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Private sector involvement in public water distribution: assessing local water systems in Massachusetts

Corey Denenberg Dehner
Northeastern University

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PRIVATE SECTOR INVOLVEMENT IN
PUBLIC WATER DISTRIBUTION
ASSESSING LOCAL WATER SYSTEMS IN MASSACHUSETTS

A dissertation presented

by

Corey Denenberg Dehner, Esq.

to

The Law, Policy and Society Program

In partial fulfillment of the requirements for the degree of
Doctor of Philosophy

In the field of
Law, Policy and Society

Northeastern University
Boston, Massachusetts
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ABSTRACT OF DISSERTATION

Submitted in partial fulfillment of the requirements for the degree of Doctor of
Philosophy in Law, Policy and Society in the Graduate School of Arts and Sciences
of Northeastern University, July 2009

ABSTRACT

Despite the fact that the debate over private sector participation in public water provision dates back to the 19th century, it lingers on. Freshwater is the most precious natural resource we have. Its supplies are dwindling while use is simultaneously rising. Moreover, the lack of access to clean drinking water has caused an international epidemic of sorts, resulting in over 2 million deaths per year. Therefore, appropriate prioritization of this resource must result in distribution focused on preserving accessibility, health of consumers, and sustainable, waste free use. The question therefore that guides this research is how to provide water to the public in an efficient manner while maintaining regulatory compliance and accessibility—that is, affordable, low cost water—for the consumer.

Free market advocates tout privatization as the antidote to dwindling supplies and efficiency problems in the public sector. Private sector participation in public water systems will, according to the market model, always result in a more efficiently functioning water system, explaining that human beings act rationally to maximize their own self interest. But what if the market model forgoes other factors that motivate human behavior? Graeme Hodge, privatization and public administration expert, discusses numerous problems with solely economic based theories and explains that self interest is one of many factors motivating human behavior. Hodge's notion, what I call *multiple motivations theory* provides the framework for this research, operating under the assumption that the public sector may be the better choice when it comes to the distribution of a life essential resource like water.

To better understand some of the differences between public and private water provision, I conducted both a quantitative analysis of 39 water systems servicing 40 municipalities throughout Massachusetts and a qualitative multiple-case study analysis of three Massachusetts public water systems. I examined three ownership/management structures: (1) systems owned and operated by a municipality; (2) systems owned and operated by a private company; and (3) systems owned by a municipality, and operated with private sector participation. My research asks whether the nature of the ownership and/or management structure of a public water system affects: (1) affordability of water and cost to the consumer; and (2) the level of a system's regulatory compliance. My multiple-case study research seeks, through 82 customer, town official, DEP and private company interviews, a deeper understanding of why the quantitative findings were such. I assessed three Massachusetts public water systems, one from each of the aforementioned ownership/management structures: (1) the Hingham/Hull system; (2) the Hanover system; and (3) the Norfolk system.

My results refute the view that private sector participation necessarily increases efficiency and reduces costs to the consumer. I found the ownership/management structure of a water system to have a statistically significant impact on the affordability of water and cost to the consumer, but not to have a statistically significant impact on levels of regulatory compliance for the years 2003-2007, for all 39 systems included. Moreover, this research raises questions about and offers recommendations for the appropriate role of the private sector in public water

distribution. By conducting a state focused analysis, this project contributes a unique data source to the growing body of research on private vs. public provision of water.

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I would like to thank Christopher Bosso, the chair of my committee and trusted mentor. A man who never sleeps on the job, whose comments were always insightful, useful and painstaking to address, but who no doubt helped this dissertation become as fluid, readable and useful as it is. I would like to thank Joan Fitzgerald, who was always there to offer advice, guidance and encouragement even though she was not on my committee. I must also thank the readers on my committee, Michael Dukakis, Lee Breckenridge and Danny Faber. Thank you for sharing your various areas of expertise with me. Thank you also to Professor and statistician David Rochefort who helped me navigate the sometimes dizzying world of statistics and turned me into a competent novice statistician. An additional thank you goes to the ever so patient and enormously helpful Gregory Wassall who helped me wade through annual household median income data and turn it into useful data points. Thank you also to Paul Osborne at the DPU for making himself so available and readily answering my many private company rate related questions. Many thanks go to Damon Gutterman, from the DEP's Drinking Water Program for his advice, information and willingness to help me find the answers to even the most detailed questions. I would also like to thank Richard Friend and Duane Levangie from the DEP Water Management Program and all of the municipalities and private companies included in this study for helping me track down the necessary information and for

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To my son, my joy and my delight, who saw way too little of mommy during the final months of writing. Lastly, to my unborn child who gave me a little kick in the stomach whenever I got too serious.

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LIST OF ACRONYMS, ABBREVIATIONS AND SYMBOLS

- ACS: American Community Survey
- ANOVA: analysis of variance
- ASR: annual statistical report
- AWWC: American Water Works Company
- AWE: American Water Works and Electric Company
- AWWG: American Water Works and Guarantee Company
- BHC: The Bridgeport Hydraulic Company
- BPW: Board of Public Works
- Camdessus Report: report produced by the World Panel on Financing Global Water Infrastructure examining the root causes and potential solutions to global water infrastructure problems
- CCR: consumer confidence report
- CEDAW: Convention on the Elimination of all forms of Discrimination Against Women
- CGE: Compagnie Générale des Eaux
- CRC: Convention on the Rights of the Child
- DEP: Department of Environmental Protection
- DPU: Department of Public Utilities
- DPW: Department of Public Works
- EPA: Environmental Protection Agency
- HLE: higher level of enforcement
- ICCPR: International Covenant on Civil and Political Rights
- ICESCR: International Convention on Economic Social and Cultural Rights
- LLE: lower level of enforcement
- LCR: Lead and Copper Rule
- MCL: Maximum Contaminant Level
- M/R: monitoring/reporting violation
- MRDL: Maximum Residual Disinfectant Levels
- MWRA: Massachusetts Water Resources Authority
- NON: notice of noncompliance
- OMI: Operations Management, Inc.
- O&M: Operations and Maintenance
- Panel: World Panel on Financing Global Water Infrastructure
- PBC: performance based contract
- PHS: Public Health Service
- PPP or P3: public-private partnership

- PSP: private sector participation
- PR/PR: privately owned and operated water system
- PU/PU: publicly owned and operated water system
- PU/PR: publicly owned, privately operated water system
- PWF: Public Works Financing
- RH White: RH White Companies, Inc.
- RWE: Rheinisch-Westfälisches Elektrizitätswerk Aktiengesellschaft
- SDWA: Federal Safe Drinking Water Act
- SITA: Société Industrielle des Transports Automobiles
- SMCL: Secondary Maximum Contaminant Level
- TT: treatment technique violation
- UAW: unaccounted for water
- United Water: United Water Resources, Inc.
- VE: Veolia Environnement
- VIO: catchall category for higher level violations not included in the other categories
- WhiteWater: WhiteWater, Inc.
- WMA: Massachusetts Water Management Act
- WSF: World Social Forum
- W & C: Woodard and Curran
- η^2 : eta squared (strength measure for analysis of variance)
- χ^2 : chi squared (significance measure for cross-tabs)

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PART I

BACKGROUND INFORMATION

CHAPTER 1
WHO CONTROLS OUR DRINKING WATER...DOES IT MATTER:
HISTORY OF WATER DISTRIBUTION IN MASSACHUSETTS AND THEORETICAL
ARGUMENTS FOR AND AGAINST PRIVATIZATION

I. INTRODUCTION

“Of all natural phenomena there are perhaps none which civilized man feels himself more powerless to influence than the rain, the sun, and the wind. Yet all these are commonly supposed by savages to be in some degree under their control.” (Frazer 1890 at 13)

No natural resource is more essential to human life than water. Our bodies are approximately 60 percent water (U.S.G.S.) and we require anywhere from 2.2-3.7 liters/day to prevent life threatening conditions associated with dehydration (Standing Committee- IOM 2004).

Despite its obvious necessity, debates over the appropriate characterization of water have been around for over a century (e.g. Shiva 2002). Is water simply another commodity, readily available to be traded on the open market? Or is access to clean water a basic human right, and thus not subject to market whims? According to Barlow and Clarke freshwater resources account for “less than ½ of 1% of all the water on the earth. The rest is sea water, frozen in the polar ice, or water stored in the ground that is inaccessible to us...Not only is there the same amount of water on the planet as there was at its creation; it is almost all the same water” (2002 at 5). Moreover, freshwater is a finite resource, replenished only through rainfall. And, as James Winpenny and the Overseas Development Institute noted, groundwater aquifers are utilized at a rate that far exceeds the rate of natural recharge (1994). Further, Winpenny noted the exorbitant costs that would be required to gain access to

supplies sufficient enough to meet the rapidly increasing demand in the face of increases of both population and per capita water consumption. This precious resource is dwindling at truly astonishing rates. As Rogers (1993) so eloquently wrote,

“[n]o other commodity is used with such reckless abandon as water, no other bulk commodity is demanded at such high quality, and no other natural resource is the subject of such intense struggles within the federal establishment and in Congress—not even oil.”

Given these sobering statistics, it must be a priority to protect the quality and sustainable use of this resource. There is continuing tension over the degree to which markets are appropriate for providing what is historically regarded as a public good. Therefore, the question that motivates this study is both an analytical and a normative one: how do we best make this necessity available in sufficient supply to all in a sustainable manner? Should the public sector be in control of water distribution or can the private sector play an effective role? Specifically, I examine whether the ownership or management structure of a public water utility affects access to, affordability and cleanliness of water.

Cost and relative affordability, used as a proxy for access to water, and regulatory compliance, a measure of cleanliness, are some of the strongest indicators of the success of a water utility. High regulatory compliance may require high cost outlays, potentially compromising the affordability of the resource. Moreover, the primary claim of market advocates is that private companies can do what the public sector does with the same compliance results, but at a lower cost. However, there are other potential drawbacks associated with private sector participation (PSP)

including: the democratic functioning of the resource, such as, accountability, and degree of public participation in the regular operations of the public water system; customer service issues, including poor response times to water quality, leakage, quantity, odor or color issues; impacts on the local watershed and the local economy. However, these, while related to affordability and regulatory compliance, are less quantifiable.

The United States has made tremendous strides in the legal protection of potable water quality. Taken together, the Massachusetts Water Management Act and the Federal Safe Drinking Water Act are designed to guarantee the provision of clean, safe drinking water (when taken from a groundwater source) and as such, provide the basis for the regulatory compliance portion of this research. However, there is a dearth of law and policies on how, when, and under what circumstances public drinking water can be owned and/or managed by a private company. Without question the public hopes that the legally mandated drinking water protections are sufficient to adequately protect our health and the health of the environment, but is this so?

In the following sections I summarize the history of drinking water distribution in Massachusetts, discuss the theoretical core of this debate, detail the anecdotal experience some towns have had with privatization, provide a brief overview of the research design, and offer the reader a roadmap for this study.

II. HISTORY OF WATER DISTRIBUTION SERVICES IN MASSACHUSETTS

"On [the topic of water privatization], I deem it my duty to declare explicitly my opinion, that in such a project the City ought to consent to

no copartnership. If there be any privilege which a city ought to reserve exclusively in its own hands, and under its own control, it is that of supplying itself with water. No private capitalists will engage in such an enterprise without at least a rational expectation of profit. To this, either an exclusive right, or privilege of the nature of, or equivalent to, an exclusive right, is essential.” Mayor Quincy during his Inaugural Address January 1826 (Bradlee 1868 at 6)

When analyzing a policy or governmental service structure, it is essential to understand that present circumstances do not exist in a vacuum. This country has over two centuries worth of experience in public water distribution so there is much to learn from a historical review of public water distribution. Contextualizing Massachusetts’ place in public water distribution history also demonstrates why it is an appropriate test case for this research.

Public provision of water began in New England in the mid 17th century (Bhave and Gupta 2006; Kempe 2006). It remained a rarity outside of the region until the late 19th century. Consequently, this history focuses on New England states and specifically, Massachusetts where the first public water supply was developed.

A. EARLY PUBLIC WATER SYSTEMS

1) 1652-1794

As was the case nationwide, throughout the 17th and 18th centuries the majority of New England residents obtained water from wells, streams and rainwater collecting cisterns (Nesson 1983; Kempe 2006). The water quality, particularly in populated areas, was frequently awful—saline, putrid, and sometimes polluted (Nesson 1983).

The first organized public water supply in the United States was founded in Massachusetts in 1652 with the incorporation of the privately owned ‘Massachusetts Water Works’ Company (Bradlee 1868). The Water Works Company, created to develop a conduit (essentially a reservoir) for limited domestic use and fire prevention, was the first water utility (private or public) in the nation (Kempe 2006).¹ The conduit was not entirely successful facing leaks, service and quality issues (Bradlee 1868; Kempe 2006). The next advances in public water distribution in this country would not occur for almost 100 years.

In the mid 18th century, Schaeffers Town (now Schaefferstown), Pennsylvania built the nation’s first piped public water supply system (Mays and Knovel (Firm) 2000; Historic Schaefferstown 2009). These early piped systems, appropriately called gravitational water systems, relied on gravity to move water from high to low elevations. Water was brought into the town via wooden pipes and stored in wooden tanks that people could access at their leisure (Mays and Knovel (Firm) 2000).

About twenty years later in Bethlehem, Pennsylvania, water was moved *without* the assistance of gravity, using horse-driven pumps (Mays and Knovel (Firm) 2000). In 1772, Providence, Rhode Island established its first public water supply also using wooden piping (Kempe 2006). Massachusetts’ residents would not receive piped water for another two decades.

In 1794 the Aqueduct Corporation requested, and was granted, permission to distribute, via wooden pipes, water from Jamaica Pond to Boston residents, at a price

¹However, parts of Europe had privately run water services as early as 1215 (Kempe 2006).

regulated by the Massachusetts General Court (the state legislature). The Corporation's authority was extended in the following years and in 1803 water was delivered via subterranean pipes extending about fifteen miles beyond Jamaica Pond (as far as the Massachusetts General Hospital) (Bradlee 1868). Though a step towards public water distribution in the state, the Corporation's efforts were not entirely successful; customers had to abstain from water usage whenever there was a fire and there was limited customer service available if there was a problem with the distribution system (Nesson 1983).

2) 1790s-1850

The majority of piped water systems prior to 1850 were built by private companies who experienced similar problems to the Aqueduct Corporation (Kempe 2006). Between 1790 and 1850, Beverly, Salem, Peabody, Worcester, Haverhill, Cambridge, Springfield and Chicopee, Massachusetts; Portland, Maine; Montpelier, Bellow Falls, Hyde Park and Windsor, Vermont; Dover, Portsmouth, Drewsville, Hanover, and North Conway, New Hampshire; and Durham, New London, Bridgeport, and Danbury, Connecticut established piped water systems.

“[B]y 1800 there were only 16 public water supplies systems in the USA—most of them in New England or larger cities near the Atlantic Coast—originally built for “fire protection or the laying of dust” with little thought given to domestic service. The number of water supply systems in the US grew to 83 by 1850, 600 by 1880 and 3350 by 1897 (LaNier 1976).” (Bhave and Gupta 2006 at 2).

Though New England states had made many advances in public water distribution, public water systems were not widespread. This changed with a spate of devastating urban fires in the late 18th and early 19th centuries, which created

incentives to expand Boston's water sources in particular (Nesson 1983). In 1825, Mayor Josiah Quincy led an effort to undertake the provision of freshwater to Boston residents (as the Aqueduct Corporation serviced only a small portion of the city) (Bradlee 1868). His efforts focused on development of a publicly, as opposed to privately, run water system (as evidenced by his 1826 inaugural address quoted on the first page of this chapter). The city in turn, created a committee (chaired by Mayor Quincy) to look into the practicability of the matter. Subsequently, the Mayor appointed Professor Daniel Treadwell to study the best method for creation of a public water distribution system (Bradlee 1868).

Professor Treadwell analyzed appropriate water sources (looking primarily at surface water) and gave his recommendations to the city government. Despite Mayor Quincy's adamancy and fervor pushing for a *public* water utility, and similar sentiments by his successors, little was done to facilitate creation of a public utility (Bradlee 1868). The committee discussions and debates led to endless bureaucratic stalling. The roadblock was due in large part to continued disagreement by local politicians over whether the water should be supplied by a public or private entity (Nesson 1983). Reports and discussions continued for the next decade, with no action toward creating a more widely distributing public water system (Bradlee 1868).

3) First Publicly Owned and Operated Water Utility in New England

During the early to mid 19th century a series of serious epidemics, including cholera and yellow fever, struck cities throughout the country (KD Patterson 1992; Andreen 2003; Kempe 2006). The epidemics were so severe that health advocates

finally convinced the federal government to modestly involve itself, albeit temporarily, in the protection of public health (Andreen 2003). Having not yet developed an understanding of germs as the cause of these outbreaks, the general perception was that the filth of cities—the “miasma” of the air and water—was to blame. This public perception combined with the inadequacy of the Aqueduct Corporation was enough to spur Boston city government into action (Nesson 1983). The negative experience of other states convinced the city that private companies were too focused on the bottom line to invest sufficient capital and adequately provide safe, high quality water to town residents (1998; Gleick 2002). For example, in Chicago, Illinois the private company providing the water service chose a water source that would require limited initial investment regardless of the fact that the quantity and quality of water was poor (Gleick 2002, citing Anderson, L. "Water and the Canadian City." *Water and the City*. Public Works Historical Society, Chicago (1991)).

Two plans for the creation of a citywide water system were developed: a long term distribution scheme, known as the Baldwin plan after the engineer who developed it; and a short term scheme intended to ease current demand. An engineer by the name of John Jervis was asked to decide which of the proposed plans to follow. Jervis chose the Baldwin plan which recommended tapping water from Long Pond in Natick rather than one of the closer, smaller sources, and in 1846 the legislature passed the Boston Water Act, granting the city permission to provide Boston with water from Long Pond, later named Lake Cochituate (Nesson 1983).

Shortly thereafter construction began on what is now known as the Cochituate system (Nesson 1983). The water was turned on in October 1848, for the first time enabling all Boston residents to have access to piped water.

In 1851, because the distribution system had grown so large, the city delegated the responsibility of running it to the Cochituate Water Board. The Board was effective and efficient in its job, preventing both disease outbreaks and water shortages. The success of this publicly run water system buried the public-private debate over water distribution management. In 1851, the Board requested and was granted approval from the city to purchase the Aqueduct Corporation (Cochituate Water Cochituate Water Board 1852; Boston Water Boston Water Board 1892). Reports of the Cochituate Water Board indicate that the Aqueduct Corporation changed between public and private hands a number of times before landing permanently with the city (Cochituate Water Cochituate Water Board 1852). The Water Board's record and the need to expand capacity with population growth enabled the city to continually approve expansion of the public water supply system in the greater Boston area. In the following years the reservoirs used to store the city's water changed, the population and municipalities served grew, but the management remained public.²

4) 1855-Present Day

Other New England towns likewise investigated public water distribution for fire prevention. For example, Plymouth, Massachusetts, which has one of the oldest

² For additional information on the History of the greater Boston water distribution system see, <http://www.mwra.state.ma.us/04water/html/hist1.htm> (last visited October 27, 2008).

publicly run water systems, began successfully withdrawing pond water as a proactive fire prevention measure in 1855 and remains municipally owned and municipally operated to this day (Davis 1885). By 1879 64 municipalities in Massachusetts enjoyed the benefits of a public water supply (Mason 1937). Massachusetts made further history, in 1893 when the town of Lawrence built one of the first municipal water purification plants in the country (Mason 1937). The town could now provide its residents with not only freshwater, but purified, higher quality potable water.

Perhaps one of the most progressive state developments was the 1984 creation of the Massachusetts Water Resources Authority (MWRA), a public authority charged with providing water and sewer services to 2.5 million people throughout 61 communities in and around Boston (MWRA 2009- "About MWRA"). MWRA water is obtained from the massive Quabbin Reservoir in central Massachusetts, constructed in the 1930s by the MWRA's predecessor agency, the Metropolitan District Commission.

B. PRIVATE WATER COMPANIES

While the majority of towns in Massachusetts had municipally owned water systems throughout the 19th and 20th centuries, there were exceptions. The Housatonic Water Works Company in particular offers a unique example of longstanding private involvement in water distribution in the Commonwealth. The Company (previously the Housatonic Water Company) was incorporated in 1897 to provide water to Great Barrington's Housatonic Village (Housatonic 2008). The Company had tumultuous

beginnings with management and water quality. While it went through periods of relative calm, its problems continued well into the 20th century. Customers displayed evidence of contaminated water at public meetings as recently as the early 1980s. In 1984 the Company was sold to the Mercer family which made many infrastructure improvements noting “little had been done to the infrastructure since the 1880s.” The Company currently serves Housatonic Village as well as other sections of Great Barrington, Stockbridge and West Stockbridge. It is still a family owned and run company (Housatonic 2008). As explored in chapter 2, private water companies continue to have a presence in public water distribution in the Commonwealth.

C. CONTEMPORARY ISSUES

Once again in the 21st century, Massachusetts is on the cutting edge of domestic water distribution. Massachusetts will soon join California, Texas and Florida, in being one of a few states with a large capacity desalination plant. Spain-based Inima Corporation and the Massachusetts-based Bluestone Energy Services, LTD have joined to form Aquaria Water, LLC which received state approval to construct the Taunton River Desalination Plant (United States Geological Survey 2008). Many residents in the town of Hull hope to follow closely on the heels of the Taunton Desalination plant and build a desalination plant in town to provide water to its residents (Customer 2009). With this country’s dwindling freshwater resources desalination plants could be widespread in the near future.

Other contemporary issues concern aquifer problems, wells coming ‘under the influence’ of surface water thereby compromising the quality of the groundwater source, in suburban towns outside of Boston.

III. MASSACHUSETTS AS A TEST CASE

Massachusetts has throughout history served as a laboratory and model for public water systems throughout the country. It has and continues to be on the forefront of public water distribution issues nationwide. Massachusetts housed the country’s first public water supply and was one of the first states in the country to have a piped water system. In addition to the longstanding municipally run systems, Massachusetts has had longstanding involvement of private companies in water distribution.

Moreover, Massachusetts has been asking questions about the benefits and drawbacks of public vs. private water distribution since the 1800s. Presently, the state has a mixture of publicly owned and operated utilities, publicly owned systems operating with private sector participation and privately owned and operated systems. Given the historical blueprint for public water distribution in the Commonwealth and the current public water distribution scheme in the state, it is an appropriate site to analyze the potential impact of the management and/or ownership structure of a public water utility on the level of regulatory compliance and cost to the consumer.

IV. THE QUESTION OF PRIVATIZATION

In recent decades many in the international community have come to regard private sector participation in water provision as the general solution to problems of inefficient delivery and poor water quality. Private companies can provide financial

capital and scientific expertise to communities facing unstable infrastructure and governance. For similar reasons—lack of adequate financing, aging infrastructure and insufficient access to expertise—many municipalities in the United States look to the private sector for assistance.

Many cities and towns have efficiently privatized public services such as trash removal and towing—with “efficiency” defined here as “the ability to produce a product or service in a cost effective manner” (Greene 2002 at 39). Such privatization efforts have saved these towns substantial amounts of money and improved the quality of the service, relying, as Jeffrey Greene points out in *Cities and Privatization*, on increased competition rather than the private or public nature of the service provider (2002).

A central debate over the provision of water is whether it is a natural monopoly, that is, a commodity which by nature does not easily lend itself to the forces of competition (Levin, Epstein et al. 2002). As a natural monopoly, Greene argues, once a water provider is granted contractual rights over some aspect of the public water service any hopes of competition (if any existed) are extinguished and any potential benefits of competition lost (2002). However, as Fauconnier argues, water service may *not* always be a natural monopoly; the benefits of competition can be retained when the operation and management of water distribution is contracted on a short-term basis and the terms of the contract allow it to be easily rescinded (1999).

Market advocates argue that a natural monopoly phenomenon is more likely to occur with public sector control as public actors have no financial incentive to

manage the public utility in a cost-effective manner. They argue that the private sector, driven by stronger rules of competition, gives birth to innovation and new technology, such as the use of ozone in early drinking water treatment. Moreover, Seidenstat et al. explain that when the private sector is hired to serve as a contract operator for a public water utility, private company reputational concerns and relative competitor success, motivates the private company to operate as efficiently as possible. Private water companies worry about the competition gaining control over the public water utility market, which in turn, keeps private sector water service providers on the cutting edge of innovation (Seidenstat 2005).

Critics do not buy such arguments. Food & Water Watch, a consumer advocacy organization, analyzed data from over 1,000 utilities and found that privatization leads to higher prices and not greater economic efficiency. The study included utilities from California, Illinois, New York and Wisconsin and found the water rates charged by privately owned systems to be 13-50 percent higher than those charged by the publicly owned systems (Food & Water Watch 2007).

Even if private provision is more efficient than publicly owned and operated systems, to some critics privatization nevertheless brings up concerns over the loss of a democratically functioning essential service (National Research Council 2002). Additional concerns include protection of the water system and security for preexisting water servicing jobs. Positive answers to the aforementioned concerns require carefully worded contracts detailing cancellation terms and risk sharing as well as continuous monitoring of the corporation to ensure contract compliance and

prevent criminal activity. Unfortunately, diligent contract negotiations, drafting, and review are expensive and labor intensive and may require assistance of outside experts.

If the private company does not live up to its promises, what recourse will the community have? Again, the answer may well depend on the contractual terms and more importantly, on the tenacity of a town's elected officials. After town firefighters were forced to confront a fire with an inoperative hydrant, and being told she had to boil her water before using it, Mayor Laurel Prussing, of Urbana, Illinois, heeded residents' needs and decided to buy back her town's water system (Food and Water Watch 2006). Prussing flew to Germany to convince the multinational corporation RWE to sell her town back its water rights. A bit closer to home, in Nashua, New Hampshire, residents are engaged in a six year battle to buy back, using eminent domain, their water utility from Pennichuck Water Works, Inc. Arguing that Pennichuck is more expensive than a water utility should be and has compromised the city's water supply by developing land around it, Nashua is determined to prevail (Smith, August 31 2008).³

While these selective examples are illustrative of potential problems and benefits of privatization, we lack a comprehensive understanding of the impact of private sector participation in water servicing within the confines of a single state. To date, most analysis of the costs and benefits of PSP have been scattered throughout the country, focusing on individual cities and towns. A systematic analysis of water

³ For additional information on the Nashua, New Hampshire eminent domain action, see chapter 2.

provision in Massachusetts will give us insight into the relative merits of public versus private provision.

V. **PRIVATE SECTOR PARTICIPATION IN WATER DISTRIBUTION:
THEORETICAL ARGUMENTS**

A. **THE ARGUMENT FOR PRIVATIZATION**

Nobel Laureate economist Milton Friedman is thought to be one of, if not, the most influential economists of the twentieth century (Economist 2006). A leader of neoclassical, free market economic theory, Friedman felt that a country could not foster socialist principles whilst maintaining democratic governance. Rather, Friedman believed “economic freedom [to be] an indispensable means toward the achievement of political freedom.” (Friedman 1962 at 7). His research and writings on the free market are recognized as establishing the intellectual basis for much of the economic theory anchoring pro-privatization arguments (Savas 2000). While there are a myriad of neoclassical economic theories used to support privatization of public enterprise, all originate with the notion that individuals, whether politicians, consumers, employers or producers, act rationally to maximize their own self interest, however defined (Henig 1989-90; Hodge 2000; Savas 2000; Lopez-Calva 2003).

Moreover, in the face of failing infrastructure and hard economic times, where is the financial capital necessary to maintain and improve public water distribution going to come from if not the private sector? Certainly municipalities have the option of seeking tax-free bonds, a substantial advantage over the private sector, but all water systems can access tax-free state revolving fund money. Moreover, increased debt leads to the politically unpopular necessity of raising water rates. Additionally,

many of the reasons public water systems are forced to raise current water rates has to do with the rise in chemical costs rather than any major capital improvement (Diniak 2009; Tierney 2009).

“Shedding services” to the private sector—selling all water assets to a private company, whereby the public sector retains no control over the withdrawal, operation, management or distribution of the asset—can greatly reduce the financial strain felt by localities and free up its funding and resources for other services (Fixler, Jr. 1986). Additionally, the private sector can take advantage of economies of scale—reducing production costs by increasing output—something rarely done in water provisioning by the public sector.⁴ When a private company owns or operates multiple water supplies in a region, those communities can share personnel and have highly specialized experts available for consultation (Carter 1986-1987). Buying the increasingly more expensive chemicals necessary for disinfection and treatment in increased quantities can reduce the overall cost per gallon of water distributed. Moreover, increasing the number of customers provided for increases water revenue.

Public choice theory provides one rationale for privately owned water services (Boyne 1998). At the heart of public choice theory is the notion of the rational actor working towards self maximization. Public choice theorists argue that public officials generally end up serving themselves over the public, whether through the layering of unneeded employees or politically driven pricing that leaves the system underfunded and eventually broken. The end result of a publicly owned and run utility, according

⁴ The MWRA is a strong example of a public water system taking advantage of economies of scale. This option for publicly owned and run utilities is explored further in chapter 7.

to public choice theory, is inefficiency (Boyne 1998; Savas 2000). Moreover, in line with public choice theory is the importance of competition to increase efficiency and allow supply to equal demand. A publicly owned and run utility arguably lacks the competition necessary to drive the innovation, efficiency and cost-effectiveness of industry.

Some advocates of private sector participation tout a public-private partnership (PPP or P3) as the antidote to the perceived shortcomings of both public and private sector management. A public-private partnership, whereby the public utility contracts out some or all of the operation and management of the utility to a private company, is thought to allow the benefits of private capital operations to be controlled by public sector oversight. Moreover, retained public sector involvement heightens the competition thought to drive increased efficiency, as the public sector may, depending on contractual terms, cancel the company's contract if it is not happy with the company's performance. (Seader 1986).

B. THEORETICAL CRITIQUE OF PRIVATIZATION

The theoretical underpinnings of water service privatization hinge on Friedman's classical liberal view that individuals act rationally to maximize their own self-interest and that free markets offer the optimal mechanism for allocating goods and services. Graeme Hodge, an expert on privatization and public administration, acknowledges that self-interest is a strong motivating factor but contends that "the motivations of many individuals [also] include generosity, adherence to a moral code including an acceptance of various obligations to others, and an interest in rewards

other than money” (2000 at 37). People are not one dimensional and are in fact *individual*. Many are motivated strictly by self-interest, but many are guided by cooperation and philanthropic world views.

“[H]uman beings are not merely economic beings, but also political, cultural and moral beings who inhabit an economic system which is profoundly influenced by, and in a sense dependent upon, the attitudes, habits, beliefs, aspirations, ideals, and ethical standards of its members. Any theory which ignores these broader contextual factors, social relations and normative commitments is at best incomplete, and at worst misleading and damaging” (Boston 1991 at 13; Greene 2002 at 37)

From this notion of the human being as a complex individual with multiple, variable and altruistic behavioral influences, what I call *multiple motivations theory*, it follows that public actors involved in public water distribution can work both efficiently *and* conscientiously to maintain regulatory compliance, low environmental impacts and affordable drinking water.

Political scientist Deborah Stone would call this view the *polis* (city-state or “essential political society”) model of society and contrasts it against the *market* model that undergirds the rational actor view of individual motivations (2002). Where the pure market model uses the concept of self-interest maximization to predict outcomes, the polis model uses a notion of public interest maximization. Stone lays out the basic differences between these contrasting notions of society. For example, in the market model the focus is on individual rather than on community impacts (*polis*). Collective activity and maximization of the opposing interests (public or self) is achieved solely through competition in the market model in contrast to both competition and cooperation in the polis model. Most significantly, as stated above,

in the market model the motivating factor is maximizing self interest; in the polis model the motivating factor is a combination of loyalty (to people and places), self interest, and public interest (Stone 2002). In *Service Shedding—A New Option for Local Governments*, Fixler notes that when this combination of loyalties is not present, turning total control of a public water supply to the private sector could have some serious drawbacks including “inadequate service to the poor, [insufficient number of companies] to offer sufficient competition..., and lack of guarantees concerning the future price, quality, and effectiveness of the service” (1986 at 41).

Stone’s polis model of the community when combined with Hodge’s theory of multiple human motivations provides the theoretical foundation for my hypothesis. Therefore, I hypothesize, that when a public entity operates a water utility regulatory compliance, affordability, *and* cost to the consumer will motivate decision making and yield better overall results for the consumer than private provision.

