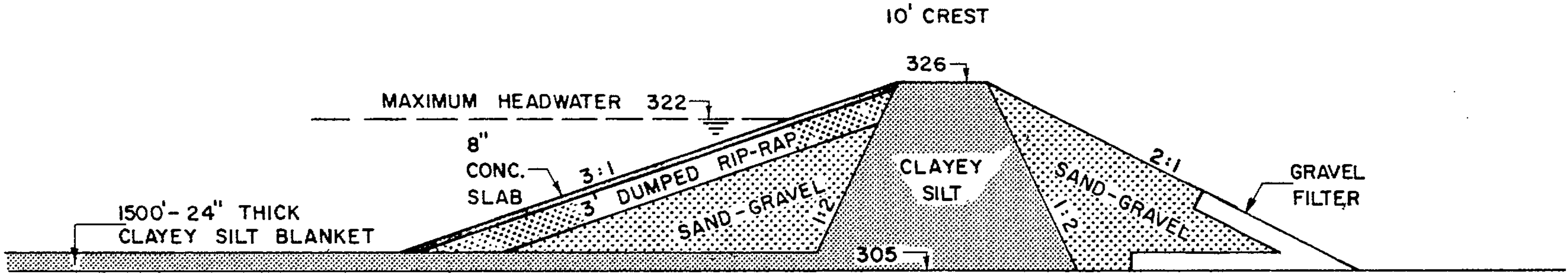
The lowest annual precipitation recorded was 31.84 inches in 1943. On two other occasions 34.20 inches was recorded (1947 and 1960). The average long term precipitation is 40.62 inches.

During the three complete years of gauged stream flow on Harry's River, the average annual precipitation has been 46.12 inches. The average annual rate of discharge per square mile was 3.49 cfs/sq. mile. The ratio of the lowest annual precipitation to the average annual precipitation is 31.84:46.12 or 69.0%. Therefore, the minimum annual discharge to be expected from Dribble Brook during period of lowest precipitation is

$.690 \times 3.49 \times 9.0 = 21.67$ cfs

or 15,688 acre feet/year

or 8,113 gpm



CREST LENGTH 600'—800'

EARTH DAM FOR DRIBBLE BROOK

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

FIGURE No 3

De Leuw, Cather
consulting engineers

Factor of Safety: $\frac{\text{Min. Annual Inflow}}{\text{Average annual consumption}} = \frac{8,113}{830} = 9.8$

Storage Volume - At an average consumption rate 830 gpm. and assuming a negligible inflow during the four months December through March, the required water storage will be:

$$\frac{335 \times 60 \times 24 \times 125}{6.24 \times 43,560} = 222 \text{ acre feet}$$

A dam with a maximum effective depth of 17 feet and impounding a reservoir of 30 acres will be required to store adequate reserves.

Dam and Impounding Reservoir - The location of the dam and impounding reservoir (Exhibit #8) on Dribble Brook was chosen from aerial photographs and confirmed by a field reconnaissance. The topography is not ideally suited to dam construction as the stream flows through a shallow wide valley.

The overall crest length would be 600 to 800 feet long with a maximum height of 21 feet to yield an effective 17 feet depth of water. The dam would be constructed with an impervious clay inner core and sand and gravel backfill (Figure 3). The upstream face of the dam would be overlain with an 8-inch thick reinforced concrete slab. The storage reservoir would have a clayey silt blanket over its bottom for approximately 1,500 feet upstream of the dam. The storage capacity of the dam will be approximately 230 acre feet.

The dam would have a combined control chamber and overflow spillway located in the deepest section. An intake pipe would extend just beyond the upstream toe of the dam and the intake would normally have 17 feet of water above the trash rack level. The inflow would enter the control chamber base, rise and pass through a fish screen and then enter the feeder main to the low-lift pumps. One half of the chamber would be utilized as a spillway overflow. An overflow pipe extending beyond the downstream toe of the dam would discharge the spillway overflow into the existing stream bed.

Normal water level would be maintained at elevation 322.0. A freeboard of 4 feet on the dam sets the crest of the dam at elevation 326.0.

Low-Lift Pumps - The low-lift pumping area would house a screen and 2 low-lift pumps each of 500 gpm capacity with space provided for a third pump to supply the treatment plant with raw water from the impounding reservoir.

Water Treatment Plant - The treatment plant which would be used is described in Chapter 3.

High-Lift Pumps - The high-lift pump would supply treated water from the small underground treated water reservoir to the water reservoir. Individual pumping capacity would be about 230 gpm. Two pumps would normally operate alternately with a third pump as a standby unit. Space would be provided for a fourth pump as required when the maximum daily water demand exceeds 460 gpm. The total head on the high-lift pumps would be about 70 feet (about 30 psi).

Transmission Main - A 10-inch diameter transmission main will be required on an overland route for the High-lift pumps to the Water Storage reservoir, a distance of 11,500 feet.

Water Storage Reservoir - Similar to Scheme "A"

Industrial Distribution System - Similar to Scheme "A".

COST ESTIMATE

Surface Water Supply, Treatment and Transmission

1.	Dam and impounding reservoir (approx)	$ 400,000.	
2.	Water Treatment Plant, complete	345,000	
3.	10-inch transmission main - Treatment plant to Reservoir (11,500')	184,000.	
	Sub-total		$ 929,000.

Storage

4.	400,000 Imp. gallon reservoir	100,000.	
5.	12" Supply Main - reservoir to Distribution System	92,000	
	Sub-total		192,000

Industrial Distribution System

6.	Main Street West - Steel Mountain Road to Fish Plant Road (3,300')	69,300.	
7.	Main Street East - Steel Mountain Road to Flintkote (4,350')	82,700.	
8.	Fish Plant Road - Main Street West to Cold Water Fisheries (1,000')	19,000.	
	Sub-total		171,000.
	WATER SUPPLY AND DISTRIBUTION		$ 1,292,000.
	10% Engineering		129,000.
	TOTAL		$ 1,421,000.

SCHEME "C" - FLAT BAY BROOK

This scheme was selected to provide the shortest route from Flat Bay Brook to the Distribution System. As the largest watershed in the area Flat Bay Brook will supply all the needs of industry and community through a stream intake. Exhibit #9 shows the system components which are detailed as follows:

Holding Pond - The intake pipe would be located in a small holding pond on Flat Bay Brook at the location shown on Exhibit No. 9. The pond serves as a reservoir for the raw water supplied to the low-lift pumps. The intake will be suitably screened to keep out fish and trash.

Low-Lift Pumps - The low-lift pumps supply raw water from the holding pond to the water treatment plant. Two 500 gpm low-lift pumps and a screen will be housed nearby the river.

Water Treatment Plant - Similar to Schemes "A" and "B".

High-Lift Pumps - Pump capacity sufficient to meet a maximum daily water demand of 460 gpm will be provided initially. Three 230 gpm high-lift pumps will pump the water into the system. Normally two pumps would operate alternately, but would pump in unison during periods of high demand. The third pump is required as a standby unit.

The high-lift pumps discharge into the 10-inch transmission main to the storage reservoir. The total head on the high-lift pumps would be 224 feet (about 97 psi).

Transmission Main - A 10-inch diameter transmission main would be required from the high-lift pumps overland 6,600 feet to the water storage reservoir.

Water Storage Reservoir - A reservoir identical to Scheme "A" will be located along the overland route of the transmission and supply mains. The mean water level of the reservoir will be 280.0.

Industrial Distribution System - Similar to Scheme "A".

COST ESTIMATE

Surface Water Treatment Plant, Pumping, and Transmission

1.	Water Treatment Plant, complete	$ 345,000.	
2.	10-inch transmission Main - treatment plant to reservoir (6,600')	119,000.	
	Sub-total		$ 464,000.

Storage

3.	400,000 Imp. gallon Reservoir	100,000	
4.	12-inch supply main - reservoir to Main Street	109,000.	
	Sub-total		209,000.

Industrial Distribution System

5.	Main Street West - Fish Plant Road to Steel Mountain Road (3,300')	69,300.	
6.	Main Street East - Steel Mountain Road to Flintkote (4,350')	82,700.	
7.	Fish Plant Road - Main Street West to Cold Water Fisheries (1,000')	19,000.	
	Sub-total		171,000
	WATER SUPPLY AND DISTRIBUTION		$ 844,000.
	10% Engineering		84,000.
	TOTAL		$ 928,000.

SCHEME "D" - FLAT BAY BROOK (Recommended)

Test pits excavated in sand and gravel deposits of the Flat Bay Brook river terrace confirmed the presence of a groundwater aquifer capable of supplying the community needs. Analysis of the sand and gravel strongly suggests that water from the river filtering through the deposits would be significantly improved with regard to colour and turbidity. This scheme (Exhibit #10) is based on a groundwater extraction system from the Flat Bay Brook area which would not require the use of a treatment plant.

Extraction - The purpose of excavating test pits was to confirm the presence of an aquifer and the type of granular materials in the terrace. It is not possible to determine, without further testing, which would be the most economical or suitable method of extraction. The cost estimates for this proposal assumes the use of three deep wells in the aquifer which would be the most expensive method. It may be possible to use either an infiltration gallery or well point system which would be considerably cheaper than the deep well system.

Treatment - Treatment other than chlorination would probably not be required.

High-Lift Pumps - Water would be pumped from the source, chlorinated and transferred to a clear well in the Control Building. Three high-lift pumps would deliver water through the transmission line. Two pumps would normally operate with the third acting as a standby unit. The head on the high-lift pumps would be about 100 feet.

Transmission Line - The transmission line would be a 10" line approximately 13,500 ft. long across country connecting with the storage reservoir on Steel Mountain Road.

A further 4,000 feet of 12" line would connect the reservoir with the industrial system.

Storage Reservoir - Similar to Scheme "A"

Industrial Distribution System - Similar to Scheme "A"

COST ESTIMATE

	Deep well water supply, Pumping and Transmission		
1.	Well Drilling and development (3 wells)	$ 24,000.	
2.	Deep well pumps, piping, controls, buildings, electrical, complete (3 wells)	60,000.	
3.	Clear Well, high-lift pumps, standby generator	60,000.	
4.	10-inch transmission main (13,500')	216,000.	
	Sub-total		$ 360,000.
	Storage		
5.	400,000 Imp. gallon reservoir	100,000.	
6.	12-inch supply main (4,000') reservoir to distribution system	92,000.	
	Sub-total		192,000.
	Industrial Distribution System		
7.	Main Street West - Steel Mountain Road to Fish Plant Road (3,300')	69,300.	
8.	Main Street East - Steel Mountain Road to Flintkote (4,350')	82,700.	
9.	Fish Plant Road - Main Street West to Cold Water Fisheries (1,000')	19,000.	
	Sub-total		171,000.
	TOTAL WATER SUPPLY AND DISTRIBUTION		$ 723,000.

CHAPTER 6 - COSTS

CAPITAL COST SUMMARY

The following table summarizes costs included with descriptions of the preferred schemes.

DESCRIPTION	SCHEME "A"	SCHEME "B"	SCHEME "C"	SCHEME "D"
a) Intake and Treatment Plant	$ 345,000.	345,000.	345,000.	~~345,000~~.
b) Well Development	-	-	-	144,000.
c) Dam and Impounding Reservoir	-	400,000.	-	-
d) Transmission Main	155,000.	184,000.	119,000.	216,000.
e) Storage Reservoir	100,000.	100,000.	100,000.	100,000.
f) Supply Main	92,000.	92,000.	109,000.	92,000.
g) Industrial Distribution System	171,000.	171,000.	171,000.	171,000.
SUB-TOTAL	863,000.	1,292,000.	844,000.	723,000.
+ 10% Engineering	86,000.	129,000.	84,000.	72,000.
TOTAL	$ 949,000.	1,421,000	928,000.	795,000.

COMMUNITY SYSTEM

The additional cost of extending distribution mains to the remainder of the community is summarized as follows:

10" diameter	900 ft.	$ 18,000.
8" diameter	11,800 ft.	248,500.
6" diameter	14,600 ft.	217,500.
4" diameter	7,400 ft.	110,000.
		$ 594,000.
	+ 10% engineering	59,000.
	TOTAL	$ 653,000.

These costs include excavation, fittings and all miscellaneous items. The cost of connecting and installing house services is not included in the above prices. The average cost per house service would probably be in the order of $300.00 depending on distance from the main.

OPERATION AND MAINTENANCE

It is assumed that the system would be operated and maintained by the Town Council.

These costs would vary little between the schemes which require a treatment plant. Somewhat lower costs are anticipated for Scheme "D" where chlorination only will be required.

The estimated initial (1st. year) annual cost for operation and maintenance is as follows:

	SCHEMES "A", "B", "C"	SCHEME "D"
Administration	$ 1,500.	$ 1,000.
Plant Operator	3,000.	2,000.
Transportation	1,500.	1,000.
Plant Maintenance	1,000.	1,000.
Chemicals	3,000.	1,000.
Power costs	10,000.	10,000.
	$ 20,000.	$16,000.

METERING AND FINANCING

We would recommend that all industrial water be metered at the individual points of consumption. Water users would pay on the basis of the amount consumed.

In the past, the capital cost of many projects of this type in Newfoundland has been subsidized by the Provincial Government or by Federal Government agencies. There is no information available at this time as to what the funding arrangements would be for this project.

Once the capital debt has been established, it would be feasible for us to recommend a specific rate structure based on water consumption and extent of the system. In the meantime, some examples showing the order of cost to be expected have been calculated.

It is emphasized that these calculations are NOT recommendations.

INDUSTRIAL SYSTEM

Example 1

Assumptions
- 100% grant
- Metered user cost at .20¢ per 1,000 gallons
- 1st. year operation only
- Provincial revenue subsidy at 70¢/1.00

(a)	Annual Cost		
	Operation and maintenance		$16,000.
	TOTAL ANNUAL COST		$16,000.
(b).	Revenue meter $\frac{20,000,000 \text{ gallons} \times .20}{1,000}$ =	$4,000.	
.	Other (meters ships etc)	1,000.	
		5,000.	
.	Revenue subsidy	3,500.	
	TOTAL REVENUE		8,500.
	SPECIAL SUBSIDY REQUIRED		$ 7,500.

Example 2

Assumptions
- . 50% grant, 50% loan
- . 20 year repayment period
- . 8% interest
- . Metered water at 20¢/1000 gallons
- . 1st. year operation only
- . Provincial revenue subsidy at 70¢/1.00

(a) Annual Cost

. Interest $400,000 x 8%	$ 32,000.
. Principal repayment	18,000.
. Operation and maintenance	16,000.
TOTAL ANNUAL COST	$ 66,000.
(b) Revenue - as in example 1	8,500.
SPECIAL SUBSIDY REQUIRED	$ 57,500.

