



King County

INDUSTRIAL WASTE PROGRAM

*Partnering with Industries
to Prevent Pollution*

Characteristics of Brewery Wastewater and Management Strategies

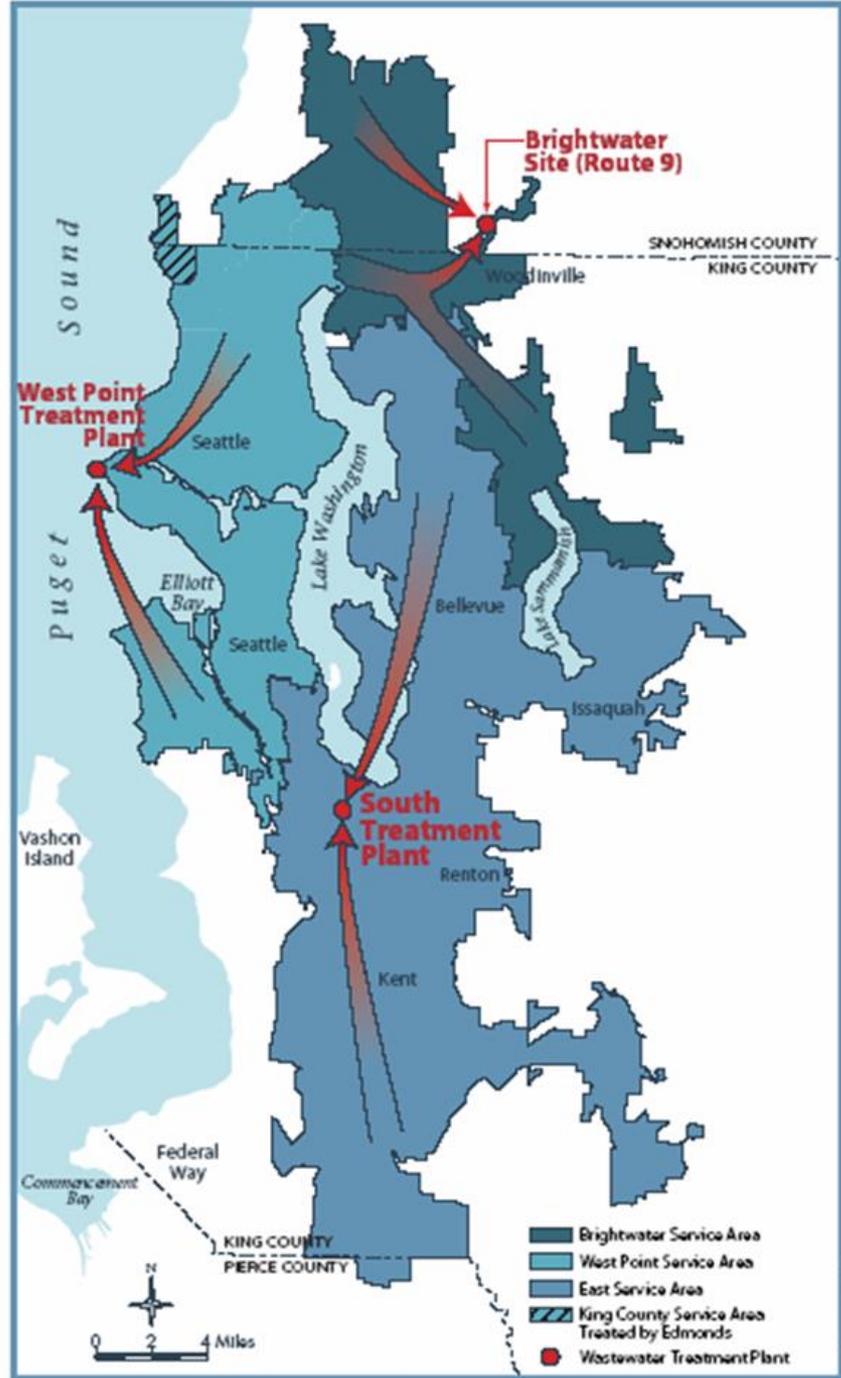
American Water Works Association Pacific
Northwest Section 2019 Conference

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King County Industrial Waste Compliance Investigator

