Water Chemistry for Brewers

Key Considerations for Quality and Consistency

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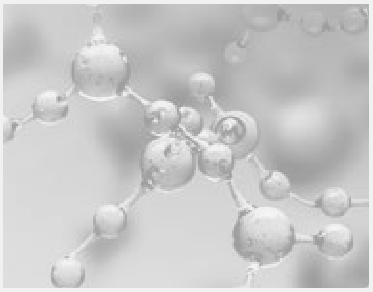

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– *Martin Brungard*

Introduction to Water Chemistry: What Every Brewer Needs to Know

Water makes up the highest percentage of the ingredient list for beer, yet water quality is not always a priority consideration for brewers. This ebook is dedicated to all things water–from an introduction to water chemistry to brewing different beer styles to the effects of climate change on your water.

Starting with the basics, we’ll give insight into how alkalinity infuses into natural water sources, how water hardness is an important factor to consider, as well as how to remove disinfectants from brewing water. From there, it’s necessary to know classic water profiles and how they affect sensory notes of beers–including famous European beer styles as well as IPAs and stouts that are all the craze in the US. Knowing the techniques employed to alter water to tailor to desired styles is key to creating the best possible example of those styles. And finally, given the changing climate there are higher temperatures and lower water supplies. These impact raw water sources in ways that make it critical to focus on greater chemical consistency of your water, we’ll show you tools and strategies to employ.

By understanding the way water chemistry impacts the sensory quality of finished beer, and by analyzing fermentation and other data, brewers can control sensory aspects of their brews like never before.

Longtime environmental engineer Martin Brungard is an expert on water. As a technical advisor for the Brewers Association’s text Water: A Comprehensive Guide for Brewers,* he knows what a difference this highly variable and often overlooked ingredient — which comprises up to 97% of a beer’s volume — can make to the drinkability of the final product. So he wishes both brewing schools and brewers would devote more attention to the importance of ensuring its suitability for making suds of varying styles.

“I know of a brewer who’d won several World Beer Cup gold medals for one particular beer but the rest of his beers were just terrible,” he says. “When brewers pay a little bit of attention to their water then their full repertoire of beers improves tremendously.”

One water supplier can draw from many sources, from wells to rivers to springs, and every fount may vary in its chemical composition. Even a single source can fluctuate when it rains or snows. So imagine the variety between geographic locations. What happens when a brewery draws water whose mineral makeup results in less-than-stellar styles? Or a craft brewer in Maine aims to recreate the magic of the Belgians? Or a global behemoth like Anheuser-Busch InBev must create consistency between its far-flung facilities?

John Palmer and Colin Kaminsky write in Water, “This is the first take-home message: Know your water source and what to expect from it.”

**https://www.brewerspublications.com/products/water-a-comprehensive-guide-for-brewers*

How Brewing Water Develops Its Unique Chemistry

Water picks up minerals as it contacts and permeates rock and soil; when those minerals dissolve they either gain or lose molecules and become known as ions. With their limestone and gypsum geological formations, a lot of the American west and midwest is characterized by hard water, meaning it contains high quantities of calcium and magnesium ions. The prevalence of granite and sandstone in mountain and coastal regions suggests a softer water profile.

Contrary to conventional wisdom, Brungard says both types of water can produce equally enjoyable beer. However, because certain mineral salts lend themselves better to certain colors and styles (think of a classic example like Pilsner, originally brewed with the soft water of Pilsen), a brewer may wish to increase or reduce hardness to achieve their desired effect.

Boosting the calcium and magnesium content can be accomplished simply by adding calcium or magnesium chloride, calcium sulfate (gypsum), calcium carbonate (chalk), magnesium sulfate (Epsom salt) or calcium hydroxide (pickling lime).

According to Jason Trujillo, who works on beer chemistry in New Belgium's QA department, that brewery adds gypsum to the mash or boil (depending on the recipe) to harden its water. Because of divergent water sources, its sites in Colorado and North Carolina add different quantities to the same beer to reach a shared target.

