ECONOMIC CONSIDERATIONS OF POTENTIAL SOLUTIONS TO GROUND WATER OVERDRAFT IN MISSISSIPPI

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The process of selecting a water supply source is basically an economic decision based on the criteria of quantity, quality, and cost. As a standard rule the supply source must be capable of providing the desired quantity of water of an acceptable quality at a cost that is no higher than the next lowest cost option available which can satisfy the minimum acceptance criteria with respect to quantity and quality. The elements of quantity and quality can be viewed as hurdle factors and if more than one source can provide these features which meet a user's standards, the ultimate decision boils down to a choice of the alternative with the lowest cost.

Household consumers, industrial firms, as well as agricultural operations show striking similarities in the economics of this selection process. The industrial firm obviously engages in a more sophisticated approach as it prepares detailed projections of demand which are, in turn, used as screening criteria for determining options available. Eventually the procedure involves selecting the lowest cost of available alternatives that often includes using a combination of different sources for different types of uses. On the other hand, households are less sophisticated primarily because there are fewer facts and alternatives available. Sometimes there is only one option. In that case it is the lowest cost alternative. If a homeowner has a choice between providing his own private well and connecting to a public supply system, the choice will be reconciled by the minimum acceptance criteria of adequate quantity, acceptable quality, and lowest cost.

Minimum acceptance standards for quantity and quality vary greatly among users. Demand for water will obviously be greater for industrial and agriculture users, but it will also vary greatly among users in each of these groups depending to a large extent on size of firm and type of industry and on size of farm and type of crops. Likewise, for the household users, the minimum criteria vary. This is especially true in connection with quality. Every small public supply system in the state has probably encountered situations where some customers chose the public system because their private wells did not provide acceptable quality while other residents chose to use private wells because the public supply did not measure up to their standards of quality.

Ground water in the state of Mississippi has measured up very well in terms of quantity, quality, and cost criteria for a large portion of all types of users. This is why approximately 43% of the over 3.5 billion gallons per day of total water intake in the state is withdrawn from this source. Most of the ground water intake is accounted for by the categories of domestic, industrial, and agriculture related uses.

Management of ground water in an overdraft area mandates that tools employed to control use focus on the causes of the problems. The portion of a county's ground water intake accounted for by each of these three major categories of use provides the basic indicator of the focus for water management.

It is preferable to develop management tools with as much universal applicability as possible. This is especially true in view of increased concentration of management authority at the state level that occurred when House Bill 762 of the 1985 Legislature revised portions of the code dealing with water management. The logical process is to identify those areas of the state where ground water overdraft is a problem, and determine the minimum number of homogeneous overdraft classification groups based on mutual factors responsible for the overdraft.

OVERDRAFT AREAS GROUPED BY CAUSES

Data shown in Table 1 represent a list of the twenty counties with land area included in, or bordering on, the Mississippi River Alluvial Plain. There is consensus among water management authorities in the state that this Delta region represents one of the most significant overdraft problem areas in the state. Counties are listed in a rank order according to total ground water intake with the largest first. The five counties with estimates of over 100 MGD of ground water intake volume can be considered the nucleus of the overdraft region. To some extent there is a systematic and progressive decline in ground water by each successive county as one moves outward from this central nucleus.

Table 1 data clearly disclose the predominate type of use responsible for the overdraft problems in this region. When overdraft is a problem it is almost always due to agriculture-aquaculture and related uses. With the exception of Yazoo County, domestic and industrial intake are comparatively significant in those counties with larger volume uses. Generally, domestic and/or industrial use account for significant percentages of use only in those counties where total ground water intake is comparatively low. This is true in some of the fringe counties where Delta land comprises only a fairly small portion of the county land area. Among the five largest volume user counties, agriculture-aquaculture intake accounts for 82.2%-99.1% of all ground water uses. In Bolivar County, for example, this use is almost 45 times larger than the second largest category of domestic use.

These data have very obvious management and planning implications. If the objective is to reduce ground water depletion, tools will have to be tailored to bring about reductions in agriculture use. At the present time very little reduction benefits will be produced by tools designed to reduce domestic and industrial use. The readily apparent homogeneity among counties of this group does suggest that region-wide management is especially suited to this area because causation narrows down to one factor.

Unfortunately management tools designed to control ground water use in the Delta cannot be expected to produce the same results if applied to overdraft problems in three other overdraft regions of the state whose use date is presented in Table 2 simply because agriculture use is not the causal factor.

