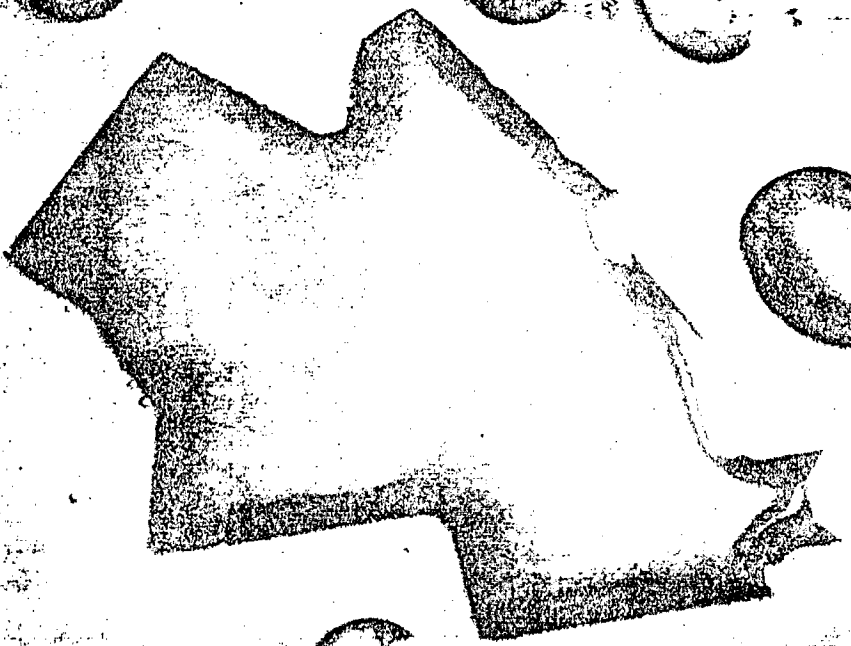
Regional Municipality of Waterloo

LONG TERM WATER STRATEGY



Executive Summary

PHASE 1 REPORT

ASSOCIATED ENGINEERING

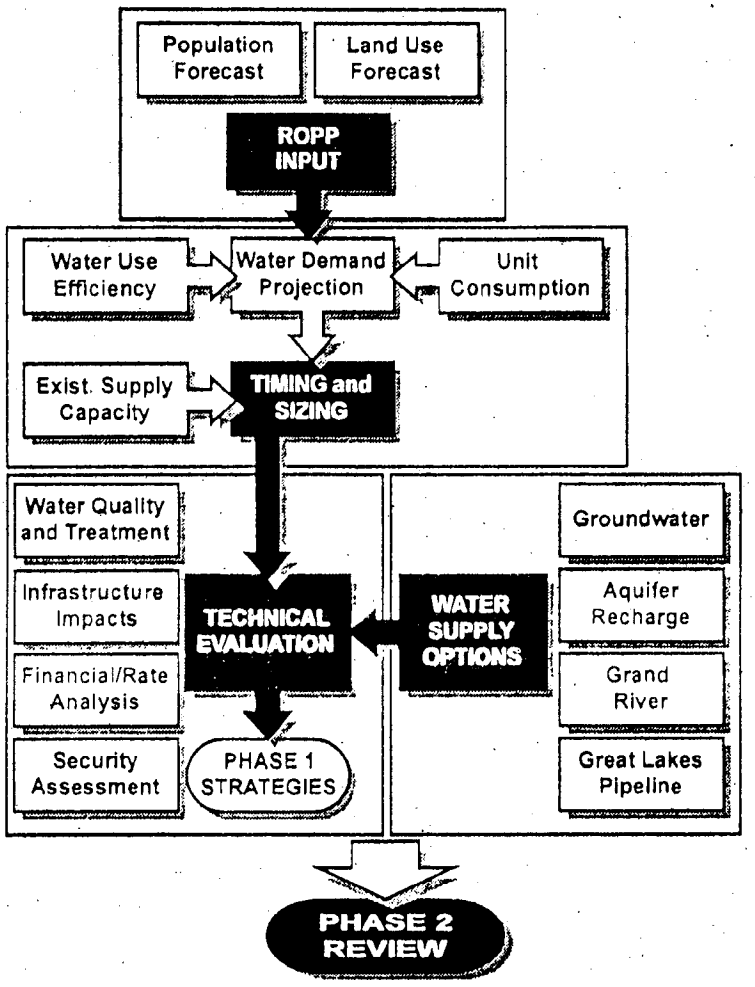
GENERAL

This document is the Executive Summary of the Phase 1 Report produced for the Region's *Long Term Water Strategy*.

The Phase 1 Report is a comprehensive summary of the technical evaluations, prepared to assist in the evaluation and decision-making process. It is anticipated that Phase 1 will be a screening phase, leaving a limited number of Water Supply Strategies for further analysis in Phase 2.

The Phase 1 Report is also supported by the Technical Appendices, consisting of Working Papers and Position Papers prepared during the course of the study. Although certain papers may have been superseded as the study progressed, their value remains in that they provide a complete record of the technical efforts completed to date.

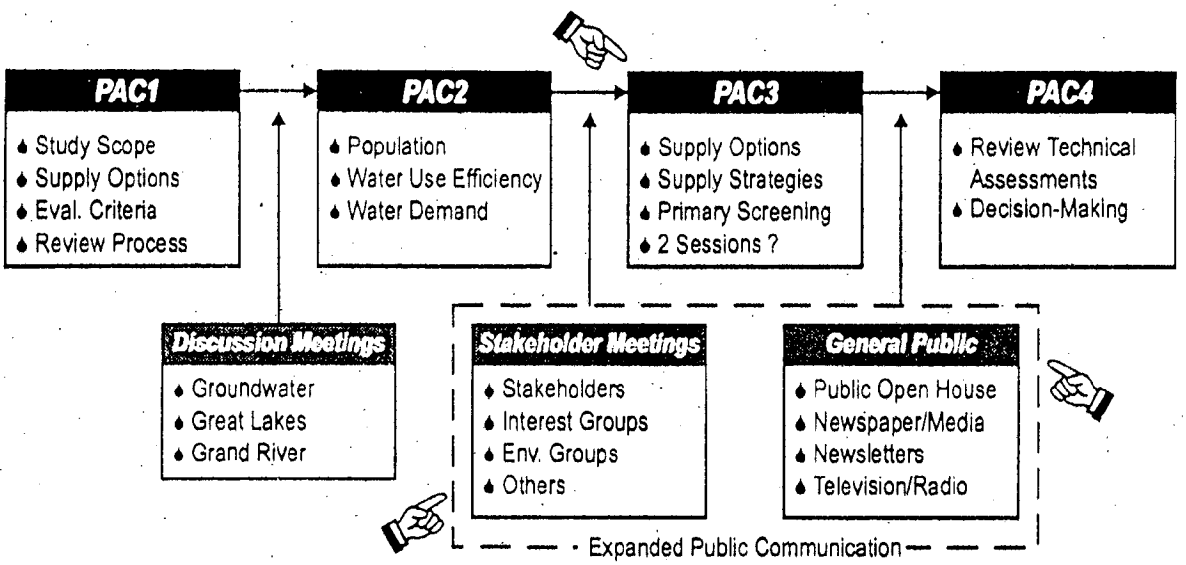
The study commenced in January 1992 with the preparation of a *Work Plan* that identified specific technical tasks to be completed under the project. The technical assessments were completed in accordance with the approved *Work Plan*, with frequent review and input from Regional staff. The technical process is illustrated as follows:



Control of the study was maintained by the following integrated group of study teams:

- Project Steering Committee
- Public Advisory Committee
- Project Team
- Management Team
- Consultant Team

Opportunities for public involvement were provided frequently throughout the study to obtain feedback used to develop the study's conclusions and recommendations. The public involvement process, showing current events, is illustrated as follows:



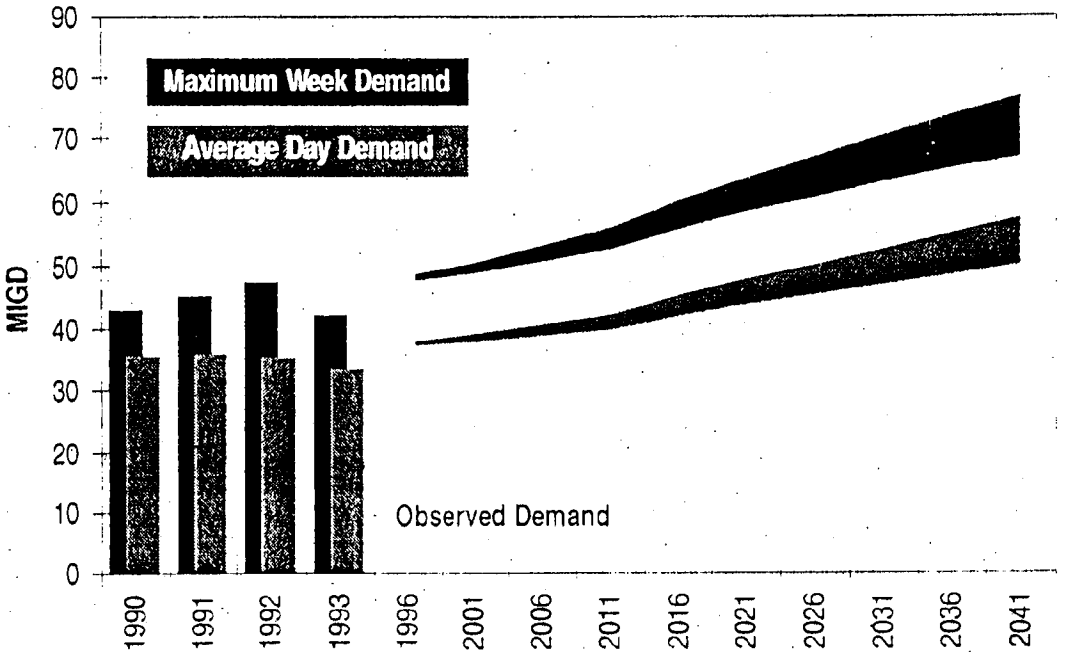
WATER DEMAND

Water demand projections were developed to 2041 for each of the four (4) major water service areas in the Region.

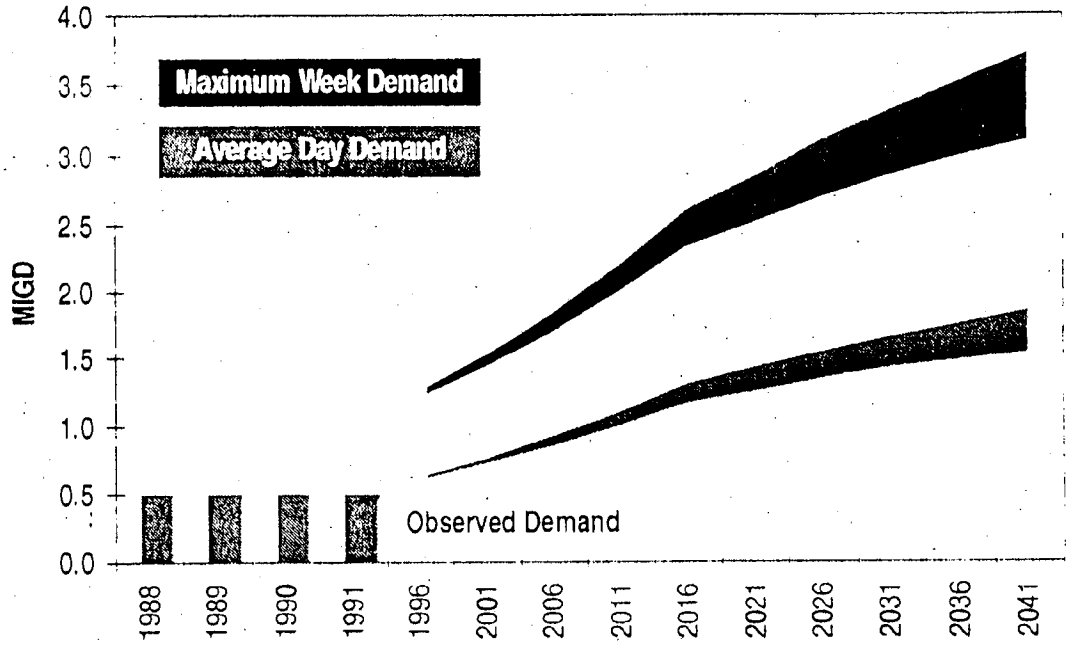
- Tri-City-Elmira-St. Jacobs
- Baden-New Hamburg
- Ayr
- Wellesley

The demand projections were prepared using population and land use forecasts together with unit consumption factors and application of certain water efficiency initiatives. The population and land use forecasts were developed in cooperation with the Region's Department of Planning and Culture, to be consistent with the current review of the Regional Official Policies Plan (ROPP). *Water Use Efficiency* was completed as an independent analysis to evaluate this important management element of the *Long Term Water Strategy*.

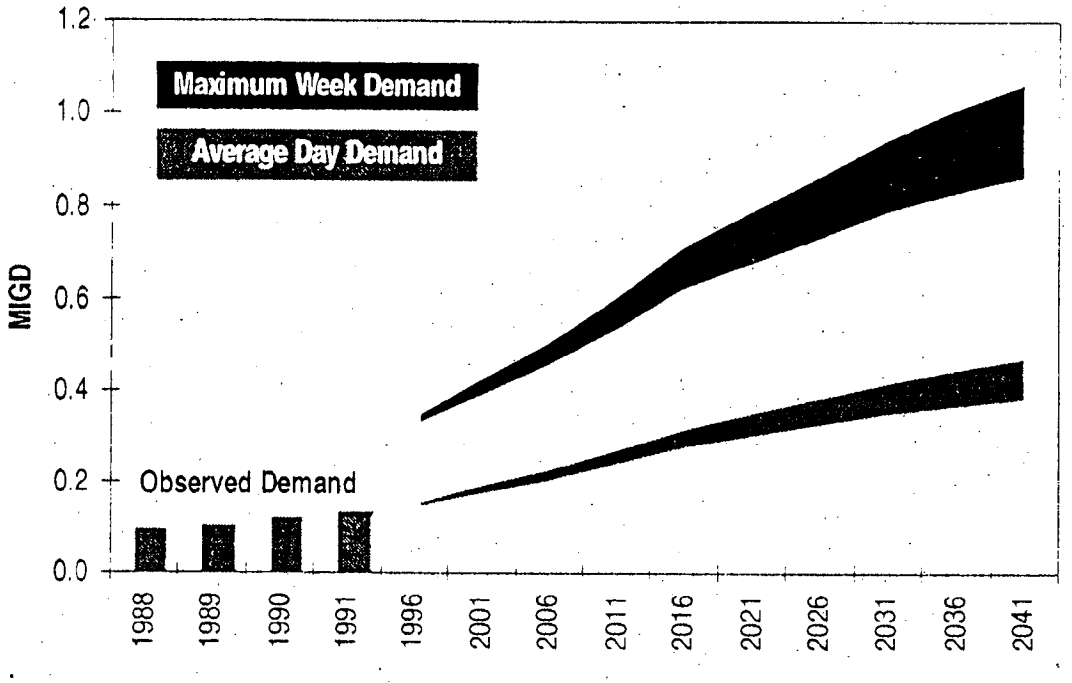
The water demand projections, together with historic observations, for each of the identified water service areas are shown in the following figures:



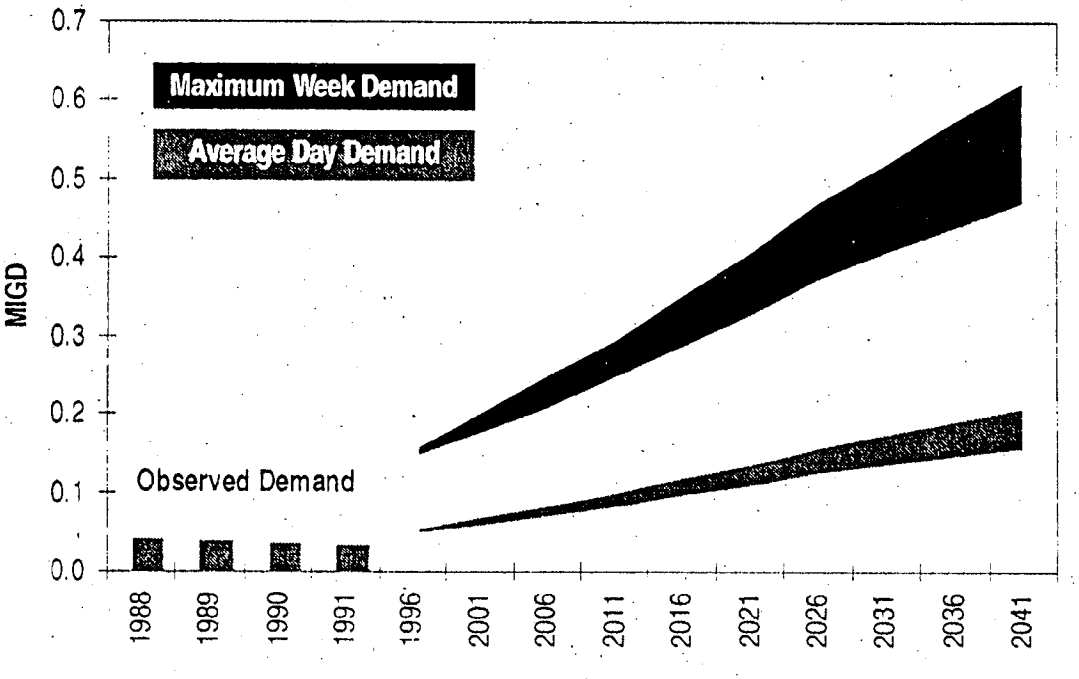
Tri-City-Elmira-St. Jacobs Demand Projection



Baden-New Hamburg Water Demand Projection



Ayr Water Demand Projection



Wellesley Water Demand Projection

WATER SYSTEM CAPACITY

Future water capacity requirements for the four water service areas were assessed based on the preceding water demand projections, and the existing system capacities as defined in cooperation with the Region, reproduced as follows:

Existing Water System Capacity

- Tri-City-Elmira-St. Jacobs: 57 million imperial gallons per day
- Baden-New Hamburg: 1.2 million imperial gallons per day
- Ayr: 0.46 million imperial gallons per day
- Wellesley: 0.33 million imperial gallons per day

WATER QUALITY AND TREATMENT

Water quality and treatment considerations were assessed for each of five (5) surface water sources, in addition to the groundwater source.

- Grand River
- Lake Ontario
- Lake Erie
- Lake Huron
- Georgian Bay

Each of these sources has different physical, chemical and biological raw water characteristics which were evaluated to define appropriate treatment requirements.

INFRASTRUCTURE IMPACTS

Certain modifications or improvements to the existing water distribution systems will be required to accommodate growth and/or supplemental water supplies. For the purpose of this exercise, infrastructure improvements were defined as those parts of the water supply system required to expand the existing facilities. Infrastructure improvements do not include the source of water supply, water treatment, disinfection or plant storage.

SUPPLY OPTIONS

The four major engineering options considered to satisfy the projected water demands were:

- Groundwater
- Aquifer Recharge
- Grand River
- Great Lakes Pipeline

The following table lists the codes and descriptions, supply concept, supply capacity and project costs associated with each of the sub-engineering options which fit to the respective major engineering option classification.

Engineering Option Summary

Engineering Option	Code	Source	Description
Groundwater	GW1	Groundwater	Additional groundwater from new and existing well fields
Aquifer Recharge	AR1	Grand River/ Mannheim WTP	Aquifer storage and recovery using the upper and lower Mannheim aquifers
Grand River Increased Low Flow Abstraction	GR1	Grand River/Mannheim WTP	Increased allowable withdrawal from the Grand River during peak demand periods
Grand River Increased Low Flow Augmentation	GR2	Grand River/West Montrose Reservoir	Flow augmentation of the Grand River via the West Montrose Reservoir/Dam
	GR3	Georgian Bay Pipeline	Flow augmentation of the Grand River via Lake Huron pipeline to Lake Belwood
	GR4	Lake Huron Pipeline	Flow augmentation of the Grand River via Lake Huron pipeline to Conestogo Lake
Great Lakes Pipeline	GL1	Lake Ontario (H-W System)	Treated water pipeline connection to the existing Hamilton-Wentworth system
	GL1A	Lake Ontario (H-W System)	Treated water pipeline connection to the existing Hamilton-Wentworth system that also supplies North Halton
	GL2	Lake Erie (OCWA)	Treated water pipeline connecting to the existing treatment works at Nanticoke (OCWA)
	GL3	Lake Huron	Treated water pipeline connecting to new treatment facilities at Goderich
	GL4	Lake Huron	Treated water pipeline connecting to new treatment facilities at Bayfield
	GL5	Lake Huron	Treated water pipeline connecting to existing treatment works at Grand Bend (OCWA)
	GL6	Georgian Bay	Treated water pipeline connecting to new treatment facilities at Thornbury
	GL6A	Georgian Bay	Treated water pipeline connecting to new treatment facilities at Collingwood, also serving York Region
	GL7	Lake Ontario (Halton System)	Treated water pipeline connecting to new treatment facilities at Halton, also serving North Halton

Supply Concept	Supply Capacity	Project Cost ($M)	O&M Cost ($M/yr)	Comments	Code
Traditional	10 MIGD	61.3	2.4 (avg)	Extension of an existing supply source	GW1
Traditional Security	10 MIGD 20 MIGD	8.6 17.0	5.9/10 MIGD 8.8/20MIGD	Storage of surplus water to be used when required	AR1
None	Insufficient				GR1
Traditional	10 MIGD	112.0	6.2/10MIGD	• Increase in recreational use • Aids assimilation of wastewater • Increase in river flows to be investigated	GR2
Traditional	10 MIGD	123.6	6.6/10MIGD		GR3
Traditional	10 MIGD	111.3	6.7/10MIGD		GR4
Traditional* Security	10 MIGD 20 MIGD	71.4 120.4	1.3 (avg) 4.2/4 MIGD	Treated water purchased from H-W at $2.20/1000 gallons. Partnership	GL1
Traditional* Security	10 MIGD 20 MIGD	118.5 102.7	1.5 (avg) 4.2/4 MIGD	Similar to GL1 but incorporates North Halton. Partnership	GL1A
Traditional Security	10 MIGD 20 MIGD	89.4 126.0	1.1 (avg) 3.4/4 MIGD	Treated water purchased from OCWA Nanticoke at $1.78/1000 gallons	GL2
Traditional Security	10 MIGD 20 MIGD	126.7 181.4	2.3 (avg) 1.3/4 MIGD	Utilizes abandoned rail right-of-way for route alignment	GL3
Traditional Security	10 MIGD 20 MIGD	125.3 181.3	2.3 (avg) 1.3/4 MIGD	Major centers between Lake Huron and the Region can be serviced	GL4
Traditional Security Displacement	10 MIGD 20 MIGD 70 MIGD	110.0 154.3 428.2	0.9 (avg) 2.1/4 MIGD 13.6 (avg)	Treated water purchased from OCWA Grand Bend at $0.92/1000 gallons	GL5
Traditional Security	10 MIGD 20 MIGD	181.3 222.2	2.5 (avg) 1.9/4 MIGD	Longest route results in higher cost	GL6
Security	10 MIGD	193.5	4.9/20 MIGD	Private sector partnership with TCPL, water purchased at $3.80-$3.30/1000 gallons	GL6A
Security	20 MIGD	145.8	1.4/4 MIGD	Introduces partnership between the Region and Halton	GL7

Note: * Traditional only applies if used as a security option in 1999

WATER SUPPLY STRATEGIES

A number of water supply strategies were assembled for each of the 'traditional', 'security', and 'displacement' supply concepts. It was assumed that optimization of the existing supply sources would be completed as a pre-requisite for any strategy. Additionally, it was assumed that certain infrastructure improvements would be implemented prior to 1996 to achieve the identified capacity of the Tri-City-Elmira-St. Jacobs system. These infrastructure improvements are:

- Freeport Tank and Fountain Street connections integrating the networks of Kitchener/Waterloo and Cambridge
- Cambridge East Project,
- Middleton Reservoir and Pumping Station,
- Myers Road Project,
- Grand River Reservoir and Pumping Station, and
- Standby Wells and Treatment

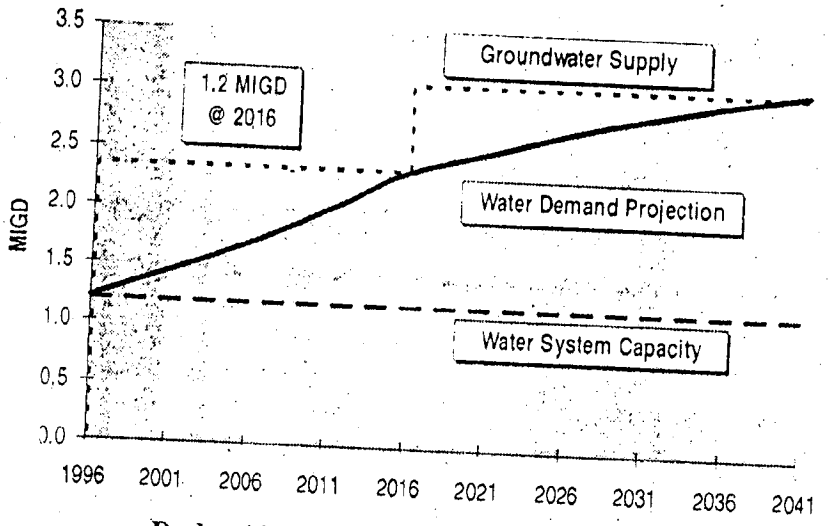
The water supply strategies were defined in the context of three alternate supply concepts:

Traditional: The '**traditional**' concept requires that supplemental water supply would be provided immediately prior to the time of need, i.e. when demand exceeds supply.

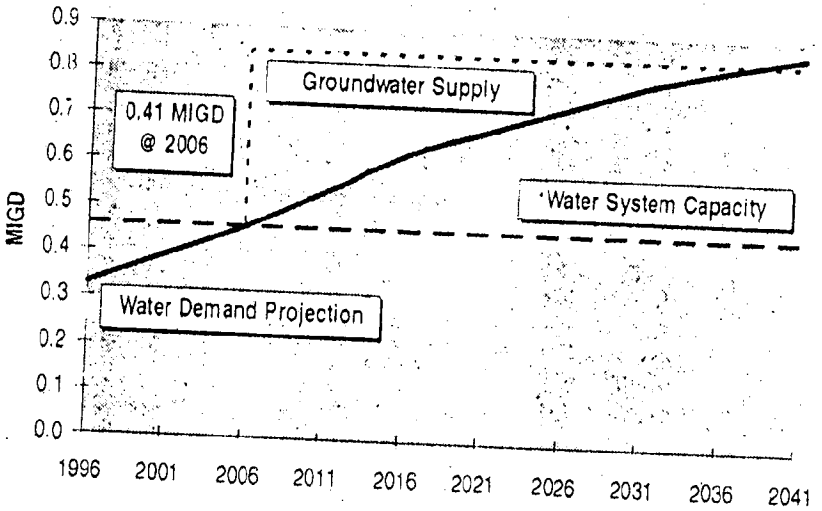
Security: The '**security**' concept requires sufficient additional capacity to insure against the potential loss of an existing water source.

Displacement: The '**displacement**' concept requires that all existing groundwater and surface water supplies would be displaced by a Great Lakes pipeline. This concept was considered to investigate the potential economic benefit of not having to soften water at the residential level.

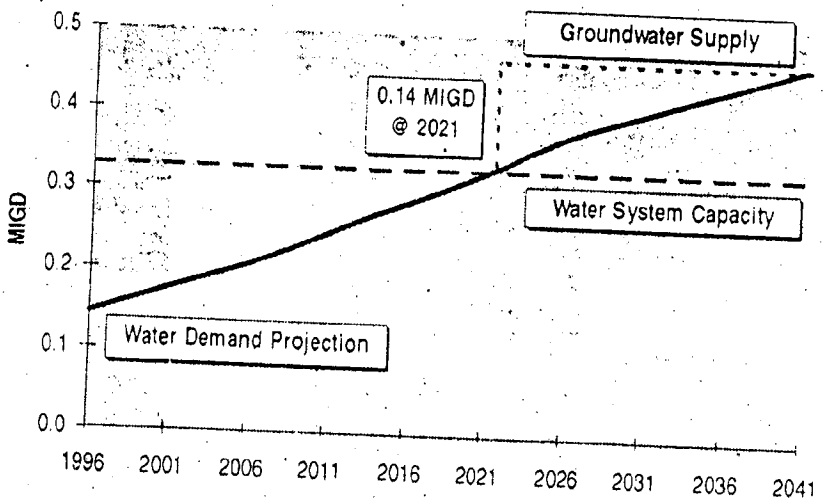
It was assumed that the 'traditional' approach is appropriate for the Baden-New Hamburg, Ayr and Wellesley systems, illustrated as follows:



Baden-New Hamburg Water System

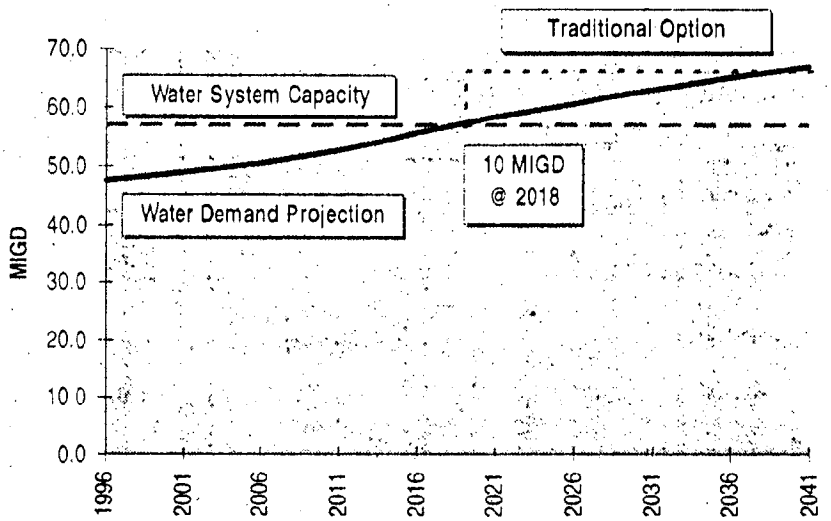


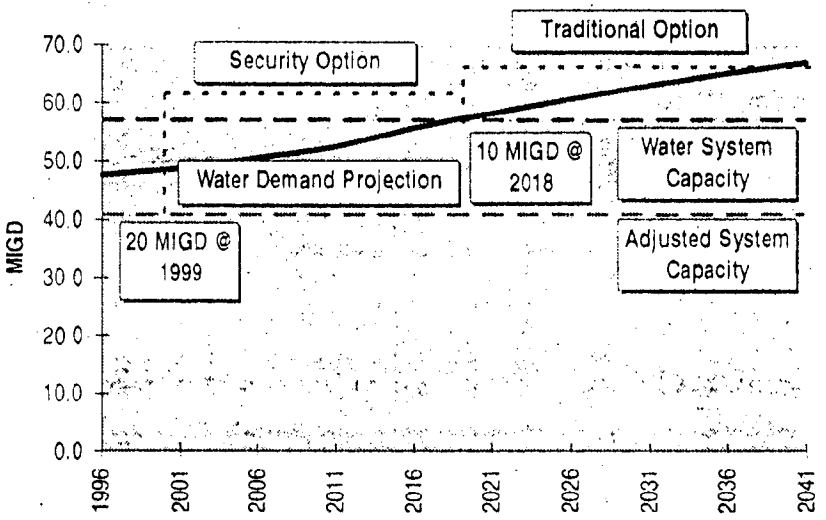
Ayr Water System

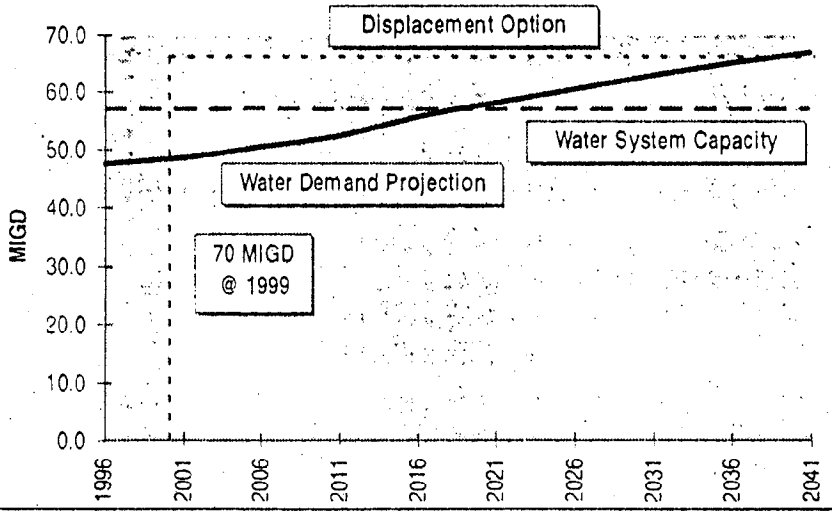


Wellesley Water System

For the Tri-City-Elmira-St. Jacobs system, the three alternate supply concepts are illustrated as follows:







Traditional Strategy

Under the traditional approach, for the Tri-City-Elmira-St. Jacobs system, a 10 MIGD engineering option would be required to be commissioned by 2018.

Security Strategy

This supply strategy takes into consideration the issue of security of supply. It overrides the demand-driven timing requirements dictated by the 'traditional' concept and commissions a 20 MIGD engineering option as early as possible (1999). This would secure the Region's supply capacity should the largest single supply source, the Grand River/Mannheim Water Treatment Plant (16 MIGD) be shut-down. Additionally, the requirements of the 'traditional' supply strategy apply i.e. optimization of existing supply sources and improvements to the Tri-City infrastructure and commissioning a 10 MIGD engineering option by 2018.

Displacement Strategy

This strategy is unique in that it considers completely displacing the Region's existing supply sources i.e. groundwater and the Grand River source. The strategy examines the economics of avoiding the need for softening at the householder level. The viable engineering option would be a Great Lakes pipeline, with the GL5 alignment from Lake Huron to the Region being adopted as the representative example.

The following table lists the codes and strategies, present values and projected rates over the study horizon (2041). See page 7 for descriptions of the engineering option codes.

Strategy	Overall Present Value	Projected Wholesale Water Rates Inflated $'s			Comments
	$M	High	Low	Avg.	
T1 - *GW1*	385	2.98	1.56	2.17	
T2 - *AR1*	380	2.96	1.56	2.14	Requires proving of recovery rates.
T3 - *GR2*	454	4.29	1.56	2.88	
T4 - *GR3, GR4*	431	3.91	1.56	2.71	Financial analysis based on a representative cost of GR3 and GR4.
T5 - *GL1, 1A, 2,5 (Purchased Water)*	407	3.35	1.56	2.40	Financial analysis based on a representative cost of GL1, GL2, and GL5.
T5 - *GL3, 4, 7(New Treatment Facilities)*	415	3.33	1.56	2.44	Financial analysis based on a representative cost of GL3, and GL4.

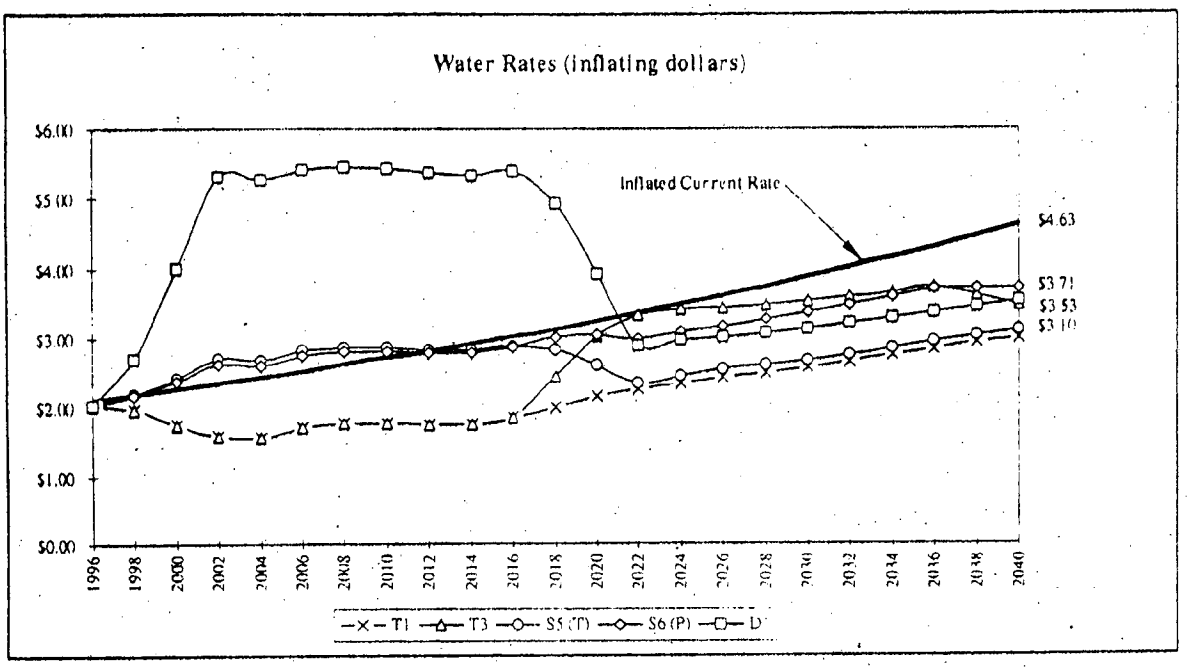
Note: The financial analysis for those strategies that include a pipeline option was based on a representative cost of the pipelines noted, because their costs were relatively similar.

Strategy	Overall Present Value	Projected Wholesale Water Rates Inflated $'s			Comments
	$M	High	Low	Avg.	
S1 - *AR/GW*	401	3.01	1.68	2.21	Requires proving recharge and recovery rate of 20 MIGD.
S2 - *AR/GL1, 1A, 2, 5 (Purchased Water)*	424	3.37	1.68	2.44	Financial analysis based on a representative cost of cost GL1, GL1A, GL2, and GL5.
S2 - *AR/GL3, 4, 7 (New Treatment Facilities)*	431	3.36	1.68	2.48	Financial analysis based on a representative cost of GL3, GL4 and GL7.
S3 - *AR/AR*	396	2.99	1.68	2.19	Requires proving recharge and recovery rate of 20 MIGD.
S4 - *GL1, 1A, 2, 5 (Purchased Water) /AR*	521	3.36	2.01	2.76	Financial analysis based on a representative cost GL1, GL1A, GL2, and GL5.
S4 - *GL3, 4, 7(New Treatment Facilities)/AR*	530	3.09	2.01	2.67	Financial analysis based on a representative cost of GL3, GL4 and GL7. Aquifer recharge would need to be site proven.
S5 - *GL1, 1A, 2, 5 (Purchased Water) /GW*	526	3.38	2.01	2.79	Financial analysis based on a representative cost of GL1, GL1A, GL2, and GL5.
S5 - *GL3, 4, 7 (New Treatment Facilities)/GW*	534	3.10	2.01	2.69	Financial analysis based on a representative cost of GL3, GL4, and GL7.
S6 - *GL1, 1A, 2, 5 (Purchased Water)*	544	3.73	2.01	3.00	Pipeline twinned in 2018. Financial analysis based on a representative cost of GL1, GL1A, GL2, and GL5.
S6 - *GL3, 4, 7 (New Treatment Facilities*	560	3.39	2.01	2.93	Pipeline twinned in 2018. Financial analysis based on a representative cost of GL3, GL4 and GL7.
S7 - *GL6A (Privatization Option)(TCPL)*	761	3.80* 4.20†	3.30* 3.30†	3.55* 3.50†	May not be an optimal strategy for the Region as the operating philosophy fails to optimize the existing supplies.
D1 - *GL5*	810	5.46	2.01	4.03	Financial analysis based on GL5 sized for 70 MIGD

Note: * reflects the purchase price of water only.
† reflects the blended cost, i.e. TCPL at 20 MIGD with the balance from existing supplies

FINANCIAL ANALYSIS CONCLUSIONS

The primary objective of the financial analysis was to assess the affordability of the Strategic Supply Options. **The general conclusion is that all of the options, except the privatization option from Georgian Bay (S7) and the displacement strategy (D1) from Lake Huron, entail costs that fall below expected rates that would be encountered based on inflating the current rate of $1.99/1000 gallons at 1.8% per annum** i.e. the wholesale water rates that are expected to recover the costs of the existing system and the new investments determined by the Study are expected to be comparable to or lower than inflation built into the existing rate.