COMPLETE SYSTEM

Example 3

Assumptions:
- . Initial year operation
- . 50% loan 50% grant
- . 8% interest
- . 20 year repayment period
- . Metered industrial user cost 20¢/1,000 gals.
- . Fixed charge (TAX) to other users
- . 345 connections out of possible 375
- . 90% collections
- . Provincial revenue subsidy 70¢/1.00

(a) Annual cost

. Interest (795,000 + 653,000) x 50% x 8%	$ 57,900.
. Principal repayment 660,000÷ 20	22,000.
. Operation and maintenance	16,000.
TOTAL ANNUAL COST	$ 95,900.

Example 3 (Cont'd)

(b) Revenue

SOLUTION (1) - Full cost covered

. Industrial 20,000,000 x .20 =	4,000.	
. Other meters, etc.	1,000.	
. Revenue subsidy (Ind. only)	3,500.	$ 8,500.

Balance to be obtained as follows:

. Revenue	$ 51,400.	
. Revenue Subsidy	36,000.	87,400.
		$95,900.

Monthly charge to user

$$\frac{51,400. \times 100}{345 \times 90 \times 12} = \$11.60$$

SOLUTION (2) - Special subsidy required

. Industrial revenue	5,000.
. Fixed monthly user charge 7.00	
$\frac{345 \times 90 \times 7 \times 12}{100}$	26,100.
.Revenue Subsidy	
31,000 x 70	21,700
	$ 52,800.
SPECIAL SUBSIDY REQUIRED	43,100.
	$ 95,900.

CHAPTER 7 - STAGING

The development of a water supply and distribution system for the Town of St. Georges is envisaged as being undertaken in two stages.

Stage 1 - The water supply and industrial distribution system, which has been investigated in this report.

Stage 2 - Community distribution system.

Severe water shortage conditions have occurred periodically in summer months and it has been suggested that the existing well in the Town be used as a temporary supply source and connected to the industrial system.

Subsurface investigations have shown that there does not appear to be any area close to the Town capable of being developed as a substantial groundwater aquifer. The existing deep well in the Town was pump tested and is estimated to yield flows in the order of 40 gallons per minute.

The sea water pumps in the fish plant are theoretically capable of delivering 2,500 - 3,000 gallons per hour. This amount, according to the fish plant operator, is in fact inadequate for the quantities of fish processed. The volume used is also substantially less than that required in most modern fish plants. At the normal rate of usage (2 1/2 gallons per lb) the fish plant would require for its present daily operation approximately four times the total production of the well in 24 hours.

The well could contribute little towards any community need while the fish plant is in operation on any continuous basis, even if the 400,000 gallon storage tank (required in all schemes) were constructed as part of a temporary system.

A temporary system based on the well is shown on Figure 5. Permanent elements would be as follows:

Industrial Distribution System	$ 171,000.
400,000 gallon storage tank	100,000.
Supply main (Steel Mountain Road)	92,000.
	$ 363,000.

The temporary installations would consist of

Well development	$ 22,000.
Transmission line to industrial system	15,000.
	$ 37,000.

It should be noted that the connection to the well in the Town is not required in any of the recommended schemes and would be redundant upon completion of the supply system.

For the reasons set out above, it would seem preferable to proceed with a water supply system which would meet the needs of both industry and community.

