ONTARIO WATER RESOURCES
AND
SUPPLY COMMITTEE

PRELIMINARY STUDY
OF
WATER SUPPLY FROM LAKE ERIE
FOR
ST. THOMAS - LONDON AREA

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DESIGN
PLANS AND SPECIFICATIONS
SUPERVISION OF
CONSTRUCTION
REPORTS - VALUATIONS

MUNICIPAL ENGINEERING
WATER SUPPLY AND
PURIFICATION SEWERAGE AND
SEWAGE DISPOSAL
DRAINAGE -FLOOD CONTROL

ONTARIO WATER RESOURCES

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February, 1956.

February 7, 1956.

Ontario Water Resources and Supply Committee,
Mr. A. M. Snider,
Chairman,
67 College Street,
Toronto, Ontario.

Re: Preliminary Study of Water Supply from Lake Erie for the St. Thomas - London Area - Part I

Gentlemen:

In your letter of December 16, 1955 you asked this firm to make a preliminary survey and study and submit a proposal with estimates of cost for a water supply scheme to pump water from Lake Erie and supply the water requirements of the city of St. Thomas and vicinity, and provide for future expansion for the next 25 years. Your letter also asked that an alternate proposal be made on a plan provide extension further inland to the London area.

Subsequent to the reference in your letter, and as discussed with your Chairman, it was decided that our studies should cover four alternative schemes, which for convenience we have designated as A, B, C, and D.

Scheme A - Municipal Water Supply for St. Thomas and bordering areas along the way

Scheme B - Municipal Water Supply for St. Thomas and London and bordering areas along the way

Scheme C - same as Scheme A with additional capacity for irrigation between Lake Erie and St. Thomas

Scheme D - Some as Scheme B with additional capacity for irrigation in rural areas between Lake Erie and London.

The present submission herein is Part I of our preliminary report and deals only with Schemes A and B.

Part II of the report will deal with Schemes C and D and will be submitted as soon as we have completed further studies of the several difficult features related to irrigation.

We wish to emphasize that this report is preliminary only. Doubtless further study of details and physical features in the areas, and further consideration of the requirements and views of the municipalities and rural communities will modify or alter in some degree the schemes herein outlined; but the main elements and the overall cost will remain substantially the same assuming, of course, that there is no departure from the basic data on which the proposals are predicated.

These basic data are, in the main, the following:

1. Quality of Water

Raw lake water, sterilized at the source by chlorination. It is assumed that any further treatment such as sedimentation and filtration will be carried out by the municipalities concerned.

2. Capacity

Scheme A - Capacity of 9.0 M.G.D. (Million Imperial Gallons Daily) from Lake Erie to a reservoir at St. Thomas as shown on the General Plan (file: 352-D-2166) accompanying this report.

Scheme B - Capacity of 30 M.G.D. from Lake Erie to reservoir at St. Thomas and 21. M.G.D. capacity re-pumped from St. Thomas to storage reservoir at London, as shown on the general plan.

DISCUSSION OF THE FACTORS INFLUENCING THE DESIGN OF SCHEMES A AND B

Existing St. Thomas Supply

The existing water supply of St. Thomas is obtained from Kettle Creek and from wells and springs in the vicinity of the city. The flow in Kettle Creek is utilized by impounding the waters of the creek behind a dam which was constructed to the north-east of the city around the year 1921. Since that time, additional work has been done on the watershed to develop springs and shallow wells so that they would flow by gravity into the creek and increase the yield of the stream for the use of the city. Quite recently a well was developed on the northern boundaries of the city which has a capacity of 450,000 g.p.d. from which water is pumped into the system.

We are informed that the reliable dry weather flow from these sources totals about 1.16 M.G.D. The 1954 population of St. Thomas as recorded in the 1955 Municipal Directory is 19,117 but the population supplied with water by the St. Thomas Public Utilities Commission in that same year was 24,572 because many consumers live outside the municipal boundaries.

In the year 1955 the total pumpage of water was 825,101,000 gallons or an average of 2.26 M.G.D, which is about 90 G.C.D. The maximum day's water use during 1955 was 3.413 million gallons, this figure being 151 percent of the average daily use.