VI. RESEARCH QUESTIONS

In order to dissect whether the operation and management structure of a public water utility has a positive or negative effect on the consumer, I conduct both a quantitative statistical analysis and a qualitative in nature multiple-case study analysis. My quantitative analysis asks whether the nature of the ownership and/or management structure of a water utility affects: (1) affordability and cost to the consumer; and (2) the level of a utility’s regulatory compliance. I then conduct the qualitative case study analyses including three Massachusetts water systems representing each of the three water management structures studied—publicly

owned/publicly run, publicly owned but operated with private sector participation, and privately owned/privately run. In this comparative case study I attempt to find: (1) whether and why (or why not) the nature of the ownership and/or management structure of a water utility impacts affordability and cost to the consumer; and (2) whether the nature of the ownership and/or management structure of a water utility impacts the level of regulatory compliance and/or customers perception of water quality.

I answer these questions by looking at the varying levels of regulatory compliance, cost and affordability of water for the years 2003-2007 in the 39 water systems and 40 towns included in the quantitative portion of this research and the three towns included in the case study portion of this research. In an effort to control for as many differences between water systems as possible, outside of the operation and management structure of water distribution in the town, I look only at systems servicing between 1500 and 12000 connections that primarily utilized groundwater for their drinking water source for the duration of the research period. Four towns that meet these criteria have a privately owned/privately run water system, while seven towns have some sort of O&M contract with a private water company. All 11 towns are included in this research and can be found in Table 1.

Given the degree of variation among municipally owned and run utilities, and in order to make the most fruitful comparison between public and private operation, I include the most public-in-nature of the municipally owned utilities—those that operate as part of a department of public works. The quasi-public nature of the

Massachusetts Water Resources Authority, water districts and independent water departments would increase the probability of skewed results. To reduce further variation among the publicly owned and run utilities, I include only towns where the water division operates as an enterprise fund—a fund that offers services to the public for a fee which provides sufficient financial capital to make it a self-sustaining entity. The majority of municipalities with publicly owned water utilities operate as an enterprise fund. Twenty-eight towns in the Commonwealth of Massachusetts meet the aforementioned criteria and can be found in Table 1. A more detailed description of the research design used in this study can be found in chapters 5 and 6.

VII. ROADMAP FOR THIS STUDY

In the following chapters I discuss much of the historical evolution of private sector participation throughout the world as well as in the United States, discuss the primary reasons municipalities turn to the private sector for assistance in drinking water provision and detail the benefits and potential problems with PSP. Finally, I discuss the methodology and results of my research hopefully informing the ongoing debate over privatization.

This study is broken down into two parts. Part I, *Background Information* (chapters 1-3), contains historical information about private sector participation and why municipalities turn to the private sector for assistance. It addresses privatization as a worldwide phenomenon to provide context about the United States and, more specifically, the Massachusetts experience with private sector involvement in drinking water provision.

In chapter 2, *Evolution of Water Privatization*, I discuss the rise of the three largest multinational water companies and their influence on water provisioning in the United States. Some of these companies operate in Massachusetts, but all have influenced the growth of private sector participation in the drinking water industry. I also analyze a sampling of smaller private companies operating in the state to offer perspective on the breadth of the market.

In chapter 3, *International Discourse on Water Provisioning and Why Municipalities Turn to the Private Sector*, I review the evolving international discussion which has caused a maturation of private sector involvement worldwide. I examine the primary reasons municipalities turn to the private sector for assistance in public water provision, including discussion of infrastructure, funding and scientific expertise issues many municipalities face and analyze some of the drawbacks to PSP. In chapter 3 I conclude with a discussion of mechanisms whereby the private and public sector can work together to increase efficiency while simultaneously protecting the affordability and quality of the resource.

Part II of this study, the *Research Design and Results*, encompasses chapters 4-6. In chapter 4 I lay out the two statutes guiding the regulatory compliance analysis; the Federal Safe Drinking Water Act and the Massachusetts Water Management Act. In chapter 5, *What Privatization Looks Like: A Quantitative Analysis*, I describe the methodology used and analyze the results of the quantitative portion of this study, while in chapter 6, *Behind the Numbers: The Experience of Three Massachusetts*

Water Systems, I describe the case study methodology and results and dig more deeply into the experiences of three selected towns.

In the Conclusion section, chapter 7, *Conclusions and Recommendations*, I provide my conclusions given the historical evolution of privatization and the Massachusetts experience. In chapter 7 I also offer recommendations for alternative methods of drinking water provision beyond privatization that will preserve the goals of efficiency, sustainability, and equity.

CHAPTER 2

EVOLUTION OF WATER PRIVATIZATION

I. INTRODUCTION

In order to further contextualize this research, it is important to understand more than just water supply provision in Massachusetts, but also the external forces affecting privatization within the state. This chapter explores the evolution and influence of private water companies on the industry in the United States and internationally.

As this history will demonstrate, other countries' experience with privatization and the behavior and trajectory of water companies operating outside of the Commonwealth have an impact on what goes on within the state. For example, the historical behavior, successes and failures of the French multinational Suez Environnement have influenced the trajectory taken by Veolia Environnement, which operates in Massachusetts. Veolia has, in turn, largely affected Aquarion Water's course in Massachusetts and so on.

In this chapter I discuss the multinational companies that have been most instrumental in securing a permanent place for private sector participation in water distribution in the United States and internationally. I continue with a discussion of the currently active competitors among private water companies in Massachusetts to demonstrate the size of the market and allow the reader to gain an understanding of the variety of companies offering private services for water distribution.

II. PRIVATIZATION IN GENERAL

The privatization of public services is not new to this country.⁵ In fact, governments were contracting out public services to private entities long before the United States had a written Constitution (Greene, AWC - 2009). However, at that time the United States was a less complex nation with far fewer people and far fewer services needed. Corruption overwhelmed much of the private sector as profit, and not the service being provided, guided their actions (Cooke 2008). Throughout the 19th century, in reaction to perceived inefficiencies and abuses, cities and towns slowly took over responsibility of public services to enforce accountability and assert control (Greene 2002; Cooke 2008).

As a result, private sector involvement in water supply provisioning was not widespread throughout much of the 20th century. Indeed, the trend ran in the opposite direction as public entities continued to take control of privately run services and/or initiate widespread services not previously offered to the public on a large scale.

While at one time in the 19th century and earlier in the 20th century, the private sector offered numerous public services including: fire protection, police, electricity and transportation, market failure caused the private sector to consolidate and/or abandon its involvement in providing public services. Privatization did not regain ground as a viable method for delivery of public services until the late 20th century (Bortolotti and Siniscalco 2004).

⁵ For a history of privatization in general, see E.S. Savas, *Privatization and Public-Private Partnerships* (2000).

The philosophical argument for private market provision of public services resurfaced late in the 1970s as critics attacked what they saw as inefficiencies in the public sector, including: high labor costs, poor customer service, and high utility costs. In 1979 Margaret Thatcher, a proponent of private sector participation in public services (Savas 2000), was elected prime minister of Great Britain. Shortly thereafter, the Thatcher government decided to denationalize all state-owned-enterprises (Savas 2000; Bortolotti and Siniscalco 2004) and in 1989 privatized 100 percent of its drinking water supply (Levin, Epstein et al. 2002). The Thatcher government's service denationalization was the first of its kind, at least on a national scale, based more on dissatisfaction with the state-owned-enterprises' performance than on any efficiently working model of privatization elsewhere (Bortolotti and Siniscalco 2004).

The apparent success in Great Britain, led the United States to follow Thatcher's lead. In 1987 the Reagan administration had a legitimate privatization success, the sale of its majority interest in Conrail, a Northeast freight rail service corporation (Henig 1989-90).⁶ Though unable to implement the remainder of its private sector goals, the Reagan administration forced a "maturation of privatization as policy theory" (Henig 1989-90), highlighted by its creation of the Commission on Privatization in 1987. The administration's efforts facilitated increased privatization at the state and local level, in part due to cuts in federal aid that, when coupled with a recession and declining local tax revenues, resulted in tremendous strains on public

⁶ For an in-depth theoretical discussion of why the Reagan administration's privatization efforts failed and some pre-Reagan 'privatization-as-practice', see Henig 1989-90 at 659-61, 664; see also Donahue 1989 at 5-6.

sector institutions (Greene 2002).⁷ Bolstered by Reagan's free-market economic policies, the Thatcher government's sale of the public sector gave birth to a new age of privatization world-wide. Shortly after the Thatcher government denationalization, France, Spain, Japan, Turkey, Malaysia, Argentina, Singapore, Mexico and Brazil all denationalized aspects of their service delivery (Donahue 1989).

However, the British model of total asset sale was largely abandoned in favor of variations of the public-private partnership arrangement—by which government contracts out a portion of water related services to private companies (Petrova 2006). As I discuss below, the three primary variations of the PPP arrangement in water provision include: (1) the French model, whereby long-term contracts are given to private companies for some portion of water servicing; (2) Public Water Corporations, which are controlled by both private and public shareholders; and (3) a free market model, whereby operation and maintenance are contracted to private companies through a bidding process.

In the United States, approximately half of all community water supplies are investor owned, although they provide water services to only 16 percent of the population (Levin, Epstein et al. 2002). The remaining 84 percent of the population is serviced by public water systems. However, privatization of public water systems is on the rise (Arnold 2005). Between 1997 and 2003, the United States experienced an almost 200 percent increase in the number of privatized water systems increasing from about 400 to approximately 1100 (Arrandale 2003; Arnold 2005). This increase

⁷ At this time however, private companies did not own, manage and maintain public services as they had originally. Rather they developed contractual relationships with governments.

was largely due to three multinational water giants targeting financially struggling municipalities.

III. MAJOR PLAYERS IN WATER PRIVATIZATION

The three biggest players in the multinational water privatization game include European firms: Veolia Environnement, RWE⁸/American Water, and SUEZ Environment. These companies have dozens of wholly owned subsidiaries, some of which have a history almost as long as the municipally operated towns mentioned in chapter 1. Identifying the true corporate owner of a local company can prove a dizzying task. Though, “the big three” did not become the major players they are today until the privatization resurgence of the late 1980s early 1990s.

More recently, some of these water giants have started to downsize, selling off smaller utilities and opting for contract operations projects over ownership of a utility. Contracts for operation allow for risk sharing, but may still give the investor-owned company almost total power over the operation and management of the utility. There is some discussion of the big three moving away from the water business entirely and domestic giants such as General Electric moving in (Maxwell 2006), though the trend is unclear and the current fiscal crisis may have forestalled General Electric’s previous agenda.

A. VEOLIA ENVIRONNEMENT

Veolia Environnement (VE) is a multinational corporation of staggering proportions; operating in almost 100 countries, with five subsidiaries in the United

⁸ RWE: Rheinisch-Westfälisches Elektrizitätswerk Aktiengesellschaft

States: Veolia Water North America, Onyx Superior Services, Onyx North America, Connex North America, Dalkia North America (Wolff and Hallstein 2005) and numerous others internationally.

VE finds its origins in Compagnie Générale des Eaux (CGE), formed in 1853 by imperial decree to provide water to communities throughout France. CGE secured water distribution contracts outside of France by 1880. A century later its business had greatly expanded to include transportation, incineration, energy, and wastewater contracts. CGE changed its name to Vivendi Universal in 1998 and reorganized the water, waste management, energy, and transportation divisions into Vivendi Environnement in 1999. Also in 1999 Vivendi Universal purchased a division of the United States Filter Corporation, US Filter Operating Services, which is now Veolia Water North America (presently a subsidiary of Veolia Environnement).

A few years later, Veolia Environnement acquired a majority share in Vivendi Environnement and in 2003 Vivendi Environnement became Veolia Environnement (Veolia Environnement; Veolia Water North America).

Many of the company's US Filter assets were sold off in 2004, but Veolia Water North America remains a Veolia Environnement subsidiary. According to the Veolia website, "Veolia Water is the No. 1 provider of water servicing" and currently serves over 110 million people worldwide (Veolia Water North America). Veolia Water is the division of Veolia Environnement that deals with drinking and waste water related contracts. It claims to have held "the first industrial water outsourcing agreement" in 1950 with Bethlehem Steel and the "first municipal public-private

partnership for wastewater services” in 1972 in Burlingame, California (Veolia Water North America 2004). Veolia Water North America (a branch of Veolia Water) has contracts with municipalities in Massachusetts, two of which are included in this research: Westborough and Sturbridge.

B. RWE/AMERICAN WATER

1) American Water: A United States Born Giant

Like Veolia Environnement, the American Water Works Company is over a century old, but its empire was contained within the United States. In 1886, the American Water Works and Guarantee Company (AWWG) was founded in McKeesport, Pennsylvania by two brothers, James and W.S. Kuhn, along with Edmund Converse. The AWWG Company immediately began buying up smaller water utilities, offering financial backing, and building new water utilities. It was one of the earliest public utility parent companies in the country. AWWG continued its rapid growth in the early 20th century by expanding its repertoire to include electric utilities, coal companies and irrigation projects. However, while the company was fairly successful, its ambitions were grander than its means, causing it to go into receivership in 1913 (Cross 1991).

In 1914, the Kuhn brothers no longer managed the AWWG and its name was changed to the American Water Works & Electric Company (AWWE) (Cross 1991). Under new leadership and bolstered by the boom in electricity use and the growing economy during World War II, the AWWE Company grew to be an important part of early 1920s America. However, this rapid growth came with a price and AWWE

came close to failing as its holdings grew faster than it could reliably finance. This was not unique to AWWE and was the unwelcomed fate of numerous holding companies throughout the country as the United States entered the Great Depression (Cross 1991).

The fate of holding companies like AWWE was addressed by the Roosevelt administration as part of the New Deal. In his 1935 State of the Union address, President Franklin Roosevelt talked of repairing stability and instilling economic sense to public utilities. The speech was written to say “aboli[shing] the evil features” of these parent companies, but Roosevelt either consciously or unconsciously said what needed to happen was “the abolition of evil holding companies.” Whether a slip of tongue or a truism of conscience, historians lament the truth of Roosevelt’s misstatement, since the artificially inflated value of these holding companies contributed greatly to the stock market crash of 1929 (Cross 1991).

Shortly thereafter, Congress began debating a public utility holding company bill that would rein in some of the unfettered power the companies had previously enjoyed. The Public Utility Holding Company Act was signed into law in August of 1935. This was not a consummate victory. The Act was immediately and obstinately refuted by the holding companies who challenged it in court as unconstitutional. The Supreme Court did not rule on the case until 1945, when it voted to uphold the law (Cross 1991).

In 1946, AWWE initiated a divestment plan. Entrepreneur John Ware, already an owner of numerous smaller water utilities, took interest in AWWE’s water

business and won a controlling share in the fall of 1947. By 1953, a businessman by the name of Jack Barr, who had worked closely with Ware, had taken over most of the control of the now named American Water Works Company (AWWC) and continued the tremendous growth it enjoyed under Ware. In 1963 American Water Works merged with John Ware's Northeastern Water Company. Throughout the 1950s and 1960s, AWWC had some heated dealings, selling off difficult subsidiaries to unsuspecting buyers, and refusing to sell local subsidiaries back to adamant localities (Lexington, Kentucky and Peoria, Illinois). In the end, the AWWC retained the companies it wished, dealt off those it no longer found profitable and purchased yet more local utilities (Cross 1991).

AWWC would hence forward make a more concerted effort to have a presence in the towns where it delivered water and launched a successful public relations campaign to connect the company with customers and offer explanations for rate increases. By 1960 Ware was ready to leave the water utility business behind entirely. Through the creation of a strawman (United Utilities), Northeastern Water Company was sold and a few years later merged into the AWWC with Jack Barr at the helm. The next 15 years, while on the whole successful, were filled with lawsuits and financial battles, and in 1975 Barr retired. According to Gilbert Cross, this marked "the end of an era" (1991).

John Gubanich and Jim LaFrankie took over leadership of the AWWC and brought it into the modern age, attempting to centralize organization and management, professionalize the operations and fix the regulatory obstacles they

often encountered. Their work paid off, and between 1976-1982 earnings rose between 13-16 percent annually, with a 33 percent increase in 1983. From 1984-1991 the focus of the AWWC changed from buying up local subsidiaries piece meal to regionalization, where AWWC would focus on purchasing all water companies in multiple specific regions. This in turn, made AWWC a dominant force in the targeted regions of the United States (Cross 1991).

The empire created by the AWWC made it the biggest water utility in the United States. This, of course, made it a highly desirable prize to the growing multinational water companies—and one in particular, RWE.

2) RWE: A German Based Electric Company Turns to H₂O

Rheinisch-Westfälisches Elektrizitätswerk Aktiengesellschaft (RWE) was founded in 1898 as a German power company. Its business expanded to gas in 1909 and its service area continued to grow. Like the AWWC, RWE soon entered the holding company business and began buying up smaller utility companies. During the 1920s and 1930s RWE expanded its utility market beyond gas into different types of coal and lignite fired power plants. Much of the 1920s growth of the company was funded by USA floating dollar bonds. Still, this growth was not unfettered. RWE encountered significant expansion obstacles in Europe, particularly in Prussia. But it still had not ventured into the United States market. Its first official step into the US market was a 1981 joint venture between RWE subsidiary Rheinbraun and U.S.-based Consolidation Coal Company (RWE).

By 1967, RWE had majority ownership of 98 companies, increasing to 759 by 1997. This major increase was due in a large part to its newly gained international presence in the United States and Eastern Europe. RWE's international reputation was solidified in 2000 when it purchased Thames Water Company of Great Britain, turning RWE into the third-largest water utility in the world. In turn, Thames Water took over the operations and control of RWE's water division. Further, in January 2001, RWE offered to take over the AWWC and the shareholders accepted. Once the transaction was complete in 2003, AWWC became a subsidiary of Thames Water (RWE 2009).

There has been talk in recent years that RWE was going to make another bid to purchase Veolia Environnement (having been turned down initially in 2000), but thus far no deals have been struck (Antelman 2003). However, RWE's reign in the water business would not last long. In 2006 RWE, presumably due to international opposition and difficulties in the water market, sold Thames Water to an Australian outfit, Macquarie bank, and "floated" the AWWC on the stock exchange (RWE 2009). As of February 2009 RWE's presence in the American water market is small, and none of the towns included in this research get their water from RWE or an RWE subsidiary.

C. SUEZ ENVIRONNEMENT-ONDEO/UNITED WATER

1) United Water Resources, Inc.

United Water Resources, Inc. (United Water) has, for over a decade been one of the largest water service providers in the United States (second only to American

Water). Originally established in 1869 as the Hackensack Water Company, it suffered numerous financial and water quality issues throughout its history. The Company was plagued with bad press due to poor tasting and smelling water throughout much of the late 19th Century and went into receivership. As with the AWWC, the 1929 stock market crash severely impacted the Hackensack Water Company's earnings, but the company survived (Antelman and Derdak 2001).

The Hackensack Water Company made a swift comeback in the post-World War II years and grew through purchases of numerous smaller water companies. It became United Water Resources, Inc. in 1983 and the second largest domestic water utility by 1994. Also in the mid 1990s United Water began what would prove a profitable relationship with French water giant, Lyonnaise des Eaux-Dumez, resulting in the French water giant's 26 percent ownership interest in United Water. Following World War II and the French nationalization of gas and electric utilities, United Water Resources, Inc. became even more attractive to its French partner and would eventually become a subsidiary of Suez Environnement (the successor of Lyonnaise des Eaux-Dumez) (Antelman and Derdak 2001).

2) Suez Environnement

Present day Suez Environnement is a result of the creation and merger of multiple French companies. Beginning in 1880, La Société Lyonnaise des Eaux et de l'Eclairage was formed to manage water in Cannes, France. Approximately 40 years later, La Société Industrielle des Transports Automobiles (SITA) was established to handle waste collection in Paris. In 1939 a water treatment company named

Degrémont was founded. Degrémont is credited with building Egypt's first drinking water treatment plant in 1948 and has in large part continued to the present day as Suez's principal drinking water subsidiary (Suez Environnement 2009).

The first relevant merger took place in 1997 between La Lyonnaise des Eaux (Lyonnaise Water Company) and the Compagnie Financiere de Suez, forming Suez Lyonnaise Des Eaux. In 2000 Suez Lyonnaise Des Eaux was "the world's largest provider of water and wastewater services..." and succeeded in further bolstering their holdings by making U.S. based United Water Resources Inc. their wholly-owned subsidiary (U.S. Water News Online 2000).

In 2001 Suez Lyonnaise des Eaux became Suez Environmental and the Suez French water operations were grouped together to form Lyonnaise des Eaux. A year later, all environmental operations were grouped together in one branch of Suez, Suez Environnement. In 2002, multinational Degrémont Industrie, French Lyonnaise des Eaux Industry, Phillip Müller Hager and Elsasser, Infilco, Northumbrian Water Industry, Purite, Herco and Falk merged to create Ondeo Industrial Solutions. Ondeo is consequently a multinational, wholly owned subsidiary of Suez Environnement (Ondeo Industrial Solutions 2009).

Today, Suez Environnement exists as a branch of GDF Suez (a company created from a 2008 merger between Gaz de France and Suez), in which GDF Suez holds a 35 percent stake (GDF Suez 2009-Email response). Suez Environnement now operates on five continents with over 63,000 employees worldwide (GDF Suez 2009). In 2008 Suez Environnement, through its subsidiary United Water, strengthened its

hold on the water industry in the United States with its acquisition of “several [Earth Tech, Inc.] water sector activities...acquiring 130 O&M contracts” (Suez Environnement 2008). As of 2007, United Water held eight percent of private drinking water distribution, production and waste services. United Water currently operates in 21 states in the country and holds 145 O&M contracts, including both drinking water and sanitation services (Suez Environnement 2008).

While Suez Environnement has a United States presence, none of the towns included in this research have contracts with Suez or their subsidiaries.

IV. OTHER PRIVATE COMPANIES OPERATING IN MASSACHUSETTS⁹

A. AQUARION WATER COMPANY

Aquarion Water Company, originally known as The Bridgeport Hydraulic Company (BHC), was founded in 1857. At its inception it had a substantial service area, delivering water to approximately 18,000 residents through traditional log pipes. The BHC’s first president, serving from 1857-1876, was Joseph H. Richardson. Richardson was followed up by circus extraordinaire P.T. Barnum. Barnum was president for the next decade and helped moved the company forward by laying the groundwork for “an extensive reservoir system” (Aquarion Water Company 2007).

In 1927, an engineer became President and Chief Executive Officer for the Hydraulic Company and would remain in this post for over three decades. Under Samuel P. Senior’s guidance the Bridgewater system flourished and grew exponentially. After the

⁹ This list is not intended to be comprehensive, but offers some examples of the variety of companies involved in the Massachusetts water industry either through utility ownership or contractual obligations and elucidates the competitiveness of the industry.

passage of the U.S. Safe Drinking Water Act in 1974, the Hydraulic Company began an almost two decade long process to build six water treatment plants, which were eventually completed in 2007 (Aquarion Water Company 2007).¹⁰

Between 1997 and 2007 The Hydraulic Company expanded its service area beyond Connecticut into other portions of New England (Aquarion Water Company 2007). In 2002, The Hydraulic Company was purchased by the Kelda Group (a British utility company), and changed its name to Aquarion Water Company after Aquarius, the Greek goddess of water (Business Editors 2002; Communications Department - AWC, 2009).

Also in 2002, what became known as “Aquarion of Massachusetts” was purchased by the Aquarion Water Company (Aquarion of Massachusetts 2009). Aquarion of Massachusetts is the result of the purchase and merger of multiple smaller water supply facilities, formerly owned by the American Water Works Company (Business Editors 2001; Business Editors 2002; Communications Department - AWC, 2009). The Kelda Group’s reign over the Aquarion Water Company was short-lived. In 2006, Aquarion was sold to Macquarie Bank Limited (an Australian financial giant) for the staggering sum of \$860 million (Aquarion Water Company 2006). Aquarion remains a subsidiary of Macquarie Bank Limited today.

¹⁰ In 1980 the BHC changed its name to The Hydraulic Company for two reasons: (1) because it was about to be listed on the stock market; and (2) to demonstrate its expanded market base beyond Bridgeport (Communications Department - AWC, 2009).

¹¹ Incidentally, in 2004 two Millbury wells had to be taken off-line for perchlorate contamination (an ingredient used in rocket fuel and explosives). Again in 2008, while not within the study period of this research, the Millbury system had to take a well off-line due to a perchlorate contamination. (Siemens AG 2006; Aquarion Water Company 2009).

¹² The White family owns other water companies not highlighted in this paper, including the Milford Water Company (Whitewater 2009).

As of 2007, Aquarion is one of the largest investor-owned water utilities in the country and the largest water utility in New England, servicing more than 720,000 people in four states, including the Commonwealth of Massachusetts. There are three water systems included in this study that are serviced and/or owned by Aquarion: the Hingham/Hull/North Cohasset system (Hingham/Hull system), the Millbury system,¹¹ and the Oxford system. However, the town of Oxford is currently attempting to takeover its public water system from Aquarion using eminent domain. In a letter to Oxford residents, the Town Manager explained some of the reasoning behind the town's decision. He explained that *all* Aquarion customers are being asked to pay for a treatment plant that benefits only one town.

“When the Water Company submitted its rate increase request in 2008, it proposed and has now received approval to charge all their customers, not just Millbury customers, for the new \$5 million treatment plant in Millbury. This is the reason for the 33 to 35 percent increase proposed for Oxford customers.”

He continues,

“a private company is in business to make a profit and provide a return to its investors. And because private companies make a profit they have to pay corporate income taxes. That means that Oxford water customers are not only contributing to the cost of operating the Millbury system, they are paying the corporate income taxes and dividends to the company's owners/investors. When the Town owns and operates the water system, all of the money received will stay in the water enterprise account to pay for the debt (at a much lower interest rate than any private company can get), the operation, the maintenance and the repair of the water system. And any surplus will be reinvested in the system here in Oxford to make improvements needed here” (Zeneski 2009).

In a response to Zeneski's letter and the town's initiation of a special town meeting for the purpose of voting on the eminent domain action, Aquarion responded strongly asking

residents to consider the cost associated with such a decision. Harry Hibbard, Jr., Vice President of Operations, detailed some of the costs the town would face if it took over responsibility of its water distribution and treatment. (AWC Aquarion Water Company of Massachusetts 2009). As of the completion of this report, no additional information on the eminent domain action was available.

B. PENNICHUCK CORPORATION

The Pennichuck Corporation is a smaller, more local version of the water industry giants mentioned in section III (*above*). Originally founded in 1852 in New Hampshire, Pennichuck has grown to be the largest publicly-traded water company in New Hampshire. Pennichuck became a holding company over a century after its establishment and currently has five wholly-owned subsidiaries including: Pennichuck Water Works, Inc.; Pennichuck East Utility, Inc.; Pittsfield Aqueduct Company, Inc.; Pennichuck Water Service Corporation; and The Southwood Corporation. All but the Southwood Corporation are involved in the water industry. Pennichuck Corporation and most of its subsidiaries operate primarily in New Hampshire, but the Pennichuck Water Service Corporation is the contract operator for two Massachusetts towns: Salisbury and Hyannis (Pennichuck Corporation 2009).

Pennichuck Water Works is currently fighting an eminent domain action initiated by the city of Nashua to buy back its water utility. Nashua initiated this eminent domain action in 2002 in light of a potential takeover of Pennichuck by Philadelphia Suburban Corp. of which French based, multinational Veolia Environnement is a partial owner. The City was unhappy with the prospect of having its water delivered by an out of

state company (Smith, September 14, 2008). Philadelphia Suburban Corp.'s takeover fell through, but the City pushed forward with its eminent domain action arguing that Pennichuck: (1) is more expensive than a water utility should be; and (2) has compromised the City's water supply by developing land around it (Smith, August 31 2008). In 2003, the voters approved the eminent domain action. Five years later the New Hampshire Public Utilities Commissions found a take-back of the water utility to be in the City's best interest and priced the water utility at \$243 million (Smith, August 31 2008). Pennichuck is in the process of appealing that decision. If Nashua is successful in their eminent domain action, they plan to set up a regional water utility and contract out the operations to Veolia Water North America (discussed above section IIIA) (Smith, August 31 2008). While a prominent Pennichuck Corporation shareholder has expressed a strong desire to sell the company to the City of Nashua, nothing has been settled and Pennichuck continues to own and operate the City's water utility (Sanders 2008).

Two towns receiving water from Pennichuck are included in this research, Hyannis and Salisbury.

C. RH WHITE COMPANIES, INC.

RH White Construction, Inc. was established in 1923 by Ralph H. White. The RH White Companies currently include three divisions: the Construction Group, the Utility Management Group (run by WhiteWater, Inc.) and the Real Estate Group. The White family (Leonard White, Ralph's son and David White, Leonard's son) still own and operate RH White and its subsidiaries.

In addition to RH White and Whitewater, the White family also owns the

Whitinsville Water Company.¹²

1. WHITEWATER, INC.

WhiteWater, Inc. (WhiteWater) has a somewhat unique history. In 1980 RH White Companies, Inc. (RH White) purchased the Southbridge Water Company (located in Southbridge, Massachusetts) and simultaneously incorporated WhiteWater as a subsidiary holding company of RH White. Southbridge Water Company subsequently became a subsidiary of the newly created WhiteWater. For almost a decade, WhiteWater's only function was as a holding company of the Southbridge Water Company. In 1989, WhiteWater began to expand and won numerous operation and management water contracts throughout Massachusetts. In 2004, the Southbridge Water Company merged into WhiteWater and the Southbridge water rights were sold back to the town of Southbridge. Whitewater has, however, continued to serve as the contract operator for the town since 1989. Whitewater currently serves as the contract operator for numerous towns in Massachusetts. Hyannis, Norfolk and Northbridge are included in this study.

2. WHITINSVILLE WATER COMPANY

The Whitin family has been tied to the town of Northbridge since the 18th century. In fact, as early as the late 18th century, much of the town was named for the Whitin family (Gosselin -Genealogy: The Very Beginning (2008)) and in the late 18th century the Whitin Machine Works was built (Gosselin - Genealogy: Part II (2008)). The RH White Construction Company has been involved in the town of Northbridge's water system since the 1970s, when it purchased Northbridge Water Works from the Whitin Machine Works (Gosselin - WWC (2008)). The Whitinsville Water Company was incorporated a little over

a decade before in 1954, though the piping and infrastructure had existed since the 1800s (Whitinsville Water Company 2009). The Whitinsville Water Company is owned by the White family (also owners of RH White) and services approximately 14,000 people throughout Northbridge and an additional 1100 in surrounding communities (Whitinsville Water Company 2009). The town of Northbridge is included in this study.

D. WOODARD AND CURRAN

Woodard and Curran (W&C) is an east coast company with offices in Maine, Massachusetts, Rhode Island, Connecticut, New York and Georgia. Established in 1979 by Frank Woodard and Al Curran, W&C offers a wide range of engineering, environmental and construction services including contract operations for water, wastewater and remediation projects and currently has almost 600 employees. It does not often operate and manage entire distribution services, nor own water utilities like Pennichuck Water Works or Aquarion Water Company (Curran 2007). Rather, more frequently W&C serves as an overseer of water and wastewater projects, or as a treatment plant operator (Curran 2007; Personal Communication - Dedham Employee: Woodard and Curran Dedham Office 2009).

Provincetown contracts out the operation and management of its water to Woodard and Curran and is included in this study.

E. CH2M HILL OMI

What would become CH2M Hill OMI, was established in Oregon in 1946 named for its originators, Fred Merryfield, Holly Cornell, James Howland and T. Burke Hayes.

The engineering firm originally called Cornell, Howland, Hayes and Merryfield, quickly became CH2M for convenience. In 1971 CH2M merged with the California Engineering firm of Clair A. Hill and Associates, following a successful working relationship with the company on several wastewater treatment projects, and became CH2M Hill, Limited (CH2M Hill). CH2M Hill expanded its repertoire in the late 1970s when it landed an urban planning project in Dammam, Saudi Arabia (CH2M Hill 2009). In 1978 CH2M Hill was ranked the 10th largest engineering company in the United States (Antelman 1998).

By 1980 CH2M Hill's reputation in the engineering and wastewater field was well established. During this time of rapid growth, CH2M Hill founded a subsidiary company, Operations Management, Inc. (OMI), which would, approximately 25 years later, merge with CH2M to create CH2M Hill OMI (CH2M CH2M Hill 2009).

In the early 1980s CH2M Hill won a major Superfund contract from the U.S. Environmental Protection Agency (EPA). This relationship with Superfund took a nasty turn when CH2M Hill engaged in some questionable billing practices. CH2M Hill was audited for the years 1987-1990 and subsequently berated in a Congressional hearing. This caused much bad publicity for the company, but it quickly recovered (Antelman 1998).

By the 1990s CH2M was an established name in international engineering. It handled major projects (often in conjunction with foreign companies), for example, in Thailand, Hungary, China and Australia and became the leading contractor for the United States Agency for International Development (Antelman 1998).

Today, CH2M Hill OMI has over 17,000 employees domestically and over 25,000 employees throughout the world. No towns included in this study contract CH2M Hill

OMI to operate and manage its public water supply.