Reducing hardness usually requires a more elaborate process, and not all solutions work for all types of hardness. Options include:

- A distilled or reverse osmosis (RO) water dilution.
- A boil.
- An addition of pickling lime.

How Alkalinity Impacts Brewing Water Quality

Alkalinity represents the buffering capacity of water, or, as the U.S. Geological Survey defines it, alkalinity provides "a measure of the ability of the water body to neutralize acids and bases and thus maintain a fairly stable pH level."

Water used for sparging and most brewing should register low in alkalinity, which presents a problem considering that most American water sources are very high in alkalinity. Brungard believes beers can end up tasting dull, flat, and not very lively unless brewers have added enough acid to the mash.

With an acid addition, he says, brewers "end up with a much brighter beer that dances on your tongue."

A distilled or RO water dilution works well to lower alkalinity, and though massive breweries like Guinness treat at least some of their water with RO, Brungard says, "Water treatment is not terribly expensive. The advent of RO treatment equipment put decent water into the hands of just about anybody."
Occasionally a beer – often a dark style like porter or stout, brewed with acidic

According to Jason Trujillo, who works on beer chemistry in New Belgium's QA department, that brewery adds gypsum to the mash or boil (depending on the recipe) to harden its water. Because of divergent water sources, its sites in Colorado and North Carolina add different quantities to the same beer to reach a shared target.

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BrewMonitor gives you a number of valuable data points the minute you turn it on. And, once you've okayed your starting levels and pitched your yeast, you can practically set it and forget it. As Denver Smyth, head brewer and owner of Western Red Brewing in Poulsbo, Washington, has discovered, automatic digital readings mean he can track his fermentation from home instead of driving 30 miles to and from the brewery every Saturday and Sunday to take gravity readings, as was his custom:
"My favorite thing is when I pitch a yeast on Friday night, I can leave and I don't have to come in because I can see exactly what's happening. Now it's pretty rare that I run to the brewery on a Saturday or Sunday at all."

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roast malt – calls for mashing water with higher alkalinity to buffer the low pH created by the high-acid malts. This can be accomplished by adding pickling lime (calcium hydroxide), or baking soda.

Removing Disinfectants from Brewing Water

To make drinking water safe to drink, almost all US water utilities add disinfectants like chlorine to the water supply; the water reaching the brewery will likely have residual traces. While beneficial to human health, these chemicals can combine with the compounds in wort to form chlorophenols, which can smell and taste soapy or detergent-like at very low levels. According to Brungard, typical tap water has approximately 100 times the concentration of chlorine compounds required to produce chlorophenols and the failure to completely remove those chlorine compounds from the raw water can taint your beers.

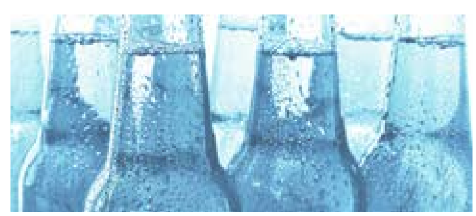
To remove chlorine from water, a brewer may choose to treat it by boiling, aerating, filtering through activated carbon or adding metabisulfite or ascorbic acid. A good step in maintaining beer quality is to test and confirm that all chlorine compounds have been removed from the water prior to using it in brewing.

"Completely removing disinfectants from municipal water eliminates a huge detractor in beer quality right there," Brungard says.

Creating Classic European Beer Styles

Want to brew classic European styles of beer? Here's what you need to know about matching the water in the Old World capitals that invented them.

If you're a brewer, you've almost certainly heard the term "Burtonizing." But do you understand exactly why, when, and how to do it? According to Merriam-Webster, burtonizing refers to the process of hardening brewing water by "adding gypsum or certain salts especially for the purpose of approximating the flavor" of beers produced in the English town of Burton-on-Trent. Burton's sought-after pale, hoppy beers earned it a prized reputation by the 12th century; by the 1800s, the original home of pale ale had fashioned itself into the epicenter of British brewing.