TABLE 1
GROUND WATER USE IN 20 MISSISSIPPI RIVER ALLUVIAL PLAIN COUNTIES, BY TYPE OF USE, 1980

County	Total Ground Water Intake	Domestic Intake	Industrial Intake	Agriculture Related Intake
(Amount in Million Gallons per day)				
Bolivar	266.815*	5.703	3.942	256.450
Sunflower	183.471	3.727	.675	179.069
Washington	168.075	8.781	9.225	150.069
Humphreys	138.716	1.078	.091	137.547
Leflore	104.986*	5.762	1.292	86.310
Coahoma	57.786*	3.559	3.022	40.638
Tunica	53.760	.835	.003	52.922
Yazoo	42.781*	3.764	17.513	20.710
Tallahatchie	38.190	1.173	.007	37.010
Quitman	35.879*	1.008	.235	33.742
Sharkey	32.775*	.625	.135	31.524
Holmes	17.264	2.169	.521	14.574
DeSoto	12.526	3.756	1.784	6.986
Grenada	11.426	2.357	3.846	5.223
Warren	11.387	7.077	3.214	1.096
Panola	9.316	2.448	1.026	5.842
Issaquena	9.122	.124	.001	8.997
Tate	3.240	1.626	.316	1.298
Claiborne	1.792	.947	.743	.102
Carroll	1.049	.672	-	.377
(% of County Total)				
Bolivar	100	2.1	1.5	96.1
Sunflower	100	2.0	0.4	97.6
Washington	100	5.2	5.5	89.3
Humphreys	100	0.8	0.1	99.1
Leflore	100*	5.5	1.2	82.2
Coahoma	100*	6.2	5.2	70.3
Tunica	100	1.6	-	98.4
Yazoo	100*	8.8	40.9	48.4
Tallahatchie	100	3.1	-	96.9
Quitman	100*	2.8	0.7	94.0
Sharkey	100*	1.9	0.4	96.2
Holmes	100	12.6	3.0	84.4
DeSoto	100	30.0	14.2	55.8
Grenada	100	20.6	33.7	45.7
Warren	100	62.1	28.2	9.6
Panola	100	26.3	11.0	62.7
Issaquena	100	1.4	-	98.6
Tate	100	50.2	9.8	40.1
Claiborne	100	52.8	41.5	5.7
Carroll	100	64.1	-	35.9

SOURCE: *Water Use in Mississippi, 1980,* U.S. Geological Survey, Jackson, Mississippi, 1983.

*Total includes uses other than the three categories shown.

TABLE 2
GROUND WATER USE IN THREE AREAS OF LOCALIZED OVERDRAFT IN MISSISSIPPI, BY TYPE OF USE, 1980

County/Area	Total Ground Water Intake	Domestic Intake	Industrial Intake	Agriculture Related Intake
(Amounts in Million Gallons per Day)				
Total-Tupelo Area Counties	13.569	10.163	2.695	.711
Lee[a]	9.444	6.636	2.345	.463
Itawamba	1.889	1.615	.205	.069
Pontotoc	2.236	1.912	.145	.179
Total-Jackson Area Counties	27.261	18.656	4.254	.895
Hinds[a]	14.160[b]	8.066	2.286	.352
Rankin	8.521	7.095	1.251	.175
Madison	4.580	3.495	.717	.368
Total-Coastal Area Counties	50.929	30.176	16.694	2.246
Jackson[a]	21.910[b]	11.424	10.227	.097
Harrison[a]	24.240[b]	16.577	5.922	.090
Hancock	4.779	2.175	.545	2.059
(% of County Total)				
Total-Tupelo Area Counties	100	74.9	19.9	5.2
Lee[a]	100	70.3	24.8	4.9
Itawamba	100	85.5	10.9	3.7
Pontotoc	100	85.5	6.5	8.0
Total-Jackson Area Counties	100	68.4	15.6	3.3
Hinds[a]	100[b]	57.0	16.1	2.5
Rankin	100	83.3	14.7	2.1
Madison	100	76.3	15.7	8.0
Total-Coastal Area Counties	100	59.3	32.8	4.4
Jackson[a]	100[b]	52.1	46.7	0.4
Harrison[a]	100[b]	68.4	24.4	0.4
Hancock	100	45.5	11.4	43.1

SOURCE: *Water Use in Mississippi, 1980,* U.S. Geological Survey, Jackson, Mississippi, 1983.

[a]Central nucleus counties in the overdraft areas.

