A NEW DIRECTION FOR WATER RATES AND DEBT FINANCING FOR THE CITY OF WINNIPEG

BY

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Abstract

A set of policy guidelines for the City of Winnipeg is developed upon which a recommended conceptual rate structure is based. The new concept involves charging a uniform rate for all water consumed, surcharging excess water use, and establishing a reserve fund for the purpose of financing system expansion. Also recommended is the institution of an annual meter charge which reflects potential demand, and plumbing code changes and informational programs which will result in a modification of water demand patterns.

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TO HEATHER AND CHRISTOPHER
FOR YOUR ENCOURAGEMENT AND PATIENCE

INTRODUCTION

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Utility:

The greatest happiness of the greatest number.

Webster's New College Dictionary

A significant event took place on March 26, 1919. It was the day on which the first water flowed through the completed aqueduct from Shoal Lake to the City of Winnipeg. It represented the beginning of a period in the City's history during which an unlimited supply of good quality drinking water was available to the citizens. The problems in obtaining this water supply were not simple and the history of the Greater Winnipeg Water District aqueduct is one of social injustice, economic hardship, and political maneuvering unequalled in the history of this city.

For the past 61 years the city has enjoyed an abundant water supply with water price structures that have made it among the lowest priced utility supplied commodities. In fact, this City currently enjoys one of the lowest water prices in North America.

The citizens will soon again be at a crossroads with respect to water supply. The Shoal Lake aqueduct is reaching capacity and the supply will have to be supplemented. In addition, rising costs for labour, chemicals, replacements and new facilities will severely affect rate levels. These are times of inflation and high interest rates and

the long term prognosis is for this trend to continue. These problems will be compounded by the City's self imposed limit on its borrowing authority which will have serious consequences on the supply, if available, of money for capital projects.

A good deal of criticism has been directed of late at the decreasing block rate method of obtaining utility revenue. It has been said that these types of rate structures are inequitable since high volume consumers pay the lowest prices. There also seems to be a problem with the present financial system through its inability to provide for the future and finance expansion in a rational method without causing enormous rate increases. The present system also appears to be unable to cope with unusual or emergency situations without unduly affecting rate levels. Finally the present system of percentage increases to rate levels seems inequitable since the increases are applied uniformly from block to block. The effect of this is cumulative as the percentage increases are applied across the blocks from year to year.

The focus of this study is to examine the question of rate structures and debt financing to establish if there is merit in maintaining the status quo, or if a new direction more in tune with today's social needs and values in in order. The study will examine not only the practical aspects of utility financing but also look into the theoretical justification for utility

and rate structures. Such an analysis would seem to be valid at this point in time since the mass consumption society of today is radically different from that of even twenty years ago when much of the early work on rate structures was done. Our affluent society has created new demands upon utilities through lifestyle changes brought on by technological advance. The question of needs and value are not the same as they were in years gone by and the ability to pay or to choose not to use the service must be taken into account.

The fuel shortage of the 70's has introduced a new term, one seldom heard in the 60's and that is conservation. Society has suddenly decided that it may be economically advantageous to use less or to "think small." The effect on the economy of this conscious decision can be seen all around us. For example, the auto industry has reacted by down-sizing cars and Manitoba Hydro, due to low load growth, has postponed much of its anticipated construction. Would not then a legitimate strategy be to defer expansion and therefore expenditures by control of service demand? This study attempts to deal with these issues and offers conclusions on the equity of such a strategy.

It should be pointed out right at the outset that this study is conceptual in nature. It attempts to deal with the issues through an analysis of the theoretical and equity positions while at the same time attempting

to produce pragmatically acceptable solutions. The study is not intended to be "A How To Do It" rate manual but will put forward recommendations, which if accepted form the starting point for a traditional rate study analysis.

Chapter one begins by examining the theoretical question of equity and the legitimacy of using pricing structures as a mechanism for manipulating the access to or use of goods. Some of the theoretical aspects of utility pricing are examined and their usefulness assessed.

In Chapter 2 a set of policy guidelines are developed which will serve as the foundation upon which the rate structure recommendations are made. It is manditory at the outset that the policy decisions are made for it is only through understanding what one is trying to achieve that one will be able to develop rational methodology to cope with the issues.

Chapter 3 gives the reader some understanding of the historical continuity by outlining the physical and financial history of the City's waterworks system. If one does not know the past it will be difficult to comprehend the future.

The future is discussed in Chapter 4 where the physical requirements and financial impact that these requirements will have on the citizenry are outlined.

In Chapter 5 an analysis of conventional and innovative alternatives is then made, resulting in Chapter 6 with a set of recommendations and concluding

statement in Chapter 7.

The study deals with a particular utility in a specific jurisdiction, however, an attempt has been made to present the arguments in such a manner that they could be extrapolated to other kinds of utilities in other jurisdictions. The concept behind the study is that equality is a universally sought-after goal and that techniques may exist to make the goal a reality in a water supply.

THEORETICAL CONSIDERATIONS

THEORETICAL CONSIDERATIONS

a) Water Supply Models

Provision of a service by the public sector may be justified on a number of grounds including the failure of the private sector to enter the field, the need for stringent quality controls, or the ability of the public sector to take account of equity considerations in the distribution and pricing of the service. The supply of water is a service which is used by the individual, business, and industry to varying degrees and under a variety of conditions. What then are the criteria for insuring that this public service is required and that the costs for it are properly proportioned to each user?

Perhaps a logical starting point would be to determine if in fact a public water supply is a public good. This can be done by examining the genesis of the public water supply concept. In the beginning man used whatever water supply happened to be available at the time. This usually consisted of a nearby artisian well, river or lake. In areas where there was no water or where water quality was unfit for consumption the areas remained barren and undeveloped.

As urbanization began to take place deterioration of surface water quality from human pollution began to occur. In many areas local surface water quality was such that the water was unfit for human consumption. Water supply in cities usually consisted of a system of central wells, which were used by the entire community

at no cost to the individual. In 1554 the English Parliament institutionalized water supply by passing legislation which required that the city "provide for clear water for the residents of London."1

The "town pump" method of water supply continued for the next three hundred years. In 1854 Dr. John Snow removed the handle from the Broad Street pump and ended a cholera epidemic in London.[2] The landmark realization that cholera and typhoid were water-born diseases revolutionized the concept of public water supply systems. The threat of disease transmission from private supplies and the inability and lack of initiative by the private sector in supplying adequate quantities of safe water resulted in the large scale public acceptance of and confidence in community operated water supply systems.[3] The incidence of water born disease in the U.S. dropped from 100 deaths per 100,000 people in 1950 to less than .1 deaths per 100,000 in 1980. This data would attest to the success of the role of the public water supply in promoting public health.

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1. LaHier, J.M. Historical Development of Municipal Water Systems in the United States 1776 - 1976. American Waterworks Association Journal. April 1976. Vol. 68. p. 174.

2. Sawyer, C.N. and McCarty, P.L., Chemistry for Sanitary Engineers. McGraw - Hill Book Co. New York. 1967. p. 364.

3. LaHier, J.M. op. cit. p. 175.

The World Health Organization sees the community water supply system serving more than the public health purpose. Their position is as follows:

> "the community water supply system must service more than the bare minimum needs of safe water for drinking and culinary purposes. For health, comfort and convenience, additional quantities for bathing, washing and public cleansing are necessary. The ultimate goal is the provision of safe water of acceptable quality, and in adequate quantity, for home use and for public, industrial and recreational uses."[4]

If this then is the goal, can its implementation be justified on purely theoretical grounds? If it can, how does society equitably distribute the cost incurred in reaching this goal.

The two recent theoretical statements by John Rawls and Robert Nozick are both relevant and incompatible concerning the moral, philosophical aspects of equity. There is some benefit in examining the social policy implications of these philosophical theories in order to get some idea of the conflict which exists between the theory of equality and the theory of liberty. Rawl's A Theory of Justice[5] directly addresses the question of what is just distribution in society or stated differently whether inequities are justified in society.

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4. World Health Organization. Health Hazards of the Human Environment. WHO. Geneva. 1972 p. 351.

5. Rawls, J. A Theory of Justice. Harvard University Press. Cambridge, Mass. 1971. 607p.

In the final analysis it would seem that Rawls' conclusion respecting inequalities in society is simply that only those inequalities are justified which are to the benefit of the least advantaged. Inequalities which may produce greater productivity and thus greater benefits to all may be justified if they result from inequalities of position or resources.

Robert Nozick's book Anarchy, State and Utopia[6] offers a theory which is diametrically opposed to that of Rawls. His position is that justice demands neither equality nor an inequality that must benefit the least advantaged, but rather that each person has the right to what he has justly acquired.

> "Whereas for Rawls a central authority is entitled to distribute the fruits of everyones labor, for Nozick, only the individual is entitled to the fruits of his own labor and he has full right to the use and disposal of them"[7]

Thus, we can see that these philosophical arguments are in themselves the main argument regarding equality as the only fair distribution and the main argument for regarding inequalities as justified and equality as an artifically imposed state.

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6. Nozick, R. Anarchy, State and Utopia. Basil Blackwell. Oxford. 1974. 367 p.

7. Coleman, S.S. Rawls, Nozick, and Educational Equality. The Public Interest. 1976. No. 43. Spring. pp. 121-122.

In terms of water supply it may be instructive to evaluate each of the models to see if there is a theoretical basis for the existence of public water supply systems as we know them. The Nozickian notion would have a society in which water supply was at the discretion of the individual, with each family having its own source of supply and treatment if it so desired. Alternatively this position would allow for the entry of private enterprise in unlimited numbers into any market area to sell water in competition with other private suppliers in the same area. The price of the water and the level of service desired would be left to the choice of the individual.

A Rawlsian model of water supply would move in the direction of equality and individuals would lose individual liberty to a central authority which would impose equality. This would be the development of a public water supply system which would price its water and determine its level of service based on the needs of those least advantaged in the market area.

From these models it would seem clear that neither of these extreme positions would be the best for society. The egalitarian position would not take into account the differences that exist in society due to its complexity, such as industrial and commercial requirements versus domestic requirements and in addition would not recognize the benefits to society that can be derived from an

adequate water supply. For while adequate quantities of potable water are required for life the existence of abundant supplies can attract water using industries the benefits of which in turn are reflected in the total socioeconomic development of the community.

The individualist or inequality position cannot be justified for public health reasons in that many water borne diseases are communicable and access to a contaminated supply could well affect whole communities. In addition, since water is unique, in that humans require it for survival and for which no substitute exists, limiting access to it for economic or other reasons would not be condoned in our society. The models therefore offer little agreem nt on a substantive theory of distributionable justice.

Thus a position has been developed where water is an absolute requirement for life, must be controlled to ensure its quality in order to safeguard society from disease and also, should be available in various quantities and qualities to meet the needs of potential consumers in order to foster community economic development. Water supply it would seem can be defined as an essential service and a public good that cannot be adequately described by either of the models proposed but is a compromise position between the extremes.

b) Public Goods Theory

Samuelson[8] proposed an elegantly simple theory of public goods. According to his definition, if a service is classified as a public good, it should be distributed in a way which gives everyone equal access, that is if a public good is supplied to one person it must be equally available to everyone else. His theory also recognized production efficiency; he stated that if an additional person enters the group to which a public good is supplied, there should be "no subtraction from any other individual's consumption of that good."[9] This in essence means that equal access is cost-free and that the service is not subject to congestion. Finally, he said that equal access to goods classified as public is the only possibility.

Goldin[10] in his examination of this truly egalitarian traditional public goods theory came to the conclusion there are few goods and services if any which fit Samuelson's theory from both a practical and theoretical standpoint.

The traditional position then is to consider some goods and services as public goods and that equal access is both necessary and efficient for these goods. In examining this position from an economic theory standpoint a conflict

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8. Samuelson, P. The Pure Theory of Public Expenditure. Review of Economics and Statistics. 1954 Vol. 36. pp. 387 - 389

9. Ibid. P. 389

10. Goldin, K.D. Equal Access vs Selective Access: A Critique of Public Goods Theory. Public Choice. 1977 Vol. 29. No. 4.

arises between the individualism of economic theory, since it is largely based on an individualistic value system and the egalitarian principals embodied into equal access philosophy. Samuelson feels that if a service is worth having at all then everyone should have equal access for reasons of "necessity" (exclusion is impossible) and "efficiency" (zero marginal costs of serving additional persons).

In terms of a water supply system the equal access position is not truly the case. For example, a water distribution system has set boundaries beyond which services are not supplied. In addition within certain service areas anyone applying for a water connection is not necessarily granted a connection unless certain criteria are met. The size of the service connection also limits equal access in that large service connections can obviously supply more water than small service connections. The size of the service connection is determined by an established protocol.

Each of these items can be considered negotiable in dealing with the central authority. Engineering considerations must be taken into account to ensure that the desired access is practical and the access to the system is made selective by means of a tariff imposed on the new connection. This shows that price is an important factor which makes access to the service selective.

When considering Samuelson's efficiency definition everyone should be able to consume the same unit and not detract from another individual's consumption. Essentially this means that the service should be non-congestible and that there should be no rivalry among consumers. In terms of economic theory this position means that there should be a zero marginal cost associated with serving additional persons.

However, in the case of a public water supply there is always rivalry among consumers and the marginal cost of serving additional persons is positive. To serve more persons without increased congestion generally requires the provision of more facilities with the attendant capital and operating expenses associated with them. Alternatively more users can be served by using existing facilities, but only by increasing congestion which results in a lower quality service and therefore, is a "cost" to existing users. Once again cash price is a method of making access selective in that there is a positive relationship between the amount of the service used and the price that must be paid.

From the above it is found that a water utility does not fit Samuelsons' definition of a public good. It does fit the more common definition in that water supply is a good the inherent quality of which requires public production. The above are certainly not all of the arguments pro

and con that can be made with respect to the equity considerations in water supply systems. They do however highlight the main thrust of the argument, that being that price is an important factor in determining access to water supply.

This would mean that water supply is not a service which is egalitarian in the traditional sense and therefore, this leads to a discussion of how utilities can impose prices on society which are in the best interests of everyone in the community.

c) Pricing Theory

The price of a service may take into account social considerations, as well as economic and operational considerations. A utility should have a pricing system which is fair for all sectors in society, and at the same time properly reflect the costs incurred in operating and financing a major service.

Lachky has suggested that the proper approach to rate making must include:

> "a compromise of a number of rate making factors including cost of service, the present level and condition of the rate structure, the ability of customers to pay, the nature of the service area, the value of the service, and customer demand for service and competition."[11]

This philosophy represents a deviation from the traditional cost/price concept in rate making, and raises the important question of whether or not public utilities should concern themselves with social problems. The Committee on Government Productivity-Task Force Hydro which examined Ontario Hydro operations suggested that there could be serious problems in determining the social implications of modifications in electricity rates. They said:

> "we suggest that the solution to such social issues is to be found in the income tax machinery or through income supplements, rather than through departures from cost-based electricity rate."[12]

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11. Lachky, C.C. Does Utility Management have Social Responsibilities. American Water Works Association Journal. 1977 Vol. 69 p. 299.

12. Committee on Government Productivity. Task-force Hydro Hydro Policy in Ontario: Financial Policy and Rates. Report #4. 1973. p. 81.

In discussing natural gas prices Lance Partridge, Chairman of the Manitoba Public Utilities Board, recently stated:

> "fuel prices may soon be based on conservation and social needs, rather than on the actual costs of providing energy."[13]

It can be seen from the positions taken by each of these writers that there is a tremendous range of options that can be taken in establishing the type and the magnitude of the charges imposed on the public for the delivery of a service.

There are two fundamental techniques for obtaining revenue for services, these being taxation and fees. Historically, in the interests of greater equity and simplicity, general taxation took the place of fees as a method of financing many public services.

> "The dominant doctrine came to be that citizens should pay for public services through compulsory tax levies based on capacity to pay and that public services should be uniformly available with special charitable provision for those who do not have the means to care for themselves."[14]

In terms of equity considerations, who pays the taxes, who gets the benefits and the value of those benefits, must all be considered. It could turn out on analysis that the distribution of both benefits and taxes would work disadvantageously for the lower income groups, and to the comparative advantage of those with larger incomes. Alternately

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13. Partridge, L. Need for Fuel to Decide Cost? Winnipeg Tribune. September 12, 1979.