V. THOUGHTS ON THIS PRIVATIZATION BOOM

Given the enormity of private sector participation in our drinking water systems, the question remains; is it a good thing? Apparently the residents of Oxford, Massachusetts do not think so, but is that situation an anomaly? Is there a difference between having a company own your public utility (a.k.a. total asset sale) and contracting out the operations and management of a town utility while keeping ownership of the utility and water rights within the town? Or, is this merely a semantic difference? Aside from ideological issues with privatization in the drinking water field (discussed in chapter 3) and the potential for harm, if harm has not yet been realized, does private involvement actually cost consumers more money and/or lower the level of regulatory compliance of our drinking water? This study hopes to answer these questions and shed light on the ongoing debate over private sector participation in the drinking water field.

CHAPTER 3
INTERNATIONAL DISCOURSE ON WATER PROVISIONING AND WHY GOVERNMENTS
TURN TO THE PRIVATE SECTOR

I. INTRODUCTION

“By the law of nature these things are common to mankind—the air, running water, the sea, and consequently the shore of the sea.”

Institutes of Justinian 2.1.1

Throughout history water has been revered. People and animals alike have historically chosen to settle based more on proximity to water than on their proximity to any other natural resource. The easy and probable explanation is the sheer necessity of water. But could it also be because of something deeper, like the spiritual nature of water, or its healing powers? Many religions view water as a source of renewal or rebirth. For example, in the Jewish religion observants toss rocks into water to symbolize removal of their sins, cleansing of their behavior and commitment to being kinder in the upcoming Jewish year. In Christian religions water is used in baptisms to purify new members and signify their commitment to the religion. In India residents believe flowing waters like the Ganges are sacred and have magical powers (Shiva 2002). This sacred resource, normatively speaking, should be protected at all costs.

Today’s reality, however, is complicated. Municipalities throughout the United States are facing unprecedented budget shortfalls *and* aging infrastructure. Given the size and financial capacity of multinational water companies it may seem obvious why municipalities across the world turn to them for assistance in public water distribution.

Is financial acumen the recipe for a successfully run public service or does it require something more? What about equity, social justice and fairness in the distribution of an essential public service? Does private sector participation compromise access to this essential resource? Lastly, can the public and private sector collaborate to create an efficient *and* equitable public water distribution system?

In this chapter I discuss the international discourse of water provisioning and review the reasons governments privatize their public water distribution and the potential drawbacks of such a decision. I conclude with a discussion of how, if privatization is utilized, the private and public sectors can work together to protect against privatization's externalities while increasing the efficiency of service delivery.

II. HISTORY: THE INTERNATIONAL DISCUSSION BEGINS¹³

“Access to safe water is a fundamental human need and, therefore, a basic human right. Contaminated water jeopardizes both the physical and social health of all people. It is an affront to human dignity.” (United Nations Information Service 2001).

Lack of sufficient water protection has devastated much of the world.

According to the World Health Organization, at least 1.1 billion of the world's approximately six billion people do not have regular access to clean drinking water, resulting in more than two million deaths *per year* (World Health Organization 2003). Poor water conditions account for over half of illnesses worldwide and caused, between 1993 and 2003, more child deaths than all deaths resulting from armed conflict in the 60 years following World War II (World Health Organization 2003;

¹³ A legal analysis of the justiciability of a right to water is beyond the scope of this study. But it is covered in numerous law review articles (see e.g., Astle 2005).

Petrova 2006). The growing worldwide population, finite nature of accessible, clean water, and sobering health statistics have brought this pressing issue to the forefront of international discourse in recent years.

The international community first entered into discussions on water protection in 1977 at the United Nations Conference on Water, held in Mar del Plata, Argentina. This was a major milestone in water history as it was the first time international leaders gathered for the sole purpose of discussing the world's water resources. This Conference was followed by the United Nations General Assembly declaring 1980-1990 the International Drinking Water and Sanitation Decade. Little was accomplished in the 1980s, but it did substantially further the discussion of water resources on the international level. In 1992, at the United Nation's International Conference on Environment and Development (Dublin) and the Rio de Janeiro Earth Summit, international players discussed the formation of a world water council and established some principles regarding the equitable provision and management of water (World Water Council 2005; World Water Assessment Programme 2006).

At the 1994 World Water Congress in Cairo, international players passed a resolution creating the first World Water Council so a body could be dedicated to continuing discussions, securing nation-state commitment, and facilitating proactive solutions to sustainable water use (World Water Council II 2005). The World Water Council was formed by the United Nations and the World Bank in 1995 and incorporated in 1996. Additional conferences in 1995 and 1996 discussed the importance of access to safe drinking water resulting in a number of peripherally

related declarations (e.g., Rome Declaration on World Food Security and The Habitat Agenda). In 1997 the World Water Council held the First World Water Forum in Marrakech, Morocco and was viewed as very successful by the nation-states involved. The Forum resulted in the issuance of the Marrakech Declaration which detailed the importance of access to clean water, sustainable use of water and preservation of watersheds (World Water Council I 2005; World Water Assessment Programme 2006).

The World Water Forums take place every three years in different host countries. The Forums are intended to increase global awareness of water issues and encourage international collaboration on protection of this resource. World Water Forums were held in 2000 (The Hague, the Netherlands), 2003 (Kyoto, Japan) and 2006 (Mexico). All were viewed as successful, productive Forums—imposing action requirements on participating states, conducting reports on local water actions, and assessing water usage and water needs. In attendance at the World Water Forums are nation-state representatives, policy makers and analysts, World Bank officials and prominent representatives from the private water industry (World Water Council I 2005; World Water Assessment Programme 2006). The next World Water Forum is scheduled for 2009 in Istanbul, Turkey.

The World Water Forums have been a monumental step in bringing water issues to the global stage. However, many water rights activists believe the Forums are narrowly focused on corporate involvement and commodification of water rather than ensuring equal access for all in a democratic manner (Osava 2003). They believe

that privatization led solutions lack transparency and neglect the needs of the poor.

Consequently, in 2001 the World Social Forum was created as an alternative medium for solving the global water crisis. In its own words,

“The World Social Forum (WSF) developed as a response of the growing international movement to neo-liberal globalization and the effects of neo-liberal economic policies being pursued in most countries.” [The founders and participants of the WSF believe] “the path to sustainable development, social and economic justice lies in alternative models for people-centered and self-reliant progress, rather than in neo-liberal globalization” (World Social World Social Forum 2009).

In 2000 the United Nations General Assembly adopted the Millennium Declaration. Of particular importance to water rights is part III(19) of the Declaration which states, “We resolve [t]o halve, by the year 2015, the proportion of people who are unable to reach or to afford safe drinking water” (United Nations General Assembly 2003). This was one of the strongest statements about the urgency of clean water access to come out of an international body. Moreover, the United Nations General Assembly asked the United Nations Secretariat’s Department of Economic and Social Affairs to provide it with periodic progress reports on achievement of the Declaration goals.

This newfound focus on water led the United Nations to declare 2003 the International Year of Freshwater and 2005-2015 the International Decade for Action “Water for Life”¹⁴ (World Water Council I 2005; World Water Assessment Programme 2006).

¹⁴ The UN resolution can be found at http://www.unesco.org/water/water_celebrations/decades/water_for_life.pdf.

The seriousness of the United Nation's declarations is demonstrated in the 2001 formation of a World Panel on Financing Global Water Infrastructure (Panel). The Panel, a joint initiative between the Global Water Partnership, the World Water Council and the 3rd World Water Forum, convened on numerous occasions to develop a concrete plan for achieving the aforementioned Millennium Development Goal in developing and transitional countries.¹⁵ Specifically, the Panel focused on increasing the financial capital available and flowing to the issue of clean water availability. The result of Panel meetings was a 64 page report detailing the root of water infrastructure problems, governance and potential paths to a solution (Camdessus Report) (Winpenny 2003).

The Panel and Camdessus Report are a proactive, serious means of addressing such a crucial issue but have some major shortcomings. As with the World Water Forums, Panel members were primarily made up of prominent members of the private water industry, World Bank officials, and International Financial Institutions with limited representation from community advocacy groups. Not surprisingly, the Camdessus Report has a strong tone in favor of water privatization (Winpenny 2003)¹⁶ and lacks adequate focus on the poor, concentrating instead on large-scale infrastructure projects as opposed to community based and controlled solutions (International Water and Sanitation Center (IRC) 2003).

¹⁵ The focus countries include: developing and transitional countries of Latin America, the Caribbean, Africa, the Middle East, Asia, Oceania and Central & Eastern Europe and the former Commonwealth of Independent States.

¹⁶ Chapters 2 and 3 of the Panel Report in particular have a strong tone in favor of the private sector management of public water utilities.

The international community has made progress in reaching the aforementioned Millennium Development Goal and improving access to clean drinking water. In the 2008 Millennium Development Goals Report, the United Nations Secretariat's Department of Economic and Social Affairs reported that, since 1990, approximately 1.6 billion additional people now have access to safe drinking water. While undoubtedly a vast improvement, many targeted countries are still ten to 25 percent below the established 2015 Millennium Development Goal (Department of Economic and Social Affairs of the United Nations Secretariat 2008). Moreover, some of the drawbacks, environmental and social, of private sector participation in bringing this goal to fruition are not considered in any serious manner by the United Nations or Panel.

Without question, the debate continues and governments are being encouraged, even pushed, to take notice of the alarming nature of the problem. The real question now lies with finding (and realizing) the appropriate, democratic and just solution.

III. WHY GOVERNMENTS PRIVATIZE

Given the nature of the worldwide water provisioning problem why would a government turn control of such a resource to the private sector? There are numerous reasons why municipal governments in the United States turn to the private sector for assistance with public services, but most come down to the financial burdens on, as well as knowledge and expertise gaps within the municipality. The primary motivating factors include: budgetary constraints, heightened regulatory standards, reducing fiscal burdens on the municipality, aging infrastructure, risk sharing or

shifting, and poor service quality (Seader 1986; Wolff and Hallstein 2005). Another strong impetus for hiring private contractors includes the lack of adequately trained personnel on staff, and the dearth of licensed, educated water operators available for hire (Vito 2009).

The private sector arguably can increase the economic efficiency of a public service and benefit a system by sharing knowledgeable, educated and experienced staff among systems. Efficiency is defined here as allocating resources in a manner which results in an overall net economic benefit. In public policy, economists often turn to the Kaldor-Hicks' definition of efficiency for guidance: if the individuals who gain from a policy *could* compensate those who lose from the adoption of a policy (whether they actually do is immaterial), it is seen as economically beneficial and hence should be adopted.¹⁷ While the public sector could and on occasion has, private companies, like Veolia and Aquarion, are set up to take advantage of economies of scale (thereby reducing cost outlays), delivering water services to multiple municipalities in one region and sharing experts among service regions. Taking away all or a portion of the risk associated with water service provision offers an additional financial incentive to municipalities.

According to the EPA's 2007 Drinking Water Infrastructure Needs Survey and Assessment (EPA Assessment) the Commonwealth of Massachusetts will need over \$6.7 billion over the next 20 years to fix the state's aging water infrastructure. Moreover, of this \$6.7 billion, 75 percent of the infrastructure needs are in small

¹⁷ Kaldor-Hicks efficiency was developed as an improvement to Pareto efficiency, where resources are allocated in such a way as to make it impossible to reallocate them and make at least one person better off without making another person worse off.

(serving under 3,300 people) and medium size systems (serving between 3,301 and 100,000 people) with 68 percent of the need (or \$4.65 billion) in medium size systems alone.¹⁸ This is a staggering sum of money. Put into historical perspective, however, the 2007 fiscal infrastructure needs are down from the previous three surveys (1995-\$8.6 billion, 1999-\$7.7 billion, 2003-\$10.2 billion) (U.S. EPA Office of Water 2009).

The fiscal issue is further compounded by the financial outlook for America's cities. The National League of Cities 2009 report, conducted from December 2008-January 2009 found that 84 percent of city finance officers believe their cities are less able to meet current needs than in the previous year, compared to 64 percent of city finance officers believing the same less than six months prior. Additionally, 42 percent of cities report having to delay or cancel capital infrastructure outlays (Hoene 2009).

However, insufficient tax dollars do not plague the publicly owned water systems included in this research as these systems operate using an enterprise fund and could legitimately raise rates if necessary to support capital investments, seek state revolving fund financing¹⁹ or tax-free, low interest rate bonds for funding. Still, rate increases are wildly unpopular with constituents and are, therefore, often seen as a last resort by public employees (Diniak 2009; Vito 2009).

¹⁸ As you will recall, this study focuses on these small and medium size systems with the largest infrastructure needs.

¹⁹ Via the 1996 amendments to the Federal Safe Drinking Water Act, Congress established the Drinking Water State Revolving Fund. This fund can provide financing to public and privately owned systems for major capital improvements such as building new treatment plants or revamping a distribution system (EPA Office of Water 2000).

What the fiscal and enormous infrastructure needs may precipitate is the desire for a municipality to pass off the headache of major infrastructure improvements to a private company. Additionally, rising chemical costs and inadequate in-house expertise were pointed to as a strong reason for some communities to turn to the private sector for assistance (Diniak 2009; Tierney 2009). Unsurprisingly, many cities and towns view the private sector as the silver lining on an otherwise dark fiscal cloud. However, private sector participation may not be the panacea many hope for.

IV. POTENTIAL DRAWBACKS OF PRIVATE SECTOR PARTICIPATION

A. INTRODUCTION

Private sector participation *may* provide an improvement to the efficiency of an economically-struggling public works department, but it comes with its own very real potential for problems. The objections to private sector participation in water distribution include: lack of transparency and accountability; harm to the local economy in the form of job losses; access issues; cost increases; declining service and water quality; ecological ramifications; ideological objections; and potential irreversibility for the length of the contract (Gleick 2002; National Research Council 2002; Keesecker 2008). Any combination of these problems could have devastating impacts on an already financially struggling community.

Opponents to privatization see water as a noncommodity item necessary for all and thereby a human right. Consequently, opponents believe it is the government's responsibility to secure water for its residents at an affordable cost. In this section I

discuss these issues and expand in more detail on some of the risks to low-income communities in particular.

B. RATIONALE FOR IDEOLOGICAL AND PRACTICAL OBJECTIONS TO PRIVATIZATION OF WATER

1. Costs and Transparency of Rate Increases

In Massachusetts, the Department of Public Utilities (DPU) only regulates rates from investor owned and run utilities. This translates to public hearings on potential rate increases or a settlement process.

The DPU offers settlement proceedings to water companies seeking a rate increase when the increase does not appear to be too controversial. Settlement proceedings are most frequently utilized when smaller water companies seek a rate increase. In the event of a settlement proceeding, the DPU will dedicate settlement staff to act as a referee during the settlement. The role of the referee varies somewhat depending on whether the town council has intervened on behalf of town customers. If the town council is not involved, the DPU settlement staff will attempt to represent the interest of the consumer, much as the Massachusetts Office of the Attorney General would in a gas or electric rate proceeding, as well as moderate the proceedings (Osborne 2008).

If there is controversy, as is most often the case with the larger companies operating in the state, such as Aquarion of Massachusetts, the DPU will hold rate hearings. These hearings are adjudicatory in nature, utilizing witness testimony, and cross examination from any interveners. Interveners would typically be town councils and/or any industry in the town that uses a high quantity of water. Residential

customers are not directly involved in rate hearings. Paul Osborne, Assistant Director of the DPU Rates and Revenue Requirement Division, noted that most town councils are not well versed in negotiating rate proceedings since they do them so infrequently. This translates to an enormous learning curve for a town and the potential for disparity in the quality of representation. For the most part, the DPU grants rate increases when need is well documented, though it often grants a smaller increase than is requested by the private company (Osborne 2008). While the DPU attempts to level the playing field, the extensive resources of the larger privately owned and run utilities can surmount a municipality's attempts to fight these increases.

The DPU also regulates rates of return for investor-owned companies, the total overall rate of return financed by a combination of water rates and equity. It does not have a specific formula of an appropriate rate of return but rather sets them on a case by case basis. The rates of return for private water companies operating in the Commonwealth range from almost nothing up to nine percent (Osborne 2008). This however, is not the rate of return for investors, a ceiling for which is also set by the DPU. According to Troy Dixon, Manager of Regulatory Compliance at Aquarion Water Company of Connecticut, the return on equity (rate of return for investors) is theoretically higher than the overall rate of return—closer to 10 ½ percent—but due to a regulatory lag, companies rarely accomplish the return on equity permitted by the DPU (Dixon 2009).

While rates are not regulated by the DPU for municipally owned utilities, most (if not all) municipalities have rules requiring some sort of open meeting or rate

hearing where public input is permitted. Not all of these open meetings are publicized, reducing the transparency of the process. Some towns hire an outside consultant to conduct rate evaluations and help them assess financial needs (recall that all publicly owned and run utilities included in this study operate as enterprise funds, whereby expenses are covered entirely from profits). After the open meeting, the appropriate town officials (i.e. Board of Selectman, Town Manager, Board of Public Works, etc.) vote on the rate increase (Administrator at Bellingham Department of Public Works 2009; Administrator Hopkinton Water and Sewer Department 2009; Town Manager 2009).

Theoretically speaking, municipal operators have no (or limited) profit incentive. Rather, they have *multiple motivations* including incentive to keep the quality of the service high, costs down and customers (as opposed to shareholders) satisfied if they hope to be reelected (Wolff and Hallstein 2005 at 36). This established relationship with the general public has proven a successful oversight mechanism and often yields competitive water rates (Hodge 2000).

On the other hand, private contractors have a direct incentive to increase profits and reduce costs (see discussion of rational choice, chapter 1). Private companies need to be concerned with shareholders, investors and company reputation. Cutting costs and increasing profit is essential for increasing efficiency and does not necessarily lead to decreased quality and exorbitant costs to the consumer. However, profit motives make it harder for a company to keep consumer costs down and/or rationalize system upgrades necessary for long-term security of the

water supply. Conversely, a private operator concerned about its reputation may push for system upgrades, but in a privately run system, the cost of such upgrades will translate to increased costs to the consumer.

This downside is not without its benefits. Higher costs arguably have the added benefit of promoting conservation of this essential and finite resource. As Garret Hardin surmised in his seminal piece “The Tragedy of the Commons,” free goods will be abused if some measure of control is not imposed on their use. Hardin, had multiple ideas for alleviating this tragedy, not all of which involved conservation pricing.

“What shall we do [to prevent the tragedy of the commons?] We might sell them off as private property. We might keep them as public property, but allocate the right to enter them. The allocation might be on the basis of wealth, by the use of an auction system. It might be on the basis of merit, as defined by some agreed-upon standards. It might be by lottery. Or it might be on a first-come, first-served basis, administered to long queues. These, I think, are all the reasonable possibilities. They are all objectionable. But we must choose--or acquiesce in the destruction of the commons that we call our National Parks.” (Hardin 1968).

Pro-privatization advocates often point to Hardin’s example of the cow pasture—the iconic example of a commons—and the ensuing tragedy when unfettered use is permitted. They argue that without free-market imposed limitations the “tragedy” is inevitable. However, as Vandana Shiva astutely points out in *Water Wars*, Hardin’s cow pasture assumes ineffectiveness of regulation or community management of the commons (Shiva 2002). On the contrary, the United States has a very strong and stable infrastructure to answer questions of both conservation and

equitable distribution. This country's command and control²⁰ method, whereby a federal agency sets comprehensive standards (the command) but delegates enforcement authority (the control) of those standards to state agencies and citizens for managing natural resources, such as air and water, has proven extremely effective at preventing Hardin's "tragedy."

2. Public Participation

One of the strongest arguments against large-scale private involvement in public water distribution is the lack of public participation in how the private company manages and operates a municipality's water system (Fauconnier 1999). Once a private company steps into control, either through ownership or management, water distribution is removed from the public eye. Private companies have no obligation to make their daily operations transparent or subject to discussion in a public forum. In fact this top-down method of running a public water utility has caused numerous PPPs to fail (Commonwealth Foundation 2004).

Limited democratic process and lack of transparency in operation and management decisions could have far-reaching consequences on the local watershed, water quality, infrastructure of the system and the local economy (Gleick 2002; National Research Council 2002). A private contractor (or owner-operator) may find certain conservation measures too costly and potentially cause problems for the local watershed in the long-term. A private contractor (or owner-operator) may prefer its own employees over municipal employees resulting in large-scale layoffs and/or out-

²⁰ For more thorough discussion of command and control regulatory framework see (Plater, Abrams et al. 2004).

of-town hiring. Alternatively, local employees may be retained, but subject to poor working conditions, lower wages and/or no benefits. This problem can often be overcome with unionization of the work force and many private water companies are unionized.

Undoubtedly, PPP or investor owned utilities can increase efficiency, but increased efficiency does not necessarily translate to equitable distribution of a resource (Fauconnier 1999). The Commonwealth Foundation details numerous instances of increased efficiency, but no increase—and in some cases a decrease—in equity (Commonwealth Foundation 2004). Depending on the user of the term equity, it can have vastly different meanings. In this context equity refers to vertical (as opposed to horizontal) equity, whereby the focus is on evening out the financial spectrum so “ability to pay” does not impact access to a resource. I also include Fauconnier’s expanded definition of equity as including access to the utilities’ decision-making process over decisions that may affect the consumer (Fauconnier 1999).

Decisions made to cut costs and increase profits may arguably be required at times, but when a private company is making these decisions, the public has limited access and real opportunity for voicing their concerns until a decision has been made and they have observed its impacts. Closed door behavior for an essential public resource, whether in public or private control, can breed deception and corruption (Fauconnier 1999).

3. Service and Water Quality

Clean, good tasting water, low in contaminants is a primary concern for any drinking water customer. Both public and privately run utilities can suffer from poor water quality and unacceptable response times to water leakages, quality, or pressure issues (Naegele 2004; Seidenstat 2005). Consumers want to know that if there is a problem they have someone they can call who will be responsive. If this is not the case, the elected officials involved in securing the private contractor may pay the price in the next election, but there may be no recourse for a contract-operator.

4. Accountability/ Irreversibility of Contract

The limited transparency of private operation and, perhaps more importantly, the limited democratic functioning of a privately owned and operated system does not easily permit the kind of watch-dogging present in publicly run utilities. Without recourse a municipality is placing an enormous amount of faith in a private company. What if something (or many things) goes wrong? Contract cancellation is not always an easy task, nor is holding a contractor or owner-operator accountable for even serious shortcomings.

Service outages, boil orders (issued when water quality poses a public health risk), dirty water and poor response times have happened in both publicly and privately managed systems. Publicly managed systems have open lines of communication and the *accountability* of a democratic system. Private systems must rely on the media to investigate potential wrongdoing. Media is an affective watchdog, but is less focused on the happenings of small-medium sized

communities—incidentally, the communities that are currently the focus of private water companies. Again, well written, short-term contracts are essential to protect the public’s ability to cancel or otherwise hold the private company accountable for any service failures.

5. Ideological Concerns

Many opponents to privatization have objections beyond the aforementioned service and quality concerns. They fear what it means to commodify what should be, and often is, regarded as a basic human right. Proponents of public sector management believe that wealth should not be a prerequisite to an individual’s access to water, let alone access to high quality water. Public-sector proponents believe that water is a human right, much like an individual’s freedom. We would be hard-pressed in the United States to turn back the clock and limit the freedom of women to vote or African-Americans to choose where to live, go to school, go to the bathroom, or be recognized by the government as free individuals. For over forty years, these have been legally enforceable rights.²¹

C. RATIONAL FEARS? SOME EXAMPLES OF REAL PROBLEMS

Following are a handful of examples of particular PPP and privately owned company failures illustrative of the primary issues municipalities struggle with. Some of these issues may not be insurmountable, given the right set of circumstances and contractual terms, but every municipality should be aware of them.

²¹ A combination of case law and statutory law increased protections for African-Americans throughout the 20th century (e.g., *Brown v. Board of Education*, 347 U.S. 483 (1954); The 1964 Civil Rights Act, 42 U.S.C. sec. 2000a). The Nineteenth Amendment to the United States Constitution, proscribing infringement of the right to vote based on gender, was passed in 1920. U.S. Const. amend. XIX.

In Felton, California an RWE/American Water subsidiary purchased the town's water system in 2001 and caused an uproar in the town. Residents were unconvinced by a company spokesperson's promises for efficiency, low cost and improved customer service, especially after their rates increased by 100 percent and their phone calls were answered by an outfit located in Illinois (Salzman 2005).

One of the most widely publicized PPP failures took place in 2003 in Atlanta, Georgia where corruption, widespread layoffs, unsafe conditions and unacceptable emergency response times resulted from partial privatization of the city's water and led the city to cancel its contract with United Water (Food and Water Watch 2006). Had United Water been more transparent and instituted a mechanism for public involvement, the corruption, quality and safety issues could have been addressed by the company and allowed it to retain its contractual relationship with the city. In New Jersey in 2006, two senior managers at a Suez/United Water plant were indicted for covering up high levels of potentially carcinogenic radium in the drinking water (Salzman 2005). Forced transparency and increased process could have forestalled many of these issues.

The aforementioned examples underscore the importance of a carefully worded, proactively written contract for the protection of consumers.

V. COMBATABLE PROBLEMS?

“[The] market needs a place, and the market needs to be kept in its place. It must be given enough scope to accomplish the many things it does well. It limits the power of bureaucracy,...responds reliably to the signals transmitted by consumers and producers...Most important, the prizes in the market place provide the incentives for work effort and productive contribution...For such reasons I cheered the market; but I

could not give it more than two cheers. The tyranny of the dollar yardstick restrained my enthusiasm.” (Okun 1975)

As economist Arthur Okun so wisely lamented, unfettered access of the marketplace to essential public goods can prove dangerous. However, the existence of drawbacks to private sector participation does not necessarily preclude it. Given the breadth of problems in theory and in practice, can a municipality protect its’ residents while retaining a place for the private sector in public water distribution?

Eliot Sclar in, *You Don’t Always Get What you Pay For*, noted three preconditions to a successful public contract with a private company: (1) the contract must be highly specific about expectations; (2) the contract must contain a detailed assessment of the cost of the contracted work; and (3) pay attention to history, if the public service has been provided by the government for a substantial amount of time, outside contractors may not have the requisite expertise (Sclar 2000). A larger municipality with some resources may have the expertise in-house or be able to hire a good lawyer to assist in contract negotiations.

Other experts in the public water distribution field echo Sclar’s sentiments about detailed contract negotiations and finely tuned, specific and protective contracts. One contractual option proffered by proponents of private contracts for natural monopolies is a “Performance Based Contract” (PBC) (Kessler and Alexander 2004 at Appendix 1.3). PBCs give a municipality the oversight and monitoring control that could prevent many of the problems detailed above from occurring. However, Kessler and Alexander warn that continual monitoring of an outside company is costly.

Smaller municipalities typically have limited financial capital. In either of the aforementioned scenarios, the fact that the multinational water companies and large domestic water companies are targeting smaller municipalities may preclude both hiring of outside experts to draft contracts and continual monitoring of a contract-operator. A successful PPP may work under the oversight of a strong, stable and well-run public sector (Seader 1986). Perhaps the federal and state regulatory framework established to protect drinking water and groundwater is enough to protect water quality and promote conservation of this essential resource. The following chapter describes the most important legal mechanisms for protecting the quality of drinking water.

PART II

RESEARCH DESIGN AND RESULTS

CHAPTER 4 STATUTORY AND REGULATORY FRAMEWORK

I. INTRODUCTION

Drinking water involves more than just turning on “the tap.” A complicated and labor intensive process brought piped water into American homes. This water was brought from reservoirs, wells, rivers or storage basins via pipes using gravity or pumping. However, ensuring the quality of this water often proves difficult, and over time has led to a number of federal and state statutes seeking to protect water quality. Actions at the federal level include the Clean Water Act and Safe Drinking Water Act, and in the Commonwealth, the Wetlands Protection Act, Public Waterfront Act (c. 91), Rivers Protection Act and Water Management Act.

The Federal Safe Drinking Water Act (SDWA)²² and Massachusetts Water Management Act (WMA)²³ are the most effective indicators of a public water supplier’s regulatory compliance performance, when using primarily groundwater, and the most relevant laws to this research.

The SDWA is the primary statute governing drinking water protection and was established to secure the protection of human health, in other words—water that is good enough to drink—while the primary driver for the aforementioned state and federal statutes is resource protection. The SDWA regulates the quality of all drinking water (both surface and ground) whereas the Clean Water Act, Wetlands Protection Act, Rivers Protection Act and Public Waterfront Act regulate surface waters. The

²² 42 U.S.C. §§300f to 300j-26 (2008)

²³ M.G.L. c. 21G, §§1-19

water suppliers included in this study all obtain the majority of water from underground sources, making the SDWA the most relevant water protection statute. As a result, this research uses compliance with the SDWA as an indicator of whether public or private management of a water supply is better at protecting water for human consumption.

The Massachusetts Water Management Act provides additional criteria useful for analysis. In Massachusetts, before large quantities of water can be withdrawn from any ground or surface source a supplier must obtain a withdrawal permit pursuant to the WMA. Through these permits, the Massachusetts Department of Environmental Protection (DEP) tracks two performance standards (detailed below). As a second indicator of regulatory compliance, I have included one of the WMA performance standards, the amount of unaccounted for water (water that has been ‘lost’ in the system through leaks or malfunctioning meters) occurring in each public water system. This indicator will help determine whether public or private provision of drinking water is more efficient in its distribution.

In this chapter I discuss some of the background and evolution of the SDWA and water protection in general to provide an understanding of the breadth of water pollution problems as well as the breadth of solutions proffered by the SDWA. I discuss the relevant details of the two statutes and explain how I use them in this research.

II. HISTORY

Clean drinking water is a human necessity. It is also a finite resource and

vulnerable to pollution, waste and misuse. Mandatory drinking water protection was limited in the late 19th and early 20th century. In 1912, bowing slightly to pressure from constituents, and in response to numerous water borne diseases spreading through the country, Congress changed the name of the Public Health and Marine Hospital Service to the U.S. Public Health Service (PHS). The PHS was given a newly expanded role to assist states in water protection. It performed a number of valuable studies on watershed pollution, and worked closely with state health departments to assist them in adopting stricter measures for sewage disposal and for alleviating serious drinking water problems (Andreen 2003). The U.S. Public Health Service set limited bacteria standards for drinking water in 1914 (and expanded them throughout the century) but did not protect against chemical contaminants. By contrast, the 1962 revisions of the PHS standards were very broad and covered 28 substances. While a strong precursor to the 1974 passage of the Safe Drinking Water Act, they would not protect the country from the deleterious environmental and public health impacts of numerous other manmade and agricultural chemicals (EPA 2004).

It was not until the mid 20th century that the Public Health Service recognized the environmental and health threats of manmade chemicals to drinking water quality. In 1969 the Public Health Service conducted a survey of water systems in the United States. The survey illustrated many of the problems plaguing the public water systems, including inadequate poorly functioning treatment plants and failure to meet the then current (albeit limited) public health standards. A subsequent study,

conducted in 1972, found 36 chemicals present in already treated drinking water drawn from the Mississippi River. These surveys coupled with the government's increased understanding of the relationship between water and outbreaks of certain diseases led to the passage of the 1974 Safe Drinking Water Act (EPA 2004). The 1974 Act was the first major federal statute regulating drinking water quality and limiting the presence of potentially dangerous contaminants. The 1974 Act included 18 maximum contaminant limitations on organic and inorganic chemicals, turbidity levels (cloudiness)²⁴, and total coliform bacteria (fecal bacteria). However, the 1974 Act was not a consummate success. It did not include a number of harmful drinking water contaminants, such as volatile organic compounds, and did not require monitoring for all contaminants nor disinfection and filtration for all surface and groundwater systems. Perhaps most importantly, the 1974 Act did not have a requirement for keeping the community abreast of the quality of its drinking water.

Despite the view over much of the 20th century that groundwater was less susceptible to pollution than surface water (being protected from airborne contaminants by its below ground status) some drinking water experts believe groundwater is actually *more* vulnerable because once it becomes polluted, cleaning it is more arduous and costly than cleaning surface water (Platt and Klejna 1991).

There are different considerations in the care and sustainable use of this country's

²⁴ Turbidity is a water quality indicator that measures the cloudiness of a water body. High turbidity occurs when there is a high concentration of suspended and dissolved organic and inorganic matter. United States Geological Survey Office of Water Quality, *Field Manual*. http://water.usgs.gov/owq/FieldManual/Chapter6/6.7_contents.html (last visited October 31, 2008).

surface and groundwater sources, but both need protection. This realization would not come until the late 20th century.

A string of serious human health disasters in the late 1970s caused by polluted groundwater further brought the necessity of groundwater protection and the inadequacy of the 1974 Act to light. For example, in Woburn, Massachusetts, the subject of Jonathan Harr's novel, *A Civil Action*, residents experienced a high incidence of childhood leukemia and other types of cancer resulting from contaminated groundwater supplies (1995). Such incidents were widespread in the 1970s.

