CONDITIONS FOR POSSIBLE DISTRICT EXPANSION

A Report to the Acton Water District Commissioners

Water Land Management Advisory Committee

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EXECUTIVE SUMMARY

The Water Supply District of Acton (usually called the Acton Water District or AWD) was formed in 1912 as an independent government body to supply water for domestic and fire fighting purposes in South and West Acton. Since then, District boundaries have been expanded to include the entire geographic boundaries of the Town. While its goal of providing safe, adequate water has remained constant, the District now faces new challenges, such as population growth, limits of water resources, and the impact of environmental pollutants.

In recent years, AWD has received occasional requests for water service to properties in adjacent towns. The Commissioners for the Acton Water District have reestablished the Water-Land Management Advisory Committee (WLMAC) to recommend the conditions, if any, under which the District should consider expansion.

How can expansion of water service be consistent with the fact that the availability of groundwater is limited? In this report, WLMAC will present concepts that support the idea that, under some circumstances, expansion will help the District address the limits of its resources.

Future Expansion of the Acton Water District

During the past year, WLMAC has considered three major types of expansion:

Expansion Within-District: AWD is chartered by the state to provide water to the residents and businesses within District boundaries. Anticipation of build-out demand for water must be central to its planning and development activities.

Expansion Outside-District: In considering extension of water service across current District boundaries, AWD must make certain that there is adequate benefit to the District in serving such properties. Possible benefits include:

- Improved protection of groundwater recharge areas that extend beyond current District boundaries, by control over the nature of the development and the amount of withdrawal allowed.
- Potential for development of new water supplies.
- Spread fixed costs of District over a larger number of ratepayers.

Regionalization: Combining water supply and service with one or more contiguous municipalities may offer AWD a way to share both resources and risks. In addition to the benefits listed above, regionalization could offer the following:

- Larger range of possibilities for increased water supply.
- Application of uniform control of land use in groundwater recharge zones.
- Combined resources for monitoring water quality and quantity-related issues.
- Risk of major supply problem reduced by spreading likelihood over a larger area.

Strategies

The merit of any proposed expansion should be measured by its positive impact on the efforts of the District to continue its present level of excellent service. WLMAC has identified four strategies that will be critical to those efforts.

Water Source Protection: The District's water supply is vulnerable to the loss of any of its wells due to contamination. Even if it did not force a well to be closed, groundwater contamination would increase treatment costs. To protect the quality of existing water resources, control of activities is critical on land above groundwater recharge areas. Because portions of groundwater recharge areas for several AWD wells lie within neighboring towns, AWD benefits from maintaining cooperative working relationships with those towns. By expanding water service to properties above recharge areas, the District could increase its opportunities to control activities on that land. WLMAC recommends the purchase of land and establishment of conservation restrictions in recharge areas.

Water Conservation: While the current water supply meets present needs, both expected and unpredictable increases in use could place additional stress on existing resources. Water conservation is the most cost-effective way to optimize use of those resources. WLMAC recommends that AWD enhance its efforts to promote and reward water conservation, by public education programs and by using the rate structure as an incentive. Such incentives would also apply to any rate payers with service beyond current District boundaries and extend the District's conservation authority to a larger portion of the land above the aquifer.

New Water Supplies: Protection and conservation of existing water resources are essential to the future of the water supply, but by themselves may not be sufficient. AWD should pursue new water supply sources to allow for a margin of safety as well as for new growth. Because of the expense of developing new water sources, AWD should consider combining efforts with neighboring towns. Extension of AWD water service to properties in those towns will enhance options for finding new sources.

Collaboration: Cooperative efforts between AWD and Town planning and zoning departments already make a positive contribution to the future of our water supply. WLMAC recommends a formal process linking the AWD and the Town when making decisions about development and long range planning. Recognizing the value of their political separation, AWD and the Town must work together to ensure that new development does not impose demands that exceed a prudent safety margin for available water.

Conclusions

In responding to requests for expansion of water service, the Acton Water District must determine whether there are benefits in terms of the four strategies outlined above. The Committee recommends taking this approach one step further, to consider proactive exploration of expansion scenarios that offer benefits to the District.

WATER LAND MANAGEMENT ADVISORY COMMITTEE BACKGROUND

The Commissioners for the Water Supply District of Acton reestablished the Water-Land Management Advisory Committee (WLMAC) to define the conditions, if any, under which the District should consider expanding its service area beyond its present boundaries. The members of the Committee were selected after applications were reviewed and interviews conducted. Two members were appointed by the Acton Water District; two members were appointed by the AWD Moderator and one member was appointed by the Acton Town Selectmen. Not long after the WLMAC began meeting, Arthur Gagné, one of the original members resigned and was replaced by Charles Olmstead. The Committee would like to acknowledge the early contributions made by Art.

Meetings of the WLMAC were open to the public (except for very rare executive sessions) and were held two times per month on average. The Committee consulted publications and information available to it through the Internet, and conducted interviews with various Acton officials as well as with people in the AWD and Littleton Electric Light and Water District and with others. In addition, the WLMAC spent many hours discussing and refining points of view during its numerous and open meetings.

In an effort to make the public aware of a few of the issues the WLMAC was researching and discussing, the Committee contacted the local periodicals and asked them to publish a series of articles that the WLMAC would write. A number of them did publish some or all of the articles. Finally, on December 7, 2005, the Committee conducted a "Public Discussion Meeting" at the new Acton Public Safety Facility to let the citizens of Acton know about the WLMAC, explain our thinking up to that point and to elicit opinions and ideas from those in attendance. Many of the ideas expressed have directly influenced the thinking and therefore the conclusions articulated in this document.

This report summarizes the findings and opinions of the committee which are based on a review of all pertinent literature, technical reports, discussions with experts in the field and opinions of interested citizens.

HISTORY OF WATER SUPPLY IN ACTON

The concept of a public water supply district for Acton had its beginnings in the nineteenth century. Records of the 1895 Acton Town Meeting indicate that a committee was formed to study potential sources for water supply. While the specific reason for studying this topic was not stated, it is apparent that the water supply from private wells had become inadequate for growing domestic and commercial use, particularly in South Acton and West Acton. The study committee included members with names that are still well-known in Acton: H.A. Littlefield, D. J. Wetherbee, William D. Tuttle, D. H. Hall and Francis Conant.

Frank L. Fuller of Boston was hired by the committee to serve as engineer for the study. One of his recommendations was to use Great Hill, with an altitude of 361 feet, as a

standpipe. His study also examined a variety of possible sources for public water supply. Initially, Fort Pond Brook appeared to offer adequate supply for the populated districts in town, but subsequent test wells yielded very little water. After testing a number of other sites, a productive well site was found on land owned by Isaac Reed, the site of the present-day Acton Water District headquarters. Of this site, the committee stated that "it is an ideal location… free from anything likely to contaminate the water. The quality of the water is excellent." Furthermore "Although 10 acres are not needed for driving the wells, it would be better for the town to control it, and thereby keep building or other things away that might tend to pollute the water." .

The committee's final report to the Town Meeting of 1896 states that residents of the "villages" (West Acton and South Acton) would benefit from a public water supply and for that reason the Town should move forward with this project, since "anything that helps the villages must correspondingly help the town." It is evident from the wording in the report that the committee had concerns about the politics surrounding their recommendations. In fact, the report had insufficient impact to convince Town Meeting to support the development of a public water supply, and the study's recommendations were ignored in the following years. Residents of Acton Center and other more sparsely populated areas did not want the financial responsibility for a water district that would primarily serve the villages of West Acton and South Acton.

It was not until 1912 that a public water supply district was formed in Acton. The State Legislature established "The West and South Water Supply District of Acton" in response to requests from the residents of the two villages for a self-funding water district that was independent from the Town. The District obtained financing to build a system based on the study prepared for the town by Frank Fuller 16 years earlier. The District could not reach agreement with Isaac Reed on the value of the land for the well site. The final value of the land ($800) was eventually determined through an eminent domain proceeding. Once begun, the system was built quickly. During this process, the residents of Acton Center changed their collective view and successfully petitioned the State to amend the District boundaries to include an additional strip connected to their neighborhood. Over the course of the next several decades, the District was enlarged several times until it eventually encompassed the entire Town of Acton. It was re-named "The Water Supply District of Acton" although it is most commonly referred to as the "Acton Water District."