[b]Total county use includes uses not shown.

Fortunately, there is some degree of homogeneity among causation factors in these three separate locations so that tools developed to deal with a problem in one area can also be applied in the other two. There are similarities in patterns and in causes. First, the central nucleus at the heart of the depletion problem in each area is the most urbanized area. Cones of depression are most apparent directly beneath these areas with overdraft decreasing in importance as one moves away from the central nucleus. The city of Tupelo represents the focal point of one nucleus, the city of Jackson represents another focal point, and the combined cities from Gulfport to Pascagoula on the coast represent the other focal point.

Water use data for some of the counties listed in Table 2 are more relevant to the overdraft problem analysis than others. Lee, Hinds, and the combination of Jackson and Harrison Counties provide data that reflect the major impact of water use responsible for the overdraft as these counties contain the larger portions of the land area affected by the overdraft situations.

The second similarity between these urban-nucleus overdraft areas is in causation factors. Industrial use is a significant factor, but domestic use is even more important. These two categories must be the focus of attention in these areas. The two are interrelated. Industry provides job; jobs attract people; new industry locates near existing firms; and more jobs attract more people. To an extent, the amount of water intake by these two groups is a measure of the amount of economic growth and development that has taken place. If this process is to continue it has to be possible for new players in the game to gain access to a water supply source or the process will come to a halt.

Evidence shown in Tables 1 and 2 suggest that policy makers will have to be concerned with at least two types of overdraft situations in the state. It must be remembered that most of the parties responsible, whether agriculture users, industrial users, or domestic users whose interest is represented by the public supply system in the urban areas, perceive the *status quo* as preferable because this represents the culmination of the selection process that included quantity, quality, and cost variables. Variations in use behavior will occur only after some type of alteration occurs in the factors that made this option the most attractive initially. For example, quantity can become insufficient as the result of ground water mining or through imposed use restrictions. Typically, quality deterioration of ground water has not been a factor in Mississippi. Insufficient quantity is the signal that initiates the search process for the new source which is the next least cost alternative. Public supply systems, likewise, follow the same process.

It is not feasible at this point to begin a discussion of the economic impacts of modification of user behavior in each of the categories of agriculture, domestic, and industrial use. Our predicament in dealing with some of the economic side effects of the solutions to overdraft problems is somewhat like trying to rob a bee hive. We desire the honey, which is represented by solutions to the problem, but there sure are a lot of ways to get stung. Therefore we are going to very carefully release only as many of the bees as we can examine in the time allotted. Since the public supply system is caught in the middle of the problems at the urban nucleus overdraft areas, attention now concentrates on some of the implications of solutions on these players.

ALTERNATIVE SOLUTION OPTIONS OF THE PUBLIC WATER SUPPLIERS

Options available to solve ground water overdraft in an urban area can be consolidated into two categories (1) those that reduce water intake and (2) those that employ an alternate supplemental supply source. Those tools designed to reduce consumption are generally referred to as conservation devices and can be divided into the categories of education programs, legislated use limitations, and pricing practices. Many of the same types of user reduction incentive devices can be applied to domestic users as well as industrial users. This is especially true of pricing policies.

Conservation Incentive Considerations

Domestic Users

Lord, Chase, and Winterfield conducted a study a few years back to determine how the more common conservation tools faired among domestic users in terms of public acceptability, effectiveness, and financial feasibility. Some of the findings of that survey are shown in Table 3. "Public Acceptability" was determined to be a very important criteria among domestic users because they represent the voting public. The fear of retaliation from this group has often been a critical factor preventing public supply management from initiating certain conservation practices. In our hive of bees, public acceptability may be thought of as the "Queen Bee." If this factor can be neutralized the task of finding a solution becomes much simpler. Overall, the group of economic incentive policies appear to rank better than regulatory policies in terms of the combined "Public Acceptability Rating" and "Effectiveness Rating". Information policies work only if they provide specific "how-to" information.

Industrial Users

Dun and Bradstreet conducted a study for the California Department of Water Resources in 1979 to determine the economic impacts on industry of increasing the price of water. Table 4 contains a summary of the survey results which also includes separate data on impacts of increases in sewage disposal charges and stricter discharge standards. These data clearly reveal increases in price of water to industry have impacts extending far beyond simply a reduction in intake volume. Only the first three responses represent favorable actions consistent with conservation objectives. The next five represent negative economic side effects. Evidence presented does indicate price increases generally produced beneficial conservation impacts of a greater magnitude among industrial firms than the magnitude of undesirable economic side effects. In a sense "go out of business" or "move out of state" are consistent with water conservation objective, but these can be viewed as desirable only if a location has too much industry and excess jobs. The point emphasized by this data is that potential side effects should be investigated before the fact and not after rate increases have occurred. One clue in determining the possible side effects is to identify those industries in the service area which may already be marginal operations and cannot tolerate additional expenses.

