

# Let There Be Beer

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*The precise origins of beer are a mystery long lost to time, but its prominence in human history is undeniable. Early grain-based cultures found their lives enriched by the invention of beer as it allowed them to concentrate grain-wealth, sanitize drinking water, and improve their social and religious ceremonies.<sup>1</sup> American poet John Ciardi even went so far as to proclaim that “fermentation and civilization are inseparable.”<sup>2</sup> While the definition of beer is dynamic and its recipes wildly diverse, there is one ingredient that beer simply cannot do without: water. As the American brewing industry continues to make a strong showing second only to China in the ever growing global beer market,<sup>3</sup> the demand for adequate water supplies also grows. In the context of increasing household and industrial water demands, widespread drought, pollution concerns, and allocation conflicts in the eastern United States, an understanding of the water needs and responsibilities of eastern American breweries is necessary to maintain an adequate supply of beer.*

## I. INTRODUCTION

There is no liquid more vital to the genesis and sustenance of life on Earth than water. This is a biological matter of little dispute.

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<sup>1</sup> TOM STANDAGE, A HISTORY OF THE WORLD IN SIX GLASSES 18–19, 22, 35 (Walker and Company 2005).

<sup>2</sup> *Id.* at 9.

<sup>3</sup> Research and Markets, *Beer in China 2008: A Market Analysis*, “Summary” [http://www.researchandmarkets.com/reportinfo.asp?report\\_id=652011&t=e&cat\\_id=](http://www.researchandmarkets.com/reportinfo.asp?report_id=652011&t=e&cat_id=) (last visited November 8, 2008).

Humankind has never been satisfied with mere life, though. In order to flourish, mankind needed civilization, and for civilization, mankind needed beer. The Sumerians, Earth's oldest known culture, even laid down in the *Epic of Gilgamesh* that drinking beer, along with eating food and bathing, was a vital step in the transformation of Enkidu from wild man to human.<sup>4</sup>

Just as water is vital to biological organisms in order to sustain life, it is vital to nearly every business. Some industries rely on water in a much more central fashion than others, but none can operate entirely without it.<sup>5</sup> The industry of beer brewing is highly dependent on a steady supply of water in great quantities and of certain qualities. This is of particular importance to the American brewing industry, which led the world in beer production and is now second only to China's exploding beer market.<sup>6</sup> By 1972, the United States had reached production levels roughly equaling the production of that year's second and third largest beer producers combined by producing 131,800,000 barrels of beer.<sup>7</sup> In 2008, the United States sold a staggering 210,619,000 barrels of beer.<sup>8</sup> With the industry standard of thirty-one gallons to a barrel,<sup>9</sup> that comes to over six and a half *billion* gallons.

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<sup>4</sup> THE EPIC OF GILGAMESH 14 (Andrew George trans., Penguin Books 2000).

<sup>5</sup> Bill Staudenmaier, *Water and the Law: A Guide to What Matters*, 15 APR BUS. L. TODAY 13–14 (2006).

<sup>6</sup> Research and Markets, *supra* note 3.

<sup>7</sup> JOHN PORTER, ALL ABOUT BEER 89 (Doubleday and Co. 1975).

<sup>8</sup> *Craft Brewing Statistics*, Brewers Association, <http://www.beertown.org/craftbrewing/statistics.html>, (last visited July 13, 2009).

<sup>9</sup> *Id.*

Beer obviously plays a major role in the American economy; approximately \$101 billion worth of product was sold in 2008.<sup>10</sup> However, this economic activity is not without its price, as the brewing industry requires equally staggering quantities of water to sustain its operations, and that water must fit certain quality standards. The destinies of water and beer are intertwined; tensions about their respective uses in relation to one another have been known to blossom into outright disputes.

One of the most famous documented water/beer disputes was between Arthur Guinness and the Dublin City Corporation in 1775. Following claims that the lease to the St. James's Gate Brewery did not include water rights, the sheriff and a handful of interested parties attempted to physically shut off Guinness's water supply, only to be met by an angry, pick-wielding Arthur Guinness who threatened to re-dig any channel they shut off. The sheriff allowed the court to settle the situation by fixing a reasonable fee on Guinness's water use.<sup>11</sup> While Guinness's story may be more amusing than directly relevant to current practices in the United States, the situation in the United States is no less dire.

A problematic blend of increasing demand and recurring shortages have struck the traditionally water-rich eastern United States causing heightened conflicts over water allocation. If beer and water use are going to continue to exist in relative harmony, the relationship between the two must be more deeply understood. Breweries require

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<sup>10</sup> *Id.*

<sup>11</sup> BILL YENNE, *GUINNESS: THE 250-YEAR QUEST FOR THE PERFECT PINT* 19–20 (John Wiley and Sons, Inc. 2007).

certain quantities and qualities of water to continue their valuable business. They also have a responsibility to understand the quantity and quality of their outgoing wastewater and to take steps to ensure that their negative impacts are minimal.

While there are roles for policymakers and average citizens in the formulation and implementation of effective water management techniques in breweries, it is the owners and operators of the breweries themselves who must shoulder the bulk of the adaptation that is necessary for the eastern United States brewing industry to survive and thrive in a future where water can no longer be regarded as infinite. In the United States, breweries, like many other water users, can no longer take unlimited usage for granted in the face of modern water issues.<sup>12</sup> The breweries that will be most successful at this adaptation will be the ones that understand the problems and incorporate the lessons to be learned from the policies and techniques of those U.S. breweries that are already reducing their negative impacts on water issues. Such policies and techniques can and should be used to reduce water demand, boost water use efficiency, reduce wastewater quantity, improve wastewater quality, and in some situations, even provide extra streams of income for breweries. Breweries that most effectively reduce their water needs and minimize or eliminate their negative impacts will be best situated for success as water conflict continues to escalate in the eastern United States.

Section II of this paper will outline the basic process of water use in a brewery from input as source water to output as product and

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<sup>12</sup> Robert Glennon, *Water Scarcity, Marketing, and Privatization*, 83 *Tex L. Rev.* 1873, 1873 (2005).

waste. Section III will analyze issues of water intake with separate subsections for sources of water as well as concerns about influent quantity and quality. This section will also address some suggestions for managing intake policies and reducing demand in breweries. Section IV will focus on issues of output, including methods of disposal and problems generated by brewery effluent. Discussion of these output issues concludes with suggestions for improving brewery wastewater management policies and techniques with a special emphasis on innovative techniques already in place in many American breweries.