Consequently, in 1986 and 1996 the SDWA was substantially amended to increase the number and type of contaminants regulated and require annual water quality reporting to the public (EPA 2004).

III. FEDERAL SAFE DRINKING WATER ACT

The SDWA safeguards drinking water quality using multiple layers of protection. Drinking water is protected at the source, within the distribution system, and with specified treatment requirements when certain contaminants are found.

Pursuant to the SDWA, the United States Environmental Protection Agency has established maximum contaminant level goals for contaminants which “may have an adverse effect on the health of persons.”²⁵ These contaminant level goals are monitored in coordination with states (discussed in more detail *infra* section A). Contaminant levels may vary depending on the type of public water system being

²⁵ §300g-1(b)(a)(A)(i)

regulated. The SDWA has two categories of public water systems: community water system (systems servicing at least 15 connections used by year round residents or systems serving at least 25 year round residents) and noncommunity water systems (aptly defined as “a public water system that is not a community water system”).²⁶

This research focuses exclusively on community water systems which are, consequently, subject to all of the SDWA and federal regulations and state regulations promulgated to implement the SDWA.

In accordance with 42 U.S.C. §300g-2 of the SDWA, a state may be granted primacy authority (authority to enforce the requirements of the SDWA, with EPA oversight) if the state environmental agency has adopted drinking water regulations that are at least as stringent as the EPA regulations and has the capacity to administer the SDWA. Massachusetts has been granted SDWA primacy authority and the Massachusetts DEP’s Drinking Water Program is responsible for enforcing the SDWA and state and federal regulations.

A. STATE DRINKING WATER REGULATIONS

The state drinking water regulations, promulgated pursuant to the SDWA, can be found at 310 CMR §§ 22 et seq.; 236 CMR §2.00 and §3.00. According to §310 CMR 22.03, a public water system is in violation of the drinking water regulations if it fails to comply with any of the standards established by 310 CMR §22.00 et seq. The most recent update to the state regulations occurred in November 2006. Water systems collect and test samples from the water supply at designated intervals

²⁶ 42 USC 300f(4)(C)(16)

throughout the year (or less frequently if applicable). The DEP gets the laboratory testing results from these samples and subsequently determines whether the water system is in compliance or in violation of the SDWA and accompanying state regulations. States may pass regulations with standards that are more stringent than those passed by the EPA.

1) Tiers of Protections

a. Maximum Contaminant Levels

In Massachusetts there are four tiers of contaminants a water system is protected against. The most protective set of standards for substances is called the Maximum Contaminant Level (MCL). The EPA sets a legal limit for how much of any particular substance is allowed in a drinking water supply. For certain substances, such as 1, 4-Dichlorobenzene (p-DCB), the Massachusetts MCL is more stringent than the standard set by the EPA. Some substances do not have an MCL, but rather have a required treatment technique (which operates like an MCL) if the substance is detected in the water supply. There are over 70 substances currently governed by MCLs, including: organic and inorganic compounds, radionuclides, biologicals and Maximum Residual Disinfectant Levels (MRDL).²⁷

An MCL violation occurs when a laboratory test shows a substance (with an MCL or MRDL) present above the established federal and state limit. The number of MCL violations is quantified for this research (see Table 2 and chapter 5 for additional methodological detail).

²⁷ MRDLs focus on the amount of substances left in a drinking water system after disinfection. While they are distinguished from MCLs by name, for enforcement purposes they act the same as MCLs.

b. Lead/Copper Rule

While there are strict standards for the presence of copper and lead in drinking water, they are not regulated the same way other substances with MCLs are. Rather, the lead and copper rule (LCR)²⁸ mandates assessing the presence of copper and lead using an average “action level” or point at which the DEP forces the water utility to take action to reduce the presence of copper or lead. The action level for lead is 0.015 mg/L and for copper is 1.3 mg/L. The state action levels for copper and lead operate as a 90th percentile which means the water system is in compliance if 90 percent of the homes tested were below the action level. Conversely, this means 10 percent of homes tested can be above the allowable lead and/or copper levels. Copper and lead action level exceedances are quantified for this research (see Table 2 and chapter 5 for additional methodological detail).

c. Massachusetts Drinking Water Guidelines

While enforceable to some extent, guidelines operate distinctly from both copper and lead action levels and MCLs. Drinking water guidelines are statements regarding certain substances which may pose a threat to human health. They are issued by the DEP’s Drinking Water Program once approved by the DEP’s Office of Research and Standards.

Pursuant to 310 CMR 22.03(08),

“In the event the Department finds on the basis of a health assessment made by the Department's Office of Research and Standards that the level of any contaminant found in water collected within the distribution system and/or at the sampling point at the entry to the

²⁸ 40 CFR 141 (2008)

distribution system, pose [sic] an unacceptable health risk to consumers, acting alone or in combination with other contaminants, public water system [sic] shall take appropriate actions to reduce the level of contaminant concentrations to levels the Department deems safe or remove the source of supply from service by the deadline specified by the Department. The supplier of water shall be required to monitor the source as directed by the Department, provide public notification and notify the Department of the actions it intends to take in response to a finding that a source of supply poses an unacceptable risk to health.”

In other words, the DEP may enforce guidelines, once a guideline has been approved as necessary for the protection of human health by the DEP Office of Research and Standards. In practice, when a guideline standard is exceeded (it is not considered a violation) the DEP requires additional monitoring, but little else. The DEP currently has over 20 enforceable guidelines, and does not maintain a running list of water system guideline exceedances. Guideline exceedances are not included in this research.

d. Secondary Maximum Contaminant Levels

Pursuant to the authority given to it in the Safe Drinking Water Act, the DEP has established secondary maximum contaminant levels (SMCL) for 16 substances. These SMCLs act more like substance level goals for public water systems than the enforceable MCL limits. Public water systems are mandated under 310 CMR 22.07D(3) to “take all action necessary to reduce SMCL concentrations to levels the Department deems safe by” a specified deadline and to monitor the SMCL levels and provide the public with notice of any SMCL exceedance. However, the DEP has no further enforcement authority to ensure that SMCLs are maintained. Exceeding an

SMCL is not considered a violation. SMCL exceedances are not included in this research.

2) Tiers of Violations

The DEP has two categories for violations and the subsequent enforcement actions—higher levels of enforcement and lower levels of enforcement. The EPA considers the most severe violations (and consequently requiring a higher level of enforcement) to be those that could compromise human health, as does the DEP (Gutterman 2009).

Public water systems are required to notify the public any time a violation of a state or EPA rule occurs.²⁹ Although the EPA retains oversight and enforcement authority, since the DEP has been granted primary enforcement authority for the SDWA, the EPA generally defers to it (EPA 2004; Gutterman 2009). Going up the hierarchical chain, the SDWA requires the DEP (or relevant state authority) to submit to the EPA, annually, a report of water quality violations within the state (DEP Report).³⁰

For the quantitative portion of this research, the DEP database of violations and enforcement actions is used to determine when a violation has occurred and whether the DEP took a Lower Level Enforcement action (LLE) or a Higher Level Enforcement action (HLE).

a. Higher Level of Enforcement

i. HLE Violations

²⁹ 42 USC §300g-3(c)(1)(A); 310 CMR §22.16

³⁰ SDWA 42 USC §300g-3(c)(3)(A)

Violations requiring Higher Level of Enforcement actions include MCL violations, treatment technique violations, failure to monitor and report in the predetermined timeframe and, the catchall category, “violation”.

Treatment technique (TT) violations occur when a public water system has failed to use a required treatment for a substance found in that systems drinking water. A monitoring and reporting violation (M/R) occurs when a public water system fails to test its water supply and/or report laboratory testing results to the DEP in a timely manner. This is considered a high level violation because of the risk associated with a failure to monitor or report. In the case of a M/R violation, an MCL or TT could have been violated, but the DEP has no way of knowing without regular monitoring and reporting. The violation category (VIO) is essentially a catchall category for higher level violations that do not fit into any other category. It may include failure to submit a Consumer Confidence Report, failure to notify the public of a TT, MCL or M/R violation, or a record keeping violation. VIOs are not considered as serious as MCL, MR or TT violations but still require a higher level of enforcement (EPA 2004; Gutterman 2009).

ii. *HLE Enforcement Actions*

In Massachusetts, enforcement actions begin with the DEP. Under most circumstances, the DEP will attempt to negotiate an Administrative Consent Order (where the agency and the water system agree to the terms), that may or may not include a penalty against the water system. If this does not result in compliance, or if the DEP determines the violation is serious enough, it will issue a Unilateral

Administrative Consent Order, which may or may not include assessment of a penalty against the water system. Lastly, if public health requires, the DEP may issue a boil order—a notice to customers of a particular public water supply that they must boil the drinking water prior to consumption (Gutterman 2009).

While the DEP has the aforementioned recourse against violators available to them, the SDWA has a built in EPA oversight mechanism. The EPA has the authority to take action if a public water system does not comply with a regulatory requirement (EPA Action).³¹ This EPA Action might extend only so far as notifying the state enforcement agency and pertinent water system of the violation or to filing a civil action against the offender (42 USC §300g-3(g)).

b. Lower Level of Enforcement

A lower level enforcement action is a response to a lower level violation, that is, a violation which does not pose a risk to public health. When such a violation occurs, the DEP will issue some sort of paper enforcement action, such as a Notice of Noncompliance or an informal letter requesting some action on the part of the water system (Gutterman 2009).

3) Variances and Exemptions

Pursuant to 310 CMR §§22.13 and 22.14 respectively, the DEP may grant public water systems a temporary variance (Variance) from complying with the maximum microbiological contaminants levels and maximum radionuclide contaminant levels and/or an exemption (Exemption) for meeting any maximum

³¹ 42 USC §300g-3(a)(1)

contaminant levels. Both Variances and Exemptions are granted when a system is unable to meet maximum contaminant levels, taking cost to the supplier into account, as long as “the variance [or exemption] will not result in an unreasonable risk to health.” The supplier must, at its own expense, make the public aware of any Variance and/or Exemption.

4) Reporting Requirements

There are two comprehensive drinking water reporting mechanisms outlined in the SDWA and accompanying state regulations: Consumer Confidence Reports (CCR) and Annual Statistical Reports (ASR).

The SDWA requires each community water system within a state to prepare annually CCRs containing information about, *inter alia*, the water supplier, drinking water source, contaminant levels, treatment methods, potential health effects, violations and corrective actions. (42 USC §300g-3(c)(4); 310 CMR §22.16A).

In addition to the CCRs, the Commonwealth requires water suppliers to provide the DEP with an annual statistical report. The ASR includes the total number of customers broken down by class of user (i.e. community, noncommunity, etc.), water usage broken down by class of user, and the amount of unaccounted for water (to be discussed *infra* section III) (310 CMR § 22.15(5)).

The DEP violation, copper and lead exceedances, and enforcement action database and annual CCRs provide the basis for my SDWA regulatory compliance analysis (see Table 2 and chapter 5 for additional methodological detail).

IV. MASSACHUSETTS WATER MANAGEMENT ACT

The Massachusetts' Department of Environmental Protection is also charged with implementing the WMA. Originally passed in 1986, the WMA regulates (among other things) water withdrawal from surface and groundwater³² to protect the quantity of groundwater and allow enough time between withdrawals for the water to recharge. In addition to the rapid depletion of clean freshwater sources, groundwater quantity impacts instream flow levels (the amount of water flowing in a river or stream)(Annear, Chisholm et al. 2004). Many states have been placing increased attention on methods for managing instream flow levels and have recognized that water quantity is intrinsically linked to water quality.³³ Water quantity levels can therefore serve as an indicator of environmental health and of the ability of the water supply to support human uses.

In fulfilling its statutory mandate, the DEP promulgated regulations in furtherance of the WMA.³⁴ These regulations stipulate how and under what circumstances the DEP is to issue a permit to any potential water withdrawer.³⁵ The Massachusetts WMA and implementing regulations³⁶ regulate two categories of water withdrawers. The first is registered users, withdrawers who existed prior to the

³² M.G.L. c. 21G, §§1-19 (1986).

³³ Bradford Bowman offer a thoughtful discussion of Maine's transition in the debate over surface water management in the state from water quality to water quantity (2002).

³⁴ 310 CMR 36.00 et seq.

³⁵ See 310 CMR §36.03.

³⁶ 310 CMR 36.00 et seq.

1986 passage of the WMA and withdrew water in excess of the threshold volume.³⁷

Registered users can register their withdrawal amounts, thereby qualifying them to continue to withdraw at those levels for an additional ten years, renewable every ten years.

The second category is permitted users, users who began withdrawing water after the enactment of the WMA. Most public water suppliers (regardless of the ownership and management structure) are both registered and permitted (Friend 2008). If a public utility withdraws water in a manner that does not comply with its permit (i.e. withdrawing over the permitted amount or withdrawing during an unpermitted time of year) the DEP will typically first take a lower level enforcement action, e.g. issuing a notice of noncompliance (NON). If the NON is not sufficient to correct the action, the DEP will move to a higher level of enforcement (for more detail see *supra* section II(A)2).

In the last two years, pursuant to its WMA authority and the 2006 Massachusetts Water Conservation Standards (EOEA and WRC 2006), the DEP's Water Management Division has implemented performance standards to assess the efficiency and sustainability of a public water supplier. It has established two performance indicators: (1) Residential Gallons Per Capita Per Day (RGPCD) tracking how many gallons of water each resident uses on average per day; and (2) Unaccounted For Water (UAW) which encompasses water used but not tracked due

³⁷ Pursuant to 310 CMR §36.03, threshold volume is an average daily withdrawal of 100,000 or more gallons of water for any period of three consecutive months, where the total withdrawal is equal to or greater than 9M gallons; or an average daily withdrawal of 100,000 or more gallons for any duration exceeding three consecutive months.

to math errors, leakages, and meter problems. The UAW indicator demonstrates how successful a water utility is at preventing water waste from the point of withdrawal to its delivery to the customer. The RGPCPD number is a good indicator of how successful the public utility is at promoting sustainable, conservative water use and controlling overuse once the water reaches the customer.

The DEP has been tracking UAW more rigorously since 2006, but tracked it in previous years in each public water supplier's annual statistical report. The UAW amount reported prior to 2006 was accepted by the DEP at face value. Since 2006, the DEP's Water Management team has adjusted the UAW numbers, taking into account reported leaks among other things, to strengthen the UAW number's accuracy (typically adjusting the number upward). Members of the DEP's Water Management Program warn that they cannot guarantee the accuracy of the UAW numbers reported in the ASRs prior to 2006 (Levangie 2009).

The UAWs and enforcement actions provide the basis for my Water Management Act analysis (see Table 2 and chapter 5 for additional methodological detail).

The SDWA and WMA may provide the necessary oversight for equitable distribution of high quality drinking water with private sector participation. The next chapter discusses the results of my quantitative analysis and will help determine whether this is in fact the case.

CHAPTER 5
WHAT DOES PRIVATIZATION LOOK LIKE?
A QUANTITATIVE ANALYSIS

I. Overview

My research asks whether the ownership and management structure of a public water system has an impact on the levels of regulatory compliance, cost and affordability to the consumer. The theoretical literature supporting privatization suggests that private sector participation can play a role in increasing the efficiency of water treatment and distribution services by both reducing costs to the utility and increasing regulatory compliance. Conversely critics suggest that the economic predictions of private sector participation forgo acknowledgement of potential externalities and that publicly owned and operated utilities result in a “better” service for the customer. Given these opposing views, I sought to examine the extent to which the ownership and management structure of a public water system has an impact on cost to the consumer, affordability and levels of regulatory compliance.

My chosen variables—cost, affordability and level of regulatory compliance—are influenced by the National Research Council’s “Privatization of Water Services in the United States: An Assessment of Issues and Experience”(2002) and “Beyond Privatization” by Wolff and Hallstein (of the Pacific Institute) (2005). I’ve chosen cost, affordability and regulatory compliance as my variables for two reasons. First there is sufficient data available to analyze the aforementioned variables, and second they are good indicators of whether the polis or market model is more efficient at providing this public service.

Market Model

It is assumed by pro-privatization advocates that it is always more efficient to have a private entity provide a public service. They contend that the political self-maximization inherent in public officials decision-making process, will prevent them from taking necessary cost cutting measures if they are not popular with his/her constituency, could hurt his/her chance of reelection or could in some other way compromise that official's own self interest. By contrast, they argue, cost will be the *primary* driving force when the market guides the functioning of a service, leading to a highly efficient system and, by extension, lower costs, which in theory are passed on to the consumer in the form of lower prices or, at least, better service.

Additionally, privatization advocates assert that as a natural, *secondary* consequence of free market policies, an efficiently functioning system reduces externalities and increases lawful compliance (assuming it is more cost-effective to comply with the law than to pay the fine for noncompliance).

Polis Model/Multiple Motivations Theory

The polis model on the other hand incorporates community outcomes and the public interest into decision making. Like Hodge's *multiple motivations theory* (discussed in more detail in chapter 1), human beings are complex and respond to a variety of motivations which may include economic considerations but will also include altruistic ones.

If the polis model and multiple motivations theory accurately depict societal functioning in water service provisions one can assume that regulatory compliance

would be at least as high in a publicly run utility as in a privately run water utility since both cost and result will be taken into *primary* consideration when decisions are made. Similarly, under the polis model one would assume that cost to the consumer would be *affordable* as it is in the public interest to make life-sustaining water accessible to all economic classes. Of course, this argument presumes honesty on the part of public officials as well as the absence of major cleavages in a community or personal issues between a public official and a section of the community.

To gauge these relationships, I look exclusively at community systems, defined as a public water system that services at least 15 service connections or 25 residents year round, within the Commonwealth of Massachusetts.³⁸ I chose community water systems because I am analyzing the impact of privatization on residents rather than the market economy in any one community. The health of a community is dependent upon its access to affordable, safe drinking water.

I limit my study to towns within a single state to minimize variation in economics, government resources, presence of interested not for profit organizations, rules, regulations and rigorousness of environmental protection and water quality enforcement. My unit of analysis is a water service provider operating within one public water system.

I compile and analyze data for the years 2003 through 2007. I do not include any of the 50 towns serviced by the Massachusetts Water Resources Authority, or special water or fire districts because all are considered quasi-public entities and have

³⁸ Public Health Service Act 42 U.S.C. §300(f)(15); 310 CMR 22.02.

the potential to mask or skew the results. I also do not include water departments which operate independently from the town and are thus less public in nature.

II. QUANTITATIVE RESEARCH DESIGN

For the quantitative portion of this research, I analyze data from 39 public water systems within the Commonwealth and the 40 communities serviced by those systems. In order to make generalizable conclusions, there is minimal variation in factors that may impact cost and/or regulatory compliance within a water system. All systems included are comparable in terms of system size (servicing between 1,500 and 12,000 households) and water source (water supplied primarily from ground rather than surface sources). Holding the number of service connections relatively constant is important because bigger systems have more pipes and potentiality for problems than smaller systems. Lastly, the current trend in the United States is for private or investor-owned companies to purchase or contract with small-medium sized municipalities, making the 1,500-12,000 number more generally applicable.

I focus on municipalities that rely primarily on groundwater for the following reasons: (1) surface and groundwater are different animals, they can both be challenging to treat but in different ways, making it difficult to compare levels of regulatory compliance if both surface and groundwater were included in my analysis; (2) most small and medium sized towns use ground rather than surface water; (3) the majority of community water systems in the United States (~80 percent) use groundwater (EPA 2004); and (4) taking the Massachusetts Water Resources

Authority out of the equation, the majority of municipalities in Massachusetts use groundwater.

All systems involved in this research have been owned either publicly or privately for a minimum of five years in order to allow sufficient time for any potential impact of the ownership/management scheme to surface.³⁹

A. DATA COLLECTION

In the following section I relay my data collection methods in as much detail as possible to exhibit the reliability of my sources, collection processes and data findings.

1) Independent Variable: Public/Private Nature of Water Utility

My independent variable is the public or private nature of a town's water system. Savas defines privatization "as relying more on private institutions of society and less on government to satisfy people's needs" (Savas 2000 at 3). Privatization has come to exist on a variable continuum of private involvement in the delivery of public services (see Figure 1).

The following four categories cover the bulk of these public-private relationships (Hodge 2000; National Research Council 2002):

- 1) *Outsourcing*: a particular aspect of the service is outsourced to a private company,
- 2) *Operation and Maintenance or O&M*: the public entity still owns the utility but a large portion of the responsibility for operating and maintaining the infrastructure and delivery of the service is contracted to a private company,

³⁹ In actuality, Norfolk should not have been included in this research, not having operated with private sector participation for five years prior to 2003. However, my initial data source at the town was misinformed about the length of time WhiteWater had been assisting in the town's water operations and I did not learn of the 2002-2003 start date until my research was near completion.

- 3) *Design-Build-Operate or DBO*: the public entity still owns the utility but contracts a private company to design, construct and operate everything related to service delivery, and
- 4) *Total Asset Sale*: the public entity no longer holds any claim to the utility, rather all assets have become the property of the private company.

Most forms of privatization in Commonwealth consist of public-private relationships where the O&M is contracted to a private company. People in the water service industry often use the term PPP, P3 or ‘public-private-partnership,’ when the O&M is contracted to a private company. However, many municipalities do not like that label and consider a PPP to be much closer to the Total Asset Sale relationship than having the private company operate as a contracted employee of the town. For this reason, and in recognition of the variation in public-private relationships throughout the industry, even within the O&M structure, I refrain from calling any of the relationships studied PPPs.

The second most common relationship is Total Asset Sale, where the entirety of the water system is investor-owned or privately owned.

Consequently, I look at three types of systems: (1) systems where the O&M is contracted out to a private company, but the public retains ownership over the system; (2) systems where a municipally owned system is also municipally operated and managed; and (3) systems where a public system is both privately owned and privately operated and managed (Total Asset Sale).

Neither the DEP, New England Water Works Association nor any government

entity maintains a comprehensive list of the ownership and management structure of public water systems in the state. According to a 2007 US Census, the state of Massachusetts has almost 6.5 million people (U.S. Census Bureau 2007) living in 351 cities and towns throughout the state. The Massachusetts Department of Public Utilities regulates the privately owned and privately run water systems and was able to provide me with a complete list of these public water systems. Approximately⁴⁰ 17 or five percent of the 351 municipalities receive their water from privately owned/privately run water utilities (Osborne 2008). Another 50 municipalities receive some or all of their water from the MWRA, a quasi-public government agency governed by an appointed Board of Directors (MWRA 2009).

More than 20 municipalities get their drinking water via water or fire districts that, similar to the MWRA, have a quasi-public nature. Water and fire districts are created by special legislation and operate independently from the municipality with an independent budget and the ability to set their own tax and water rate (Erickson 2008). The remaining city and town water systems are municipally owned, operating either within a financially independent water department, or a water division housed under the umbrella of a department of public works. Approximately 30 of these municipally owned systems are operated and managed by private companies, and these numbers are rising as the large private water companies have begun targeting smaller struggling municipalities (Grant 2008). Many of the private companies involved in community water distribution in the Commonwealth are owned by

⁴⁰ I use the word approximately here because the DPU does not regulate all private/investor-owned companies.

subsidiaries of the three largest multinational water companies (discussed more fully in chapter 2).

In order to deduce the nature of the management structure of drinking water systems in the remaining Massachusetts municipalities, I analyzed data from the DEP's Drinking Water Program on public water supply contacts.⁴¹ This offered a sound framework to begin, but failed to note whether the contact was the owner and/or operator of the water system. On occasion the contact information would provide a private company email address alerting me to the possibility that the town outsourced its operations. Subsequently: I reviewed the 1999-2008 *Public Works Financing* newsletters, a water and wastewater industry newsletter, which revealed towns with ongoing and/or newly signed water contracts with private companies; I spoke with representatives from American Water Works and New England Water Works; I reviewed the websites of the company names repeatedly coming up through the aforementioned sources, including Pennichuck Corporation, Aquarian Water Company, Earthtech International, Veolia Water North America, RH White Companies, RWE, CH2M Hill, Suez-Ondeo/United Water, Housatonic Water Works Company, White Water Company, Whitinsville Water Company and Woodard & Curran, for information on the town's they served and followed up with phone calls

⁴¹ NOTE FROM THE DEP APPLICABLE TO ALL DEP GENERATED DATA:
Please note that the Drinking Water Program makes every attempt to ensure that this data is accurate, complete and current. However, no guarantee is given that this data is error free. In addition, since updates and corrections are occurring at all times this data is time sensitive. Any published use of this data should include this disclaimer and acknowledge the Massachusetts Department of Environmental Protection, Drinking Water Program.

All DEP generated data was accessed in February and March of 2009.

to the respective corporations to confirm the information. I analyzed United States Conference of Mayors Urban Water Council documents on privatization searching for additional towns. I called the remaining municipalities listed by the DEP's Drinking Water Program as predominantly utilizing groundwater in the state and asked if the town had contractual relationships with a private company for any aspect of their management or if they knew of any town that did. Lastly, a data management contact at the DEP Drinking Water Program questioned the DEP drinking water regional chiefs to find out if they knew of any additional towns within their region that outsourced any portion of their operation and management.

Through my research I discovered that approximately 30 of the 351 municipalities in the Massachusetts deliver water to their residents through some public-private contractual relationship. Of these 30, approximately seven predominantly utilize groundwater and service between 1,500 and 12,000 households. I include 100 percent of the municipalities with a public-private relationship that meet the aforementioned criteria. Additionally, of the 17 municipalities where a private or investor-owned company both owns and runs the water utility, only four predominantly utilize groundwater sources and meet the household service connection criteria. I include 100 percent of these municipalities in my research.

There are a larger number of municipalities with municipally owned and run water utilities. Of these municipalities approximately 60 utilize groundwater and service between 1,500 and 12,000 households. In order to make the municipally owned and run sample as streamlined and comparable as possible, of these 60

municipalities I include only Water Divisions that are both enterprise funds (that is, self sufficient departments run exclusively with water bill proceeds) and operate within a town Department of Public Works (DPW) or similar governmental umbrella. This encompasses the majority of municipally owned and run water utilities serving between 1,500 and 12,000. Additionally, water divisions are more “public” in nature as they operate using shared equipment with the other DPW Divisions, making them a better indicator of the efficiency of a more public in nature utility. I exclude any town with a unique contractual relationship with a private company to avoid outlier problems. For the same reason, I exclude water systems that have not been municipally owned and operated for at least five years. I include 28 of the 29 municipalities that meet the aforementioned criteria. Freetown meets the criteria for this study, but employees in the DEP’s Water Management Program lamented the reliability of Freetown’s data both historically and at present (Friend 2008). Consequently, I leave Freetown out of my analysis to prevent outlier problems and the potentiality for skewed results. I analyze 39 public water system operators in total (See Table 1 for a complete detailed list and Figure 2: Relative Frequency of Ownership/Management Structures of Towns Included in Study).

2) Dependent Variable: Cost

Cost encompasses more than the price of potable water; it implies affordability. In response to the 1996 Amendments to the Safe Drinking Water Act, the US Environmental Protection Agency issued a document, *Information for States on Developing Affordability Criteria for Drinking Water*. While the affordability

thresholds included range from 0.8 percent of annual household income, the majority considered average annual water costs below two percent of annual median household income to be affordable (EPA 2004). Wolff and Hallstein, examine the accuracy of this common affordability threshold and contend that most of the urban population can afford water at current rates, while recognizing arguments to the contrary. Consequently they recommend incorporating “customer-specific analysis” into the affordability variable to determine what customers actually find to be an affordable water rate (Wolff and Hallstein 2005).

For the purposes of the quantitative portion of this research I used cost (defined as affordable when cost is less than two percent of median annual household income) but included customer specific analysis in the multiple-case studies (discussed in more detail in chapter 6).

In order to deduce cost to the consumer, I compiled rate data from each of the 39 selected communities and interviewed their water system operators. Four different rate structures are used in Massachusetts according to the Engineering Firm Tighe and Bond: (1) a flat rate system used by 41 percent of communities (where consumer rate is fixed regardless of water usage); (2) an ascending rate system used by 55 percent of communities (where rate increases as water usage increases); (3) a flat fee system used by three percent (where total fee is fixed regardless of amount of water used); and (4) a descending rate system (where rate decreases as usage increases), used by less than one percent of water systems (Tighe and Bond). Following Tighe

and Bond's model, I calculated cost on an annual basis, assuming annual consumption of 120 hundred cubic feet (90,000 gallons).

I then compiled data on median annual household income in each of the 40 included communities. Median household income is tracked by the U.S. Census bureau every ten years. Additionally, pursuant to the authority of sections 141 and 193, Title 13 of the United States Code, the American Community Survey (ACS), a product of the U.S. Census Bureau, tracks Massachusetts county data annually for most counties. I utilized data from the 2000 U.S. Census and adjusted it for the years 2003-2007 using the ratio increase of ACS county data.

For three counties, Berkshire, Hampshire and Barnstable, 2003 and 2004 annual median income data is unavailable. Therefore, to calculate the annual median income for those counties I used the 1999 data from the 2000 U.S. Census and the 2005 ACS county data, calculate the ratios of those two data points for 1999 and 2005 and did a linear interpolation of the ratios for the intervening years. I then used the 2003 and 2004 ratios to extrapolate municipality income.

I analyzed both the annual average water rates for the 39 municipalities included in this research and the affordability of these rates given the annual median income of the municipalities. In order to accurately analyze affordability, I included 40 (as opposed to 39) municipalities as the Hingham/Hull/North Cohasset system services more than one municipality. I included annual median income from both Hingham and Hull to reach the relative affordability statistic. North Cohasset annual median income is not tracked by the U.S. Census and is therefore not available to

further enlighten the statistical analysis. However, North Cohasset makes up a very small fraction of the customers serviced by the public water system, less than one percent.

The cost dependent variable null hypotheses are as follows:

- H₀₁: The ownership/management structure of a public water system has no impact on overall annual average water cost to the consumer.
- H₀₂: The ownership/management structure of a public water system has no impact on the affordability of water.

3) Dependent Variable: Regulatory Compliance

There are two pieces of legislation most relevant to my research on regulatory compliance: the Federal Safe Drinking Water Act,⁴² and implementing regulations,⁴³ regulating drinking water quality, and the Massachusetts Water Management Act,⁴⁴ and implementing regulations,⁴⁵ regulating water withdrawal from surface and groundwater in the Commonwealth.

For the purposes of this research, SDWA regulatory compliance is judged by the number of violations, action level exceedances, and enforcement actions taken by the Massachusetts Department of Environmental Protection and/or the United States Environmental Protection Agency in accordance with the SDWA.

The DEP violation tracking database, DEP copper/lead action level database,

⁴² 42 U.S.C. §§300f to 300j-26 (2008)

⁴³ 310 CMR §§ 22 et seq.; 236 CMR §2.00 and §3.00

⁴⁴ M.G.L. c. 21G, §§1-19

⁴⁵ 310 CMR 36.00 et seq.

Consumer Confidence reports, and any EPA Action provide the basis for my SDWA regulatory compliance analysis. The DEP database information and Consumer Confidence Reports are available either online or through the DEP drinking water program (depending on the year in question). Information on EPA Actions is available through the EPA's online "envirofacts" database.⁴⁶ All are public record.

The Massachusetts' Department of Environmental Protection is also charged with implementing the WMA.⁴⁷ As a further indicator of regulatory compliance, I used the WMA UAW amounts, withdrawal violations and WMA enforcement actions, useful for examining how successful the water utility is at preventing water waste in its distribution system and complying with the law. The DEP WMA database and ASRs are available through the DEP main office and are public record.

The regulatory compliance dependent variable null hypotheses are as follows:

- H₀₃: The ownership/management structure of a public water system has no impact on the number of water quality violations incurred by the system.
- H₀₄: The ownership/management structure of a public water system has no impact on the number of copper and/or lead action level exceedances in a water system.
- H₀₅: The ownership/management structure of a public water system has no impact on the number of enforcement actions imposed on the system.
- H₀₆: The ownership/management structure of a public water system has no impact on the amount of unaccounted for water in the system.

⁴⁶ EPA's envirofacts database is available at www.epa.gov/enviro (last visited August 14, 2008).

⁴⁷ M.G.L. c. 21G, §§1-19 (1986).

B. DATA ANALYSIS

To test the null hypotheses and compare the three different ownership and management structures of water utilities in the state and their respective impact or lack of impact on regulatory compliance (not including the copper and lead exceedances), cost and affordability, I used the SPSS data analysis program to conduct an analysis of variance (ANOVA) f test for significance. To analyze compliance with the lead and copper rule⁴⁸ I used the SPSS data analysis program to conduct a crosstabulation analysis (discussed below).