About King County's Wastewater Treatment System

- 1.7 million people over 424 square miles
- About 200 million gallons of wastewater treated every day
- Three regional and two local treatment plants
- 391 miles of pipes
- 34 local sewage agencies
- About 650 businesses approved to send industrial wastewater into the sewer

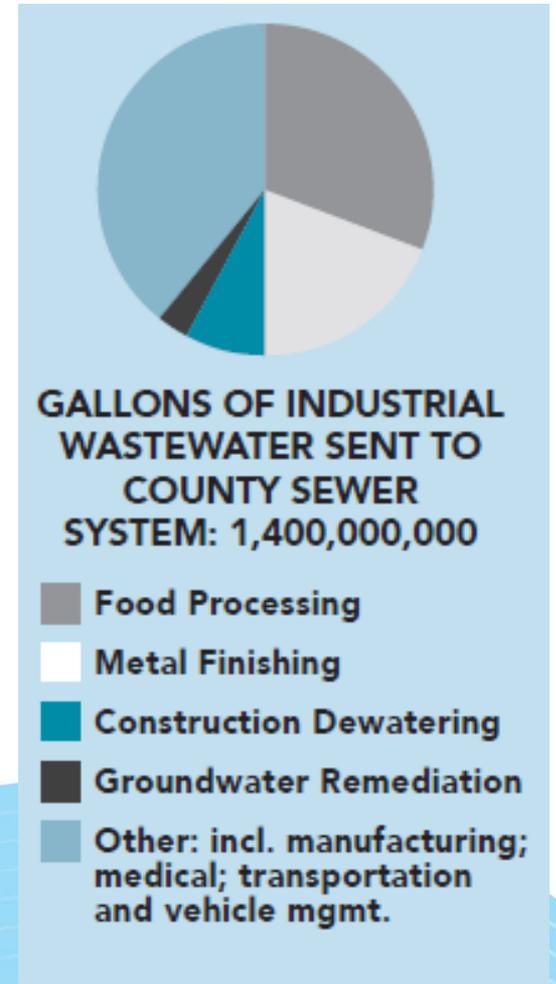




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Working with many types of industries

- Metal finishing / Electroplating
- Pharmaceutical manufacturers
- Can makers
- Iron manufacturing
- Centralized waste treatment
- Food processors
- Contaminated stormwater
- Construction dewatering



The services we provide

- Issue approvals to send treated industrial wastewater to the sewer
- Inspect and monitor the quality of the wastewater coming from businesses
- Provide assistance and incentives to businesses
- Enforce regulations, federal and local limits
- Research new trends and investigate problems



Why do breweries matter?