In order to meet demands which may reach a peak of 3.413 M.G.D. averaged over a maximum day from a supply which has an inflow at times as low as 1.16 M.G.D. it is necessary to store water in the impounding reservoir. The waters of Kettle Creek carry an extremely high turbidity during times of flood and since 1921 when the storage available behind the dam was about 340 million gallons, the sediments which are deposited as the water slows up in approaching the dam have reduced the

available storage to 171 million gallons.

In a period of 34 years this has been a loss of 1.46 percent per annum or a total of 49.7 percent of the initial storage has been lost in this time. In 1951 stop logs were constructed on the top of the dam to raise the water level and thus gain an additional 157 million gallons. Unfortunately the full extra height of 4.07 feet cannot be made available during the winter because of the danger of spring floods reaching the dam before the stop logs could be removed which would threaten the safety of the structure.

Of the total of 328 million gallons storage provided with the full 4.07 feet of stop logs in place, the usable storage is still only about 274 million gallons. This figure then is the maximum available storage with the stop logs in place. The minimum available storage has on at least one occasion been as low as 38 million gallons during January due to the formation of 14 inches of ice on the reservoir. This occurred when no logs were in place. The first and most urgent problem, then, for St. Thomas is to secure an adequate supply of water plus a comfortable margin of safety to allow for contingencies. It is considered to be a prudent water works management policy to have in sight an available supply of about double the average demand of a system.

Tastes, Odours, High Temperatures

In addition to the basic lack of sufficient water the impounded supply of Kettle Creek has other severe limitations. The large expanse of shallow water is quickly warmed by the summer sun and at times reaches temperatures of 80 degrees and more. The sunlight has the further effect of encouraging aquatic growths such as algae and micro-organisms which impart to the water unpleasant tastes and odours that are very difficult if not sometimes impossible to remove, and which render the water very expensive to treat.

Existing Water Treatment Plant

The city's water treatment plant is located in the valley of Kettle Creek adjacent to the dam. The water level in the filters is 708 feet above sea level datum. This plant is a rapid sand filtration plant of 4 M.G.D. capacity. The raw water flows from the Kettle Creek reservoir into a sedimentation basin of 4.5 million gallon capacity which affords a period of preliminary settling to aid in clarifying the water. The water is then chlorinated after which alum, ammonium sulphate and activated carbon are added before the water is pumped into the plant. Here it is aerated and passed through mixing chambers where the alum forms a floc, and settling basins where the floc and entrained impurities are settled out. The water is then passed through the rapid sand filters and into the clear well. Chlorine is added in this reservoir for final sterilization of the water.

The distribution system lies considerably higher than the filter plant and the water is pumped from the clear well to a standpipe with a top water level elevation of 890 feet which is 182 feet above the filters.

Advantages of a Lake Supply for St. Thomas.

It can be said then of the existing St. Thomas water supply that it is seriously inadequate as regards quantity of water available and that the quality is much loss desirable than would be obtainable from a lake supply even although it is safe from the public health standpoint.

With Lake Erie as its source of water supply the city of St. Thomas would have for all time a never-failing quantity of water of comparatively good quality which can be readily treated by conventional water purification methods even when the turbidity is high due to storms.

Future Requirements for St. Thomas

The future water requirements of St. Thomas are difficult to estimate on the basis of past growth in the city. According to data made available to us by the St. Thomas Public Utilities Commission the population supplied with water has increased from 23,316 in 1941 to only 24,572 in 1954. The corresponding increase in the average daily demand has been from 1.88 M.G.D. in 1941 to 2.12 M.G.D. in 1954, is previously stated the average daily demand for 1955 is 2.26 M.G.D.

It is likely that the 1955 population supplied was about 24,600 persons, so that the average per capita rate of water use has increased from slightly less than 81 g.p.d. in 1941 to about 92 g.p.d. in 1955. Considerable further expansion by development of industrial areas to the east of the city is expected and with this development a considerable increase in the demand for water is anticipated. The most important inducement to the establishment of industry at St. Thomas will be the availability of an adequate supply of high Quality water.

After discussing the Question of the probable future needs of the city of St. Thomas for water with officials of the Public Utilities Commission and considering mainly the probable industrial development of the city, we have concluded that about 8 M.G.D. should be provided to take care of the requirements for the next 20 to 25 years.