There may be some "Killer Bees" uncovered when price of water supplied to marginal industrial firms is increased. If the increase forces a firm out of business, a portion of the utility's revenue base is lost along with that of domestic users who lose jobs.

TABLE 3

SUMMARY OF RELATIVE MERITS OF WATER CONSERVATION OPTIONS

Type of Policy	Public Acceptability Rating	Effectiveness Rating	Financial Feasibility Rating
Information Policies			
Information	High	Moderate	Low Cost
Persuasion	High	Low	Low Cost
Regulatory Policies			
Water Rationing:			
Uniform standard	Low	High	Low Cost
Prior standard	Low	*	Low Cost
Watering restriction (time of day, duration, frequency)	High	Low	Moderate Cost
Landscaping requirements	High	Moderate	Low Cost
Water waste prohibitions	High	Low	Low Cost
Incentive Policies			
Conservation water pricing (increasing block rates)	Moderate	High	Revenue Increasing
Conservation rewards (tax credits)	High	Moderate	High Cost
Conservation penalties (water surcharges)	Low	Moderate	Low Cost

SOURCE: Lord, Chase, and Winterfield, "Choosing the Optional Water Conservation Policy," *AWWA Journal*, Vol. 75, No. 7.

*Depends on level of standard.

Barriers to Supply Increases

The city of Tupelo, which is the nucleus of one of the overdraft areas provides an excellent illustration of the types of barriers encountered in attempting to solve the depletion problem by developing an alternate source of supply. The overdraft problem in this location has been extensively investigated over a period of several years as evidenced by a stack of reports from studies conducted through the Mississippi Water Resources Research Institute, a comprehensive economic feasibility study conducted by the Tennessee Valley Authority, and an economic-engineering study conducted by Cook-Coggin Engineers. All reached a consensus conclusion that the only solution to preventing further declines in the cone of depression beneath the city is to switch to an alternate surface water supply source for a major portion of the Tupelo public supply system demand.

This conclusion was reached after evaluating the potential of conservation incentives and the possibility of remote well drilling in the area. Due to current and projected population and industrial development, these options did not offer a permanent solution.

Both the TVA study and the Cook-Coggin study concurred that the most cost effective system capable of supplying the needs of the city into the next century would consist of a new system to gain access water from the Tombigbee River located 16 miles away. The engineering report contains detailed specifics on components and improvements needed to make such a system operational.

Total estimated cost of capital expenditures for the intake structure on the river, treatment plant and pumping equipment,

TABLE 4

CALIFORNIA INDUSTRIAL USER RESPONSES TO INCREASES IN WATER COST FACTORS

Action	Increase Increase Rates for Intake Water	Amount of Municipal Sewage Discharge Rates	Reduce Discharge Allowed
Start/Increase Recycling	27.8%	22.5%	22.6%
Install More Water Efficient Processes	22.3%	18.7%	20.2%
Accept Lower Quality Alternate Source Water	16.8%	5.5%	5.4%
Decrease in Production	14.4%	10.9%	14.2%
Decrease in Employment	11.7%	8.8%	12.6%
Go Out of Business	6.1%	4.8%	7.9%
Move Out of State	5.4%	4.3%	1.5%
Increase Price to Consumer*	6.6%	6.0%	3.0%
Absorb Increase*	4.5%	4.3%	1.5%
No Effect*	3.7%	4.6%	3.7%
Don't Know	30.1%	44.6%	47.0%

SOURCE: *A Study Concerning the Effect of Various Incentives to Induce Industry to Recycle Water* (Prepared by Research Services Department, Marketing Services Division. Dun & Bradstreet for Department of Water Resources, State of California, 1979)

TABLE 5
REQUIRED WATER RATE INCREASES IN TUPELO

	20% Local Financing	50% Local Financing	75% Local Financing	100% Local Financing
Increase Per 1000 Gallons	$0.66	$1.36	$1.94	$2.52
Monthly Increase to Minimum Users	1.98	4.08	5.82	7.56
Monthly Increase to Average Residential User (7,900 gal/mo. or 1,059 cf/mo.)	5.21	10.74	15.33	19.91
Monthly Increase to Average Industrial User (34,700 gal/mo. or 4,638 cf/mo.)	22.90	47.19	67.32	87.44