14. Muskin, S. An Agenda for Research in Public Prices for Public Products S. Muskin, editor. The Urban Institute. Washington 1972.p. 441.

it could be that the principal users might turn out to be the lowest income group and the tax burden may not rest on them in proportion to the benefits they receive. Neuner et al. examined the use of taxation rather than user charges as a means of funding water supply and concluded that user charges are a more equitable means of collecting revenue.[15] Milton Karfoglis, who has given perhaps more thought to this question than any researcher advocates the use of service charges over the use of tax levies.

> "although much research remains to be done before the distributional implications of service charge finance can be assessed fully it has been suggested that in some communities increased reliance on cost of service finance might ameliorate the conditions of the low income classes. Proportional utility rates and flat rates per house are specially suspect since they encourage inefficiency and lead to service rate structures that are more regressive in their effects than the property tax. The distributional problem created by service charges may be due to faulty pricing practices, rather than to faulty principle."[16]

Those public goods which cannot be divided into purchasable units, such as police protection and education, seem best handled through the general levy mechanism. With urban water supply the units of service can be

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15. Neuner, E., N. Popp and F. Sebold. User charges vs Taxation as a Means of Funding a Water Supply System. American Water Works Association Journal. January. 1977. Vol. 69. pp. 39-44.

16. Karfoglis, M.Z. Local Service Changes: Theory and Practice in State and Local Tax Problems. H.L. Johnson, ed. University of Tennessee. Press 1969.p.195.

measured and the individual user can be identified easily. These factors can be used to assure that the price paid for the service is in proportion to the amount of the service used. Metered servicing can therefore be equitable and pricing can become a viable means of ensuring that the allocation of public resources becomes more effective. Quite simply this means that an individual should only pay for that quantity of service that is used by that individual. In this way the consumer is allowed to make priority decisions with respect to the amount of the service desired. In making the case for user fees Muskin et al. state the following:

> "The economic case for the expansion and rationalization of pricing in the urban public sector rests essentially on the contribution it can make to allocative efficiency. Prices will provide correct signals to indicate the quantity and quality of things citizens desire and help bring about the proper balance between private and public production of these things. A properly designed price system can potentially serve this end whenever the public provision of a service, or the private use of a common property resource such as air or water, is accompanied by significant divisible or appropriable benefits accruing to identifiable individuals, provided the cost of its implementation and operation does not exceed the gains in terms of more efficient resource allocation. Many of the services provided by urban local governments appear to qualify by this criterion.
>
> In practice, of course, it may not be desirable to exclude people by imposing user charges even when it is technically possible to do so; for example, because an objective of policy is to redistribute income in the form of a particular service, or because it is believed that individuals will, if faced with a money

> price, choose to consume less of certain services than is considered socially desirable."[17]

Thus, while a reasonable case has been made for the existence and equity of water supply user rates it still remains to determine how these user rates can be set in a manner that will attend to the equity and policy considerations that must be taken into account. Three of the major considerations are; equity, that is fairness in charging beneficiaries, revenue production, and efficiency in the use and production of the public service.

In his review of the public finance literature Milliman found that in general the stress is on the equity and efficiency gains in having users pay for benefits received. The gains, however, are considered within the context of how to finance expenditures.

> "problems of optimal resource allocation and efficiency are introduced only indirectly and are usually more concerned with the long run questions of investment in public facilities."[18]

He goes on to say that the equity aspect of benefit charges is viewed generally as a matter of simple justice. In other words users of a public service should pay for its costs when the benefits do not spill over to other people.

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17. Muskin, S. Public Prices for Public Products. S. Muskin, ed. The Urban Institute. Washington. 1972. p.11.

18. Milliman, J.W. Beneficiary Charges - Toward a Unified Theory. In Muskin op. cit. p. 29.

> "the efficiency aspects of benefit charges are largely limited to the long run questions of proper investment in capacity or the optimal scale of service, and questions of how best to ration service from existing capacity are seldon discussed."19

Those proponents of marginal cost pricing feel that the present techniques for establishing utility rates are based in large part upon two principles that are questionable from the standpoint of efficiency in the use of resources. Namely that rates tend to be based upon recovery of historical or original costs and rates tend to be determined by the average cost of service, as opposed to the marginal cost of supply.

> "Neither the public finance nor the public utility literature has succeeded in rationalizing the need for reimbursement of financial costs with the efficiency rationale of marginal cost pricing that may generate surpluses or deficits. The theory of marginal cost pricing stresses that investment and operating decisions on social investment should be made independ-tly of reimbursement policies for individual lumps or units of productive capacity."20

By way of definition the principal rule of marginal cost pricing says that the demand price should be made equal to marginal cost, with marginal cost defined as the incremental cost of production or the cost of each additional unit of production of a specific product. With marginal cost pricing resources are drawn away from alternative uses and the prices should reflect accurately

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19. Ibid. p. 30.

20. Ibid. p. 33.

the social opportunities foregone. The equality of the price and marginal cost ensures that consumers equate marginal benefits from this use of resources with the real alternatives foregone elsewhere. In discussing marginal cost pricing in electric utilities, Caywood states:

> "the basic approach of the academic economist is that rates for service should reflect marginal cost and that the embedded or residual cost should be covered by a tax or other subsidy. The claim is that this method of pricing orients consumer choice to the lowest cost service resulting in the optimal allocation of resources and thus a saving in resources and promotion of maximum economic welfare. This theory is of course not compatible with investor ownership and operation of a utility system. Further the approach does not fit the electric utility which is a decreasing cost business."[21]

Another theory is the "value of service" approach to rate making. This method is one which uses the philosophy, "what the traffic will bear" as its main criterion. Ability to pay considerations bring a social slant into the value of service philosophy. In practical application the marginal price based on long term marginal cost is considered to be the floor and the value of service the ceiling with respect to the prices that can be charged for any particular service. The value of service approach to rate making is one that is rarely used in establishing utility rates because of its difficulty in justification.

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21. Caywood, R.E. Electric Utility Rate Economics. McGraw-Hill New York. 1972. p. 247.

Utility rates are generally based on costs and there are two general kinds of cost analysis, namely, fully allocated and marginal. As the name implies in developing a fully allocated cost all expenses are distributed to the various service categories included in the analysis. One of the difficulties with this type of rate setting technique is where several classes of users are being supplied from common facilities under conditions where a large proportion of cost is related to a fixed investment. The method of allocation of the cost is of prime importance and is not always clearly defined. Further, establishing a rate using historical cost leaves one vulnerable as it is not possible to anticipate environmental, social, or financial conditions which can drastically affect demand.

Caywood cites numerous court and commission decisions respecting the methodologies utilized in establishing electric utility rates, with the basic conclusion being that rate making is far from being a science and that:

> "rates are ultimately based on judgements as to how costs are to be allocated, but do not and should not exclude consideration of the promotional, competitive and other aspects of a utility business."[22]

The reasoning expressed by Mosher and Crawford summarizes well a widely held view of rate making.

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22. Ibid. pp. 250.

> "Despite the predominant importance of costs as the basis of rates, secondary emphasis has been given and probably will be given to the ability of certain classes of consumers to pay proportionately more of the fixed investment and overhead costs than a strict cost accounting would require. That is to say, the policy known as 'what the traffic will bear' continues to have its place and probably should have its place in rate making. It is used here not in the sense of permitting utility companies to earn more than a reasonable return on a reasonable investment, but rather with reference to the distribution of costs in such a way that certain consumers will assume somewhat more than their due share of the total charges."[23]

In summary it has been argued that water supply is a service that is best rendered by a single authority in a particular jurisdiction. For a variety of reasons the service in not delivered in a truly egalitarian fashion, but that access to it has been made selective through the price mechanism. It has also been suggested that water supply systems lend themselves to user charges since individual consumption of the service can be readily measured. Substantial disagreement on the methodology for imposing user charges equitably has been found in the literature.

From a theoretical standpoint marginal cost pricing seems to offer promise as a methodology for more equitably distributing costs to user groups. The proponents of marginal cost pricing are mainly

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23. Mosher & Crawford. Public Utility Regulation. in Caywood, R.E. op. cit. p. 250.

academic economists, such as Muskin and Milliman. The practioners in the field of rate studies, however, take a more pragmatic approach towards the establishment of rate structures. Caywood and Mosher and Crawford while agreeing with the concept of marginal cost pricing find its application in real world situations most difficult. One of the major problems to be overcome is that most marginal cost pricing structures do not account for "sunk" costs. However a fact of life is that debt charges on capital spending must be paid by someone, and the answer cannot be to pass these costs to more senior levels of government or to mill rate payer.

The cash basis budgeting system used by most public utilities lends itself to historical cost recovery systems as we shall see later. There is also a problem in establishing the base use of the service. Does marginal costing adequately reflect water use for an apartment dweller versus an individual with a half acre of lawn to be watered, or does a pensioner's one-room electricity usage compare equitably with a four bedroom all electrical house?

Other factors such as peak demands, industrial usage, and seasonal variation must be taken into account. In addition the historical development of rate structures and the vast number of legal precedence must be taken into consideration when radical departures from existing rate structures are proposed.

Each situation is unique and every jurisdiction has conditions and characteristics that require individual study. Muskin says:

> "this means fewer reviews of general concepts and far more concentration on the specifics of public products and pricing policy centering on the appropriateness of present charge practices in terms of efficiency and equity and the optional pricing methods that could be applied to improve the incentives generated by those pricing practices."[24]

These factors will be taken into account in an effort to answer the question as to whether or not water rate structures in the City of Winnipeg are equitable.

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24. Muskin, S. op. cit. p. 426.

POLICY DEVELOPMENT

POLICY DEVELOPMENT

a) Revenue Production

Many pricing schemes have been used for services. The "value of service" price is a price established at a level which will generate maximum revenue. Other price regimes include "historical cost recovery" schemes, "mariginal cost recovery" schemes, or pricing structures designed to bring about social, economic or other changes in society. Up to this point this study has made no attempt to legitimate any particular pricing scheme, and therefore, has not attended to the question of "how much" is a legitimate charge for a service such as water or "how to" charge for the service.

Prior to any discussion on the nature of the rate structure and the magnitude of the rate itself, careful consideration must be given to the intent behind the collection of revenue in the first place. If one does not understand completely why revenue is being obtained and for what purpose the obtained revenue is to be used then it is impossible to devise a rational method for obtaining revenue. For certain elements in society it may even be considered immoral for a utility supplying an essential service to obtain revenue without considering all of the ramifications that this process will have on society. Justificatiion for this statement can be readily seen in the prevailing attitude that the general

population in North America has towards the windfall profits of the multinational oil companies. The price increases and profits which are generated are legitimated on the basis of requirements for exploration and future demands, yet are still subject to wide spread skepticism by the general public. However, unlike utilities the multinationals are not responsible directly to the public. Since the political interfaces are so much different so then are the requirements for legitimation.

In examining rate structures we find that there are many purposes that can be served. Level of service changes can be reflected in the rate in two ways. Change can be instituted and the rates adjusted to reflect the change or change can be reflected in the fiscal reserves of the utility. Another purpose to which rates can be put is to spur economic development in a community, by for example, offering incentives to industry to locate in an area through the offer of reduced industrial rates.

The rate can be used to bring about socioeconomic change in a community by offering lower rates to those who are less able to pay for a service. The adoption of "life-line" rates by some electrical utilities in the U.S. is an example of social manipulation through the use of a rate formula. The rate structure can be used to promote efficiency and penalize inefficiency of use within a system by developing a structure which rewards conservation and penalizes waste. This is accomplished through systems

of inverted rate structures, off peak use rates, and summer - winter rates which have been described in the literature.[25]

Rate structures can also be used to plan and control development of an area. This can be accomplished by instituting, through rates, various area charges wherein older areas receive the service at a lower cost than newer areas or by subsidizing growth in various ways. Finally, the rate is designed to generate revenue with the magnitude of the rate obviously affecting the amount of revenue produced. These potential rate functions are summarized in Table 1.

The rate level and revenue produced can be manipulated in such a way as to achieve many ends. For example, revenue can be obtained that will, in any given year, offset historical system costs which include operating and maintenance costs, plus financial or debt charges. Alternately the rate may be sized to cover only the marginal cost price of the service, leaving the historical or "sunk" costs to be collected in another manner quite apart from the rate.

Rates can be sized to generate a profit for privately owned facilities or to build reserve funds in public utilities. The accumulated reserve funds

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25. Boland, J.J. The Requirement for Urban Water -- A Disaggregate Analysis. AWWA 1979 Annual Proceedings. pp. 51-66.

TABLE 1

POTENTIAL FUNCTION OF A RATE STRUCTURE

1. Change level of service.
2. Enhance community economic development.
3. Bring about socio-economic change through redistribution of costs.
4. Promote efficiency and penalize inefficiency of use.
5. Control or influence physical development.
6. Generate revenue.

can be used to finance major system maintenance or offset revenue short-falls which may result due to unforeseen circumstances. These functions are in effect rate stabilization.

Another possibility with surpluses is to establish sinking funds to be used for system expansion to service growth. Alternately excess revenue could be returned to the general coffers to be used on other projects. This situation presently exists with Winnipeg Hydro, in that revenue surpluses resulting from excess rates caused by statutory requirements are returned to general revenue to be used by the City of Winnipeg at large. While this may at first glance seem unfair to hydro users one could almost consider it analogous to the issuance of a dividend by a company to its shareholders. Winnipeg Hydro is owned by the citizens of Winnipeg who are therefore rightfully entitled to the benefits of profit. On the other hand this line of reasoning destroys the concept of cost of service and alters the consumer's right to choose what he spends his money on or how much of a service to use. The potential uses for revenue are summarized in Table 2.

The above can be regarded as the chief purposes to which the rate can be put to use. It is imperative to note that this study is dealing with the rate itself and is not discussing any of the many additional surcharges, taxes, levies, rentals or other mechanisms that are available

TABLE 2

POTENTIAL USES FOR GENERATED REVENUE

1. Cover annual O & M and debt costs (Historical Cost Recovery)

2. Cover O & M cost (Marginal Cost Recovery)

3. Profit (Private Utility)

4. Build reserve fund which can be used:

   a) Offset annual shortfalls i.e. rate stabilization
   b) Change level of service
   c) Major and minor system maintenance and replacement
   d) Subsidize growth and system expansion
   e) Finance other projects within City government.

to a utility for obtaining revenue. The revenue from these additional charges form a part of a utilities total revenue production picture. In the City of Winnipeg water utility, for example, they represent approximately 25% of total revenue[26] and at this point they are considered beyond the scope of this discussion.

It would seem in order to reach consensus on what a rate structure is to be used for, one must first understand the theoretical aspects or, more to the point, the policy framework, under which the utility will operate.

Policy decisions such as those affecting level of service, socio-economic change and economic development in the community must be decided prior to making any decisions on rate structures. The obvious reason for this is that policy determination will greatly affect the amount of revenue needed which relates back to the rate structure. In addition the rate structures can be manipulated in such a way as to bring about certain ends. Simply stated, the policy framework will tell us the goals and a stategy will be developed in an effort to obtain these goals in an equitable manner.

The policy decisions obviously have many political ramifications since tax paying customers are affected.

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26. City of Winnipeg - Current Estimates 1980.

In examining various alternative policy choices an attempt will be made to make policy recommendations that are sound from equity and economic standpoints but that are also politically defensible at this point in time in Winnipeg. Obviously changing political climates could result in shifts in philosophy but any system is subject to change and the arguments to be put forward are hopefully strong enough in substance to stand the test of time.

b) Policy Decisions

It has been the policy of the City of Winnipeg to supply water to its citizens which is of high quality and under adequate pressure and will be of sufficient quantity to satisfy peak demands. The policy to date has been "to supply water at cost", with the water utility rates being established in a manner which will produce revenue sufficient to offset expenditures including debt changes in any given year. A policy of maximization of consumption while never being made explicit has nevertheless been in effect. The reason for this position being that maximum consumption yields maximum revenue, which in turn means that expenditures may increase with no apparent cost to the citizen through increased rates. This issue will be dealt with more fully later.

The City of Winnipeg has basically adopted the policy position which has been put forward by the American Water Works Association (AWWA). This policy states that:

> "AWWA believes that the interests of the public and of individual customers of water supply systems serving the public can be served best by self sustained, utility-type enterprises, adequately financed, and with rates to the public and customers based on sound engineering and economic principals designed to avoid discrimination between classes of, or individual, customers.
>
> To this end, AWWA establishes as an ideal toward which each water supply utility should strive, the standards set out in the paragraphs that follow:
>
> Each water supply utility serving the public should deliver water meeting, as a minimum the U.S. Public Health Service Drinking Water

> Standards (Environmental Protection Agency Primary Drinking Water Standards), adequate in quantity for all sanitation and other domestic use, safe and desirable for industrial and commercial use, and adequate for fire protection service.
>
> Its services should be on an uninterrupted basis with a minimum of fluctuations in pressure."