In the past, efforts have been made to find wells which would provide additional water. Exploration programmes were carried out in 1949, 1950 and 1951 without much success. In 1955 the deep well previously referred to was developed which produces 450,000 gallons daily. A test drilling programme is underway at the present time but so far out of four test holes only one has shown any promise, and this one, on test pumping, proved disappointing. This programme is being continued in the hope that a well with a capacity of at least one-half M.G.D. may be found to tide the city over the summer of 1956.

Consideration has also been given to the possibility of obtaining more water from Kettle Creek by building a higher dam. The tastes and odours, high temperatures, and high losses due to evaporation from such a large surface area, have deterred the city from committing themselves to the Kettle Creek supply for a further period of 20 or 25 years.

The Public Utilities Commission in St. Thomas now looks to Lake Erie as the only completely reliable source for future water supply for the city. In view of the experience now accumulated regarding the prospects of supplies from wells and from Kettle Creek, we must concur in their opinion.

Existing London Supply

The water works system in London under the jurisdiction of the London Public Utilities Commission is supplied entirely with water from underground sources by springs and wells, although a comparatively small quantity of water is drawn from the Thames river and distributed through a limited and separate system for industrial use.

In a report made by this firm on water supply in London, and presented to the Public Utilities Commission in January, 1954, the sources of supply and related matters, forecast of population and consumption are dealt with. Briefly it can be said that the city enjoys good duality water. Like all underground supplies the water is somewhat hard, but is cool in summer. The problem is one of quantity rather than quality.

The present system is reported to be capable of yielding 18,000,000 M.G.D. by pumping when augmented by water recovered by water spreading from Fanshawe. This water spreading experience is interesting. The Public Utilities Commission reports that about 3,000,000 gallons a day is recovered or about 75 percent of the water actually drawn from the reservoir and spread over the ground.

At present average consumption is of the order of 15 M.G.D. with peak days reaching 15 M.G.D. In order to keep pace with the rapidly growing demand for water in the metropolitan London area, exploratory work to develop new wells is continuing. In this connection we repeat the following taken from the brief submitted to your Commission in November, by the London Public Utilities Commission:

> "Test drilling operations during 1954 disclosed a potential 3,000,000 I.G.D. field in the White Oak area, south of the city. This is now being tested. 1,000,000 I.G.D. has been pumped continuously this summer."
>
> "Another source was located on the Hyde Park Sideroad one mile north of the River Thames; and has been continuously tested this summer at 500,000 I.G.D. A permanent well with a capacity up to 1,000,000 gallons per day will be installed hero this winter."
>
> "During 1955 an extensive drilling program has been continued some miles east of the city in the general area north of Dorchester and south of Highway No. 2. To date the results have been negative and the search has been continued north of the highway following an arc back to the Fanshawe Lake area."

Future Requirements for London

As in the case in St. Thomas, all water services are metered in London. When meters were first installed consumption was of the order of 60 g.p.c.d. this being the figure reported in 1925. By 1953 the per capita rate had increased to 98 g.p.c.d. The experience everywhere is that per capita consumption is increasing roughly about one gallon per day each year and experience in London substantiates this.

In the brief presented by the Public Utilities Commission to your Committee, it is stated that, consumption is expected to double within 20 years and that an additional 18 M.G.D. will be required to meet peak demand.

In our opinion this is not an unreasonable assumption having regard for the city's present status and rate of development.

Assuming that only 5 M.G.D. of this additional water will be obtained from the continued programme of well exploration leaves 13 M.G.D. to be supplied in the future either from the Lake Erie water system or from the Fanshawe reservoir. The additional water could only be made available from the latter by the construction of two additional dams on the Thames River above Fanshawe at Glengowan and Wildwood.

In considering a scheme to use Lake Erie as a source of raw water, and planning for the next 25 years, we would recommend that design capacity of 20 M.G.D. to meet London's requirements be used.

Requirements in Rural Areas Bordering the Pipe Line

In the rural areas, between Port Stanley and St. Thomas and between St. Thomas and London are several smaller communities within about five miles or less from a possible main transmission line which could be served by smaller branch lines extending latterly from the feeder main. It is to be expected that there will be increased residential and light commercial development along roads containing such branch mains.

