

NON ALCOHOLIC BEER

Basically just water?

What's the point?

Do you have plans tomorrow?

Just kidding, this is
water for
homebrewers



WATER QUALITY FOR HOMEBREWERS

Water treatment process

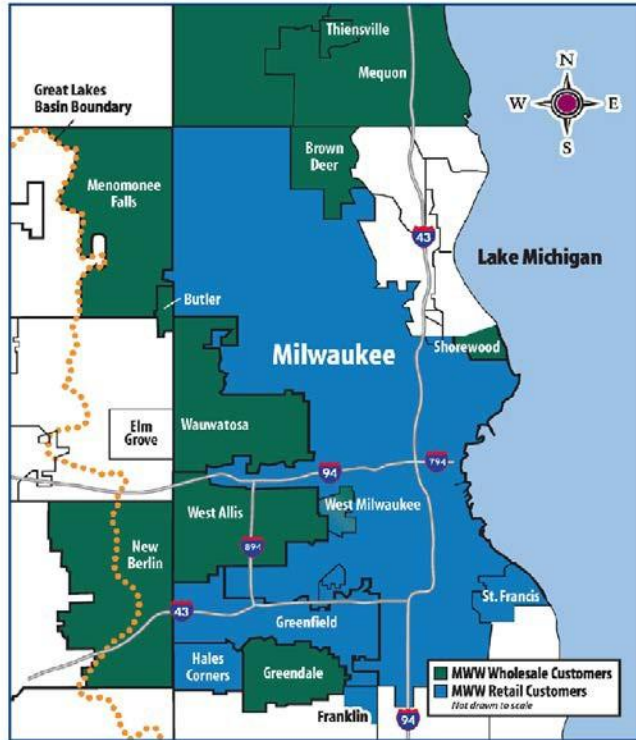
Water Quality testing

Chemistry impact on brewing

Milwaukee Water Works

Safe, Abundant Drinking Water.

Service Area



UTILITY AND SERVICE AREA

Provide water to over 860,000 people in Milwaukee, Brown Deer, Butler, Greendale, Greenfield, Hales Corners, Shorewood, St. Francis, Wauwatosa, West Allis and West Milwaukee. Also provide water to the Milwaukee County grounds, and portions of Franklin, Menomonee Falls, Mequon, New Berlin, Thiensville and Waukesha.

The Milwaukee Water Works (MWW) is a division of the Milwaukee Department of Public Works and is publicly owned

Utility is self supported from the water rates, not taxes. In 2014 the MWW made a \$12.4 million payment in lieu of taxes to reduce the city tax rate. Since 1993 MWW has invested \$459 million in its treatment plants, water mains and booster stations.

MWW operates two treatment plants, Linnwood Ave. and Howard Ave.

Treat 29.9 billion gallons of water per year, with average daily pumpage of 103 million gallons