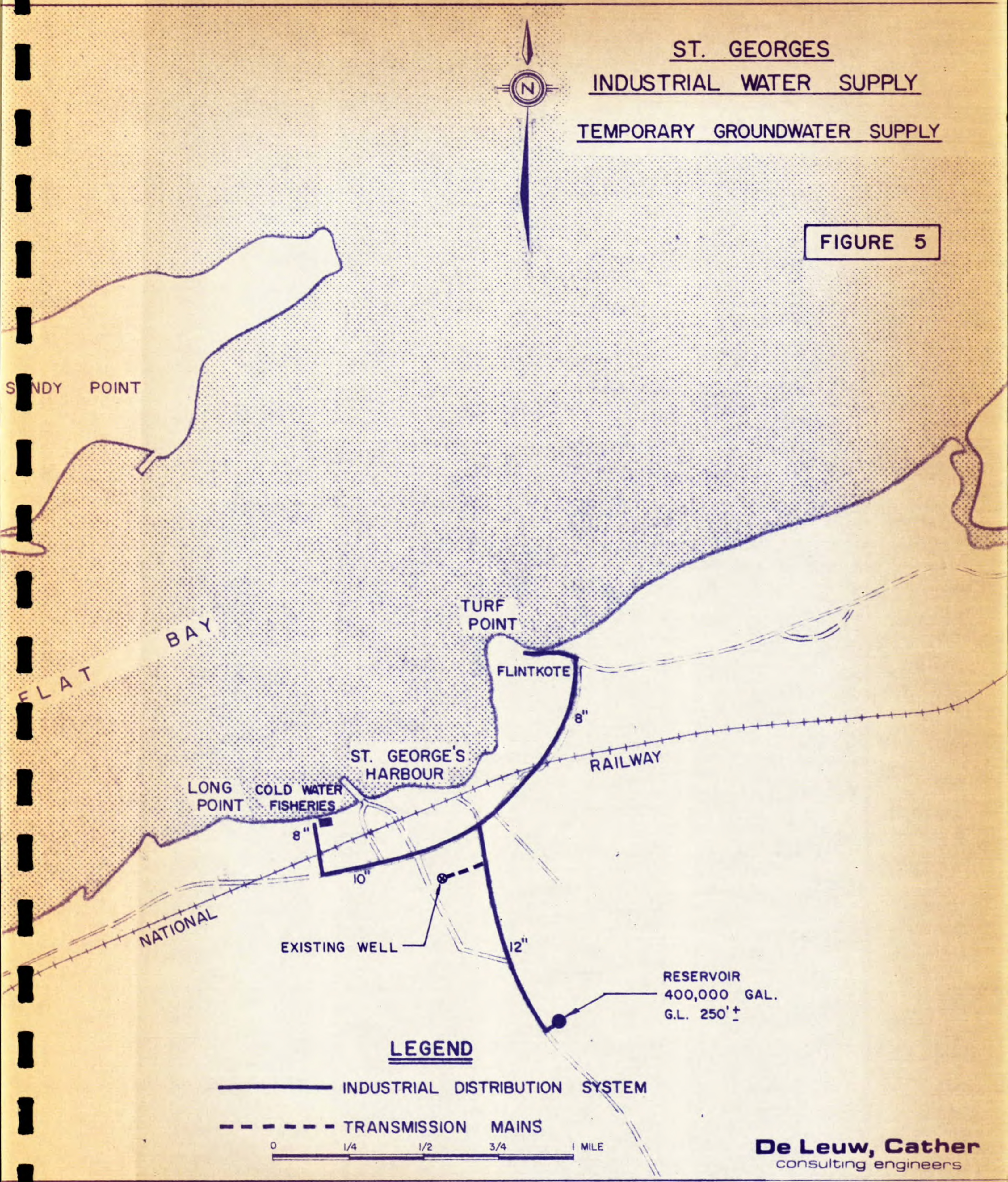
o o o 0 o o o

REGISTERED PROFESSIONAL ENGINEER
B.D. Henderson
B.D. Henderson
SIGNATURE
PROVINCE OF NEWFOUNDLAND

ST. GEORGES INDUSTRIAL WATER SUPPLY

TEMPORARY GROUNDWATER SUPPLY

FIGURE 5

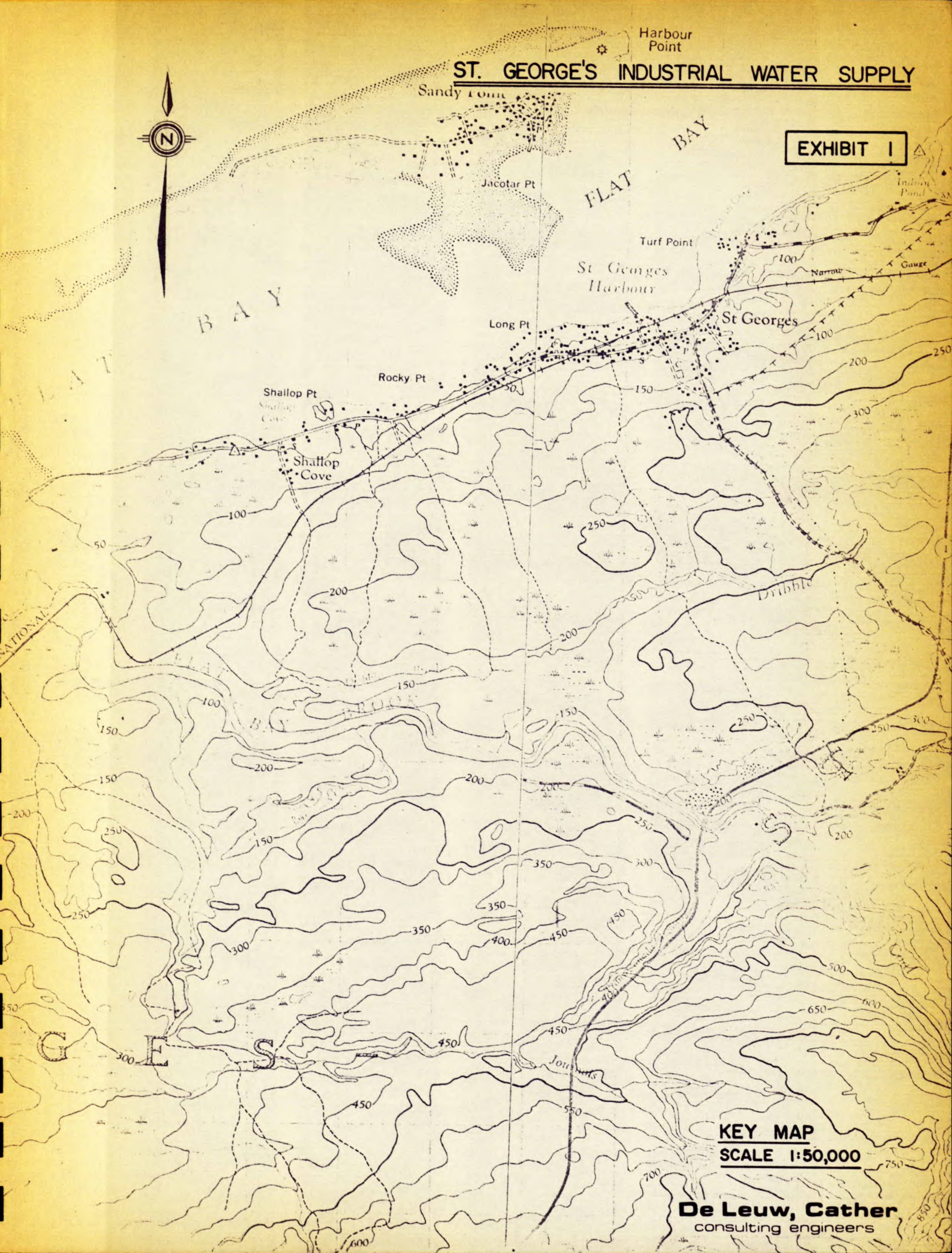


De Leuw, Cather
consulting engineers

EXHIBITS

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

EXHIBIT I



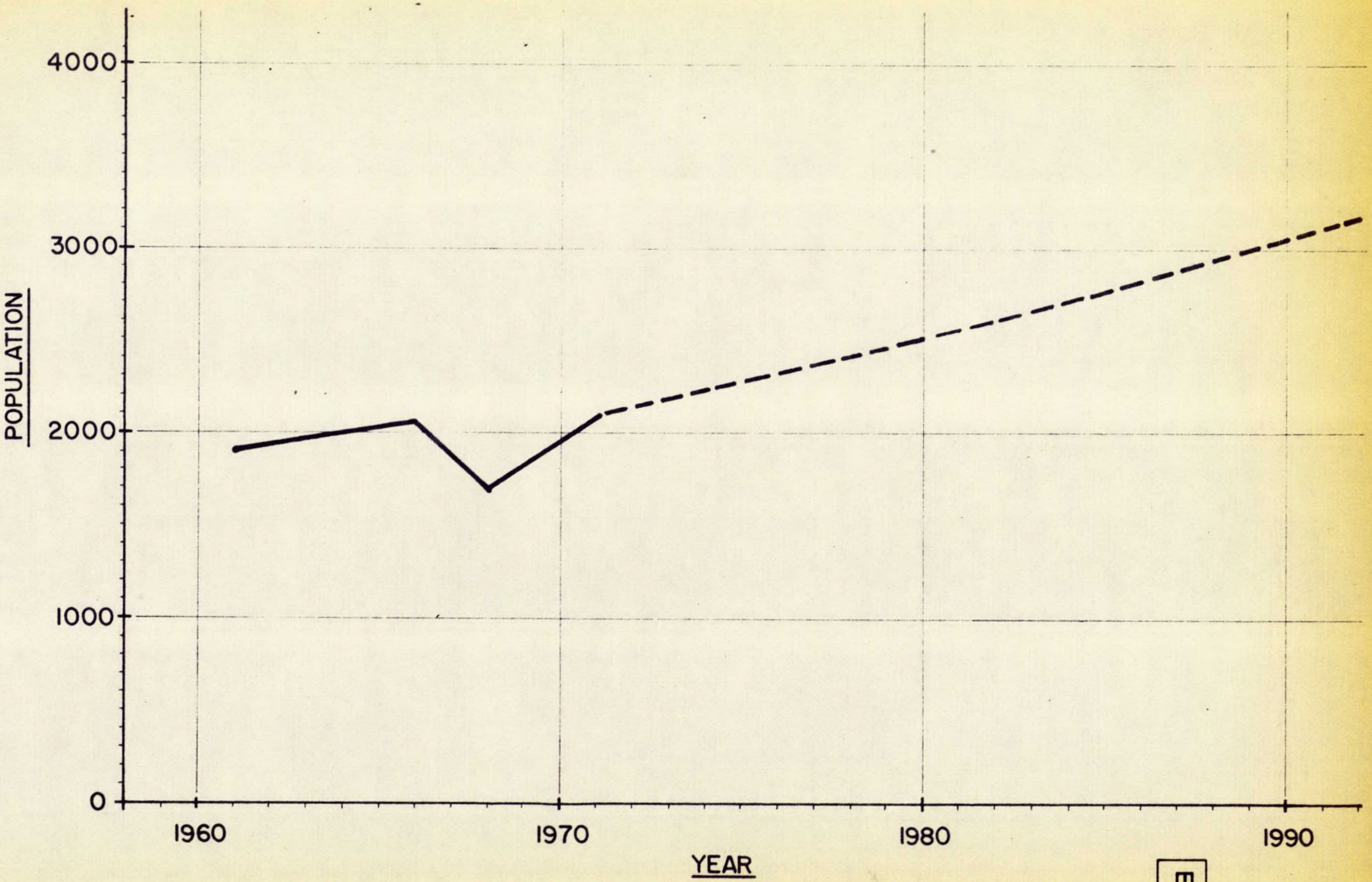
KEY MAP

SCALE 1:50,000

De Leuw, Cather
consulting engineers

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

EXHIBIT 2

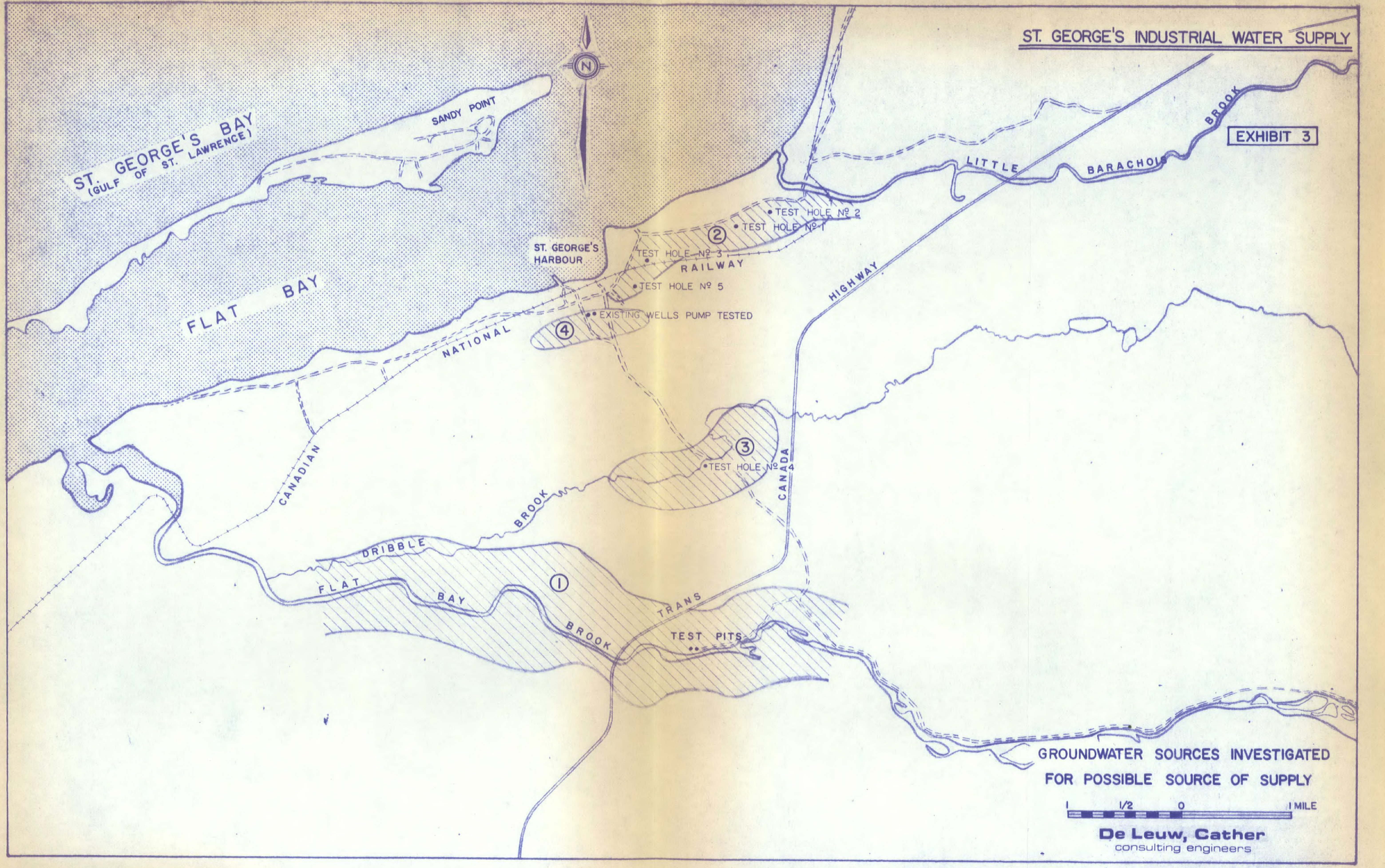


TOWN OF ST. GEORGE'S
PROJECTED POPULATION

De Leuw, Cather
consulting engineers

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

EXHIBIT 3

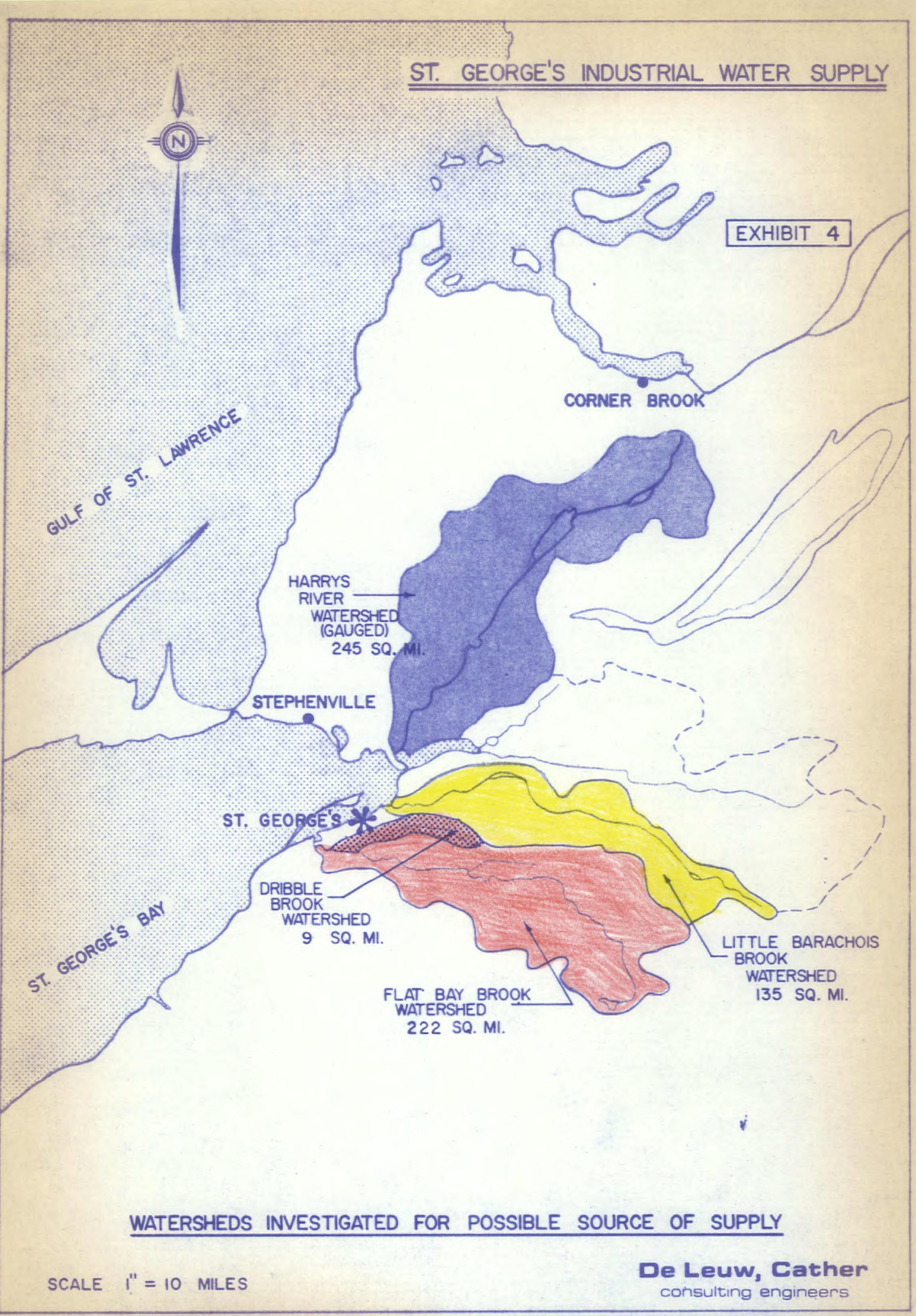


GROUNDWATER SOURCES INVESTIGATED
FOR POSSIBLE SOURCE OF SUPPLY

De Leuw, Cather
consulting engineers

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

EXHIBIT 4



