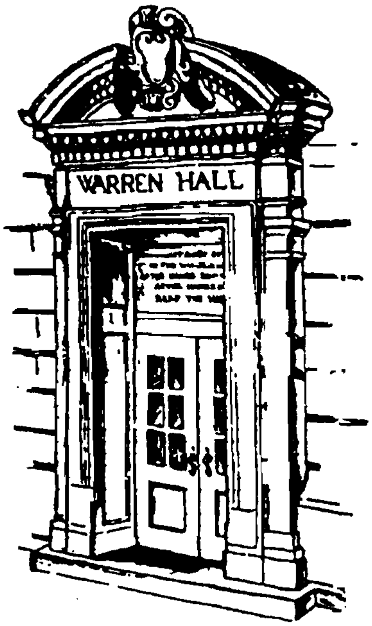

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EFFECTS OF AMENDMENTS TO THE SAFE DRINKING WATER ACT ON LOCAL GOVERNMENT FINANCE AND RURAL RESIDENTS IN NEW YORK

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ABSTRACT

This research assesses implications for local governments and households by income and property class as small water systems in New York comply with recent SDWA Amendments. It is clear that needed surface water system improvements will place a substantial financial burden on many small communities, as well as their low-income residents.

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Introduction

Despite significant improvements in drinking water quality since passage of the Safe Drinking Water Act (SDWA) of 1974, it was clear by the mid-1980's that provisions of the existing SDWA were inadequate to deal with new risks to drinking water across the country. Congress' frustration with EPA's apparent slow progress and its concern for increased risks of contamination were evident in the 1986 and subsequent SDWA Amendments. These amendments allowed for regulation of 83 contaminants in the first three years, with the regulation of 25 more every three years thereafter. For each contaminant, EPA sets non-enforceable health goals, maximum contaminant level goals (MCLG), and enforceable maximum contaminant levels (MCL) or treatment techniques. There are also provisions for monitoring and treatment, including filtration and disinfection.

Compliance with the 1986 SDWA Amendments would ensure that most Americans have access to safe drinking water. Compliance has proven neither simple nor inexpensive. Based on EPA's (1997) recent survey of the need for improvements in the public water system infrastructure, the nation's 55,000 community water systems must invest about $140 billion (1995 dollars) over the next 20 years to install, upgrade, or replace infrastructure to insure the provision of safe drinking water. Estimates of average costs per household range from $970 for large systems to $3,300 for small systems. These small water systems, serving fewer than 5,000 people, constitute 90% of the nation's community water systems, and it is here where the need for financial assistance is most acute. In recognition of this need, the 1996 Amendments to the SDWA provided for more flexibility with regards to small system variances and assistance and requirements for annual reports to water utility customers on existing contaminant levels, as well as for a federally funded state revolving loan fund. This fund provides $9.6 billion in grant and loan funding for local water system improvements (AWWA, 1996).

To date, there are no national or state estimates of the distribution of small systems' costs for systems serving under 10,000 people, or how costs are borne differentially by various income classes. Without this information, one cannot estimate total compliance costs, determine the need for assistance to local governments, isolate the effects on low-income residents, or decide how to allocate state and federal funds most efficiently.

To begin to shed some light on these issues, this research assesses financial implications of compliance with recent SDWA Amendments for local governments served by small water systems across New York State. Differential costs to households by income class and property class, depending on whether the water system improvements are financed through property taxes or user charges, are also assessed. The objectives are accomplished through a complex analytical framework consisting of three components (programmed in visual basic and run in EXCEL): one to estimate compliance costs for systems of different sizes and treatment needs; a capital budgeting component; and a third to distribute the costs to local households by income and property class. The paper continues with a description of the model, followed by a discussion of the data, the empirical results, and some policy implications.

The Model and Its Components

In this section, the three major components of the model are discussed in turn. The first component is one that can be used to estimate the operating and capital costs of various types of water treatment for systems of different sizes. Costs can be entered by the user, or can be calculated within the program. If they are calculated from within the program, combined annualized capital and operating costs, *C*, for fixed prices, are represented by a translog cost function of system size, *q*. That is $ln\ C = A_o + \alpha_q\ lnq + \gamma_{qq}\ lnq^2$.