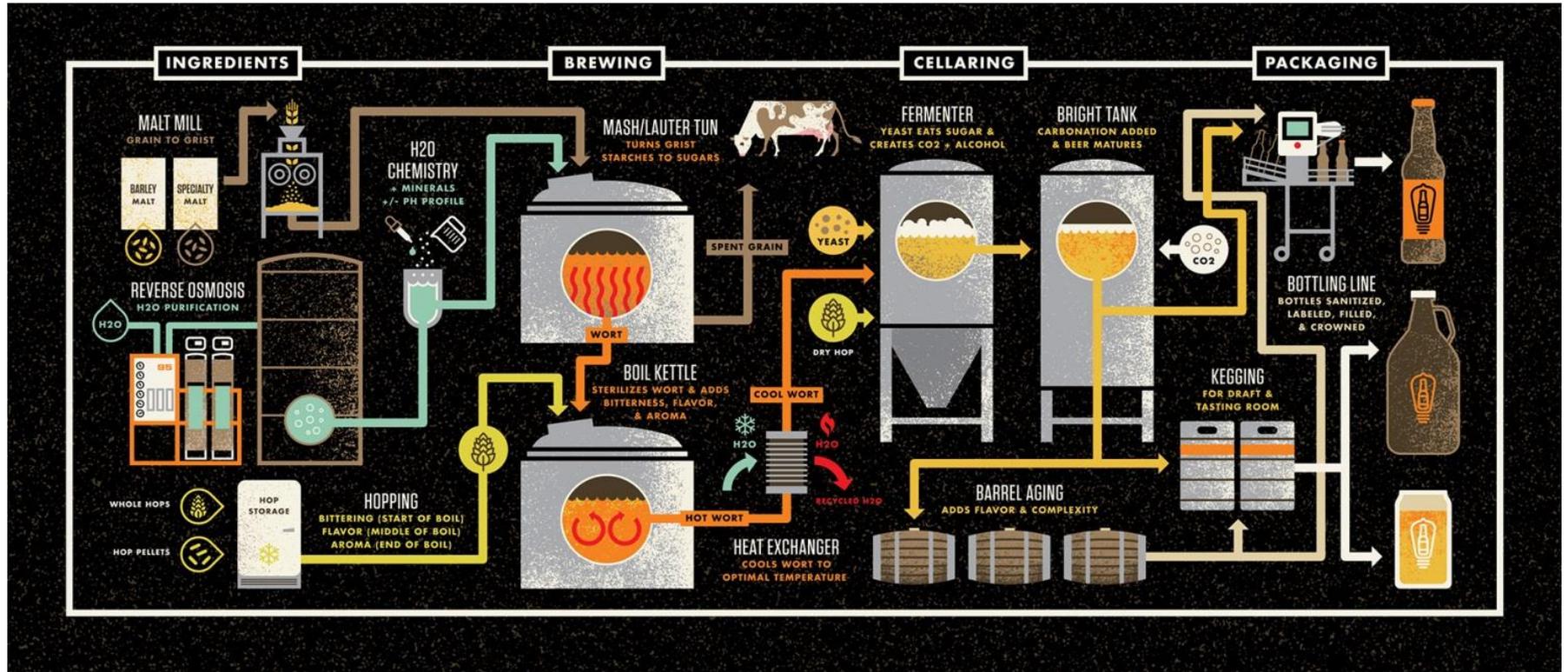
- Rapidly growing industry nationwide
- pH issues
- Solids issues
- High temperature discharges to smaller treatment plants
- BOD/TSS, loading may be a concern for smaller treatment plants.



Brewery Wastewater Characteristics and Sources of Wastewater



Brewing Process



Brewery Wastewater Generation and Characteristics

Main Areas Of Wastewater Generation

| SOURCE | OPERATION | CHARACTERISTICS |
|---------------|--|---|
| Mash Tun | Rinsing | Cellulose, sugars, amino acids. ~3,000 ppm BOD |
| Lauter Tun | Rinsing | Cellulose, sugars, spent grain. SS ~3,000 ppm, BOD ~10,000 ppm |
| Spent Grain | Last running and washing | Cellulose, nitrogenous material. Very high in SS (~30,000 ppm). Up to 100,000 ppm BOD |
| Boil Kettle | Dewatering | Nitrogenous residue. BOD ~2,000 ppm |
| Whirlpool | Rinsing spent hops and hot trub | Proteins, sludge and wort. High in SS (~35,000 ppm). BOD ~85,000 ppm |
| Fermenters | Rinsing | Yeast SS ~6,000 ppm, BOD up to 100,000 ppm |
| Storage tanks | Rinsing | Beer, yeast, protein. High SS (~4,000 ppm). BOD ~80,000 ppm |
| Filtration | Cleaning, start up, end of filtration, leaks during filtration | Excessive SS (up to 60,000 ppm). Beer, yeast, proteins. BOD up to 135,000 ppm |
| Beer spills | Waste, flushing etc | 1,000 ppm BOD |
| Bottle washer | Discharges from bottle washer operation | High pH due to chemical used. Also high SS and BOD, especially thru load of paper pulp. |
| Keg washer | Discharges from keg washing operations | Low in SS (~400 ppm). Higher BOD. |
| Miscellaneous | Discharged cleaning and sanitation materials. Floor washing, flushing water, boiler blow-down etc. | Relatively low on SS and BOD. Problem is pH due to chemicals being used. |

Common wastewater generating processes and effluent characteristics from Breweries
 Taken from Brewers Association Water and Wastewater: Treatment/Volume Reduction Manual