The comparative economic analysis of the Strategic Supply Options lead to some obvious conclusions:

- Strategies based on the groundwater and aquifer recharge options appear the most financially attractive options. These two options are financially similar from a financial perspective.
- The security of supply strategies add a minimum of about $10 to $20 million to the present value of costs. Where pipeline construction in 1999 is involved, the additional cost is in the order of $100 million.
- The total displacement option and the TCPL strategy entail a higher cost because neither takes advantage of low cost local sources of water.
- The lowest cost security of supply option (S3) is only marginally more expensive than the low cost traditional strategies (T1 and T2).

DECISION MAKING PROCESS

The logic and procedure of the decision-making process can be best summarized by the following flow chart. The essential points of the decision-making process are that having selected a **supply concept** ('traditional', 'security', or 'displacement') the possible solutions are:

Traditional (4) (2018 components)
- groundwater, aquifer recharge, Grand River, or Great Lakes solution

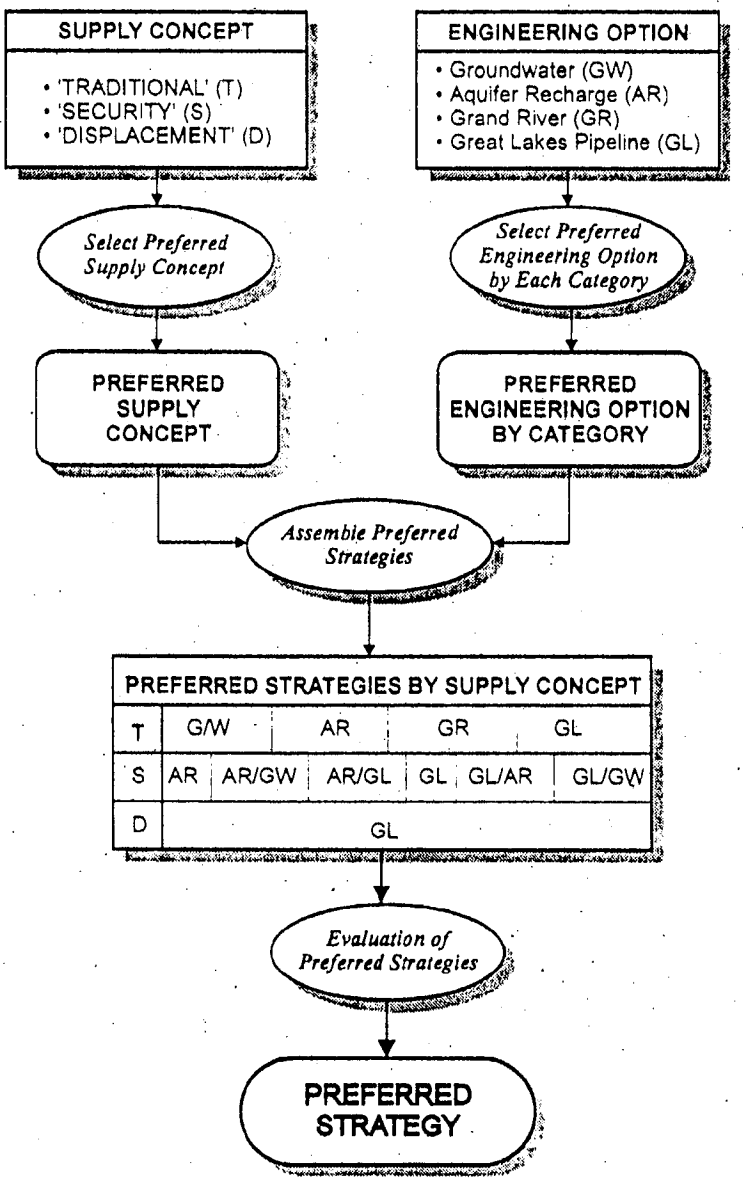
Security (6)

(1999 and 2018 components)

- aquifer recharge for both components
- aquifer recharge (1999) followed by groundwater (2018)
- aquifer recharge (1999) followed by a Great Lakes pipeline (2018),
- Great Lakes pipeline for both components
- Great Lakes pipeline (1999) followed by aquifer recharge (2018)
- Great Lakes pipeline (1999) followed by groundwater (2018)
- Great Lakes pipeline.

Displacement (1)
(1999 component)

DECISION-MAKING PROCESS



Decision-Making Flow Chart

OBSERVATIONS AND RECOMMENDATIONS

Observations that summarize the analysis of the Study work completed to date are as follows:

- the long term solutions to supplying the Region with potable water is more complex than those for most municipalities due to the dependency on groundwater.
- water supply is not an immediate problem.
- the concept of maximum week being the driving force for the timing of new water supply works has been possible by the ability of the Region to demonstrate that infrastructure (storage, piping, transmission etc.) investment can support the incremental supply component of maximum day; a significant cost saving for the Region.
- by adopting a water efficiency program and operating the Mannheim Water Treatment Plant to its maximum of 16 MIGD, and applying the maximum week theory it may be possible to delay future supply needs by 24 years.
- increased withdrawals from the Grand River without augmentation are not justified.
- aquifer recharge is, subject to detailed on-site testing to prove its viability, a possible economic solution to both security and demand needs.
- a Great Lakes Supply option is viable considering that the existing rate inflated at 1.8% per annum would be generally higher throughout the 50 year horizon. This is based on being used as a supplemental supply. It may be further financially enhanced by developing a partnership with another municipality.
- the TransCanada Pipeline option requires a $3.18/1000 gallons purchase price in 1999 expressed in 1993 dollars. When other costs are added it would become the most expensive option next to the displacement option, although savings in Regional operations and reduced debt load would be realized. The issue is one of economics and philosophy: does the Region wish to privatize its water supply?

The philosophy of Phase 1 of the Study is not to reach a 'hard' conclusion specific to the Region's *Long Term Water Strategy*, but rather to debate the various strategies available. There are however, some Phase 1 Recommendations that should be noted:

1. **Regional Council should consider the Study's philosophical approach and approve or otherwise consider the following fundamental concepts:**

   - future supplies being **supplemental** to existing supplies.
   - demand forecasts be based on a **water use efficiency program**. If approved the Region should adopt a Water Use Efficiency Program as outlined but subject to refinement in Phase 2 of this Study.
   - the four rural municipalities continue to have a dependence on groundwater but with future Regional supplies considering their needs, such that they could be supplied from the urban sources.
   - the preferred concept of 'traditional', 'security', or 'displacement' should be adopted at this stage.

- the need for or consideration of a third water source to provide additional security and flexibility to the Region's water supply.

2. **Water supply forecasts for the Tri-City-Elmira-St. Jacobs system be based on considerations of 'maximum week' rather than 'maximum day' with daily water demand forecasts used to determine peak requirements. If approved, this concept should be carried to the Ministry of Environment and Energy for their approval.**

3. **Depending on whether or not Regional Council adopts the need for a 'security of supply' concept, the Phase 2 direction of the study would be resolved as follows:**

   - if further security of supply is not deemed necessary, pipeline water from the Great Lakes be dropped from the short term strategic considerations.

   - assuming the above, the Phase 2 study work focus on a strategy that includes additional groundwater sources or aquifer recharge.