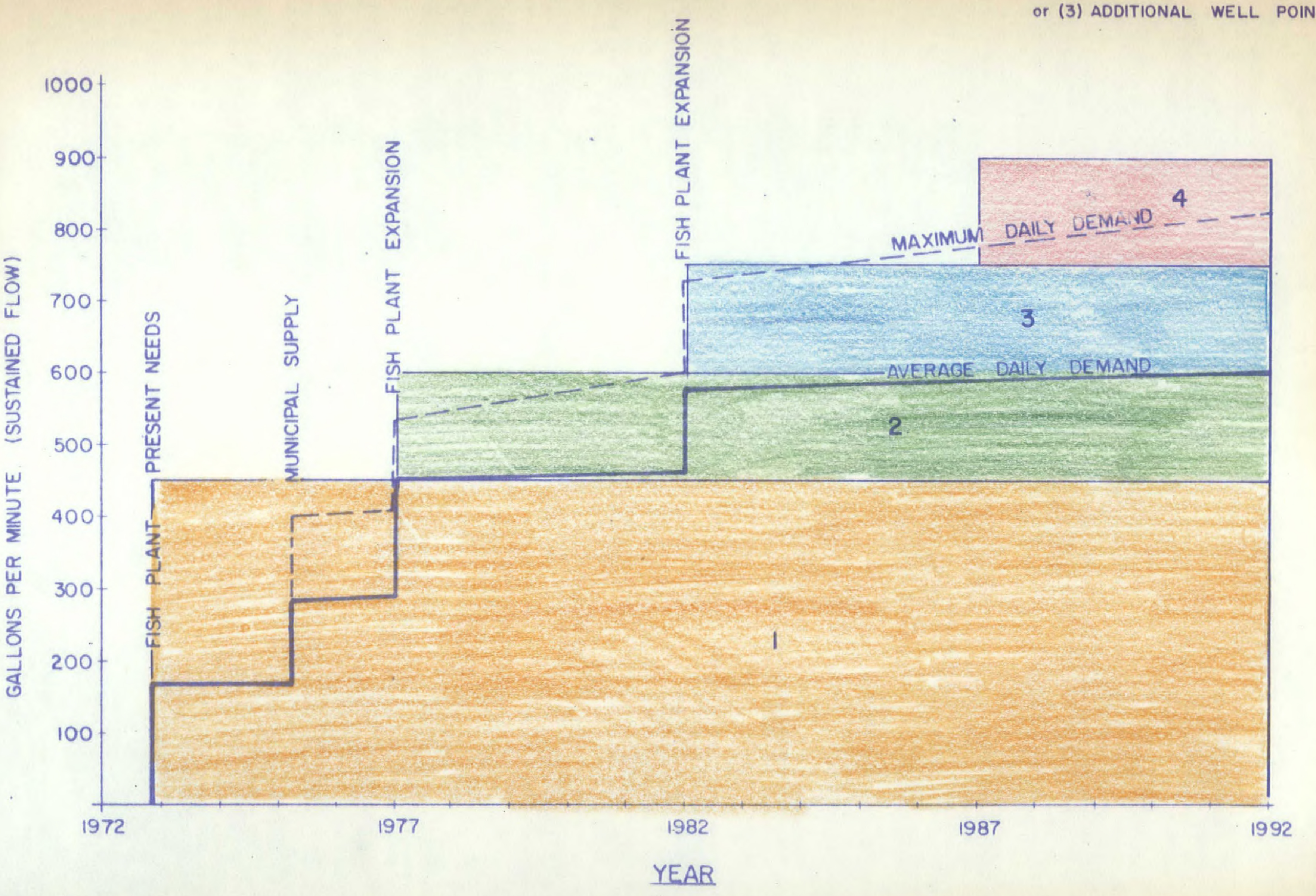
WATERSHEDS INVESTIGATED FOR POSSIBLE SOURCE OF SUPPLY

SCALE 1" = 10 MILES

De Leuw, Cather
consulting engineers

INCREMENTAL EXPANSION BY MEANS OF

(1) ADDITIONAL DEEP WELLS
(2) EXTENSIONS TO INFILTRATION GALLERIES
or (3) ADDITIONAL WELL POINTS



POSSIBLE DEVELOPMENT OF SUPPLY
GROUNDWATER SOURCE

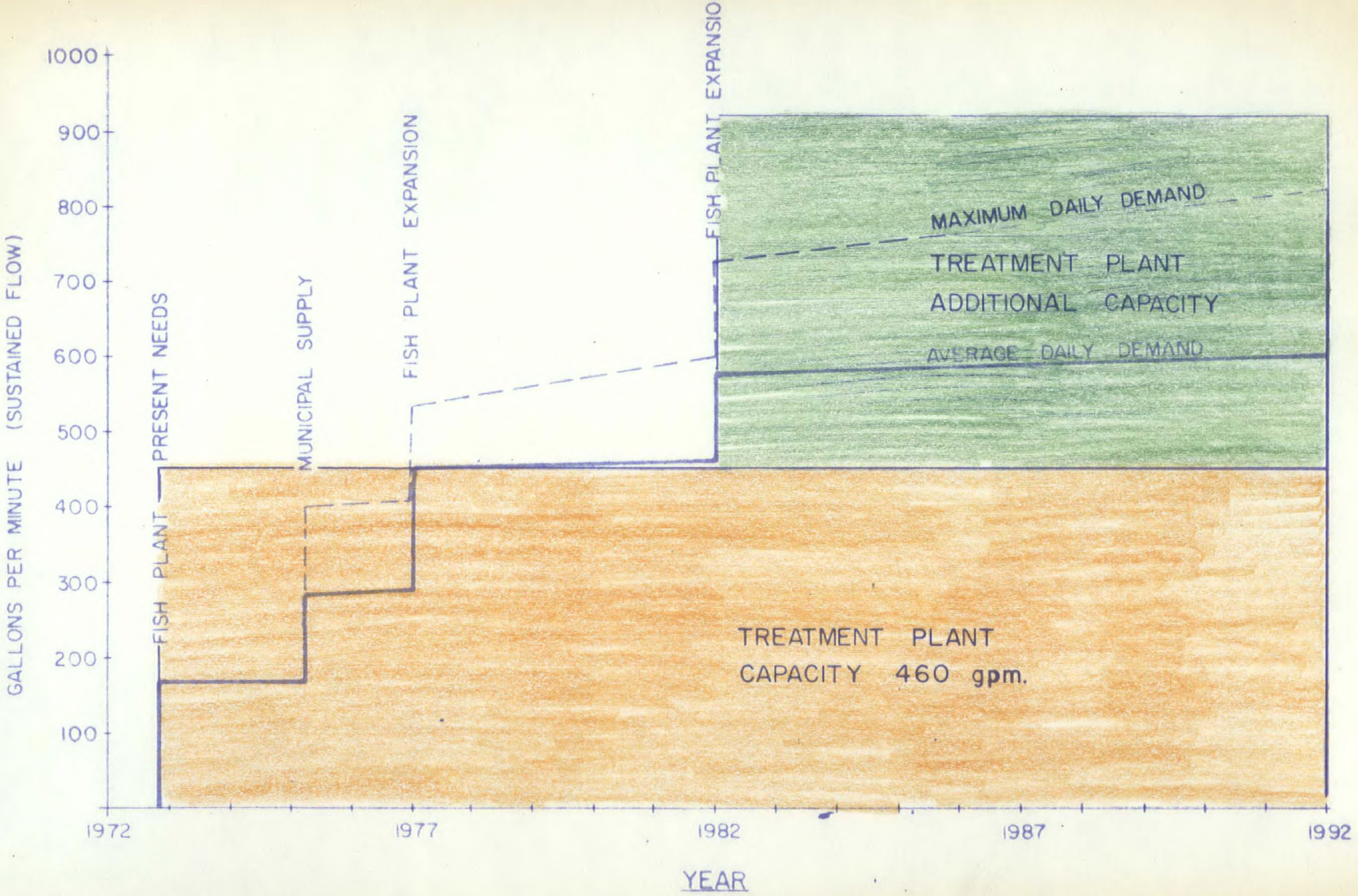
ST. GEORGE'S INDUSTRIAL WATER SUPPLY

EXHIBIT 5

De Leuw, Cather
consulting engineers

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

EXHIBIT 6



POSSIBLE DEVELOPMENT OF SUPPLY
SURFACE WATER SOURCE

De Leuw, Cather
consulting engineers

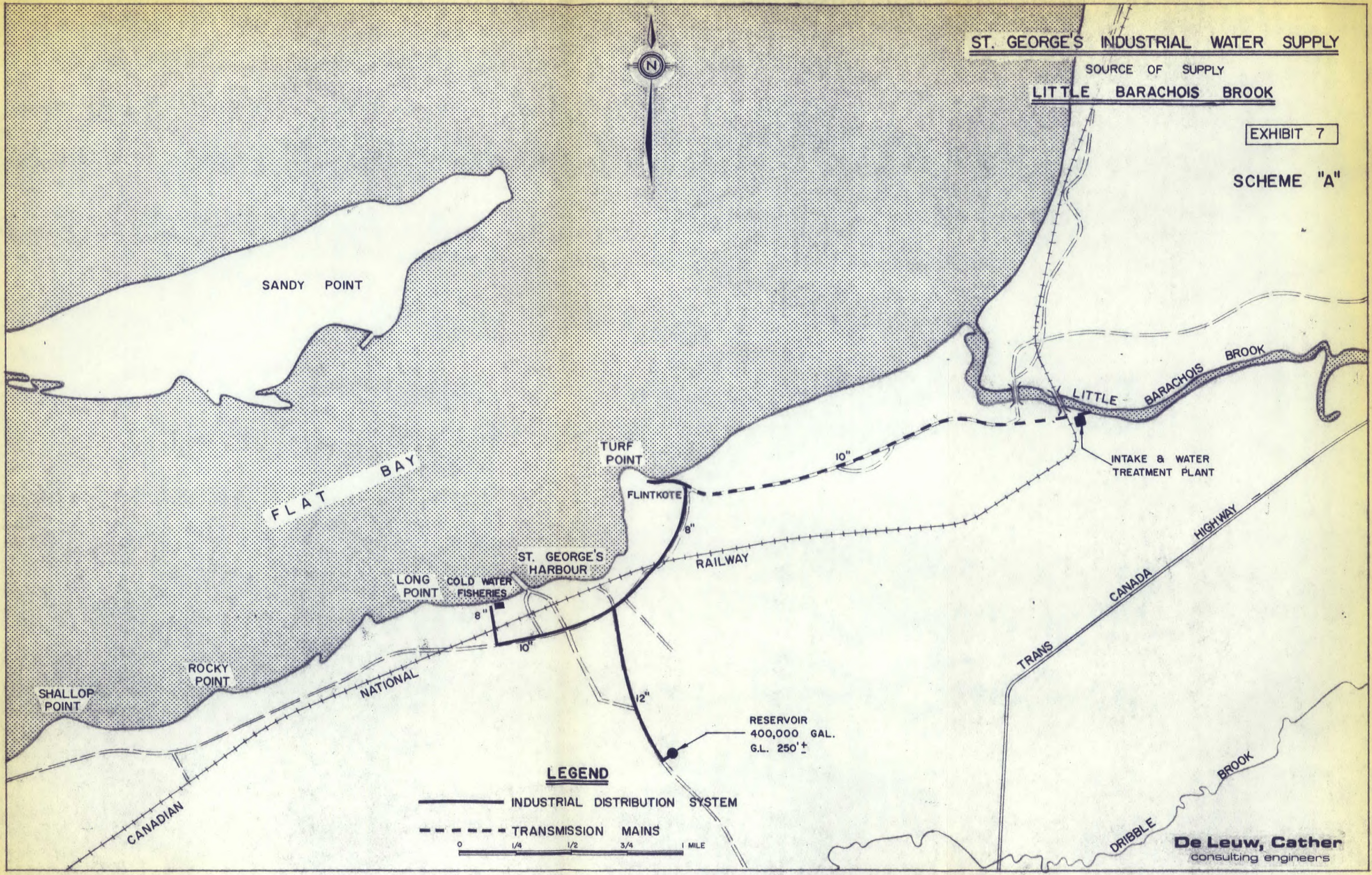
ST. GEORGE'S INDUSTRIAL WATER SUPPLY

SOURCE OF SUPPLY

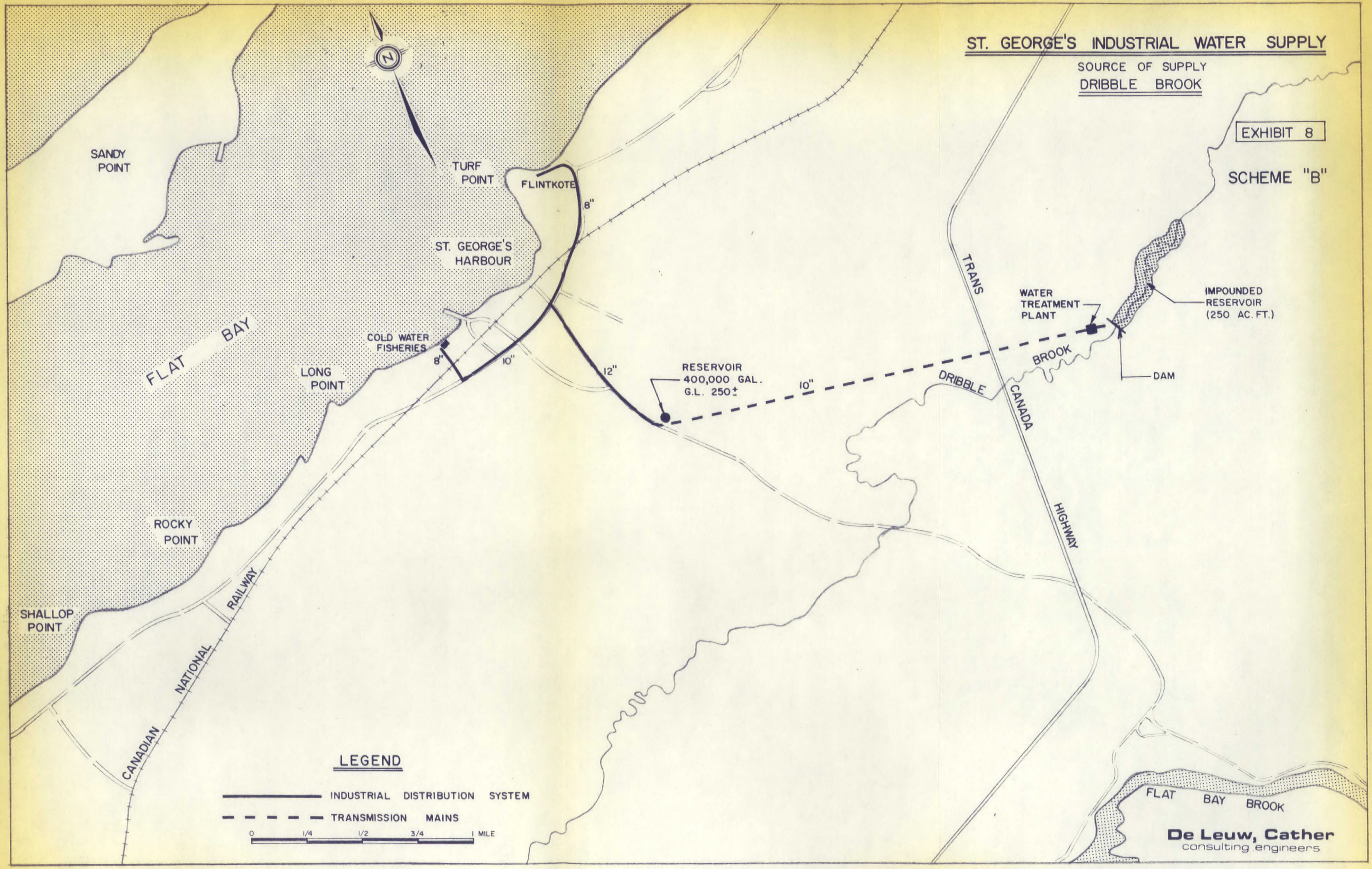
LITTLE BARACHOIS BROOK

EXHIBIT 7

SCHEME "A"



De Leuw, Cather
consulting engineers



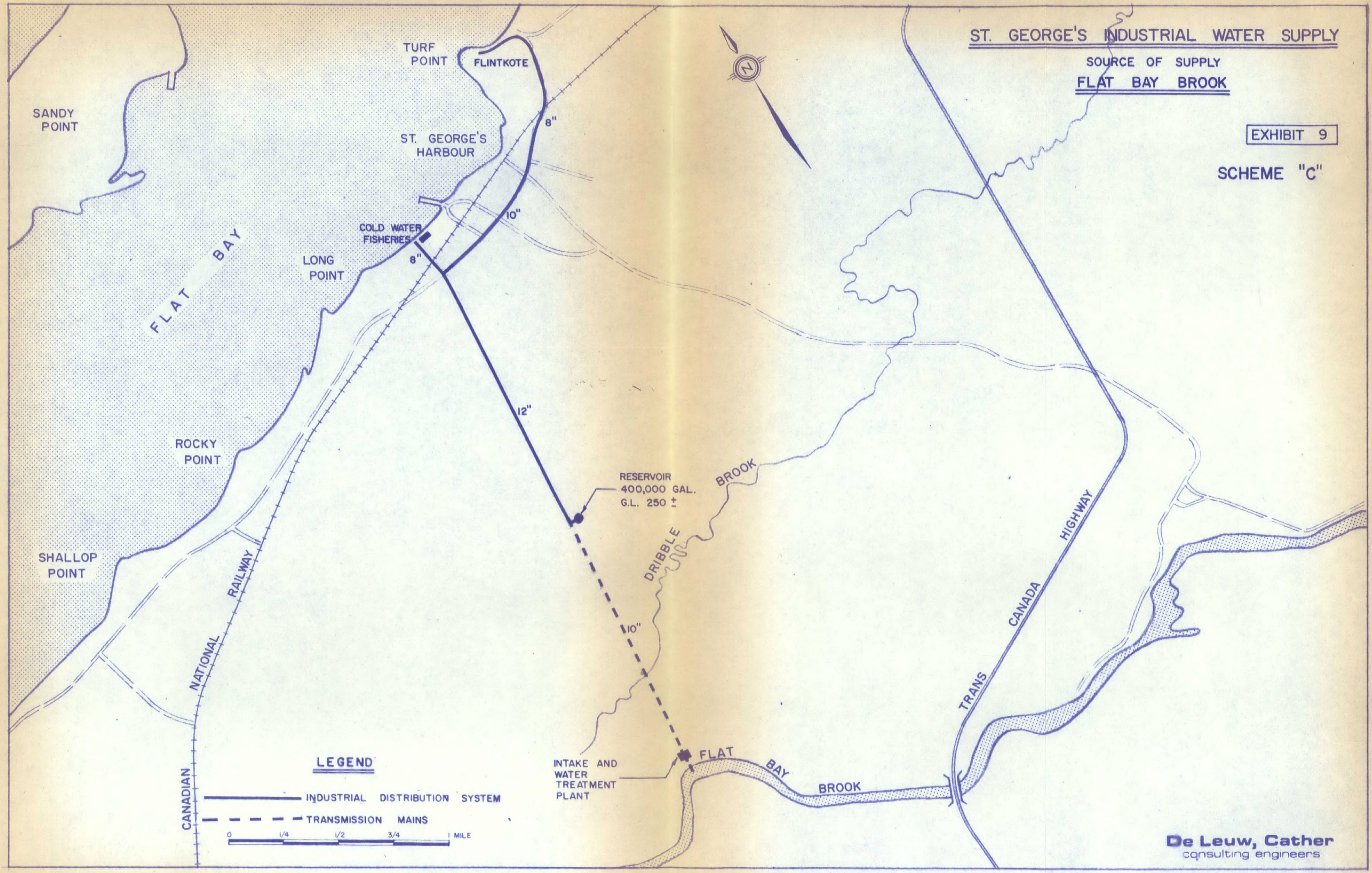
ST. GEORGE'S INDUSTRIAL WATER SUPPLY

SOURCE OF SUPPLY
DRIBBLE BROOK

EXHIBIT 8

SCHEME "B"