There are two kinds of statistical measures that help summarize or describe the results of a larger set of numbers, central tendency and dispersion. Central tendency is useful for looking at how things cluster and determining the most typical value in a distribution of numbers. Dispersion is useful for explaining distribution spreads. ANOVA is a bivariate technique, useful when examining the relationship between a multcategory independent variable (X) and a continuous dependent (a dependent variable that can assume a large number of values) variable (Y). It takes into consideration variance from the mean both across and within the categories of the independent variable. To the extent that the former outweighs the latter, the results are more likely to be significant.

The multcategory independent variable in this research is the ownership and management structure of the water system. The continuous dependent variables are: annual average water cost, affordability, water quality violations, enforcement

⁴⁸ 40 CFR 141 (2008)

actions, and unaccounted for water amounts. The ANOVA test will determine whether the three categories of my independent variable account for a statistically significant amount of variation in my dependent variables. I tested at the .05 significance level; if this standard is met, I can be 95 percent certain that my decision to reject a null hypothesis is correct. If I reject a null hypothesis, however, I do run the risk of making a Type I error, that is, of incorrectly rejecting the null hypothesis. Since I am using a .05 significance level, my risk of making a Type I error is 5 percent. If I fail to reject a null hypothesis, I run the risk of making a Type II error, that is, of incorrectly accepting the null hypothesis. The chances of making a Type II error are more difficult to quantify but vary inversely with the risk of making a Type I error.

In addition to tests of significance, I conducted a strength test to determine the percentage of variance in the dependent variable that can be explained by the ownership/management structure of a municipality's water system. A strength test is important because strength is unaffected by sample size, whereas significance testing is always affected by sample size. If significance is not found between one or more of the dependent variables and the independent variable, it does not mean there is no connection between the two or that the ownership/management structure has no impact on regulatory compliance and cost to the consumer. Rather, this result may be a reflection of the relatively small number of communities in my study (40). Strength, being unaffected by sample size, therefore can be a useful indicator of the relationship between the independent and dependent variables when the sample size is relatively

small (or when N differs according to the variables being analyzed). Strength is analyzed using the eta squared (η^2) statistic. Eta² tells us the percentage of variation in the dependent variable that is explained, or accounted for, by the independent variable. I calculate the η^2 results of the relationship between the independent and dependent variables, calling attention to the stronger relationships in my findings.

Since the copper and lead regulatory compliance statistics are categorical, as opposed to numerical, I used a bivariate technique called crosstabulation (cross-tabs), also known as a contingency table, to assess the impact of the ownership/management structure. Cross-tabs analyzes the nature of the relationship between the independent variable and the copper/lead compliance dependent variable, tests for statistical significance, and provides a measure of the strength of the association. The chi squared (χ^2) value tells me whether the ownership/management structure of a water system has a statistically significant impact on a system's compliance with the LCR.⁴⁹ Cross-tabs is helpful for standardizing categorical data, with the use of percentages, allowing for easier comparison when a variable with multiple categories has a differing number of cases in each category. I used Cramer's V, a widely used chi-square based measure of association, to test the strength of the relationship between the independent variable and the LCR compliance dependent variable. If the measure of association is less than 0.25, a "weak" relationship exists between the two variables. If the measure of association is between 0.25 and 0.5, a "moderate"

⁴⁹ 40 CFR 141 (2008)

relationship exists, and if the strength measure is 0.5 or greater, a “strong” relationship exists between the two variables (Berman 2007).

Descriptive statistics for all numerical dependent variables included in this study can be found in Table 3.

TABLE 3: DESCRIPTIVE MEASURES OF DEPENDENT VARIABLES*							
Variable	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Affordability 2003	38	.0124	.0018	.0142	.005445	.0026397	0
Affordability 2004	40	.0118	.0017	.0136	.005396	.0024548	0
Affordability 2005	40	.0135	.0021	.0156	.005390	.0025753	0
Affordability 2006	40	.0128	.0020	.0149	.005455	.0025555	0
Affordability 2007	40	.0121	.0020	.0141	.005577	.0024593	0
Cost 2003	37	\$499	\$166	\$665	\$311.2605	\$122.38418	\$14977.887
Cost 2004	39	\$499	\$166	\$665	\$323.16	\$121.07966	\$14660.285
Cost 2005	39	\$519	\$175	\$694	\$339.8769	\$131.28584	\$17235.972
Cost 2006	39	\$519	\$175	\$694	\$353.4677	\$130.22661	\$16958.971
Cost 2007	39	\$477.50	\$187.50	\$665	\$381.6710	\$121.73326	\$14818.987
UAW 2003	37	29.60	0	29.6	14.0038	7.41956	55.050
UAW 2004	39	37.34	0	37.34	15.0915	8.66818	75.137
UAW 2005	39	24.9	1.2	26.1	11.9944	5.47218	29.945
UAW 2006	37	29	3	32	14.5135	7.69784	59.257
UAW 2007	38	41	1	42	15.5263	8.65163	74.851
MCL Violations 2003	39	3	0	3	.15	.587	.344
MCL Violations 2004	39	4	0	4	.41	.850	.722
MCL Violations 2005	39	2	0	2	.21	.469	.220
MCL Violations 2006	39	2	0	2	.26	.595	.354
MCL Violations 2007	39	2	0	2	.10	.384	.147

M/R Violations 2003	39	23	0	23	1.6410	5.50831	30.341
M/R Violations 2004	39	23	0	23	1.2564	3.78166	14.301
M/R Violations 2005	39	2	0	2	.1538	.43155	.186
M/R Violations 2006	39	24	0	24	.9744	3.86950	14.937
M/R Violations 2007	39	43	0	43	2.4103	8.07112	65.143
VIO Violations 2003	39	1	0	1	.0513	.22346	.050
VIO Violations 2004	39	1	0	1	.0769	.26995	.073
VIO Violations 2005	39	1	0	1	.0256	.16013	.026
VIO Violations 2006	39	1	0	1	.0256	.16013	.026
VIO Violations 2007	39	1	0	1	.0256	.16013	.026
TT Violations 2003	39	0	0	0	0	0	0
TT Violations 2004	39	0	0	0	0	0	0
TT Violations 2005	39	0	0	0	0	0	0
TT Violations 2006	39	0	0	0	0	0	0
TT Violations 2007	39	0	0	0	0	0	0
HLE 2003	39	1	0	1	.03	.160	.026
HLE 2004	39	1	0	1	.18	.389	.151
HLE 2005	39	1	0	1	.05	.223	.050
HLE 2006	39	2	0	2	.15	.489	.239
HLE 2007	39	3	0	3	.15	.540	.291
LLE 2003	39	3	0	3	.56	.788	.621
LLE 2004	39	5	0	5	.87	1.080	1.167
LLE 2005	39	2	0	2	.31	.569	.324
LLE 2006	39	2	0	2	.69	.800	.640
LLE 2007	39	3	0	3	.64	.811	.657

* Only the data for numerical variables is included in this table. The copper and lead compliance variables are categorical and the aforementioned measures cannot be computed for them.

III. THE RESULTS:

A. COST AND AFFORDABILITY OF WATER

- H₀₁: The ownership/management structure of a public water system has no impact on overall annual average water cost to the consumer.
- H₀₂: The ownership/management structure of a public water system has no impact on the affordability of water.

None of the towns included in this study had water rates surpassing the percent of annual median household income affordability threshold, but three towns (Provincetown, Hull and Salisbury) had water rates ranging from 0.98-1.5 percent of annual median household income, well above the average for all years considered, which hovered around 0.5 percent of annual median household income. All three of the aforementioned towns operate their water system with some degree of private sector participation. Hull is privately owned and operated by the Aquarion Water Company of Massachusetts, Salisbury contracts out the O&M of its water system to the Pennichuck Water Service Corporation, and the Provincetown water system subcontracts much of its operation to Woodard & Curran.

A few towns had annual water costs almost double the mean annual water costs for all towns included in this research. As you would expect many of these towns were the ones found to be least affordable as well. Norfolk, however, also made the cut in some of the years considered for having one of the highest annual average water costs of the towns included. As with the aforementioned towns, Norfolk operates with private sector participation. The town contracts out its

treatment operations to WhiteWater, Inc. The rates for the three most expensive systems, for each of the years considered, can be found in Table 4.

TABLE 4: WATER SYSTEMS WITH THREE HIGHEST ANNUAL WATER RATES (2003-2007)					
Systems	2003	2004	2005	2006	2007
Norfolk	\$594	\$594	\$694	\$694	\$618.50
Salisbury	\$556	\$556	—	—	—
Hingham/Hull	\$665	\$665	\$665	\$665	\$665
Provincetown	—	—	\$603	\$603	\$603

Using the SPSS system to conduct an ANOVA analysis, I found the ownership and management structure of the water systems included in this research to have a statistically significant impact on both the overall annual water cost per household and the levels of affordability for all years considered. In other words, I reject null hypotheses H_{01} and H_{02} .

As Table 5 illustrates, the publicly owned and operated systems provided water at the lowest cost to the consumer for all years considered, at a cost ranging from \$130-\$184 per year less than the privately owned and/or privately operated systems. In other words, for the duration of this study, the publicly owned and operated systems provided water at a 37-54 percent lower annual cost when compared to the systems owned and/or operated by private companies. Additionally, the publicly owned and operated systems were the most affordable to the consumer for all years considered.

Eta² values for the relationship between the ownership/management structure and cost ranged between .286 and .416 for the five years examined. Thus, my independent variable is able to account for between 28.6 percent and 41.6 percent of the variation in my cost dependent variable, depending on year selected. Eta² values for the relationship between affordability of water and the ownership/management structure ranged between .229 and .366. Therefore, between 22.9 percent and 36.6 percent of all variation in the affordability of annual water costs for the years 2003-2007 can be explained by the ownership/management structure of a public water system. (See Figures 3 and 4 for a pictorial image of the impact of the independent variable on cost and affordability).

TABLE 5: QUANTITATIVE FINDINGS: COST AND AFFORDABILITY					
VARIABLE	N value*	F_{calculated}	Significance	Mean	Eta²
AFFORDABILITY 2003	38	9.786	.000	Mean: 0.0054 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.004391 PU/PR: 0.007476 PR/PR: 0.008081	.359
AFFORDABILITY 2004	40	10.665	.000	Mean: 0.0054 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.004443 PU/PR: 0.007367 PR/PR: 0.007976	.366
AFFORDABILITY 2005	40	8.815	.001	Mean: 0.0054 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.004446 PU/PR: 0.007730	.323

				PR/PR: 0.007398	
AFFORDABILITY 2006	40	6.099	.005	Mean: 0.0055 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.004634 PU/PR: 0.007514 PR/PR: 0.007164	.248
AFFORDABILITY 2007	40	5.508	.008	Mean: 0.0056 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.004816 PU/PR: 0.007416 PR/PR: 0.007265	.229
COST 2003	37	9.299	.001	Mean: \$311.25 <u>Broken Down by Own/Mgt Structure</u> PU/PU: \$265.2308 PU/PR: \$403.3771 PR/PR: \$449.2500	.354
COST 2004	39	8.506	.001	Mean: \$323.16 <u>Broken Down by Own/Mgt Structure</u> PU/PU: \$280.9857 PU/PR: \$419.8057 PR/PR: \$449.2500	.321
COST 2005	39	7.782	.002	Mean: \$339.88 <u>Broken Down by Own/Mgt Structure</u> PU/PU: \$295.2643 PU/PR: \$455.8286 PR/PR:	.302

				\$449.2500	
COST 2006	39	5.667	.007	Mean: \$353.47 <u>Broken Down by</u> <u>Own/Mgt</u> <u>Structure</u> PU/PU: \$314.0571 PU/PR: \$456.3771 PR/PR: \$449.2500	.239
COST 2007	39	6.014	.006	Mean: \$381.67 <u>Broken Down by</u> <u>Own/Mgt</u> <u>Structure</u> PU/PU: \$344.0221 PU/PR: \$473.4557 PR/PR: \$484.5900	.250

* The N value goes up to 40 rather than 39 for the affordability statistic because I separated out Hingham and Hull for this specific analysis. Even though Hingham and Hull receive their water from the same system, the towns have different annual median household incomes. Annual median income data is not collected by the U.S. Census for North Cohasset, also serviced by the Hingham/Hull system, and North Cohasset customers makes up a small fraction (less than 1 percent) of the overall system.

LEGEND

- PU/PU= publicly owned and operated
- PU/PR=publicly owned and privately operated
- PR/PR= privately owned and operated

B. REGULATORY COMPLIANCE

Using the SPSS system to conduct an ANOVA analysis, the ownership and management structure of a water system was found not to have a statistically significant impact on any of the regulatory compliance dependent variable factors. Therefore, I must accept null hypotheses H_{03} - H_{06} . In the following sections (1-4) I discuss the relative strength of the relationship between the independent and

dependent variables. (See Tables 6, 7, 8 and 9 for the quantitative findings related to regulatory compliance).

1) Number of Water Quality Violations⁵⁰

H₀₃: The ownership/management structure of a public water system has no impact on the number of water quality violations incurred by the system.

The overall analysis of water quality violations (including MCL violations, M/R violations, TT violations and VIO violations) resulted in a strength range showing between <1 and 15.1 percent of all variation in number of violations incurred can be explained by the ownership/management structure of a water system.

Specifically, MCL violations resulted in η^2 values ranging from .026-.141, demonstrating that between 2.6-14.1 percent of all variation in the number of MCL violations can be explained by the ownership/management structure of a water system. For two of the years considered (2004 and 2006) greater than nine percent of all variation in the number of MCL violations can be attributed to the ownership/management structure. In 2004, only the publicly owned and operated systems had MCL violations. Indicating that a full public system may increase the number of MCL water quality violations. Again in 2006, the privately owned and operated systems had no MCL violations, though the significance level was .064

⁵⁰ I counted the number of violations per public water system using the federal (EPA) method. The EPA assigns violations based on individual contaminants when a public water system fails to comply with either monitoring requirements or MCLs any given year. The DEP, however, groups monitoring violations and some contaminants by type. When a public water system fails to collect a sample for all the contaminants in one group, the DEP will track and count the collective noncompliance as one violation. For example, if a public water system fails to monitor for the 23 contaminants that form the volatile organic contaminant (“VOC”) group in 2006, the DEP will count this as one violation (one per group). The EPA will count this as 23 violations (one per contaminant) (Guterman 2009).

(slightly above the .05 measure), the publicly owned and privately run systems had a mean almost four times higher than the mean of the publicly owned and run systems.

Treatment technique violations had no variation. Therefore zero percent of variations in treatment technique violations can be explained by the ownership/management structure of the system.

The M/R violations had η^2 values ranging from .023-.151. In other words, between 2.3 and 15.1 percent of all variation in M/R violations can be explained by the ownership/management structure of a water system. Only one year, 2006 had a strength measure greater than nine percent. In 2006 15.1 percent of the difference in variation of M/R violations can be explained by the relationship between the ownership/management structure, this is a moderately strong relationship and worthy of further examination. In 2006, the privately owned and run systems had no M/R violations, the publicly owned and run systems had a mean of .32 and the publicly owned/privately run systems had a mean of 4.14—almost 13 times greater than the publicly owned and run M/R violation mean (see Table 6).

The final category, VIO, had η^2 values ranging from .01 to .136. In other words, for the years 2003-2007, between one and 13.6 percent of all variation in VIO violations can be explained by the ownership/management structure of a water system.

For two of the years considered, 2004 and 2007, the strength measure was 13.6 percent and 12 percent respectively. In both years the privately owned and run systems had no VIO violations. In 2004 the publicly owned and run systems had a

mean of .04 and the publicly owned/privately run systems had a mean of .29, over seven times higher than the publicly owned and run system VIO violation mean. In 2007 only the publicly owned and privately run systems had violations. While not statistically significant for either year, the strength measure demonstrates an association between the independent variable and VIO violations for 2004 and 2007.

As Table 6 illustrates, even though statistical significance was not found for the independent variable's impact on MCL, M/R or VIO violations, the strength measure shows a relationship between the independent variable and dependent water quality variables for most of the years considered. Hence, more research including a greater sample size is warranted to determine the impact of the ownership/management structure on water quality violations.

TABLE 6: QUANTITATIVE FINDINGS: WATER QUALITY VIOLATIONS*					
VARIABLE	N value	F_{calculated}	Significance	Mean	Eta²
MCL 2003	39	.513	.603	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.21 PU/PR: 0.00 PR/PR: 0.00	.028
MCL 2004	39	1.867	.169	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.57 PU/PR: 0.00 PR/PR: 0.00	.094
MCL 2005	39	.478	.624	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.21 PU/PR: 0.29 PR/PR: 0.00	.026
MCL 2006	39	2.965	.064	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.18 PU/PR: 0.71 PR/PR: 0.00	.141

MCL 2007	39	1.035	.365	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.07 PU/PR: 0.29 PR/PR: 0.00	.054
M/R 2003	39	.490	.616	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 1.46 PU/PR: 3.29 PR/PR: 0.00	.027
M/R 2004	39	.417	.662	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 1.61 PU/PR: 0.43 PR/PR: 0.25	.023
M/R 2005	39	.972	.388	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.21 PU/PR: 0.00 PR/PR: 0.00	.051
M/R 2006	39	3.206	.052	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.32 PU/PR: 4.14 PR/PR: 0.00	.151
M/R 2007	39	.620	.543	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 3.32 PU/PR: 0.14 PR/PR: 0.00	.033
VIO 2003	39	.391	.680	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.07 PU/PR: 0.00 PR/PR: 0.00	.021
VIO 2004	39	2.831	.072	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.04 PU/PR: 0.29 PR/PR: 0.00	.136
VIO 2005	39	.188	.829	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.04 PU/PR: 0.00	.010

				PR/PR: 0.00	
VIO 2006	39	.188	.829	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.04 PU/PR: 0.00 PR/PR: 0.00	.010
VIO 2007	39	2.462	.100	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.00 PU/PR: 0.14 PR/PR: 0.00	.120

* TT violations are not included in this table because no variance was found within the groups

2) Number of Enforcement Actions

H₀₅: The ownership/management structure of a public water system has no impact on the number of enforcement actions imposed on the system.

As Table 7 illustrates, the ANOVA resulted in low η^2 values ranging from .004 to 0.71. Therefore for the years 2003-2007, between 0.4 and 7 percent of all variation in the number of enforcement actions in each municipality can be explained by the ownership and management structure of the water system.

TABLE 7: <u>QUANTITATIVE FINDINGS: ENFORCEMENT ACTIONS</u>					
VARIABLE	N value	F_{calculated}	Significance	Mean	Eta²
LLE 2003	39	.812	.452	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.54 PU/PR: 0.86 PR/PR: 0.25	.043
LLE 2004	39	.756	.477	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.96 PU/PR: 0.86 PR/PR: 0.25	.040
LLE 2005	39	.517	.601	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.32 PU/PR: 0.14	.028

				PR/PR: 0.50	
LLE 2006	39	.675	.515	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.75 PU/PR: 0.71 PR/PR: 0.25	.036
LLE 2007	39	.843	.439	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.57 PU/PR: 1.00 PR/PR: 0.50	.045
HLE 2003	39	.188	.829	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.04 PU/PR: 0.00 PR/PR: 0.00	.010
HLE 2004	39	.920	.408	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.21 PU/PR: 0.00 PR/PR: 0.25	.049
HLE 2005	39	.751	.479	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.04 PU/PR: 0.14 PR/PR: 0.00	.040
HLE 2006	39	1.385	.263	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.14 PU/PR: 0.00 PR/PR: 0.50	.071
HLE 2007	39	.067	.935	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 0.14 PU/PR: 0.14 PR/PR: 0.25	.004

3) Unaccounted For Water Amounts

H₀₆: The ownership/management structure of a public water system has no impact on the amount of unaccounted for water in the system.

The ownership and management structure of a public water system was found to have no statistically significant impact on unaccounted for water amounts and the strength of the relationship as measured by η^2 , ranged in value from 0.001 to .048. Therefore, for all years considered, between 0.1 and 4.8 percent of all variation in the UAW amounts can be explained by the ownership and management structure of the water system (see Table 8). However, while not statistically significant, the table illustrates that for all years included, the publicly owned and operated systems had the lowest UAW amounts, and for all but 2005, the privately owned and run systems had the highest UAW amounts. This finding is certainly interesting and worthy of further investigation. The lack of statistical significance within the given data reflects, again, a relatively small sample size for this study and a substantial amount of variance *within* as well as *between* water system types.

TABLE 8: QUANTITATIVE FINDINGS: UNACCOUNTED FOR WATER					
VARIABLE	N value	F_{calculated}	Significance	Mean (as % of total water available for distribution)	Eta²
UAW 2003	37	.851	.436	Mean: 14.0038 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 13.0873 PU/PR: 15.1257 PR/PR: 17.9975	.048
UAW 2004	39	.678	.514	Mean: 15.0915 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 14.2018 PU/PR: 16.2171 PR/PR: 19.3500	.036
UAW 2005	39	.596	.557	Mean: 11.9944 <u>Broken Down by Own/Mgt Structure</u>	.032

				PU/PU: 11.4671 PU/PR: 14.0143 PR/PR: 12.1500	
UAW 2006	37	.020	.980	Mean: 14.5135 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 14.3462 PU/PR: 14.8571 PR/PR: 15.0000	.001
UAW 2007	38	.793	.460	Mean: 15.5263 <u>Broken Down by Own/Mgt Structure</u> PU/PU: 14.4444 PU/PR: 17.4286 PR/PR: 19.5000	.043

4) Copper/Lead Action Level Exceedances

H₀₄: The ownership/management structure of a public water system has no impact on the number of copper and/or lead action level exceedances in a water system.

Using the SPSS system to conduct a cross-tab analysis, I found the ownership/management structure not to have a statistically significant impact on compliance with the LCR. Consequently, I am unable to reject null hypothesis H₀₄. Additionally, the strength of the relationship between the independent variable and LCR compliance levels was found to be weak (less than .25) for most years considered. In 2004, the copper compliance levels demonstrated a moderate strength measure (.267). Additionally, as indicated in Table 9, in all years considered, a subgroup of publicly owned and operated systems had copper compliance problems, but none of the privately owned and operated systems had copper compliance problems. In 2003, 2004 and 2005 a subgroup of publicly owned and operated systems had lead compliance problems, whereas none of the privately owned and

operated systems had lead compliance problems. The scope of such problems, which may be of interest from a practical regulatory perspective in which 100 percent compliance is the goal, does not attain a noteworthy level from a statistical perspective.

TABLE 9: QUANTITATIVE FINDINGS: COPPER/LEAD ACTION LEVEL EXCEEDANCES					
VARIABLE	N value	Pearson χ^2	Significance	Percentage in Compliance	Cramer's V
LEAD 2003	39	1.277	.528	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 89.3 PU/PR: 100 PR/PR: 100	.181
LEAD 2004	39	1.412	.494	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 82.1 PU/PR: 71.4 PR/PR: 100	.190
LEAD 2005	39	.828	.661	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 92.9 PU/PR: 100 PR/PR: 100	.146
LEAD* 2006	39	-	-	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 100 PU/PR: 100 PR/PR: 100	-
LEAD* 2007	39	-	-	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 100 PU/PR: 100 PR/PR: 100	-
COPPER 2003	39	2.253	.324	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 82.1 PU/PR: 100 PR/PR: 100	.240
COPPER 2004	39	2.786	.248	<u>Broken Down by Own/Mgt Structure</u>	.267

				PU/PU: 78.6 PU/PR: 100 PR/PR: 100	
COPPER 2005	39	1.277	.528	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 89.3 PU/PR: 100 PR/PR: 100	.181
COPPER 2006	39	.587	.746	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 89.9 PU/PR: 85.7 PR/PR: 100	.123
COPPER 2007	39	.403	.817	<u>Broken Down by Own/Mgt Structure</u> PU/PU: 96.4 PU/PR: 100 PR/PR: 100	.102

* No statistics were computed for lead 2006 and lead 2007 because lead compliance was 100 percent for all ownership/management structures in those years.

IV. DISCUSSION

The results of my quantitative data show that the ownership and management structure of a public water utility had a statistically significant impact on the annual average water costs and affordability of water for the years 2003-2007. Moreover, in all years considered the publicly owned and run utilities were the most affordable and the privately owned and operated systems operated at the highest cost to the consumer. Therefore, the market model does not appear to predict efficiency in the management of public water systems. However, using the market model as a theoretical starting point can explain the high consumer costs. Private water companies are required to hold profits and shareholder interests as its first priority. This accountability to shareholders coupled with the statistical cost and affordability results are consistent with the notion of the rational actor. The self-interest of private

companies and the employees who run them is to keep shareholders happy, therefore private companies must maintain high profit margins and ensure the company remains in the black. Increased cost to the consumer translates to increased profits and increased dividends for shareholders. However, shareholder accountability is just one potential explanation for the cost and affordability significance findings (additional explanations are discussed below).

Conversely, the ownership and management structure of the water systems included did not have a statistically significant impact on the level of regulatory compliance for all years considered. These results are somewhat surprising. Since all of the publicly owned and operated systems operate as enterprise funds and since the privately operated systems are similarly funded by water rates one would assume that the higher the average annual water cost, the higher the level of regulatory compliance or conversely the lower the average annual water cost, the lower the level of regulatory compliance. If cost does not translate to regulatory compliance than what explains the high regulatory compliance in the lower costing publicly owned and operated systems?

There are many potential explanations for these results. One explanation is that 39 subject public water systems is too small a sample size to make generalizable conclusions about significance, especially considering some of the apparent different water quality related findings. While not statistically significant, the data showed a strength measure above 10% for at least a portion of the years considered. So there does appear to be a relationship between the ownership and management structure of

public water systems and compliance with water quality standards. Additionally, the privately owned and run systems had no MCL violations or VIO violations for all years considered, suggesting that total privatization may result in slightly higher levels of compliance with those water quality standards. Conversely, the publicly owned/privately run systems had a higher mean of MCL, M/R and VIO violations for all years where a moderate measure of strength was found.

There are numerous potential explanations for these results that were not controlled for in this quantitative analysis. Perhaps the ownership/management structure had an impact on cost and affordability because privately operated water systems make more infrastructure improvements and conduct preventative maintenance more regularly than publicly operated systems, yielding the seemingly higher, though not statistically significant, compliance rates. Another possible explanation, as mentioned above, is that the public/private and private/private ownership/management structures charged more, not to make infrastructure improvements or improve regulatory compliance, but because the companies were accountable to shareholders and consequently concerned about profit margins.

Another potential explanation for the higher cost of privately operated systems include the requirement that private companies must pay taxes, which publicly operated systems are exempt from. Other potential explanations include the difference in the conditions of the systems being compared and the degree and cost of each systems capital investments.

A sixth possible explanation is that the five year time span studied is too short to accurately depict the consequences of a management structure. Perhaps the ownership/management structure had no impact on regulatory compliance levels because the Massachusetts DEP is such an effective regulatory body.

I believe the most important lesson learned from this quantitative analysis is that since the ownership/management structure of a public water system has had a statistically significant impact on cost to the consumer and affordability for the years considered in this study, further investigation is warranted. Private sector participation should not be assumed to increase efficiency nor decrease overall cost to the consumer. It is unclear at this stage, whether the multiple motivations theory is sufficient to explain why publicly owned and run systems maintain lower annual average water rates that are more affordable than privately operated systems. The qualitative in nature, case-study portion of this research, discussed in the following chapter, hopes to enlighten these results and offer additional explanation for them.

CHAPTER 6
BEHIND THE NUMBERS:
THE EXPERIENCE OF THREE MASSACHUSETTS WATER SYSTEMS

I. Overview

My comparative case study research explores why, as opposed to whether, the nature of the ownership/management structure of a public water utility impacts costs and affordability of water to the consumer and fails to have a significant impact on the level of regulatory compliance. I conduct three case studies of water systems within Massachusetts, one from each of the three ownership/management structures examined in the quantitative analysis. I include multiple explanatory case studies in my research because numerous town and company employees, policy analysts, industry and academic researchers have expressed concern with being able to adequately explain the impacts (or lack thereof) of a public water system's ownership and management structure based on quantitative data alone.

While case studies are typically criticized as a research method lacking generalizability, in this study they are being utilized to supplement the quantitative methodology and give greater depth to the quantitative results. The quantitative results alone cannot examine the personnel, water source quality, treatment techniques, budget, environment and town structure. Such in depth case study analysis can help explain why the three different ownership and management structures studied have varying water and affordability rates. The multiple-case study analysis employed here explores whether and why customers find their water affordable and what customers think of the town's water quality. Customer perception

and opinion is more difficult to quantify than compliance and cost. The following case studies will shed some light on the connection between high regulatory compliance and customer perception of high water quality. These “whether” and “why factors” justify the use of explanatory and exploratory case study methodology (Yin 1994).

On the one hand, various town superintendents have explained to me how municipalities might keep costs to the consumer down by failing to repair and/or update a system’s infrastructure; whereas private companies may raise rates to cover the cost of necessary infrastructure improvements. On the other hand, some town superintendents have shared with me their opinion that the financial motive present in investor-owned or privately run utilities has prevented those companies from making necessary capital investments or caused them to increase rates to improve profit margins.

Additionally, one town employee commented that regulatory noncompliance in his town resulted from a privately owned and operated water system. He lamented that under the total privatization structure preventative maintenance was neglected. The municipality consequently bought back the assets from the private company and contracted the operation and maintenance to a private company. Once the public private contract was put in place and preventative maintenance, such as “flushing” the system, began, contaminants surfaced resulting in water quality violations. These anecdotal examples require investigation beyond the quantitative analysis.

I use interviewing as my primary case study data collection method. As with the quantitative research design, the unit of analysis is a water service provider operating within one public water system. Additionally, to stave off problems of spuriousness (seemingly plausible relationship between two variables actually caused by a third unidentified variable) I include three separate water systems, one from each of the three ownership and management structures included in the quantitative analysis: (1) publicly owned and operated public water systems; (2) publicly owned public water systems operated with private sector participation; and (3) privately owned and operated public water systems. Including three cases (one from each of the ownership/management structures) will help explore the ability of Graeme Hodge's *multiple motivations* theory to explain the quantitative results. All of the components of the multiple-case study research design were flexible to accommodate interview roadblocks such as difficulty securing an interview, availability of interviewees and new information sparking a need for additional interview questions and/or interviewees (Yin 1994).

II. MULTIPLE-CASE STUDIES RESEARCH DESIGN

A. VARIABLES

- 1) Independent Variable:
Public/Private Nature of Water Utility

The case study analysis utilizes the same operationalized concept of public/private nature of the water utility as was discussed in chapter 5. I conducted case studies of three water distribution systems in the Commonwealth of Massachusetts. One with a publicly owned/publicly run utility, Hanover,

Massachusetts; one with a publicly owned system operated with private sector participation, Norfolk, Massachusetts; and one with a privately (or investor) owned/privately run utility, the Hingham/Hull system.

Since the ownership and management structure of the water systems was found to have a statistically significant impact on cost and affordability of water rates, I included the three water systems with the highest average annual water rate for each of their respective categories for all years considered. Both Hanover and the Hingham/Hull systems had no water quality violations or enforcement actions imposed for all years included in this research. The Norfolk system had a number of violations which are discussed in detail below.

2) Dependent Variables: Cost and Regulatory Compliance

The case study analysis expands upon the operationalized concept of cost discussed in chapter 5. In the case studies the focus is on both *whether* and *why (or why not)* consumers find the current cost of water affordable. Wolff and Hallstein provide a useful analysis of what may go into affordability determinations (Wolff and Hallstein 2005). First they explain that, while widely used, the two percent threshold for affordability is subject to debate. Further they persuasively argue for customer specific analysis to determine if, when and why this two percent threshold is unaffordable. Additionally, Paul Osborne of the Massachusetts Department of Public Utilities explained that looking solely at water rates may give an inadequate picture of the water cost to the consumer because public companies can bury costs in property taxes. However, this does not pose a significant issue in this research as all publicly

owned and operated systems included operate as enterprise funds and are therefore exclusively supported by water fees.

The case study analysis utilizes the same operationalized concept of regulatory compliance as was discussed in chapter 5. However in the case studies, the focus is on *why* the level of regulatory compliance found was such, as well as on customer specific opinions of water quality, rather than on *what* the level of regulatory compliance was.

In order to deduce *why*, customer perception of water quality and whether current water rates are perceived as affordable, I conducted a series of interviews with water company employees, town officials and employees in each of the three water distribution systems being studied, DEP employees in the Water Management Program and Drinking Water Program, and an exploratory sample of customers in each of the towns included.

The complete list of interview questions is included in Appendix A.

B. DATA COLLECTION

To ensure reliability of the data, I documented all private company, town employee, town official and DEP employee interviews, including date, time, number of years in their respective position and any previous positions held with the town, another water utility or a regulatory agency.