## II. THE LIFE OF WATER IN A BREWERY<sup>13</sup>

The bulk of water in a brewery can be categorized in three separate ways based on use: liquor, process water, and cleaning water. Liquor is an industry term for the water used as an actual ingredient in the beer, process water is used to enact some change on the liquor and is frequently a coolant, and cleaning water is used to clean the brewing equipment.

The brewing process can vary greatly based on the training of the brewer and the style of beer being brewed. Different styles call for different details but the basic process is the same in any American brewery. Liquor is sometimes treated as a first step but that will be

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<sup>13</sup> For a more detailed discussion, see J.S. HOUGH, D.E. BRIGGS & R. STEVENS, *MALTING AND BREWING SCIENCE* 3–9 (Chapman and Hall, Ltd. 1971); Bluegrass Brewing Co., *Our Beer*, "The Basic Brewing Process," <http://www.bbcbrew.com/ontap.php> (last visited Dec. 11, 2008); wikiHow, *How to Brew Commercial Beer*, "Making the Beer," <http://www.wikihow.com/Brew-Commercial-Beer> (last visited Dec. 11, 2008).

discussed in a later section. Liquor is then heated and steeped with grains and drained as sugar-rich water known as wort or sweet-wort. The wort is transferred into a boil kettle where it is heated to a boil and combined with hops and any other additives or adjuncts. A great deal of evaporation can occur during the boil. After boiling, the wort is cooled and moved to a fermenting vessel where live yeast is pitched, or added, to it. Left behind in the boil kettle is a waste substance known as trub that is composed of the loose hops, grain particles, precipitated proteins, and a number of other solids that can collect at the bottom of the tank. After fermentation, the wort officially becomes beer and is aged and conditioned either in another storage tank or directly in the keg or bottle. If any filtration is performed, it is generally done between fermentation and kegging or bottling. Fermentation leaves behind a substance called floc that is composed of precipitated yeast cells and any trub that was not left in the boil kettle.

Cooling large quantities of boiling wort to pitching temperature would take a prohibitively long time without some sort of active cooling process. Most breweries use process water, which is sometimes prechilled in a refrigerator, in a process called counterflow chilling. A counterflow chiller is comprised of a thermally conductive manifold in contact with a second thermally conductive manifold. The boiling wort is passed through one manifold while the process water is passed in the opposite direction through the other manifold. This allows rapid cooling based on very high surface contact without compromising the sanitation of the wort. Cleaning water is then used in a variety of ways to clean all tanks, pipes, pumps, and other equipment in the brewery. Cleaning water can carry with it a variety of cleaning agents, as well as

trub, unwanted floc, and any other substance left behind on the equipment. Any water that did not evaporate along the way then leaves the brewery either as wastewater or as beer.

### III. INTAKE ISSUES

#### A. SOURCES OF BREWERY WATER

Historically, all industries that required large quantities of water had to be located somewhere with direct access to a water supply. Breweries were no exception. Areas such as the Great Lakes region, famous for its beer production, achieved success and notoriety in large part because of their ready access to acceptable quantities of suitable water.<sup>14</sup> As industry grew, particularly in the eastern United States, so did the number of ways that industries, including breweries, received their water. While breweries located on riparian land are, like any other riparian landowner, allowed access to water based on the riparian laws of their jurisdiction, some breweries rely on municipal sources to meet their water needs.<sup>15</sup>

One brand that recently made the switch from self-collected water to municipally supplied water is Rolling Rock. In 2006, Anheuser-

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<sup>14</sup> Audio: *The Science of Making Great Beer* (National Public Radio broadcast May 16, 2008), available at <http://www.npr.org/templates/story/story.php?storyId=90517078>.

<sup>15</sup> Kevin G. DeMarrais, *Drinking It All In: Pennsylvania Town Loses Rolling Rock to Newark*, NEW JERSEY RECORD, June 14, 2006, at B01; Ron DaParma, *\$2.3M Sewer Bill on Tap for Brewer*, PITTSBURGH TRIBUNE REVIEW, Apr. 28, 2005, available at [http://www.pittsburghlive.com/x/pittsburghtrib/s\\_328748.html](http://www.pittsburghlive.com/x/pittsburghtrib/s_328748.html); *Brewery Brings Big Thirst to the Banks of the Etowah*, ATLANTA JOURNAL & CONSTITUTION, Apr. 18, 1993, at C4; Peter Panepento, *Beermaker Faces Fluoride's Bitter Taste*, ERIE TIMES-NEWS, Oct. 27, 2002, at 1.

Busch Inc. bought Rolling Rock's producer, the Latrobe Brewing Co., closed the original plant, and moved production to its Newark, New Jersey facility. At this facility, Rolling Rock is made with water from the Wanaque Reservoir which is supplied by the North Jersey Water District Supply Commission.<sup>16</sup> Anheuser-Busch was able to preserve the flavor of Rolling Rock by treating the water used in its production to resemble the water used by Latrobe.<sup>17</sup> Not surprisingly, some brewers claim that the particular water supply to their brewery is a vital element in the flavor of their beer.<sup>18</sup> As particular water supplies grow scarce, breweries will have to be flexible in their demands in order to adapt to the water available to them.

## B. CONCERNS ABOUT INCOMING WATER

### i. INFLUENT QUANTITY

The issue of water quantity has not been historically problematic in the relatively water-rich eastern United States.<sup>19</sup> Industries that needed water were mainly limited by the specific riparian laws that governed their state. Most states tempered riparian rights with somewhat elastic "reasonable use" principles, which limited riparian use.<sup>20</sup> Lately, however, more attention has been paid to water

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<sup>16</sup> DeMarrais, *supra* note 15.

<sup>17</sup> *Id.*

<sup>18</sup> See e.g. *Copper Dragon Flying Higher*, YORKSHIRE POST, Mar. 4, 2008 (Copper Dragon managing director Steve Taylor on Embsay Reservoir water); Simone Wilson, *The Beer Flows*, MEMPHIS FLYER, Aug. 7, 2008, at 42 (Ghost River Brewing founder Chuck Skyepeck on Memphis Sands Aquifer water).

<sup>19</sup> Kristin Choo, *Gulp: Litigation won't end the Battles over Depleted Water Resources in Several Regions of the Unites States*, 94 A.B.A. J. 56, 60 (2008).