De Leuw, Cather
consulting engineers



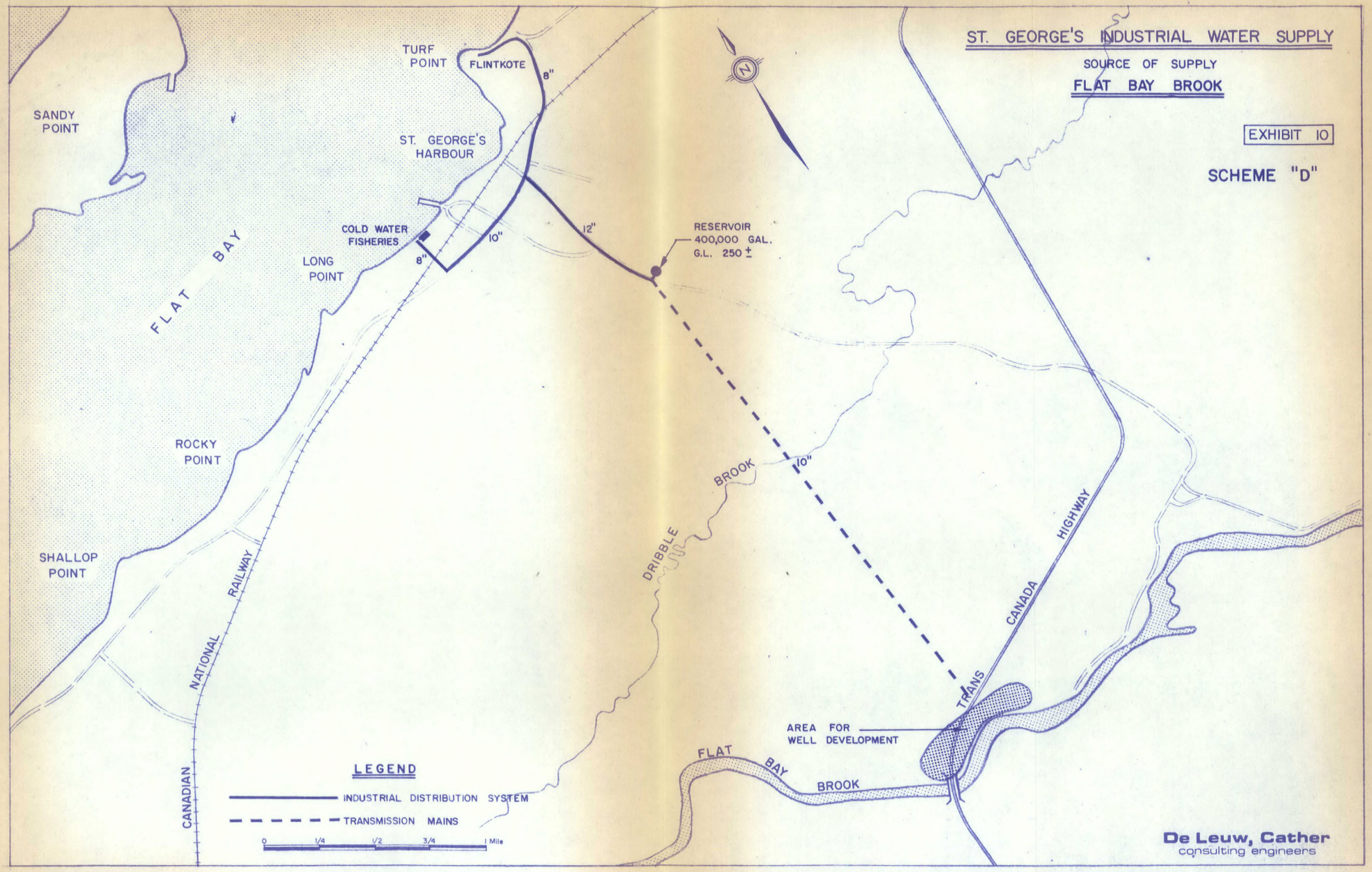
ST. GEORGE'S INDUSTRIAL WATER SUPPLY

SOURCE OF SUPPLY

FLAT BAY BROOK

EXHIBIT 9

SCHEME "C"



ST. GEORGE'S INDUSTRIAL WATER SUPPLY

SOURCE OF SUPPLY

FLAT BAY BROOK

EXHIBIT 10

SCHEME "D"

De Leuw, Cather
consulting engineers

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

DISTRIBUTION SYSTEMS

EXHIBIT 11

De Leuw, Cather
consulting engineers

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

DISTRIBUTION SYSTEMS

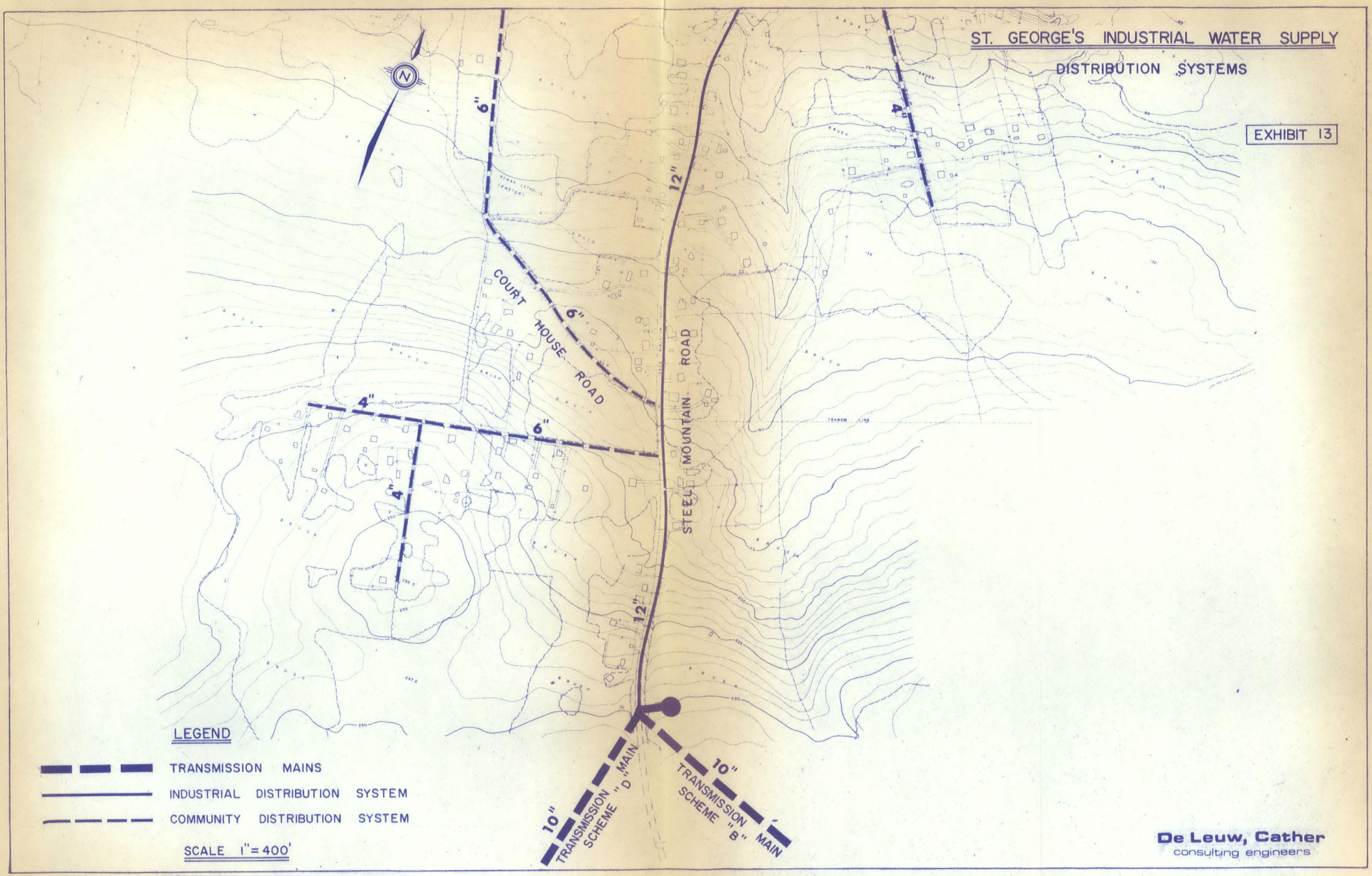
EXHIBIT 12

LEGEND

— — — COMMUNITY DISTRIBUTION SYSTEM

SCALE 1" = 400'

De Leuw, Cather
consulting engineers

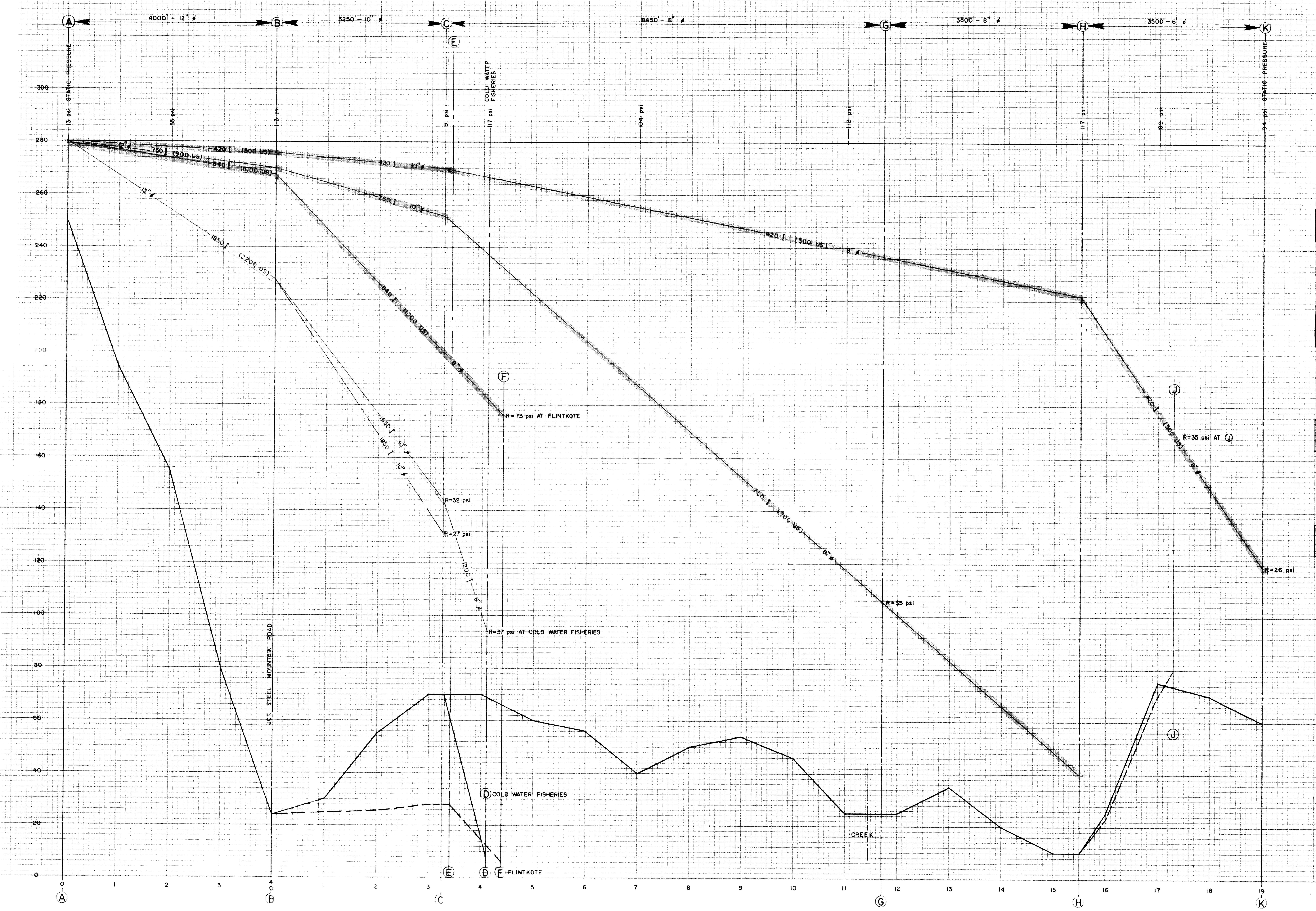


ST. GEORGE'S INDUSTRIAL WATER SUPPLY

DISTRIBUTION SYSTEMS

EXHIBIT 13

De Leuw, Cather
consulting engineers



CONDITION 1 — MAJOR FIRE DOWNTOWN – SECTION B-C
Q=1850 I GPM (2200 US)

CONDITION 2 — FIRE AT "E" / FIRE AT "F" — Q=840 I GPM (1000 US)

CONDITION 3 — FIRE AT "H" — Q=750 I GPM (900 US)

CONDITION 4 — FIRE AT "K" — Q=420 I GPM (500 US)

SCALE
H 1"=1000'
V 1"=20'

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

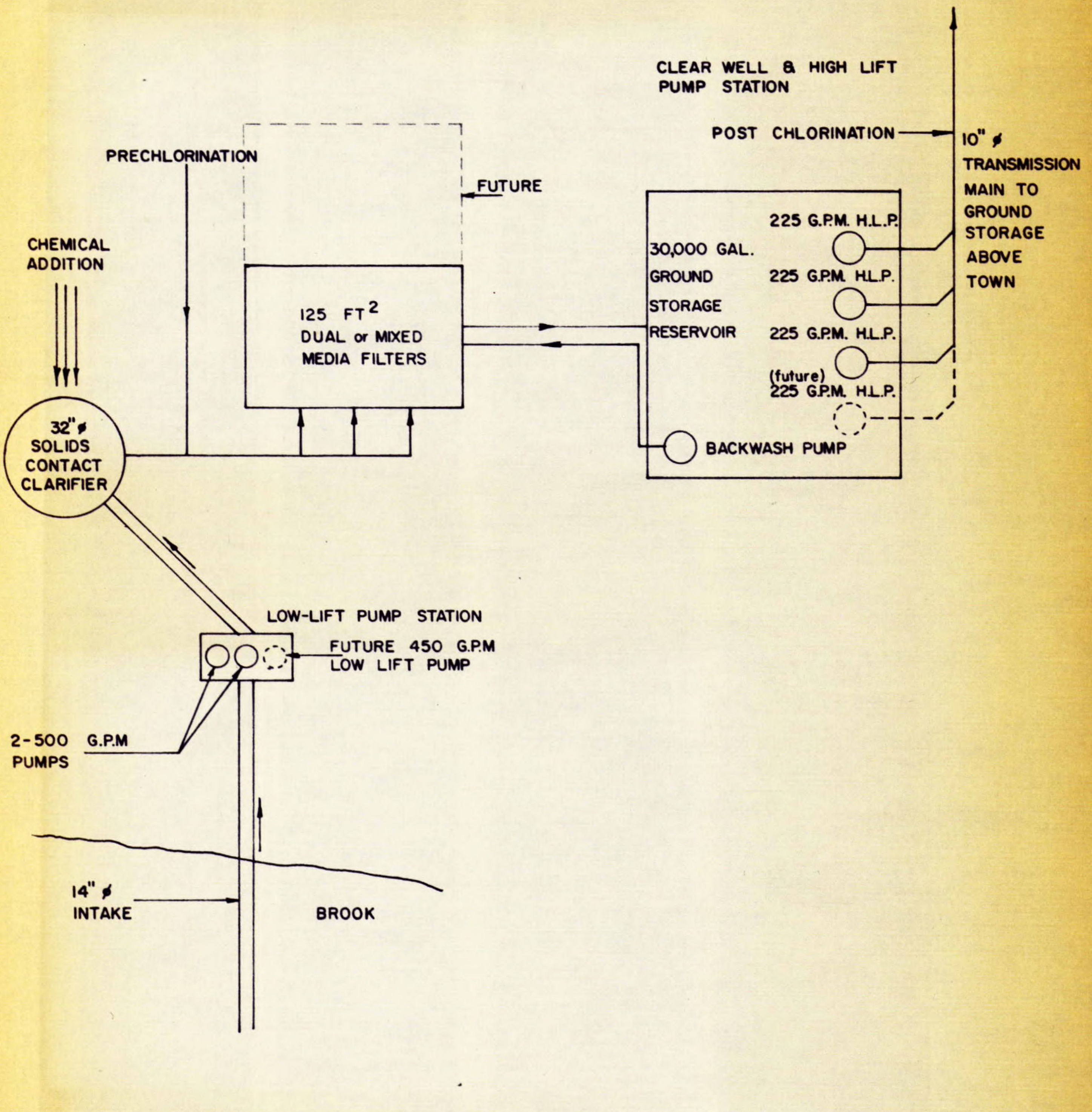
EXHIBIT 14

HYDRAULIC GRADIENT DURING FIRE FLOW

De Leuw, Cather
consulting engineers

ST. GEORGE'S INDUSTRIAL WATER SUPPLY

EXHIBIT 15



WATER TREATMENT PLANT - SCHEMATIC

(TYPICAL FOR SCHEMES "A" "B" AND "C")

De Leuw, Cather
consulting engineers

COLDWATER FISHERIES PLANT

LOOKING WEST

JUNE 4, 1972

LOOKING EAST

JUNE 4, 1972

FLINTKOTE COMPANY OF CANADA LIMITED

ANHYDRITE STOCKPILE AND LOADING OPERATIONS

JUNE 4, 1972

SHIPPING TERMINAL

JUNE 4, 1972

LITTLE BARACHOIS BROOK

DOWNSTREAM
OF T.C.H.