   - should aquifer recharge be part of the preferred Phase 1 strategy, a rigorous site specific proving program be adopted prior to confirming the option.

4. **Should Regional Council wish to adopt the 'security of supply' concept, the following actions start immediately, such as to yield a recommended source by the end of Phase 2 of the Study:**

   - if aquifer recharge is one of the preferred 'security of supply' components, a detailed testing/proving program be adopted such that the option would have an equal confidence level as say a Great Lakes pipeline

   - if a Great Lakes pipeline is one of the preferred 'security of supply' components, because of the range of interests from the private sector, Provincial Government (OCWA), and other Regional Municipalities, it is recommended that 'Expressions of Interest' be sought such that first-hand information is available for evaluations. In this regard, the Regional Municipality of Hamilton-Wentworth would be a possible partner as would OCWA related to their systems at Nanticoke (Lake Erie) and Grand Bend (Lake Huron).

4.7 GREAT LAKES SUPPLY (GL1 - GL7)

4.7.1 GENERAL

The Great Lakes Pipeline engineering options are, due to there sizing, relevant under both the **'traditional'** and **'security'** supply concepts. Additionally, the pipeline engineering option is the only engineering option that could be viable under the **'displacement'** supply concept which considers the existing supply sources (groundwater and river water) being displaced based on an economic evaluation of avoiding the need for water softening.

The Great Lakes Supply Option would provide a third source of water supply available to the Region, from the surrounding major water bodies; Lake Ontario, Lake Erie, Lake Huron or Georgian Bay. Water would be transported to the Region via a high pressure pipeline from pumping and treatment facilities located at the source.

4.7.2 MASTER WATER SUPPLY STUDY, 1987

The Master Water Supply Study considered the Lake Erie pipeline option as a potential supply option for the Region. With the option, all existing groundwater supplies in the Tri-Cities would be abandoned and the Lake would act as the sole supply source. This option would include using an existing lake intake located at the Nanticoke Generating Station on [illegible] The water would be treated at the lake, then pumped through a large diameter pipeline to the Tri-Cities.

4.7.3 SCOPE OF WORK

The Technical Appendices contain Commentaries prepared by Associated Engineering and TransCanada Pipelines Ltd. that provide a full description of the work scope for the pipeline supply options. In summary, the task has the major objectives of:

(i) determination of alignments to carry water from the four (4) major surrounding water bodies to the Region.

(ii) collation of conceptual designs for the required high pressure transmission mains and associated facilities.

4.7.4 SUPPLY CAPABILITY

For the purpose of this Study, the supply capacity of the pipeline options have been sized for 10, 20 and 70 MIGD depending on whether it is adopted as a solution for the 'traditional', 'security' or the 'displacement' supply concept.

4.7.5 DESIGN CRITERIA

To provide consistency though each of the Great Lakes pipeline engineering options, the Working Paper, 'Pipeline Design Concept and Criteria' was prepared to determine pipe wall thickness, diameter and the hydraulic gradients required for each of the different supply routes. Steel was determined as the material of construction based on economic considerations presented in the Working Papers: 'Economic Comparison of High Pressure and Conventional Pipelines' and 'Choice of Economic Diameter for High Pressure Steel Pipeline'.

4.7.6 OPERATING PHILOSOPHY

From the supplemental supply requirements of the Region determined in the Working Paper, 'Demand and Supply Considerations', the operating philosophy of the pipeline options was determined (Working Paper, 'Pipeline Operating Philosophy').

The following operating philosophy assumptions were made depending on the type of supply concept; 'traditional', 'security', 'displacement', that is chosen:

- **'traditional'** - the pipeline would operate to provide supplemental incremental supply to the Region when required.
- **'security'** - the pipeline would be operated at a minimum flow of 4 MIGD.
- **'displacement'** - the pipeline would operate similar to the 'traditional' supply concept but at much higher flows

4.7.7 OPTIONS

Various pipeline routes have been investigated that would transport water from the surrounding four (4) major water bodies (Lake Ontario, Lake Erie, Lake Huron, and Georgian Bay) see Figure 4-3: Great Lakes Supply Options Route Alignments. All options take into consideration the potential for partnership arrangements with other suppliers of treated water i.e. Regional Municipalities, Government Agencies, or the Private Sector.

The GL1 option involves linking with the supply system of Hamilton-Wentworth and purchasing treated Lake Ontario water. This option has also been considered for supplying the Town of Milton.

Another option that incorporates the Region of Halton would originate from new treatment facilities in Oakville, from where water would be transported to North Halton (Milton) and then to the Region.

The opportunity for the Region to connect to the existing Grand Bend to London transmission main was considered as the GL5 supply option. Treated water would be purchased from the Ontario Clean Water Agency (OCWA).

Another option that was considered was that of TransCanada Pipelines Ltd. (TCPL) who have proposed a pipeline from Georgian Bay (Collingwood) that would serve the Region as well as the Region of York.

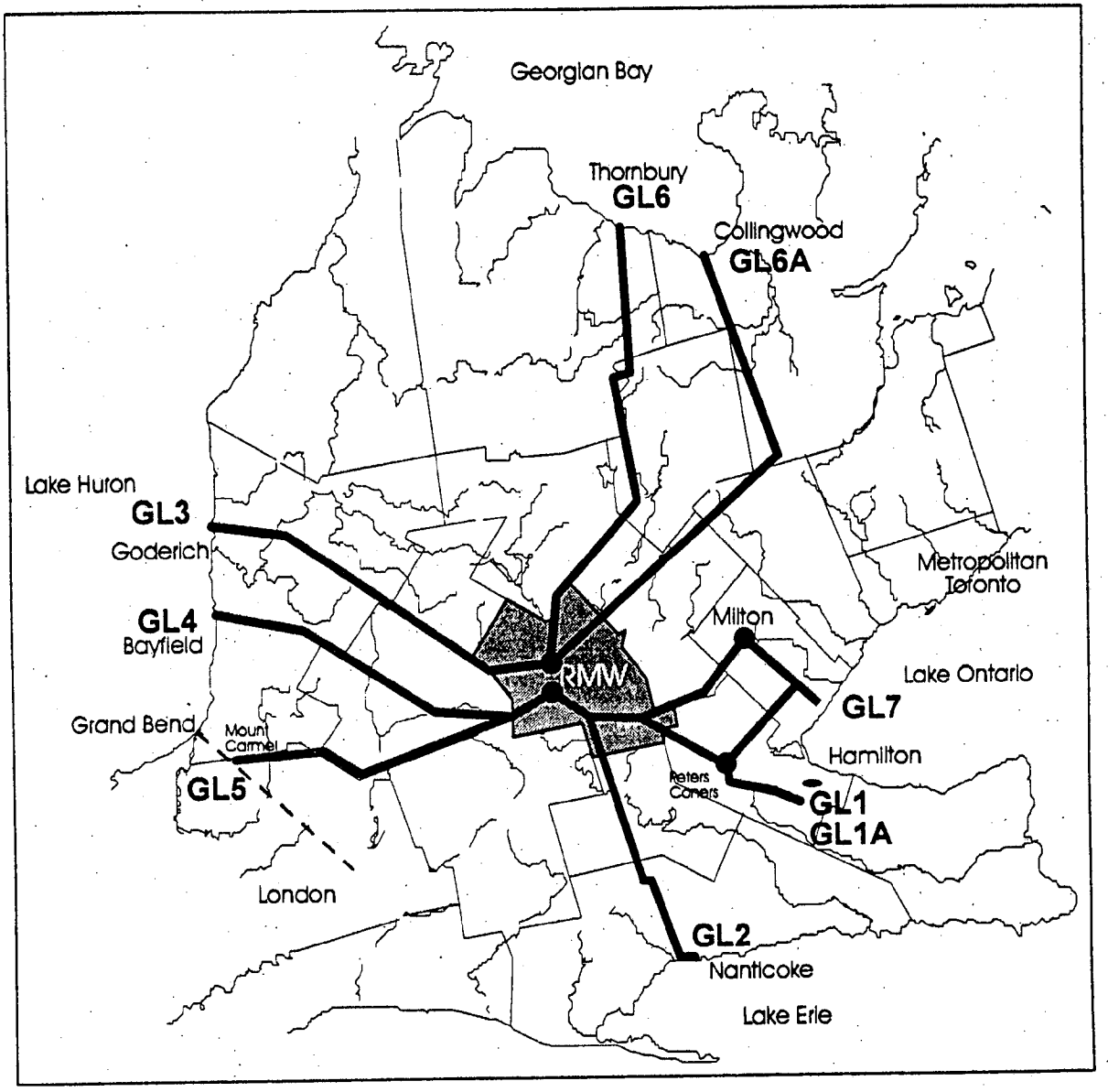


Figure 4-3: Great Lakes Supply Options Route Alignments

Full discussion of each of the supply routes is presented separately in the commentaries. These commentaries contain detailed information including a route description, design factors, water quality, environmental and social impacts, and costs of the option. The following is a summary of each of the pipeline routes including the option prepared by TransCanada Pipelines.