Actual BOD/TSS observed from individual breweries

| <i>Brewery Size</i> | <i>2017 Production in barrels/year</i> | <i>2018 BOD average mg/L</i> | <i>2018 TSS average mg/L</i> | <i>2018 Average discharge rate gpd</i> | <i>2018 Loading lbs/day</i> |
|---------------------|--|------------------------------|------------------------------|--|-----------------------------|
| Small Brewery | 3,590 | 8,663 | 740 | 2,114 | 166 |
| Medium Brewery | 11,274 | 8,831 | 1,437 | 6,385 | 547 |
| Large Brewery | 64,975 | 9,356 | 2,487 | 17,775 | 1,756 |



Estimated Breweries Loadings to Treatment Plants in 2015

| Treatment Plant | Flow from Breweries | BOD Loading from Breweries | TSS Loading from Breweries |
|-----------------|---------------------|----------------------------|----------------------------|
| Brightwater | 0.08 % | 4.79 % | 0.82 % |
| South | 0.00 % | 0.04 % | 0.01 % |
| West Point | 0.02 % | 1.87 % | 0.27 % |

Calculated using 2.5:1 ratio of wastewater to beer. Estimate for all breweries in service area based on production. Historical Average BOD (7,435 mg/L) and TSS (1,124 mg/L) used.

pH of common brewery discharges

- Beer can range 3.0 to 6.0 with the average being 4.0 to 4.5
- CIP Alkaline Cleaners – can be up to 60% NaOH with a pH of 13 when diluted for use
- CIP Acid Rinse (passivation/beer stone removal)- can be 60% nitric acid with a pH of 1.1 when diluted for use
- General sanitizers may be acid based, caustic based, or quaternary ammonium.
- All breweries we have visited have required pH neutralization to meet limits. 5.5 s.u. to 12.0 s.u



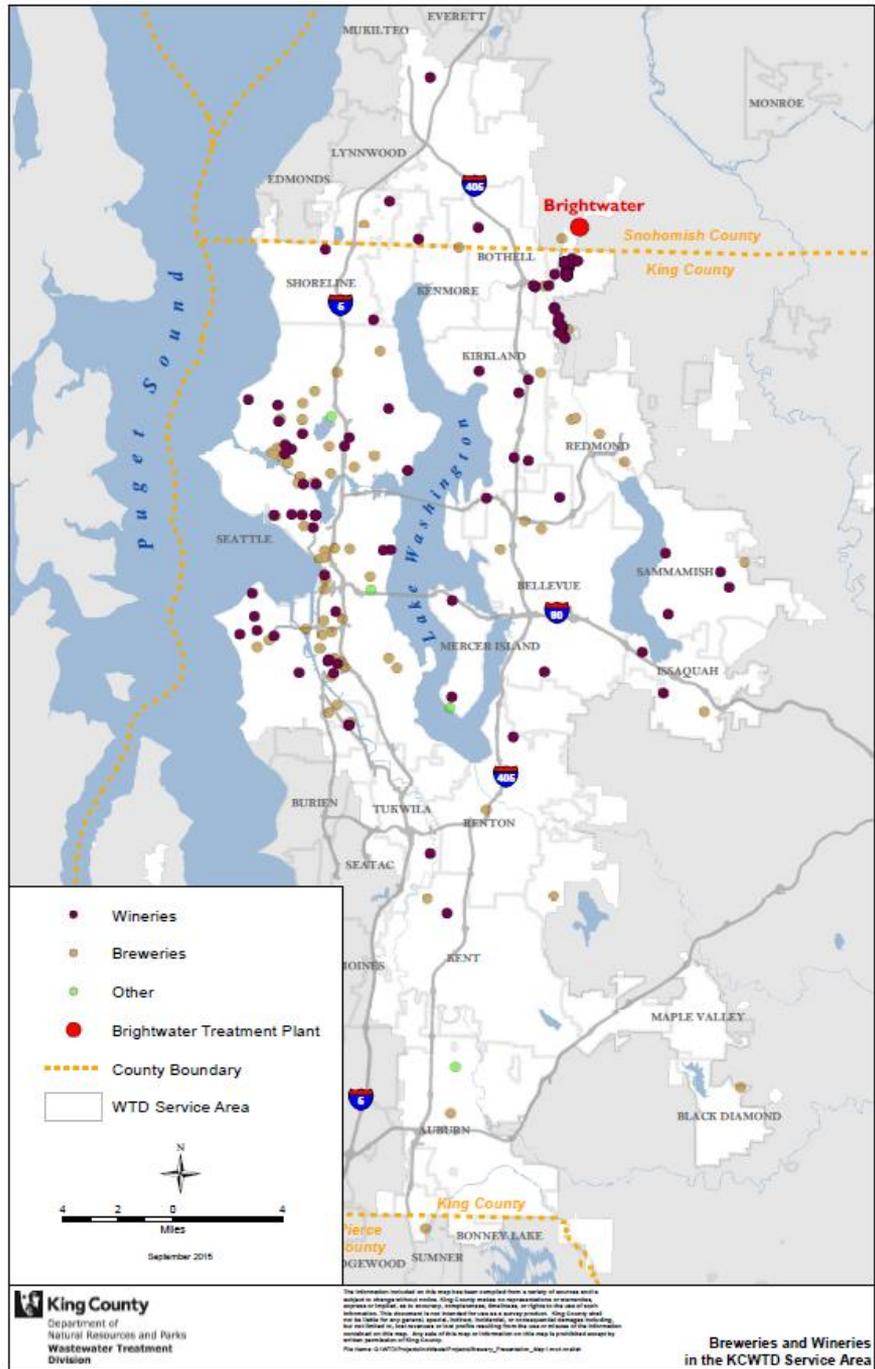
Brewery Management Strategy used by King County Industrial Waste Program