<sup>20</sup> DAVID H GETCHES, *WATER LAW IN A NUTSHELL* 4 (3d ed. West 1997).

quantities in the eastern United States. A combination of drought and increasing population has forced the reevaluation of a policy that allows riparian landowners to simply use what they will so long as the use is reasonable.<sup>21</sup> As water becomes scarcer, some businesses that rely only tangentially on water may be slightly inconvenienced, but breweries will be utterly crippled without sufficient quantities of water.<sup>22</sup> In order to effectively approach any allocation plan involving breweries, the quantities of water needed to brew must first be understood.

Breweries can vary greatly in size and, thus, in water consumption. Some breweries start small, such as the Oregon Trail Brewery, which produced only 300–400 barrels per year in its first years of operation.<sup>23</sup> Others, such as the Anheuser-Busch brewery in St. Louis have an annual capacity of 15.8 million barrels.<sup>24</sup> Product output, though, only measures the quantity of liquor that makes it through the brewing process to become beer, thus it is only a rough indicator of the total quantity of water used. Additional water is lost to evaporation, and some quantity is used as process water and cleaning water. Nalco, a global water treatment company, estimates that breweries use about

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<sup>21</sup> Choo, *supra* note 19, at 60.

<sup>22</sup> *Id.*

<sup>23</sup> Glenn Tinseth, *Oregon Trail Brewery--Creative Problem Solving Revives a Brewery*, Oregon Trail Brewery, <http://www.oregontrailbrewery.com/history/> (last visited November 8, 2008).

<sup>24</sup> Anheuser-Busch Companies, Inc., *Anheuser-Busch - Community - Diversity*, <http://www.anheuser-busch.com/breweryMO.html> (last visited November 8, 2008).

60% of their water for washing, cleaning, and sanitizing.<sup>25</sup> Evaporated liquor and process water can vary greatly depending on the equipment and circumstances of the brewing, but the amount is certainly not negligible. In fact, Pittsburgh Brewing once claimed that the Pittsburgh Water and Sewer Authority overcharged it by \$1.4 million between 1996 and 2005 for treatment of wastewater that Pittsburgh Brewing said it lost to evaporation rather than the sewage system.<sup>26</sup> A slightly more simplistic calculation can be derived from the usage of the Anheuser-Busch Cartersville, Georgia brewery, which has the capacity of using about 5.6 million gallons of water per day to produce 1.6 million gallons of beer.<sup>27</sup> That is a total demand of 3.5 times the output. That may be a good rule of thumb, but the real lesson from all these varying numbers is that any water use plan that involves a brewery must consider the specific needs of that brewery in order to properly account for it.

## ii. INFLUENT QUALITY

After sufficient quantities are achieved, the next concern about water coming into a brewery is quality. The necessary quality for process and cleaning water is obviously lower than that necessary for liquor. Due to the fact that most breweries rely on a single source for all their water, this section will focus on the quality needs for liquor. A convenient baseline standard is that any water of sufficient quality to drink will make beer of sufficient quality to drink. Therefore, as long as

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<sup>25</sup> Nancy Seewald, *Water Treatment: Squeezing out More from Less*, 167 CHEM. WK. 19, 21 (2005).

<sup>26</sup> DaParma, *supra* note 15.

<sup>27</sup> *Brewery Brings Big Thirst to the Banks of the Etowah*, ATLANTA JOURNAL & CONSTITUTION, Apr. 18, 1993, at C4.

the incoming water meets the guidelines mandated in the Safe Drinking Water Act,<sup>28</sup> the resulting beer will be safe to drink as long as there is no catastrophic flaw in the brewing process itself. Breweries acquiring their water from municipal systems in some jurisdictions have the additional protection of case law which demands that the public, including breweries, be provided with water that is reasonably pure and wholesome<sup>29</sup> or that reasonable care, vigilance, or prudence is taken by the municipal provider to ensure the water it provides is pure.<sup>30</sup> In fact, the brewing process generally makes water safer due to the sustained boil, the production of alcohol, and the addition of hops, which has natural antimicrobial properties.<sup>31</sup> Even before humankind came to understand modern microbiology, people discovered that boiled drinks such as beer were safer to drink than possibly contaminated communal water sources.<sup>32</sup>

Making potable beer, however, is rarely the aspiration of any respectable brewery. A brewery can only sell its beer if it meets certain taste standards. Thus, "quality water is the key to quality beer."<sup>33</sup> Once potability is achieved, the remaining quality concerns of a

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<sup>28</sup> 42 U.S.C.A. §§ 300(f) *et seq.* (1996).

<sup>29</sup> *Seiden v. Passaic Valley Water Comm'n*, 199 A. 420, 422 (Dist. Ct. N.J. 1938); *Canavan v. City of Mechanicville*, 128 N.E. 882, 882 (N.Y. 1920).

<sup>30</sup> *Boguski v. City of Winooski*, 187 A. 808, 812 (Vt. 1936); *Hamilton v. Madison Water Co.*, 100 A. 659, 663 (Me. 1917); *see City of Salem v. Harding*, 169 N.E. 457, 460 (Ohio 1929).

<sup>31</sup> NPR Talk of the Nation, *supra* note 14.

<sup>32</sup> *Standage*, *supra* note 1, at 21-22.

<sup>33</sup> Debra Lynn Vial, *A Toast to Saving Highlands Water*, N. J. RECORD, Apr. 1, 2004, at A1.

brewery can be divided into things it wants to keep out of the water and things it wants to have in the water. Two common additives that can negatively affect the taste of beer are fluoride and chloramine. Fluoride is commonly added to municipal water systems for dental reasons, because it helps prevent cavity formation if taken steadily in very low doses. Even in small doses, however, fluoride can adversely affect the flavor of beer by imparting a slight bitter taste.<sup>34</sup> In some styles, this slight flavor may be overpowered by other flavors, but more subtle beers may be significantly affected by fluoride concentrations. Chloramine is a water treatment additive, which is a mixture of chlorine and ammonia intended to disinfect treated water for a longer period of time than basic chlorine.<sup>35</sup> While basic chlorine can simply be boiled off in the brewing process, chloramine remains in solution and, according to Paul Gatza of the Institute for Brewing Studies in Boulder, Colorado, imparts a plastic taste to the finished product.<sup>36</sup> Even basic chlorine can present problems. If chlorine concentrations are too high, stainless steel, a common material in breweries, corrodes in some chlorinated waters.<sup>37</sup>

The next step in analyzing the quality of brewing water concerns the presence of desirable substances. As water flows through and over natural geological formations, it can pick up quantities of various

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<sup>34</sup> Peter Panepento, *Fluoride in Water Leaves Bitter Taste for Erie, Pa., Brewery*, ERIE TIMES-NEWS, Oct. 27, 2002.