The policy goes on to state:

> "Such a water supply utility should receive sufficient gross revenue from those using the service to enable it to pay all operating and maintenance expenses and all fixed charges on capital investments; to employ and compensate trained and competent personnel for operating and maintenance functions; to enhance sufficient funds to develop and perpetuate its system in accordance with sound technical and economic principles"[27]

It is of fundamental importance to note here that there are two ways to operate water utilities, privately and publicly. While most of the water utilities operated in North America today are public utilities, there is considerable evidence in the recent academic literature which argues that privately supplied urban services are less expensive than publicly supplied services.

Deacon states:

> "the central empirical conclusion that emerges from this analysis is that purchasing cities spend significantly less on public services than do otherwise similar producing cities."[28]

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27. AWWA. Policy on Rates & Finances - adopted January 1965. p. 17.

28. Deacon, R.T. The Expenditure Effects of Alternate Public Supply Institutions. Public Choice. 1979. Vol. 34. p. 392.

Bennett and Johnson[29] reached similar conclusions in their examination of refuse collection and DeAlessi[30] has found electric power costs are lower from privately owned utilities.

In examining the cost of public service versus private service, Savas[31] has shown that most public service costs are arrived at using budget figures, and that these budget values understate the true costs of services. This occurs since many overhead costs are not included or are felt to be beyond the scope of departmental budgets, but do reflect true costs to the citizens. In addition opportunity costs such as real estate and business taxes from private suppliers are also lost.

On the positive side Lineberry says that:

> "it is infrequently remembered that one of the victories of the municipal reform movement was the "publicization" or monopolization of urban service matters once handled by private entrepreneurs - even firefighting, street lighting and policing - were effectively converted into municipal monopolies."[32]

In dealing with two of the issues most important to the

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29. Bennett, J.T. and Johnson, M.H. Public vs Private Provision of Collective Goods and Services. Public Choice 1979. Vol. 34. pp. 55 - 63.

30. DeAlessi, L. Ownership and Peak-Load Pricing in the Electric Power Industry. Quarterly Review Economic Business. 1977. Vol. 17. pp 7 -26.

31. Savas, E.S. How Much Do Government Services Really Cost? Urban Affairs Quarterly 1979 Vol. 14 Sept. p. 23.

32. Lineberry, R.L. On the Politics and Economics of Urban Services. Urban Affairs Quarterly 1977. Vol. 12. Mar. p. 267.

citizen, that is responsiveness and equity, Rich[33] does not call for a return to the private sector but suggests some institutional design changes which could be made to alleviate the present problems.

Thus, while it has been argued that it is perhaps from a cost standpoint (assuming that the data in the literature is valid) in the best interests of the citizenry to have services supplied by the private sector, it may not be the most effective from an equity standpoint. The questions of monitoring and control of service have not been adequately dealt with nor has the question of control of price setting in the absence of competition. In addition the political realities of the situation must be taken into account. One need think back no further than the controversy and demonstrations by garbage collectors at City Hall as a result of the Urwick - Currie report on civic services[34] in Winnipeg to realize that changing from a "make to buy" position is not politically acceptable at this time. Even though it was clearly demonstrated that private garbage collection was cheaper the concept was not politically acceptable and for this reason was not implemented.

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33. Rich, R.C. Equity and Institutional Design in Urban Service Delivery. Urban Affairs Quarterly 1977 Vol. 12. Mar. p. 383.

34. Urwick, Currie & Partners. City of Winnipeg - Reorganization of Public Works, Engineering and Parks and Recreation Services. Oct. 1972.

The policy that emerges from this analysis is that the City continue to operate the water supply system in a utility-like manner. The term "utility-like" is used since the water supply system operated by the City of Winnipeg does not operate in the autonomous manner characteristic of true utilities. This point will be elaborated on later. Again the political reality would indicate that no change could be anticipated in this format.

Earlier, six potential functions of a water rate structure were outlined (see Table 1). All of these functions have associated with them policy decisions, some of which overlap from one potential function to another. Each potential function will be examined separately and a policy proposed.

i) Revenue Production

The policy discussion for this function has been attended to above. That is, by deciding that the City will continue to operate its waterworks systems, the City must therefore continue to generate revenue. The methods for generating this revenue will be dealt with in the alternative strategy section and the uses of the revenue will become more clear once policy decisions on the remaining five items have been determined.

ii) Control Physical Development

The thrust of this section is that growth funding can be done in alternate ways to shift costs away from the water user or that alternate growth funding from the private sector can be utilized. The present policy of the

City of Winnipeg with respect to growth and system expansion is that supply requirements and regional facilities which form an integral part of the water supply system are funded through the water rate. Residential growth which encompasses local developments is funded by the developer who in turn recovers the money through the sale of serviced lots. In areas where houses exist, yet services do not, new water services are paid for through frontage levies which are passed means of local improvement by-laws. Thus, we can see that only regional growth and supply items are funded through the water rate.

The above raises the important question of why a long time resident in an older area should be responsible for paying through the water rate for regional growth services from which he may derive no benefit. It also raises the question of the cost/benefit of developing new, raw land while valuable serviced land exists in the older areas of the City. In supporting the use of existing areas Gaffney argues that high density areas near the load center of the utility are more cost effective than low density areas located farther away from load centers. He says:

> "this process not only leads to an over investment of resources in the supply of

> water services but also results in premature development of land at the rural urban fringe."[35]

In addition Hanke[36] argues that new areas increase costs since most urban developments consist of single family residences on large lots which have high summer lawn sprinkling demands. These demands create most of the water system peak requirements. In discussing the financial implications of growth Hanke says:

> "Even though most utilities impose user fees for the provision of water service, their method of doing so is inefficient, because their pricing policies are not based on sound economic principles. Rather, they adhere to the long accepted principle of a "fair return" on invested capital and the corollary policy of charging uniform prices over time and space. The principle of a fair return, while limiting the rate of return earned on invested capital, does not limit the amount of capital employed. Hence, the aggregate profits earned by the utility can be increased by extending both the intensive and extensive margins of capital. The fair return policy will, therefore, encourage an expansion of the water utility system beyond its optimal size."[37]

Essentially this means that expending capital for growth allows for the legitimation of more revenue through

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35. Gaffney, M. Replacement of Individual By Mass Systems in Urban Growth. Proceeding American Real Estate and Urban Economic Association. 1969. Vol. 4 p. 24.

36. Hanke, S.H. Pricing Urban Water in Public Prices for Public Products. S. Muskin - ed. The Urban Institute. Washington 1972. p. 292.

37. Ibid. pp 303-304.

the fair rate of return principle. Even if the growth area remains unoccupied, existing system users pay for the additional capacity and system size since pricing is usually uniform across the service area. This argument is valid for private utilities but does not apply totally to public utilities such as Winnipeg who use historical cost recovery as the basis for collecting revenue. Thus there seems to be some merit to the argument that uncontrolled system growth is costly and inefficient.

From a social standpoint one could make arguments for the continuation of regional growth funding by the City. In examining Hydro utility growth in Ontario the Task Force said:

> "perhaps the most fundamental argument against this practice* is put forward on behalf of the customer who, having contributed to equity formation in one municipality for years, moves to a new community and loses the benefits of these contributions. Given the mobility of people today, it would seem preferable to have the benefits apply uniformly to all customers, regardless of where they choose to live in the Province."[38]

Utilizing the same train of thought the person who feels that he will gain no benefit from City growth, assumes that he will be living in the same area of the City for

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* The practice referred to is Growth or buy-in charges. These are charges used by some utilities to pay for regional growth or to compensate the utility for the privilege of connecting to an existing system. For details see Ferry, W.K. footnote 40.

38. Committee on Government Productivity. Task-Force Hydro. Hydro Policy in Ontario: Financial Policy and Rates Report #4 1973. pp 54 - 55.

the rest of his life. However, in the City of Winnipeg we know that growth is slow (0.54% per year)[39] and that the bulk of the shift from the core areas to the suburbs is internal movement of City residents. The basic principal here is that these residents who are now moving have in the past contributed to regional growth services for others. At the same time they are paying a premium with respect to a new location since the local services are included in the lot price. Adding to this the additional price for regional services could make costs unreasonable and therefore, deny a benefit to the citizen that has been enjoyed by his predecessors and paid for by himself for many years.

Another important consideration is that if the City were to abandon the concept of rate funding growth the complex problems of City planning and new supply considerations with respect to urban growth would be influenced and directed by developers who had a vested interest and were willing to finance growth and recover these costs later. The resulting growth areas may not be in keeping with the overall goals of the City with respect to growth. Ferry says:

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39. Department of Environmental Planning - City of Winnipeg.

> "the rate making and municipal financing concepts of recovering costs from those who cause the cost may therefore conflict with other public policy goals."[40]

In terms of additional supplies, questions would arise as to who determines when additional supplies are required, how they are sized, how they are financed, and how the costs are proportioned to the new customers who presumably caused the requirement in the first place. This problem is so complex that it is not reasonable to expect that it can be solved by abandoning the present policy in favour of growth charges.

Some other factors favoring the retention of growth funding through the rate are that the problem of urban sprawl characteristic of many cities is not considered to be a costly major problem in Winnipeg. The reasons for this are that firstly the council of the City of Winnipeg has declared that no serviced development occur outside of the perimeter highway and thus, we have a physical boundary to contain development. Secondly, most of the major regional system to supply this area (within the perimeter) has been constructed and the growth expenses will be relatively small until such time as new supply facilities are needed as will be shown later. And finally, the present low growth

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40. Ferry, W.K. Connection Changes: One Way to Finance System Expansion. American Water Works Association Journal. 1979. Vo. 71. p. 4.

rate has been projected to continue further limiting growth expenditures. It should also be noted that there is considerable debate in the literature over the rationality of displacing low income families by destroying existing buildings and infilling the city with new development. Often times the social costs outweigh the servicing costs.[41]

The present policy allows for controlled uniform development and does require a financial obligation by the developer and ultimately by the consumer. The benefits to be gained by shifting the burden of growth expenses to the citizen through other mechanisms appears to be outweighed by the potential loss in control that could be experienced. Therefore, the position recommended is that the present policy of funding supply additions and regional system growth through the water rate be continued.

iii) Socio-Economic Change

It is possible to use the price of water to alter inequities which exist in society. Ferry states:

> "rate making bodies whether they be regulatory agencies, City Councils, or water district boards of directors, are and should be politically motivated; that is, they are responsive to state legislators, court decisions, and special interests groups. At times their decisions are based on politics, rather than economics, and this is their preogative."[42]

Much publicity has been received in the electric utility

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41. Lindbloom, C. Market and Democracy in Politics and Markets. 1977.

42. Ferry, W.K. op. cit. pp. 4-5.

field for so called "lifeline" rates,[43] such rates usually implying a lower than cost charge for minimal consumption. The aim is to reduce the cost for retired persons on fixed incomes and low income families.[44] Keller argues:

> "unfortunately from a utility standpoint there is little correlation between the cost of providing water and the customers income. If some customers are provided with water at low costs it can only be accomplished by charging the other customers more. Utility bills for needy cases could be better paid by funds intended for welfare purposes rather than requiring other water customers to provide relief."[45]

Task Force Hydro reached a similar conclusion in their Future Role and Place Report in which they found that the proportion of income spent on electricity decreases as income increases. Meaning that upward adjustment in the price of electricity has a greater relative impact on low income families than on high income families. They concluded that:

> "any policy which increases the cost and therefore the price of electricity will be at least directionally effective in reducing residential consumption in the long run. Although the burden will fall more heavily on low income groups, this "problem", the regressive effect of higher electrical prices on income distribution, is a general one shared by a wide range of goods loosely classified as necessities such as, food.

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43. Lifeline Rates for Utility Customers. Wall Street Journal. 1975. September 25.

44. Pace, J.D. The Poor, the Elderly and the Rising Cost of Energy. Public Utilities Fortnightly 1975. June 5. pp. 26 - 30.

45. Keller, C.W. Trends in Water Rates. American Water Works Association Journal. 1975. Vol. 67. p. 255.

> The solution is to be found not in departures from cost based power rates, but in the structure of the income tax which is designed specifically to mitigate such inequalities."[46]

Additionally, Banker, a member of the A.W.W.A. Water Rates Committee, stated:

> "it seems safe at this point to say that the committee may be expected to strongly emphasize the point that the application of social policy to rate making should be incorporated in rate design only where so directed by those legislative bodies responsible for social legislation."

He goes on to say:

> "probably the one fact about lifeline rates which gives their advocates a problem is the realization that the defiency in revenue from the subsidized customers must be paid by someone else. A solution to this problem proposed by a serious witness in a recent water rate hearing was to the effect that such subsidies should not be borne by other customers, rather they should simply be absorbed by the water utility. A.W.W.A. may be assured that the Water Rate Comittee will not recommend that such a solution be given serious consideration."[47]

It seems, then, that what is being advocated is that the costs for services accurately and equitably reflect the true costs of producing and delivering a service.

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46. Committee on Government Productivity. Task-Force Hydro. Hydro Policy in Ontario: A Future Role and Place. Report #1 1972. p. 26.

47. Banker, R.F. Progress Report of the Water Rates Committee. American Water Works Association. 1979 Annual Proceedings. pp. 46-47.

The logic follows that hiding social welfare costs in water rates does not lead to either efficient resource allocation nor does it reflect accurately total social welfare costs to society. The policy that emerges from this is that the City should not manipulate rate structures to achieve ends other than those that reflect the true costs of service delivery to the majority of the water utility customers.

iv) Economic Development

Water rates can be used to stimulate economic development in a community by for example offering discount rates to high volume users. Many feel that decreasing block rate structures such as the one used by the City of Winnipeg, to be described more fully later, achieve exactly this end. Others argue that high volume rate discounts are justified due to economies of scale and "better load characteristics of larger use customers."[48] Research done by Wolfe and others [49] demonstrate the ratio of maximum day demand to average day demand ranges between 1.9 and 4.8 for residential developments depending on the individual lot size and value of property. The peak hour to average day ratio was found to be generally twice the above maximum day to average day ratios. By contrast large industries using a public water supply have a much lower maximum day

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48. Keller, C.W. op. cit. p. 256.

49. Wolfe, J.B. Peak Demands in Residential Areas. American Water Works Association Journal. 1961. Vol. 53. p. 1253.

to average ratio (less than 1.5) and for those operating on a 24 hour per day basis the load factor is even more uniform. Since it is peak demands and maximum day demands which greatly influence the system cost, the argument for lower industrial rates has some merit.

On the other hand, if the pricing structure is set up in such as way as to charge consumers equitably for the water used then discount rates would be required only as a promotional tool. Examining electrical discount and promotional rates in Ontario it was determined that

> "the use of hydro electric power in the Province had not yet been fully exploited and substantial benefits derived from Hydro's efforts to promote the use of electrical energy. But in a mature economy such as is now enjoyed in Ontario there is no longer justification for encouraging consumption through subsidized rates."[50]

This point ties in closely with the conservation ethic which will be discussed later.

The prices charged to industry for services are naturally reflected in the prices that the industry establishes for its products. By establishing cost of service prices for water and by not allowing discount rates the industry can properly price its products. Discount rates are a means of subsidizing industry at the expense of other water users who may not reap the benefit of lower product pricing made available by low cost water.

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50. Committee on Government Productivity. Task-Force Hydro. Hydro Policy in Ontario: Financial Policy and Rates Report #4 1973. pp 27-28.

In terms of the economic development of a community Lewis[51] argues that while water is a factor of production and therefore, is economically significant, studies have convincingly shown that the importance of abundant water supplies as a factor in industrial location and economic growth have been overstated. Kollar et al. confirms this analysis and says that "heavy-water using industries are increasingly locating in the water-short south west U.S."[52] Due to the prevalence of these and other myths concerning industrial water perhaps the value of promotional water rates has also been overstated. Of the major services water is without question the cheapest and in terms of most companies overall costs, the costs of water are generally not a major factor in production. Industry is,however, sensitive to price and will respond to incentive or penalties. In his study of pollution charges, Simms[53] demonstrated that industry showed a positive response to higher costs by reducing pollution levels when charges were imposed. He also showed that industry took advantage of loop holes in industrial waste charges in order to lower the cost to industry.