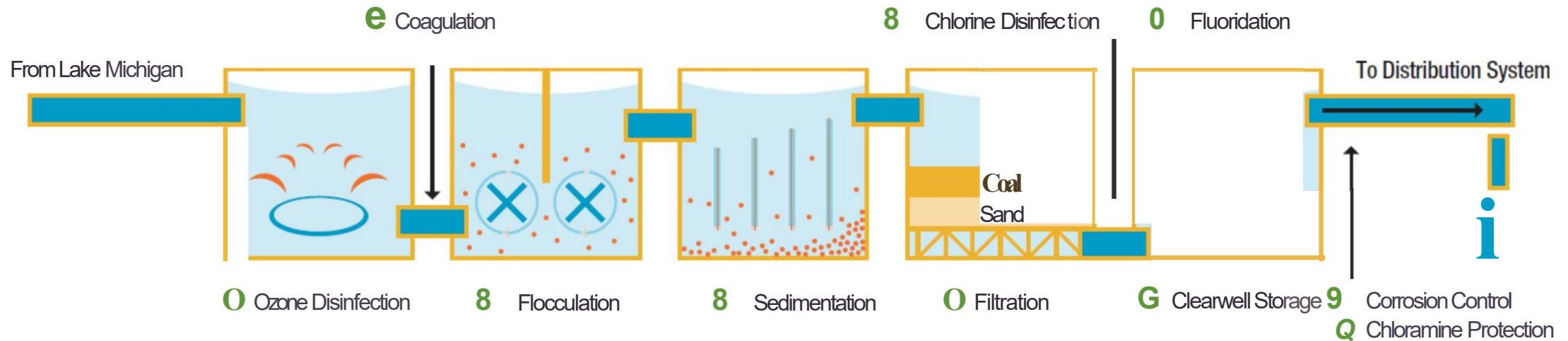


Linnwood Purification Plant

Howard Ave. Purification Plant



Milwaukee Water Works Drinking Water Treatment Process



Ozone Disinfection Ozone gas is bubbled through the incoming lake water. Ozone destroys disease-causing microorganisms including *Giardia* and *Cryptosporidium*, controls taste and odor, and reduces the formation of chlorinated disinfection byproducts.

Coagulation and Flocculation Aluminum sulfate is added to the water to neutralize the charge on microscopic particles in the water. The water is then gently mixed to encourage the suspended particles to stick together to form floe.

Sedimentation Sedimentation is the process in which the floe settles out and is removed from the water.

Biologically Active Filtration The water is slowly filtered through 24" of ant hracite coal and 12" of crushed sand to remove very small particles.

Chlorine Disinfection After filtration, chlorine is added as a secondary disinfectant. This provides extra protection from potentially harmful microorganisms.

Fluoridation Fluoride, when administered at low levels, is proven to help prevent tooth decay.

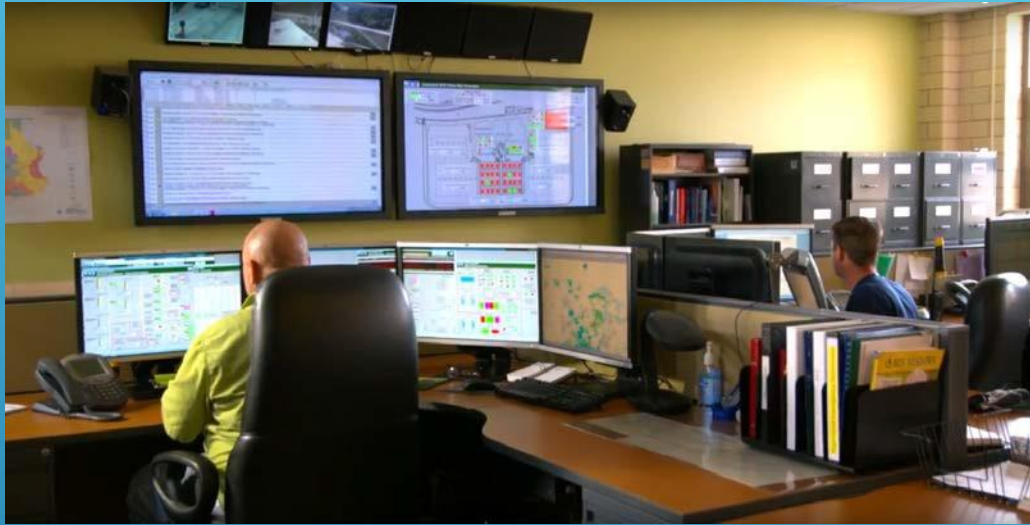
Clearwell Storage Treated water is stored in deep underground tanks and pumped as needed through the distribution system.

Corrosion Control A phosphorous compound is added to help control corrosion of pipes. This helps prevent lead and copper from leaching from plumbing into the water.

Chloramine Protection Ammonia changes the chlorine to chloramine, a disinfectant that maintains bacteriological protection in the distribution system.