SOURCE: Cook-Coggin Engineers, *Engineering Report of Water Supply for Tupelo, Mississippi*, April 1984.

transmission line and pumping equipment, and general improvements required in the existing distribution system in the city came to an estimated $23,705,000 to make the system operational in 1984. Increases in operating and maintenance costs would total about $320,132 in each of the early years of the project with anticipated increases later on due to inflation and larger user volume. Revenue bonds, with a remote possibility of some form of Federal grant, appear to be the only financing sources.

Outside financing needed would total about $22 million dollars. If the city had to finance all of this with revenue bonds, average annual debt service would total about $3,856,019 added to increased operating and maintenance costs of $320,132 bringing the annual increase in revenue required from customers to$4,176,151. Table 5 copied from the study shows the impact these needs for additional revenue would have on monthly water bills of the average residential user and the average industrial user assuming the number of users in both groups do not change and the amount of water intake per user does not change.

Under the 100% local financing scenario, which is the more likely one in view of current cut-back trends of the Federal government, the important figures to note are the $19.91 increase per month on residential user bills and the $87.44 increase per month on industrial user bills. These figures are assessments to recover the allocation of what is primarily a fixed cost. Only a small portion of the $320,000 of operating & maintenance costs are variable. Most of these figures and all of the over $3.8 million of debt service are fixed costs. If consumption declines among residential users, rates will have to be raised again to a level that will generate the average assessment needed from customers.

Assessment Alternatives

Actually there are two ways the assessment could be prorated. One method consists of determining how much revenue must be generated from each category of user and dividing that figure by the number of users. The amount of the assessment is then added as a fixed cost charge to each monthly bill. Within this scheme it is possible to have different classes of residential users as well as different classes of industrial users. This scheme has advantages of emphasizing the fixed cost nature of the obligations and is less likely to fall short of projected revenues. Disadvantages include the problem of defining different classes of customers and determining the appropriate category for every user on the system.

The other option suggested by the figures in Table 5 is to simply increase the price per 1,000 gallons across-the-board to all users. This is the main advantage of this scheme. It does not entail having to define classifications of customers. On the other hand, the main disadvantage is the inability to accurately project the amount of revenue prior to having the increases in effect for a period of time. The $2.52 projected increase per 1,000 gal. shown in Table 5 is based on the assumption that the total consumption per month for all residential and industrial users is unaffected by the increase in price. This scenario describes a perfectly inelastic demand for water.

Demand elasticity expresses the relationship between a percentage change in price and a percentage change in quantity purchased. Evidence in the literature presents a rather conclusive case that water demand has some degree of elasticity even though it is usually considered to be relatively inelastic. This means that as price rises, consumption will decline but by a lesser percentage than the increase in price. If water demand does not have some degree of elasticity, none of the conservation techniques based on pricing would have any validity. Conservation, normally considered a benefit, becomes one of the "Bees" that can sting as it hampers the process of determining how much the rates must be increased of generate $19.91 from the average residential customer and $87.44 from the average industrial customer.

Numerous studies have been conducted over the years in attempts to generate elasticity coefficients for water demand. Two in particular are cited more frequently than any others. Howe & Linaweaver came up with a -.225 coefficient for domestic use, and Hauke and Davis provide a coefficient of -.10 for industrial use.

If this domestic use coefficient is appropriate for Tupelo, theoretically, the user rate increases needed could be computed once it is determined how much consumption will decline in response to the price increase. Presently a residential customer using 7,900 gal./mo. has a bill of $13.43. An additional increment of $19.91 represents a 148%

increase in price. Applying the -.225 coefficient, use would, theoretically, decline 33% for this customer. For other customers using a different volume the percentages would be different.

The public utility is anticipating $33.43 from this customer based on existing rates plus the $19.91 increment. However, the actual amount of the bill for both the initial charges and the increment to cover new costs are strictly a function of use volume. The customer's bill would be about $23 because of the decrease in consumption that was the response to the $2.52 increase per 1,000 gallons.

Under this type of assessment it will likely not be possible to accurately predict what increment of rate increase must be added to generate revenue to cover the fixed costs. Elasticity coefficients will have very limited reliability in projecting use changes if price go up by 148% in one fell swoop. These devices are normally applicable to only relatively small incremental changes. The literature indicates that coefficients do change as prices continue to rise because users that are wasting water eliminate this during the early price increases and are basically down to essential uses at some phase of this increasing price process. The large percentage price increase projected for the Tupelo customer actually covers a broad range in which many different coefficients should be averaged together to produce an average coefficient.