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51. Lewis, W.C. Regional Economic Development; The Role of Water. National Technical Information Service. Springfield, Va. 1971. PB 206372.

52. Kollar, K.L. and MacAuley, P. Water Requirements for Industrial Development. American Water Works Association Journal. 1980. Vol. 72. pp. 2 - 9.

53. Simms, W.A. The Response of Firms to Pollution Charges. Canadian Journal of Economics. 1979. vol. 12 pp. 57-74.

By inference this tells us that industry will respond to water pricing either by reducing consumption or if that is not possible by passing the price increase along to consumers. It also tells us that industry will take advantage of promotional rates if they are offered, but that these rates do not necessarily influence location decisions or result in lower product prices. The argument made by some is that if water prices are raised, industry will seek new locations and there will be an overall economic loss to the community. Kollar et al. state the more important factors are: "labor market, raw materials, transportation, product market, tax incentives, infrastructure, services, housing and energy."[54] It would seem from this data that the decision to locate or relocate industry is based on factors other than rationally imposed service charges.

The policy recommendation, , therefore, is that the City operate its water supply system as a service to the community and not offer promotional or discount rates, that encourage system overuse, by any class of customer.

v) Level of Service

There are two facets to the question of level of service; namely, quantity and quality. Both of these factors

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54. Kollar, K.L. and MacAuley, P. op. cit. p.4.

have a price associated with them in that increasing either quality or quantity will be reflected by increases in cost. Vickery says:

> "an often dominant attitude (in water supply) is that people ought to have some specified supply of water almost regardless of cost and that the water supply system should be designed to provide the supply under all but extemely rare conditions. If a shortage should occur the name of the water engineer will be mud; there is thus a strong tendency to err on the side of more ample provision."[55]

Hanke et al.[56] feel that this situation has arisen by adopting the approach that water is necessary for life, hence price-demand relationships are ignored and forecasts of water demands are in effect water requirements.

In an effort to determine how the citizens of Winnipeg perceive their water supply requirements Rempel[57] conducted a consumer attitude survey on water quality in 1971. A statistically significant number of randomly selected residential water consumers were personally interviewed by a team of students. The questions were designed to give the utility a broader understanding of the general feeling of the user with respect to the level of service offered by the utility.

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55. Vickery, W.A. Responsive Pricing of Public Utility Services. Bell Journal of Economics and Management. 1971 Spring. p. 342.

56. Hanke, S.H. and Davis, R.K. Demand Management Through Responsive Pricing. American Water Works Association Journal. 1971. Vol. 63, pp. 555-560.

57. Rempel, G. Consumer Attitude Survey on water Quality and River Pollution Control. Metropolitan Corporation of Greater Winnipeg. Oct. 1971. 18 p.

The survey results showed that 92% of those surveyed taking everything into account rated the water system as average to very good. The lowest rating was for taste, 84.3% average to very good, and the highest was pressure 96.2% average to very good. This would indicate that a vast majority were satisfied with the quality as measured by taste and quantity as registered by the pressure. When asked about the cost of water supply 87.1% rated it as average to very expensive, and 56.1% indicated that they were not willing to pay higher costs for improved water quality. A further 26.8% indicated that they were willing to spend $0.50 per month per household to improve water quality. Rempel concluded:

> "the indication is that there is no marked dissatisfaction with any specific characteristic of the water and the majority do not feel improvements are warranted at this time."[58]

Although somewhat dated the survey results tell us that the present level of service, since it has not changed since 1971, is more than satisfactory, except from the cost standpoint. It does not, however, answer the question of how the citizens would react to a decrease in level of service. If we tie together the two ideas put forth in the previous paragraph, we find that perhaps a rational way to reduce water costs is to reduce consumption which is essentially a reduction in

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58. Ibid. p. 14.

level of service. This idea will be discussed in the efficiency of use subsection and a policy recommendation covering level of service, and efficiency of use will be developed.

vi) Efficiency of Use

Almost everyday in the newspapers we are reminded that shortages are occurring. The shortages range from gasoline to grain cars to public funds. These shortages are in part a result of the mass consumption ethic which theorists such as Thomas Blair[59] and Daniel Bell[60] describe in their writing on urban culture and society. Against these shortages one must consider the cost and value which is placed on the items in short supply. In examining water supply one must be cognizant of the fundamental change that has occurred in the industry in the past 100 years. While in the beginning water supply satisfied basic health and sanitation needs, now enormous quantities are used for such convenience purposes as lawn watering, auto washing and swimming pools. While technically it is possible to supply any amount of water required the public is caught between the twin phenomena of rising supply cost and increased nonessential or convenience uses of water.

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59. Blair, T.L. The International Urban Crisis. Hart-Paris, MacGibbon. London 1974.

60. Bell, D. The Cultural Contradictions of Capitalism. London Heinemar, 1976.

Hanke et. al, feel that:

> "solutions may be found in various social and economic adaptions to the facts of cost and value. Demand management is an alternative to conventional supply management and should be given equal consideration in urban water planning."[61]

It has been suggested that while prices are charged for water and used to finance existing systems, prices are almost never used to control water use or to accumulate funds for future expansion. In considering this idea, perhaps, it would be possible to use the pricing system to promote efficiency and penalize inefficiency of use.

The concept of efficiency has a variety of meanings differing greatly in scope. At a broad level, efficiency of resource use may relate to the welfare of society as indicated by the total level of monetary and non-monetary satisfaction. For our purposes efficiency will be used in the broad sense to reflect the overall satisfaction that can be obtained from the water resource. Walker et al. say:

> "with regard to the allocation of a particular resource a condition of efficiency exists when society is receiving the greatest returns possible from its use. Under conditions of efficient use the value of the last unit of the resource supplied is the same for each of its various alternative uses. Thus, then it is possible to further increase values attributable to a resource by altering its allocations. When viewed in this broad context efficiency in use becomes

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61. Hanke, S.H. and Davis, R.K. op. cit. p. 555.

62. Walker, W.R. and Cox, W.E. Method for Achieving Efficiency in Water Use. American Water Works Association 1978 Annual Proceedings Paper 4 - 3. p.1.

> a goal which can only be approached rather than an objective capable of precise measurement and total attainment. Thus, the efficiency criterion simply provides a direction for movement."[62]

There are many known places of excessive use in a water system. Some of these are due to leakage during transportation or storage, large scale industrial uses in operations which were designed on the basis of water abundance, and large scale outdoor residential uses, such as lawn watering. In addition the existing plumbing fixtures and appliances in most homes are designed to use excessive quantities of water. The technology exists to decrease water waste, but the challenge is to develop management schemes and institutional arrangements which will result in a maximization of use of the resource.

Three approaches are required in order to effect a resource conservation program, and they are: direct governmental regulation, use of economic incentives and public education. What is being suggested here is a change in level of service from the present water on demand situation to a resource conservation oriented water demand structure. The approach is analagous to the energy situation where the government regulates automobile mileage and gasoline price but does not tell the consumer how far he can drive or how much gasoline he can purchase. Here the regulatory agency sets specifications for water using equipment and prices the water fairly but does not interfere in the consumers choice as to volume

used. The program can be instituted by using physical, economic and educational tools, but prior to adopting this policy we must determine if the program is in the best interest of the community.

The shortages which are partly a result of the mass consumption ethic have resulted in another phenomenon which seems to be sweeping North America and that is the development of a conservation ethic. The City of Washington, D.C. has interpreted this as a public directive with respect to their water planning and has changed their philosophy from "abundant to conservative" in order to meet the needs for future water demands.[63] Many other urban areas have adopted or are considering the adoption of permanent water conservation measures and President Carter on June 6th, 1978 indicated that all Federal Agencies would be directed to require development of water conservation programs as a condition of contracts for storage or delivery of municipal and industrial water supplies from federal projects. The guidelines for this program were promulgated in the May 24th, 1979 Federal Register.[64] The American government is therefore,

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63. McGarry, R.S. Washington Suburban Sanitary Commission Water Conservation Experience. American Water Works Association 1979 Annual Proceedings. pp. 1107-1114.

64. U.S. Water Resources Council. Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resource Planning. Federal Register 44: 30194. May 24, 1979.

very serious about the use of water conservation measures as a tool in water planning. The water supply situation in Canada is little different from that in the United States and in Winnipeg the situation is particularly critical due to the short and long range implications of the required capital works needed to continue the supply of water as will be shown later.

A) direct governmental regulations

The regulatory approach to encourage increased efficiency and therefore, conservation can most easily be accomplished through the institution of changes to present building and plumbing codes. These changes would require that low volume toilets, shower flow controls and pressure reducing valves be placed on all new construction or renovations. The Washington experience indicates that no problems or complaints have resulted from changing the codes as indicated.[65] Other more serious regulations restricting actual use have been implemented during times of emergencies such as drought, but as a long term mechanism such measures are not considered fair or equitable since they infringe on the individuals' right to choose when he wishes to use his supply.

B) economic incentives

The principle here is to use economic forces to maximize efficiency. Economic incentives can be built into user

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65. McGarry, R.S. and Brusnighan, J.M. Increasing Water and Sewer Rate Schedules: A Tool for Conservation American Water Works Association Journal. 1979. vol. 71. pp. 474 - 479.

charges in a way to promote efficient use of the resource. The primary criticism directed at conventional water rate structures is that charges to the consumer do not create incentives for more efficient use.[66] This raises the very important question of demand elasticity. The responsiveness of the quantity used to price changed is measured by the "elasticity of demand" which is the relative change in the quantity divided by the relative change in the price. To state for example that the elasticity of demand with respect to price is -0.5 means that when price increases by 1% the quantity demanded is reduced by 0.5%.[67] If it found that the demand for water is inelastic little will be achieved by manipulating price structures. On the other hand, if demand for water is elastic economic incentives may prove to be a powerful tool for eliminating waste.

Analyzing the effect of pricing on demand for various goods can be a complicated procedure. Taylor[68] points out in his electricity demand study that one of the complicating factors is that most studies use average price results, while most cities use declining block rate pricing schedules.

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66. Hanke, S.H. Water Rates: An Assessment of Current Issues. American Water Works Association Journal. 1975. Vol. 67. p. 215.

67. Hanke, S.H. and Davis, R.K. op. Cit. p. 558.

68. Taylor, L.C. The Demand for Electricity. Bell Journal of Economics and Management. 1975. Vol. 6. pp. 74-110.

Gibbs[69] argues that marginal price and not average price must be used in the analysis where block rate structures are used and his data demonstrates considerable variation in response to consumption between the two pricing systems. The important work of Howe and Linaweaver[70] used marginal pricing while Hanke and Davis[71] and North[72] used aggregate data but evaluated the price in the appropriate block rate.

Examining demand elasticity Hanke[73] showed elasticities generally ranging from -0.10 to -1.00. This type of variation has led some writers such as Sonnen et al. to conclude: "it is clear enough that elasticity of demand with respect to price is an intractable variable for water planners to estimate."[74]

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69. Gibbs, K.C. Price Variable in Residential Water Demand Models. Water Resource Research. 1978. Vol. 14 pp. 13-18.

70. Howe, C.W. and Linaweaver, F.D. Jr. The Impact of Price on Residential Water Demand and Its Relation to System Design and Price Structure. Water Resources Research. 1967. Vol. 3 pp. 13-32.

71. Hanke, S.H. and Davis, R.K. op. cit. pp. 555-560.

72. North, R.M. Consumer Responses to Prices of Residential Water. Proceedings of Third Annual American Water Resources Conference. 1967. pp. 651-663.

73. Hanke, S.H. A Method for Integrating Engineering and Economic Planning. American Water Works Association Journal. 1978. Vol. 70. p. 487.

74. Sonnen, M.B., and Evenson, D.E. Demand Projections Considering Conservation. Water Resources Bulletin. 1979. Vol. 15 p. 447.

Camp[75] argues that consumers are reluctant to change use patterns until faced with serious supply shortages or with price increases substantial enough to provide sufficient incentive. He says that the principle determinantes of domestic water use are: number of persons per household, number of clothers washers, education level of household head, property value and family income.

In summary, Boland in his excellent study and review of demand elasticity concludes that:

> "when examined in the light of these points (methodological difficulties)* the studies reported in the literature excluding those few with conspicuous methodological faults show considerable consistency and agreement with a priori expectations. It would appear that reliable guidance is available for the water planner who wishes to estimate the effect of water price changes on water use provided the literature is used carefully."[76]

Beattie et al.[77], show that when adjusted for inflation real water rates in 13 of 23 cities actually declined making water a greater bargain in 1976 than in 1960. He argues that any rational consumer should increase his or her consumption of water and that the key to affecting

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* My parenthesis

75. Camp, P.C. The Inelastic Demand for Residential Water: New Findings. American Water Works Association Journal. 1978. Vol. 70. pp. 453-458.

76. Boland, J.J. op. cit. p. 60.

77. Beattie, B.R. and Foster, H.S. How Much Water Do We Need? How Much Are You Willing to Pay? American Water Works Association 1979 Annual Proceedings. p. 72.

demand through water pricing has to involve price changes in excess of the general level of inflation if responses are to be elicited on the part of the consumers.

It can therefore be concluded that a price exists at which a water user will seek a less expensive means of satisfying the demand for water, for example, by purchasing water using equipment that requires less water. Kim, et al.[78] have estimated that a reasonable conservation program, one that is technologically feasible at the present time, could reduce water use for showers and baths by 50%, laundry by 30%, and toilet use by 40%. Such a program would result in a total reduction in residential water use of 35%. Modification of demand for other residential water uses are currently possible and thus, a 35% saving is considered to be slightly conservative. Howe and Vaughn[79] report that an overall saving of 32% of residential use could be achieved at the present time. Stone[80], however, feels that case studies of physical conservation methods have shown that

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78. Kim, J.R. and McCuen, R.H. The Impact of Demand Modification. American Water Works Association Journal. 1977. Vol. 69. p. 94.

79. Howe, C.W. and Vaughn, W. In House Water Savings. American Water Works Association Journal. 1972 Vol. 64. p. 118.

80. Stone, B.G. Suppression of Water Use by Physical Methods. American Water Works Association Journal. 1972. Vol. 70.

the long term residential water use reduction of 6 - 12% is the best that can be achieved. MacLaren[81] indicate that an 8% reduction could be achieved through a water conservation program in Winnipeg.

In terms of industrial and commercial use Kim[82] et al. has suggested that using conservation techniques similar to those for residential water use could reduce demand. The potential impact of demand modification in 14 categories of industry surveyed revealed that water demand could be reduced in the commercial sector by about 30%. He states, however, that without economic incentives the demand modification program would be relatively ineffective. This claim, however, has not been substantiated in fact since McGarry[83] reports that the water conservation program instituted in Washington, D.C. has resulted in total demand which was down 13% over the previous year. A side benefit of this water conservation program was that sewage flows were also lowered, therefore reducing the required capacity of sewage treatment facilities and deferring capital expenditures. DeZeller, et al.[84]

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81. James F. MacLaren Ltd. City of Winnipeg. Study A - The Total Demand for Water to the Year 2030.

82. Kim, J.R. et al. op. cit. p. 95.

83. McGarry, R.S. op. cit. p. 1109.

84. DeZeller, J.T. and Maier, W.J. Effects of Water Conservation on Sanitary Sewers and Wastewater Treatment Plants. Journal Water Pollution Control Federation. 1980. Vol. 52. pp 76-88.

have recently reported on this important aspect of water conservation programs.

C) public education

> "The first step in achieving greater efficiency in water use consists of recognition among users that inefficiency exists and that improvement is possible. Until the public is made aware of resource limitations and the consequences of wasteful use efforts to change water use patterns in the direction of greater efficiency may be ignored or opposed. Thus, an increase in public consciousness through education is of fundamental importance."85

From this we can see the philosophy of this part of the program is to make citizens more aware of their water use and the cost involved in supplying and in the use of water. Madison, Wisconsin[86], has developed a voluntary conservation program in order to postpone construction of certain supply facilities. San Francisco[87] has developed an active public education program in an effort to reduce water consumption. These and other utilities[88] have attempted to convince

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85. Walker, W.R. and Cox, W.E. op. cit. p. 9.

86. Deibert, L.E. Fiscal Planning and Water Conservation in Madison, Wisconsin. American Water Works Association Journal. 1978. Vol. 70. pp. 2 - 5.

87. Lottie, J.E. and Nossbrink, D.J. Water Conservation Education for the Public. American Water Works Association Journal. 1977. Vol. 69. pp. 568 - 573.