GL1 Supply Option	Lake Ontario	53 Mile Long High Pressure Steel Pipeline
Supply Source:	Existing Hamilton-Wentworth System (Lake Ontario)	Hamilton-Wentworth treated water - $2.20/1000 gallons (subject to confirmation)
Delivery Point:	Mannheim Reservoir (Kitchener)	
Supply Concept Consideration:	'Security' (1999) 20 MIGD	
Project Cost:	$120.4M	
Average Annual O&M:	$4.2M/yr (4 MIGD)	
Potential Supply Areas Along Pipeline Route:	Flamborough, Puslinch	

GL1A Supply Option	Lake Ontario	53 Mile Long High Pressure Steel Pipeline
Supply Source:	Existing Hamilton-Wentworth System (Lake Ontario)	Hamilton-Wentworth treated water - $2.20/1000 gallons
Delivery Point:	Mannheim Reservoir (Kitchener)	North Halton (Milton)
Supply Concept Consideration:	'Security' (1999) 20 MIGD	
Project Cost:	$102.7M	
Average Annual O&M:	$4.2M/yr (4 MIGD)	
Potential Supply Areas Along Pipeline Route	Flamborough, Puslinch, Milton	

GL2 Supply Option	Lake Erie	59 Mile Long High Pressure Steel Pipeline
Supply Source:	Nanticoke Water Treatment Plant (Lake Erie)	OCWA treated water ($1.78/1000 gallons)
Delivery Point:	Mannheim Reservoir (Kitchener)	
Supply Concept Consideration:	'Traditional' (2018) 10 MIGD	'Security' (1999) 20 MIGD
Project Cost:	$89.4M	$126.0M
Average Annual O&M:	$1.1M	$3.4M/yr (4 MIGD)
Potential Supply Areas Along Pipeline Route:	Brantford, Paris, Brantford (TWP), Burford, Oakland, South-Dumfries, Blandford-Blenheim	

GL3 Supply Option	Lake Huron	66 Mile Long High Pressure Steel Pipeline
Supply Source:	Goderich (Lake Huron)	New treatment facilities
Delivery Route:	Right-of-way of abandoned Goderich to Guelph Rail line	
Delivery Point:	Waterloo System at Conservation Drive	
Supply Concept Consideration:	'Traditional' (2018) 10 MIGD	'Security' (1999) 20 MIGD
Project Cost:	$126.7M	$181.4M
Average Annual O&M:	$2.3M	$1.3M/yr (4 MIGD)
Potential Supply Areas Along Pipeline Route	Blyth, Brussels, Milverton, Grey, McKillop, Morris, Elma, Mornington	

GL4 Supply Option	Lake Huron	65 Mile Long High Pressure Steel Pipeline
Supply Source:	Bayfield (Lake Huron)	New treatment facilities
Delivery Point:	Mannheim Reservoir (Kitchener)	
Supply Concept Consideration:	'Traditional' (2018) 10 MIGD	'Security' (1999) 20 MIGD
Project Cost:	$125.3M	$181.3M
Average Annual O&M:	$2.3M	$1.3M/yr (4 MIGD)
Potential Supply Areas Along Pipeline Route	Stratford, Seaforth, Mitchell, McKillop, Tuckersmith, Downie, Elice, Fullarton, Hibbert, Logan, North-Eastope, South-Eastope	

GL5 Supply Option	Lake Huron	70 Mile Long High Pressure Steel Pipeline	
Supply Source:	Mount Carmel (Lake Huron)	OCWA Treated Water Transmission Main $0.92/1000 gallons	
Delivery Point:	Mannheim Reservoir (Kitchener)		
Supply Concept Consideration:	'Traditional' (2018) 10 MIGD	'Security' (1999) 20 MIGD	'Displacement' *(1999) 70 MIGD
Project Cost:	$110.0M	$154.3M	$428.2M
Average Annual O&M:	$0.9M	$2.1M (4 MIGD)	$13.6M
Potential Supply Areas Along Pipeline Route	Stratford, St. Mary's, Usborne, East-Zorra-Tavisock, Zorra, Blanshard, Downie, South Eastope		

Note: * The costs for the 'displacement' option reflect the building of new treatment facilities

GL6 Supply Option	Georgian Bay	85 Mile Long High Pressure Steel Pipeline
Supply Source:	Thornbury (Georgian Bay)	New treatment facilities
Delivery Point:	Waterloo System at Conservation Drive	
Supply Concept Consideration:	'Traditional' (2018)10 MIGD	'Security' (1999) 20 MIGD
Project Cost:	$181.3M	$222.2M
Average Annual O&M:	$2.5M	$1.9M (4 MIGD)
Potential Supply Areas Along Pipeline Route:	Guelph, Orangeville, Shelburne, Stayner, Fergus, Grand Valley, Dundalk, Flesherton, Creemore, Arthur, Elora, East-Garafraxa, East Luther, Melancthon, Osprey, Proton, Guelph (TWP), Nichol, Peel, Pilkington, West Garafraxa, West Luther.	

GL6A Supply Option	Georgian Bay	109 Mile long 54 and 36 inch High Pressure Steel Pipeline
Supply Source:	Collingwood (Georgian Bay)	New Treatment Facilities, water purchased from TCPL ($3.30 to $3.80/1000 gallons)
Delivery Point:	Mannheim Reservoir (Kitchener)	
Supply Concept Consideration:	'Security' (1999) 20 MIGD	
Project Cost:	$193.5M	
Average Annual O&M:	$4.87M	
Potential Supply Areas Along Pipeline Route:	York Region	

GL7 Supply Option	Lake Ontario	55 Mile Long High Pressure Steel Pipeline
Supply Source:	Lake Ontario	New Treatment Facilities
Delivery Point:	Mannheim Reservoir (Kitchener)	North Halton (Milton)
Supply Concept Consideration:	'Security' (1999) 20 MIGD	
Project Cost:	$145.8M	
Average Annual O&M:	$1.4M/yr (4 MIGD)	
Potential Supply Areas Along Pipeline Route	Milton	

Note: *The cost of purchasing water from other Regional Governments, Government Agencies and the Private Sector are 1994 proposed rates and are subject to change.*

Each of the pipeline routes have been selected for a variety of reasons including dependable supply source, ability to purchase treated water from others, routes that limit environmental impacts, consideration of external demands, and connection to existing transmission mains..

4.7.8 ENVIRONMENTAL IMPACTS

As with any major construction project, certain environmental impacts during construction cannot be avoided, but with careful planning and construction practices, the detrimental environmental impacts can be effectively mitigated. The Technical Appendices Commentaries contain detailed information on the environmentally sensitive areas that may be encountered along each pipeline route. The use of highway right-of -ways tends to reduce the impact of the pipeline on such areas. Complete investigation of the areas along the route alignments would be necessary to determine the feasibility of a pipeline in terms of environmental issues, both within the Region and neighboring municipalities.

The Ministry of Natural Resources noted in their review of the draft Phase 1 Report:

- long term environmental impacts from a pipeline cannot be easily avoided or mitigated.
- the pipeline supply option poses significant potential for creating growth-related pressures along the pipeline corridor and therefore the Region must recognize that the decision to proceed with a pipeline cannot be made in isolation of other municipal and provincial considerations.