The Milwaukee Water Works is a member of the American Water Works Association, the Association of Metropolitan Water Agencies, the Water Research Foundation, and the Wisconsin Water Association

Control Center



Ozone Disinfection



Filtration



Pumping





WATER QUALITY TESTING

Operate water quality lab for process instrument control, microbiological testing and distribution system testing



TYPICAL VALUES FOR MILWAUKEE WATER

Parameter	Median Value	Range
Alkalinity	103 mg/L as CaCO ₃	97 - 116 mg/L
Hardness, total	135 mg/L	131 – 152 mg/L
Hardness, Calcium	89 mg/L	86 – 96 mg/L
Hardness, Magnesium	46 mg/L	45 – 56 mg/L
Calcium	34 mg/L	34 - 34 mg/L
Magnesium	12 mg/L	12 – 12 mg/L
Sodium	9.45 mg/L	9.30 – 9.60 mg/L
Chloride	14.7 mg/L	Maximum 21.5 mg/L
Sulfate	26.5 mg/L	Maximum 27.0 mg/L
Chlorine	1.54 mg/L	1.30 - 1.84 mg/L
Conductivity	308 uS/cm	288 - 353 uS/cm
Fluoride	0.58 mg/L	0.09 - 0.73 mg/L
Iron	0.123 mg/L	0.119 – 0.126 mg/L
pH	7.64	7.38 – 7.79
Potassium	1.4 mg/L	1.4 – 1.4 mg/L
Temperature	47.3°F	36.3°F – 72.1°F

IMPACTS OF WATER CHEMISTRY

Chlorine and chloramines, both added for disinfection can leave chlorine odors in beers. Easily removed with campden tablets (potassium or sodium metabisulfite) and vigorous boiling.

Sulfate to chloride ratio impacts the impression of hop bitterness to maltiness. Higher sulfate leads to more hop presence, while chloride favors malt. ^a

Hard water contains more calcium and magnesium. Alkaline water contains more carbonates. Hard water favors hops, many of the classic IPAs used very hard and alkaline water. Some of the softest lowest alkalinity water is used in Czech Pils. ^b

Calcium salts can lower mash pH and improve enzyme activity, can also improve yeast flocculation and diacetyl reduction. ^c

Hard waters are also better buffers, resisting acid's impact on pH. Hard water can have pH over 8, soft water can be near 6. Yeast enzymes are most active at pH 5.2 to 5.5. ^{b, c}

Harder, more alkaline water and those higher in chloride can produce a richer mouthfeel. Softer, more acidic water a lighter, crisper beer. ^{b, c}

Carbonates can result in less fermentable wort, unacceptable wort colors and difficulty sparging, proteins and tannins do not separate well in hot and cold breaks ^c

a. <https://beersmith.com/blog/2016/02/11/the-sulfate-to-chloride-ratio-and-beer-bitterness/>

b. <https://beerconnoisseur.com/blogs/hard-or-soft-water-best-brewing-beer>

c. <https://www.montana.edu/barleybreeding/learning-center/brewer-resources/ionic/mineral-impacts.html>

IMPACTS OF WATER CHEMISTRY

Iron can be detrimental to saccharification and produce hazy worts. °

Magnesium can add a sour astringent flavor. °

Phosphates occur in malt husks and from phosphoric acid additions to adjust pH. Often found in commercial brewing wastewaters in high levels. °

Potassium is naturally high in malt. Can taste salty at high concentration, potassium softened water can have this if malt potassium is high °

Silica also occurs in malt husks. High levels can cause slow runoff and haze in beer. Can combine with calcium and magnesium to produce heavy scale in brewing equipment. °

Sodium can round out flavor, enhancing malt sweetness, too much sodium can taste sour and astringent. °

WATER SOFTENERS

Water softeners remove calcium and magnesium ions from water, replacing them with sodium ions. For every calcium or magnesium removed, two sodium ions must be added. Calcium, magnesium and sodium are all positively charged ions. Chloride, carbonate and other negatively charged ions are unaffected by water softeners.

Water chemistry shifts to a very soft, high sodium water that isn't seen in any traditional brewing style. Increased sodium can lead to sour or astringent flavors in the finished beer.

Loss of calcium salts leads to higher mash pH, and decreased enzyme activity. Lack of calcium is detrimental to flocculation and diacetyl production.

Required additions of calcium salts to correct for the softener require knowledge of the starting water profile, which most home brewers using ground water and softeners might not have.