Following completion of the initial water supply system, the District operated for many years without much change other than slow expansion of its service area. George Clapp served as superintendent, hiring local workers for "ditch digging" and other work as required to construct and maintain the infrastructure. Each year the District met its financial obligations and steadily paid off its loans. During this period, District income was derived from property taxes, water rates and hydrant fees charged to the Town. For a number of years in the early 20th century, the same bookkeeper served both the Town of Acton and the Acton Water District. Unfortunately this situation led to shuffling of funds between the two municipalities. When this treasurer died while in office, the water district was forced to absorb a discrepancy of $1,800. Much of this was recovered through insurance after several years of wrangling.

The District survived the economic Depression of 1930's, and during that time was able to fund replacement of original pumps while it continued to extend new service lines. Maintenance and growth of the system were halted by the advent of World War II. During the war, concern about the security of the well site led to employment of a night watchman.

Once the war was over, the District experienced a sharp rise in demand for water to serve many types of development. In the late 1940's there were several years of debate at District meetings because those households that had originally been part of the District did not want additional addresses connected to the system without those new addresses paying additional fees equal to the original assessment taxes, in addition to guaranteeing revenue to pay for the mains extensions. At the same time, industry was attracted to the town. In 1947, a company called Dewey and Almy established a chemical industry on land that appeared to offer abundant clean water for its use. The following excerpt from Harold Phelan's encyclopedic 1954 *History of Acton* is ironic in light of the fact that the Dewey and Almy property would be acquired by W. R. Grace in 1954 and become a Super Fund site less than 25 years later.

> Within recent years Acton has felt the impact of an entirely new trend in the industrial world. Due in part to prohibitive taxes in the completely urban areas…but certainly in major measure because of Acton's superior supply of cool water, new plants have come to town. These are not the architectural horrors that congregated along the railway in previous eras, but are located in unsettled areas, in some cases in the forest far away from residences and even from the highway. They are neat compact, modernistic structures, run by electricity and having none of the offensive attributes of the smoke belchers of the past.
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> Early among these newcomers was the Dewey and Almy Chemical Company, which, seeking to expand its Cambridge plant and needing location remote from dwellings where the more hazardous of its projects could be carried on, found the abandoned two hundred and fifty acre tract of the former smokeless powder mills particularly attractive since it had a sandy gravel soil, abundant water supply and was on the main line of the Boston and Maine Railroad. Here in 1946 they started the manufacture of solvent solutions of rubbers and resins.
>
> As a result of expansion after the war there are now twenty two buildings in which are produced sealing compounds, soldering fluxes, and machinery used in the canning industries; similar compounds for the steel drum and pail manufacturers' insoles, cements, adhesives, and synthetic and reconstructed leather for the shoe trade, bags, shipping cases, and adhesives for the paper container market; sealing compounds, soldering fluxes and storage battery appurtenances for the automotive industry; and various products that are utilized in the rubber, paint and plastic industries.[1]

[1] Phalen, Harold R. (1954), History of the Town of Acton, Middlesex Printing, Inc., Cambridge, Massachusetts.

Throughout the 1950's the District continued to expand service in small increments to existing streets at the edges of the service area. In addition significant housing development started in earnest in the 1950s and the developers connected their new neighborhoods to the system.

Up to this time, the Acton Water District had provided reliable water service at a reasonable cost to rate payers throughout the town. The actions of the District appeared to be centered on minimizing water rates, which encouraged both residential and commercial development.

1960 through 1985—a time of complete transformation

Great change occurred in the Water District between 1960 to 1985. In 1960, the District operated in much the same manner as it had 45 years earlier, serving about 2000 homes and businesses with about 150 million gallons of water pumped. The annual District budget was a little under $100,000. These numbers are about 10 times what they were in 1915, but the original system infrastructure was still the majority of the system. By 1986, the District served approximately 4,000 customers, pumped 650 million gallons and had an operating budget over $1 million. Through the efforts of the District managers and commissioners during this time, the District transformed itself from what was essentially a village well to a modern, complex, municipal water system which acts after giving careful consideration to the relationships between itself, the local environment and the community of people it serves. Many of the changes in this period are worth noting.

District name and boundaries

In 1962, after receiving a petition from residents in unincorporated areas, and with clear understanding that many land owners in Acton would convert their land into subdivisions and create water demand away from the railroad station areas in West and South Acton, the Commissioners asked District voters to approve a petition to the state legislature to incorporate all of the land in the Town of Acton into the District. The enabling legislation also changed the name of the District to reflect its increased size. Subsequent to this expansion, and with awareness that long time Superintendent Ray Harris would retire at the end of 1965, the commissioners reviewed with Town selectmen, in 1964, the possibility of merging the District into the Acton Town government. This idea apparently was not well received as it is not mentioned at all in subsequent annual reports.

Boxborough working framework

Through the early 1960's the District held discussions with Boxborough officials and residents about parallel issues of water supplies and water service in Boxborough. Boxborough residents were aware that there was substantial water supply available along the Acton/Boxborough town line near the site of the Whitcomb well and very little water supply in the rest of Boxborough. The result of these discussions was State legislation which allows the District to provide water service to homes in Boxborough and to develop wells in Boxborough, provided that the water from these wells can be used only in Boxborough.

Supply and Demand

Until 1960, the District was operating principally from its original well. The commissioners had struggled through the 1950's with inadequate supply in the summer months and most years had to ban lawn watering. The District had set up a temporary well on leased land in the mid 1950's, but given the rapid development of new homes in Acton, it was evident that more supply was needed. The District tested almost every potential well site in Acton and found some worthwhile and others not viable. This effort started in the early 1960's with the rental of the Christofferson land on School Street. The District had the opportunity to purchase this land in 1964 after two years of renting, but decided to continue renting. At the same time the District rented land off of Willow Street at the Stow line. The well on this site produced water, but drained the water table below some household wells in Stow and so it's use was discontinued. The struggle to find more water continued for the next 40 years in the same pattern, with some potential sites working out and others not. The District believed it had solved the problem in the early 1970's with the opening of the Assabet wells. After these wells were taken off line in 1978 due to ground water pollution, the effort resumed at a greater pace. Eventually water needs convinced the Town to close down its septage disposal ponds in the area now occupied by NARA Park. This closure allowed the District to investigate well sites in North Acton. The current collection of many wells represents the results of these 40 year's efforts to maximize the available well sites.

Storage

In 1962, at the urging of Superintendent Harris, and the town's fire underwriters, the District voted to buy two acres of land near the top of Flagg Hill at the Boxborough-Stow-Acton corner. The District appropriated $200,000 to buy this land and build a 2 million gallon storage reservoir. The foresight required to acquire this land and build this structure cannot be overstated, as this land would otherwise have been developed and there is no other point in town at the same height. (The water system in Acton operates as an open head system with operating pressure and flow coming from the height of the storage reservoirs in town. Small diameter storage, such as the standpipe on Great Hill does not have adequate volume per foot of height to maintain pressure during periods of high demand, such as when there are two simultaneous fires in town.) Only the Flagg Hill reservoir, which can supply water at a volume of 80,000 gallons per foot of head, can keep the system operating in these conditions. Undoubtedly part of the credit for this action belongs to commissioners of that time who understood the development potential for the balance of the Flagg Hill land and the need to preserve this highest land in the area for water supply purposes. In the mid 1970's another group of foresighted commissioners bought land adjacent to Nagog pond and developed the large storage tank on this land. The final piece of the present reservoir system was put in place with the purchase of seven Acres of land off Main Street in North Acton in 1980 and the appropriation of $1.7 million for the construction of a 3 million gallon supply reservoir in 1988 on this land. This tank was named for William Walsh, a District commissioner in the 1980's. This last tank is 110 feet below the open head level of the water system and requires use of a supplemental pump to be placed in use as a supply.

Distribution

Throughout this period the commissioners and superintendent extended and expanded the District's piping system using 8-, 10- and 12-inch mains. Much of the system prior to 1960 had operated with 4- or 6-inch mains and some portions with 2-inch mains. It appears that these were installed as the lowest cost alternatives available, but while they provided water for simple domestic use for scattered houses, they were completely inadequate for any potential fire fighting use. In an effort to increase water main life, reduce corrosion byproducts and reduce costs in the 1930's, the District used pipe manufactured from Transite®, a mineral fiber and Portland cement composite that often included asbestos at that time,

Through the 1960-80s the District worked to complete "loops" in the system and to insure that there would be adequate fire-fighting flow throughout the town. A loop is a water main which serves no direct customers but creates a connection between two water mains that would otherwise be dead-end water mains. Loops are important because they allow minimal interruption of service for maintenance or repair of water mains. In addition, loops reduce water taste concerns for those households that would otherwise be near the end of the mains. Many of the water main extensions that were built in the 1920's and 1930's were dead-ends and benefited from the effort to complete loops during this period. A bizarre, almost humorous series of meetings occurred in 1964 in which a 12-inch main was first approved at the regular annual meeting, then a few months later rescinded at a sparsely attended meeting where in a separate article a 10-inch main in the same street for $7,000 less was also rejected. Finally, three weeks later at another sparsely attended special District meeting, the original article to fund the 12-inch main, was again approved.