Reality Sinks In

- Large number of breweries in service area
- Many new breweries opening
- Businesses likely not meeting pH limits
- Have to regulate and do so equitably
- Where do we start????





Winery/Brewery Permitting Project

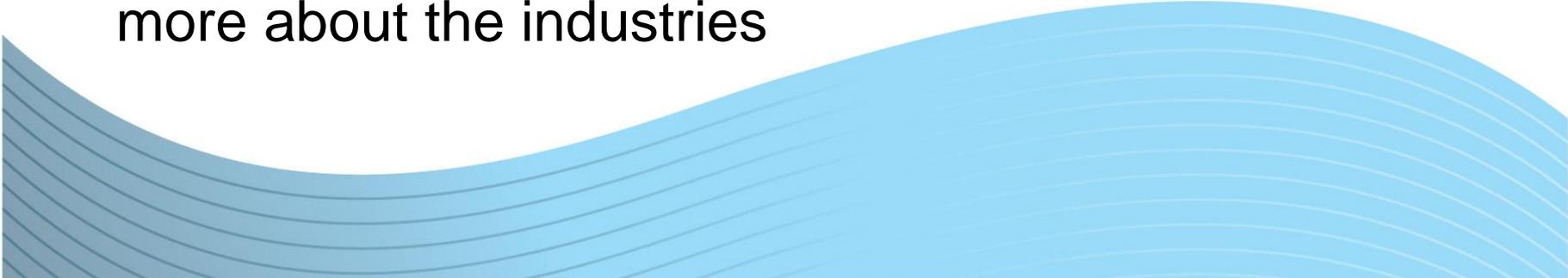


Objectives

- Development of permitting guidelines specific to industrial and commercial wine & beer making businesses located in our service area.
- The guidelines will outline recommended best management practices to be implemented at these businesses.
- Establish minimum production and/or discharge volume based permitting threshold for individual permits



Tasks

- Develop and send IU survey form specific to the winery and Brewery industries
 - Create Breweries and Wineries master lists summarizing company production information learned from surveys
 - Visit facilities to learn about processes and sources of wastewater
 - Using the list of facilities that volunteered to assist us, visit selected wineries / breweries to learn more about the industries
- 

Tasks cont.

- Write a summary of our findings and develop draft permitting guidelines & BMP's for industries
- Solicit comments regarding the draft permitting guidelines & BMP's with industry representatives (focus group of volunteers), all affected known facilities & WA State Wine Commission equivalent Beer Commission (if applicable) & Woodinville Wine Association, LSA's, Ecology
- Draft Proposed permitting guidelines & BMP's



Tasks Cont.