	Hardness, Total	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Colgate (ground)	413	292	65	71	< 41 ^{a,b}	119	54
Softened (calculated)	3	292	2	1	246	119	54

a. <https://pubs.usgs.gov/wsp/1229/report.pdf>

b. <https://cms3.revize.com/revize/waukeshawater/Documents/Water%20Quality/Consumer%20Confidence%20Report/Waukesha/2025/2025%20CCR%20Report%20FINAL%20in%20English.pdf?t=202605051019430&t=202605051019430>

COMPARING BREWING WATER SAMPLES

	Hardness, Total	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee	135	103	34	12	34	15	27
Menomonee Falls (MWW supplied)	155	110	44	13	34 ^a	15	37
Colgate (ground)	413	292	65	71	< 41 ^d	119	54
New Berlin (Willow Creek) (ground)	420	338	102	47	< 41 ^d	48	45
New Berlin (Hillcrest Dr) (ground)	540	440	120	69	< 41 ^d	237	46
Waukegan (Municipal)	136	105	37	13	9 ^b	20	24
Ice Mountain (Bottled)	139	98	38	12	20 ^c	21	27
Distilled (Grocery)	3.8	8	0.7	0.6	0	.8	.7
Mequon	170	160	31	26	< 41 ^d	5	49
Mequon (Softened)	3	162	2	1	-	5	45
Mequon (RO)	4	16	0	1	-	1	2

- a. <http://www.menomonee-falls.org/DocumentCenter/View/9682/2017-CCR-Surface-Water?bidid=>
- b. <https://www.waukeganil.gov/555/Reports>
- c. <http://www.evart.org/doc/2016%20City%20of%20Evart%20Consumer%20Confidence%20Report.pdf>
- d. <https://pubs.usgs.gov/wsp/1229/report.pdf>

Preparing Brewing Water

Its important to note that many breweries treat their water before brewing. The water profiles for a particular city may not represent what the brewery is using.

Many brewers use reverse osmosis to strip salts and create a blank slate for their water. Using Milwaukee water as a start many traditional water profiles can be achieved, while some will be impossible without additional treatment. ^a

In the Milwaukee area the treatment processes can vary, a few brewers shared their processes.

Amorphic runs through a particulate filter, carbon filter and then make salt additions. They stated that they try to make water profiles that don't exist anywhere to get the flavors and mouthfeel they want. Also stated they don't need to use reverse osmosis like they would if they were in the western suburbs. ^b

Gathering Place removes the water ions to build water that matches traditional European water. ^c

Third Space runs through a carbon filter, adjusts pH and makes minor salt additions. Kevin Wright said that Milwaukee water is great for making beer. ^b

Vennture Brewing runs through a carbon filter, adjusts pH and makes minor salt additions. Simon McConico said they don't do a lot overall. ^b

a. <https://www.themadfermentationist.com/2010/02/classic-brewing-water-profiles-rant.html-impacts.html>

b. Email communication

c. Based on Google search results, unverified by the brewery

MATCHING A PROFILE – BURTON ON TRENT (Really Close)

	Amount	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee	-	103	34	12	34	15	27
Gypsum (CaSO ₄)	17 g	-	209	-	-	-	500
Table Salt (NaCl)	0 g	-	-	-	-	-	-
Epsom Salt (MgSO ₄)	9.4 g	-	-	49	-	-	194
Calcium Chloride (CaCl ₂)	0.2 g	-	3	-	-	5	-
Baking Soda (NaHCO ₃)	2.7 g	101	-	-	38	-	-
Chalk (CaCO ₃)	2.8 g	89	60	-	-	-	-
Total	-	293	306	61	72	20	721
Target Profile	-	300	295	45	55	25	725
Difference	-	-7	11	16	17	-5	-4

For 5 gallons of water units in mg/L unless otherwise stated.

MATCHING A PROFILE – DUBLIN (Pretty Close)

	Amount	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee	-	103	34	12	34	15	27
Gypsum (CaSO ₄)	1.0 g	-	12	-	-	-	29
Table Salt (NaCl)	0 g	-	-	-	-	-	-
Epsom Salt (MgSO ₄)	0 g	-	-	-	-	-	-
Calcium Chloride (CaCl ₂)	0.2 g	-	3	-	-	5	-
Baking Soda (NaHCO ₃)	0 g	-	-	-	-	-	-
Chalk (CaCO ₃)	3.1 g	98	65	-	-	-	-
Total	-	201	114	12	34	20	56
Target Profile	-	200	115	4	12	19	55
Difference	-	1	-1	8	22	1	1

For 5 gallons of water units in mg/L unless otherwise stated.