JUNE 4, 1972

DOWNSTREAM
OF T.C.H.

AUGUST 4, 1972

DRIBBLE BROOK

UPSTREAM OF T.C.H

JUNE 4, 1972

ADJACENT TO
STEEL MOUNTAIN ROAD

AUGUST 1, 1972

FLAT BAY BROOK

UPSTREAM OF
T.C.H. BRIDGE

JUNE 4, 1972

UPSTREAM OF
T.C.H. BRIDGE

AUGUST 1, 1972

APPENDICES

EXTRACT from "Fish Inspection regulations, Fish Inspection Act - Federal Department of Fisheries & Forestries, 18th. May, 1971.

APPENDIX I

5. Natural or mechanical ventilation systems shall provide clean air, remove undesirable odours, steam and smoke and prevent condensation in rooms where work is performed.

6. Toilet facilities of types and in numbers approved by the Minister shall be provided.

7. Rooms in which toilet facilities are located shall have doors of a type approved by the Minister.

8. Sanitary washbasins equipped with hot and cold runnning water, liquid or powdered soap, and air dryers or single service towels of types, and in locations and numbers approved by the Minister shall be provided.

9. (1) An adequate supply of safe, sanitary water that

(*a*) has a coliform bacteria count, determined by a method acceptable to the Minister, of not more than two per hundred millilitres, or

(*b*) is derived from a source approved by the Minister,

shall be provided under a minumum operating pressure of twenty pounds per square inch.

(2) Notwithstanding subsection (1), an establishment may use water other than water referred to in subsection (1) for fire protection, boilers or auxiliary services if there is no connection between the water systems providing water to the establishment.

10. The frames and legs of all equipment on which fish is processed shall be constructed of metal or other material approved by the Minister.

11. Tables shall be so constructed that they and the areas beneath can be readily cleaned.

12. (1) Bins or receptables in which offal is stored shall be watertight, constructed of metal or other material approved by the Minister and, where necessary to prevent contamination of the establishment or any fish processed therein, be equipped with well-fitted covers.

(2) A concrete or other suitable surface, sloped for drainage purposes, shall be placed under elevated offal bins.

13. Wood shall not be used for the construction of any part of a conveyor that comes in contact with fish.

14. Flumes for conveying fish shall be constructed of noncorrodible material, other than wood, and in such a manner that they can be properly cleaned.

15. A minimum illumination intensity of twenty foot candles shall be provided on all working surfaces in processing rooms.

PART II

Canneries

16. Rooms in which fish is processed shall have ceilings that are free from cracks, crevices and open joints and that

(*a*) are constructed of smooth, washable, light coloured material, and

(*b*) are of a height

acceptable to the Minister.

5. Des systèmes de ventilation naturelle ou mécanique doivent fournir de l'air pur, chasser les mauvaises odeurs, la vapeur et la fumée et prévenir la condensation dans les salles de travail.

6. Des toilettes, dont le Ministre approuve le modèle et le nombre à pourvoir, doivent être installées.

7. Les portes des pièces où se trouvent les toilettes doivent être d'un type approuvé par le Ministre.

8. Un nombre suffisant de lavabos sanitaires bien approvisionnés en eau chaude et en eau froide, en savon liquide ou en poudre, ainsi que des séchoirs à air ou des serviettes non réutilisables, doivent être installés dans un lieu approuvé par le Ministre.

9. (1) Un approvisionnement suffisant d'eau pure et sans danger,

a) qui contient au plus deux bactéries-coliformes par cent millilitres, compte établi selon une méthode qui agrée au Ministre, ou

b) qui provient d'une source approuvée par le Ministre,

doit être assuré, l'eau devant être fournie sous une pression minimale de vingt livres par pouce carré.

(2) Nonobstant le paragraphe (1), un établissement peut se servir d'une autre eau que l'eau mentionnée au paragraphe (1), pour la lutte contre l'incendie, pour l'alimentation des chaudières ou pour les services auxiliaires, si les canalisations qui alimentent l'établissement en eau sont parfaitement autonomes.

10. Le bâti et les pieds de tout le matériel sur lequel le poisson est traité ou emballé doivent être construits en métal ou en un autre matériau approuvé par le Ministre.

11. Les tables doivent être construites de façon qu'il soit facile de les nettoyer et de nettoyer en dessous.

12. (1) Les bacs ou les réceptacles à déchets doivent être étanches, construits en métal ou en un autre matériau approuvé par le Ministre et, au besoin, être munis de couvercles qui ferment juste pour éviter la contamination de l'établissement ou du poisson qui y est traité.

(2) Une surface de béton ou d'autre matériau approprié, inclinée aux fins d'égouttage, doit être ménagée sous les bacs à déchets surélevés.

13. Il est interdit d'utiliser du bois dans la construction d'une partie quelconque d'un convoyeur qui vient en contact avec le poisson.

14. Les canalisations à ciel ouvert destinées au transport du poisson doivent être faites d'un matériau résistant à la corrosion, autre que le bois, et construites de manière à permettre de les bien nettoyer.

15. Dans les salles de traitement, toutes les surfaces de travail doivent être pourvues d'un éclairement minimal de 20 bougies-pied.

PARTIE II

Conserveries

16. Les pièces où le poisson est traité doivent avoir des plafonds qui sont exempts de fissures, de crevasses et de joints ouverts, et qui

a) sont construits en un matériau lisse, lavable, de couleur claire, et

b) sont d'une hauteur

qui agréent au Ministre.

APPENDIX 2

MAY 72

ATTEN	INITIAL

FLINTKOTE

THE FLINTKOTE COMPANY OF CANADA LIMITED

P O Box 38 St. George's, Nfld

May 3, 1972

6-149-00

De Leuw, Cather
Consulting Engineers
272 Duckworth St.
St John's

Attention: Mr. B. D. Henderson

Dear Mr. Henderson:

Upon a review of our water requirements at Turf Point, St Georges - we feel we would require about 1000 gals of water per day as a normal requirement. This would be for our domestic supply as well as water required for dust control. If facilities were later installed for supplying water to vessels at our dock, this figure would of course be higher. We handle approximately 12 to 15 ships per year and therefore occasionally this requirement of 1000 gals per day would be upped by 100 tons of water for the ship. - 20,000 Imp Gal.

I trust this information meets with your approval. If you require more information, please do not hesitate to let me know. Also, we anticipate this above mentioned requirmment but this letter in no way should be considered as a commitment on our part to the purchase of this water.

Yours truly,

D. I. McLachlan
Plant Engineer

ccP A.G Tiede
F X Alexander

APPENDIX 3

De Leuw, Cather

COPY

May 16, 1972
Our Ref: 06-149

Mr. Alex Dunphy
St. Georges, Nfld.

Re: St. Georges Industrial Water Supply

Dear Mr. Dunphy:

This will confirm recent discussions when you met the writer and Mr. J. Riggs of De Leuw, Cather, to review the water requirements for the Cold Water Fisheries Plant in St. Georges.

Sea water used in the existing processes at the plant is delivered by 2 pumps having an approximate theoretical capacity of 16,000 gallons per hour. The plant now processes 30 to 50 tons of herring per day and facilities can be expanded to handle 100 tons per day.

We understand that it is hoped to expand the plant to process ground fish. Immediate plans are to process 50 - 100,000 lbs. per day with a possibility of reaching a figure of 250,000 lbs./day at some future date. For the purpose of making an assessment of water requirements, we are assuming that herring and groundfish would not be processed simultaneously.

Based on volumes used in modern fish plants, the maximum daily requirements would be (250,000 lbs @ 2 1/2 gals. per lb.) 625,000 gals. per day, which could be required within a ten hour period. However, we understand that a normal monthly requirement in a plant of this size would average out at 5,000,000 to 7,000,000 gallons.

Processing of filleted fish is governed by regulations which stipulate that water used in the plant be provided from an approved source, which may be either sea water or fresh water. The source must be acceptable with regard to bacteria content and in any case should be chlorinated.

We have been informed that new regulations are being introduced to cover processing of herring which will require similar standards to those required for filleted fish.

........2

Fresh water is, or will be required for washrooms, ice making and in skinning machines. Processing may involve the use of salt water provided that it meets Federal Fisheries Department standards.

The fish plant is the principal user of industrial water in St. Georges at present and future expansion of facilities here is one of the major factors in considering future industrial water requirements for the Town.

As required under the terms of reference for our Study, we will be considering the most suitable means of supplying acceptable sea water and/or fresh water to the plant to meet the demands outlined above.

Yours very truly,

DE LEUW, CATHER & CO. OF CANADA LIMITED

B D Henderson

B. D. Henderson, P. Eng., Associate,
Manager, Newfoundland Operations

BDH:md

APPENDIX 4

REPORT ON

GROUNDWATER STUDY

ST. GEORGE'S, NEWFOUNDLAND

Our Project No. 2298

Prepared For

De LEUW, CATHER & COMPANY OF CANADA LIMITED

September 11, 1972

NOLAN, WHITE & ASSOCIATES LIMITED

ST. JOHN'S NEWFOUNDLAND

TABLE OF CONTENTS

PAGE NO.

SYNOPSIS . . . . 1 - 2

PUMP TESTING EXISTING WELL 3

TEST DRILLING PROGRAM . . . . 3 - 6
  Borehole No. 1 4
  Borehole No. 2 4
  Borehole No. 3 5
  Borehole No. 4 5
  Borehole No. 5 6

FLAT BAY BROOK (ZONE #1) . . . . 6 - 7

CONCLUSIONS 8

RECOMMENDATIONS 9

APPENDIX A . . . . LOCATION PLAN -

APPENDIX B . . . . PHOTOS -

APPENDIX C . . . . BOREHOLE LOGS -

APPENDIX D . . . . GRAPHS -

* * * * * * *

NOLAN, WHITE & ASSOCIATES LTD.
CONSULTING ENGINEERS

GROUNDWATER STUDY

ST. GEORGE'S, NEWFOUNDLAND

For
De LEUW, CATHER & COMPANY OF CANADA LIMITED
Our Project No. 2298

SYNOPSIS

The firm of Nolan, White & Associates Limited was retained by De Leuw, Cather & Company of Canada Limited to carry out a groundwater study in the St. George's area of Western Newfoundland. The purpose of this study was to determine the feasibility of a subsurface source of water supply for industrial demand and possible use by the town of St. George's. Since it was known that much of the Stephenville/St. George's area is underlain by glacial outwash deposits of sand and gravel, it seemed obvious to consider this material as a potential source for a water supply. Our suggested procedure for carrying out this study is documented in De Leuw, Cather's initial proposal to DREE, dated February 29, 1972.

Fieldwork commenced in May and included pump testing one of the existing deep wells in St. George's. A geological field survey was made, supplemented by an air photo interpretation of the surficial deposits in the area. The results of this study were presented in an interim report (De Leuw, Cather; May 19, 1972) and outlined favourable zones with respect to groundwater potential. The recommended procedure for further evaluation of these zones was also included in the report and was subsequently carried out. This involved drilling five test holes, all of which were in Zones 2 and 3 (see Figure 1). A diamond drill utilizing a two-man crew was used for this purpose. The holes were advanced using conventional wash boring techniques and samples were retrieved by means of a split spoon or by washing to surface. Bedrock and boulders were cored thru the use of diamond type bits. Since the results of this program were unfavourable, it was decided to test Zone #1 which, although considered to have the greatest potential, is furthest from the community. Test pits were dug on the north side of Flat Bay Brook to evaluate the quality of subsurface material beneath the water table, and the results of this are included in the following report.

PUMP TESTING EXISTING WELL

A pump test was carried out on one of the two deep wells in the town of St. George's. These wells were within 100 feet of each other which would imply that one was to be used as an observation hole for the other. One of the wells had been filled with debris and could therefore not be tested. The other was pumped for a period of 24 hours using a 30 GPM capacity submersible pump. Drawdown and recovery curves, along with other pertinent data, are included in Appendix D of this report. These results indicate that the well is considerably better than average for drilled wells in this province but would fall far short of meeting the anticipated industrial demand. Production is probably from fractures within the sandstones which underlie much of the area.

TEST DRILLING PROGRAM

Zone #2 was first appraised because of the high quality granular material it contained near the mouth of Barachois Brook and because of its proximity to the community. Four boreholes were put down in this zone.

Borehole No. 1

Borehole No. 1 was centrally located within the zone and close to Highway No. 60. It was taken to a total depth of 32 feet. The overburden consisted of dense silty sand to 25 feet, at which point bedrock in the form of poorly consolidated sandstone and conglomerate was encountered (see borehole log). This was considered an unfavourable hole in that the bedrock was encountered at a fairly shallow depth and the overburden was high in fines.

Borehole No. 2

Borehole No. 2 was positioned about 1000 feet east of the first hole in the midst of a bog which, at this site, was 13 feet thick. Between the bog and bedrock, 32 feet of interbedded silty sand and sandy silt were penetrated with some thin (less than 4 inches) seams of clayey silt. Bedrock consisted of sandstone, conglomerate, and siltstone, typical of the Carboniferous strata of this area. The hole terminated at 91 feet and was unsatisfactory because of the high percentage of fines in the overburden.

Borehole No. 3

Borehole No. 3, toward the west end of Zone #2, yielded encouraging information in that 35 feet of very fine uniform sand was encountered from surface downward. Since the water table was at 5 feet, it was felt that a well point system might be developed here. The borehole was continued to a total depth of 56 feet without encountering bedrock. Below 35 feet, however, silt and clayey silt predominated. A sieve analysis performed on the fine sand samples indicated the material to be too fine to properly develop, although it was a borderline case.

Borehole No. 4

Zone #3 was tested next with Borehole No. 4 which was positioned adjacent to Dribble Brook at Steel Mountain Road. It was felt that if suitable sand and gravel strata were encountered, a series of screened wells could be developed utilizing the principle of induced infiltration from the brook. The overburden proved to be mostly a till like material which was high in fines. The hole was terminated at 28 feet.