<sup>35</sup> Joe Malinconico, *Amid the Drought, Newark Brewer Taps into New Water Supply*, THE STAR-LEDGER (Newark, N.J.), Mar. 8, 2002, at 1.

<sup>36</sup> *Id.*

<sup>37</sup> J.S. HOUGH, D.E. BRIGGS & R. STEVENS, *MALTING AND BREWING SCIENCE* 191 (Chapman and Hall, Ltd. 1971).

minerals that take the form of dissolved salts.<sup>38</sup> The presence of certain salt ions such as sodium, chloride, sulfate, calcium, and magnesium as well as mineral effects on water's pH, or acidity, are of particular concern to breweries.<sup>39</sup> One brewing text details the plethora of effects these minerals can have:

[T]he kind of salts and their individual concentrations have a profound effect upon the brewing process. In mashing, enzyme activity and stability is influenced and therefore the yield extract. At the same time, the pH level and concentration of phosphates in the mash and derived wort are strongly affected by particular salts. Extraction of hop-bitter substances and precipitation of tannins and proteins are influenced by both the pH level of the wort and the concentration of salts. Fermentation and growth of the yeast may be enhanced or inhibited.<sup>40</sup>

Some breweries, such as the Copper Dragon Brewery in England, want a certain mineral profile. These breweries therefore prioritize remaining on the same water supply to maintain their historic flavor.<sup>41</sup> Other breweries, such as Ghost River Brewing in Memphis, Tennessee, prefer a soft, or low mineral content, water supply in order to provide a blank slate from which to build their own mineral profile.<sup>42</sup> By understanding these desirable and undesirable additives, policymakers can more

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<sup>38</sup> *Id.* at 170-171.

<sup>39</sup> STEPHEN SNYDER, *THE BREWMASTER'S BIBLE* 88 (HarperPerennial 1997).

<sup>40</sup> Hough, *supra* note 37, at 191.

<sup>41</sup> *Copper Dragon Flying Higher*, *Yorkshire Post* (Mar. 4, 2008).

<sup>42</sup> Simone Wilson, *The Beer Flows*, *Memphis Flyer* 42 (Aug. 7, 2008).

adequately account for the needs of breweries when formulating adaptive water management plans that may affect those breweries.

### C. SUGGESTIONS FOR MANAGING INTAKE WATER

#### i. WHAT A BREWERY CAN DO

If a brewery is to maintain a sufficient supply of incoming water for its unique needs, it cannot be complacent about quantity and quality. Breweries must be proactive in attending to their use of water in such a way that those breweries remain more of a benefit than a burden in the eastern United States. Three things a brewery can do with regards to its intake of water are to reduce its consumption, enact programs that will offset its consumption, and treat its own incoming water rather than relying on others to do so.

Just as any other finite resource must have its consumption reduced when scarcity rears its head, so must water consumption by breweries that use a large quantity of it. There are a number of strategies currently employed by breweries to conserve water, however, the list of current techniques is by no means exhaustive of possible future techniques. The most common sense techniques are simply to make sure that equipment is well maintained so as to be free of leaks and to turn off water supplies when not in use. Breweries could also reuse some of the water they take in. Obviously liquor cannot be reused because it becomes the final product, but process water and cleaning water can be reused under certain conditions. Process water used for cooling, for example, can be reused to spray down dirty equipment or even to become the liquor for the next batch

since it is already pre-heated.<sup>43</sup> Cleaning water should be used to rinse several surfaces before it is put down the drain. Treating and recycling this water, along with efficient use of cleaning agents and techniques, can also reduce the amount of cleaning water used.<sup>44</sup> Many breweries will do these things simply because it saves them money, but it will also help them to adapt to water use plans that require less industrial intake.

Additionally, breweries could engage in voluntary water audits. These may be cost-prohibitive for some smaller breweries, but the larger breweries would almost certainly benefit from them. A water audit is a process by which a team of water lawyers and technical analysts survey the supplies, needs, and options that a business has in order to find creative methods and solutions that will help conserve water, boost efficiency of water use, and secure additional or alternate supplies.<sup>45</sup> Staudenmaier suggests that many western United States businesses would benefit by incorporating water audits into their planning,<sup>46</sup> but perhaps those in the East, especially those as water-reliant as breweries, could benefit from them as well.

In addition to reducing their total consumption, breweries can offset some of their consumption by participating to some degree in the preservation or restoration of the watershed from which they draw their water. Two of America's biggest brewing companies, Anheuser-

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<sup>43</sup> See wikiHow, *How to Brew Commercial Beer*, "Making the Beer," <http://www.wikihow.com/Brew-Commercial-Beer> (last visited December 11, 2008).

<sup>44</sup> Seewald, *supra* note 25.

<sup>45</sup> Staudenmaier, *supra* note 5, at 16-17.

<sup>46</sup> *Id.* at 17.

Busch and MillerCoors, have information on their websites concerning their community involvement in the field of watershed conservation and restoration. Anheuser-Busch lists fifteen separate groups with whom it partners in conservation efforts ranging from wetlands preservation with Ducks Unlimited to environmental education grants through the Anheuser-Busch-owned SeaWorld.<sup>47</sup> They also tout their Anheuser-Busch Water Council, which was created in 2002, as a team of water specialists from different sections of the company who monitor water related issues and set water related objectives for various areas of the company.<sup>48</sup> MillerCoors has comparable information on its website describing its watershed conservation measures to reduce its daily impact and its more stringent water use and reuse policies.<sup>49</sup>

Smaller breweries with fewer financial resources are also doing their part to preserve and restore the waters on which they rely. The New Belgium Brewing Company has crafted a detailed scheme of environmental consciousness and conservation, which includes a

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<sup>47</sup> Anheuser-Busch Companies, Inc., *Anheuser-Busch - Environment - Wildlife and Habitat*, <http://www.ourpledge.com/Environment/WildlifeandHabitat.html> (last visited Nov. 8, 2008).

<sup>48</sup> Anheuser-Busch Companies, Inc., *Anheuser-Busch - Environment - Water Conservation - AB Water Council*, <http://www.ourpledge.com/Environment/ABWaterCouncil.html> (last visited (Nov. 8, 2008).

<sup>49</sup> MillerCoors LLC, *Water Use and Preservation - MillerCoors*, <http://www.millercoors.com/what-we-believe/healthy-environments/water-use-preservation.aspx> (last visited Nov. 8, 2008).

number of watershed issues.<sup>50</sup> In addition to general statements about stewardship beliefs, the New Belgium website includes a section devoted to water conservation and treatment strategies. It highlights their partnership with “1% For The Planet”, an organization whose member companies donate 1% of their sales to be distributed to various environmental nonprofits.<sup>51</sup> The company also highlights general public advocacy and education attempts. The website also includes a section discussing what consumers can do to reduce their impact, by recommending a series of lifestyle choices, such as drinking tap water rather than bottled water.