1) Study Participants

I conducted a series of interviews with the water system employees and management and town officials in each of the three water distribution systems being

studied and employees of the DEP's Drinking Water and Water Management programs. There are two main ways of conducting interviews: (1) in person; and (2) via telephone. Both methods were utilized in these case studies, as indicated below.

a. DEP Employees

I interviewed DEP employees because their regulatory capacity and breadth of exposure to municipal water systems offers a unique perspective on the efficiency levels of the varying ownership/management structures of public water systems within Massachusetts. I interviewed a member of the DEP Water Management Program looking for insight into the ability and interest of town's in minimizing water waste. I also interviewed a member of the DEP Drinking Water Program looking for insight into the varying capabilities of public water systems to minimize water quality violations, maintain high regulatory compliance and respond to violations should they arise.

b. Town Officials/Employees

In all three towns included I interviewed town employees and officials regarding their opinion and perspective of the operation and maintenance of the water system as well as their opinion of private sector participation in public water distribution. Even if the water system is owned and operated by a private entity, town officials may be more connected to the perspective of constituents, and/or reasons for high costs and compliance issues. Town employees typically also have a deeper and longer stretching historical knowledge base of the town water distribution system.

c. Private Water Company Employees

Where appropriate I conducted interviews with a representative from the private company operating and maintaining the town's water system. Contract operators, where engaged, have the greatest knowledge of operation costs and circumstances which may have led to higher water rates or compliance issues.

d. Customers

Additionally I interviewed an exploratory sample of twenty to thirty (20-30) customers in each of the three systems studied. Customers offer the on-the-ground perspective of affordability that numbers alone cannot explain. A water rate may appear high relative to other municipalities but customers may find them very affordable and have no issue paying the higher cost. Alternatively, a high cost may appear affordable given a town's annual median household income, but still pose a financial burden for a family for a variety of reasons. Customers may also enlighten the discussion of water quality even in the presence of a system with no compliance issues.

2) Interview Methods

To obtain diversity among the exploratory customer sample, I conducted interviews outside of major grocery stores in the morning (between 7-9 AM), afternoon (between 11:30AM-2PM) and evening (between 4:30-7PM). I chose grocery stores as data collection sites because they provided the best opportunity to obtain a diverse array of the town population. Alternative sites, such as retail centers, libraries and community centers may attract only specific portions of a town's population, which would hinder the exploratory findings of this research. However, it

is generally accepted that the majority of residents in a town will buy groceries, and that they will buy these groceries in a local supermarket. Where appropriate, I visited multiple grocery stores to obtain customers from different parts of town.

Customer interviews lasted anywhere from five to 15 minutes and consisted of a series of short, focused questions. In general, the following type of information was sought from the town residents:

- Overall impression of operation and maintenance of town's water system.
- Overall impression of water quality.
- Overall impression of affordability of water to consumer.
- Overall impression of operation and management of town water system.
- Opinion of private involvement in public water distribution and justification for such opinion.

For the town officials, private company, DEP and town employees I conducted interviews ranging from 30-120 minutes and asked a series of focused yet open-ended questions. This gave the interviewees the opportunity to explore their answer and the issue being asked about.

The interviews were tailored, depending on the interviewee's role in the agency, town, or company and the particular information I hoped to gather. In general, the following type of information was sought from the DEP, town and company employee interviews:

- Any perceived difference in efficiency levels of varying public water system ownership/management structures.

- Any perceived differential impacts of a public water system's ownership/management structure on cost or affordability to the consumer.
- Any perceived differential impacts of a public water system's ownership/management structure on unaccounted for water amounts.
- Any perceived differential impacts of a public water system's ownership/management structure on compliance with water quality standards.
- Justifications for above average water rates.
- Explanation for high regulatory compliance.
- Explanation for regulatory compliance problems.
- Thoughts on future rate increases or decreases.

In total, I conducted ten semi-structured, open-ended interviews with town, regulatory agency and private company employees over the course of this study and 72 focused interviews with residents of the three systems/four towns included. None of the interviews were recorded. I chose not to record the interviews for two reasons: (1) tape recording has the capacity to make interviewees more uncomfortable and guarded and may have hindered the frankness with which most interviewees spoke to me; and (2) tape recording would have greatly decreased the number of customers willing to participate in the interview process.

3) Institutional Review Board

Because this research involved human subjects, this study was submitted for review and approval to the Northeastern University's Institutional Review Board (IRB). The protocol for the human subject interviews is described below.

The identification of the customer interviewees was never obtained in order to protect them against any potential backlash from the town and/or water service provider and to increase the ease with which they answered questions. Consequently, customers are identified only by the town they are from. Prior to each interview, I verified that each participant was over 18 years of age and lived in the subject town. I explained the nature of the study, the length of the interview and confirmed that their identity was not required for the study and would not be requested. I explained that there was no compensation for participation and neither risks nor benefits to them for partaking in the study. Lastly, I impressed that their participation was strictly voluntary. At the conclusion of each interview each customer was provided with a short handout with my contact information and the contact information of the principal investigator, Professor Christopher Bosso. All customer interviews were conducted in person.

Prior to the DEP employee, town official and water system employee interviews, each participant was asked if they wished to keep their identity confidential. This option was left open for all interviewed to allow them to speak as frankly and openly as possible about their experiences with and opinions of private sector participation in public water distribution without the risk of negative recourse or political backlash. None of the aforementioned interviewees requested that their identity be kept confidential. Prior to each interview participants were emailed an informed consent document detailing the nature of this study, why they were being asked to participate, the nature of their participation, duration of interview, any

potential risks or benefits to the participant and contact information for the Division of Research Integrity, the principal investigator and myself. As most of the employee interviews were conducted via telephone, the IRB did not require that I obtain written consent. Rather, verbal consent was sufficient as long as all participants received the informed consent in advance of the interview and agreed to participate prior to beginning. All interviewees expressed their verbal consent to take part in the interview process.

The IRB approved this study on January 6, 2009. IRB materials, including the informed consent document, customer handout and approval form, are available at the Northeastern University's Office of Human Subject Research Protection.

C. DATA ANALYSIS

The opposing theoretical propositions of the market model and the polis/multiple human motivations theory discussed in chapter 1 guided my analytic strategy (Yin 1994). Economic theories of efficiency and arguments for private sector participation matched against the multiple motivation theory for decision-making yielded the quantitative and case study research questions, and provided the framework for this case study analysis. The theoretical framework enabled me to highlight data discussing worker motivations and incentives as well as varying abilities (and priorities) of water providers to reduce costs while maintaining and improving water quality.

I analyzed the interview responses for explanation of the above average rates and varying levels of regulatory compliance in the three towns studied. Included in

Table 10 is a comparison of the overall water rate, affordability and UAW averages for all towns included in this study. Recall that for the affordability analysis, there are 40 rather than 39 towns used. While the towns of Hingham and Hull received their water from the same system, the annual median household incomes in each town substantially differ from 2003-2007 and therefore needed to be analyzed separately to determine affordability. I include Table 10 to contextualize the statistics of each of the three case studies.

TABLE 10: AVERAGE WATER RATE, AFFORDABILITY AND UAW STATISTICS			
YEAR	ANNUAL WATER RATE	AFFORDABILITY (% OF ANNUAL MEDIAN INCOME)	UAW AMOUNTS (% OF TOTAL WATER AVAILABLE FOR DISTRIBUTION)
2003	\$311.25	0.54%	14%
2004	\$323.16	0.54%	15.1%
2005	\$339.88	0.54%	12%
2006	\$353.47	0.55%	14.5%
2007	\$381.67	0.56%	15.5%

III. RESULTS

A. NORFOLK, MASSACHUSETTS

Established in 1870, Norfolk, Massachusetts is, by their own account, “a semi-rural suburban community” (Virtual Town Hall May 4, 2009). It is located in Norfolk County and has, as of the 2000 U.S. Census, 10,460 residents (United States Census Bureau 2000) living in 15.1 square miles (MASS Online 2009). The annual median household income as of 2000 was \$86,153 (United States Census Bureau 2000). Per my calculations and adjustments, the annual median household income as

of 2007 was approximately \$107,577.16 (see chapter 5 for additional detail). There were 228 commercial establishments in the town, as of 2006, according to the North American Industry Classification System (NAICS) (developed by the Office of Management and Budget), but the present new construction promises to change that (NAICS 2006). The town is governed primarily through the Board of Selectman but also utilizes open town meetings and a Town Administrator (Virtual Town Virtual Town Hall May 4, 2009).

Norfolk's water system has an interesting and varied history. It has been publicly owned since its inception, but until the 1960s received its water from the neighboring town of Wrentham. At that time, Norfolk began operating its own water system and formed a public water company funded through an enterprise fund and governed by an independently elected Board of Water Commissioners (Water Board). This system lasted until 2004, when a selectman proposal to create a Department of Public Works was approved through an open town meeting and passed by the legislature. There was an interim DPW for two years to assist with the transition and the current DPW structure was in place as of 2006 (Garrity 2009).

Many lament the organization, efficiency and record keeping of the Water Board (Garrity 2009; Vito 2009). Butch Vito, DPW Director, noted that "while the Board wasn't necessarily deficient, there were a lot of things that weren't necessarily being addressed." The Board did not look to the future to increase supply with the growth of the town and there was no harmony between the water board and the separate road program. "[R]oads might be dug up [one year] for new roads, and then

dug up again a year later to put in a water main. Now these things aren't duplicated, but are done at the same time" (Vito 2009).

WhiteWater, Inc., a subsidiary of and the utility management division for R.H. White Companies, Inc.,⁵¹ was first contracted by the town of Norfolk in 2003 due to maintenance problems, water quality issues and the departure of the superintendent. It is now contracted on a three year basis, with the current contract ending in 2011. Initially WhiteWater was contracted to act as the town's superintendent and was responsible for oversight of the water treatment and distribution operations. The Town assumed responsibility for distribution operations in 2005⁵² and currently contracts WhiteWater to maintain water quality (Tierney 2009). Specifically, WhiteWater operates the two treatment plants in Norfolk with one Norfolk dedicated WhiteWater employee, but has forty employees on staff throughout the state with a variety of maintenance and operations expertise. WhiteWater's current responsibilities include recording flows, checking chemical levels, ordering chemicals and monitoring the water quality (Tierney 2009).

The town's water budget (projected for the upcoming fiscal year) is \$1.3 million with almost half of it allocated to distribution costs (including salaries, routine expenses and other contracted services). A little over \$500,000 is allocated to debt service and approximately \$170,000 allocated to WhiteWater (Garrity 2009). The Town has three employees dedicated to the water system (two involved in distribution

⁵¹ The background of WhiteWater, Inc. is discussed in more detail in Chapter 2.

⁵² Town responsibilities include hydrant, valve and meter maintenance, distribution pipe laying, repair and maintenance, leak detection, billing and customer service.

and one administrative assistant). The DPW Director splits his time between the five DPW divisions (water, solid waste, highway, grounds maintenance and vehicle maintenance).

The town's water system consists of 57 miles of water mains, approximately 2,200 service connections (the majority of which are residential), two storage tanks and two well sites (with more than one well at each site) (Garrity 2009; Vito 2009). Curiously, all interviewees had remarkably different answers when asked what percentage of the town was on town, as opposed to private well, water. Mr. Garrity estimated the number to be about 50/50, Mr. Vito thought at least 70 percent of the town was on town water, while Mr. Tierney relayed that only about 1/3 of the town was on town water (Garrity 2009; Vito 2009; Tierney 2009). Based on this information, it appears that somewhere between 33 percent and 70 percent of residents are on town water.

Through my quantitative analysis, I discovered that, for the duration of this research, the town of Norfolk had the highest water rate for all publicly owned systems utilizing private sector participation. Moreover, for 2005 and 2006, it had the highest annual average water cost and the second highest annual average water cost for 2003, 2004 and 2007 of all 39 systems included. The average annual water costs for Norfolk were from approximately \$200 up to \$350 per year more than the mean rates for all towns included in this study (see Table 10 above). The Norfolk rates were as follows: \$594 (2003 and 2004), \$694 (2005 and 2006) and \$618.50 (2007) (see Table 11).

The affordability statistics, while above average, did not yield such stark results. The affordability numbers were slightly above the average (which hovered around 0.55 percent) and ranged from 0.57 percent of annual median household income up to 0.71 percent of annual median household income (see Table 11).

The Town of Norfolk had regulatory compliance problems during the period studied. As shown in Table 11, in 2003 and 2004 the water supply exceeded the lead and copper action levels, in 2006 the system reported two MCL violations for total coliform as well as 24 monitoring violations. Norfolk also reported above average UAW amounts for all years considered: (2003 and 2004) 28 percent of all water available was lost; (2005) 16.3 percent; (2006) 16 percent; (2007) 42 percent. The DEP Water Management Act Program Chief commented that these are “really high numbers...[and, referring to the 2007 42 percent amount,] you would guess they could catch a leak that big” (Levangie 2009).

TABLE 11: NORFOLK SYSTEM STATISTICS				
YEAR	ANNUAL WATER RATE	AFFORDABILITY (% OF ANNUAL MEDIAN INCOME)	VIOLATIONS	UAW AMOUNTS (% OF TOTAL WATER AVAILABLE FOR DISTRIBUTION)
2003	\$594	0.65%	<ul style="list-style-type: none"> • exceeded lead and copper action levels 	28%
2004	\$594	0.62%	<ul style="list-style-type: none"> • exceeded lead and copper action levels 	28%
2005	\$694	0.71%	0	16.3%
2006	\$694	0.70%	<ul style="list-style-type: none"> • 24 M/R violations • 2 MCL violations (total coliform) 	16%
2007	\$618.50	0.57%	0	42%

In order to determine the reasons for the above average annual water costs, regulatory compliance issues, high UAW amounts and overall affordability of water, I questioned Remo (Butch) Vito, Director of the town's DPW and veteran superintendent having operated numerous systems throughout the state; Robert Garrity, a town selectman who has been working in town government since 1996 and was a member of the adhoc DPW committee⁵³ from 2000-2001; Russell Tierney, a WhiteWater Division Manager responsible for water and wastewater operations along the Mass Pike line; Duane Levangie, DEP Water Management Act Program Chief; and Damon Gutterman, a DEP Drinking Water Program supervisor.

Gutterman could not understand why Norfolk's water rates were so expensive and commented that the last capital improvements he was aware of happened in 2001 and should have been paid for by 2003. Levangie also could not understand why Norfolk's water rates were so high. Levangie argued that private sector participation tends to increase costs to the consumer and Gutterman commented, "I am assuming [the town is] saving money by [contracting out the treatment to a private company] but maybe they are just saving headache" (Gutterman 2009; Levangie 2009).

Neither Tierney, Vito nor Garrity believed that WhiteWater's involvement has had a negative impact on the town's water rates. Rather, all felt that WhiteWater helped to keep costs down by taking care of things Norfolk was not yet capable of handling in house. They commented that Norfolk's water rates were above average for a number of different reasons unrelated to the private subcontractor, including: (1)

⁵³ The adhoc DPW committee was responsible for initiating the action that led to the eventual creation of a Department of Public Works and charged the Board of Selectman with folding the independent Water Board into a DPW (Garrity 2009).

they moved to a graduate rate structure as a conservation measure, to serve as a disincentive for high water use; (2) Norfolk is a rural community with the same miles of water pipes as many towns, but substantially fewer users to spread the maintenance and operation costs onto; and (3) they made many capital investments in the last five years to improve water quality and efficiency, including an electronic (as opposed to manual) meter system and rehabilitation of a water tank which increased their debt.

Regarding water quality and the aforementioned violations, Gutterman felt that a total coliform violation does not necessarily indicate a poorly run system, noting that it is a relatively common water quality violation. He found the 24 monitoring violations more problematic, but felt that they appeared to have gotten a wakeup call since 2006, as Norfolk's compliance record has improved. He also commented that, anecdotally speaking, privately run systems tend to have slightly higher compliance rates when compared to publicly run systems (Gutterman 2009).

The DEP recommends preventative maintenance as a strong antidote to compliance problems. Specifically, the DEP recommends annual flushing of the water mains, annual exercising of valves and regular tank inspections to search for debris buildup, corrosion and degradation (Gutterman 2009) (see Table 14: Comparative Table of Preventative Maintenance Measures).

Tierney and Vito spoke to Norfolk's compliance issues as well. According to Vito, the lead and copper violations were caused by high pH levels and corrosion, which he feels was addressed in 2004 shortly after the copper and lead issues arose. Vito explained that the coliform violation occurred because of a storage tank

problem, which has since been rectified. Vito was adamant to note that, in his opinion, it is the response time, not the number of violations that should be the focus. Once the copper and lead violations surfaced, Norfolk contracted WhiteWater to rectify the water quality issues (Vito 2009).

Tierney described some of these issues in a bit more detail. He explained that the copper and lead issues were caused by the pH levels. Once WhiteWater made changes to the treatment system, no additional lead and copper compliance issues were reported. Tierney further explained that a coliform violation is not surprising because of the high quantity of water stored in Norfolk's tanks—stagnant water can breed bacteria. However, he continued, Norfolk cannot afford to store water at lower levels because they also have a water supply issue. In 2006, the town started to flush more regularly which can also cause a bacterial outbreak. Consequently, chlorine is now added to the system when it is flushed to prevent bacterial contamination (Tierney 2009).

Tierney believes the monitoring violations were part of the town's learning curve. The town assumed the sampling and reporting responsibilities from WhiteWater in 2005 and initially had some problems conducting the monitoring in a timely manner. He believes this is improving (Tierney 2009).

On the positive side, Vito explained that the town utilizes an extremely clean water source, requiring minimal treatment. Norfolk uses an Ultra Violet radiation system to disinfect the water, and has chlorine stations only as a backup. Treatment is currently conducted to prevent corrosion, adjust pH levels, and reduce iron and

manganese levels. Norfolk uses a sequestering agent (polyphosphate) to reduce the iron and manganese levels and potassium hydroxide to minimize corrosion and adjust the pH (Vito 2009; Tierney 2009). The town recently learned that the polyphosphate chemical used to reduce iron and manganese has caused a pitting problem in their copper pipes (little holes throughout the pipes causing water leakage). This, the town believes, is responsible for its high UAW amounts. The town plans to switch to a more expensive chemical that is safer for the pipes in the hopes of reducing leakage (Tierney 2009).

Neither Vito, Garrity nor Tierney felt there was any difference in regulatory compliance levels when a private company is *involved* in public water system operations. However, Vito adamantly expressed that a town should always *own* its own water supply. Vito continued, the town cares more about its residents than a private company and will consequently be more responsive to complaints (Vito 2009). Garrity added that in a town owned system you can do things a private company would not think or care to do, such as helping people finance the replacement of the pitted pipes that are on their property (Garrity 2009). Both Vito and Garrity felt a town owned system with private sector participation to be the best case scenario for a small town like Norfolk (Garrity 2009; Vito 2009).

Norfolk has a fairly aggressive preventative maintenance schedule (see Table 14: Comparative Table of Preventative Maintenance Measures). They normally flush the system biannually, but because of the leakage issues are currently only flushing annually. The town also exercises their valves annually, inspects the tanks every two

to three years using divers, maintains the hydrants regularly, and inspects for leaks annually (currently Norfolk is undergoing leak detection twice annually in an effort to resolve the high leakage issues) (Tierney 2009).

To round out the perspective, I sought interviews from town residents. There are no supermarkets in the Town of Norfolk. Therefore, I conducted interviews at four supermarkets in neighboring towns, including: (1) Shaws in Franklin; (2) Super Stop and Shop in Franklin; (3) Super Stop and Shop in Walpole; and (4) Roche Brothers in Millis. In general, the customer sentiment was fairly negative about the water rates, but neutral about WhiteWater's involvement in the operation of the system. Of the twenty customers interviewed, nine commented that the water rates were extremely high and one found them unaffordable.

Customers had different opinions about the impact of private sector participation on rates. One customer commented that "as long as there is competition in the bidding process she is okay with private involvement" (Customer 2009). Another customer found the extent of accountability and oversight more important than the public or private nature of the water operator (Customer 2009). Still another customer felt that since a private company is involved "the water is more expensive, but [the system is] probably more efficient" (Customer 2009). Another customer felt that the town is doing the responsible thing by hiring a private company to do something they must not have the expertise to do (Customer 2009).

With regard to water quality, only three of the 20 customers surveyed had negative things to say. The customers mentioned that during flushing the water often

turns brown, and expressed concern over some of the aforementioned compliance problems mentioned in the annual CCRs (Customer 2009).

In general, Norfolk's water system has had a rocky transition from running as a Water Board to a division housed within a Department of Public Works. They have had quality and monitoring issues and still face substantial leakage problems. However, the town is well aware of its shortcomings and contracted WhiteWater to help repair the somewhat broken system. The short-term contractual relationship (renewed every three years) offers the town much flexibility. If they become unhappy with WhiteWater's performance they can put the contract out to bid again in 2011. Additionally, Tierney does not feel that this relationship is for the long-term. Rather, he sees WhiteWater as helping Norfolk through a rocky patch and anticipates WhiteWater's services not to be needed in the long run. In reality, it appears that Norfolk still needs quite a bit of assistance to maintain the treatment program and quality of the town's water. A publicly owned *and* operated system may be in its future, but not the near future.

B. HANOVER, MASSACHUSETTS

Established in 1727, Hanover, Massachusetts has approximately 14,000 residents and 1,000 commercial establishments housed within its 15.61 square miles (Hanover 2009). The annual median household income in Hanover as of the 2000 US Census was \$73,838. Per my calculations and adjustments, the annual median household income as of 2007 was \$94,414.13 (see chapter 5). By all accounts, Hanover is thought to be a nice place to live and raise children (Customer 2009).

Hanover is located in Plymouth County and sits approximately 25 miles south of Boston, Massachusetts. The town is run by an elected Board of Selectman responsible for overseeing all town related operations. Town residents also elect its Board of Public Works which governs the town's Water Department (Hanover 2009).

Since its inception, Hanover has always owned and run its water distribution system (Hanover 2009). However, for the duration of my study it had the distinction of having the highest water rate of all 28 publicly owned and run systems included. Moreover, for all years considered, Hanover had a water rate approximately \$150, or 44 percent, above the average for *all* systems included. Hanover's water rates for the duration of the study were as follows: \$486 (2003 and 2004); \$532 (2005 and 2006); and \$532.50 (2007) (see Table 12).

The town's UAW amounts were slightly higher than average for most of the years considered. As shown in Table 12, Hanover had UAW amounts as follows: (2003) 15.7 percent, (2004) 16 percent, (2005) 12.1 percent, (2006) 23 percent, (2007) 14 percent. For 2003-2006, Hanover's UAW amounts ranged from less than 1 percent above the average up to 8.5 percent above average in 2006. However for 2004 and 2005 the UAW amounts were less than one percent above average and in 2007 Hanover's UAW was 1.5 percent below average. With the exception of the 2006 UAW amount, these statistics point to Hanover having a fairly strong leak detection and rectification program.

TABLE 12: HANOVER SYSTEM STATISTICS				
YEAR	ANNUAL WATER RATE	AFFORDABILITY (% OF ANNUAL MEDIAN INCOME)	VIOLATIONS/ ENFORCEMENT ACTIONS	UAW AMOUNTS (% OF TOTAL WATER AVAILABLE FOR DISTRIBUTION)
2003	\$486	0.58%	0	15.7%
2004	\$486	0.6%	0	16%
2005	\$532	0.6%	0	12.1%
2006	\$532	0.6%	0	23%
2007	\$532.50	0.56%	0	14%

In order to deduce why Hanover's water rates are above average, as well as gather additional information on their water quality and leak detection system I conducted a total of 29 interviews, including: (1) 27 customer interviews; (2) an interview with Douglas Billings, the Hanover Water Supervisor; and (3) an interview with Victor Diniak, the Superintendent of Public Works and Water Superintendent. Additionally I questioned a DEP Drinking Water Program Supervisor, Damon Gutterman, and Duane Levangie, the Water Management Program Chief about Hanover's water rates, compliance and UAW history.

Hanover has, by all interview accounts, a well functioning, highly technical water treatment program. The town's water budget is presently \$2.5 million/year with almost 60 percent of that allocated to treatment related costs, 14 percent allocated to administrative functions and the remaining 30 percent allocated to distribution related

expenses.⁵⁴ Hanover's water department employs approximately⁵⁵ 15 individuals, with the largest number of employees involved in running and overseeing the three water treatment plants (about half the total number of employees). The system distributes water to its 5000 service connections (including residential, commercial and industrial users) through 110 miles of pipes. The town obtains its water from nine different wells, all with varying degrees of iron, manganese, turbidity and color problems. The town's water source is lamented to be below average and consequently requires a lot of treatment (Diniak 2009). Hanover has three treatment plants, including two green sand plants which operate like water filters, though chemicals may be added to the treatment as well, and a more expensive, but more versatile, conventional plant used to treat the lower quality water and color issues (Diniak 2009).

For all the years included in this research, Hanover reported no water quality violations and no enforcement actions against them by the DEP. Hanover is one of only six systems (out of the 39 included in this study) with no reported water quality violations or enforcement actions. The DEP did not have any specific opinion of why Hanover, in particular, achieved this compliance record, but commented that "aggressive flushing systems...can lower the incidence of total coliform violations" (Gutterman 2009). Again, the DEP recommended preventative measures include: annual flushing, annual exercising of valves, annual inspection of tanks (Gutterman

⁵⁴ Percents do not add up to 100% due to rounding.

⁵⁵ This number is an approximation because the two town employees I interviewed guesstimated total employee numbers during the interview.

2009), annual or biannual leak detection program, strong metering program and regular maintenance of and/or replacement of water pipes (Levangie 2009).

Hanover has an active preventative maintenance program (see Table 14: Comparative Table of Preventative Maintenance Measures). They exercise the valves and flush the entire system twice annually to remove sediment buildup, clean the water mains and keep the system flowing better. Hanover also inspects its tanks regularly, including monthly surface visual inspection and approximate annual inspections of the interior and exterior of their tanks by an outside vendor. The annual inspection does not typically involve draining the tanks, but rather involves sending a remote video into them to inspect for debris buildup, cracks, leaks, and other structural or quality problems (Billings 2009; Diniak 2009). The town hires an outside vendor to conduct a thorough leak detection assessment every two years, though they budget for leak detection annually in case the need arises. The town also has a 20 year cycle for meter replacement, replacing five percent of the meters every year (this is conducted in house) (Diniak 2009).

Both Billings and Diniak felt that the systems successful compliance record was due to the aggressive preventative measures which help them detect problems before they arise. Additionally, the Superintendent commented that their substantial treatment system addresses any problems before the water reaches the customer. The Water Supervisor noted that, for the most part, the DEP tends to work with them when small issues do arise. They may get a phone call off the record if something looks amiss before the DEP engages in an enforcement action. Diniak also

commented that they have always had extremely supportive commissioners in the town who are willing to provide them with whatever tools they need to keep the water system running safely and smoothly (Billings 2009).

Diniak explained that in upcoming years, as their water gets closer to the well head, the quality may deteriorate and begin to behave more like surface water. Fortunately, Hanover already has a conventional treatment plant that can accommodate the need for more vigorous treatment. The Hanover Superintendent describes himself as forward looking, preparing for the ‘what ifs’ and strategically planning for future water needs, potential compliance issues and necessary capital improvements.

Despite Hanover’s compliance record, residents had a different opinion about the quality of the town’s drinking water. On May 15, 2009, I conducted interviews at the Shaws on Route 53 in Hanover. I interviewed 27 residents from the town. Of the 27 residents interviewed, ten had minor to significant complaints about the quality. One customer found the water “fairly decent,” another called it “mediocre” and two more customers found the quality “awful,” explaining that it was frequently yellow or orange in color. Three customers commented that the water smells of chlorine and five noted that the water had a bad metallic or chlorine taste. Conversely, one customer thought the water quality had been improving in recent years. She noted that it had been discolored for a number of years previously, but had been clearer in the last two years (Customer 2009).

The high water rates were attributed to recent capital expenses. Hanover built a new treatment plant between 2003 and 2005, a \$6 million project, replaced and looped a number of water mains. According to Diniak, the town tries to be proactive in water main replacements. Rather than digging up a road when a main needs to be replaced, they proactively and regularly replace mains whenever roads are being dug up or repaved so they do not get to a point where replacement is urgent and force the town to pay for road maintenance on two separate occasions. Diniak also pointed to chemicals as a high ticket cost item (Diniak 2009).

Hanover water customers also had a fair amount to say about the cost of water in the town. While the majority of residents asked found the water to be reasonably priced and affordable, six thought the water was too expensive and bordering on unaffordable.

When questioned on their opinions of private sector participation, Douglas Billings, the Water Supervisor, explained that “[i]f you privatize [the private company will] have to make a profit and in the long run it would cost the consumers more to do the same job [the town is already doing].” However, he thought private sector participation was not necessarily a bad thing for struggling towns who may need help or are unable to hire people with sufficient expertise to maintain the water system (Billings 2009). Diniak agreed. He felt that the town retains more control over quality when it is owned and run in house. The town “is not worried about the bottom line, [they are] worried about quality and providing a good service... [the] town makes sure the residents get what they need” (Diniak 2009). Similar to Billings,

however, Diniak noted that for some towns, given the capital intensive nature of water operations, it may make sense to utilize an outside contractor since a private company can spread costs over a larger service area.

Both Diniak and Billings explained the benefits of operating under the umbrella of a town Department of Public Works. Billings found operating within a DPW to be a benefit since the water operators can accomplish things without having to hire an outside company. For example, if they need to dig something up they can borrow a backhoe from the highway division (Billings 2009). Diniak agreed wholeheartedly, “[it is] definitely a good thing [that the town operates the water system within a DPW. Because there is] very good cooperation between water and highway [departments] because the managers are shared between departments. Equipment is shared, expertise is shared” (Diniak 2009).

For the most part, all customers surveyed were happy that their water was delivered through a publicly owned and operated system. Customers felt that a privately run system would cost them more. One customer asked, why change something when there are no problems? Another customer explained that a drawback to private company involvement is that they do not know the town, the land, or the geography (Customer 2009). Another customer preferred a publicly run system because she believes public employees can be held accountable to the residents much more easily than a private company can, and in the public sector resources are more easily shared between departments. Another customer was concerned that a private company would “cut corners” in an effort to increase its profit margin (Customer

2009). Out of all 27 residents interviewed, three would prefer a private company commenting that private involvement may improve the quality of the water.

Based on the interviews, Hanover appears to have a well developed system with knowledgeable, committed operators. They were frank about the quality of the source water and the color problems they have to deal with. The customer reaction mirrors many of the problems with the source water described by the town employees. Additionally, Hanover appears to have a conscientiously planned water system, ready to anticipate future needs without extreme capital improvements being made. Moreover, the Superintendent had a strong response to my information about customer opinions on water quality. He seemed genuinely concerned about what they had to say, wanted details of the specific problems mentioned so he could attempt to address them, and lamented that these customers did not call the DPW to report any concerns they had.

C. HINGHAM/HULL, MASSACHUSETTS

The Hingham/Hull system, run by Aquarion Water Company of Massachusetts, services the entire towns of Hingham and Hull, with about 2/3 of the system servicing Hingham, 1/3 of the system servicing Hull, and a small fraction of it servicing residents in North Cohasset (less than one percent). Consequently, I focus this brief historical, geographic and economic discussion on Hingham and Hull.

Hingham is an old New England town first incorporated in 1635. It has 21,978 residents, occupies 22.5 square miles and sits 16 miles southeast of Boston. The town of Hingham is governed by a Board of Selectman, Town Administrator and open

town meetings (Hingham Town Hall 2009). Hingham residents, as of the 2000 U.S. Census, had an annual median income of \$83,018. Per my calculations and adjustments, the annual median income in Hingham as of 2007 was \$106,152.28.

The neighboring ocean town of Hull, established in 1644 (Hull Nantasket Beach Chamber of Commerce 2009), sits 20 miles southeast of Boston and has a little over 11,000 residents (U.S. Census Bureau 2007) occupying only 3 square miles of land (Department of Housing and Community Development). Hull is similarly governed by a Board of Selectman, Town Manager and open town meetings (Hull Town Hall 2004). The annual median income in Hull as of the 2000 U.S. Census was \$52,377. Per my adjustments and calculations, the annual median income in Hull as of 2007 was \$66,972.68.

Hingham and part of Hull have been provided with water service from a private company ever since the towns had a public water supply. The Hingham Water Company was incorporated by legislative action in 1879 and began supplying water to Hingham and Hull shortly thereafter. The towns would receive their water from the Hingham Water Company for the next century (though the company ownership would change hands multiple times during that period). It was not until 1980 that the Hingham Water Company (then owned by the American Water Works Company) became the Massachusetts-American Water Company (R. Sylvester 2009), which would eventually become Aquarion of Massachusetts (Aquarion), a subsidiary of Macquarie Bank Limited.⁵⁶

⁵⁶ For additional background information on Aquarion of Massachusetts, see Chapter 2, section IV(A).