88. Sharpe, W.E. Why Consider Water Conservation. American Water Works Association Journal. 1978. Vol. 70. pp. 475 - 479

consumers that even with water conservation stimulated rate increases customers who participate in the conservation program can save money.

While the results of public education programs are difficult to determine because of concurrent impacts associated with other changes, it is generally considered that a public education program is mandatory if the conservation program is to succeed. A continuing program is likely necessary in order to reinforce and maintain awareness of efficiency needs.

Therefore, the policy recommendation for the City of Winnipeg is to implement a water conservation program with the goal being to reduce water consumption in all use sectors and therefore delay or defer indefinitely major water supply capital expenditures which affect rate levels.

c) Policy Summary

A new water rate structure for the City of Winnipeg should be developed based upon the following recommended policy guidelines:

1) The City continue to operate its water supply and distribution system in a utility-like manner. The revenue generated be used to finance the utility in accordance with the policies developed below in the most practical and equitable manner possible recognizing the need for resource conservation.

2) The City continue its policy of capital recovery through rate charges for those water supply and regional facilities necessary for system expansion and growth.

3) The City not attempt socio-economic change for the benefit of any class of customer by manipulation of water rates.

4) The City not offer promotional or discount rates to any class of customer but encourage conservation and discourage waste through the rate structure.

5) The City actively pursue a level of service reduction through the development and implementation of a water conservation program.

HISTORICAL PERSPECTIVE

HISTORICAL PERSPECTIVE

In analyzing a water rate structure the American Waterworks Association, in its Water Rates Manual[89], stresses that specific rate making for any particular utility must be based on a careful study of the past and present conditions existing in the jurisdiction. Every utility, whether public or privately owned, has a particular set of political, financial, legal, physical and social conditions under which it must operate. These factors influence present and future water requirements which in turn affect the rate structure of the utility.

In order to have some appreciation for the future requirements of a particular utility it is usually instructive to be well versed in the historical development of the system being studied. For water utilities there are two elements to examine. The first is the physical system which is comprised of all of those elements necessary to take water from the source and supply it to the consumer. The second element is the financial burden that the utility carries to service the debt for the physical facilities and to maintain and operate these facilities. This section will examine the development of the City of Winnipeg Waterworks system to date and a subsequent section will examine the physical and financial commitments that will be required in order to perpetuate the system.

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89. American Water Works Association. Water Rates Manual AWWA. New York. 2nd ed. 1972. P.V.

a) Physical System

The first water system in Winnipeg was installed and operated by the Winnipeg Water Works Company, which obtained its charter on December 30th, 1880. The Company constructed and placed in operation in 1882 an intake and pumping station on the north bank of the Assiniboine River just downstream from the present Maryland Street Bridge. In 1899, the City purchased the plant of the Water Works Company and changed the source of supply from the Assiniboine River to a system of artesian wells. Between 1900 and 1908, a group of seven wells was dug, averaging about 18 feet in diameter and varying in depth from 46 to 102 feet. The City of St. Boniface was also supplied by wells. In 1901, Winnipeg constructed a water softening plant, using lime-soda ash, which was the first of its kind on this continent.

The City was at that time experiencing tremendous growth in population, and it soon became apparent that wells could not be depended upon to supply a sufficient quantity of water for the rapidly expanding population. Accordingly, after a series of engineering investigations and reports from 1906 to 1912, the Greater Winnipeg Water District was formed in 1913 to bring water from Shoal Lake to Greater Winnipeg and replace the well supplies.[90]

Shoal Lake is part of the lake of the Woods system

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90. Hering, R. F.P. Stearns, J.H. Fuertes, "Report on the Water Supply from Shoal Lake for the Greater Winnipeg Water District"., August 20, 1913.

and its water is of excellent quality, relatively soft, and requires no physical treatment. Furthermore, the lake is roughly 300 feet higher than reservoir level in Winnipeg, so that it was possible to design a pipeline which could deliver the water to the reservoirs by gravity without pumping, at normal lake levels.

Between 1913 and 1919, an aqueduct was constructed from Shoal Lake on the Manitoba-Ontario boundary to existing reservoirs in the Greater Winnipeg area. As one of the first steps in the construction of the aqueduct from Shoal Lake, a standard gauge railway line was constructed and this line has been maintained to the present time.

The pipeline, as constructed, is 97 miles long, the most easterly 80 miles being arch shaped plain concrete, and having a design capacity of 85 million gallons per day (MGD). Deterioration over the years has reduced this capacity to around 75 MGD. Approximately 17 miles east of the original McPhillips Street Reservoir, the arch-shaped section changes to a circular 8 ft. diameter section and continues four miles west to Deacon, where the diameter changes to 5 ft. 6 in. and the capacity is reduced. At this location, provision was made for 250 MGD reservoir and a future second branch pipeline to develop the full 85 MGD capacity of the upper aqueduct.

It was originally expected that this second branch aqueduct would have to be constructed before 1930, but with the outbreak of World War I and the opening of the

Panama Canal, Winnipeg's rapid population growth stopped and did not resume with the exception of a small peak after World War II. The capacity of the aqueduct section of the pipeline was designed such that it would reach its maximum capacity by 1944, or a 25 year design life. It is therefore due to good fortune rather than good planning that 36 years beyond design we are still able to satisfy annual demands with the present supply aqueduct.

In 1960, the 12 mile long Branch II aqueduct was completed. This consists of a 5 ft. 6 in. diameter concrete pipe extending from Deacon westerly, several miles south of the Branch I pipe, across the Red River tunnel and terminating at a reservoir located near Wilkes and Waverley Streets at the south boundary of the old City of Winnipeg. Branch II has a capacity of 35 MDG by gravity and provision was made for the future construction of a booster pumping station, which would increase capacity to 50 MGD when required.

Although the aqueduct, with the two branches in operation, has an actual capacity of 75 MGD, it is only possible to deliver this quantity of water through the gate house at the Intake when the lake level is above geodetic elevation 1058.3. In 1960, a low lift pump station was constructed at the Intake, adjacent to the original gate house, in which two low lift pumps are installed, one rated at 85 MGD and the other 65 MGD, both driven by diesel engines. With these pumps, an average daily demand of up to 75 MGD in the Metropolitan Area could be satisfied at all lake levels.

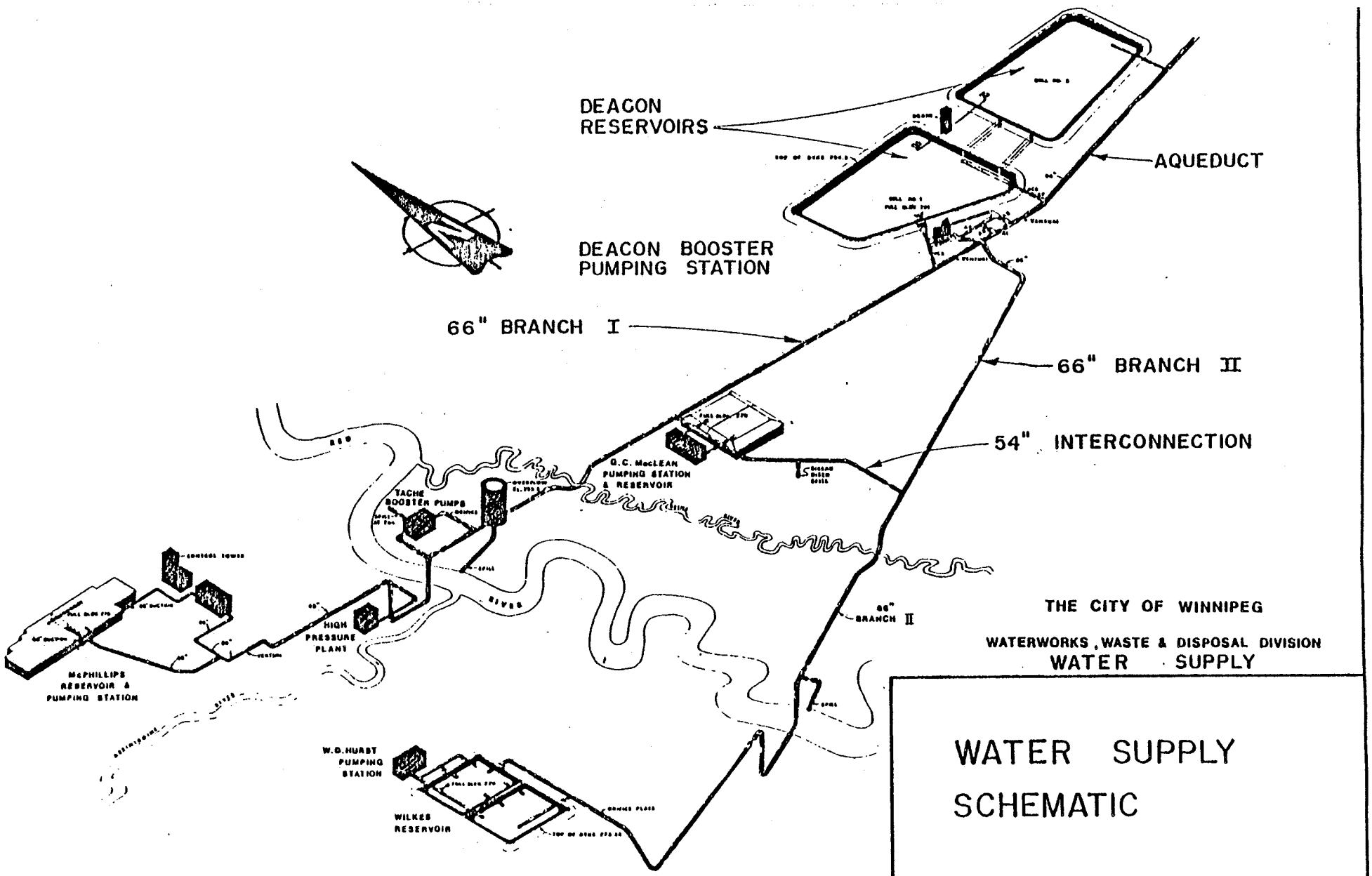
Until 1961, the Water District had the responsibility of delivering water to the municipalities in bulk and not under pressure, it being the municipalities' responsibility to store, treat and distribute the water to their own consumers. When the Metropolitan Corporation of Greater Winnipeg was formed on March 26th, 1960, provision was made for the Corporation to assume all responsibilities of the Greater Winnipeg Water District, together with the additional responsibilities of storage, treatment, pumping and arterial distribution. Some arterial feedermains were taken over from the municipalities on January 1st, 1961 and others were constructed. To complete the integration of waterworks facilities, the Corporation assumed from the municipalities five domestic water pumping stations on January 1st, 1962 and began delivering water, treated and under pressure, through a system of trunk feedermains to the various municipalities.

In 1960 an analysis of the water demand and distribution system capacity indicated the necessity of expanding the feedermain system and adding pumping and storage capacity. A ten-year program was adopted by the Council of the Metropolitan Corporation. During this program an additional 45.4 miles of feedermains were constructed and a new reservoir and fully automatic pumping station were constructed at Marion Street and Lagimodiere Boulevard. This new MacLean Pumping Station has an installed pumping capacity of 70 MGD. The reservoir is a reservoir two sections with a 45 million gallon total capacity.

In 1968 the old McPhillips Street pumping station was replaced with a new automatic station with an installed Pumping capacity of 80 MGD. In 1971 the first cell of four of 400 million gallons capacity of a planned 1,500 million gallon reservoir was built at Deacon on the eastern edge of the City. This reservoir is designed to serve as a buffer for peak demands so as to defer the need for aqueduct construction. The reservoir is filled during the winter and discharged in summer.

On January 1, 1972 under the provision of the City of Winnipeg Act which was passed at the 1971 session of the Manitoba Legislature, the Metropolitan Corporation of Greater Winnipeg was dissolved and all of the duties, rights and liabilities of the water supply system became the responsibility of the new City of Winnipeg.

System development continued with the addition of the second of four cells at the Deacon Reservoir location in late 1978. In 1980 construction was completed on the Deacon Booster Pumping Station which will ensure that the water stored in the Deacon Reservoir can be moved into the 3 City storage reservoirs and be made available for consumption. Finally due to the imminent collapse of the open reservoirs at Wilkes Ave. in early 1980 (as a result of unstable soil conditions) construction was begun on a new enclosed reservoir at that location. Figure 1 shows a schematic of the system as it exists today.



THE CITY OF WINNIPEG

WATERWORKS, WASTE & DISPOSAL DIVISION

WATER SUPPLY

WATER SUPPLY SCHEMATIC

FIG. 1

b) Political Considerations

The above description would lead to the impression that to date the physical development of the water supply and distribution system has been orderly and without difficulty. This is by and large a factual statement recognizing that the catalyst to this rational orderly development was the construction of the Shoal Lake Aqueduct itself. The aqueduct however has a history of parochialism, mistrust and inaction that is not widely known. It is common for the uninformed to be awed by the planning and forethought of our political forefathers in constructing the aqueduct. However, we see that poor projections rather than good engineering have more than tripled the original design life.

The political and social problems which were overcome through the development of the first reliable supply system have been eloquently described by Allan Artibise. In his conclusion, he states,

> "Certainly since 1874 the majority of Winnipeg's citizens had been refused their right to an adequate and safe water supply by civic officials who were so concerned with money matters that the human dimension of the water shortage rarely was considered. And, given the nature of civic politics during this era, there was little hope that those who suffered most could force the municipal government to act. Though recognizing serious inadequacies in the city's water supply, successive City Councils and Boards of Control took over thirty years to obtain a pure and inexhaustible supply. Here, as in the case of Winnipeg's water power development, the successful completion of a worthwhile public project came only after every attempt had been made to find

> a cheap, short-term solution to a problem that demanded an expensive and long-term answer."[91]

At least with regard to supply planning and service delivery it would seem that the lessons of the past have been learned. Since its inception the water supply system in Winnipeg has been relatively free of the type of political maneuvering described by Artibise. Water supply planning is by its very nature an activity which must be highly structured, technical in nature, comprehensive and focused on the long term. Municipal politics on the other hand tends to be cautious, concerned with compromise and focused on the short term. Politicians for the most part rarely alter long range supply plans that are proposed by the administration. The reasons for this are three fold. Firstly long range water supply plans normally span periods far beyond the term of office of the politician and for this reason are not seen as a threat to reelection or controversial if approved. The issues only become controversial if they are not concurred with and the issue of supply shortage is raised. This brings us to the second point. Rarely is the political body in a position, from an information standpoint, to disagree with a long range water supply plan. These programs are usually highly technical in nature and

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91. Artibise, A.F.S. Winnipeg: A Social History of Urban Growth 1874-1914. Mc-Gill-Queen University Press. Montreal. 1975. p. 222.

since the administration serves as both the formulator of the plan and the politicians technical arm the plan cannot help but be approved.

Obviously all long range plans sooner or later become current and reach a point where capital funding decisions must be made. Thus the third reason plans are rarely changed is that once capital funding is necessary it is no longer possible to change plans without confronting the issue of a potential water supply shortage. A supply shortage is a readily understood problem by the politican and is not at all politically acceptable from the public standpoint. For this reason the capital budget for essential services such as water supply is seldom changed. Thus the long range plan becomes a physical reality. In interviewing several long time senior water supply officials it was indicated that the above scenario accurately reflects the true pattern of events.

It is in the short term programs reflected in the operating budgets where the most political manipulation takes place. Politicans are concerned with rate levels and service levels as the public is immediately affected by change. Water rates, as explained, are presently set at levels that will cover costs in any year. Theoretically the rate would be set at a level that allows for the continuation of programs from year to year. In reality rate increases are recommended by the administration but are subject to arbitrary cuts at the political level. Rate cuts are usually not related to specific service level reductions that are immediately noticeable to the consumer. Rather

they are aimed at reduction in maintenance, replacement and improvement programs. The reductions are in a sense false economy since neglecting these types of programs usually results in capital expenditures that would not have been necessary had adequate preventative maintenance been conducted. Programs aimed at saving money in the long term are also rarely approved since they normally require expenditures in the short term.

Rate cuts are, however, politically expedient since they defer expenditures to a later date and give the appearance of doing something positive for the consumer.

Level of service reductions have been implemented in the City of Winnipeg in areas other than water supply. For example garbage collection has been modified after it was shown that significant economic benefits could result. This does not relate to the "make or by" issue raised earlier but rather to frequency and method of collection. It would appear that similar service cuts could be made in water supply but only if the economic gain is significant. It has been found that service level cuts that affect permanent staff are not politically acceptable.