Just as pre-modern farmers and chefs – in the relative absence of imports or contemporary technology or technique – primarily relied on and perfected foods that grew naturally in the terroir around them, the pre-20th century brewers who created the classic styles of Europe maximized their efficiency and end results by tailoring their recipes around how the acidity of their grains would interact with the alkalinity and mineral composition of their local water sources.

"The suitability of Burton water for brewing lies in its extreme hardness, particularly in terms of calcium and magnesium sulfates. These so-called gypseous waters promote protein coagulation during boiling, allow high hop-rate usage, and promote yeast growth; the result being the clear, sparkling ale for which Burton became famous."

– Ian Honsey

Writes Ian Honsey in The Oxford Companion to Beer*, "The suitability of Burton water for brewing lies in its extreme hardness, particularly in terms of calcium and magnesium sulfates. These so-called gypseous waters promote protein coagulation during boiling, allow high hop-rate usage, and promote yeast growth; the result being the clear, sparkling ale for which Burton became famous."

Though their water sources vary considerably, the basic story reads similarly in Pilsen, Dublin, and other continental cities strongly associated with a certain style of brew. Today, brewers making them elsewhere often try to replicate these original water profiles to produce beers to style that become indistinguishable to those from their point of origin.

Here are some key things to know before you attempt to brew a classic pale ale, pils or dry Irish stout.

Wort pH and Water Alkalinity

"The primary interest to brewing is the pH of the wort during mashing. Factors such as water alkalinity and mash grist composition have greater effect on mashing pH than the starting pH of the raw water," says Martin Brungard. In other words, the pH of the mash is incredibly important, and it's therefore important to correctly manage the raw water to match your grain bill when working to reach your mash pH target. In preparing your water, although the pH in your liquor tank might not matter much, the mineral content (or hardness) of that water does, as does your overall grain bill, because the two will combine to create the right environment for all the grain-based enzymes in the mash to do the work in creating the desired flavor profile.

Brungard explains, "During mashing, calcium and magnesium in the brewing water react with phosphatic compounds (phytins) in the malt to produce acids that neutralize the brewing water's alkalinity." This reaction between the minerals in the water and the phytins in the malt effectively acidifies the mash while also reducing the hardness of the water, giving it less buffering capacity. The balance (positive or negative) of the water alkalinity here is known in the brewing world as Residual Alkalinity (RA) and is a key factor in maintaining the proper pH of the mash.

Brungard says brewers should aim for a mash pH between 5.2 and 5.8, so as not to hinder its enzymatic processes. As a rule of thumb, pale beers favor low RA water because the mash pH finds a comfortable spot in that range. The opposite can be said for dark beers, whose acidic grains can unfavorably lower the wort pH and reduce activity of the mash enzymes, possibly resulting in a beer that's inappropriately acidic, tart or sharp.

"As the acid content of the mash's grain bill increases, the mashing water RA must also rise proportionally to maintain the mash pH," writes Brungard.

To adjust the residual alkalinity of your brewing water, there are a few options. In lowering the RA, heating or boiling the water can greatly soften its hardness

https://www.oxfordreference.com

and decrease its alkalinity. The rise in temperature causes the pH to rise and the bicarbonate in the water to precipitate as calcium carbonate.

When raising the RA, John Palmer and Colin Kaminsky, the authors of Water, A Comprehensive Guide for Brewers, caution, “It is difficult to add more alkalinity to a soft water without adding significant hardness or sodium as well. It is often a case of two steps forward, one step back.” This is especially notable with sodium, as it is flavor positive and can noticeably impact the sensory profile of your finished product.

What does all of this mean? In practical terms, it’s highly important to consider the flavor contributions of the minerals in your water, and what impact additions or removals of those minerals will have on your finished beer.