Finally, in order to reduce its stress on the system, a brewery can utilize methods of treating its own water to match the necessary quality standards for any given beer. This will allow municipal sources to make treatment decisions without having to consider as many industrial demands, as well as allow the brewery to accept water from whatever available water source rather than demanding water from a specific, and perhaps scarce, source simply because of its mineral profile. Breweries can purify or use brewing salts to treat the water they receive. Purification can include the addition of disinfectants such as chlorine, chlorine dioxide, and ozone in order to use water that has not been pretreated by a water company.<sup>52</sup> A side benefit of on-site

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<sup>50</sup> New Belgium Brewing, *Sustainability*, <http://www.newbelgium.com/sustainability.php> (last visited July 13, 2009).

<sup>51</sup> 1% For the Planet, *Home*, <http://www.onepercentfortheplanet.org/en/aboutus/> (last visited July 17, 2009).

<sup>52</sup> Ted Goldammer, *Water Treatments Used in Beer: Microbiological Control*, “Chemical Treatment”,

disinfection is that breweries can relieve themselves of the sometimes costly process of removing the disinfectants added by others. As discussed earlier, basic chlorine will boil off in the brewing process, but removing chemicals like chloramine can be very costly.<sup>53</sup> A brewery's treatment can also include the addition of brewing salts, which alter the mineral profile of the water to the appropriate levels for the particular beer being brewed. One common method of salting is Burtonizing, which is the addition of calcium sulphate to harden the water and achieve the distinctively sharp flavor of beers originating from Burton-on-Trent in England.<sup>54</sup>

Intake management policies like the ones discussed above can make breweries more efficient in the short term. They also provide long-term benefits with respect to changing water situations. Setting a precedent of adaptation has a dual effect of acclimating the owners and operators of the breweries to forthcoming challenges as well as legitimizing their consideration in future adaptation plans. When policymakers sit down to create water management plans, the demands of an industry that has proven its responsibility should be taken more seriously than the demands of an industry that has remained stagnant in the face of necessary change.

## ii. WHAT OTHERS CAN DO

As suggested by beer's popularity across the United States, the average beer consumer has a significant interest in securing the survival

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[http://www.beer-brewing.com/beer-brewing/brewing\\_water/microbiological\\_control.htm](http://www.beer-brewing.com/beer-brewing/brewing_water/microbiological_control.htm) (last visited Dec. 11, 2008).

<sup>53</sup> Malinconico, *supra* note 35.

<sup>54</sup> *NPR Talk of the Nation*, *supra* note 14.

of the brewing industry. In addition, the size of the industry makes it worth preserving for its economic impact. In order to ensure that breweries continue to have access to the water necessary to produce beer, there are measures that can be taken by those outside the industry itself. Consumers can have an impact on breweries' water use and therefore the survival of the brewing industry in two main ways. First, consumers can influence water policy through their own day-to-day actions. Consumers can also have a public impact by encouraging legislators to enact legislation that will positively affect the relationship between water and breweries.

Many of the day-to-day actions people can take to influence water policy may seem small when viewed as individual impacts, but the aggregate effect of many private citizens can make significant differences. One simple action is to reduce personal water consumption as much as possible. This, of course, produces positive effects, not only on the brewing industry, but on the water management scheme as a whole. Reducing personal water consumption will also lighten the overall demand on water sources and allow high-demand industries, like breweries, to withdraw what they need to produce without placing an undue strain on the overall system. The Environmental Protection Agency has created a water use program called WaterSense, which is analogous to the EnergyStar program concerning energy use.<sup>55</sup> By selecting fixtures and products with

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<sup>55</sup> Environmental Protection Agency, *WaterSense*, <http://www.epa.gov/owm/water-efficiency/index.htm> (last visited December 11, 2008).

WaterSense labeling, consumers can greatly reduce their individual demand for water.<sup>56</sup>

Another activity the average beer consumer can do is to make informed and responsible choices when selecting a beer. This end could be advanced greatly by the implementation of an eco-labeling plan. Eco-labeling is a generally voluntary plan whereby businesses, such as breweries, can manufacture their product in such a manner as to meet standards set by a third-party certifying agency. The agency would then provide some marking on the label of the product to inform consumers that those standards have been met.<sup>57</sup> An example of this technique is the Green Seal certification program in the United States. Through standards developed for various industries, Green Seal creates an opportunity for customers to make informed choices about products based on the impact of that product's creation both on the water system and the environment as a whole.<sup>58</sup> Standards are not yet available for breweries in particular, but standards are frequently developed for new industries.<sup>59</sup> By creating a demand for beer made in a manner that is responsible in its water use practices, consumers can influence market forces which will encourage breweries to develop and implement efficient uses of the water those breweries take in.

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<sup>56</sup> *Id.*

<sup>57</sup> See Renate Gertz, *Eco-Labeling—A Case for Deregulation?*, 4 *LAW., PROBABILITY & RISK* 127 (2005).

<sup>58</sup> Green Seal, *Green Seal: About Green Seal*, <http://www.greenseal.org/about/index.cfm> (last visited December 11, 2008).

<sup>59</sup> Green Seal, *Green Seal Certification and Standards – Green Seal Environmental Standards*, <http://www.greenseal.org/certification/environmental.cfm> (last visited December 11, 2008).

Legislation, as an expression of the public will, can also have an impact on the intake issues surrounding the brewing industry at federal, state, and local levels. The barest basic requirements of breweries are met by the same legislation and resulting regulations that require safe drinking water for public use.<sup>60</sup> Additional actions, however, can be taken to ensure more than minimum quality standards are met. To encourage efficient water use in breweries, legislation could contemplate any number of creative measures rather than relying on litigation to solve problems. David R.E. Aladjem, the chair of the Water Resources Committee in the ABA Section of Environment, Energy and Resources, expressed a need for such contemplation by saying, “More and more, we’re not going to be able to solve [water resource management issues] with litigation. We’re going to have to be very creative and collaborative to try to adjust our efforts and strategies to the changing circumstances.”<sup>61</sup>

For example, tax credits could be given to breweries that create and implement efficient water use plans such as the ones discussed above or penalties could be imposed on those with particularly wasteful habits. Water use criteria can be enforced by exercising the “regulated riparianism” doctrine already in place in about half of the Eastern states. This doctrine allows “reasonable use” withdrawals only with the possession of a time-limited permit, though the rules can vary from state to state.<sup>62</sup> The public trust doctrine could also be modified from its traditional role as a protective measure against misuse of water

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<sup>60</sup> 42 U.S.C.A. §§ 300f *et seq.* (West 2009).