The Hingham/Hull system has approximately 12,500 service connections (including residential, commercial, industrial and institutional) over 190 miles of water pipes. It has twelve wells and gets the majority of its water from groundwater (over 60 percent). Aquarion has 18 employees devoted to the system (14 working in the field and four in management) (Roland 2009). However it is unclear whether this staff also assists in the management and operation of the Millbury and Oxford systems (the two other Aquarion owned and operated systems in Massachusetts). Aquarion has two separate annual budgets: the annual capital plan budget (~\$1.5 million) of which the Hingham/Hull system makes up approximately 50 percent, and the operation and maintenance budget (~\$13 million) of which the Hingham/Hull system makes up approximately 80 percent (Roland 2009).

Similar to Hanover, the Hingham/Hull system has the distinction of having the highest water rate for all privately owned and operated systems included in this research. Moreover, it has the highest water rate of *all* 39 systems included for the years 2003, 2004 and 2007 and the second highest water rate of all 39 systems for 2005 and 2006. For all years studied, the Hingham/Hull average water rate was \$665 per year, approximately \$300 per year higher than the average water rate for all towns studied.

The affordability statistics revealed that for 2003-2006, Hull had the second *least affordable* water rate of all 40 towns included. In 2007, Hull had achieved the third least affordable water rate of all 40 towns included. Despite the high annual

median income in Hingham, it still ranged from having the fifth to the eighth least affordable water rate of all 40 towns included.

The systems regulatory compliance record was stronger. The Hingham/Hull system reported no violations or enforcement actions for all years considered. They also reported UAW amounts near the UAW average of all systems included in this research for the years 2003, 2005 and 2006. In 2004 and 2007, the systems' UAW amounts were approximately eight percent higher than the average.

TABLE 13: HINGHAM/HULL SYSTEM STATISTICS				
YEAR	ANNUAL WATER RATE	AFFORDABILITY (% OF ANNUAL MEDIAN INCOME)	VIOLATIONS/ ENFORCEMENT ACTIONS	UAW AMOUNTS (% OF TOTAL WATER AVAILABLE FOR DISTRIBUTION)
2003	\$665	Hingham: 0.71% Hull: 1.12%	0	13.89%
2004	\$665	Hingham: .73% Hull: 1.15%	0	24%
2005	\$665	Hingham: 0.67% Hull: 1.06%	0	10.4%
2006	\$665	Hingham: 0.67% Hull: 1.06%	0	13%
2007	\$665	Hingham: 0.63% Hull: 0.99%	0	24%

To better assess the aforementioned statistics and gain a deeper understanding of why the annual average water rates were substantially higher than average, I interviewed Robert Roland, Director of Operations for the Aquarion Water Company of Massachusetts, a position he has held for the last three years, though he has been with Aquarion or its predecessor since 1999; Troy Dixon, Manager of Regulatory Compliance at Aquarion Water Company of Connecticut and consultant for the

Hingham/Hull system financing and rate hearings; Randy Sylvester, interim DPW superintendent, previous assistant superintendent (for the last four years) and former Aquarion operations superintendent, a position he held for eight years. Prior to his position with Aquarion, Randy Sylvester worked with the Massachusetts-American Water Company for 18 years servicing the Hingham/Hull system. I also interviewed Harry Sylvester, highway superintendent for his expertise on town operations having been employed by the town of Hingham since 1988; and 25 customers, 11 from Hingham and 14 from Hull. In an effort to obtain as diverse an exploratory sample of customers as possible, I conducted interviews at three different supermarkets: (1) Super Stop and Shop in Hingham; (2) Hannaford's in Norwell (on the Hingham line); and (3) Riddle's Supermarket in Hull. I also interviewed Damon Gutterman, DEP Drinking Water Program Supervisor and Duane Levangie, DEP Water Management Act Program Chief for their opinion on privately owned and operated systems and the Hingham/Hull system in particular.

With regard to water rates, Gutterman explained that the nature of private operation could potentially affect rates.

“A private company is freer to operate in raising their rates when they need to. Even though there is opportunity for public involvement, at the point of public involvement the private company has already submitted much documentation and proof of need [for a rate increase.] The DPU would not be as easily swayed as a local elected official might [by public opinion on a proposed rate increase]” (Gutterman 2009).

Otherwise, he did not have any specific idea as to why their rates were so high, but felt it could be related to major changes to their surface water plant

(Guterman 2009). Levangie similarly felt that since private companies need to recover more costs for profit holders than public entities, it would likely translate to higher costs to the consumer. Conversely, Levangie noted that as a general rule he thinks privately run companies are probably more efficient than publicly run ones. He was, however, quick to add that Massachusetts “has many public utilities that are just as, if not more efficient than some private [companies]” (Levangie 2009).

Randy Sylvester had a lot to say about the current water rates in the Hingham/Hull system. He pointed to a number of system upgrades, including improvements to the treatment plants (that cost approximately \$30 million) and distribution system improvements (costing approximately \$10 million). While these were important expenditures, he stressed that these upgrades could have been done much more cheaply if they were done by a municipality because they could have gone to the state for money. Randy added that he believes the rate of return for investors under Aquarion is around 13 percent, and commented that a public utility would not need to charge this additional 13 percent for operating costs and system improvements (R. Sylvester 2009). Conversely, Harry Sylvester did not believe any significant infrastructure improvements were done after the most recent rate increase yielding the \$665 per year water cost was in place (in 2001 he believes). He expressed that the rates are high because the system is run by a for profit company (H. Sylvester 2009).

Roland explained that the high rates were due to construction of a new treatment plant, put online in 1996. The major rate increase occurred in 1996 when

the rates jumped from approximately \$250 per year to \$625 per year for residential customers (a 150 percent increase). This treatment plant has the capacity to endure for the long term and accommodate future growth, Roland explained. Roland continued to relay that while the Hingham/Hull system may currently have high rates, in the future other communities will be facing a capacity issue and needs for increased treatment and will have to increase their rates. Roland also shared that the system's rates are going up again in the next fiscal year "to prevent Aquarion's budget from going in the red" (Roland 2009). When asked about the affordability of the system, Roland pointed out that people need to look at water like any other commodity and put it into perspective against your gas, electric, cable and telephone bill.

Comparatively, Roland feels, water is affordable (Roland 2009).

Dixon, when asked about the need to shift the cost of federal, state and property taxes on to the consumer, commented, "Of course we have to pass the costs on to the consumer, but property taxes were much more of an issue in New York than they are in Massachusetts." Aquarion's annual property tax bill in 2008 was \$461,000, the state taxes were \$137,000 and the federal taxes were \$671,000 annually. When broken down per consumer, each customer bill is increased an average of \$83 annually to cover the tax bills (Department of Public Utilities 2009; Dixon 2009).

On the flip-side, in anticipation of the upcoming rate increase Aquarion is currently working with state Senator Robert Hedlund and Representative Garrett Bradley to reinstate a credit program for the Hingham/Hull customers. In 1998,

shortly after the treatment plant was first built, Senator Robert Hedlund, Representative Mary Jeanette Murray and the water company operating the Hingham/Hull system at the time were successful in their efforts to pass legislation that permitted residents in Hingham and Hull, among other communities, to receive a “Treatment Facility Surcharge Credit.”⁵⁷ The Credit amounted to approximately \$97 per residential customer per year (depending on meter size) and was established to operate from 1999-2008 to offset the rate increase caused by the construction of the new treatment plant (Massachusetts Department of Telecommunications & Energy 2002). The Credit program ended on January 31, 2008.

While Roland quoted a customer satisfaction survey conducted by the Center for Research and Public Policy, finding a customer satisfaction rate of between 80-87 percent, my exploratory results showed a higher level of dissatisfaction. Fifteen of the 25 customers surveyed felt their water rates were very expensive and/or would be more affordable if the system was run by the town.

The system’s regulatory compliance record, however, was one of six included in this study with no reported violations or enforcement actions for the duration of this study. Similarly, for most of the years considered they had at or below average UAW amounts. Though, the Hingham/Hull system had fairly high UAW amounts for 2004 and 2007. When questioned about the Hingham/Hull system’s regulatory compliance record, both DEP employees questioned mentioned that the Hingham/Hull system “has had its share of violations and water management issues

⁵⁷ Massachusetts Water Pollution Abatement Trust, Section 22 of Chapter 78 of the Acts of 1998.

prior to your research [period]” (Levangie 2009). Gutterman recalls an odor issue in the system a few years back (Gutterman 2009). Levangie believes that in response to increased attention from the DEP, Aquarion has started to pay more attention to potential Water Management Act issues, changed some things in their structure and have improved operations overall (Levangie 2009). Gutterman stressed again that good compliance records tend to be connected to aggressive preventative maintenance measures (Gutterman 2009).

According to Robert Roland the following preventative maintenance measures are taken: (1) the system is flushed every three years with 1/3 of the system being flushed annually (though they increase flushing in a particular area when they receive a high number of customer complaints); (2) the tanks are given a thorough inspection every five years using a remote video device; (3) approximately 20 percent of the valves are exercised annually; and (4) change ten percent of the meters every year (2009) (see Table 14: Comparative Table of Preventative Maintenance Measures). While the breadth of preventative measures is good, they are done much less frequently than is recommended by the DEP. In addition to the preventative maintenance measures, Roland also feels that the system’s strong compliance record is due to the vast knowledge among Aquarion’s staff, pointing to staff with over thirty years of experience with the system. Also, with the introduction of the new treatment facility in 1996, the system now has more checks and balances in place. It has an onsite DEP certified lab to test for E. coli and total coliform bacteria. Though Aquarion is not certified to test for other contaminants in the onsite lab, it tests for

them, for in-house use, to help reduce reaction time to any potential quality issues (Roland 2009).

Customers surveyed were generally happy with the quality of water in the town with only six of the 25 interviewed expressing dissatisfaction with the water quality. One customer, a resident involved in town government, had much to say about the distribution system. The customer explained that the pipes in Hull are in terrible shape, and result in exorbitant amounts of lost water. This customer added that the condition of the pipes affected the quality of the water reaching Hull residents (Customer 2009). When questioned about this, Roland states that many Hull residents operate under a misconception that they receive poorer quality water than Hingham residents. He continued to say that all the pipes in the system are old, not just the Hull pipes and that because Hull has fewer homes water there may be more stagnant, but that it is all part of the same system (Roland 2009).

Compared to Norfolk and Hanover, where most customers surveyed had very little opinion on who ran their water system, the Hingham/Hull system customers had a lot to say about the ownership and operation of the town's water system. Of the 25 customers interviewed, 15 had moderate to strong opinions about private sector participation in public water distribution, with only three having a favorable opinion of private sector participation. One customer felt that a private company was good to have because competition would help lower water rates. Another customer was happy to have a private company running the water system because she felt you could hold them more responsible than a public utility. The last customer believed private

involvement to be a positive, commenting that the company is motivated to make a better product to protect their reputation. Conversely, 12 customers felt that the town should be in charge of the water system, commenting that a publicly operated system would focus on what was in the best interest of the town and its residents. A publicly owned system, customers felt, would have public interest as its bottom line as opposed to profits. Three customers commented that a publicly owned and operated system would be more accountable to the customers than the privately operated system currently is.

On the whole, the Hingham/Hull system appears to have high regulatory compliance and to have fixed earlier compliance issues (occurring before the period studied here). Aquarion has a fairly new treatment plant which employees feel will be adequate to handle any issues that may arise in the future, capacity or contaminant wise. However, all of the systems preventative maintenance measures were below average and below the frequency recommended by the DEP (see Table 14: Comparative Table of Preventative Maintenance Measures). Moreover, Aquarion seems fairly disconnected from the town. It appears to operate under a somewhat strained relationship with town residents and some of the local town employees. Additionally, Hingham/Hull system customers were much more inflamed than the other towns surveyed about the cost of the water, though few had complaints about quality. This is potentially compounded by the fact that Aquarion's customer service department is located in Connecticut, rather than Massachusetts, though it has created

a new website in an effort to enhance one-way communication with the residents (Aquarion Water Company 2009).

This is certainly far from being a broken system, but the very high and rising water rates are some cause for concern. The DPU while a helpful check on privately owned and operated system rate increases does not have the same connection to town residents that the Board of Selectman or a DPW superintendent does.

IV. DISCUSSION

The multiple-case study analysis was enormously helpful in shedding light on my quantitative results. Case studies are often considered limited in their generalizability. However, while these are only three case studies, they were conducted to explain and explore the quantitative results in greater depth and therefore are an appropriate method for bolstering my quantitative research. Some potential limitations to my qualitative in nature results include the exploratory nature of the studies. The three towns do not necessarily represent all towns operating within the ownership/management structure they represent. However, the case studies offer a strong foundation for additional research and offer support for the quantitative results which found a moderate to strong and statistically significant relationship between the ownership/management structure of a public water system, cost to the consumer and affordability.

The Hanover water system, while expensive, has legitimate reasons for the higher than average water rates—the construction of a treatment plant within the last five years. Additionally, the town impressed me by operating using *multiple*

motivations, only one of which was cost to the town, including: efforts to maintain regulatory compliance; keep customers satisfied with water quality; keep costs to the consumer down; and keep customers satisfied with the quality of the service. The detailed and long-term strategic plan appears to focus as much on protecting the town from financial outfall and capacity shortages as to protecting the town residents and keeping costs down in the long-term. The Superintendent was genuinely concerned about the negative water quality comments and stopped me when I questioned him about it seeking additional information. The Hanover DPW employees interviewed seemed to have a solid knowledge background and an extremely well thought out long-term strategic plan. Additionally the system has an active and aggressive preventative maintenance program that meets and/or exceeds DEP recommendations.

Conversely, the Norfolk system is struggling to maintain equilibrium. It has substantial leak issues, some water quality issues (though those appear to have been addressed) and charges above average water rates. However, the leak issues appear to be proactively being addressed and the water rates seem to genuinely be the result of conservation pricing. The Board of Selectman I spoke with talked extensively about other conservation measures he was trying to implement in town, including rebates for low flow shower heads and water efficient washing machines (Garrity 2009). Additionally, the quality and infrastructure issues do not appear to be the fault of the current DPW nor the fault of WhiteWater, but rather the fault of an almost fledgling DPW system operating under a tremendous learning curve. This is an example of a

system that has and will continue to benefit from WhiteWater's experience and expertise. This appears to be the appropriate place for private sector participation.

The Hingham/Hull system however does not appear to be on the efficiency track. The high water rates were explained as being from the 1996 building of a treatment plant, financed by 6 different loans. The 150% rate increase was due not to the cost of building the treatment plant, but rather due to the new operating costs associated with daily operations of the plant. The projected FY2010 rate increase described as necessary to keep the system in the black does not corroborate the market model's predictions of a private water company yielding a more efficiently functioning system.

Arguably, the publicly owned systems have a number of advantages over privately owned systems when it comes to keeping rates down: (1) they do not have to pay taxes; and (2) they can obtain tax-free bonds. Still, neither the private company employees questioned nor the DEP employees pointed to limited access to low-interest rate financing or property tax payments as contributing to the privately owned system water rates. Private companies have access to tax free state revolving fund financing just as publicly owned companies do. Robert Roland, Aquarion's Director of Operations, commented that its position as a subsidiary of a major lending institution, Macquarie Bank, offers a substantial advantage in obtaining financing (Roland 2009). Troy Dixon, Regulatory Compliance Manager at Aquarion of Connecticut, explained this benefit in more detail. Dixon described one significant advantage of having Macquarie Bank as a parent company—a \$100 million line of

credit established by Macquarie at the time it purchased Aquarion. This debt facility is available to any of Aquarion's companies for a five year period and may be renewed for another five year term when the first term expires. Essentially, this credit line allows Aquarion companies access to short-term borrowing at very low interest. The interest rates on these loans change monthly but are regularly below market interest rates (Dixon 2009).

While the payment of taxes were not pointed to as a contributor to the high rates Roland did note that the Aquarion treatment plant's Hingham location is a point of contention for Hull residents since the town of Hull doesn't benefit from the property tax contribution (Roland 2009).

Moreover, taxes and access to tax-free bonds do not explain the above average water rates in publicly owned systems utilizing private contractors.

These three qualitative in nature case studies bolster the quantitative results. While admittedly, there are a number of factors that were not able to be controlled for as mentioned in chapter 5 (i.e. varying conditions of the systems and extent of capital improvements made in each system), private operation does not appear to increase efficiency or to reduce costs to the consumer.

Given the quantitative regulatory compliance results coupled with the level of quality complaints in Hanover and Norfolk and the positive response to water quality questions in Hingham and Hull, private ownership and operation does appear to yield slightly higher water quality. Again, however, there are other factors that could not be controlled for in this study that may have contributed to these findings. With regard to

Hanover, the source water appears to have contributed substantially to customer issues with color. Given the additional number of questions raised by the multiple-case study analysis, there are a number of quantitative and qualitative studies that could serve as strong complements to this research and are detailed in the concluding chapter.

CONCLUSION

CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

I. DISCUSSION OF RESULTS

There is a longstanding and heated debate over whether private sector participation has a beneficial role to play in public water distribution. Proponents tout the private sector as increasing efficiency, and decreasing costs to the consumer. Opponents point to the importance of operating a water system with more than just economic efficiency guiding daily operations. On the one hand, free market advocates explain how individuals act rationally to maximize their own self interest and comment that this would not necessarily translate to the most efficient decisions being made for the public water system. Conversely, public sector advocates argue that there is more to running a water system than the financial bottom line. Rather, they believe that multiple factors including: democracy, affordability, customer satisfaction and the best interests of the town, should govern decision making. In this research I conducted both a quantitative analysis and a qualitative multiple-case study analysis. The aforementioned opposing viewpoints, pinning the *market model* against Graeme Hodge's notion of what I call *multiple motivations theory*, provided the framework for my analysis and led me to ask the following research questions.

The quantitative analysis asked whether the nature of the ownership and/or management structure of a water utility affects: (1) affordability of water and cost to the consumer; and (2) the level of a water system's regulatory compliance. I then conducted multiple-case studies and analyzed: (1) whether and why (or why not) the nature of the ownership and/or management structure of a water utility impacts

affordability and costs to the consumer; and (2) whether the nature of the ownership and/or management structure of a water utility impacts the level of regulatory compliance and/or customer perceptions of water quality?

For the quantitative research I analyzed data from 40 towns and 39 different water systems all servicing between 1,500 and 12,000 service connections that utilized primarily groundwater as their water source for the period studied (2003-2007). I looked at the three most common public water system ownership and management structures in the Commonwealth of Massachusetts: (1) publicly owned and operated systems; (2) publicly owned systems operated with private sector participation; and (3) privately owned and operated systems. To make my results as comparable as possible, I included only those publicly owned and operated systems that operate as an enterprise fund within a Department of Public Works. In total, 39 systems met the aforementioned criteria: four privately owned and operated systems; 28 publicly owned and operated systems; and seven publicly owned systems operated with some portion of their O&M contracted to a private company.

On the subject of private sector participation in public water distribution the results illustrate that for the 39 water systems included, for the years 2003-2007, on average, the publicly owned and operated systems provided water to the consumer at the lowest rate. On average, the privately owned and operated systems charged the consumer \$135-\$180 or between 43 and 52 percent more per year than the publicly owned and operated systems. The publicly owned systems operating with private sector participation charged the consumer rates ranging between \$130 and \$160 or

between 37 and 54 percent per year more than the publicly owned and operated systems. Unsurprisingly, the systems owned and/or operated by the private sector were also the least affordable to the consumer in the 40 towns studied. For all years considered, the ownership and management structure can explain between 29 and 42 percent of all variation in cost to the consumer and between 23 and 37 percent of all differences in affordability.

The ownership and management structure, however, did not have a statistically significant impact on levels of regulatory compliance. The strength measure for the water quality and unaccounted for water variable did not go above 15 percent and was more frequently well below five percent indicating that the ownership and management structure cannot explain very much of the variation in the aforementioned regulatory compliance levels. However, while neither statistically significant nor yielding high strength measures there were some interesting findings in the results: (1) the publicly owned and operated systems had the lowest and the privately owned and operated systems had the highest UAW amounts for all years considered; (2) the privately owned and operated systems appeared to have slightly higher MCL compliance levels compared to the other two ownership and management structures included; and (3) the publicly owned systems operated with private sector participation had slightly lower M/R levels when compared to the other two ownership/management structures studied. While from a statistical perspective this may not be significant, from a practical regulatory perspective it may be, and indicates the need for additional research including a larger sample size.

II. STUDY LIMITATIONS

There were a couple of limitations in conducting this research. The most obvious being that I am a staff of one conducting a sizeable quantitative and qualitative analysis. This in addition to time constraints prevented me from delving into areas besides cost, affordability and regulatory compliance potentially impacted by the ownership and management structure of a public water system. Areas of potential importance include: impacts of varying private company tax payments on cost to the consumer; varying conditions of the systems during the study period; and degree of capital improvements made by each system.

Additionally, Norfolk's inclusion in my analysis has the potential to skew the results for the publicly owned systems operated with private sector participation. While my criteria was to only include towns that had their ownership and management structure in place for at least five years prior to the research period, I was misinformed and did not discover that WhiteWater became involved in Norfolk's water system operations as recently as 2003 until close to the conclusion of my research. Another potential limitation is the relatively small sample size studied. Sample size affects significance testing and can falsely yield a finding of no significance. However, the strength measures utilized are not affected by sample size.

Still, notwithstanding the aforementioned limitations, given the rigor of this research and statistical analysis conducted I am confident that my results raise appropriate and necessary questions about the impacts of private sector participation on cost and affordability of water for the consumer in addition to raising numerous

questions about the actual efficiency of private sector participation in public water distribution.

III. RECOMMENDATIONS FOR FUTURE RESEARCH

This research was successful in adding to the slow growing body of data on the differential impact of public vs. private provision of public water supply. As the only predictable result of any intellectual endeavor, this research yielded additional questions regarding the public vs. private operation and management of public water systems. This study looked at compliance, affordability and cost to the consumer. A study analyzing customer satisfaction, transparency of water service provider operations and the impact of public vs. private provision on the local watershed would be a strong addition to these results.

Additionally, Hanover operators lamented the quality of the source water and customers had similar complaints about water quality in the town though there were no regulatory compliance issues. Consequently, it would be beneficial to investigate compliance and customer satisfaction against the quality of water at its source (as opposed to resultant water quality). The Norfolk case study also brought up some interesting points—about rural vs. semi-urban systems where density can impact quality, capital and consequently cost to the consumer. A similar quantitative analysis of systems utilizing surface water would further highlight any differential impacts of the ownership and management structure of a public water system.

All are really interesting and worthwhile questions that, if answered, could shed additional light on the controversy over public vs. private provision of water and

bolster the discussion of these quantitative results. Lastly, additional analyses with a larger sample size, if possible retaining the measures that keep the categories comparable (number of service connections, water source, number of years operating within a particular ownership and management structure, and state), would be a strong complement to these results.

A recommendation of a different vein regards an added potential function of the state government and was sparked by my interview with DPW Director Butch Vito. Vito remarked that a benefit of private sector participation was gaining the knowledge base retained by WhiteWater staff through their array of water operations contracts. He noted that after WhiteWater learned of the pitting causing chemical in the Norfolk system, it could share that information with the other municipalities it works with (Vito 2009). In a similar manner, a public entity could operate as a resource bank for public water systems in Massachusetts. Such a Water System Advisory Program could be housed within the DEP, prove cost effective and provide a much needed service.

A strong model is offered by the Massachusetts Riverways Program, a part of the Massachusetts Department of Fish and Game, which plays a beneficial advisory role to dam owners desiring to undertake dam removal. Among numerous other things, the Riverways Program acts like a non-profit educational liaison between state regulatory bodies and dam owners, and may provide substantial assistance to dam owners navigating their way through the permitting and financing of a dam removal or dam breaching project.

In much the same way, a Water System Advisory Program could be created within the DEP to assist systems struggling to maintain regulatory compliance, reduce water rates, secure financing, locate experienced water operators and upgrade infrastructure. Strong potential causes of many of the problems faced by Massachusetts' communities are: (1) lack of knowledge of the array of financing available to them; and (2) lack of expertise of the variety of chemicals, water quality monitoring and leak detection devices available to them. A central body armed with this information available to disseminate advice to the water systems could result in: (1) decreased cost to system operators; (2) decreased cost to the consumer; (3) increased water quality; and (4) improved customer satisfaction.

IV. POTENTIAL ALTERNATIVES TO TRADITIONAL PUBLIC WATER SYSTEM STRUCTURES

While not the subject of this research, Wolff and Hallstein discuss some interesting potential alternatives to the traditional privately run/publicly run water systems. These alternatives could assist water systems facing financial, expertise, resource (anything from excavation to meter equipment and pipe laying equipment), compliance, cost (to consumer) or water source issues. They recommend water systems begin with a strategic plan for assessing the symptoms necessitating restructuring prior to implementation of any new plan. Their program involves six steps: (1) clarification of symptoms; (2) identification of causes; (3) evaluation of options; (4) selection of solution(s); (5) implementation of solution(s); and (6) evaluation of performance. They recommend focusing on five symptoms, in particular, that could necessitate restructuring: (1) unsatisfactory service; (2) poor

regulatory compliance; (3) insufficient local control; (4) high current water rates; and (5) high projected water rates (Wolff and Hallstein 2005). It is appropriate that Wolff and Hallstein separate service from regulatory compliance. When they refer to service they are referring to response times, odor and taste issues as well as general handling of customer complaints/comments. Inclusion of service would incorporate some of the issues described by Hanover water customers related to taste and color that were not apparent in the compliance assessment. A customer service assessment would also take into consideration some of the Hingham/Hull system customer complaints regarding their lack of involvement in public water system decisions.

Once the primary symptoms and underlying causes of a struggling system are identified, the town can evaluate appropriate solutions (step 3). Wolff and Hallstein detail solutions for the following problems: (1) inefficient staffing; (2) insufficient funds; (3) limited transparency and public participation; (4) poor asset management; and (5) ineffective performance measurement and reward (2005). Their proposed restructuring solutions *include* private sector participation (what they call “privatization”) but also include regionalization, consolidation, contract operations or management, and municipalization. I will briefly describe each in turn.

Regionalization is the merger of multiple systems (public or private) within one region. This allows the operator of the joint system to take advantage of economies of scale—sharing personnel with specialized expertise, reducing per gallon chemical costs, and increasing overall revenue by increasing the customer base of a system (Carter 1986-1987). If capital improvements, such as building a new

treatment plant or exploring a new well site, are necessary, the cost of these improvements can be spread out over a wider customer base, reducing the impact on the consumer.

In addition to taking advantage of economies of scale, the benefits of regionalization as compared to privatization, in my opinion, are that the system operator is considering the needs of, at the very least, geographically similar communities and is, more importantly, close to the communities served. Close proximity allows the service provider to be more accessible to customers with questions or concerns and potentially more accountable than a service provider located further away or even out of state.

Consolidation is, similar to regionalization, the joining of multiple systems (again public or private) to take advantage of economies of scale, but this occurs among noncontiguous service areas.

Similar to pro-privatization arguments of resource availability, through both consolidation and regionalization communities are able to increase their water budget. Greater capital has the potential to increase the ability of a system to hire efficient and experienced staff, upgrade infrastructure and keep up with chemical costs and advances. However, consolidation has the potential added problem of creating an operator who is disconnected from the community(ies) it serves and potentially cares more about a financial bottom line than customer satisfaction. From the results of this research it follows that, with either consolidation or regionalization, the public or

private nature of the system may have more to do with the resultant cost to the consumer than the size of the system.

Contract operations or management is a frequently used, potentially useful restructuring option (as was seen in the Town of Norfolk). However, Wolff and Hallstein point out that the contract operators need not always be a private company. Rather, they explain, operations contracts can be made between municipalities. This has the benefit of keeping operations local *and* public, potentially increasing accountability of the operator. Moreover, a larger municipality or municipality with more experience in water treatment and distribution could provide this service to a neighboring town while increasing the financial resources for the system.

The last restructuring option detailed by Wolff and Hallstein is municipalization. Municipalization occurs when a municipality buys back its water system from a private entity either through negotiations or eminent domain. This is not an easy option as a private company is unlikely to sell its assets without a fight, but it is an option nonetheless for municipalities systematically unhappy with their private service provider. As you may recall, the town of Oxford is currently attempting to purchase its water system back from Aquarion due to increasing costs and fear that they are paying for infrastructure upgrades in another town.

V. CONCLUDING THOUGHTS

Where does this research leave us? What should you as the reader take away from this study? This analysis suggests that efficiency may be a weak argument for private sector participation. While the market model may be accurate in explaining

the results, if what the private company employees are trying to maximize is profit margins, it did not for the years and systems considered adequately predict increased efficiency. The 11 private companies included in the quantitative portion of this research were unable to provide water at a rate lower than, or even comparable to, the publicly owned and operated systems.

However, the regulatory findings, while not statistically significant, were of practical significance and pointed to the privately owned and operated systems having slightly higher compliance levels, though they also had slightly higher UAW amounts. While the compliance and UAW findings were not statistically significant, they warrant additional investigation.

Graeme Hodge's notion of multiple motivations, only one of which is economic in nature, better provides the theoretical explanation for these results. The Norfolk and Hanover town employees and officials spoke at length about the needs of the respective towns, both currently and long-term. Moreover, the Hanover DPW seemed genuinely concerned about customer opinion. The Norfolk DPW Director spoke extensively about slight reframing to the Norfolk town government to improve the inner workings of the DPW and consequently the water system so customers could be better served in the long-run. These non-quantifiables, the personalized attention to town needs, *and* town perception are the multiple motivations that Deborah Stone describes in her vision of a polis model of society.

Does this mean systems operating in private hands should restructure? Not necessarily. It may depend on the degree of public oversight and the ability of public

officials to hold private operators to their contracts, or to, alternatively, cancel their contracts. It is admittedly difficult to change something once it is in place and once a community(ies) has relinquished control and responsibility over their public water system (if they ever had it in the first place). It is also not easy to assume control over something as capital intensive and expertise intensive as water treatment and provisioning.

Perhaps many communities with privately operated public water systems are thankful to have given up the headache of hiring operators with sufficient expertise, maintaining the distribution system, monitoring the water quality, and dealing with the liability. Or, perhaps they are not aware of the illegitimacy of the efficiency argument. Local officials are unlikely to hear complaints from customers if quality is adequate and customers are unaware of their above average water costs. Moreover, if a town has a privately owned and operated system, customers are more likely to complain about quality or price issues to the company directly, rather than to a local official, further shielding town officials from the “headache” of public water system operation.

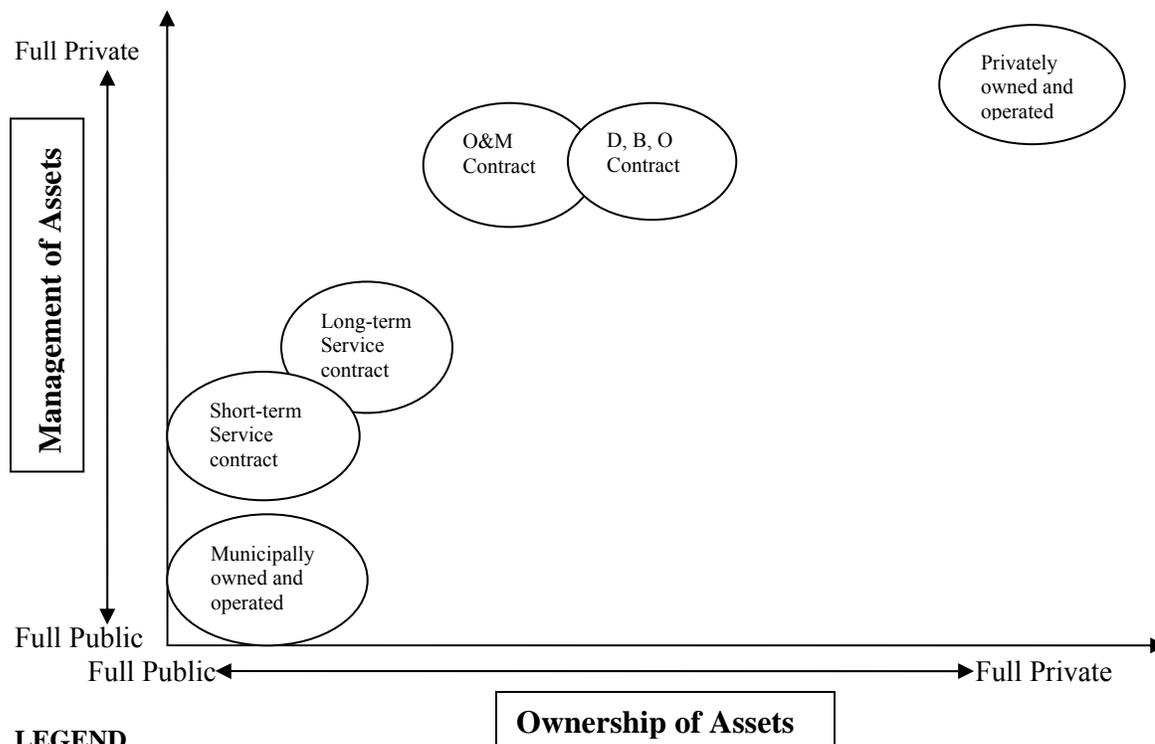
Additionally, some communities, like Norfolk, may benefit from private sector participation more than the quantitative analysis demonstrates. While Norfolk had some compliance problems during the period studied, there were reasonable explanations for these problems and private sector participation does seem to be a reasonable antidote to continued compliance and leakage issues.