At present the potential connections along the various roads in the vicinity of St. Thomas are roughly about as follows:

along No, 4 between Port Stanley and St. Thomas, about 100 connections;
along No. 4 between St. Thomas and Lambeth, which has its own well supply, about 200 connections;
along Wellington Road from St. Thomas as far north as Highway No. 401, which is the southerly limit of the London system, about 100 connections;
easterly from St. Thomas along No. 3 Highway between the eastern limit of the

St. Thomas system and Aylmer, about 200 connections;
along the road between Union and Sparta, about 50 connections.

It would not be desirable to have individual service connections to the main transmission pipe to serve consumers located upon the line of the pipe; however smaller mains could be fed from and run parallel to the transmission mains to supply houses situated along the route. The potential domestic demand for water, within the design period from this rural area has been assumed to be 2 M.G.D. of which 1 M.G.D. has been assigned to the area south of St. Thomas.

Description of Scheme A

Scheme A is to supply water for municipal needs from Lake Erie to St. Thomas with an allowance for domestic use in the rural area along the route. The components of Scheme A may be briefly described as follows:

1. A concrete or steel intake pipe, with intake crib extending not less than 4,000 feet into Lake Erie from a point on the shore about 2 ½ miles east of Kettle Creek, The raw water would be drawn from a depth of about 20 feet below mean lake level, but the exact distance from shore and location of the intake should be finally established after detailed information is available.

   The intake pipe would have an internal diameter of 36 inches and it would carry by gravity flow about 11 ½ M.G.D. for a difference in elevation of about five feet between the lake level and the water level in the pump suction well.

   At the suction well end of the intake the water would pass through a mechanically cleaned water screen. This screen would remove fish and floating material and anything which might damage the pumps.

2. A pump house and chlorinating station located on shore on a site protected by sea wall and groin construction.

In order to protect pump house, also against the crumbling of the cliffs due to weathering action, a portion of the cliff about 200 feet wide would be cut back from the beach at a slope of one and one-half horizontally to one vertically. This slope would be protected against weathering by the planting of grass and shrubs and a concrete stair—way would be constructed to provide access.

The pump house would be a well constructed, fireproof building containing the water screen and three pumps each of 4½ M.G.D. capacity. Two pumps would be electrically driven and one driven by a Diesel engine for standby purposes in case of failure of the electrical power system. The pump house would also contain the chlorinating machines and provision for chlorine storage and handling.

3. A reinforced concrete or steel pipe line with a diameter of 30 inches and a minimum cover of five feet to transmit the water from the shore line pump house to a reservoir at St. Thomas. This pipe line would follow the contour of the ground as shown on the profile marked "Scheme A - Hydraulic Gradient for 9 M.G.D." In this pipe line would be installed air release valves and blow-off valves and some means for suppressing surge; also there should be such stop valves and provision for branch connections along the line as may be decided upon.

4. A 9-million gallon reservoir et St. Thomas which would be of the open ground level type with water surface at approximately elevation 800.

This reservoir would be lined either with concrete or with asphalt and because of its elevation would provide gravity flow to the present

water treatment plant in the valley of Kettle Creek.

Estimated Cost - Scheme A

1.	Intake, 36-inch pipe, 4000 feet long	$270,000.00	
2.	Pumping station, located at foot of cliff, including mechanical screen, Pumps and controls, chlorinators, power sub-station at top of cliff, and property.	$160, 000.00	
	Seawall and groin construction for protection of pumping station site at foot of cliff; and filling and grading site	$ 85,000,00	$ 515,000.00
3.	30-inch pipe line from lake- to reservoir at St. Thomas, 53,000 feet with surge protection		$1,370,000.00
4.	Storage Reservoir at St. Thomas, 9 million gallons capacity, open type		$ 90,000.00
			$1,975,000.00

If the works are financed with 25-year, 4 percent debentures, then the annual fixed charges in respect of principal and interest throughout the currency of the debentures will amount to $126,500.00.

Estimated Expenditure and Revenue - Scheme A

While the capacity of the scheme proposed for Scheme A is 9.0 M.G.D. the volume of water used in the initial period will b substantially below this figure. In the brief submitted to your committee by Commissioner W. A. Allan on behalf of the Council and Public tilities Commission of St. Thomas it is stated that the Commission will require an additional 2.0 M.G.D, by 1960. In 1955 the Utility pumped 25,101,000 million gallons to consumers including those served beyond the limits of the City. This figure is equivalent to an average daily pumpage of 2.26 million gallons.