<sup>61</sup> Choo, *supra* note 19, at 57.

<sup>62</sup> *Id.* at 60.

resources<sup>63</sup> to a more proactive role such as facilitating public funding of water audits for those high water use businesses that cannot afford them privately. Legislators could encourage or even mandate economic conservation measures such as “increasing-block” charging by water companies which would make each unit of water more expensive than the one before it, thus placing a premium rather than a discount on high volume uses.<sup>64</sup>

There is no end to the creative measures that could be implemented to increase efficient water use, and these creative solutions will only become more necessary in the eastern United States as the issue of water use becomes more pressing.

#### IV. OUTPUT ISSUES

##### A. DISPOSAL METHODS

The two methods a brewery can use to dispose of its wastewater are municipal system disposal and private disposal. Unless the brewery owns riparian rights, it is unlikely that it has any private disposal site available. This leaves most breweries, especially those that rely on municipal supplies, dumping their wastewater into municipal sewer systems. For smaller breweries, this process differs little from a high use residential user. Larger breweries, however, can find themselves running into problems with the quantities and qualities of the waters they are disposing of in the municipal sewer system.<sup>65</sup> In

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<sup>63</sup> Getches, *supra* note 20, at 148-9.

<sup>64</sup> OECD Observer, *Pricing Water*, [http://www.oecdobserver.org/news/fullstory.php/aid/939/Pricing\\_water.html](http://www.oecdobserver.org/news/fullstory.php/aid/939/Pricing_water.html) (last visited Dec. 11, 2008).

<sup>65</sup> See *Springer v. Joseph Schlitz Brewing Co.*, 510 F.2d 468 (4th Cir. 1975).

some circumstances legal repercussions may arise as a result of excessive dumping into municipal systems. Such legal repercussions are generally governed by some combination of local ordinances, federal laws, and contractual obligations between the brewery and the operator of the sewage system.<sup>66</sup> Private disposal can carry its own set of legal obligations as well. The Clean Water Act of 1972<sup>67</sup> established, amongst other things, a mandate that the Administrator of the Environmental Protection Agency promulgate water quality standards (WQS) for specific bodies of water.<sup>68</sup> These WQS's must then be used to maintain an updated water quality management (WQM) plan.<sup>69</sup> This plan must establish the quantity and type of effluent that is allowed to be dumped into a given body of water.<sup>70</sup> Industries such as breweries are held to those limitations on any private effluent disposal in which they engage.

As the financial and ecological cost of wastewater disposal becomes more of a factor in the eastern United States, many breweries are finding creative methods of improving their wastewater disposal techniques. These techniques are being used both for private and municipal disposal and will be discussed in depth in a later section.

#### B. CONCERNS ABOUT OUTGOING WATER

Regarding brewery effluent, quantity is rarely a concern in and of itself. With the exception of possible flooding concerns, the quantity of water discharged is generally problematic only in conjunction with

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<sup>66</sup> *See id.*

<sup>67</sup> 33 U.S.C.A. §§ 1251 *et seq.* (West 2009).

<sup>68</sup> 40 C.F.R. §130.3 (2009).

<sup>69</sup> *Id.*

<sup>70</sup> 40 C.F.R. §130.6 (2009).

the qualities it carries with it. For example, Joseph Schlitz Brewing Company found itself in legal trouble in 1975, when a farmer sued Schlitz for negligently overloading the municipal sewage treatment system and causing damage to the farmer's riparian lands.<sup>71</sup> In that case, Schlitz was releasing quantities of pollutants in excess of the amount allowed by a city ordinance but was allowed to continue doing so as long as it paid the appropriate fines and maintained a plan to reduce its pollution. The court found it to be liable for its negligence only if its officers or employees knew or had reason to know that its pollution quantities would overload the municipal treatment plan and cause damage to downstream riparian landowners.<sup>72</sup> Interestingly, the court also stated that Schlitz would certainly be liable had it simply dumped this sewage directly into a stream, but its contract with the municipal sewage system granted it additional legal protections because the burden of treating the water had been transferred to the municipal system.<sup>73</sup>

The measure of pollution used in the Schlitz case was biochemical oxygen demand (BOD), and because that is a common measure for the polluting properties of brewery effluent, it is worthy of a brief discussion here. BOD is not a single pollutant but rather a way of expressing the aggregate effect of a number of separate pollutants.<sup>74</sup> The EPA states on its website that BOD "measures the amount of

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<sup>71</sup> *Springer*, 510 F.2d at 470.

<sup>72</sup> *Id.* at 476.

<sup>73</sup> *Id.* at 474 (quoting *Carmichael v. City of Texarkana*, Ark., 116 F. 845, 849 (8th Cir. 1902)).

<sup>74</sup> EPA, *EPA > OWOW > Monitoring and Assessing Water Quality*, <http://www.epa.gov/volunteer/stream/vms52.html> (last updated Nov. 30, 2006).

oxygen consumed by microorganisms in decomposing organic matter” and “the chemical oxidation of inorganic matter.”<sup>75</sup> A more technical definition is “the loss of oxygen in mg/l in solution from a closed sample at 18.3°C for five days.”<sup>76</sup> American systems generally measure BOD in ppm rather than mg/l. In lay terms, BOD is a measure of how much dissolved oxygen will be consumed by the processes going on in the wastewater. The problem with effluent with a high BOD is that the water will be depleted of oxygen, which can cause stress, suffocation, and death to downstream organisms that rely on the oxygen content of the water.<sup>77</sup> Because the brewing process involves the use of large quantities of organic materials such as grains, hops, and yeast, the effluent also tends to contain large amounts of organic material making organically derived BOD a significant issue in the wastewater of many breweries.<sup>78</sup>

### C. SUGGESTIONS FOR MANAGING OUTGOING WATER

In searching for techniques that can reduce a brewery’s impact on its watershed in the eastern United States, it can be helpful to look at solutions that breweries are already enacting in both the East and in the West, where scarcity has historically forced a more careful hand. Learning from the specific examples, as well as the general spirit of ingenuity in some of these current techniques, can help the brewing

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<sup>75</sup> *Id.*

<sup>76</sup> Hough, *supra* note 37, at 175.