Flavor Ions

Luckily, the water profiles of historic brewing cities and regions can give us a roadmap to mastering the proper mix of minerals and ions in your brewing water. Once you have the desired style of beer outlined and the grain bill calculated, it’s time to consider whether any flavor ions – notably calcium, magnesium, bicarbonate (alkalinity), sodium, chloride and sulfate – need to be added to approximate the water profile you seek.

From the Bru’n Water website*

Ion Profiles for Major Brewing Centers							
Brewing Center	Ion Concentrations (mg/L)						Residual Alkalinity
	Calcium	Magnesium	Sodium	Sulfate	Chloride	Bicarbonate	
Burton	275	40	25	610	35	270	5
Dortmund	230	15	40	330	130	235	20
Dublin	120	4	12	55	19	315	170
Dublin-Wicklow	18	2	13	22	20	35	15
Edinburgh	100	20	55	140	50	285	150
London-Wells	20	5	175	65	125	260	196
London-Thames	40	5	30	70	40	60	18
Munich	77	17	4	18	8	295	180
Pilsen	7	2	2	8	6	5	5
Vienna	75	15	10	60	15	225	125

Comparing these profiles to water composition reports from your brewery’s water source will give you an idea of what and how much you might need to add or reduce in matching these profiles. While doing so, it’s important to know that the mineral makeup of a water source can change over time. Further, given that brewers have been modifying water for hundreds of years, brewers in those historic locations may have treated their own supply. Therefore, the provided parameters don’t paint the entire picture but, rather, sketch out a close approximation. Looking at a few key places on this list can give insight to the impact and importance the particular brewing water has for the styles that originated there.

Burton Pale Ales

Palmer writes in his book *How to Brew*** that compared to London, Burton’s calcium and sulfate levels are “remarkably high, but the hardness and alkalinity are balanced to nearly the degree of Pilsen.”

** https://www.brunwater.com/water-knowledge*

***https://howtobrew.com*

He says high sulfates and low sodium content produce “an assertive, clean hop bitterness” that when compared with London, are “paler, but much more bitter.”

That said, Brungard warns that the Burton water profile in the above chart was estimated at a specific, highly mineralized aquifer whose relative concentrations of ions fluctuate throughout the year. Brewing at those concentrations may be extreme and produce notes of sulfur.

As if to illustrate the variability of Burton’s brewing water over time and space, Mitch Steele writes in IPA: Brewing Techniques, Recipes and the Evolution of India Pale Ale* that its earliest breweries drew water from shallow (approx. 30 ft) wells close to the river Trent; As the river grew polluted, brewers increasingly dug deeper and farther away where the water was found to have three times more gypsum and half the calcium carbonate as the original wells.

Pilsen Pilsners

According to Palmer and Kaminsky’s co-authored text, “Recreating a pilsner with vastly different water is one of the greatest challenges a brewer can undertake.”

That’s because every ingredient and decision that goes into this pale Czech style rests on the soft surface and groundwater of Pilsen, which has low minerality and low alkalinity. Using only base malts to reach proper mash pH, Palmer likens pilsner to the “soft rich flavor of fresh bread” derived from an absence of sulfate that “provides for a mellow hop bitterness that does not overpower the soft maltiness.”

> “It is difficult to add more alkalinity to a soft water without adding significant hardness or sodium as well. It is often a case of two steps forward, one step back.”
>
> *– John Palmer and Colin Kaminsky*

Dublin Stouts

“Famous for its stout,” begins Palmer in How to Brew, “Dublin has the highest bicarbonate concentration of the cities of the British Isles, and Ireland embraces it with the darkest, maltiest beer in the world. The low levels of sodium, chloride and sulfate create an unobtrusive hop bitterness to properly balance all of the malt.”

As opposed to breweries in the rest of Dublin, which draw from the city’s typically hard, alkaline water, Guinness’ St James Gate brewing water historically flows from the neighboring Wicklow Mountains.