MATCHING A PROFILE – MUNICH (Reasonable)

	Amount	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee		103	34	12	34	15	27
Gypsum (CaSO_4)	0 g	-	0	-	-	-	0
Table Salt (NaCl)	0 g	-	-	-	0	0	-
Epsom Salt (MgSO_4)	0 g	-	-	0	-	-	0
Calcium Chloride (CaCl_2)	0 g	-	0	-	-	0	-
Baking Soda (NaHCO_3)	0.1 g	4	-	-	2	-	-
Chalk (CaCO_3)	2.5 g	83	56	-	-	-	-
Total	-	190	90	12	36	15	27
Target Profile	-	200	75	20	10	2	10
Difference	-	-10	15	-8	26	13	17

For 5 gallons of water units in mg/L unless otherwise stated.

MATCHING A PROFILE – PILSEN (Not Possible)

	Amount	Alkalinity, Carbonate	Calcium	Magnesium	Sodium	Chloride	Sulfate
Milwaukee	-	103	34	12	34	15	27
Gypsum (CaSO ₄)	0 g	-	-	-	-	-	-
Table Salt (NaCl)	0 g	-	-	-	-	-	-
Epsom Salt (MgSO ₄)	0 g	-	-	-	-	-	-
Calcium Chloride (CaCl ₂)	0 g	-	-	-	-	-	-
Baking Soda (NaHCO ₃)	0 g	-	-	-	-	-	-
Chalk (CaCO ₃)	0 g	-	-	-	-	-	-
Total	-	103	34	12	34	15	27
Target Profile	-	15	7	2	2	5	5
Difference	-	88	27	10	32	10	22

For 5 gallons of water units in mg/L unless otherwise stated.

EMERGING CONTAMINANTS AND CONCERNS

Wisconsin uses 570,000 tons of road salt annually. ^a A DNR study in the La Crosse area found salt levels had increased from about 10 mg/L to 20 mg/L over the last 40 years. ^b Salinization of water can occur. As discussed, higher chloride favors malty beers.

Milwaukee has around 66,000 lead service laterals to replace, 10,000 laterals have been replaced so far ^c. Lead is controlled through use of orthophosphate. Orthophosphate produces a coating inside pipes. ^d This can also coat brewing equipment. Despite the number of lead services in Milwaukee most lead poisoning is from paint chips.

PFAS, the forever chemicals. Milwaukee has detected PFOS, PFOA as well as a few other compounds at very low levels, ~2 ng/L. This is well below the state of Wisconsin PFAS limits of 70 ng/L for either PFOs, PFOA or the total of both. ^e These limits will be changing in the future. Milwaukee very actively monitors PFAS.

Microplastics, very small plastic fragments, have been found in beer. A study found between 4 and 14 particles of plastic per liter in 12 different beers from breweries using Great Lakes water. The same study found the average seafood consumer ingests about 11,000 particles of plastic a year. ^f

a. <https://infogram.com/road-salt-use-by-state-1h8n6m1971nm6xo>.

b. <https://dnr.wisconsin.gov/sites/default/files/topic/Stormwater/WisconsinStatewideChlorideStrategy.pdf>

c. <https://milwaukeeenns.org/2026/03/15/milwaukee-water-works-to-replace-3800-lead-service-lines-this-year-on-north-and-south-side-is-your-neighborhood-next/>

d. <https://city.milwaukee.gov/water/LeadPipes>

e. <https://dnr.wisconsin.gov/topic/DrinkingWater/NR809.html>

f. <https://www.countryliving.com/uk/create/food-and-drink/a20120213/microplastics-american-beer/>

WATER TESTING

For Milwaukee Water Works customers or those using Milwaukee Water in your community your water is rigorously tested and safe for brewing. More information is available at www.Milwaukee.gov/water.

Some private labs in the area are available for testing, call for available tests and pricing information.

SF Analytical in New Berlin (262) 754-5300

Northern Lake Service in Waukesha (262) 547-3406

Wisconsin State Lab of Hygiene (262) 547-3406

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