<sup>77</sup> EPA, *supra* note 74.

<sup>78</sup> W. Driessen & T. Vereijken, *Recent Developments in Biological Treatment of Brewery Effluent*, 1-2, March 2-7, 2003, available at <http://www.environmental-expert.com/Files%5C587%5Carticles%5C3041%5Cpaques24.pdf> (last visited Dec. 11, 2008).

industry in the East adapt to changing water conditions and needs. In analyzing these techniques, it is useful to break these suggestions down into generally useful disposal techniques and real world examples from existing breweries.

#### i. GENERAL DISPOSAL TECHNIQUES

One of the most obvious techniques that a brewery can implement to reduce its effluent is to reduce its intake. Quite simply, the more efficient a brewery is with its water resources, the less it will have to take in to meet production, and the less it will have to dispose of as effluent. As an addition or alternative to simple reduction of use, breweries can also treat their effluent in order to reduce the demand that they place on a municipal sewage system or directly on an ecosystem if they dispose of their wastewater privately. This reduction of impact will only become more important as water use and disposal policies become stricter.

The first stage to treating brewery wastewater is pretreatment. Pretreatment is a physical process aimed at removing relatively large particles, such as grains, scrap fragments, bottle caps, or any other large solids that may have mixed with the water. Pretreatment can consist of a simple screening or filtration process.<sup>79</sup> After large particles are removed, the water is moved to a grit chamber where smaller particles are removed and the water is prepared for any additional main treatment.<sup>80</sup> This preparation can involve aeration and the

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<sup>79</sup> Nick J. Huige, *Brewery By Products and Effluents*, in *HANDBOOK OF BREWING* 655, 702 (Fergus G. Priest, Graham G. Stewart eds., 2d ed., CRC Press 2006).

<sup>80</sup> *Id.*

addition of buffering chemicals or flocculating agents that coagulate suspended solids into large enough particles that they can either be filtered out or will naturally drop out of solution.<sup>81</sup> Sometimes biological pretreatment is done using systems of bacterial cultures that remove the most easily metabolized originators of BOD.<sup>82</sup> These systems are capable of reducing BOD by up to 60 or 70 percent.<sup>83</sup> Sometimes this is all the treatment the water needs, but other times it is sent to main treatment to reduce the more difficult pollutants that create BOD.<sup>84</sup>

Large amounts of BOD can be removed in biological main treatments, which can be either aerobic or anaerobic.<sup>85</sup> Aerobic treatment techniques focus on supplying a medium on which biological mass can grow and maximizing both the surface contact with the water and the aeration of the water to supply the biological mass with ample nutrients to metabolize organic pollutants.<sup>86</sup> These systems can include rotating sheets or paddles, beds, and baffled shafts.<sup>87</sup> Anaerobic treatment techniques focus less on complex machinery and more on complex biological systems. In these techniques, three separate types of bacteria need to be cultured to perform a chain of functions that take non-aerated wastewater and reduce the BOD by a complex series of metabolic processes that result in methane production.<sup>88</sup> Some of

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<sup>81</sup> *Id.*

<sup>82</sup> *Id.*

<sup>83</sup> *Id.*

<sup>84</sup> *Id.*

<sup>85</sup> Huige, *supra* note 79, at 703–704.

<sup>86</sup> *Id.* at 703.

<sup>87</sup> *Id.*

<sup>88</sup> *Id.* at 704.

the advantages of anaerobic systems over aerobic systems are lower energy consumption due to their lack of moving parts, the usefulness of the methane byproduct as an energy source, smaller space requirements, and less sludge (biomass) production. The disadvantages include comparatively slow bacterial growth rates, more sensitive bacterial systems, and a lower rate of BOD removal.<sup>89</sup> Sometimes aerobic systems are used after anaerobic ones to balance some of the comparative advantages and disadvantages.<sup>90</sup> Biological treatment of effluent can produce a new problem with solid waste disposal of the resultant sludge, but that is beyond the scope of this paper. A more easily disposed of biomass byproduct can be obtained, however, by using certain strains of yeast and other fungi that can potentially reduce the BOD of a brewery's wastewater by up to 98 percent.<sup>91</sup>

## ii. EXISTING DISPOSAL TECHNIQUES

The specific techniques being used to treat and dispose of brewery effluent are quite diverse and because there is no single industry standard, they can be modified based on the needs of individual breweries. Some have incorporated some version of one of the techniques outlined above, and others have come up with entirely original methods that are highly tailored to a specific situation. Understanding both the application of established techniques as well as the uses of creative original techniques will be a necessary step in fashioning useful techniques for the unique issues that exist and will continue to develop in the eastern United States.

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<sup>89</sup> *Id.*

<sup>90</sup> *Id.* at 705.

<sup>91</sup> Huige, *supra* note 79, at 707.

The Stone Brewing Company in Escondido, California has implemented a common treatment method with some customized twists. Stone moved to its current location in 2005 and quickly found it was producing too much wastewater for the Escondido municipal sewage system to handle. The city limited Stone to 25,000 gallons of wastewater per day, and the brewery had to pay large sums of money to truck the rest to a San Diego wastewater plant.<sup>92</sup> In order to relieve itself of this costly burden, Stone built an \$850,000 aerobic bacterial treatment facility that will render its water suitable for the municipal sewage system. Stone does not want to just turn its water over to the sewers though. An additional stage of filtration would allow the brewery to use recycled wastewater to water its onsite landscaping, a process that currently consumes up to 5,000 gallons of potable water per day. If all goes well, Stone will even have enough treated wastewater to sell its leftovers to a nearby hospital that is under construction and in need of a source of water for its landscaping.<sup>93</sup>

The reuse of appropriately treated wastewater has enormous potential to reduce the total amount of water used in the East, ease burdens on municipal sewage systems, and provide additional streams of income to breweries as they become suppliers rather than just consumers of water. Standing Stone Brewing in Ashland, Oregon, is considering starting a private hot water district to supply nearby businesses with the hot water that it produces. It makes five times more hot water than its onsite restaurant can use, and supplying hot

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<sup>92</sup> Angela Lau, *Brewery Will Start Treating Wastewater*, THE SAN DIEGO UNION-TRIBUNE, Aug. 2, 2008.