This example highlights the almost continuous conflict reflected in old District annual reports which seems to have existed between the Commissioners' foresighted planning and some small, now unknown group that wished to spend as little as possible to keep the system running.

Demand Management

Faced with inadequate pumping and storage capacity in the late 1950's, the District banned lawn watering for many years. With the opening of the school street wells and the construction of the Flagg Hill reservoir, the District was able to allow lawn watering beginning in 1964. Unfortunately, nature intervened and there was a prolonged drought in 1964-1966. The commissioners asked residents to conserve water until rainfall increased. This theme of supply expansion followed by either interruption or a jump in demand repeated itself again when the Assabet wells were closed in 1979 and when the Clapp well was closed in the early 1980's and again one more time when an interconnection valve between Acton and Maynard was inadvertently left open in the late 1990's.

During this period (1960 to 1986) the District implemented a number of innovative demand management practices, including having developers pay for part of the new mains built under older Acton streets, adding connection charges based on pipe size and implementing odd/even outdoor water use controls.

Tragedies at Well Sites

As part of the effort to develop additional well sites, the District acquired a sizable property where the sand and gravel deposit created a mound on the land surface. This land had for many years been used as a sand and gravel supply and the District allowed continued operations as a condition of the land acquisition. This activity had the apparent multiple benefits of providing a large water supply site, providing additional revenue to fund the ongoing costs of upgrading the supply and storage systems and increasing the water infiltration/retention rate for the co-located wells. Unfortunately, the mining company, Acton Sand and Gravel did not maintain banks sloped at safe angles and tragedy struck. On October 11, 1973, 10-year old Michael Neecewicz died after being buried alive by a collapsing sand pile while playing on the sand. Six years later, on December 1 1979, 15-year old David Palazini died in a similar accident. Mining continued despite the uproar, until March, 1980, at which time District voters voted to end the mining lease over some objections by District commissioners. Neither the commissioners nor the District superintendent mentioned the deaths in their annual reports to residents. The District appointed a committee on mining operations, which concluded that gravel mining in the District's well field would not hurt water supplies or the natural gravel filtration and that such mining could be conducted safely if the slope angles were better managed. Finally, in 1981, District voters created a Committee, partially appointed by the town selectman, to guide the commissioners in future Land and Water use policy. Eventually, a complex by-law was created which effectively prevents sand and gravel mining without extensive planning and hearings.

Contamination and resolution

In December 1978, while drilling to find a new well site near the existing Assabet wells, workers noticed a "chemical" smell emitted by water drawn from the test wells. As a "precaution" the Assabet 1 and 2 wells were tested and found to have similar problems. These wells were shut down, thus decreasing the water supply available to the District by 40 percent. In the annual report the following March, the District Commissioners confidently told residents that there was no known health threat from the then unidentified chemicals. However, further investigation identified the W. R. Grace plant as the source of a number of potentially toxic industrial contaminants in the groundwater. This discovery resulted in the declaration of one of the United States Environmental Protection Agency's (EPA) earliest Super Fund sites in the Northeast. Since that time, the Town of Acton and the Acton Water District have worked with W. R. Grace through the EPA to remediate the polluted site. Pollution from the Grace site worked its way north, eventually reaching the Lawsbrook well site.

The W. R. Grace plant has not been the only source of pollution to the groundwater resource upon which the Acton Water District depends. As discussed more fully in the Water Quality section of this report, contaminants from both natural sources and other human activities have been detected from time to time in water pumped from many of the wells in the District. In each of the other cases, however, a means has been found to treat the water so that the well could be brought back into service in a reasonable amount of time. The W. R. Grace site is unique in the town, as no other source of industrial contaminants has caused the closing of productive wells for such a long period of time, nor

has any of them raised the level of concern over health effects of the contaminants to such a high degree.

The 1970's and 1980's were a time of increased public concern about environmental pollution in its many forms. Like many other states, Massachusetts developed new regulations for the protection of water resources. While the Super Fund site heightened the importance of controlling land use on the groundwater recharge areas supply wells, the closure of three major wells also increased concern regarding adequate water quantity for the District. The District has responded to concerns about water quality by purchasing land over its well recharge areas. Water quantity concerns have been addressed through public education on water conservation. Water quality is maintained today through a set of water treatment and modification systems located at each well site throughout the District. The Districts' innovative local strict water standards and testing ensure that Acton water is among the most heavily tested and regulated water supplies in the country.

Coordination with other water services and community departments

Through this period, the District worked to increase its coordination with the Town of Acton in project timing, infrastructure development and mutual support. Examples include the District's providing a site for communication equipment for the Police. The District also provided water connection for Acton Housing Authority housing without charging the Town. During this period the District first established mutual aid connections with neighboring town and provided water, through District meeting votes, to some Boxborough addresses. In 1990 the District voted to provide water to some Littleton addresses.

By-law and voting changes

During this period, the District added many rules and by-laws drafted to protect and conserve water. The District realized the District meetings would always be sparsely attended and switched to having the commissioners elected on the ballot during other elections instead of at the District annual meetings. The commissioners decided to bill for usage after the fact rather than before the billing period began. This had been a concern to some residents who complained that they were being billed for water that they could not use due to lawn watering restrictions.

1986 through the present

The 20 years from 1986 to today have seen the completion and improvement of many changes first implemented during the age of transformation. Carefully, the District has added specific water treatment processes to improve water quality and system performance. Steadily, the District has worked to improve its well system and increase the reliability of supply. In measured steps, the District has modernized its control, metering, pumping, and accounting systems to increase efficiency and performance. The District has innovated on land protection practices and rules for new development and existing well recharge areas. District conservation practices, along with a five-year wet period, have created the unusual condition of serving many more customers with noticeably reduced water use. Hard working dedicated commissioners and District employees have quietly continued to provide non-stop high quality water service to over 7,000 connected customers.

WATER QUANTITY

Currently, the Acton Water District (AWD) supplies water to 95% of the residences, businesses and municipal facilities in Acton, as well as to a small number of properties in adjoining towns. The Concord Water Department and private wells supply water to the remaining 5% of Acton's properties. This section will focus on the source and quantity of water currently used in Acton.

Aquifer

AWD relies on groundwater for its source of water, because treatment and protection of available surface water such as the Assabet River would be very expensive. The groundwater is pumped via 22 wells and well fields developed in a discontinuous, shallow sand and gravel aquifer. An aquifer is a permeable geologic formation that holds a supply of water underground. The aquifer beneath Acton was formed at the end of the last Ice Age, approximately 11,000 years ago. Water from melting glaciers eroded a river channel through the bedrock and older sediments. As the river changed course, sand and gravel deposits filled the ancient channel, creating an aquifer. Adjacent to the aquifer, the bedrock in Acton is covered with a variable thickness of a less permeable glacial deposit called till. Groundwater in the aquifer is recharged by 40 inches of annual rainfall percolating through the surface of Acton's landscape. The depth to the top surface of the groundwater, or water table, changes with the amount of rain and snow, rising during the wet months of late winter and early spring, and falling during the dry months of later summer.

Safe Yield

The geologic properties of the aquifer control the amount of water that can be withdrawn from each well, as well as the rate of withdrawal. As Acton's wells are pumped, groundwater moves through the sand and gravel aquifer toward each well. If a well is pumped too quickly, ground water cannot flow fast enough to supply water at a constant rate. Available water is further reduced when the water table is lowered during dry spells. These phenomena control the "safe yield", defined as the amount of water that a given well can produce on a continuous basis. Each of AWD's wells has a safe yield between 200 and 500 gallons per minute, which translates to 288,000 to 720,000 gallons per day. Good engineering practice, along with the fact that each group of wells is drawing from the same aquifer, prevent all wells from being pumped at the same time. While AWD could pump as much as 3.4 million gallons per day (mgd) under ideal conditions, it considers 2.6 mgd the maximum amount it can pump for an extended period of time.