Reassigning the Assessment

While increasing the cost of water per 1,000 gallons of intake may seem to be an entirely equitable distribution of the financing burden, there are those who would argue that this discriminates against lower income households. In Tupelo, as in many other communities throughout the state, poverty status households are significant. Of the 6,723 families counted in the 1980 Census, 11% had incomes below the poverty status levels. Householders of 65 years of age and older that are below poverty states comprise only about 0.9% of the urban households.

Table 6 contains a compilation of information collected from sample residential customers of public water systems located in the twelve counties of the Tombigbee River Valley Water Management District. Respondent data from the survey was divided into four groups based on the total amount of utility expenditures per household for the items listed. Figures shown are composite averages. Each set of figures represents an average profile for the households under that column.

TABLE 6
AVERAGE UTILITY EXPENDITURES OF SURVEYED HOUSEHOLDS USING MUNICIPAL SUPPLY SYSTEMS, BY MONTHLY TOTAL GROUPS

	$51 to $99 Monthly Expenditures	$100 to $149 Monthly Expenditures	$150 to $199 Monthly Expenditures	$200 to $224 Monthly Expenditures	Average Expenditures (all Groups)
Electricity & Fuels	$41.57	$ 75.45	$100.95	$136.10	$ 90.24
Telephone	22.57	24.87	41.95	41.17	34.74
TV Cable	11.10	13.93	16.43	16.25	15.60
Water & Sanitation	7.21	10.77	14.87	22.50	13.43
TOTAL	$82.45	$125.02	$174.20	$216.02	$154.01
% of Total in W & S	8.7	8.6	8.5	10.4	8.7
% of Income for Utilities	12.8	15.5	11.2	17.4	13.7

SOURCE: Survey of sample residential customers of public water supply systems in 12 TRVWMD counties.

This table does not show average number of persons per household because there was very little variation in that factor among the groups. Total expenditures, however, tied in very closely to income levels. Note the rather consistent percentage of monthly utility expenditures going to water and sewer regardless of the level of total expenditures. Since the average number of persons per household is fairly consistent among the groups, the families with higher expenditures and more affluent incomes apparently are using more water per person than those with the lower expenditures. Consequently, the more affluent users are in a position to achieve greater reductions in use in response to price increases because they have larger portions of discretionary uses. If these users cut consumption more than the lower expenditure users, part of the financing burden which was considered evenly distributed will be shifted to the lower income groups that are not able to achieve substantial use reductions as the next round of rate increases occur.

Implications for Tupelo

Ignoring political feasibility for the moment, there are several factors indicating the public supply system should first increase water rates to customers before undertaking the new project. Solving the overdraft problem will require users to sacrifice either quantity of water or money. Increases in rates will achieve a series of interrelated objectives. By increasing water rates over a period of time, information can be generated for determining actual elasticity of demand. Armed with at least some information on elasticity of demand, it will be possible to more accurately predict water demand that will exist when monthly water bills more than double. Revenue generated by this process can be invested in a new construction fund to be applied to the cost of the new facility. This not only reduces the size of required bond issue but also provides a revenue generation source as the fund earns interest compared to customers to having to pay interest on borrowed funds. There is even a remote, but unlikely, possibility that conservation induced by higher costs will reduce demand to the point that no new facilities are needed. More likely is the possibility that facilities of lesser capacity than the original projections would be sufficient. The process of raising rates through an extended series of increments can provide answers to many of the questions before the investment is undertaken.

Notice this observation is made under the assumption of a sterile environment of no political barriers. Logical solutions and political factors frequently are not compatible. However, either the course of raising rates before the bond issue or after the bond issue will require a tremendous selling effort. Public approval will be necessary in either case for domestic water users to vote for an action that will raise their monthly water bills.

All of the remedies to groundwater mining either require users to reduce intake or pay a higher price to maintain current consumption rates. Domestic users represent the voting public. The ability of the local government to deal with the overdraft problem will depend entirely on public support especially if the system is attempting to add an alternate source. To do so requires large capital expenditures. Financing requires a bond issue which must be voted on by the domestic water users. If the "Queen Bee" of the public opposition can be tranquilized and turned into public acceptability, the battle of taking the honey will be much less painful.