From this discussion it can be seen that political considerations play an important role in the operation and financial control of the water utility. In the final analysis it appears that the long term supply program and short term operation and distribution programs face vastly different political decision making processes.

c) Financial Structure

Prior to 1960 and the formation of the Metropolitan Corporation of Greater Winnipeg, the Greater Winnipeg Water District, in which the old City of Winnipeg was the prime shareholder, wholesaled water to the various municipalities, it being the municipalities' responsibility to store, treat and distribute the water to their own consumers. The municipalities were also responsible for setting their own rates of return to cover cost over and above the wholesale price charged by the Water District.

Naturally under such a system rate levels and rate structures varied from municipality to municipality depending on the level of service and the other financial considerations that the municipality had. When the Water District was dissolved and the Metro Corporation formed it took over not only the responsibilities of the Water District but also became responsible for storage, treatment, pumping and arterial distribution. The Corporation sold the water at a uniform wholesale rate to every municipality. The municipalities again retailed their water at whatever rate levels they deemed necessary.

In 1972 with the dissolution of the Metro Corporation the City of Winnipeg was given the authority under section 545 of the City of Winnipeg Act[92] to develop a rate structure.

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92. City of Winnipeg Act. Bill 36. Chapter 105. Sept. 1972 Sec. 545.

Considerable disagreement among area municipalities took place over this issue since it meant standardization of levels of service as well as rates. The problem was not near as severe as that which occurred in Toronto although the principle was essentially the same. In analyzing the Toronto situation Kaplan stated,

> "The setting of wholesale water rates was the most clearly factional issue that Metro dealt with in its first thirteen years. There were several reasons why this issue stirred such strong emotions. If Metro were to charge uniform wholesale rates to all municipalities, the result would be a substantial increase in the pre-1953 rates paid by City dwellers and a substantial decrease in suburban rates. Toronto officials thought that they were entitled to special consideration on rates because the City had provided Metro with a waterworks system and had received no compensation. To add insult to injury, Metro's initial capital budgets emphasized water and sewer projects in the suburbs. Furthermore, water rates was a sum-zero game. The province required that the water system be financially self-sustaining; giving special consideration to one municipality meant increasing the rates for all other municipalities."[93]

As a result of the controversy it was decided that a rate review study would be conducted in order to rationalize the new water rate structure to be used for the City of Winnipeg. The rate structure proposed in that study[94] was a continuation of the decreasing three step block rate

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93. Kaplan H. Urban Political Systems: A Functional Analysis of Metro Toronto Columbia University Press N.Y. 1967 pp. 111 - 112.

94. Task Force on Financial Management. Study of Water and Sewer Rates - city of Winnipeg - 1972 City of Winnipeg. Nov. 1971.

structure which had been instituted in the City of Winnipeg in 1956. This structure was instituted at that time to "permit the use of modern accounting methods and billing equipment". The rate schedules prepared in 1956 and 1959 were calculated on an empirical basis using formulas taken from the literature. In the 1972 study a direct analysis of local cost applicable to the various users was carried out to determine the validity of the earlier studies.

The 1972 study was the last review of the City's water rate structure that was undertaken. Since 1972 percentage increases have been uniformly applied against each block so that the validity of the block rates could be called into question. Table 3 shows the rate levels since the inception of the block rate system.

i) Allocation Methodology

The City of Winnipeg uses the Functional Cost Method which separates costs of production from distribution costs. Production costs can be defined as those costs associated with supplying the finished product to the pumping station, and distribution costs are those associated with distributing the water to the customer from the pumping stations including the costs of the pumping stations.

The production and distribution costs are recovered from the customer using a three step structure of blocks identified as Blocks 1, 2 and 3. Block 3 is termed the industrial or wholesale rate. The costs associated with this block are the total costs of all

TABLE 3

WATER RATE LEVEL 1956 - 1979

Effective Date	Block 1	Block 2	Block 3
Nov. 1, 1956	$ .19	$ .16 1/2	$ .12 1/2
Jan. 1, 1961	.21	.18 1/2	.14 1/2
July 1, 1962	.30	.25	.20
Aug. 1, 1964	.30	.25	.20
Sept. 1, 1966	.30	.25.	.20
Jan. 1, 1967	.34	.29	.24
Aug. 1, 1969	.41	.34	NIL
Jan. 1, 1974	.42	.27	.19
*Apr. 1, 1974	.42	.27	.19
Apr. 1, 1976	.63	.41	.29
Apr. 1, 1977	.72	.47	.34
Apr. 1, 1978	.72	.47	.34
**Apr.1, 1979	.75	.50	.38

*Instituted service charge

**Discontinued service charge

NOTE: Rates are for 100 cubic feet

production. Block 2 is termed the intermediate or commercial rate and includes all the costs arising from the distribution mains larger than 6" diameter. Block 1 is termed the domestic rate and includes the expense arising from distribution mains 6" diameter and smaller, cost of all meters and costs of billing. This method is somewhat arbitrary and has not met with wide acceptance in recent years. Table 4 shows in somewhat more detail the way in which costs are allocated to the various blocks.

There are three basic rates; domestic, intermediate and industrial. The domestic rate is for those who consume 0 to 9600 cubic feet per quarter, the intermediate rate is for those users who consume between 9600 and 96,000 cubic feet per quarter, and the industrial rate is applied to those users who consume over 96,000 cubic feet per quarter. The domestic and intermediate rates are paid on the first 9,600 and 96,000 cubic feet per quarter respectively.

It is interesting to note that while blocks 2 & 3 are termed commercial and industrial some residential use falls into this category. The use in question is that of residents in large apartment complexes where total flow not individual flow is metered. The large volume is therefore sold at the lowest rate and these consumers receive lower cost water than a single family residence. Mann has recently discussed the equity and economics of this anomaly and concluded "There is economic justification for similar treatment of apartment complexes and residential

TABLE 4

METHODOLOGY FOR CALCULATING BLOCK RATES

Block 3: Production Costs = $\frac{\text{Total Production Costs}}{\text{Total Consumption}}$ = $

Distribution Costs Increment = $\frac{\text{\% Distribution}}{\text{Total Consumption}}$ = $ _____

Block 2: Distribution Cost Increment $\frac{\text{\% Distribution}}{\text{Block 1\&2 Consumption}}$ = $

plus Block 3 rate = $_____

Block 2 rate $_____

Block 1: Distribution Cost Increment = $\frac{\text{\% Distribution}}{\text{Block 1 Consumption}}$ = $

plus Block 2 rate = $_____

Block 1 rate $_____

users in the design of rate schedules."[95] Table 5 show a summary of rates, revenue and consumption by blocks for 1979.

TABLE 5

BLOCK	RATE (/100 cu.ft.)	CONSUMPTION (billion gallon)		REVENUE ($x10^6$)	
1	0.75	6.93	(42.0%)	$ 8.20	(54.0%)
2	0.50	3.14	(19.0%)	2.86	(18.8%)
3	0.38	6.44	(39.0%)	4.12	(27.2%)
		16.51		$15.18	

The utility currently annually raises water rates, if required, to meet expenditures. Approximately 75% of the total revenue collected by the utility is from direct water sales. It can be seen from Table 6 that the Block 2 & 3 combined account for 58% of the water sold but produce only 46% of the revenue. Miscellaneous revenue sources such as fire hydrant rental, frontage levies, permit fees, railway operation, etc. account for the remaining revenue. Actual 1979 revenue amounted to slightly in excess of twenty-one million dollars. On the expenditure side approximately 6.7 million dollars is required annually to service existing capital debt charges. This means that over 30% of the budget is annually expended in servicing debts. Table 6 shows a summary of revenues and expenditures for 1979.

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95. Mann, P.C. Equity and Economics in Setting Water Rates for Apartment Complexes. American Waterworks Association Journal. 1980. Vol. 72. p.77.

TABLE 6

SUMMARY OF REVENUE AND EXPENDITURES 1979

REVENUE

Water Sales	15,400,000
Fire Hydrant REntals	1,430,000
Frontage Levy	1,779,125
Water Permit Fees	20,000
Railway Revenue	750,000
Indian bay Store	14,000
Miscellaneous	50,000
Interest Earnings on Bank	40,500
Interest Earnings on Capital	224,000
Interest on Foreign Exchange	38,015
Contribution from Sinking Fund	476,630
Contribution from Sinking Fund	289,280
Appropriation from General Levy	250,115
	20,761,665

EXPENDITURES

Water Supply	4,341,584
Water Distribution	7,896,498
Employee Benefits	842,186
Non-Departmental	8,045,595
	21,125,863
Surplus or (Deficit)	(364,198)

Source: City of Winnipeg Current Estimates 1980

The AWWA Rate Manual recommends two alternative techniques for allocating costs. The Commodity Demand method is a widely used method of allocating the costs of providing water to the customer. This method separately identifies commodity costs which vary with the quantity of the water sold from demand costs for average and peak useage. Commodity costs are defined as those costs which vary with quantity of water sold such as power and chemicals. Demand costs are those costs associated with the total operating and capital costs for providing total plant and system capacity for peak rates of use. This method relates the cost of the water system to the design parameters, average day, maximum day, maximum hour and fire demand flows.

The Base - Extra Capacity method is the other alternative method of identifying costs of providing water to the customer. This method identifies the cost of operating a water system as base costs and extra capacity costs. Base costs are defined as those costs such as power and chemicals which vary as to quantity of water used plus operating and capital costs for providing for average day demands. Extra capacity costs are those operating and capital costs associated with providing additional plant and distribution system capacity for demands greater than average day, ie. maximum day and maximum hour demands. This approach is based on engineering design parameters.

ii) Current Fiscal Position

In order to maintain its premium double A credit rating on the U.S. money markets the Council of the City of Winnipeg has imposed upon itself a 50 million dollar annual borrowing limit. In the past few years and increasingly in the future it will be difficult for the City not to exceed this borrowing authority in an effort to just maintain ongoing capital projects. This borrowing authority encompasses all capital works undertaken by the City.

In 1979 the total City expenditures amounted to approximately 269 million dollars. Of this 51.3 million dollars was for debt charges on capital works. In 1979 the total capital works program amounted to slightly over 75 million dollars of which 42 million dollars was borrowed on the U.S. money markets. The funds required to service the debt charges on these loans will show up as debt charges in the 1980 current estimate budget.

The water utility borrows its funds under the City of Winnipeg umbrella, however, the utility is accountable for all debt charges incurred for its capital projects. One of the difficulties of course is that the water utility competes against the sewer utility, streets, transportation, bridges and any other capital works that the City plans to undertake.

Water supply programs do seem to receive preferential treatment for capital funds. As explained earlier water supply capital programs are normally not altered as the

politicians fear water shortages and are essentially at the mercy of the administration regarding the necessity for capital works. It is politically much easier to defer a bridge or not to buy buses as the consequences of these types of decisions can be readily understood. Deferring major water supply programs can only be done by risking secure water supply, a political gamble not worth taking.

An additional problem is that under the present system of historical cost accountability water rates are raised to match revenue requirements on an annual basis. During periods of high inflation, high interest rates and large capital spending, annual increases to the water rates can be extreme.

The establishment of reserve or sinking funds for the purpose of funding growth has been recommended earlier. This system can overcome the need for large scale borrowing for capital works during periods of economic upset. This occurs because the funding is staged in an orderly fashion over a long period of time. The net benefit to the consumer is that the annual increase in water rates is fairly uniform and predicable and is not subject to the tremendous surges now caused by new capital works debt charges. During periods where surplus funds not necessary for capital works are available the large debt load of the utility could be partially retired resulting in reduced rates.

While this system sounds practical and is in fact used by many utilities it is difficult to accept politically. Politicans are not willing to create future benefits at the expense of present voters. Under the present system the goal is to reduce annual water rate increases to the lowest possible level rather than to implement a financial planning strategy that may require higher rates initially but will result in lower rates ultimately. It is unfortunate that the same concepts used for the water supply planning cannot or at least have not been implemented with respect to the money supply for water development projects.

In terms of actual year dollars there has been a substantial increase over the past four years for operating and maintenance. When these figures are converted in 1979 dollars however we find a total decrease of 10.1% in purchasing power for 1976 to 1979 (Table 7). This trend in expenditures in terms of constant year dollars strongly suggests that in order to maintain the status quo only, expenditures for this cost category will be at least at a level of 12%.

TABLE 7

YEAR	EXPENDITURES IN ACTUAL YR. dollars	% INCREASE OVER PREV. year	EXPENDITURES IN 1979 dollars	% INCREASE (DECREASE) OVER PREV. YEAR
1975	$ 9,084,816		$14,172,313	
1976	9,808,772	7.97%	13,732,281	(3.10%)
1977	10,535,269	7.41%	13,169,086	(4.10%)
1978	11,454,855	8.73%	13,058,535	(.84%)
1979	12,789,477	11.65%	12,789,477	(2.06%)
				(10.10%)

NOTE: Index used to convert to 1979 dollars was the Engineering News Record Toronto Building Cost Index (the same index as was used in the Water Supply Study B -- James F. MacLaren).

It would seem logical therefore faced with this fiscal dilemma to examine new strategies for system financing.

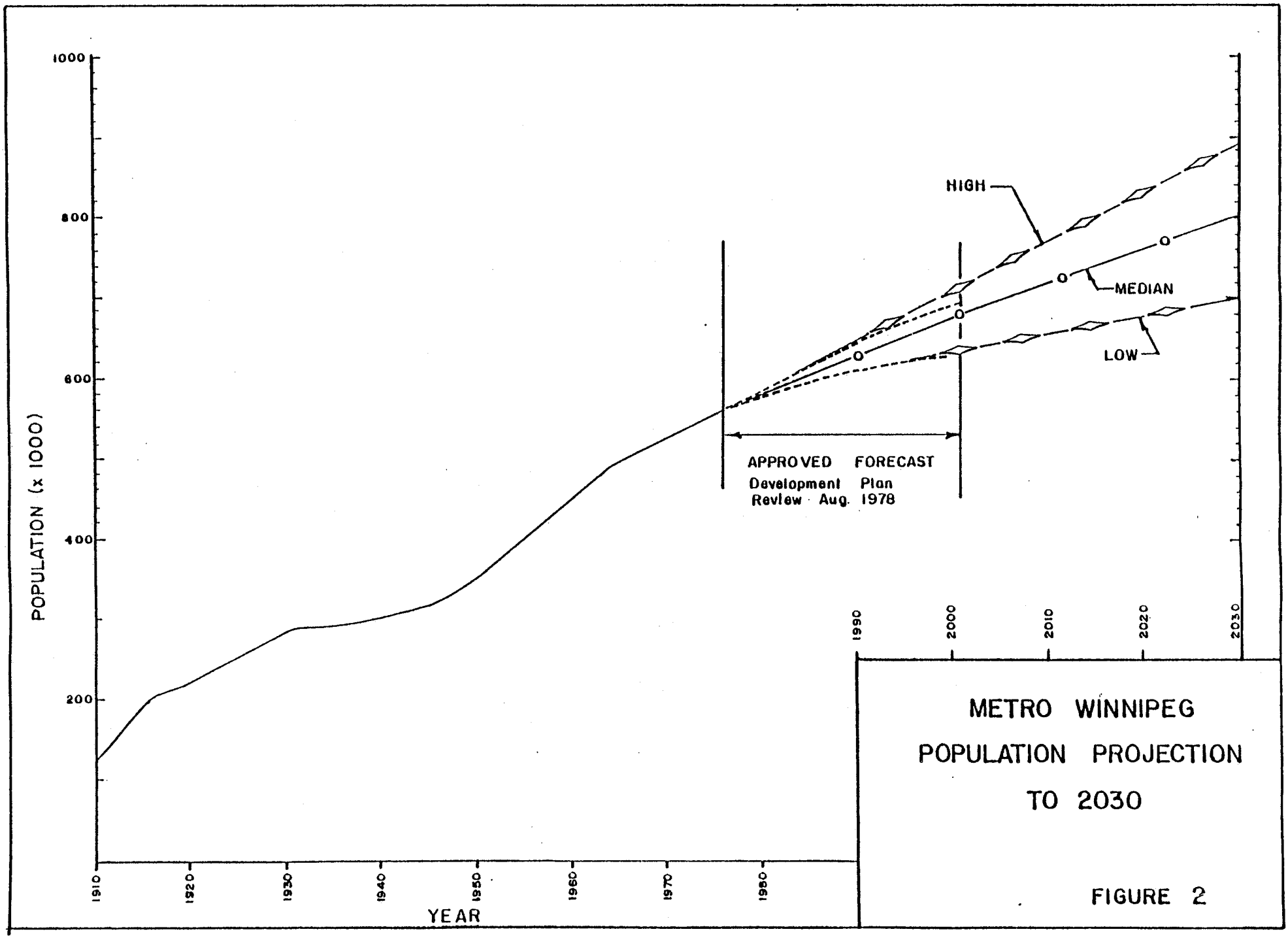
FUTURE REQUIREMENTS

FUTURE REQUIREMENTS

It is the purpose of this section to examine what additions to the physical system will be required within the next twenty years and what financial burden these new facilities will place on the consumer. The physical facilities required will be based on traditional demand projections and are therefore subject to change should demand modification programs, which will be discussed later, come into effect.

a) Physical System

Water consumption information is a fundamental parameter that is used by a water utility for determining the requirements for system improvements and for the setting of rates. This consumption information is described using three basic parameters, namely, population, unit consumption and load factors. The population information is obtained from census tract data and projections are made based on this information. Following the release of the 1976 census information from Statistics Canada, the Planning Department of the City of Winnipeg revised its 1974 population projections downwards from a growth rate of 1.45% per year to a 1.00% per year increase (Figure 2). The most recent estimate is 0.54% per year. The average increase in population projections is the basis for the present water supply projections.