DEP Limits

The Massachusetts Department of Environmental Protection (DEP) imposes on AWD a limit of 1.93 mgd for 2005, averaged over the year. This limit is based on past usage, and its intent is to protect surface water and wetlands from drying out due to over pumping. The current DEP permit runs through 2012 and allows for only minor increases to Acton's withdrawal limit.

Current Water Usage

In 2004, AWD pumped an average of 1.63 mgd. Residential customers used about 76% of this water, while 13% went to businesses and municipal facilities. Most of the remaining 11% was used for fire fighting and flushing of the system or was lost to system leaks (collectively known as "unbilled water"). Table 1 shows the amount of water actually sold to customers over the previous five years broken out by season and customer. This breakout corresponds to the semi-annual water meter reading and billing cycle. The largely residential character of Acton is reflected in water use: approximately 86% of the water is sold to residential customers. Usage varies with season and weather conditions. Low usage occurs in winter and spring when there is little or no outside water use, and usage peaks the in summer when lawns are watered and cars washed. Average water use in the summer is 1.63 mgd compared to 1.29 mgd in the winter (summer usage is highlighted in yellow in the table).

Table 1. Acton Water Usage 2001-2006 (millions of gallons per day)

	municipal	commercial	residential	Total
Summer 2001	0.032	0.221	1.398	1.652
Winter 2001-02	0.029	0.181	1.078	1.289
Summer 2002	0.032	0.197	1.457	1.687
Winter 2002-03	0.029	0.153	1.109	1.292
Summer 2003	0.035	0.197	1.315	1.548
Winter 2003-04	0.034	0.172	1.057	1.264
Summer 2004	0.032	0.198	1.348	1.580
Winter 2004-05	0.033	0.161	1.083	1.278
Summer 2005	0.030	0.204	1.433	1.668
Winter 2005-06	0.028	0.159	1.120	1.308
Average	0.032	0.185	1.240	1.457

In order to estimate future demand, the District needs to know how much water is used by each resident and business. Table 2 gives the number of water connections for the period 2001-2006 (data supplied by AWD) and the total population (Town of Acton census). Combining the population information from Table 2 with the usage data from Ta-

ble 1 shows that on average Acton residents used 65.5 gallons per person per day[2] over the 2001-2006 time period. Commercial usage per unit is more difficult to characterize in a single number because businesses use widely different amounts of water. For example, a large warehouse with a few employees will require a modest quantity of water whereas a small restaurant will use large amounts for cooking and cleaning. In the next section, we take the approach of estimating additional commercial usage as a percentage of the current usage, which implies that the mix of commercial activity remains roughly the same.

Table 2. AWD water connections and Town population

Year	Municipal Units	Commercial Units	Residential Units	Population	95% of Population
10/2001	403	138	6,672	19789	18799
4/2002	398	142	6,699		
10/2002	402	140	6,779	19781	18792
4/2003	401	146	6,898		
10/2003	402	149	6,911	19944	18947
4/2004	406	144	6,929		
10/2004	405	144	6,946	19847	18855
4/2005	411	147	6,994		
10/2005				20303	19288
4/2006					
Average	404	144			18936

The good news is that Acton's total water usage is currently below the DEP limit. The average residential usage of 65-75 gallons per person per day is also below the target level set by the DEP. Water conservation by Acton's citizens, AWD's improvements in supply system efficiency, and recent rainy summers have all contributed. However, future population and commercial growth in Acton could place strains on the water supply. A 20% increase in water demand (approximately 4000 more people and 30 new businesses) could lead to approximately 0.32 mgd additional water use on a typical summer day, exceeding the DEP-mandated withdrawal limit.

Future Water Usage

AWD has sufficient water to meet current demand. The problem is to predict demand in future years. Two components are needed to predict future demand: (1) usage rates for various users (e.g., residents of single-family homes, residents of apartments and condos, office buildings, restaurants) and (2) the number of new users in each category. Usage rates can and do change with season, and between years due to a host of reasons, but can

[2] Average Residential demand divided by Average 95% of population = 1,240,000/18936

be estimated from past usage data quite easily. For residential users over the period 2001-2005, the average water usage rate is 67 gallons per day per person (gpdpp).

The major uncertainty is the number of new users in each category. Residential use is much larger than commercial use in Acton at present. However, commercial growth, especially development of the WR Grace site, could be a major factor in future water usage. We have utilized population projections from two agencies and an estimate from AWD based on current and planned development in Acton. These projections range from negative growth to approximately 9% population growth by 2008-10 (see Appendix A). Population growth of 9% would lead to increased water use of 0.112 mgd, for a total residential demand of 1.352 mgd.[3] Growth in commercial demand in Acton is less certain, but an increase of 9% in commercial demand (to match the 9% increase in population) leads to a total commercial demand of 0.202 mgd. Based on these numbers, the average demand projected for 2010 is 1.586 mgd. Approximately 10-12% additional water is required for such purposes as fire fighting, hydrant flushing, and system uses. We estimate that the average daily water use by all municipal, commercial, and residential users will be 1.776 mgd by 2010. Noting that the State DEP permitted withdrawal is 1.93 mgd, water demand will be reaching levels uncomfortably close to the permitted withdrawal limit.

Furthermore, two large sources of uncertainty are population growth fueled by Chapter 40B housing and development of the WR Grace site in South Acton and adjacent Concord. The Town has zoned the WR Grace site as a "Technical District" with the potential for development at four times the density of other commercial areas. To estimate water usage for this new Technical District, we assumed that development would be similar to Nagog Park: a mix of offices, retail shops, and restaurants. The area of Nagog Park we considered has 20 individual buildings on approximately 120 acres. The water usage was determined by adding the maximum usage for each building for the period 2001 to 2005. Water usage for individual office buildings varied due to changes in occupancy. The water demand for Nagog Park was found to be 0.045 mgd, which is approximately one quarter of the current daily commercial demand in Acton. The Technical District is approximately three times the area of Nagog Park and is zoned to have up to four times the density. Multiplying our Nagog Park water usage number by 12 provides an estimate of water demand by the Technical District to be 0.54 mgd. Adding this new demand to the growing demand of the rest of Acton puts the District, and the Town, in the position of not having sufficient water to support this level of growth. There maybe some relief on the supply end of the equation since the Assabet 3 well situated on the Grace property could become available as a new water source. The AWD District meeting in April 2006 approved a warrant article to perform a pump test of this well. Assuming the same production from Assabet 3 as from Assabet 1 and 2 (350 gallons per minute), Assabet 3 would be able to provide 0.50 mgd, largely offsetting the increased demand from a densely developed WR Grace site.

[3] 9% times 18936 times 65.5 gpdpp = 0.112 mgd

Water Quantity Summary

Acton has sufficient supplies of water to meet current needs and to allow for a moderate amount of residential and commercial growth over the next five years. However, extensive growth due to commercial and industrial development of the WR Grace site along with high-density residential properties could overwhelm the current ground water supplies. The Assabet 3 well, situated on the WR Grace property and currently not available for use, might provide a sufficient new supply. The Committee notes that there are no other DEP-approved well sites within the Town. Part of the WLMAC charter was to determine the water usage and supply requirements for Acton at "build-out". Answering that question depends on the character of the Town at build-out. A future Acton that has a mix of properties similar to the current mix (a high percentage of single-family homes with minor commercial and industrial areas) will have considerably different water requirements from an extensively developed Town of high-density residences and large commercial/industrial areas. In view of these uncertainties, the Committee recommends finding ways to link plans for development to the estimates of water resources.

WATER QUALITY

Clean water is essential to many aspects of our daily life. For drinking and cooking, we expect water to be free of harmful compounds. We do not want discolored water to stain our laundry, and we are concerned if we detect odors and tastes in our water. In this chapter, we will review some challenges and some tools available for maintaining water quality.

Sources of Pollution

As described in the chapter on water quantity, Acton's water supply is drawn from groundwater. Because groundwater comes from tens of feet below the land surface, historically it was considered well protected from potential pollutants. Unfortunately, contaminants can reach AWD wells from a number of sources. Naturally occurring minerals such as iron oxides and salts in the soil and bedrock, as well as radon, can be dissolved in groundwater. Acton is fortunate that our aquifers have few natural problems.