These cost functions for 21 treatments were estimated from simulated observations of capital and operating costs for water systems of different sizes based on engineering equations from EPA's Best Available Technology (BAT) document (Malcolm Pirnie, Inc., 1993). The treatments include chlorine and ozone systems, numerous filtration and ultrafiltration systems, reverse osmosis, and aeration. Because the engineering equations involved both average daily flow and design capacity as measures of size, it was necessary to develop a single measure of size. To be consistent with policy measures of size used by EPA, we chose to measure size in terms of population served (EPA, 1993b). To relate the three separate measures of size to one another, a sample of over 11,000 observations from the FRDS-II data base were used to estimate average daily flow and design capacity as functions of retail population, number of hookups and dummy variables for type of water system, type of ownership, and region (EPA, 1993a). These regression equations, along with the estimated cost functions for the 21 types of water treatment are given in Boisvert, Tsao, and Schmit (1996).

The second component of the model is a capital budgeting framework designed to assess the financial implications a water system capital project would have on a local government's finances, specifically its water user fees and/or property tax revenue requirements. To simplify the analysis, it is assumed that all capital costs are financed in the first year as long-term bonds or loans, secured by future revenues from user fees or property taxes. These lump sum capital outlays are then amortized, with annualized capital costs being added to yearly O&M expenditures to provide estimates of total annualized costs for the capital improvement project. By assuming that the project is completed in the first year, capital costs need not be discounted.

Similarly, it is assumed that any grants that are received come in the first year, partially or completely offsetting any initial capital costs. The size of these grants would affect the size of the user fees or property tax revenues needed to cover the annual costs of the water improvement projects. The financial viability of any project can be judged by whether or not the present value costs can be covered by the present value of revenues.

The model is structured to be as flexible as possible. It can be run interactively, or in batch mode, where input data are supplied in spreadsheet format and output is written into spreadsheets. To run the model, the user can specify the project's capital and operating costs up front, or allow the program to calculate costs once the treatment options have been specified. Some technical data specific to each treatment may be required as well. The user is also asked to specify the systems average daily flow and design capacity, and population served. The user must provide estimates of the useful life of equipment and any inflation rates for O&M costs.

The third component of the model is designed to distribute the increased costs of the water system improvements across households and individuals in the municipalities served by the small water systems. That is, if one assumes that the water system improvements are financed through increases in the property tax, the increased burden is distributed across the major property value classes in the community. If, on the other hand, improvements are financed through increases in water rates, the burden is distributed across households by income class.

For calculations involving income class, it was necessary to estimate water consumption by household. The EPA has estimated that per capita water consumption for small systems ranged from 50 to 75 gallons per day (gpd) (EPA, 1991). A more recent study calculated small water system per capita consumption ranging from 113 to 138 gpd, depending on system size (Boisvert and Schmit, 1996). These estimates, however included some commercial and industrial demand as well. Therefore, we assumed that households with median incomes consumed water at a rate of 75 gpd/person. Water consumption was allowed to vary around this 75 gpd/person level, with an income elasticity of 0.16 (Hewitt and Hanemann, 1995).

A great deal of data are needed to analyze the effects of water system improvements for any small community. To begin, information from EPA's Federal Reporting Data System is used to identify the current characteristics of the community's water system, and to identify treatment needs. Data are for population served, connections, average daily flow, design capacity, water source (surface or ground), and treatments applied to source water prior to distribution to the service area (EPA, 1993a). For the analysis in this paper, some of the treatment cost estimates are based on equations estimated for the information in the BAT document discussed above. The costs for other treatments, particularly for slow sand and direct filtration, aeration, and some other types of filtration, are based on data for over 140 water system projects collected from Rural Economic and Community Development offices (Boisvert and Schmit, 1997; Schmit and Boisvert,1997). To estimate a water project's effects on local government finances, annual financial data, including revenue, expenditure, appropriation, and general ledger accounts were available from data tapes provided by the Office of the State Comptroller for New York (1994). The data needed to estimate the financial effects on households by income and property class are obtained from the most recent U. S. Census of Population and Housing (1990).

An Application to Small Water Systems in New York

To gain some perspective on the distribution of the effects of water system improvements by system size, primary water source, and treatment needs, data for over 400 small water systems across New York were collected for the broader study on which this paper is based. This represents just over 10% of the small water systems statewide; most are operated by villages.

The Sample. Preliminary analysis of the data suggested that about a quarter (94 systems from the sample of 400) of small systems in New York are surface water systems that are in need of the most extensive treatment. These systems are the focus of the empirical analysis here. To focus on only small systems, we eliminated those surface water system from the sample serving more than 10,000 people, and conducted the analysis using the remaining 83 systems. About 22% of these systems serve fewer than 1,000 people, while another 58% serve between 1,000 and 5,000 people. The remaining 20% serve between 5,000 and 10,000 people.