“Dry Irish stout is quite a different stout than other stouts and porters,” Brungard says. “Guinness has sort of an acidic bite because they brew with what amounts to rainwater. For most porters and stouts you want that alkalinity because all those dark grains are very acidic. With Guinness, those roasty malts become richer and fuller so the chocolate and coffee notes come through.”

**https://www.brewerspublications.com/products/ipa-brewing-techniques-recipes-and-the-evolution-of-india-pale-ale*

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– John Palmer

Hype Beer Styles – Juicy/Hazy IPAs and Pastry Stouts

Cigar City Brewing head brewer Wayne Wambles half-jokingly uses one word to characterize the type of stout that's taken a strong hold in the brewery's home state of Florida: "Underattenuated."

Indeed, lactose-laden "pastry stouts," as they're often called, have so proliferated in the Sunshine State that Voodoo Brewing – headquartered in Pennsylvania – has named its version "Florida Stout."

But brewing them in Florida can prove less sweet than the resulting liquid. While a boatload of adjuncts might mask many flaws, the base of a consistent pastry stout depends first on the brewing water chemistry it consists of. For instance, the water Cigar City draws from in Tampa rotates between up to four different sources whose sulfate readings fluctuate between 70ppm and 200ppm.

"Increased sulfate levels are not a good thing for bigger, sweeter, malt forward stouts," says Wambles, who helped make the brewery famous for imperial stouts. "It elevates the hop profile and can throw the malt balance off if the goal is to make something like an imperial stout or more malt-forward stout."

He recommends going no higher than 100ppm for this kind of beer.

While brewers aiming for a clean, assertive hop bite to their beers do favor relatively high levels of sulfate, brewers chasing the hype of a pastry stout or today's most popular new subcategory – the juicy IPA – prefer a higher amount of chloride in their brewing water profile.

"Chloride in your water chemistry tends to accentuate the malt character and also give the mouthfeel a softer, rounder sensory experience," says Sean Lawson, co-founder of Lawson's Finest Liquids in Vermont, revered for its Sunshine line of balanced, juicy IPAs. "If we were talking about music, sulfates might lend a staccato note whereas chloride would have more legato tones."

New England IPA Water Profile

Lawson wryly refers to his mostly clear or translucent Sunshine beers as "IPAs made in New England," as opposed to New England IPAs (NEIPA), a term that serves as a bit of a catch-all for hoppy ales commonly typified by a soft, citrusy or tropical hop flavor; a massive amount of dry hopping; a gentle mouthfeel and a cloudy appearance. The Brewers Association (BA) added them to its official style guidelines in 2018 but calls them "Juicy or Hazy" IPAs while noting that neither juiciness nor haze is required. In fact, the BA makes only two sensory demands: 1) "hop aroma and flavor are present," 2) "the impression of bitterness is soft and well-integrated into overall balance."

“Chloride in your water chemistry tends to accentuate the malt character and also give the mouthfeel a softer, rounder sensory experience. If we were talking about music, sulfates might lend a staccato note whereas chloride would have more legato tones.”

- Sean Lawson

As brewmaster at Massachusetts’ Trillium Brewing in 2015, Eric Thomas helped pioneer the style and credits its development to a departure from the IPA water profile that informs the more traditional British and West Coast versions.

He emails, “The traditional dogma behind IPA styles (prior to the NEIPA) was rooted in higher sulfate to chloride ratios based on historical water profiles. When the NEIPA came out and everyone began exploring higher chloride to sulfate ratios, at least for me that’s when it really drove home the impact on hop expression, softness, mouthfeel and overall textural experience of IPA styles and the water chemistry impact from these two ions alone. It’s a really powerful thing to experience.”

In subsequently perfecting his technique as head brewer at Sixpoint Brewery in Brooklyn, he settled on a chloride/sulfate ratio of 3-3.5:1 in his mash water. He notes, however, that ratio isn’t all that matters. He says chloride can and should be tasted above 50 ppm. Whereas much of the literature on the topic uses 150-200ppm as a general target (the same range Wambles uses for his stouts), he’s gone as high as 300ppm.