Homes and businesses built above aquifers can introduce a wide range of chemical compounds into groundwater. Effluent from both industrial waste systems and domestic septic systems, as well as leaks from fuel tanks, can contaminate groundwater. Chemical compounds like road salt and pesticides applied to the landscape can be carried down to groundwater by rainwater percolating into the soil. Because some AWD wells are close to roads, a fuel or chemical spill could be a significant source of contaminants. Groundwater flows slowly but continuously through the aquifer, carrying with it whatever pollutants have been added along the way.

Natural Attenuation

Pollutants in groundwater are reduced to some extent by natural processes. Underground flow allows pollutants to disperse and become diluted. Sand and gravel aquifers filter out suspended solids. Over time, chemical compounds may break down, a process that is enhanced by microorganisms in the soil. These natural processes are usually slow and cannot be relied on alone to assure us of good water quality.

Protection Zones

Historic practice and state regulations have established protection zones around public water supply wells. Zone 1 is defined as a 400-foot radius around each well, and represents the part of the aquifer that supplies water directly to the well. Contamination in a Zone 1 could require immediate closing of the well or remediation of the water. Zone 2 for a given well is the part of the aquifer that would supply water to that well in the event of maximal pumping for 180 days without rain. Although such circumstances are unlikely in Acton, this definition provides a way to identify the more distant parts of the aquifer that supply the well. Many of AWD's wells have overlapping Zone 2's. As groundwater flows through the aquifer toward one or more wells, contamination in Zone 2 can eventually impact the groundwater obtained by pumping.

Protection Tools

The Commonwealth of Massachusetts offers programs to encourage towns to protect their water resources. In 2002, AWD worked with DEP to develop and implement a Source Water Protection Plan (SWAP), which documents potential sources of contamination in each of the Zone 2 areas. SWAP is a valuable tool for planning strategies that will protect water quality in the future.

In accordance with SWAP recommendations, AWD already owns or controls the land defined as Zone 1 around each public well, along with portions of Zone 2. This allows AWD to prevent polluting activities from occurring where they would have the most direct impact on the water supply. The District has worked with the Town of Acton to establish zoning overlay districts that further limit pollutant-producing activities in Zone 2. Implementation of wastewater treatment by the Town also helps to protect groundwater.

Further protection of groundwater is possible through structural means such as retention basins and controlled drainage along roads. For new developments, the Town consults AWD to review planned site features, in order to optimize conservation and protection of water. Where Zone 2 of any of AWD's wells extends across the town boundary, the District has begun working with neighboring towns to protect shared water resources.

In its 2004 "Massachusetts Water Policy Report", the Massachusetts Executive Office of Environmental Affairs states its intention to assist local efforts to protect water resources. Recommendations include a grant program, planning assistance and dissemination of information. Participation in Massachusetts programs of this type could be of benefit to AWD in the future.

Water Treatment

A system of water testing and treatment is used by AWD to identify and remove pollutants that may have entered the groundwater despite the best efforts to protect it. Aeration and activated carbon remove volatile organic compounds. Activated carbon is also used to remove natural staining from water in West Acton. For biological contaminants, AWD uses chlorine to treat the water. Additional processes can be employed to address other pollutants. However, since extensive treatment can be costly, prevention of contamination is the most effective way to assure AWD rate-payers of good water quality.

For more information on testing and treatment of the public water, refer to the annual Water Quality Report published by the Acton Water District.

COST OF WATER

The Water Supply District of Acton, which operates under an act of the Legislature, derives its day-to-day operating revenue from the sale of water to its customers: the residents, businesses and municipal offices of Acton. Because AWD is independent of the government of the Town of Acton, its budget has its own set of expenses and income. Historically the district managed its operations to minimize water rates.

AWD Costs and Revenue

The cost of providing water includes operating expenses as well as development and replacement of distribution mains, wells, storage and treatment facilities. The 2004 operating expenses were $1.86M and the capital expenses were $0.46M. The present value of AWD's existing water system is enormous. At the same time, the cost of developing new supplies is increasing. Should a new problem occur at an existing well, the cost of developing additional supplies or installing additional treatment would be substantial.

Sale of water to customers accounts for about 90% of the revenue, with the remainder coming from demand fees for new connections to the water system. Capital costs for each new construction of new connections, including all piping under new roads and to the building, are paid by the property owner. The District is empowered to raise additional monies from the sale of bonds which it may issue with the approval of the District's voters. Bonds are primarily used for capital improvements or repairs to the infrastructure of the system. The Acton Water District enjoys an excellent credit rating that allows it to issue its bonds at favorable interest rates. Income from a settlement with W. R. Grace provides an additional source of funds for capital improvement.

Water Rate Structures

The District has one rate structure for municipal users, and a separate one for residences and businesses. The municipal rate, paid by schools and government, is a flat rate. The residential and business rate is an ascending rate that is seasonally adjusted, to encourage water conservation, with higher rates in effect from April to October. Acton does not have a separate water rate for business customers. Most of the business users in Acton are small consumers and have little effect on the revenue or total use of water within the District.

Within the Commonwealth, water suppliers utilize various rate structures. In 2004, consulting engineers Tighe & Bond performed a survey to examine water rates in Massachusetts. Based upon information from those communities responding:

- 46% used a flat rate structure (single rate for each unit of water consumed).
- 48% used an ascending rate structure (rate per unit consumed increases as the total consumption increases).
- 5% imposed a flat fee.
- Remainder used a descending rate.

Note that 18% of the towns have a separate rate structure for businesses and 6%, including Acton, have seasonally adjusted rates.

Conservation and Water Rates

Since Acton utilizes a seasonally adjusted rate, a good question one might ask is whether a rate that encourages conservation affects what one pays for water. The answer to that question is not as simple as one may think. First, it must be understood that seasonally adjusted water rates help in at least two ways: They more accurately reflect the cost of meeting peak day and peak seasonal demands. They encourage conservation of the valuable drinking water supply. There is still considerable discussion and disagreement about how best to encourage water conservation particularly on the demand side management (consumer). An example from a recent article:

> Increased reliance on demand side management (DSM) policies to manage existing water supplies is stimulating substantial debate among economists and policymakers…While economists generally advocate higher residential water rates as a means of reducing demand, others argue that non-price policies, which do not affect the price of water but place direct controls on water use such as rationing, constitute the only viable means to reduce residential demand. This conclusion relies, in part, on empirical research indicating that residential demand is price inelastic, making price a relatively ineffective DSM policy. Further, some policymakers argue that "the use of price as an allocation mechanism is constrained by the fact that water is generally regarded as a basic necessity, even a right, not an economic good." (Berk et. al. 1980) [4]

Historically, AWD has managed its finances to minimize the water rates. As the Town grew and the demand for water greatly increased, it became apparent that the District needed to implement a water conservation program utilizing multiple methods. This included a delicate balancing of the water rates and the requirement for conservation.