With more water available, service will doubtless be expanded to reach further beyond the City's limits. Also, with even normal growth of population, and with the ever-increasing per capita use consumption will continue to grow.

The introduction of piped sterilized water into rural communities, heretofore dependent upon local wells and upon springs for water for domestic use, almost invariably leads to the creation of municipal water systems and water areas. Even where such systems are comparatively small they serve to supply water in many cases for other than domestic needs such as watering stock, for spraying and for a limited degree of irrigation of cash crops.

While it is not intended that Scheme A should be considered as a dual purpose scheme, one can expect that advantage will be taken of the service for farm use to the degree that water can be spared.

Taking into account these factors concerning consumption appears reasonable to base estimates of cost of operation and revenue or the initial period on an average daily consumption of 4.5 million gallons.

Annual Cost of Operation

Using current cost for power, labour and supplies the annual cost of operation (consumption 4.5 M.G.D.) is estimated to be:

Electric power		$15,000.00
Labour		$40,000.00
Supplies -	including chlorine, fuel oil and other	$ 4,000.00
Insurance and contingencies		$ 6,000.00
	Total	$65,000.00

Cost of operation will not change proportionately because of variation in consumption as only the cost of power and supplies will be materially affected.

Annual Fixed and Operating Cost

Fixed annual cost	$126,500.00	
Allowance for depreciation at 1 ½ percent on capital cost of $1,975,000	$ 24,700.00	$151,200.00
Operations and maintenance based on 4.5 M.G.D. average		$65,000.00
	Total annual cost	$216,200.00

Charge for Water Necessary to Balance the Cost

At an average rate of consumption of 4.5 million gallons daily, which would appear to be reasonable in the initial period of say the next 5 years, the system would supply 1,642,500,000 gallons in a year.

Using the total annual cost figure of $216,200 the cost per 1,000 gallons of water supplied would be 13.15 cents.

Description of Scheme B

Scheme B is to supply water for municipal needs from Lake Erie to St. Thomas and to the city of London with an allowance for domestic use in the rural area along the route. The components of Scheme B may be briefly described as follows:

1. Intake works similar to those for Scheme A except that a 54-inch pipe would be required. At normal lake levels with the draw-down limited to five feet this intake mould have a capacity of about 35 ½ M.G.D.

2. The pump house containing facilities similar to those described for Scheme "A" but having an ultimate capacity of 30 M.G.D. Probably four pumps would be supplied two of which would be electrically driven and two with Diesel drives.

3. The discharge main carrying the water to the top of the cliff would pass through a tunnel and up a vertical shaft.

4. A 42-inch pipe line from the lake to the reservoir located near St. Thomas and passing beyond the reservoir to a booster pumping station located just east of the St. Thomas filter plant.

5. A 30-million gallon reservoir located on the 800-foot contour near St. Thomas in the same location as suggested for the 9-million gallon reservoir in Scheme "A", and of the same type of construction. This reservoir would be connected by a 42-inch branch line to the transmission main.

6. A booster pumping station containing thre pumps, one at five M.G.D. and two at 10 M.G.D one of which would be driven by a Diesel engine and the other two by electric motors.

7. A 36-inch reinforced-concrete or steel pipe line to the reservoir north-east of London at Fanshawe. This pipe line, after crossing Kettle Creek downstream from the St. Thomas dam would go westward until it reaches the right-of-way of the London and Port Stanley Railway, follow along the said right-of-way crossing under Highway No. 401 just north of Westminster. The pipe line then will extend east to the right-of-way of the Hydro Electric Power Commission powerline and along said right-of-way crossing through the bed of the South Branch of the Thames River and continuing until it reaches the proposed reservoir site near Fanshawe

Lake. The pipe lines in Scheme B would have similar valves mentioned in Scheme A. Similarly, surge suppressing devices would be required, not only at the Lake Erie pump house but at the booster pumping station north of St. Thomas.