METRO WINNIPEG

POPULATION PROJECTION

TO 2030

FIGURE 2

The unit consumption parameter is a measure of the per capita/per day/per year water use in a particular jurisdiction. This value also is obtained by statistically projecting historical information. The unit consumption is derived annually by dividing the actual average day water use by the actual recorded population during the year. Compared to other major Canadian cities, Winnipeg has relatively low unit consumption. While the average unit consumption is lower the rate of increase compared to other Canadian Cities is about the same.[96]

Unit consumption and population together define the consumption parameter called average day. Average day values are used with the other parameter, load factors, to define additional consumption parameters called maximum month, maximum day, and maximum hour. The foregoing parameters are used to size pumping stations, reservoirs, feedermains, pipes, etc. within the water system. The average day consumption parameter is used to gauge the design life of the main aqueduct. Current average day projections show the design life of the existing aqueduct is to 1998[97]. Essentially this means that in 1998 the entire carrying capacity of the aqueduct will be used to supply the daily demands within the water system leaving no excess for filling of reservoirs. The

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96. Water and Pollution Control. Waterworks, Plant Statistics Vol. 115 No. 11. Nov. 1977. pp. 44-62.

97. J.F. MacLaren Ltd. Study B Water Supply Study. City of Winnipeg Oct. 1979 p. 7.

purpose of the reservoirs is to buffer out peaks which occur during the day. If there is no excess water available to replenish the reservoirs water shortages will occur as the reservoirs become depleted. This concept can best be illustrated by showing that the maximum month, day and hour consumption values in 1977 were 68.2, 85.8 and 123.2 equivalent million gallons per day respectively while the actual aqueduct carrying capacity is 75 million gallons per day. The water stored in the reservoirs is used to make up the differences. Figure 3 graphically illustrates this point.

Utilizing these type of demand projections water supply engineers are able to determine the capital works that will be necessary in order to maintain the present level of service to water consumers. Table 8 shows the major physical works that will be required to the year 2000.

TABLE 8

Conceptual Plan for Water Supply Upgrading

Year	Physical Requirements	Cost($\$x100^6$)*
1981	Fort Garry Feedermain	3.0
1988	West Winnipeg Pressure Relief	10.0
1989	Misc. Feedermains	5.0
1990	Branch 1 Booster	1.0
1992	Deacon Cell #3	4.0
1994	Deacon Cell #4	4.0
1998	Aqueduct and Treatment	212.0
		239.0

*Cost in 1979 Dollars

b) Financial Impact

In determining revenue requirements for the future there are two widely used bases which are the "utility"

WATER SUPPLY SYSTEM
FLOW CHART

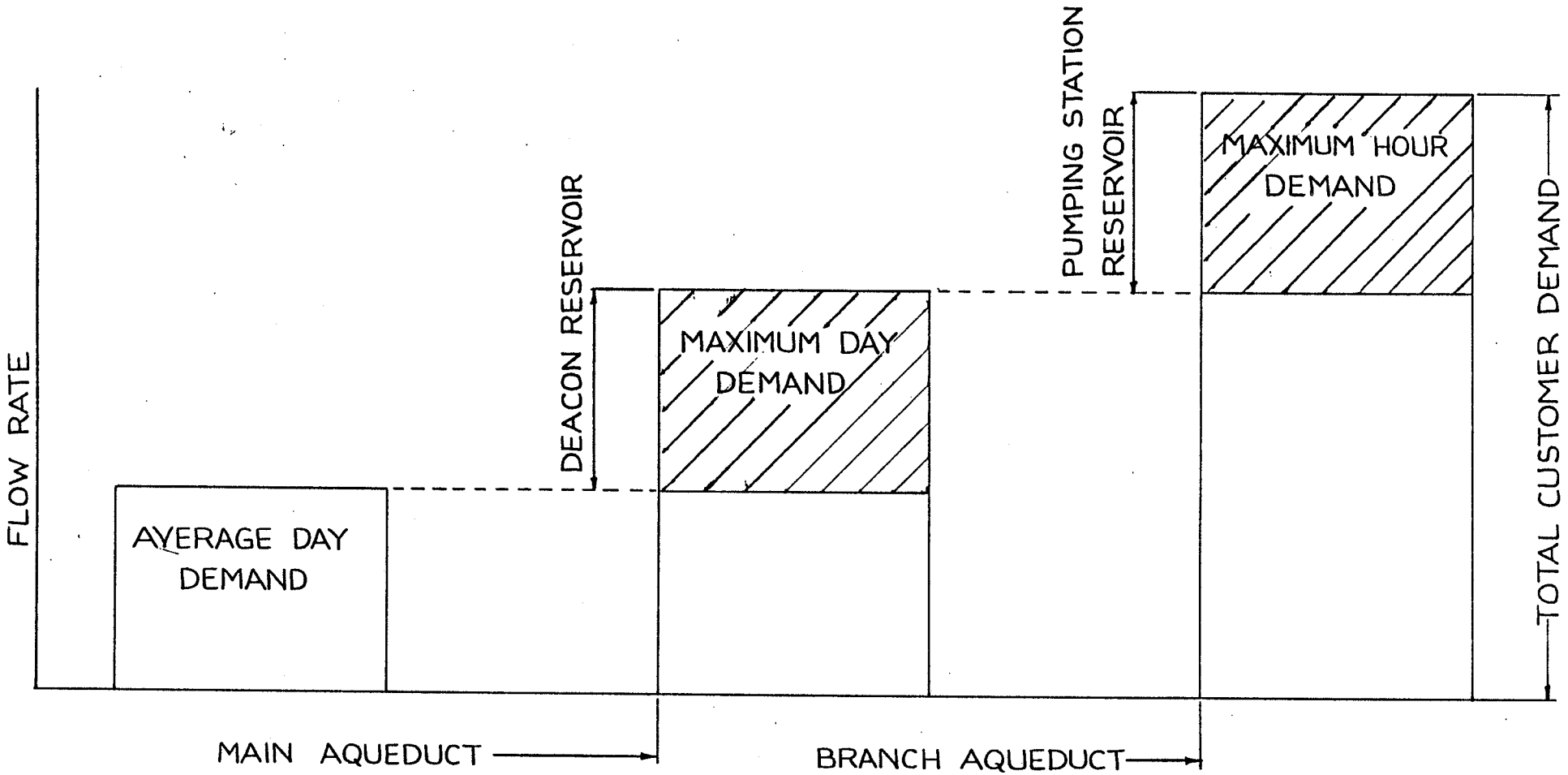

FIGURE 3

basis and the "cash" or budget basis. The utility basis requires the determination of a rate base, or the value of the property upon which the utility is entitled to earn a return, for a current or future test year and the fixing of a fair rate of return on the rate base. This system is generally applied to privately owned utilities and it is usually not considered suitable for publicaly owned utilities.

The cash basis affords an alternative and more realistic approach to the revenue needs for most publicly owned systems. The cash basis does not require determination of rate base or rate of return but is premised on the cash or budget requirements of the system as determined by local conditions and policies. One of the reasons that this system is more applicable is that public utilities are usually financed largely by serial and sinking fund debentures the retirement of which must be provided for on an annual basis, while they are outstanding. In contrast investor owned utilities often retire debt by additional borrowing or refinancing.

Secondly, publically owned utilities are not operated for profit but attempt only to cover total operational costs and to provide for investment in plant facilities. Finally, the cash basis is the same budget basis as other city departments and hence is more readily understood by administrators and politicians. The cash basis however does not rule out the establishing of sinking

funds for the purpose of funding major capital improvements. If the decision is made to cash finance all or part of these expenditures from rate revenues, all that this requires is to include that amount along with the other basic items in establishing total annual revenue requirements.

It can be seen from the preceding section that over the next twenty years using traditional demand projections approximately 239 million dollars will be required for capital projects. The long lead times required for planning and construction will mean that most of the funds will be needed within the next 10-15 years. It is obvious that this revenue requirement will have tremendous implications with respect to water rates in the City of Winnipeg, especially if the system of recovering historical costs on an annual basis is continued. The result of this method is that enormous rate increases will occur during the years while the aqueduct and treatment facilities are under construction. In addition associated with these new facilities will be increased operating and maintenance costs which will also have significant effects on the rate. It has been shown previously that a 10-12% annual increase may be necessary in order to maintain the existing system.

From the analysis conducted to this point it would appear that there are at least two mechanisms available for easing the financial burden on the consumer. The first would be the demand modification program discussed earlier which would have the effect of reducing historical

water consumption patterns and resulting in a delaying or deferring of the need for capital spending. This has the obvious effect of reducing the requirements for borrowing and consequently the requirement for rate increases to service debt.

An additional possibility is, with the fifteen to twenty years lead time available, to establish a system of sinking funds such that when large capital investments are required all or at least part of the funding could be from the sinking fund. This would have the effect of reducing the amount of borrowing necessary and therefore reducing debt load by paying in advance for future facilities. In the short term and the long-term the demand modification program would reduce the financial impact of the cost of water to participating consumers. Alternative strategies for collecting water revenue will be discussed more fully in the next section.

ALTERNATIVE STRATEGIES

ALTERNATIVE STRATEGIES

In assessing alternative revenue strategies and selecting the most appropriate alternative it will be necessary to choose an alternative that not only interfaces with the policy decisions made previously but also that is acceptable from an equity standpoint for all classes of consumer. It has been previously shown that price can be legitimately used to make access and use of the system selective. In addition since individual consumption can be readily measured, the pricing structure can be used to make each individual accountable for and cognizant of his water use patterns.

a) Demand Elasticity

It has been shown in a previous section that there is some evidence that prices charged influence the quantities of water demanded. Consumers generally reduce their use of water when price rises. Summer time uses of water for lawn irrigation and similar outdoor uses are particularly sensitive to the price charged.[98] Water therefore may be considered a normal good in the sense that the income effect is positive, that is the quantity of water demanded decreases with an increase in the unit price of water. The price elasticity, which is the change in demand per unit change in the price of water, however, has been shown to be relatively small or inelastic.[99]

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98. Hanke, S.H. Demand for Water Under Dynamic Conditions. Water Resources Research. Oct. 1970. pp. 540 - 546.

99. Howe C.W. & Linaweaver, F.D. op. cit. p. 13-32.

Water is a unique commodity in that there exists no other commodity that can be used as a direct replacement. Thus there exists a minimum amount of water required to sustain an individual's standard of living; this amount is called the minimum water use. There also exists a maximum amount of water that could be used assuming that one would not intentionally waste water; this maximum amount of water used is called the flat rate water use. A price exists at which a water user will seek a less expensive means of satisfying the demand for water by for example, purchasing water-using equipment that requires less water. This price is termed the critical price of water. Kim et al. have produced water demand curves (Figure 4) which show the inter-relationship between the price and voluntary and mandatory water conservation programs.[100]

A demand modification program may cause changes in demand at either the critical price, the flat rate price, or the price at the minimum quantity demand. For example, technological changes in water-using facilities would cause a reduction in both the flat rate quantity and the minimum quantity demand. There would be no change in the critical price because the critical price is based on the number of gallons of water used per unit used. Thus, the modified demand curve will have the same shape as the original demand curve, but it will be shifted to the left due to the reduction of water demand.

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100. Kim, J.R. et al. op. cit. p. 94.

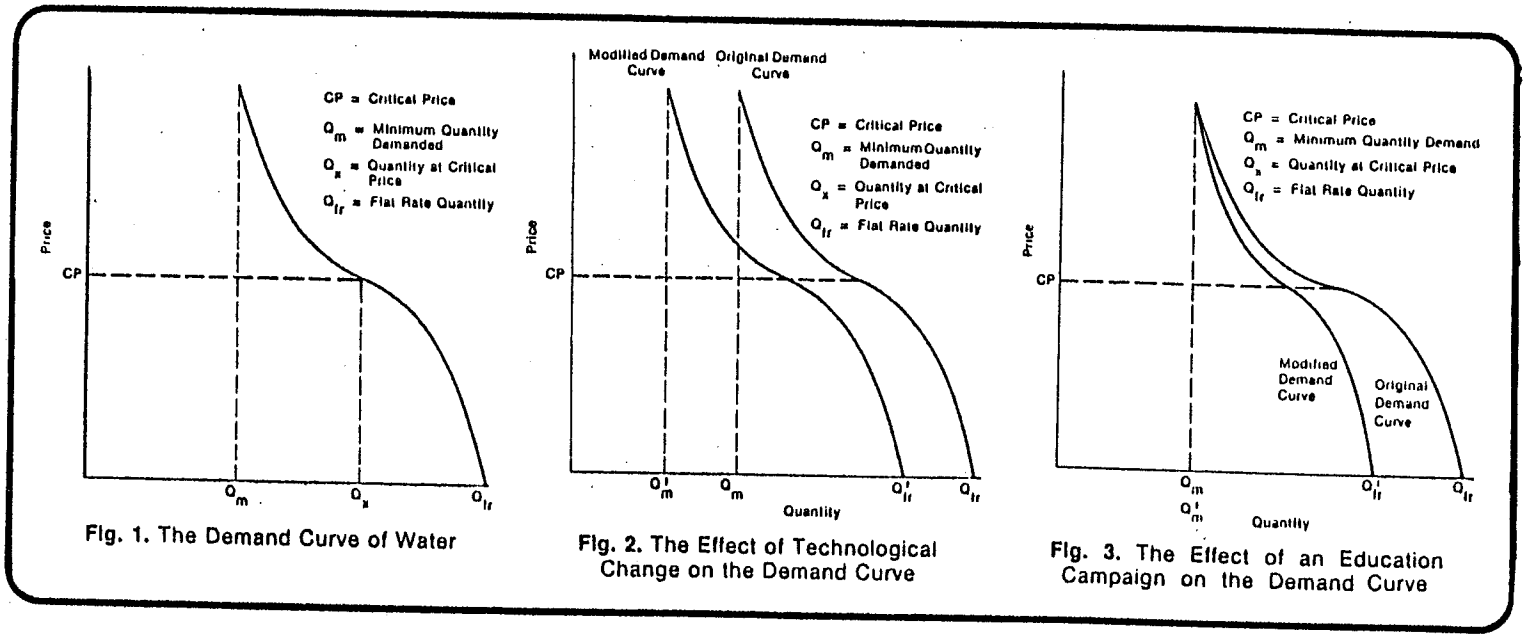

Fig. 1. The Demand Curve of Water

Fig. 2. The Effect of Technological Change on the Demand Curve

Fig. 3. The Effect of an Education Campaign on the Demand Curve

SOURCE: Kim,J.R. and R.H. McCuen. op cit. p. 94.

FIGURE 4

An educational campaign that is designed to change water using habits will have a quite different effect on the demand curve. Specifically, the minimum quantity demanded will not change because the minimum amount of water that is required to sustain a standard of living cannot be modified by changes in water using habits. The flat rate quantity, however, will decrease by an amount that depends on the specific changes in water using habits. Because the critical price does not change, the demand curve will shift to the left but with changes in the elasticity of demand at any given quantity the change in elasticity will be moderate near the critical price, and the greatest change will occur near the flat rate quantity. The change in elasticity will be very small near the minimum quantity demand.