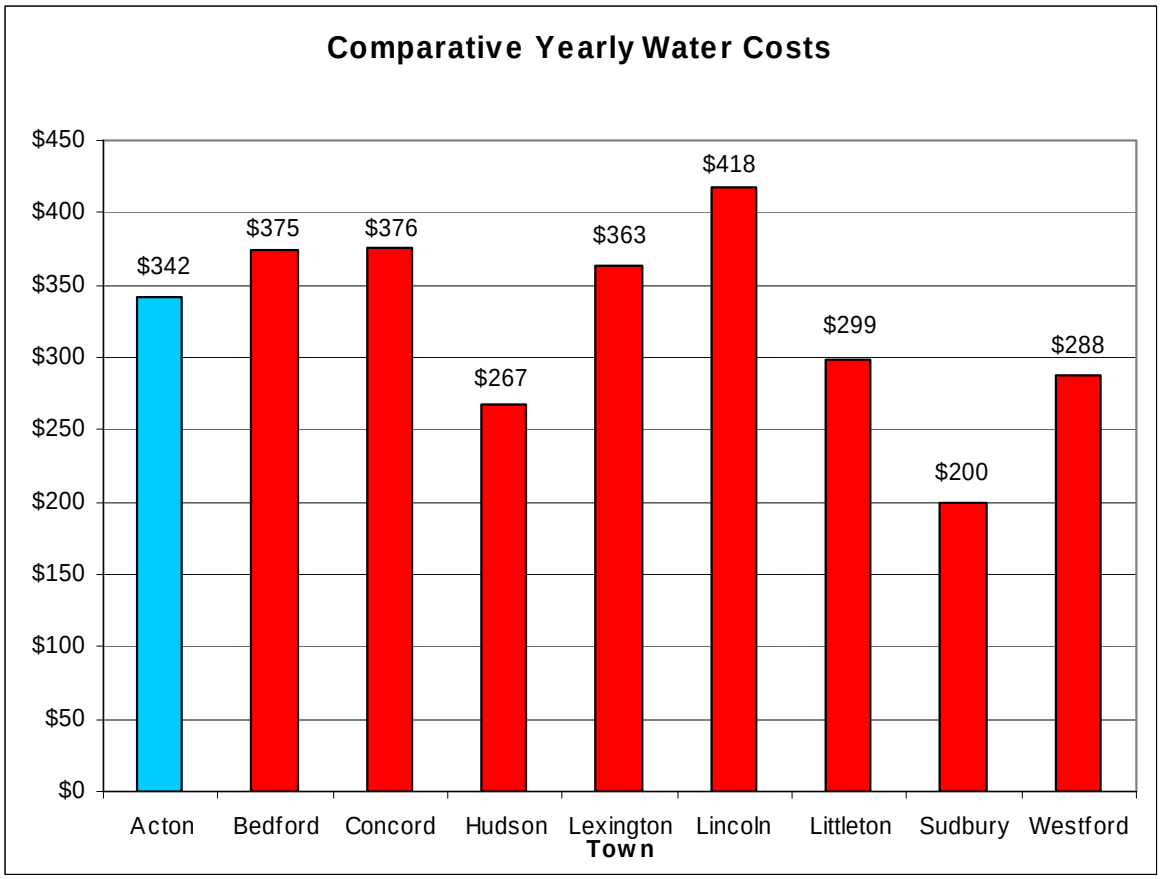
If there is too little conservation, the demand for water could exceed what the District is permitted to withdraw and/or we could lower the water in the wells to unacceptable levels if too much were pumped. What about too much conservation? If water rates were set too high, demand could be reduced to the point where the revenue would not meet the fixed expenses of the District. In this scenario, the rates might have to be adjusted to raise the revenue but this could further decrease water usage. With rates being set too high, individuals and developers might be encouraged to drill their own wells for domestic or irrigation purposes. The AWD Commissioners would not want to support this case as it would lower revenue to the District, or more importantly, would have additional wells withdrawing water from the aquifers underlying Acton. By carefully setting the water rates, the AWD has avoided all of these possibilities and has provided high quality water to its users at reasonable cost.

[4] Renwick, Mary E. and Archibald, Sandra O., Demand Side Management Policies for Residential Water Use: Who Bears the Conservation Burden? *Land Economics*, Vol. 74, No. 3 (Aug. 1998), pp. 343-359.

Residential Water Rates

It is natural to wonder how one's water bills compare to those of others. The answer depends both on how much water each household uses and on the water rates. To allow comparisons between towns, Tighe & Bond assumed that a "typical" household consumes 90,000 gallons of water in a year. They applied the various residential water rates to calculate a "typical" yearly water cost for a household in each community. The 2004 household average water cost for the Commonwealth of Massachusetts was $321. The following figure shows how Acton, with a "typical" yearly household water cost of $342, compares to the neighboring communities that participated in the survey.

Table 3. Comparative Yearly Water Costs

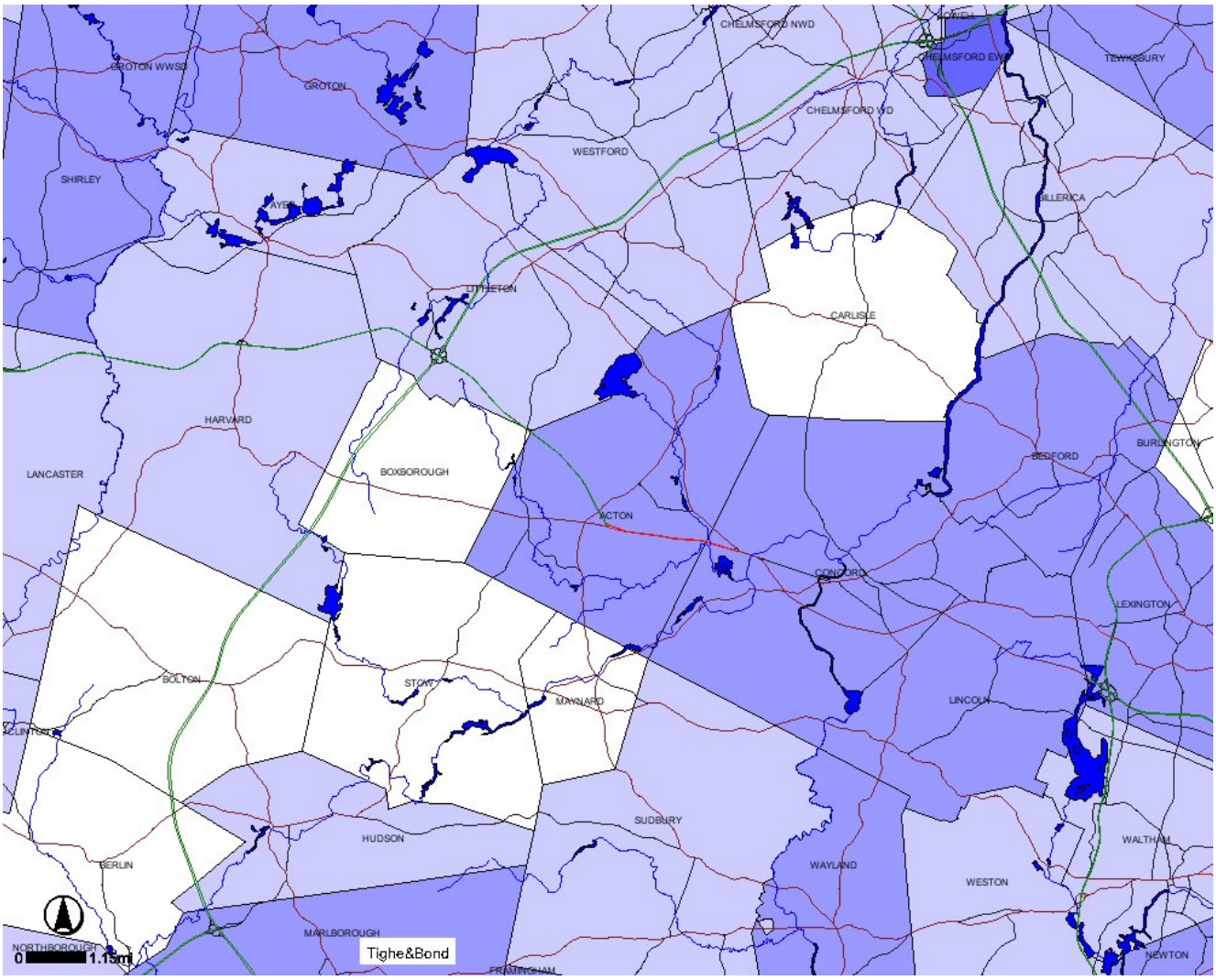


The "typical" yearly average cost for these communities is $325, with a median cost of $342. Acton, even with the additional treatment and testing it performs on its water supply, measures-up very well against the state average as well as that of the local communities.