Water System Improvements. Based on frequency of use by New York water systems (Schmit and Boisvert, 1997) and the technical aspects of the various technologies, we assumed in this analysis that water system improvements for all systems serving fewer than 1,000 people would be in the form of slow sand filtration (SSF). For this technology, water is percolated through a deep bed of sand, which filters out particulates and microorganisms. Filter loadings are low and the raw water quality must be high unless water is pretreated with coagulation, flocculation, and sedimentation processes (CFS). Diatomaceous earth filtration (DEF), which uses a thin layer of DE supported by a filter to remove particulates and microorganisms from the water, is recommended for the middle-sized systems. For the largest of these systems, rapid sand filtration (RSF), where specific contaminants are agglomerated and removed by the sand filtration media, is recommended. Here, pre-treating with CFS increases the flow rate for filtration and allows for larger porous capacity in the filtration media.

Estimating Treatment Costs. To begin the empirical analysis, it was necessary to have cost functions for these three treatment technologies. Total annualized cost functions were estimated from data for over 140 water system projects collected from Rural Economic and Community Development offices (Boisvert and Schmit, 1997; Schmit and Boisvert, 1997). Because there were not sufficient observations to estimate cost functions for each technology, the translog function was specified as: $ln\ C = A_o + \gamma_{pp}\ (lnP)^2 + \sum \alpha_i\ d_i\ ln\ P_i$, where the differences in cost by treatment are reflected by the coefficients on the dummy variables d_i. That is, the variable d_i takes on a value of unity if the observation in the data is associated with treatment i, and zero otherwise. This interactive specification along with $ln\ P_i$ allows for a unique coefficient for the level term on the logarithm of population for each treatment. The coefficient on the quadratic term is assumed constant across all technologies. This equation is reported in Table 1. Since this equation provided an estimate of annual O&M costs combined with annualized capital costs, the proportion that is capital costs was deducted from these estimates so that total capital costs could be input separately into the model. The proportion of the costs that are capital costs were estimated from the 140 loan files from Rural Economic and Community Development offices across the state (Boisvert and Schmit, 1997).

Empirical Results. The results of our analysis are summarized in Tables 2 and 3. The average size of the communities examined is nearly 3,000 people, containing just over 1,100 households. By definition, the size of the communities varies widely across groups. However, median income, averaging $26,600 for the entire sample, and average household water consumption, estimated at just under 200 gpd, are quite near the individual group averages as well. The average annual cost of the water system improvements simulated in this study is about $270,000, with that average ranging from $88,000 for the smallest systems to over six times that amount for the systems serving between 5,000 and 10,000 people. On a per household basis, the average annual cost ranges from a high of $402 for the smallest communities to a low of $214 for the communities in the largest size group. It is difficult to know how these numbers compare with the EPA estimates reported in the introduction because we cannot compare the nature of the system improvements. However, it is clear that the very small systems are at a substantial disadvantage relative to slightly larger ones serving only between 5,000 and 10,000 people.

Other measures of the relative financial burden across community size groups support this contention as well. For example, if these water system improvements are financed through increases in property taxes, local millage rate increases would range from \$0.31 to \$15.01 per \$1,000 of property values. The average of \$4.46 represents a 45% increase in tax rates. For the smallest systems, the percentage increase is over twice this average, and for systems in the largest size group, the average increase is just under 30%. For 34 of the systems, the average millage increase is over 50%, and none of these systems are in the largest size group.

If, on the other hand, water system improvements were financed exclusively through increased user fees, water rates would increase by an average of \$2.16 per thousand gallons (kgal). (The average percentage increases appear outrageous because most systems have very low or zero current water rates.) For the smallest systems, the rate increase would be \$3.18 per kgal, but only \$1.70 per kgal for the largest systems. The relative increases across groups is slightly smaller than when the improvements are assumed to be financed through additions to the property tax, probably because incomes per capita (and water consumption) differ by less between these groups of communities than does the property tax base per capita.

We can examine the distributional consequences of these cost increases in more detail (Table 3). On average, just over 90% of households in these communities would pay less than 3% of their income for water fees after the improvements have been made. But this means that nearly 10% of the households would be paying more than 3% of their income for water. At the extreme, there are communities in each group where over 20% of the households would pay more than 3% of their income for water, and in some cases, anywhere from 6% to 10% of the households would pay over 10% of their incomes for water.