8. A 20 million gallon reservoir at Fanshawe, of similar type and construction to that proposed in St. Thomas.

Pressures Available at the Transmission Main

It will be noted that the pressure, available at any point along the transmission pipe line is the vertical distance in feet indicated on the profile separating the ground elevation at that point with the elevation of the hydraulic gradient, It will be evident from an inspection of the profile that at some points it might be necessary o install booster pumps on branch lines if water were to be transmitted laterally for any considerable distance.

Estimated Cost - Scheme B

1.	Intake - 54-inch pipe, 4000 ft long	$330,000.00	
2.	Pumping station located at foot of cliff including mechanical screens, pumps and controls, chlorinators, power sub-station at top of cliff, and property	$480,000.00	
3.	Seawall and groin construction for protection of-pumping station site at foot of cliff, and filling and grading site	$95,000.00	$905,000.00
4.	42-inch pipe line from lake to reservoir at St. Thomas with surge protection and contingencies		$2,387,000.00
5.	Storage reservoir at St. Thomas, 30 million gallons capacity, open type		$300,000.00
6.	Booster pumping station, beyond St. Thomas reservoir including pumps and controls, chlorination and power substation		$350,000,00
7.	36-inch pipe line from St. Thomas to reservoir at London - approximately 107,000 feet		$3,420,000.00
8.	Storage reservoir at London - 20 million gallons capacity - open type		$200,000.00
		Total	$7,562,000.00

If the works are financed with 25-year, 4 percent debentures then annual fixed charges on a capital cost of $7,562,000.00 in respect of principal and interest will amount to $485,000.00.

Estimated Expenditure and Revenue - Scheme B

As in the case of Scheme A, we will assume that in the initial period water consumption will average one-half the capacity of the system or 15 million gallons daily. On this assumption the cost of operation is estimated as follows:

Annual Cost of Operation

Lake Erie Pumping Station (Pumping 15 M.G.D. against total head of 155.6 ft)

Electric power	$25,000.00	
Labour	$40,000.00	
Supplies, chlorine, fuel oil and other	$ 8,000.00	
Insurance and contingencies	$ 7,000.00	$80,000.00

Booster Station at St. Thomas (Pumping 10.5 M.G.D. again total head of 172 ft)

Electric power	$19,200.00	
Labour	$36,000.00	
Supplies, chlorine, etc.	$ 6,000.00	
Insurance and contingencies	$ 6,500.00	$67,700.00
	Total	$147,700.00

Estimated Annual Fixed and Operating Cost

Fixed annual cost	$485,000.00
Allowance for depreciation at $1^1/_4$ % on capital cost of $7,562,000.00	$94,525.00
Annual cost of operation	$147,700.00
Total annual cost - Scheme B	$727,225.00