Borehole No. 5

Borehole No. 5 was drilled in order to relate to Borehole No. 3. A possible extension and improvement of the fine sand deposit was considered. Silty till was penetrated to the entire depth of 27 feet.

The information obtained from the boreholes proved that a considerable amount of fluvial and marine glacial sediment was deposited in the St. George's area. The amount of coarse clean granular material within these deposits is unfortunately small with the most evident material being above the water table. It is unlikely, therefore, that highly productive wells can be developed without a much more extensive subsurface investigation.

FLAT BAY BROOK (ZONE #1)

The sand and gravel deposits on the south side of Flat Bay Brook near the Trans-Canada Highway were mentioned in the Interim Report to DREE. While this zone is fairly distant from the town of

St. George's, its development could have the advantage of eliminating the need for a treatment plant to remove color. This apparent advantage prompted the DREE Committee to request additional testing of the zone which might determine the feasibility of constructing a well point system or infiltration gallery adjacent to the river.

Three test pits were excavated by means of a mechanical backhoe on August 26, 1972. All three encountered favourable sand and gravel deposits to depths of 12 feet. Two of the pits dug 7 to 8 feet below the water table. The static water level in two of the pits at a distance of roughly 100 feet from the river was approximately the same level as the water in the river.

This river terrace deposit should have the potential for achieving high production from a system of well points, screened wells, or an infiltration gallery. The degree to which color can be removed through the process of natural filtration should be determined by additional testing but the chances for water quality improvement would appear quite good.

CONCLUSIONS

The existing deep well in the town of St. George's is inadequate for supplying the anticipated industrial demands. It and additional deep wells may prove sufficient for the community demand but this would necessitate fairly extensive additional subsurface testing.

The indicated zones of groundwater potential which are close to the community are generally unsatisfactory, although a well point system might still be practical in the vicinity of test Hole No. 3 for purposes of supplying the community. At this time, however, this situation appears marginal and would require additional field assessment.

The Flat Bay Brook River terrace deposits are favourable for meeting the industrial and community demand. Further testing is required to determine the best type of intake system and the water quality improvement which may be achieved through induced infiltration.

RECOMMENDATIONS

A subsurface screened intake device should be installed in the river terrace deposits on the north side of Flat Bay Brook in order to promote natural filtration of the river water through the sand and gravel deposits. The necessary testing to determine the type and location of such a device should be undertaken to permit design of the most practical system.

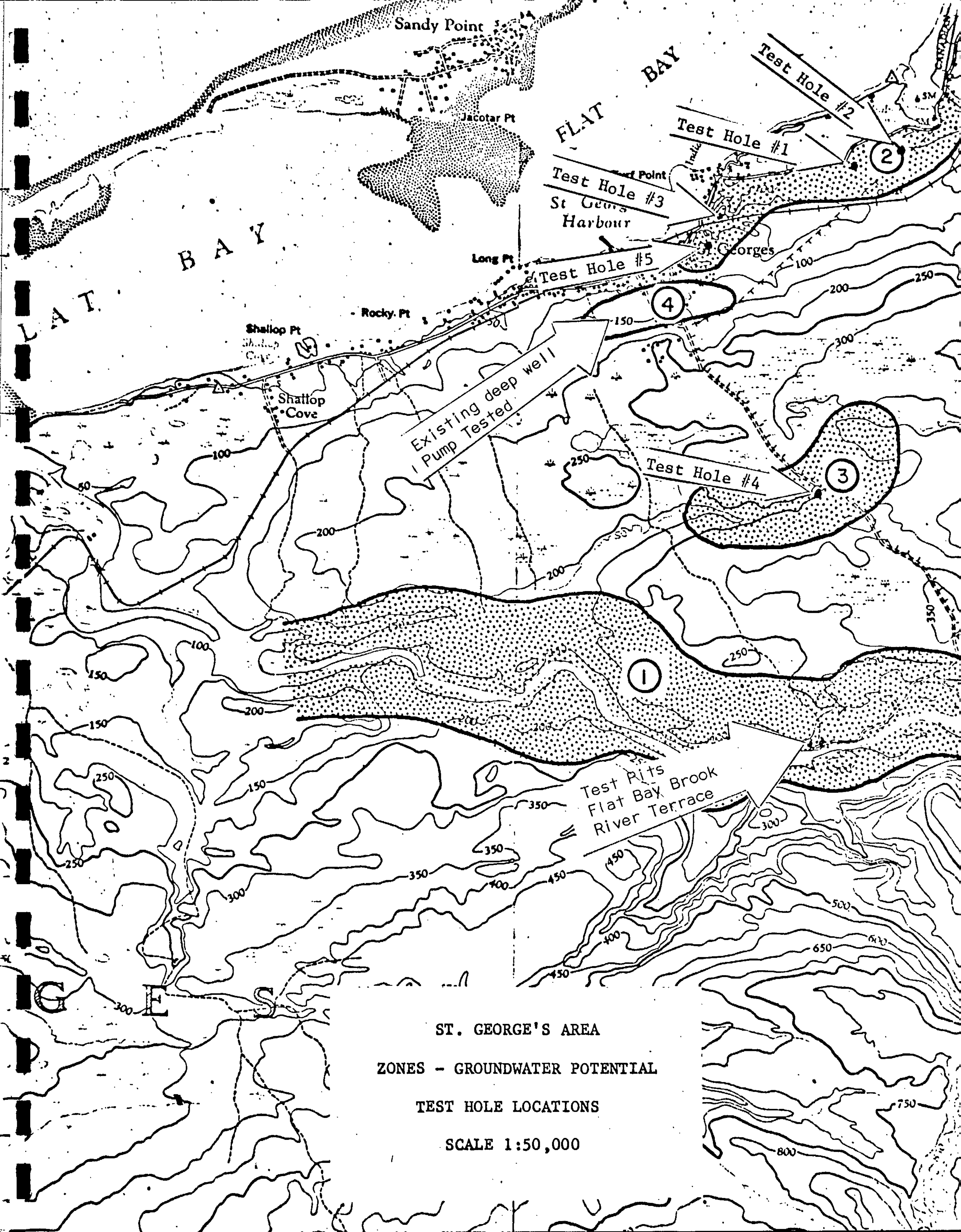
NOLAN, WHITE & ASSOCIATES LIMITED

F J Nolan

F.J. Nolan, P.Eng.

REGISTERED PROFESSIONAL ENGINEER
F. J. NOLAN
SIGNATURE
PROVINCE OF NEWFOUNDLAND

APPENDIX A



ST. GEORGE'S AREA

ZONES - GROUNDWATER POTENTIAL

TEST HOLE LOCATIONS

SCALE 1:50,000

APPENDIX B

PHOTO NO. 1

Material excavated from Test Pit No. 2

PHOTO NO. 2

Test Pit No. 3

Test Pit No. 1

PHOTO NO. 4

Test Pit No. 2. Note Flat Bay Brook in background.

PHOTO NO. 3

APPENDIX C

BOREHOLE LOG

JOB No. 2298

BOREHOLE No. 1

DRAWING No. ____

PROJECT GROUNDWATER STUDY

LOCATION ZONE #2

ST. GEORGE'S, NEWFOUNDLAND

HOLE LOCATION AND DATUM SEE DRAWING No. 1

2" O.D. SPLIT TUBE —o—o—o—o— ▨

2" I.D. SHELBY TUBE —x—x—x—x— ■

2" DIA. CONE ————

PUSHED ____ ᴾ

VANE TEST AND SENSITIVITY (S) $+^S$

NATURAL MOISTURE ×

PLASTIC AND LIQUID LIMIT ├—o

UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE ⊕ 0 5 10 15

% STRAIN AT FAILURE ↗

W.L.	SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FT.	PENETRATION RESISTANCE 350 FT. LB. BLOWS/FT. 20 40 60 80 SHEAR STRENGTH K.S.F.	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	NATURAL UNIT WEIGHT P.C.F.
▽		GRAVELLY SAND - grey-brown sand, very fine to coarse grained, gravel percent varies, very dense, silty in part.		0 5 10			
		SILTY SAND - brown to brownish grey, silty with some gravel and cobble sizes, compact to dense.		15 20			
		BEDROCK - interbedded sandstone and conglomerate, mostly friable, moderately fractured, dip 30°.		25 30			
		BORING TERMINATED		35 40 45 50			

NOLAN, WHITE & ASSOCIATES LTD.

BOREHOLE LOG

JOB No. 2298 **BOREHOLE No.** 2 **DRAWING No.**

PROJECT GROUNDWATER STUDY

LOCATION ZONE #2

ST. GEORGE'S, NEWFOUNDLAND

HOLE LOCATION AND DATUM SEE DRAWING No. 1

2" O.D. SPLIT TUBE –o–o–o–o– ▨
2" I.D. SHELBY TUBE –×–×–×–×– ■
2" DIA. CONE ———
PUSHED ——— P
VANE TEST AND SENSITIVITY (S) +S

NATURAL MOISTURE ×
PLASTIC AND LIQUID LIMIT ├—o
UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE 0 15 ⊕ 5 10
% STRAIN AT FAILURE

W.L.	SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FT.	PENETRATION RESISTANCE 350 FT. LB. BLOWS/FT. 20 40 60 80 / SHEAR STRENGTH K.S.F.	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	NATURAL UNIT WEIGHT P.C.F.
▽		BOG - soft, black to dark brown, peat.		0 10			
		SILTY SAND - grey to brown, interbedded with thin silt beds, contains lenses or beds of fine to coarse gravel.		20 30 40			
		BEDROCK - sandstone mostly, grey interbedded with claystones and conglomerate. Some beds of medium to coarse sand which is clean but beds are less than 1 ft. thick. Dip 10°. Poorly consolidated mostly. From 82 ft. to 91½ ft. rock is mainly conglomerate, fine gravel size - matrix is mainly clay.		50 60 70 80 90			
		BORING TERMINATED		100 110			

NOLAN, WHITE & ASSOCIATES LT
CONSULTING ENGINEERS

BOREHOLE LOG

JOB No. 2298

BOREHOLE No. 3

DRAWING No. ______

PROJECT GROUNDWATER STUDY

LOCATION ZONE #2

ST. GEORGE'S, NEWFOUNDLAND

HOLE LOCATION AND DATUM SEE DRAWING No. 1

2" O.D. SPLIT TUBE —o—o—o—o— ▨

2" I.D. SHELBY TUBE —×—×—×—×— ■

2" DIA. CONE ————

PUSHED ______ P

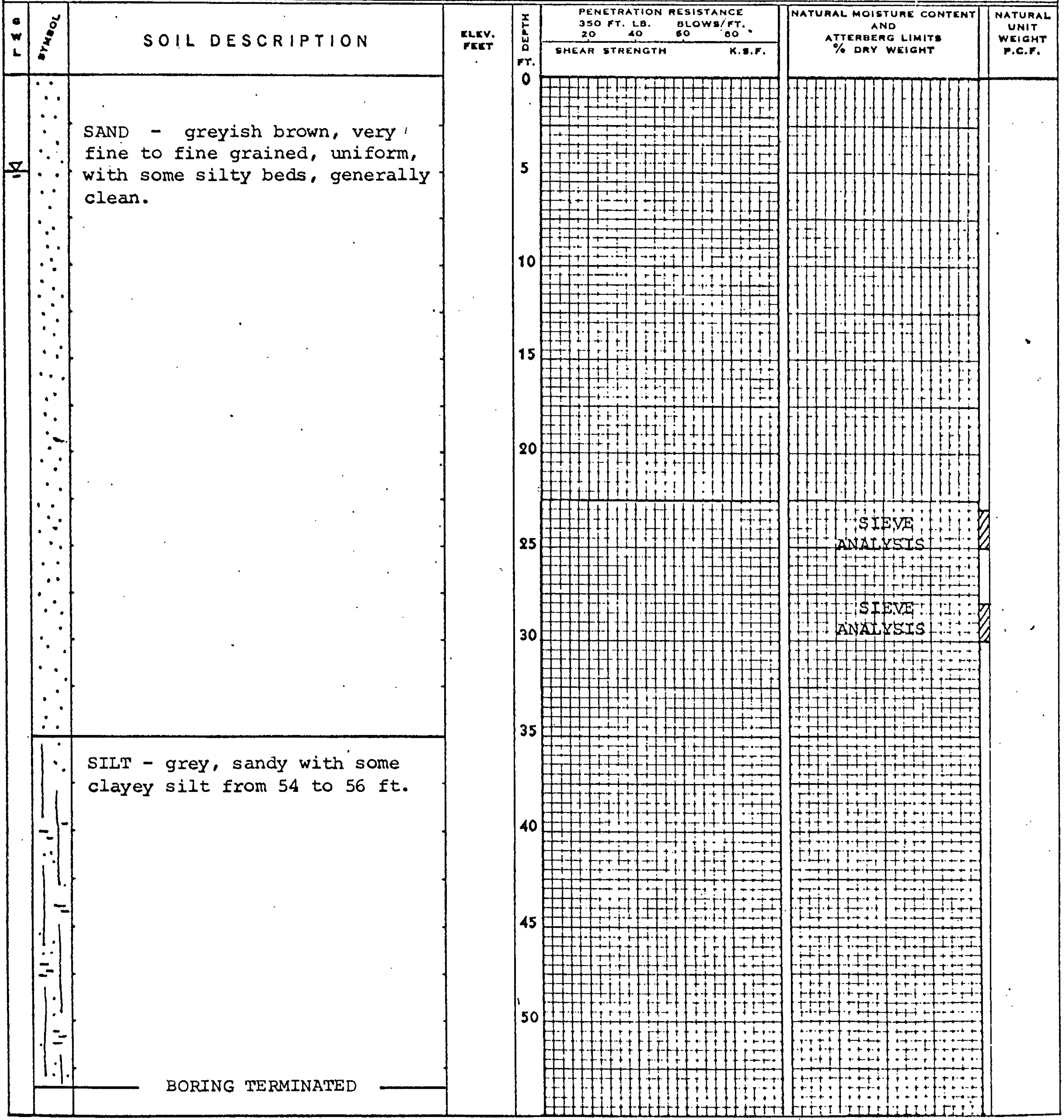
VANE TEST AND SENSITIVITY (S) $+^{S}$

NATURAL MOISTURE ×

PLASTIC AND LIQUID LIMIT ├—o

UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE

% STRAIN AT FAILURE



SAND - greyish brown, very fine to fine grained, uniform, with some silty beds, generally clean.

SILT - grey, sandy with some clayey silt from 54 to 56 ft.

BORING TERMINATED

NOLAN, WHITE & ASSOCIATES LTD.