Policy Conclusions

This research is designed to begin to assess financial implications of compliance with recent SDWA Amendments for local governments served by small water systems across New York State. The results suggest that financial implications for local governments and rural residents for water system improvements are substantial and can vary dramatically even within what EPA classifies as small water systems. The differences appear less dramatic when the improvements are financed through user fees rather than through the property tax. Thus, financing improvements through user fees appears more equitable from several perspectives.

The magnitude of the financial burden is particularly severe given that the water system improvements simulated in this analysis are minimal—only filtration is recommended. Even then, the per household cost of water system improvements typically runs between 1% and 2% of the median annual income. Were additional treatments required, it is likely that costs would exceed 2% of median income in many of the communities—a threshold beyond which EPA assumes a water system will fail (EPA, 1988). It is clear that these kinds of communities should be given priority in allocating grants, low interest loans, or other types of financial assistance.

Table 1. New Treatment Annualized Cost Function

Regressors	Description	Coefficient	Std. Error	t-ratio
INTERCEPT	Intercept term	8.49	0.32	26.94
SURFACE	Surface water dummy variable	0.27	0.24	1.13
LPOPNSQ	[Ln(Population)] squared	0.04	0.01	5.16
LPOPAERA	[Ln(Population)] * AERAT	0.10	0.05	1.93
LPOPDIR	[Ln(Population)] *DIRFILT	0.15	0.05	3.05
LPOPSSF	[Ln(Population)] *SSFILT	0.20	0.04	4.59
LPOPOFIL	[Ln(Population)] *OFILT	0.18	0.04	3.94
R^2	0.89			

Source: Boisvert and Schmit, 1997.

Note: Annualized cost function is based on an 8% discount rate and a 20-year time period.

AERAT = Aeration, DIRFILT = Direct Filtration, SSFILT = Slow Sand Filtration, OFILT = Other Filtration.

The equation for other filtration was used to estimate costs for Rapid Sand Filtration.

Table 2. Summary Statistics for Small Water Sytems by Size and Treatment

Statistic	<1,000 SSF	1-5,000 DEF	5-10,000 RSF	All Systems
	Size / Treatment*			
Number of Obs.	18	48	17	83
Ave. Population	565	2,500	6,776	2,956
Ave. No. of Hshlds.	220	969	2,570	1,134
Persons per Hshld.	2.64	2.55	2.77	2.62
Median Income ($)	$26,146	$25,965	$28,749	$26,574
Ave. Hshld Water Consumption (gpd)	198	191	208	196
Annual Cost of Treatment ($)	$88,397	$238,174	$550,887	$269,742
Property Tax Financing:				
Addl. Millage (per $1,000 of Property Value)	$6.90	$3.85	$3.59	$4.46
High	$15.01	$8.52	$7.03	$15.01
Low	$0.57	$0.31	$0.74	$0.31
Ave. % Increase	92%	38%	30%	45%
No. of Systems with % Increase:				
Under 25%	3	8	0	11
25-50%	2	19	17	38
Above 50%	13	21	0	34
Water User Rate Financing:				
Addl. Water Rate ($/kgal.)	$3.18	$1.94	$1.70	$2.16
High	$8.95	$5.20	$3.79	$8.95
Low	$0.34	$0.58	$0.21	$0.21
Ave. % Increase	700%	320%	213%	353%
No. of Systems with Mean Hshld Water Bill as a percent of Median income: (with new treatment)				
Under 1%	9	39	12	60
1-2%	7	9	5	21
Above 2%	2	0	0	2

*Treatment: SSF = Slow Sand Filtration, DEF = Diatomaceous Earth Filtration, RSF = Rapid Sand Filtration.

Table 3. Weighted Averages and Ranges, by Size Classification

Size	Percent of Households where Total Water Bill is: >10%	7%-10%	5%-7%	3%-5%	<3%
Small <1,000 people					
Weighted Averages	1.36	2.12	1.24	4.36	90.92
Range:					
High	6.90	16.45	9.23	23.28	100.00
Low	0.00	0.00	0.00	0.00	57.76
Medium 1,000-5,000 people					
Weighted Averages	0.10	1.73	1.56	2.67	93.94
Range:					
High	6.13	11.89	9.45	14.83	100.00
Low	0.00	0.00	0.00	0.00	76.47
Large 5,000-10,000 people					
Weighted Averages	0.64	0.80	0.40	3.61	94.55
Range:					
High	10.34	5.85	4.44	15.77	100.00
Low	0.00	0.00	0.00	0.00	78.45

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