This research showed a specific and potentially positive role for private sector participation, but highlighted the negative ramifications of subcontracting or total asset sale, when a community does not necessarily need private sector assistance. Wolff and Hallstein's five step program for assessing a system's need to restructure is a strong complement to my findings and could help communities considering restructuring to strategically address the symptoms and causes leading them to restructure.

Admittedly, it can be dizzying to navigate the bodies of rules, regulations and statutory obligations imposed on any entity. It is my hope that this research and the aforementioned recommendations are taken to allow for protection of our precious and dwindling freshwater supply, to reveal that public entities might actually run water systems efficiently and to note that private sector participation can play an active and beneficial role in certain circumstances.

FIGURES, TABLES AND APPENDICES

FIGURE 1
SPECTRUM OF MANAGEMENT STRUCTURES IN THE WATER UTILITY INDUSTRY
 (Modified from Commonwealth Foundation 2004 at 5; Wolff and Hallstein 2005 at 15)



LEGEND

- **Municipally Owned and Operated:** The municipality has total control and ownership over the distribution, operation and management of the town's water related assets.
- **Short-Term Service Contract:** municipality owns all of the town's water related assets (meters, treatment plant, withdrawal license, etc.) but may contract out certain functions (i.e. meter replacement, laying water pipes, building of a treatment plant, supplying certain goods) on a nonregular basis to private companies.
- **Long-Term Service Contract:** municipality owns all of the town's water related assets (meters, treatment plant, withdrawal license, etc.) but contracts out certain functions (regular supply of chemicals, maintenance or repair) to a private company on a regular basis.
- **Operation and Management of a Utility (O&M):** Municipality owns all of the water related assets, but contracts out the daily operations and management of the utility (this may or may not include customer billing). The town has limited authority (dependent on specifics of the contract) over the daily operation and management of the water utility and only regains that authority upon expiration of the contract.
- **Design, Build, Operate Contracts (DBO):** Municipality contracts out the design building and operation of a treatment plant (this may or may not be in addition to an O&M contract). The town has limited authority (dependent on specifics of the contract) over the daily operation of the treatment plant and facilities operation and only regains that authority upon expiration of the contract.
- **Privately Owned and Operated:** Private company owns all of the town's water related assets, including the meters, treatment plant and withdrawal license. The town has no authority over the operation and management, including rate increases.

Figure 2
Relative Frequency of Ownership/Management Structures
of Towns Included in Study

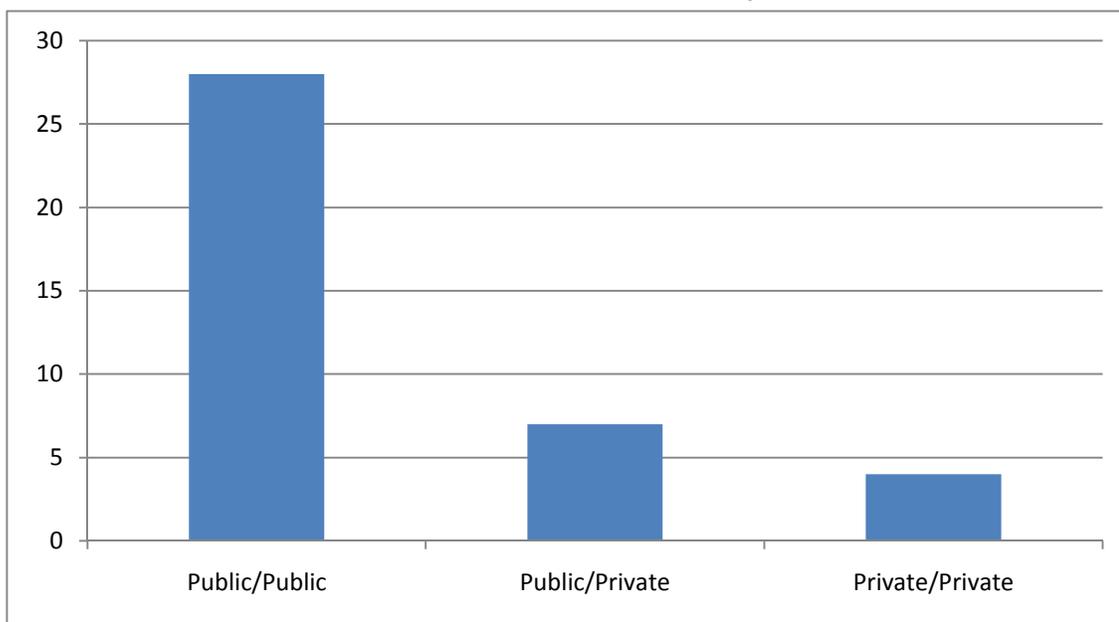
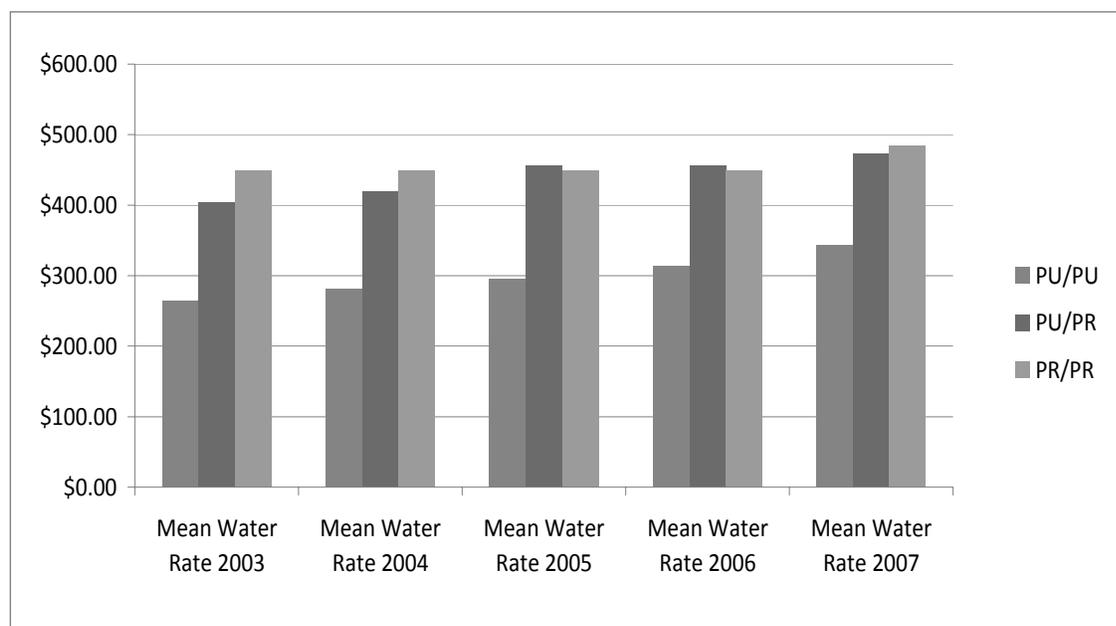


Figure 3
Average Annual Water Rate by
Ownership/Management Structure
(2003-2007)



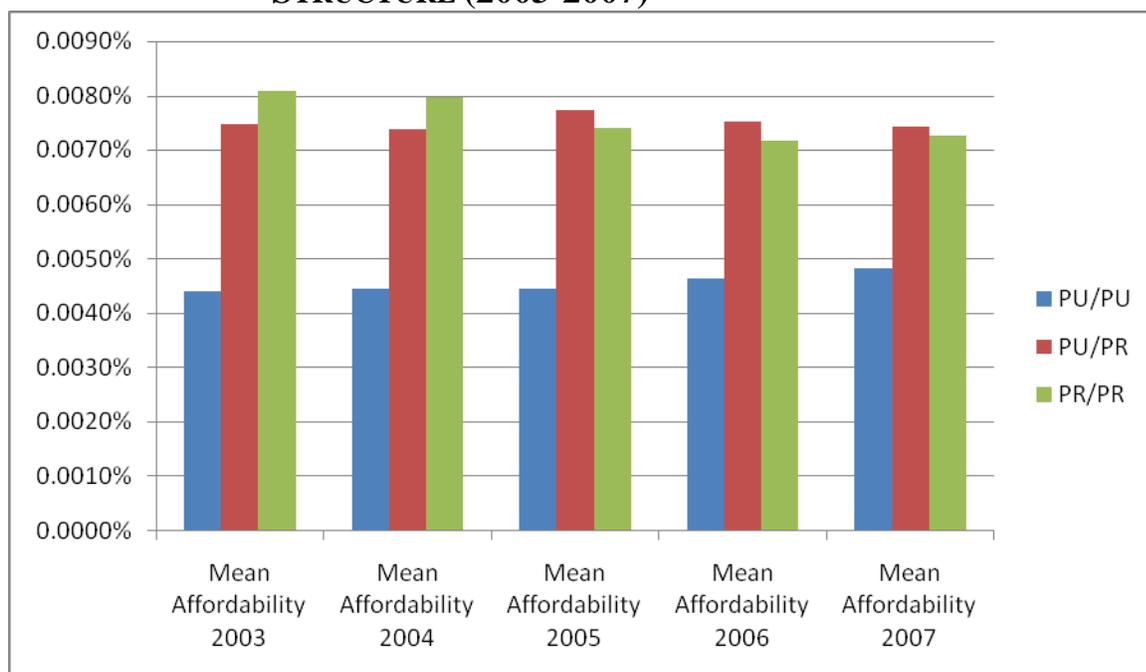
LEGEND

- **PU/PU:** publicly owned and operated water systems
- **PU/PR:** publicly owned, privately operated water systems
- **PR/PR:** privately owned and operated water systems

Mean Water Rates

- **PU/PU:** \$265.23 (2003), \$280.99 (2004), \$295.26 (2005), \$314.06 (2006), \$344.02 (2007)
- **PU/PR:** \$403.38 (2003), \$419.81 (2004), \$455.83 (2005), \$456.38 (2006), \$473.46 (2007)
- **PR/PR:** \$449.25 (2003), \$449.25 (2004), \$449.25 (2005), \$449.25 (2006), \$484.59 (2007)

FIGURE 4
AVERAGE AFFORDABILITY OF WATER RATES AS A PERCENTAGE OF
ANNUAL MEDIAN HOUSEHOLD INCOME BY OWNERSHIP/MANAGEMENT
STRUCTURE (2003-2007)



Mean Affordability Statistics

- **PU/PU:** .004391 (2003), .004443 (2004), .004446 (2005), .004634 (2006), .004816 (2007)
- **PU/PR:** .007476 (2003), .007367 (2004), .007730 (2005), .007514 (2006), .007416 (2007)
- **PR/PR:** .008081 (2003), .007976 (2004), .007398 (2005), .007164 (2006), .007265 (2007)

TABLE 1: TOWNS INCLUDED IN THIS RESEARCH			
	Town Names	Nature of Ownership/MGT	Contract Operator/Owner
11	Chatham	Public/Private	Earthtech
22	Hyannis	Public/Private	Whitewater (Pennichuck for billing)
33	Norfolk	Public/Private	Whitewater
44	Westborough	Public/Private	Veolia
55	Sturbridge	Public/Private	Veolia
66	Provincetown	Public/Private	Woodard & Curran
77	Salisbury	Public/Private	Pennichuck
88	Millbury	Private/Private	Aquarion
99	Hingham/Hull/North Cohasset	Private/Private	Aquarion
910	Oxford	Private/Private	Aquarion
11	Whitinsville	Private/Private	Whitinsville Water Co.--> Whitewater
112	Athol	Public/Public	N/A
13	Ayer	Public/Public	N/A
14	Bellingham	Public/Public	N/A
115	Blackstone	Public/Public	N/A
116	Duxbury	Public/Public	N/A
117	East Bridgewater	Public/Public	N/A
118	Easthampton	Public/Public	N/A
119	Easton	Public/Public	N/A
120	Fairhaven	Public/Public	N/A
221	Hadley	Public/Public	N/A
222	Hamilton	Public/Public	N/A
223	Hanover	Public/Public	N/A
224	Hopkinton	Public/Public	N/A
225	Lancaster	Public/Public	N/A
226	Marshfield	Public/Public	N/A
227	Maynard	Public/Public	N/A
228	Medfield	Public/Public	N/A
229	Middleborough	Public/Public	N/A
330	Natick	Public/Public	N/A
331	Pepperell	Public/Public	N/A
332	Plymouth	Public/Public	N/A
333	Spencer	Public/Public	N/A
334	Sterling	Public/Public	N/A
335	Uxbridge	Public/Public	N/A
336	Walpole	Public/Public	N/A
337	Ware	Public/Public	N/A
338	Webster	Public/Public	N/A
339	Williamstown	Public/Public	N/A

Table 2: OPERATIONALIZATION OF NATURE OF OWNERSHIP AND MANAGEMENT, REGULATORY COMPLIANCE AND COST Concepts, Variables and Indicators		
Concepts	Variable	Indicators (Source)
Public or Private Nature of Ownership and Operation of Town's water utility	<ul style="list-style-type: none"> ➤ Criteria for inclusion in this research: <ol style="list-style-type: none"> 1. Community public water system in the Commonwealth of Massachusetts with between 1,500 and 12,000 residential service connections 2. Predominantly utilize groundwater 3. If municipally owned and managed, must operate as an enterprise fund 4. If municipally owned and managed, must operate within a Department of Public Works (or similar public entity). 	<ul style="list-style-type: none"> ➤ Interviews with company officials, review of company websites (Pennichuck Corporation, Veolia Water North America, etc.) ➤ Interviews with Department of Environmental Protection data management ➤ Interviews with town officials ➤ Analysis of Public Works Financing Newsletters ➤ Analysis of US Conference of Mayors Urban Water Council documents
Cost	<ul style="list-style-type: none"> ➤ Cost = annual average residential water rate based on consumption of 120 HCF (90,000 gallons)/year ➤ Rates are affordable when the annual cost is less than 2% of median annual household income. 	<ul style="list-style-type: none"> ➤ Rate source: Tighe and Bond for the years 2004 and 2006. ➤ Interviews with PWS providing water to included towns for 2003, 2005 and 2007 rates. ➤ Median annual income (in 1999 dollars) adjusted from 2000 US Census using county data.
Regulatory Compliance: SDWA	<ul style="list-style-type: none"> ➤ SDWA Regulatory Compliance means compliance with the SDWA water quality standards. Determined by: <ol style="list-style-type: none"> 1. Copper and Lead Action Level Exceedances 2. MCL, TT, M/R, VIO violations 	<ol style="list-style-type: none"> 1. CCRs, DEP database (Damon Gutterman) 2. DEP database (Damon Gutterman)

Table 2: OPERATIONALIZATION OF NATURE OF OWNERSHIP AND MANAGEMENT, REGULATORY COMPLIANCE AND COST Concepts, Variables and Indicators		
	3. Enforcement Actions (LLE and HLE)	3. DEP database (Damon Gutterman)
Regulatory Compliance: WMA	<p>Compliance with the WMA means compliance with withdrawal permit limits and low UAW amounts.</p> <ul style="list-style-type: none"> ➤ Unaccounted for Water Amounts for 2003-2007 ➤ WMA Violations and DEP Enforcement Actions 	<p><u>2003-2005 UAW Amounts</u></p> <ul style="list-style-type: none"> • Municipal annual statistical report • Conversations with town officials <p><u>2006-2007 UAW Amounts</u></p> <ul style="list-style-type: none"> • As adjusted by the DEP's Water Management Program • Conversations with town officials <p><u>2003-2007 Violations/Enf. Actions</u></p> <ul style="list-style-type: none"> • DEP database for violations and enforcement actions.

TABLE 14: COMPARATIVE TABLE OF PREVENTATIVE MAINTENANCE MEASURES				
Measure	DEP Rec's	Norfolk	Hingham/Hull	Hanover
Flushing	Annual	Twice annually	Every 3 years (1/3 of the system per year)	Twice annually
Exercising of Valves	Annual	Annual	Every 5 years (20% exercised annually)	Twice annually
Tank Inspections	Regular tank inspections	Every 2-3 years with divers	Every 5 years using remote video	Monthly visual inspection. Annual interior and exterior inspection using remote video
Leak Detection	Annual or biannual leak detection	Annually (currently twice annually due to leakage issues)	Annually through outside vendor	Biannually through outside vendor (though budgeted for annually in case potential leakage issue arises)
Meter Replacement	Strong metering program with regular meter replacement and maintenance	Input new electronic metering system so leakages can be detected immediately	Change 10% of meters annually (10 year cycle)	Change 5% of meters annually (20 year cycle)
Additional Measures			In house lab to proactively test for potential water quality issues.	Proactively replace water mains whenever a road is dug up. Benefit of being part of a DPW, they coordinate.

APPENDIX A: INTERVIEW QUESTIONS**DEP EMPLOYEES***General Questions:*

- 1) What is your position with the DEP?
- 2) How many years have you been in this position?
- 3) Have you held any previous positions with the town, another water utility or another regulatory agency?
- 4) How often on average, do you think a water utility should flush its system? Why?
- 5) What other types of preventative maintenance should be performed regularly by a water utility to improve/maintain water quality? Please explain.
- 6) What kind of preventative measures do you think a water system can/should do to minimize unaccounted for water amounts?
- 7) Do you find public or privately operated utilities easier to work with when proposing increased standards or altering regulations?
 - o Why/Why not? Please explain?
- 8) Do you find private/private, public/private or public/public utilities easier to work with when imposing regulatory conditions?
- 9) Do you find private/private, public/private or public/public utilities to be more concerned about maintaining regulatory compliance?
 - o Why?
- 10) Do you find private/private, public/private or public/public utilities easier to work with/more reliable in their reporting of UAW amounts?
- 11) Do you find private/private, public/private or public/public utilities to be more concerned with minimizing UAW amounts?
 - o Why?
- 12) What is your opinion of private company or investor-owned companies' involvement in the operation of a public water utility?
 - o Please explain.

- 13) Do you believe municipally owned and operated utilities function more efficiently than privately owned and operated or publicly owned and privately operated utilities?
- For clarification. When I say “efficiently” I am referring to how successful the utility is at withdrawing water from their wells and delivering it to their customers while complying with the Safe Drinking Water Act and [Water Management Act] at an affordable cost to the consumer (that is less than 2% of their income).
 - Please explain.

Town Specific Questions

I am focusing on three towns in an effort to get a deeper understanding of some of the unquantifiable differences between ownership and management structure of utilities. I am looking at Hanover (a publicly run system), Norfolk (a publicly owned system, currently contracted out to Whitewater for the treatment) and the Hingham/Hull/N.Cohasset system (a privately owned and operated system).

All three towns were chosen because, of the 39 municipalities included in my study, they have the highest annual average water rate for the particular management structure they utilize.

Hanover

- 1) To the best of your knowledge: Has Hanover’s water distribution always been owned and operated by the town?
- 2) As you may now, in Hanover the water utility is both owned and operated by a public entity. In your opinion, do you think the fact that the Hanover Water system operates within a public framework has any impact on the utility’s cost to the consumer?
 - Why/Why not? Please explain?
- 3) In the period between 2003 and 2007 the annual average water rates for residential customers were between \$486 and \$532, which is above average? Do you have any idea why these rates are higher than average?

- 4) Do you think the Hanover water utility would be able to operate in a more cost effective manner if it were privately run?
 - a. Please explain why or why not?
- 5) In your opinion, do you think the fact that the Hanover Water system operates within a public framework has any impact on the utility's regulatory compliance and UAW amounts?
 - Why/Why not? Please explain?
- 6) Through my quantitative research I discovered that Hanover had no water quality or water management act violations for the entire period studied (2003-2007). Can you explain why you believe this occurred?
- 7) Through our quantitative research we discovered that Hanover had no enforcement actions taken against them by the DEP for the 5 years studied. Can you explain why you believe this occurred?
- 8) Through my quantitative research I discovered that Hanover had the following UAW amounts for the entire period studied (2003-2007). Do you believe this to be a low, high or average UAW amount?
 - Can you explain why you believe this occurred?

Hingham/Hull System

- 1) To the best of your knowledge has the Hingham/Hull system always been privately owned and operated (though it has changed hands a few times).
- 2) As you may now, the Hingham/Hull system is both owned and operated by a private entity. In your opinion, do you think the fact that this Water system operates within a private framework has any impact on the utility's cost to the consumer?
 - Why/Why not? Please explain?
- 3) In the period between 2003 and 2007 the annual average water rates for residential customers were \$665 annually, which is above average? Do you have any idea why these rates are higher than average?
- 4) Do you think the Hingham/Hull/N. Cohasset water utility would be able to operate in a more cost effective manner if it were publicly run?
 - Please explain why or why not?
- 5) In your opinion, do you think the fact that the Hingham/Hull/N. Cohasset Water system operates within a private framework has any impact on the utility's compliance with the SDWA and WMA?

- Why/Why not? Please explain?
- 6) Through my quantitative research I discovered that Hingham/Hull/N. Cohasset system has had no water quality or WMA violations or enforcement action for the entire period studied (2003-2007). Can you explain why you believe this occurred?
 - 7) Through my quantitative research I discovered that Hingham/Hull/N.Cohasset had the following UAW amounts for the entire period studied (2003-2007). Do you believe this to be a low, high or average UAW amount? Can you explain why you believe this occurred?

Norfolk

- 1) To the best of your knowledge has Norfolk always been publicly owned, but contracted out the O&M?
- 2) As you may now, in Norfolk the water utility is owned by a public entity but the treatment operations are contracted out to the Whitewater Company, a subsidiary of RHWhite.
 - In your opinion, do you think the fact that the Norfolk Water system operates within a public framework has any impact on the utility's cost to the consumer?
 - What about the fact that its operations are contracted out? Why/Why not? Please explain?
- 3) In the period between 2003 and 2007 the annual average water rates for residential customers went from \$594 to \$694 and \$618, which is above average? Do you have any idea why these rates are higher than average?
- 4) Do you think the Norfolk water utility would be able to operate in a more cost effective manner if it were privately owned or publicly run?
 - Please explain why or why not?
- 5) In your opinion, do you think the fact that the Norfolk Water system operates within a public framework but has a privately run treatment system has any impact on the utility's UAW amounts and level of regulatory compliance?
 - Why/Why not? Please explain?
- 6) Through my quantitative research I discovered that Norfolk had the following UAW amounts for the entire period studied (2003-2007). Do you believe this to be a low, high or average UAW amount? Can you explain why you believe this occurred?

- 7) Through my quantitative research I discovered that Norfolk had X water quality violations for the entire period studied (2003-2007).
- Can you explain why you believe this occurred?

TOWN OFFICIALS/EMPLOYEES

General Questions:

- 1) Before we begin, do you have any questions about the informed consent form I sent you?
- 2) What is your position with X Water utility?
- 3) How many years have you been in this position?
- 4) Have you held any previous positions with the town, another water utility or a regulatory agency?
- 5) How many employees are on staff in the town for all water related functions?
- 6) Could you breakdown the varying functions of the employees for me?
- 7) How does your town budget work? Where does your funding for the operation and maintenance of the utility come from? Does it function as an enterprise fund? What does that mean in your town?
- 8) What is the size of the water budget? (approximations are fine)
- 9) How are the rates distributed within the water system? That is where does the bulk of rate money get spent?
- 10) How big is your system? Specifically:
 - Miles of pipes:
 - Residential service connections:
 - Number of wells:
 - Surface/groundwater source:
- 11) Has Hanover's water distribution always been owned and operated by the town?
- 12) What is your opinion of private company or investor-owned companies' involvement in the operation of a public water utility? Please explain.

- 13) Do you believe municipally owned and operated utilities function more efficiently than privately owned and operated or publicly owned and privately operated utilities?
- For clarification. When I say “efficiently” I am referring to how successful the utility is at withdrawing water from their wells and delivering it to their customers while complying with the Safe Drinking Water Act and [Water Management Act] at an affordable cost to the consumer (that is less than 2% of their income).
 - Please explain.

Regulatory Compliance Data Collection:

- 14) As you may now, in the Town of X, the water utility is owned by a [public/private] entity and operated by a [public/private] entity. In your opinion, do you think the fact that the X Water system operates within a [public/private] framework has any impact on the utility’s regulatory compliance, Positive or negative?
- Why/Why not? Please explain?
- 15) What types of preventative maintenance are performed regularly in Hanover water system? Please explain. (ask the following only if they don’t mention them specifically)
- Inspect your tanks regularly? Why or why not?
 - do you flush your system regularly? Why or why not?
 - Exercise your valves regularly, why or why not?
- 16) Through our quantitative research we discovered that the Town of X had Y number of water quality violations for the entire period studied (2003-2007). Can you explain why you believe this occurred?
- 17) Through our quantitative research we discovered that Hanover had X number of enforcement actions taken against them by the DEP for the 5 years studied. Can you explain why you believe this occurred?

Cost Data Collection:

- 18) (*If applicable*) How long has the X Water Department functioned as part of the town’s Board of Public Works? As you see it, what are the benefits/drawbacks of operating under the town’s BPW?
- 19) As you may know, in the town of X, the water system is owned by a [public/private] entity and operated by a [public/private] entity. Do you think the fact that X’s water system is owned by a [public/private] entity and operated by a [public/private] entity has any impact on the utility rates (positive or negative)?
- Why or why not?

- 20) Has your system always been owned and operated by a [public/private] entity?
- 21) *(If applicable)* Was/is any portion contracted out to a private company?
- 22) *(If applicable)* What exactly is the private company responsible for, what exactly are you responsible for (if anything)?
- 23) In the period between 2003 and 2007 the annual average water rates for residential customers were between X and Y, which is above average.
- Do you have any idea why these rates are higher than average?
 - Were there any special circumstances leading to the rate increase?
 - Can you think of anything special that occurred in the town of X that would cause such a rate increase?
- 24) Do you consider X's current water rates and those of the past five years to be "affordable"?
- Please describe what you mean by affordable.
- 25) *(If applicable)* When the water system was operated by Y did you think your rates were more or less affordable than at present?
- 26) Do you expect there to be a rate increase or decrease in the near future? Why?
- 27) Could you please explain your treatment process to me?
- 28) Do you think X water utility would be able to operate in a more cost effective manner if it were run by a [public/private] entity? Please explain why or why not?

PRIVATE COMPANY OFFICIALS

General Questions

- 1) Before we begin, do you have any questions about the informed consent form I sent you?
- 2) What is your position with the Aquarion?
- 3) How many years have you been in this position?
- 4) Have you held any previous positions with the town, another water utility or another regulatory agency?
- 5) What is your opinion of private company or investor-owned companies' involvement in the operation of a public water utility?
 - Please explain.
- 6) Do you believe municipally owned and operated utilities function more efficiently than privately owned and operated or publicly owned and privately operated utilities?
 - For clarification. When I say “efficiently” I am referring to how successful the utility is at withdrawing water from their wells and delivering it to their customers while complying with the Safe Drinking Water Act and [Water Management Act] at an affordable cost to the consumer (that is less than 2% of their income).
 - Please explain.
- 7) Who operated your water system prior to Aquarion? When did Aquarion purchase the system?
- 8) What exactly is Aquarion responsible for?
- 9) Does the town have any responsibility over the water distribution system?
- 10) How easy have you found it to work with the town?
- 11) How many employees are currently on staff in the town for water distribution?
- 12) How many employees were on staff in 2003 (the beginning period of my study)?
- 13) Why was there a reduction in staff?

- 14) Has this affected your operations in any way (good or bad)?
- 15) Could you breakdown the varying functions of the employees for me?
- 16) What is the size of the water budget for this system? (approximations are fine)
- 17) How are the rates distributed within the water system? That is where does the bulk of rate money get spent?
- 18) How big is your system, specifically?
 - Miles of pipes
 - Residential service connections
 - Number of wells
 - Surface/groundwater source?

Regulatory Compliance Data Collection

- 19) As you may know, X water system is owned by [the town, a private company] and operated by a private entity. In your opinion, do you think the fact that the water system is operated by the private sector has any impact on the utility's level of regulatory compliance? (positive or negative)
 - Why/Why not? Please explain?
- 20) What types of preventative maintenance are performed regularly in X water system? Please explain. (ask the following only if they don't mention them specifically)
 - i.e. do you flush your system regularly? Why or why not?
 - Inspect your tanks regularly? Why or why not?
 - Exercise your valves regularly, why or why not?
- 21) What type of treatment/filtration is conducted in X water system?
- 22) How easy do you find it to work with the DEP?
- 23) (*If applicable*) When the water system was operated by Y did you think levels of regulatory compliance were higher, lower or about the same?
 - What do you think is the reason for that?
- 24) (*If applicable*) Through our quantitative research we discovered that the X water system had Y number of violations or enforcement actions for the 2003-2007 period studied. Can you explain, in your opinion, why you believe this occurred?

Cost Data Collection:

- 25) In the period between 2003 and 2007 the annual average water rates for residential customers were approximately X/year, which is above average. Do you have any idea why these rates are higher than average?
- 26) Were there any special circumstances leading to this high rate?
- 27) How are the rates distributed within the water system? That is where does the bulk of rate money get spent?
- 28) Do you think the fact that the X water system is operated by a private company has any impact on the utility rates? (positive or negative).
 - Why or why not?
- 29) Do you consider the X water system's current water rates and those of the past five years to be "affordable"?
 - Please describe what you mean by affordable.
- 30) Do you foresee a(n) increase/decrease in the X water utility rates in the near future?
- 31) Do you think the X water system would be able to operate in a more cost effective manner if it were [publicly owned and contracted to a private company or publicly owned and publicly operated]?
 - Please explain why or why not?

CUSTOMERS

General Questions:

- 1) What is your opinion of private company or investor-owned companies' involvement in the operation of a public water utility?
 - Please explain.

- 2) Do you believe municipally owned and operated utilities function more, less, or as efficiently as privately owned and operated or publicly owned and private operated utilities?
 - For clarification. When I say “efficiently” I am referring to how successful the utility is at withdrawing water from their wells and delivering it to you at an affordable price while complying with the law.
 - Please explain.

- 3) As you may now, in town X the water utility is owned by a [public/private] entity and operated by a [public/private] entity. Do you think the fact that X is a [public/private] entity has any impact on your water rates?
 - Why or why not?

- 4) Do you consider your current water rates and those of the past five years to be “affordable”? (Inform them of their water rates for the past five years)
 - Please explain why (or why not)?

- 5) (*If applicable*) When your water was owned by X and operated by Y did you think your rates were more or less affordable than at present?
 - Please explain

- 6) Lastly, how would you describe your satisfaction with your present water company? Why?
 - Extremely satisfied
 - Satisfied
 - Not Satisfied

BIOGRAPHICAL DATA

NAME	Corey Denenberg Dehner
EDUCATION	<p>Northeastern University, Boston, Massachusetts</p> <ul style="list-style-type: none"> • <i>Doctor of Philosophy</i>, 2009 <p>Boston College Law School, Chestnut Hill Massachusetts</p> <ul style="list-style-type: none"> • <i>Juris Doctor</i>, 2001 <p>University of Colorado, Boulder, Colorado</p> <ul style="list-style-type: none"> • <i>Bachelor of Arts</i>, 1997
PROFESSIONAL EXPERIENCE	<p>Lecturer of Record, <i>Environmental Law, Policy and Social Movements</i>, 2008 Northeastern University, Boston, Massachusetts</p> <p>Lecturer of Record, <i>Introduction to Law</i>, 2005-2007 Northeastern University, Boston, Massachusetts</p> <p>Graduate Student Assistant, <i>Law, Policy and Society Program</i>, 2004-2005 Northeastern University, Boston, Massachusetts</p> <p>Assistant General Counsel, <i>The Community Builders, Inc.</i>, 2002-2003, Boston, Massachusetts</p> <p>Law Clerk to the Justices, <i>Superior Court of Massachusetts</i>, 2001-2002, Boston, Massachusetts</p>
PROFESSIONAL ORGANIZATIONS	<p>Northeastern Environmental Justice Research Collaborative</p> <p>Capitalism, Nature, Socialism Journal: Boston Editorial Group</p> <p>American Bar Association, Section of Environment, Energy and Resources</p> <p>Massachusetts State Bar</p>

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