BOREHOLE LOG

JOB No. 2298 BOREHOLE No. 4 DRAWING No. ____

PROJECT GROUNDWATER STUDY

LOCATION ZONE #3

ST. GEORGE'S, NEWFOUNDLAND

HOLE LOCATION AND DATUM SEE DRAWING No. 1

2" O.D. SPLIT TUBE —o—o—o—o—

2" I.D. SHELBY TUBE —×—×—×—×—

2" DIA. CONE ————

PUSHED P

VANE TEST AND SENSITIVITY (S) +S

NATURAL MOISTURE ×

PLASTIC AND LIQUID LIMIT ├—o

UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE 0 15 ⊕ 5 10

% STRAIN AT FAILURE

W.L.	SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FT.	PENETRATION RESISTANCE 350 FT. LB. BLOWS/FT. 20 40 60 80 SHEAR STRENGTH K.S.F.	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	NATURAL UNIT WEIGHT P.C.F.
▽		ROAD FILL - mixed sand and gravel, some boulders.		0 5			
		CLAYEY SAND & GRAVEL - red to brown, with some boulders and gravel, very dense.		10			
		GRAVEL & SAND - sand is coarse, fairly clean, trace clay.		15			
		CLAYEY SILT - brown to reddish brown, cohesive, sandy with minor gravel.		20 25			
		— BORING TERMINATED —		30 35 40 45 50			

NOLAN, WHITE & ASSOCIATES LTD.

CONSULTING ENGINEERS

BOREHOLE LOG

JOB No. 2298

BOREHOLE No. 5

DRAWING No.

PROJECT GROUNDWATER STUDY

LOCATION ZONE #2

ST. GEORGE'S, NEWFOUNDLAND

* HOLE LOCATION AND DATUM SEE DRAWING No. 1

2" O.D. SPLIT TUBE —o—o—o—o— ▨

2" I.D. SHELBY TUBE —x—x—x—x— ▣

2" DIA. CONE ———

PUSHED ——— P

VANE TEST AND SENSITIVITY (S) +S

NATURAL MOISTURE ×

PLASTIC AND LIQUID LIMIT ├—o

UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE ⊕ (0, 5, 10, 15)

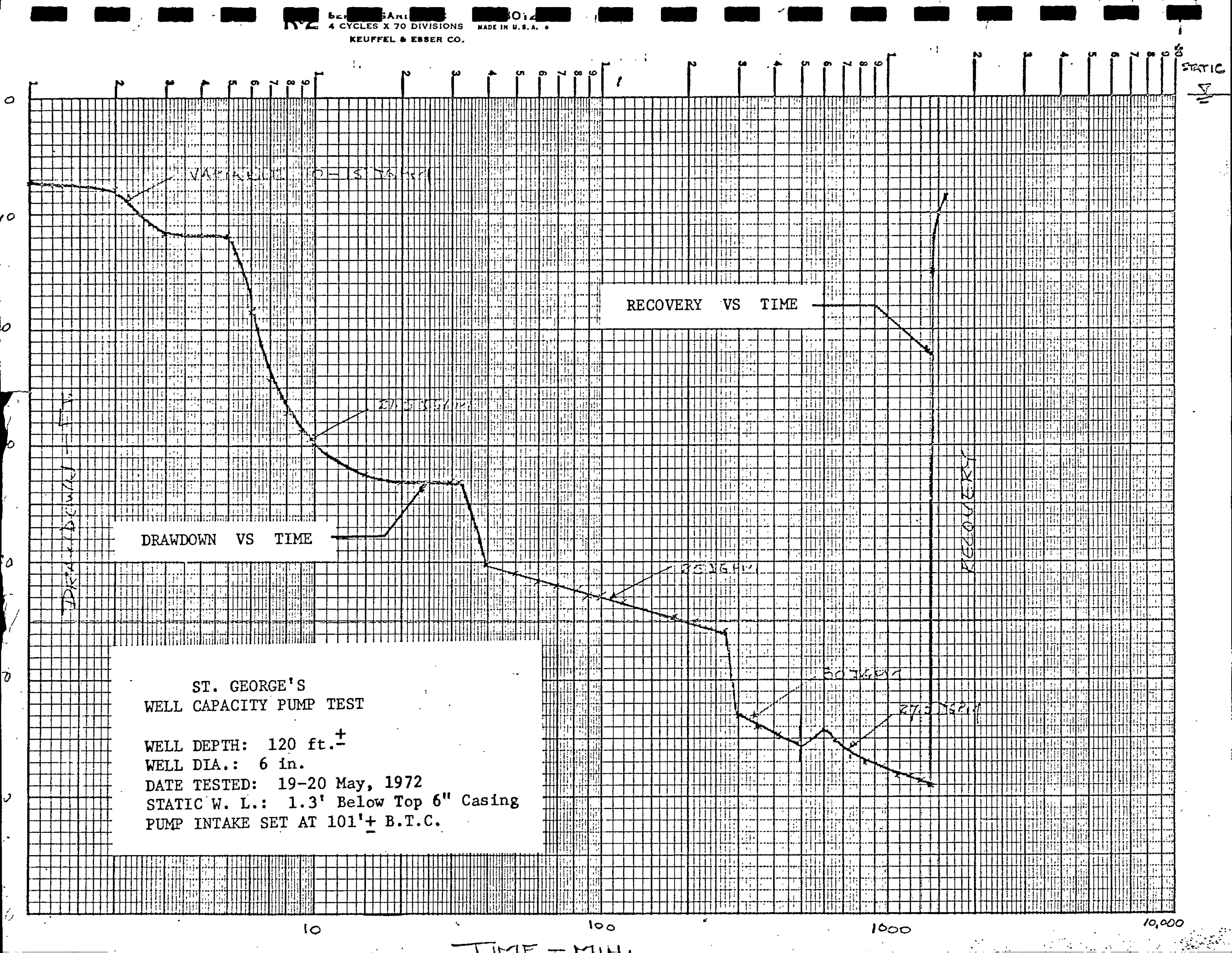
% STRAIN AT FAILURE

G.W.L.	SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FT.	PENETRATION RESISTANCE 350 FT. LB. BLOWS/FT. 20 40 60 80 SHEAR STRENGTH K.S.F.	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	NATURAL UNIT WEIGHT P.C.F.
		SAND - brown, medium to coarse grained to 6 ft. then fine to very fine to 10 ft. depth.		0 5			
▽		SILTY SAND - brown, fine to medium grained, cohesive.		10			▨ Rec. 24"
		GRAVELLY SILT - brown, cohesive, very dense.		15 20			▨ Rec. 12"
		BORING TERMINATED		25			
				30			
				35			
				40			
				45			
				50			

NOLAN, WHITE & ASSOCIATES LTD.

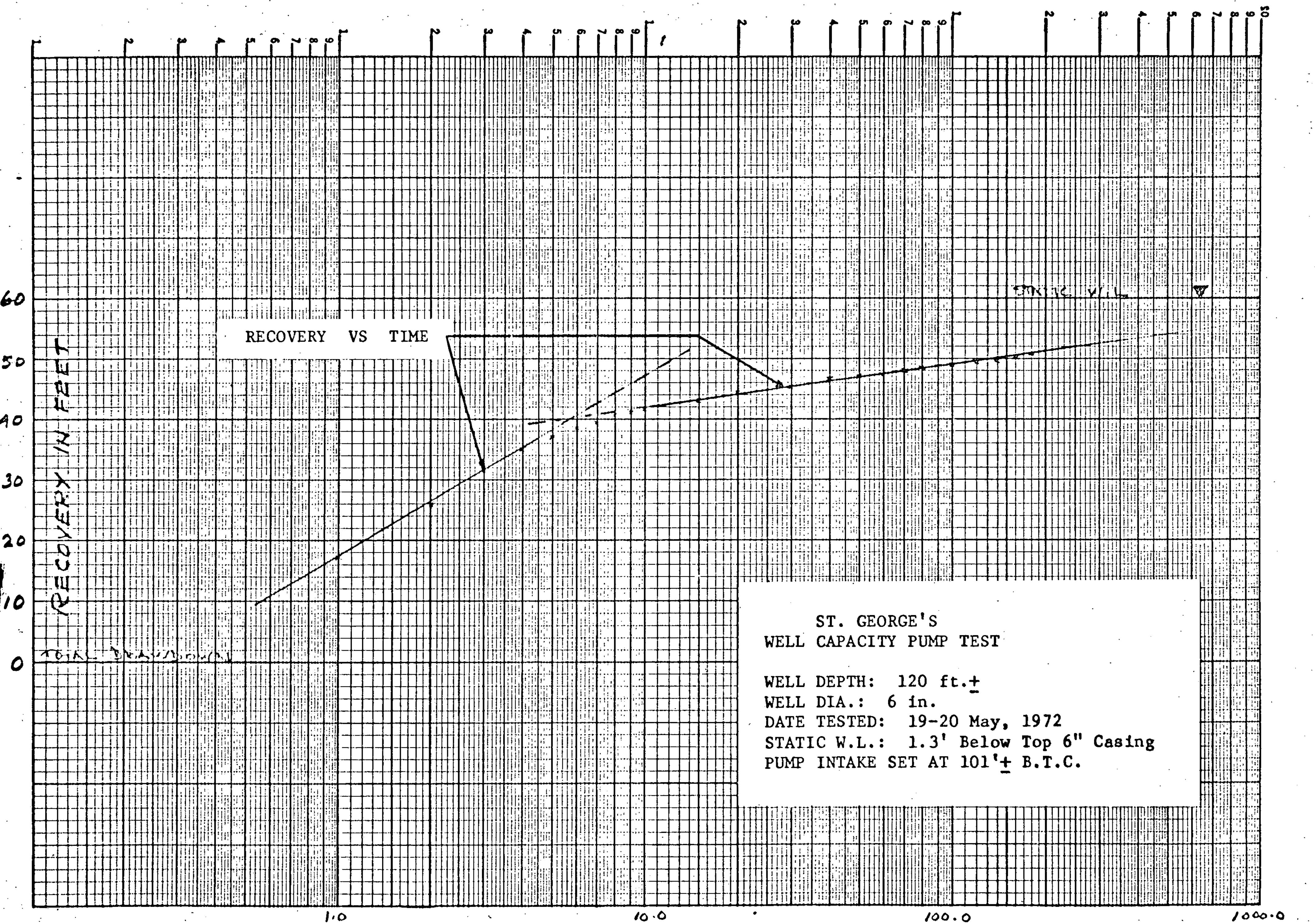
CONSULTING ENGINEERS

APPENDIX D



ST. GEORGE'S
WELL CAPACITY PUMP TEST

WELL DEPTH: 120 ft. ±
WELL DIA.: 6 in.
DATE TESTED: 19-20 May, 1972
STATIC W. L.: 1.3' Below Top 6" Casing
PUMP INTAKE SET AT 101' ± B.T.C.

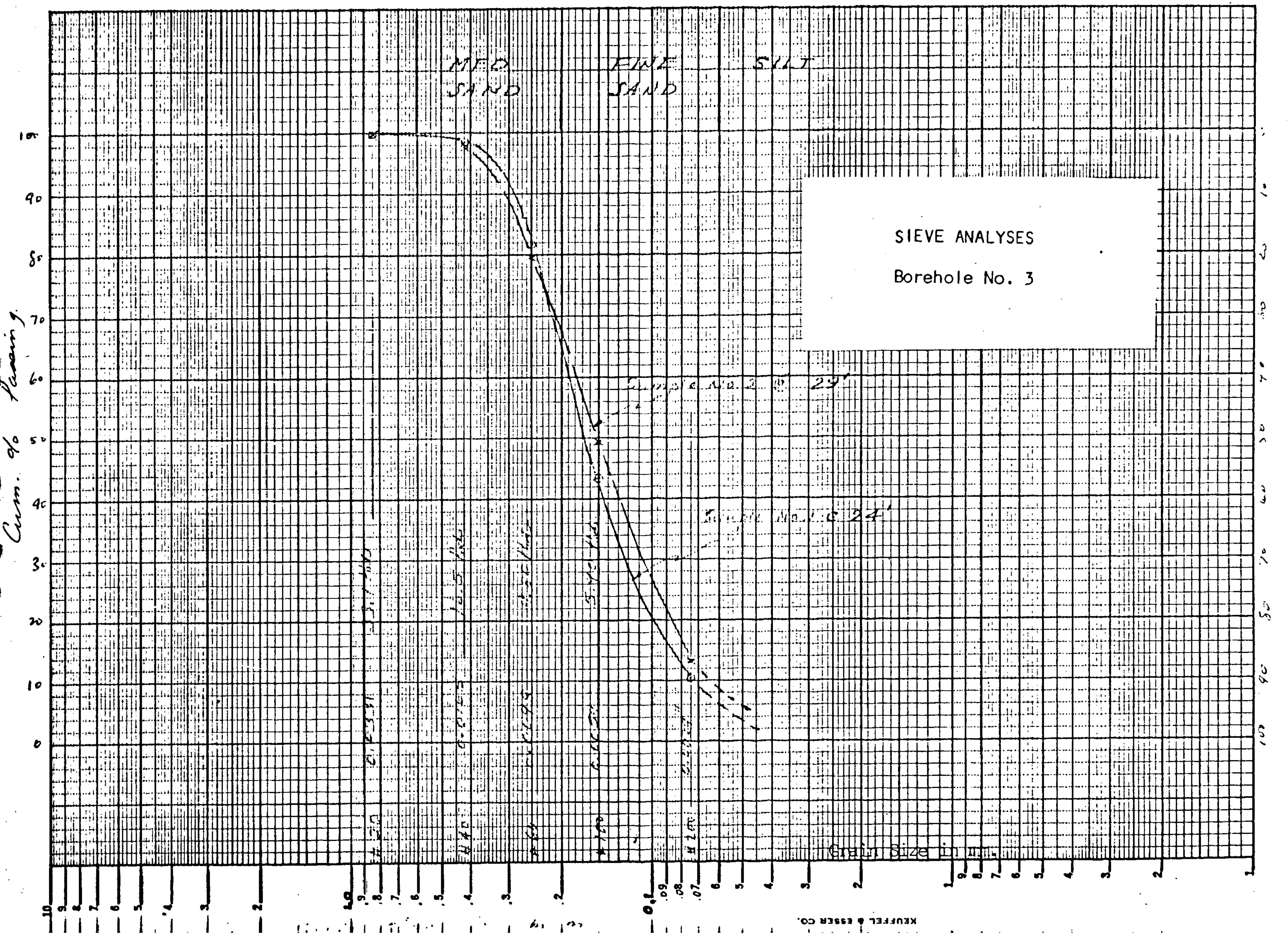


ST. GEORGE'S
WELL CAPACITY PUMP TEST

WELL DEPTH: 120 ft.±
WELL DIA.: 6 in.
DATE TESTED: 19-20 May, 1972
STATIC W.L.: 1.3' Below Top 6" Casing
PUMP INTAKE SET AT 101'± B.T.C.

SIEVE ANALYSES

Borehole No. 3



Author/*Auteur*

DeLeuw, Cather & Co.

Title/*Titre*

St. George's industrial water supply : pre-design study. 1972

Date	Borrower *Emprunteur*	Room *Pièce*	Telephone *Téléphone*

De Leuw, Cather