Charge for Water Necessary to Balance the Cost

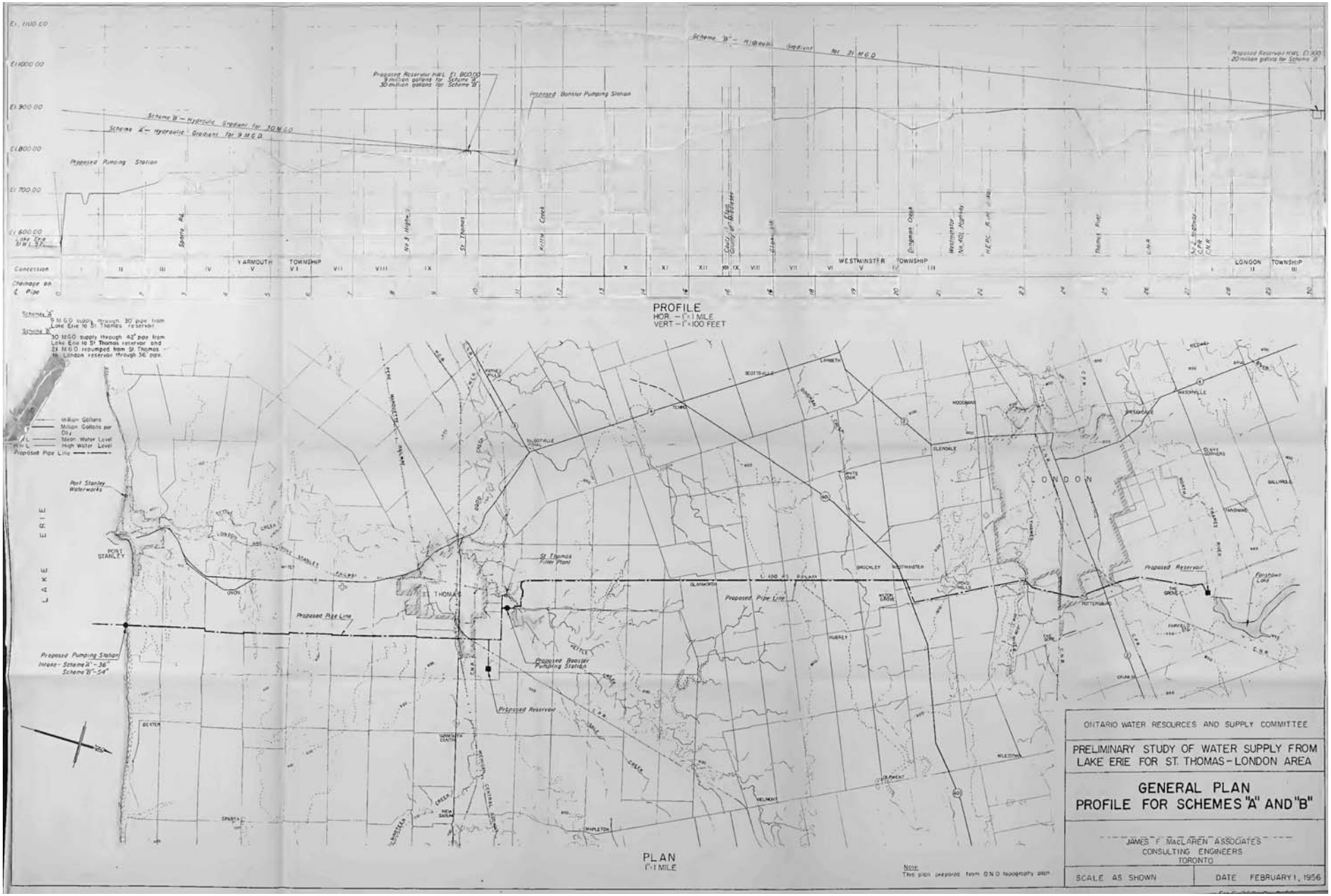
At an average rate of consumption of 15 million gallons daily, which would appear reasonable in the initial period for say the next 5 years, the system would supply 5,475,000,000 gallons in a year.

Using the total annual cost figure of $727,225.00 the cost per 1000 gallons of water supplied would be 13.28 cents.

It is interesting to note that the same figure estimated for Scheme A is 13.15 cents.

All of which is respectfully submitted.

James F. MacLaren Associates


PROFILE
HOR. – 1" = 1 MILE
VERT – 1" = 100 FEET
Scheme 'A' 9 M.G.D. supply through 30" pipe from Lake Erie to St. Thomas reservoir.
Scheme 'B' 30 M.G.D. supply through 42" pipe from Lake Erie to St. Thomas reservoir and 21 M.G.D. resumped from St. Thomas to London reservoir through 36" pipe.
Million Gallons
Million Gallons per Day
M.W.L. Mean Water Level
H.W.L. High Water Level
Proposed Pipe Line
LAKE ERIE
Port Stanley Waterworks
Proposed Pumping Station Intake - Scheme 'A' - 36" Scheme 'B' - 54"
Proposed Pipe Line
ST. THOMAS
St. Thomas Filter Plant
Proposed Booster Pumping Station
Proposed Reservoir
Proposed Pipe Line
LONDON
Proposed Reservoir
PLAN
1" = 1 MILE
Note
This plan prepared from O.N.O. topography plan
ONTARIO WATER RESOURCES AND SUPPLY COMMITTEE
PRELIMINARY STUDY OF WATER SUPPLY FROM LAKE ERIE FOR ST. THOMAS – LONDON AREA
GENERAL PLAN
PROFILE FOR SCHEMES "A" AND "B"
JAMES F. MacLAREN ASSOCIATES
CONSULTING ENGINEERS
TORONTO
SCALE AS SHOWN
DATE FEBRUARY 1, 1956