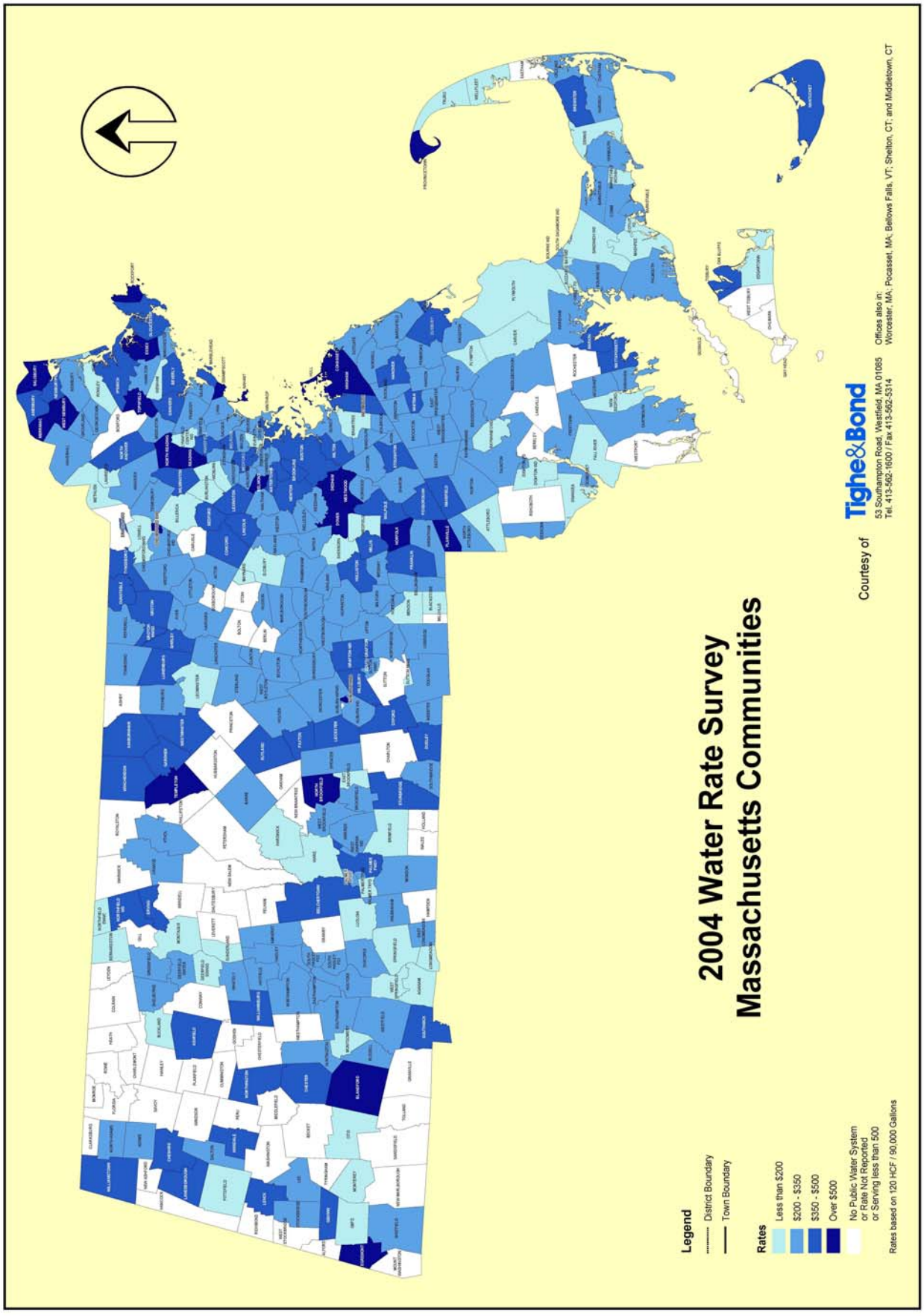
The following map is another way in which the price bands of various town rate structures can be compared. The towns in white are those without public water supplies that rely primarily on private wells to supply the residents and businesses or a town that did

not participate in the survey. The rest of the towns (in various shades of blue) have one or more (Chelmsford has several) public water supplies. The darker shades of blue indicate the towns with the more expensive water cost.

Map 1. Public water supplies near Acton



The map of the Commonwealth which follows provides a state-wide perspective of the number of towns that have public water supplies (or did not participate) and the relative water costs. The darker the shade, the greater the cost to supply an "average" amount of water to a residence in that town. Remember that a town in white either did not participate in the survey or does not have a public water supply. Acton (appearing as a town in medium blue color) appears as a district that is providing water to its consumers at a cost that is about average within the state.


2004 Water Rate Survey
Massachusetts Communities
Courtesy of
Tighe&Bond
53 Southampton Road, Westfield, MA 01085
Tel: 413-562-1600 / Fax 413-562-5314
Offices also in:
Worcester, MA; Pocasset, MA; Bellows Falls, VT; Shelton, CT; and Middletown, CT
Legend
District Boundary
Town Boundary
Rates
Less than $200
$200 - $350
$350 - $500
Over $500
No Public Water System
or Rate Not Reported
or Serving less than 500
Rates based on 120 HCF / 90,000 Gallons

For some perspective on the cost of Acton water compared to other liquids, consider the following:

Acton water compared to other purchased liquids

Item	Approx. Cost Per Gallon
Premium coffee drink (8-16 oz cups)	$ 28.00
Aquafina® bottled water (processed tap water)	$ 6.82
Regular grade gasoline	$ 2.46
Acton water	$ 0.004

Any way you look at it, Acton water is an excellent product at a remarkable price.

WATER STRATEGIES

Over the past century, the Acton Water District has provided a safe, adequate water supply for domestic, commercial and fire fighting purposes within the District's boundaries. While its goals have remained constant, the District faces new challenges. Population growth, awareness of the limits of water resources, and concerns about the impact of environmental pollutants, have required major capital expenditures and increases in operating costs. These factors determine availability of resources for possible expansion of service beyond current District boundaries. They also influence relationships between AWD and neighboring towns.

What strategies should be employed over the coming decades to continue the present level of excellent service, while addressing issues of possible expansion? We suggest that AWD invest in the future through strategies directed to four areas: source protection, conservation, new water supplies, and collaboration.

Water Source Protection

The District's water supply is vulnerable to the loss of any of its wells due to contamination. To protect the quality of existing water resources, control of activities is critical on land above groundwater recharge areas. Particular attention needs to be paid to areas where wells are close to roads and commercial developments. Acquisition of land is the strongest way to protect the aquifers from contaminants. We urge that such acquisitions be coordinated with Town goals for conservation, recreation and community preservation. Bylaws for groundwater protection on privately owned land must be enforced and strengthened through collaboration with Acton Town Departments.

Because portions of groundwater recharge areas for several of AWD's wells lie within neighboring towns, AWD benefits from maintaining cooperative working relationships with those towns. Recognition of groundwater as a shared resource should lead to innovative solutions. By expanding water service on an ad hoc basis to property above its recharge areas, the District could increase its opportunities to control activities on that land. We believe guidelines should be established to define the circumstances where it would be appropriate for AWD to purchase land or establish conservation restrictions in recharge areas.

Water Conservation

Based on State projections, Acton's population is expected to increase up to 11% by 2020. Any additional increases due to construction of affordable housing are difficult to predict. A significant increase in commercial development is possible. The former W.R. Grace site has potential for extensive development, which could generate large demand for water. While the current water supply meets present needs, both expected and unpredictable increases in use could place additional stress on existing resources. Water conservation is the most cost-effective way to optimize use of those resources.

There are several ways AWD can promote and reward water conservation, in order to keep water usage below state-mandated levels. Broad public education programs can help. The water rate structure provides an opportunity to give rate payers incentive to conserve water. Such incentives would also apply to any rate payers with service beyond current District boundaries, thus increasing the area over which AWD could influence water conservation.

New Water Supplies

Protection and conservation of existing water resources are essential to the future of the water supply, but by themselves may not be sufficient. To allow for a margin of safety as well as for new growth, AWD should develop a list of potential new water supply sources. The use of deep wells for extraction of groundwater from bedrock could be explored. Future technology may permit economical treatment of surface water to meet regulated standards. Because of the expense of developing new water sources, AWD may want to consider combining source water development efforts with neighboring towns. Extension of AWD water service to properties in those towns could enhance options for finding new sources.

Collaboration

Joint efforts between AWD and Town planning and zoning departments already make a positive contribution to the future of our water supply. The Town needs to incorporate information from AWD when making decisions on development and long-range planning, to ensure that new development does not impose demands that exceed a prudent safety margin for available water. Every means possible should be employed to enhance effective communications. It is not the purpose of this report to propose a specific linkage mechanism between the Town and the AWD. The record shows that political separation of the two has worked well and there are no compelling reasons for changing the formalities of the relationship. Nevertheless, the best interests of the citizens of Acton require that every plan, proposal, or project under the Town's jurisdiction be congruent with AWD's actual and projected availability, cost, and quality of water that is likely to be required and every plan, proposal, or project under the AWD's jurisdiction must be guided by the Town's up-to-date projections for residential, commercial, and industrial populations and locations.