From this analysis it can be readily seen that reduction in water demand is possible through physical and educational changes and from data previously described it follows that since price affects quantity or demand, similar demand modifications can be achieved through rate manipulation techniques.

It has been shown that while consumers appear to be relatively unresponsive to price differences, there does appear to be some elasticity. Clark, et al. [101] report that a 10% rise in price would be expected to result in

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101. Clark, R.M. and Goddard, H.C. Cost and Quality of Water Supply. American Water Works Association Journal. January 1977, Vol. 69. pp. 13-15.

a 6% reduction in volume, while Camp[102] argues that 3% volume reduction would occur from a 10% price increase. He does, however, say that at higher prices the elasticity index could be greater. The level of prices that would be required to elicit a significantly greater response from the water consumer, however, is unknown.

b) Traditional Alternatives

Traditionally, the utility has looked at its rate as a vehicle for raising the revenues required to cover the costs of operation. At this point it is well to draw a distinction between rate level and rate structure. Rate level is simply the level of rates that will yield a given revenue requirement. Rate structure on the other hand is the difference between rate schedules and between blocks within schedules or the form of rates. It is only recently that water utilities have begun to examine demand modification through the use of rates.

A major area of expressed concern has been and continues to be the declining block rate structure that has been used traditionally by utilities including the City of Winnipeg. Gysi and Loucks[103] have shown that for water utilities in general increasing block rate schedules are more beneficial than steady or decreasing block rate schedules. The reason

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102. Op Cite pp. 453-458.

103. Gysi, M. and Loucks, D.P. Some Long Run Effects on Water Pricing Policy. Water Resources Research. Dec. 1971.

for this is that with steady or decreasing block rate schedules, large volume users and peak volume users obtain water at lower costs. With an inverted rate structure the reverse would be true. However, the individual citizen would be penalized with increasing block rate charges during the summer months when lawns are watered. Bonem has pointed out,

> "To the extent that brown lawns are politically or aesthetically undesirable, so the peak load price exceeds the socially acceptable price. This implies that where the community economic preference prevails an average cost pricing may be closer to the social optimum and the marginal cost pricing."[104]

With regard to the question of the inter-relationship between water consumption and rates it can be concluded that higher rates will have some effect on consumer consumption. If the increases in rates are relatively small this effect will probably be minimal. If, however, substantial increases in rates are to be made the effect may be more severe. If, as a matter of policy, it was determined that rates should be set at some artificially high level, high enough to reduce consumption, some measure of success probably could be achieved. At some price people would stop watering their lawn and might even go back to the weekly Saturday night bath. A very basic question, though, is whether rates should be set at an artificially high level.

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104. Bonem, G.W. On the Marginal Cost of Pricing Municipal Water. Water Resources Research. Feb. 1968. p. 191.

The term "artificially high" is used in the context that the present policy sets rates on the traditional basis of reflecting costs in any one year. The suggested policies put forward would require that revenue in excess of expenditures be collected to be used for system growth. It is argued, however, that these rate levels are not artifically high but are set at levels established through rational and equitable accounting techniques which will in the long run save all of the users of the utility from large rate increases due to poorly planned capital works funding. A side benefit of this new practice will be reduced demand.

In conforming to these proposed policies the basic principles of rate making would not be violated. Call describes these basis principles as follows:

"1. Rates should promote an efficient allocation of resources, thus discouraging wasteful use.

2. Rates should not be discriminatory.

3. Rates should lead to stable revenues.

4. Rates should reflect a sense of historical continuity."[105]

The new policies put forward require a fundamental change in philosophy that will require a new approach to the problem of pricing structures. In discussing the use of water prices for the purpose of demand management Hanke and Davis eloquently describe the issues to be faced. They summarize this new approach to water supply planning the following way:

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105. Call, H.J. The Inter-relationship Between Water Consumption and Rates. American Water Works Association Journal. Jan.77. Vol. 69. p. 55.

> "The technical solutions to conventional supply management are oblivious to the twin phenomena of rising supply cost and diminishing marginal values of water. This clearly warrants an adjustment in approach. Urban water managers must learn to perceive a broader range of choice, one including nontechncial solutions to water supply problems. These nontechnical solutions may be found in various social and economic adaptations to the facts of cost and value. Demand management is an alternative to conventional supply management, and should be given equal consideration in urban water planning.
>
> Demand management through the use of responsive prices is at variance with standard water planning practices and represents a rather radical departure from convention. If a price is charged for water, it is to finance all or part of an existing system. Prices are almost never used to control use or accumulate funds for future expansion. Properly conceived, responsive prices avoid wasting resources on needlessly large water supply systems and at the same time avoid needless under use of the supplies that are available."[106]

The American Waterworks Association on the other hand takes a very traditional approach with regard to rate structures. In their water rates manual, published in 1972, they suggest two methods of allocating cost of service to cost function or to rate structures. They argue that,

> "Ordinarily, the development of water rates involves the following major areas of study: (1) determination of the level of annual revenues, or revenue requirements, necessary to provide for operation, maintenance, and development of the water system; (2) distribution

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106. Hanke, S.H. and Davis, R.K. op. cit. pp. 555 - 556.

> of the annual revenue requirements, or costs of service, to basic cost functions, which in turn allows further distribution of these costs to customer groups or classes in accordance with respective class requirements for service; and (3) design of water rates that will, as nearly as practical, recover from each customer class the respective costs of providing service."[107]

Two rate structure techniques are developed based on the above criteria. They are the commodity demand method and the base extra capacity method which were described in detail earlier. In both cases the costs are allocated or assigned in two steps, first to service cost functions then to customers. The service cost functions vary depending upon the basis of the allocation used, therefore resulting in the two methods.

The pricing structures that normally arise from these allocation methods are decreasing block rate structures, and implicit in these allocation methods are certain assumptions. These are; firstly that the cost and value of service are the same for all customer class users; secondly, it is assumed that an inexhaustible supply of public funds is available for expansion of facilities; thirdly, it is assumed that demand is inelastic in that customers cannot control their rate and therefore influence their water bill; and fourthly, industrial recycle is not encouraged but rather the incremental value is low for moving from one

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107. American Waterworks Association. Water Rates Manual. AWWA Denver, Colorado. 1972. p. vi.

step to the next. In neither of the above traditional approaches is the incremental value balanced against the incremental cost.

c) Nontraditional Alternatives

One of the problems with the above systems of allocating cost to consumers is that the financial criteria used are concerned with price levels rather than price structures. By designing pricing policies that are not based upon economic criteria water enterprises cannot effectively determine how fast expansion should be, how output should be divided among competing users and how existing capacities can be fully utilized. With the conventional techniques historical costs are allocated using accounting techniques among user groups.

There would appear to be three drawbacks to the conventional system of water pricing. Firstly, under the conventional system physical and financial planning are done in isolation of one another, that is to say that demands for water at current prices are viewed to be those requirements that will be necessary to satisfy in the future, notwithstanding the price change. The process as it presently works is to forecast water use requirements, design new capacity, analyze the cost and set the rates based on the cost of the completed system. Nowhere in this process is elasticity of demand or the effect of price on demand considered.

The second problem with the conventional pricing is one which has been previously discussed and that is the fact that future resource allocation is based on historical cost and not marginal or incremental cost. The addition of a new customer or an increase in the consumption of an existing customer will impose incremental costs on the system. Whereas reductions in consumption will save costs. It is these alterations in incremental not historical costs that should be reflected in prices.

> "The backward looking estimate (toward sunk cost) used by accountants creates the illusion that resources than can be used or saved are as cheap or expensive as in the past. This will lead either to over-investment or over-use or under-investment or under-use, depending on whether incremental costs are higher or lower than the average."[108]

While it may be difficult, if not impossible, to implement a system of marginal cost pricing, it may well be possible to implement a system which more closely reflects incremental costs than the present decreasing block rate structure. The new structure must take account of not only historical cost but also future cost and in this way the consumer will be in a better position to make decisions regarding water use.

Thirdy, and importantly, the accounting approach does not address the important question of the incentive effect of the rate structure. The decision to use more or less

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108. (1975) Op. cit. p. 216

water is determined by the additional costs involved. This extra cost, Gibb explains[109], is the price charged for the last water which will be used, and therefore, the average price or the price of the first water used is not a factor which enters into the decision making process. Therefore, with decreasing block rate structures there is less incentive toward the end blocks since the price of water is becoming progressively cheaper. Hartman states,

> "It is wise to consider possible customer conservation of water use in resistance to increased charges in the design of the rates. In general, reduction in customer water usage following a rate increase is usually temporary in nature, particularly with more modest increases. However, when rates reach such a level that once-through use is not economical, business and industry will initiate more stringent reuse practices with resulting permanent reductions in water requirements. Similarly, when water is no longer considered a cheap item, residential customers will take action to conserve on their usage. The extent of potential customer water conservation with increased charges warrants carefully consideration in rate design if the utility is to actually realize the required additional revenues."[110]

It is extremely important to note that some increases in consumption are much more costly than others. Supply costs vary depending when, where, and how the water is used, and it would seem rational that these considerations should be reflected in rate structures. The cost of supplying customers varies from one time period within the production cycle to another and from one part of the system to another.

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109. Gibb, K.C. op. cit. p. 13.

110. Hartman, P.J. Development and Design of Water Rate Schedule. AWWA Seminar Proceedings May 13, 1973. p. iv-19.

It has been shown that water supply is characterized by a large variability over time. Each individual user may have demand requirements that do not conform to the demand requirements of his neighbor and in a large system these differences can work to an advantage in that system diversity results in a dampening or attenuation of peak effects.

However, we have seen that the maximum day, the average day and the annual average consumption levels differ greatly from one another. The maximum day cycle is influenced mostly in the City of Winnipeg by residential use for the purpose of lawn watering. This is shown by the peak flow values which occur in the evening during the summer period. Water use has been shown to rise dramatically in the summer months during the period when lawn irrigation is practiced. This high daily use cycle is accommodated in systems design by the fire flow requirements which are unrelated to demand fluctuations. For this reason maximum day consumption values can be ignored as far as rate structures are concerned.

The seasonal demand however, has important cost implications. The system must be designed to accommodate maximum day and maximum month consumption which results in a system that is oversized for normal winter use. The pricing of summer and winter use however is not adjusted under the present rate structure.

Commercial and industrial water users on the other hand normally do not exhibit dramatic monthly or annual changes in use patterns. Their use patterns are important

to supply considerations since they consume large volumes of water which must be accounted for in system design. An ideal rate structure therefore will take into consideration not only peak demands but also large volume demands.

Like uniform prices over time, uniform prices over space lead to a loss in efficiency when marginal costs vary over space. It has been argued earlier that uniform prices under these conditions would subsidize population diffusion and result in urban sprawl. However, it was also pointed out that the City of Winnipeg has defined its boundaries and that most growth is internal. For these reasons the concept of spacial cost variations or zonal prices has been rejected for this area.

RECOMMENDED RATE STRUCTURE

RECOMMENDED RATE STRUCTURE

Unlike conventional rate studies that result in rate level recommendations required to produce given revenue requirements, this study will result in a recommended structure that is conceptual in nature. If the concept of a new structure is accepted politically then it will be necessary to undertake a conventional rate study in order to set the new rate structure at a level that would generate the appropriate amount of revenue. That task is largely an accounting procedure and is therefore considered to be beyond the scope of this study.

In light of the arguments put forward in this study it is recommended that a new water pricing structure in the City of Winnipeg be developed which would:

1. Charge a uniform rate for all water consumed, that is, the discontinuation of a block rate structure in favor of a single rate structure. The arguments for such a structure are firstly that the last volume of water used by a consumer should be as important as the first volume used and therefore the cost accountability should be the same for each unit supplied. It is only when equivalent unit costs are in effect that the consumer is able to make a rational decision with respect to use. Secondly, a uniform rate structure has an incentive effect to large volume users in that the last water used is equal in price to the first water used and therefore water conservation and

water recycle or reuse decisions can be made rationally. Thirdly, the bulk of the residential water consumed is used for human health and sanitary needs and should not be priced higher than commercial/industrial water which is used to generate profit. The following table show the effect of this new rate structure on existing water connections assuming no peak use and maximum consumption.

TABLE

Effect of Proposed Rate Structure

Volume Consumed (100 cu ft/quarter)	% change in Charge	No. Connections Affected
96	-22.7	144,820
960	+15.8	3,922
1,000	+27.9	684.*
10,000	+47.3	
100,000	+52.0	

* Include all uses over 960

2. The proposed rate structure would impose a surcharge rate on all water used in excess of a yet to be determined ratio of each customer's winter quarter use. One value which has been suggested in the literature is that all water used in excess of 1.3 x the consumer's winter consumption be billed at a seasonally adjusted rate. This allows for some increase in consumption during the summer period and acts as a deterrent to large outdoor uses of water. In addition, since it is mainly suburban users who will be faced with a surcharge the question of spacial consideration is in a fashion taken into

account. This concept also demands that the most expensive water, that is the peak use water, is priced at the highest value and for this reason is equitable.

3. It is recommended that a true reserve fund be established, the purpose of which would be to fund future system expansion. The reserve fund would be a sinking fund with interest returned to the fund and not used for other purposes. The fund could be used for planned expansion as well as emergency repairs such as the recent Hurst Reservoir collapse. The magnitude of the reserve fund would be determined by accounting techniques taking into account historical costs as well as future cost over a 10 to 20 year period. Contributions to the fund would be divided between the uniform rate portion of the new rate structure, which would take care of normal system expansion and seasonal rate surcharge portion of the rate which would be accountable for the peak capacity aspects of expansion. The development of this fund has several advantages, firstly, the resulting rate would more closely approach the marginal price of supply in that future incremental costs are being included in todays prices. Gibb has stated "only when faced with a uniform rate structure would marginal and average price be equivalent."[111] The second advantage of a reserve

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111. Gibb, K.C. op. cit. p. 13.

fund is that large expenditures such as for a water treatment plant or new supply would not result in an enormous rate increase such as will happen under conventional rate structure techniques which use historical costs. A third advantage is that the reserve fund will increase the credibility of the City at large in terms of its financial planning when viewed through the eyes of domestic and foreign money lenders. It would also allow part of the City's borrowing authority to be used for City at large purposes since water users would now be accountable for capital funding for water related projects. And finally rate levels could be adjusted through accounting procedures to increase or reduce the size of the reserve fund based on the responses that the new pricing system conservation policies would elicit on the total demand for water in the City of Winnipeg. This procedure would be dynamic and not historical as is the present case.

4. It is recommended that a system of annual meter charges be instituted which would return to the utility a fee which is related to the size of the meter which in turn is related to the potential demand on the system that the consumer could impose. This would create incentives for industry to down size water services in order that their annual meter fee would

be reduced. This proposed new change in no way relates to the present meter service charge but would be a charge based on potential capacity through a meter and the cost related to total system cost for supplying given volumes of water.

5. Finally it is recommended that plumbing code revisions and informational programs be instituted in order to effect water demand reductions through both physical and educational means.

CONCLUSION

CONCLUSION

It is concluded that alternatives to conventional decreasing block rate structures do exist and that they may be more appropriate during times of high capital costs, high inflation, and increased consumer awareness of facts of cost and value. It is also concluded that consumers want to be assured that their individual cost truly reflects an equitable distribution of the costs incurred in providing the water service. Under the proposed system those who bear the responsibility for higher costs have these costs imposed on them. In general it is anticipated that costs to innercity residents in high density apartments will tend to rise. Cost to commercial and industrial establishments will rise but so too will the incentive for water conservation and reuse which has been sadly lacking for many years. The cost to the average residential consumers will rise or fall according to their discretionary water use.

The study generally concludes that it is rational, equitable, and legitimate to use the pricing mechanism as a demand modification tool provided that the costs apportioned to each user are not inequitable. The pricing structure and financial planning must become an integral part of water supply planning and must be done in conjunction with supply planning. In the past it has been the situation that water price has been determined by what exists. This concept allows price to be a party to

what may exist in the future. Politicians must begin to think and act in terms longer than the term of office. Long term financial planning must begin today if serious supply problems and onerous economic burdens are to be avoided in the future.

It is hoped that this new concept and philosophy regarding water price structure and debt financing will allow a more efficient utilization of the resources that exist and that will exist and a more equitable distribution and accountability for the costs of providing water to the citizens of Winnipeg.

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