“I loved how the higher calcium chloride additions and chloride:sulfate ratio could lend a pillowy softness and subtle sweetness to the beer, which could help improve high attenuation scenarios and also accentuate the juicy qualities of the style,” he writes.

Veronica Vega, director of product development for Oregon’s Deschutes Brewery, aims for around 200ppm of chloride in her hazies.

“For snappier west coast style IPA’s we increase the calcium sulfate,” she says. (Note: brewers usually use calcium sulfate – gypsum – and calcium chloride salts to adjust their levels.)

West Coast IPA Water Profiles

Known for its signature hop snap, Stone Brewing in San Diego keeps the bitterness in its west coast takes on New England IPAs.

Head brewer Ethan Spiro emails, “When we released our first packaged, nationally released hazy IPA, Stone ///Fear.Movie.Lions Hazy Double IPA, it wasn’t nearly as hazy as most, and that was by design. We wanted that hop bitterness to show through, complemented by the juiciness and full mouthfeel of a hazy double IPA. We’ve since continued to explore this style with a few different variations that definitely elevate hops more than most hazies.”

That said, Spiro sticks fairly close to industry norms in his chloride-to-sulfate ratios, sometimes even leaning more heavily than most into the chloride with a range of 2:1 to 4:1 for FML and 2:1 to 1:1 for Stone Hazy IPA.

Caution When Using Chloride

While a high chloride content does lend itself to luscious NEIPAs and pastry stouts, authors of the Water: A Comprehensive Guide for Brewers warn that brewers should not exceed 200ppm of chloride in their stout and IPA water profiles. Above 100ppm, they caution, chloride can corrode stainless steel brewing equipment. Above 300ppm it can adversely impact clarification, body, colloidal stability and yeast health; and above 400ppm it can have negative effects on flavor that some might describe as “minerally.”

How Climate Change Is Changing Your Water Chemistry

In February 2022, the British journal Nature Climate Change published a startling report. The western United States, it said, is experiencing its worst drought in 1,200 years. The mega-drought has not only lasted more than two decades but covers 95% of the west. Brewers from Colorado to Wyoming to California are watching nervously as the problem grows more acute.

“Last summer Jackson Lake was drained to 20% of capacity to alleviate the pains of farmers, and the entire west is getting a very bad snowfall year,” says Sean McClurg, lead brewer at Roadhouse Brewing in Jackson Hole, Wyoming.

By the beginning of March, when most of the season’s snow should have already fallen, it had snowed 244 inches in the ski destination, not too much more than half the average winter total.

“Every mid-to-late May the Jackson Lake dam gets opened up to flush out sediment, but the less water we have the less capability we have to do that,” he says.

Even in a normal year, routine or seasonal changes to the amount of snowmelt and rainfall can alter the chemical composition of almost any brewery’s water supply. Municipal authorities might unexpectedly switch or alter the blend between sources to accommodate fluctuations; a robust snowmelt might send elevated quantities of sediment downriver; or salt on snowy roads might wash into a tributary, causing a spike to the amount of chloride it contains.

In Jackson Hole, McClurg says, spring’s melting snow pack sometimes adds slightly higher levels of calcium, gypsum, and magnesium to the Snake River aquifer that feeds its seven municipal source wells; former Anheuser-Busch assistant brewmaster Mitch Steele remembers the high variability in sodium, calcium and chloride out of the Mississippi River in St. Louis.

But climate change, particularly as it relates to the rising temperatures that lead to less precipitation and more evaporation, threatens to bring far greater instability to the brewing process.

Higher Temperatures and Lower Water Supplies

Steele, who spent a decade as brewmaster at Stone Brewing outside San Diego, says most of Southern California’s water blends Colorado River water with Sierra Nevada mountain snowpack transferred via the California Aqueduct. Extreme drought conditions in California results in suppliers upping the blend percentage from the Colorado River, which picks up a large quantity of minerals as it travels the long distance.