<sup>93</sup> *Id.*

water to adjoining businesses, if implemented, could provide extra income for Standing Stone as well as reducing water use and energy costs of participating businesses.<sup>94</sup>

At its Jacksonville, Florida brewery, Anheuser-Busch came up with a profitable solution to its wastewater disposal problems by taking the concept of wastewater reuse to the next level. Rather than selling the actual wastewater, Anheuser-Busch is using its wastewater to create a profitable product: grass.<sup>95</sup> Nutri-Turf Inc. is a subsidiary of Anheuser-Busch that operates 1,000 acres of grass fields and a series of retention ponds near the Jacksonville brewery. After an initial filtration inside the brewery, the wastewater is dumped out onto Nutri-Turf's fields where the nutrients that give it a high BOD serve to fertilize the grass. The water then filters down to retention ponds where solids settle out, and specially grown aquatic vegetation render it suitable for release into Thomas Creek and the Broward River. Anheuser-Busch saves over one million dollars in disposal costs annually and Nutri-Turf grows sod for golf courses and state Department of Transportation construction projects, as well as feed grasses for cattle.<sup>96</sup> Nutri-Turf also contributes to the broader issue of watershed conservation by operating a wildlife preserve on its 900 acres of wetlands and conducting educational wildlife education programs.<sup>97</sup> This sort of ingenuity is going to prove vital in managing the water assets of the

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<sup>94</sup> John Foyston, *Dining Brew News Benefit at Amnesia*, THE OREGONIAN (Portland, OR), Jan. 14, 2005, at 23.

<sup>95</sup> Matt Cristy, *Brewer Enjoys Watching This Grass Grow*, JACKSONVILLE BUSINESS JOURNAL, Aug. 29, 1997.

<sup>96</sup> *Id.*

<sup>97</sup> Cristy, *supra* note 95.

eastern United States. All companies are interested in finding ways of saving money. Finding ways of opening new revenue streams by selling waste products, especially in businesses like brewing that produce large quantities of a particular waste product, provides the financial motivation that may be necessary to effectively manage natural resources before shortage crises become even more widespread.

While large companies like Anheuser-Busch are capable of implementing these multiphase projects because of their large supplies of capital, smaller companies have the advantage of being more flexible and adaptive, which allows them to implement highly customized comprehensive water management plans. One example of such a customized plan can be seen at Anderson Valley Brewing Company in Boonville, California.<sup>98</sup> Employee Peter Suddeth says it tries to find as many ways as possible to use its water before that water becomes waste. These methods include reusing cooling water for cleaning the equipment, cleaning the brewery floor, or even using the hotter process water as preheated liquor for a future brew.<sup>99</sup> Once Anderson Valley has to call its water waste, it implements physical filtration and settling before moving the wastewater to a series of three ponds that treat the water with specifically cultured organisms. This process begins with bacteria in pond one and progresses to frogs, fish, algae, and even an egret in pond three.<sup>100</sup> The water is then used to irrigate onsite pastures.<sup>101</sup> Those irrigated pastures are then used for a population of

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<sup>98</sup> Jerome Goldstein, *Sustainable Water Supplies with Wastewater Recycling*, BIOCYCLE, Jan. 2006, at 24.

<sup>99</sup> *Id.*

<sup>100</sup> *Id.*

<sup>101</sup> *Id.*

shire horses that Anderson Valley uses to boost its tourism revenues with onsite tours and carriage rides.<sup>102</sup>

New Belgium has similarly customized water use techniques that also include a methane capture device on its biological treatment ponds.<sup>103</sup> By capturing the methane produced by anaerobic bacterial treatment, the brewery can fuel a combined heat and power engine that provides both heating and electricity for the brewery and can offset up to 15 percent of the brewery's energy costs while running at capacity.<sup>104</sup> As energy costs rise worldwide, turning wastewater into a source of energy will be an increasingly attractive policy for many breweries. Wastewater treatment facilities that can simultaneously lower a brewery's sewage disposal costs and lower their heating and energy costs will need to come into wider use in the eastern United States as the population becomes more aware of the fact that clean water and available energy are neither infinite in supply nor eternally cheap.

## V. CONCLUSIONS

The issues of water conservation, preservation, and allocation are not easy ones to work through. Traditionally these problems have been of a secondary concern in the water-abundant eastern United States, but as demand for and conflict over water grows, so does the concern for ensuring adequate supplies. As a major consumer of clean

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<sup>102</sup> Anderson Valley Brewing Company, *The AVBC Shire Horses*, <http://www.avbc.com/tour/shires.html> (last visited Nov. 8, 2008).

<sup>103</sup> New Belgium Brewing, *Sustainability*, <http://www.newbelgium.com/sustainability> (last visited Nov. 8, 2008).

<sup>104</sup> *Id.*

water and a major producer of wastewater, the beer industry is deeply entrenched in the water concerns of America. The eastern United States can benefit from the examples of many breweries in the West where scarcity has already forced a heightened awareness of the issues confronting water supply and disposal.

Many of the quantity and quality specifics of incoming water have enormous effects on the beer that a brewery produces, and there are steps that can be taken both by the breweries themselves and by the public to ensure that breweries receive adequate supplies of water in order to supply the nation with adequate supplies of beer. By taking conservation measures to reduce consumption, boost efficient use, offset consumption, and treat water on-site, breweries can reduce their demand on the water supply. The public can help to ensure the ability of the eastern United States' water systems to support breweries by personally conserving water, making informed and responsible consumer choices with regards to a brewery's water use practices, and supporting legislators and legislation that favors efficient water management programs in breweries.

Breweries also produce enough wastewater to pose a significant threat to the water sources into which they dump their effluent. While some breweries will actively seek out ways to reduce the impact of their wastewater simply because they feel a sense of responsibility, others will not heed the impacts of their effluent until there is a financial incentive. Fortunately for all involved, many financial incentives are available to make breweries control the impact of their wastewater. Eastern breweries can take notes from a number of western breweries as well as some of the more progressive eastern

breweries. Simply reducing consumption can have its benefits. Adventurous breweries can even develop customized strategies for turning their waste into profit by reusing water, selling the water itself, selling a product of the wastewater's reuse or even its treatment.

In the years to come, pressing issues of water demand in the eastern United States will create tension in and around the brewing industry, which consumes enormous quantities of water and has the potential to put out a great deal of pollution. An understanding of the issues surrounding a brewery's water use, as well as an effective implementation of plans based on that understanding, must be found both by the operators of those breweries and by the general public, which has an interest in the continued operation of the American brewing industry. As water resources become scarcer, industries that cannot adapt to changing water conditions and needs will be at a marked disadvantage when competing with those that can. The brewing industry must be preserved, because while there is no doubt that water is necessary to the continued existence of individual human beings, beer is necessary to the survival of civilization.