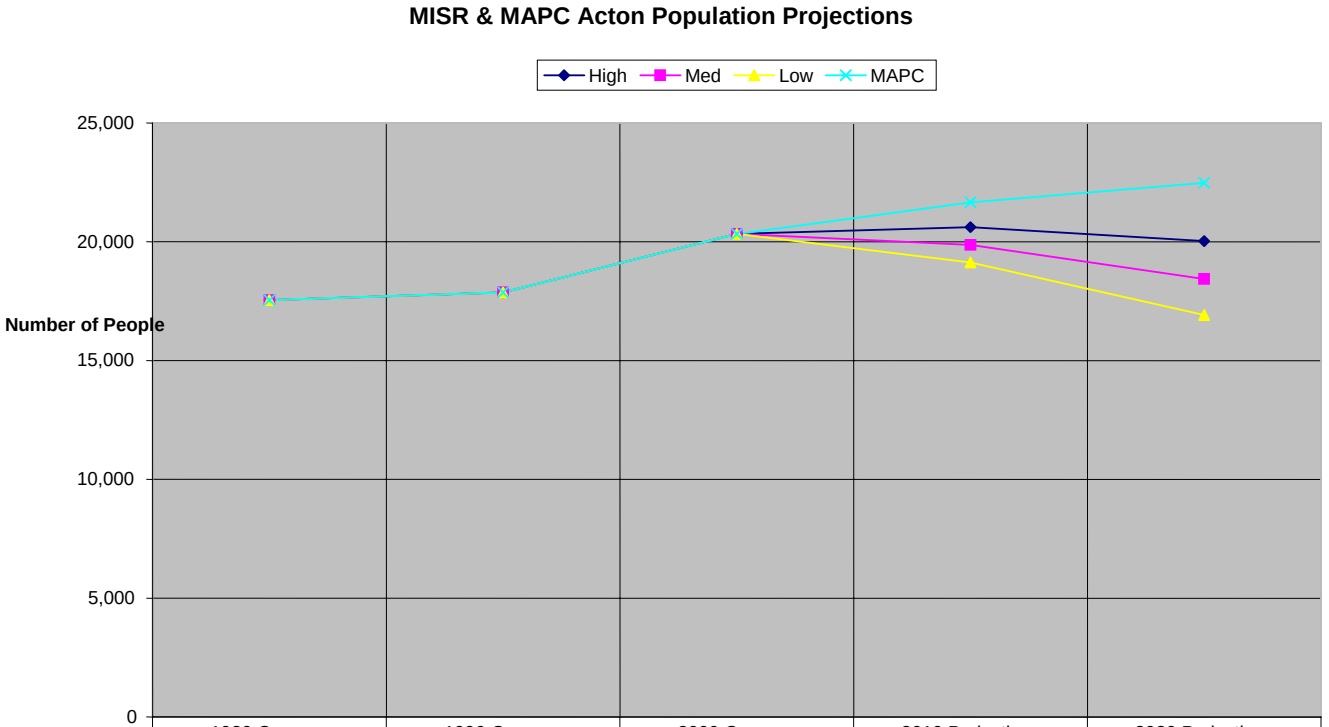
Expanded cooperation between AWD and neighboring towns through the relevant municipal departments could benefit from formal processes for communications and joint planning. These processes would maximize flexibility for taking advantage of new tech-

nologies as they emerge, and improve protection and development of new and existing sources of water.

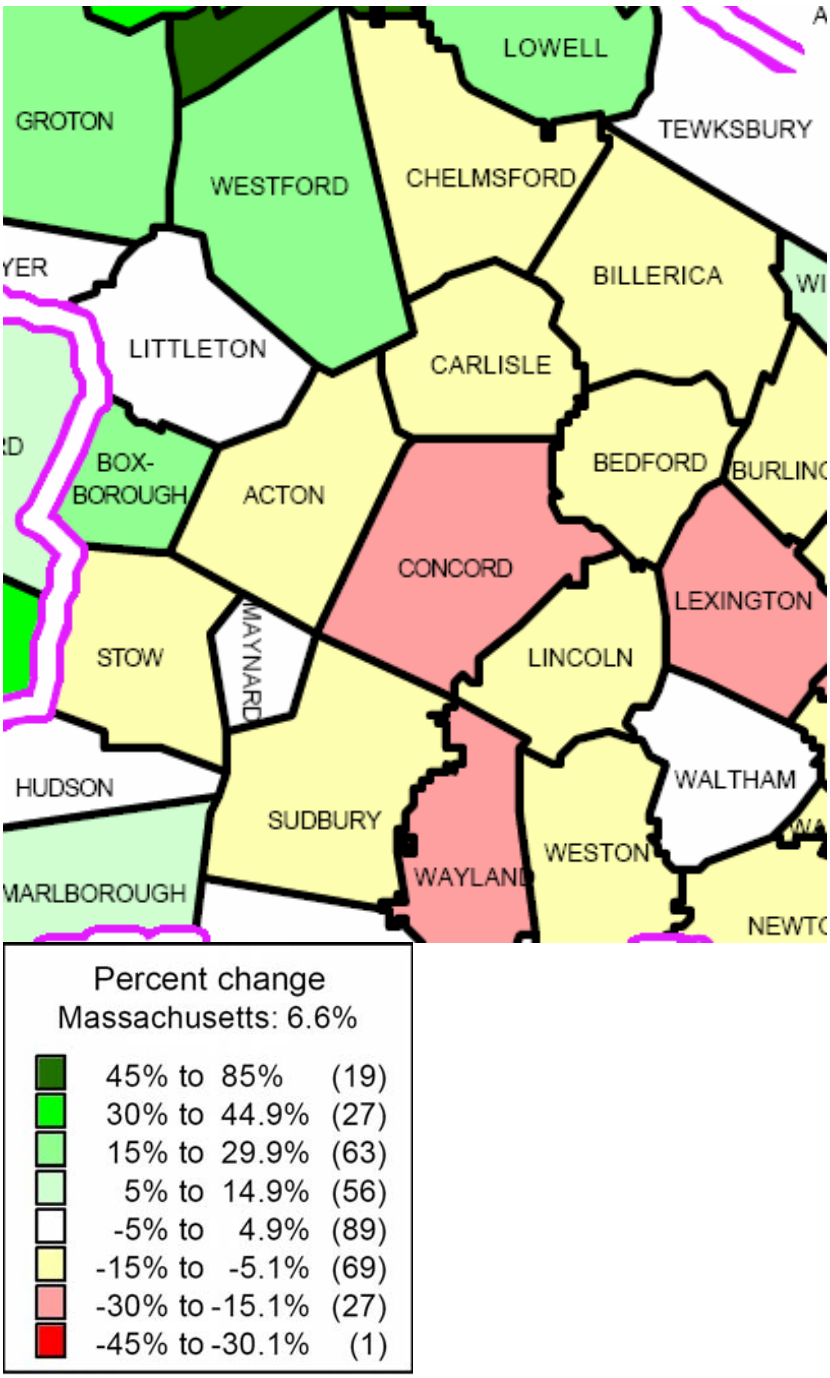
Water quality, quantity, and cost are essential, interdependent elements in planning the future of our water supply. Strategies for optimizing them will need to enhance protection and conservation of existing resources while remaining open to expansion of both supply resources and water service. Collaboration between Acton Water District and other agencies within and beyond the District boundaries is an important, if not essential, part of these efforts.

APPENDIX A: POPULATION PROJECTIONS FOR ACTON.

The chart below shows population projections produced by two agencies, Metropolitan Area Planning Council (MAPC) and the Massachusetts Institute for Social and Economic Research (MISR) through 2020. The models range from +6.6% to -5.9% growth by 2010 (relative to the 2000 census). Based on the 2005 Town census, the current population is 20,303, suggesting that the negative growth models are unrealistic. The Town of Acton Planning Department uses a number of models to estimate future growth. Separately, the AWD estimated 9.2% population growth through 2008-10 based on residential developments currently under construction or in the planning stages.



	1980 Census	1990 Census	2000 Census	2010 Projection	2020 Projection
High	17,544	17,872	20,331	20,621	20,033
Med	17,544	17,872	20,331	19,871	18,435
Low	17,544	17,872	20,331	19,134	16,915
MAPC	17,544	17,872	20,331	21,663	22,487



Explanation:

MISER utilizes three models for their population forecasts: low, medium and high growth models. This population change map was created utilizing the MISER middle growth model. The "cut" of this map shown above consists of most of the towns comprising Middlesex County.

The legend color indicates which of the 8 population growth/decline bands is forecasted for the town from Census 2000 to 2020. The numbers to the right that are within parenthesis indicate the number of towns that fall within this band. The purple lines indicate the Middlesex County border.
MISER = Massachusetts Institute for Social and Economic Research (Thompson Hall, University of Massachusetts, Amherst, MA). www.umass.edu/miser

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