He says, “We would see variations of 100-150 ppm hardness to over 400 ppm. Stone had one reverse osmosis system when I started and that pulled enough calcium out of the water to bring it back to levels good for brewing. Then when we had extreme droughts we put another one in because it created a logjam.”

Increasing Water Chemical Consistency by Building Communication

The Brewers Association’s supply chain subcommittee is preparing a report that encourages brewers to become more proactive about monitoring their water chemistry by purchasing a relatively cheap test kit. At his current brewery, Atlanta-based New Realm Brewing, Steele uses a LaMotte brand product that costs around $200 for a year’s worth of tests.

The BA’s recommendations will also steer brewers to increase beer quality and consistency by fostering a relationship with their water authority – inviting representatives for a tour and explaining how mineral content can impact a brew. This, in an effort to get the authority to warn brewers before they alter the blend of water sources, which often have different chemical makeups.

“We’d notice that parts per million of sodium bicarbonate would be super high because of a change in the water table caused by drought, and in recent years all of a sudden our manganese levels go up,” says Richard Norgrove, Jr., co-owner of Bear Republic Brewing in Sonoma County, California. “Eventually, because we built a partnership with the city, we started getting calls saying, ‘You might not want to brew tomorrow.’”

Steele advises tenacity in fostering this type of communication. “At Stone it took us years to get to that point,” he says.

Controlling Growth by Controlling Water Supply

A relationship with municipal leaders can help mitigate other water-related issues.

A community that lacks sufficient water may be loathe to approve permits for construction or expansion, as Richard Norgrove, Sr. found out decades ago when he decided to remediate one well and fund two new ones for the city of Cloverdale, California, which initially proclaimed itself disinclined to permit an expansion to Bear Republic before officials could add appropriate infrastructure.

“The city didn’t have it in their budget so my dad literally went down there with a check and said, ‘I’m going to pay for the wells because you’re holding up business,’” says the junior Norgrove.

Norgrove notes that today many California cities require breweries-in-planning to pay fees based on estimated water usage, and Charlie Hoxmeier, chief brewing officer for Gilded Goat Brewing in Ft. Collins, Colorado, says distributing water between burgeoning municipalities at varying distances from the Colorado River creates a dilemma for users and water managers.

“We (at the brewery) have pretty reliable access to water because we’re at the source, but a large proportion of our water gets sent to other communities downstream, and between the increasing likelihood of poor snowfall years and rapid population growth, it’s probably the biggest hurdle we have in maintaining our source water and the health of our local watershed,” he says.

Replenishing the Fresh Water Supply with Desalination

Norgrove says he expects Northern California will soon have to follow its southern counterpart’s lead in drawing and desalinating seawater to quench the state’s thirst for drinking and brewing water. Desalinated water is softer and lower in total dissolved solids and chlorides, effectively making it easier on equipment. But the process is controversial because it threatens marine ecosystems while costing more and expending far more energy than other options, like wastewater reclamation and rainwater capture.

Pizza Port Carlsbad’s owner, Gina Marsaglia, is quoted in a study commissioned by the non-profit Water Research Foundation as saying, “The addition of desal water into our region’s distribution system has created a noticeable increase in overall water quality. It has also provided assurances that there will never be a shortage of high-quality water in this region – giving me peace of mind that we have a long and sustainable future for our business and our industry right here where we started.”

With the majority of unique beer styles requiring their own unique water profiles, the data on water chemistry is a critical component for a proficient brewer seeking the utmost consistency from one batch to the next. Additionally, the potential changes in water supply due to climate change and government regulations make this increasingly urgent. Utilizing continuous fermentation monitoring can help gain insight into the overall consistency of product, stemming from variations in flavor positive water chemistry with incredible precision.