- Public Comment Period
- Update IW Procedures manual
- Update KCIW web site & communicate final policy / BMP's to industry representative
- Send Copy of Final guidelines / BMP's to all affected parties
- Implementation of Permitting policy



pH from cluster of small wineries



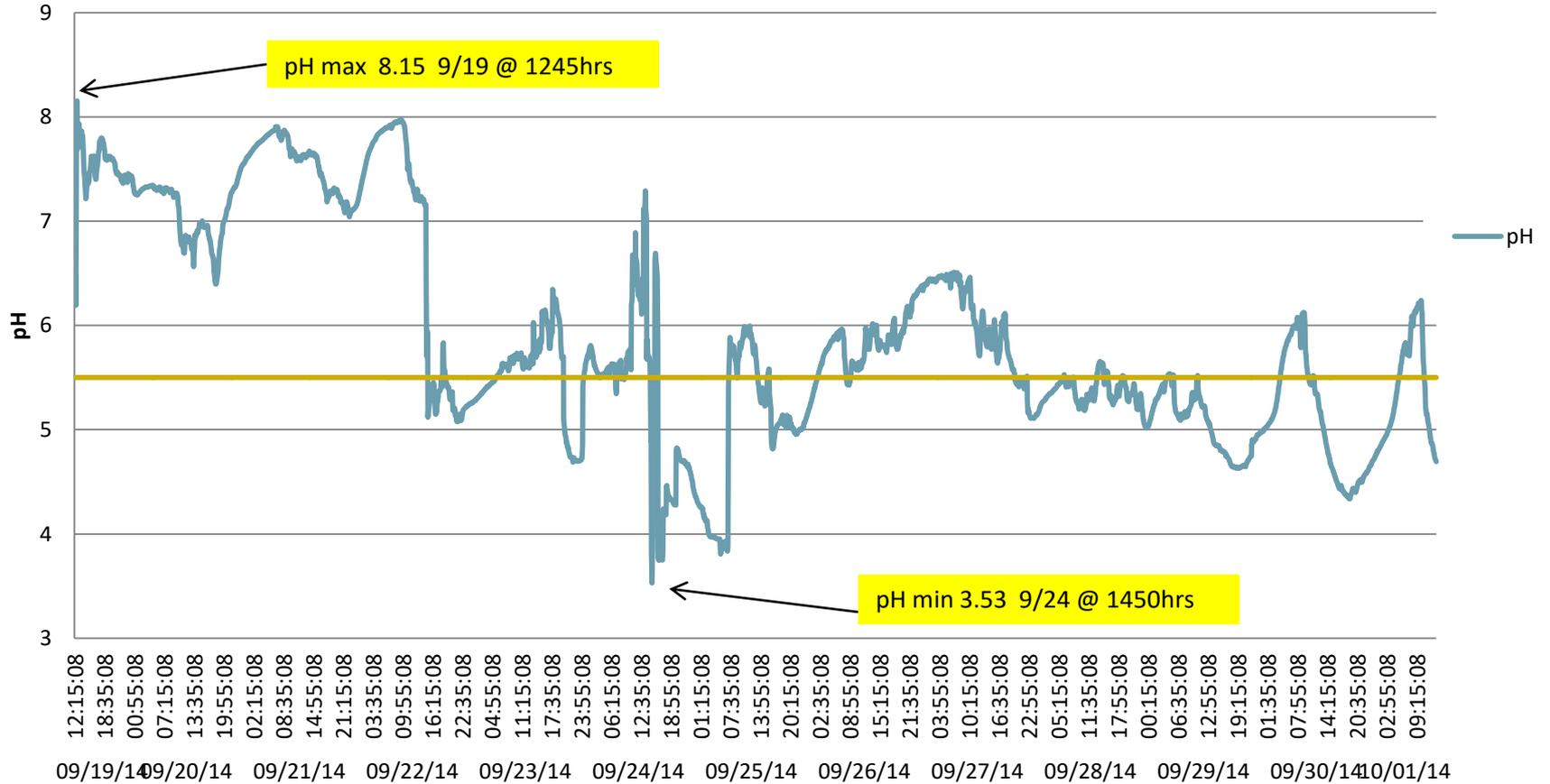
- Concern due to lack of pH adjustment at small wineries.
- YSI Sonde deployed downstream of complex housing numerous small wineries.
- pH measured over the course of one week.

Continuous pH site



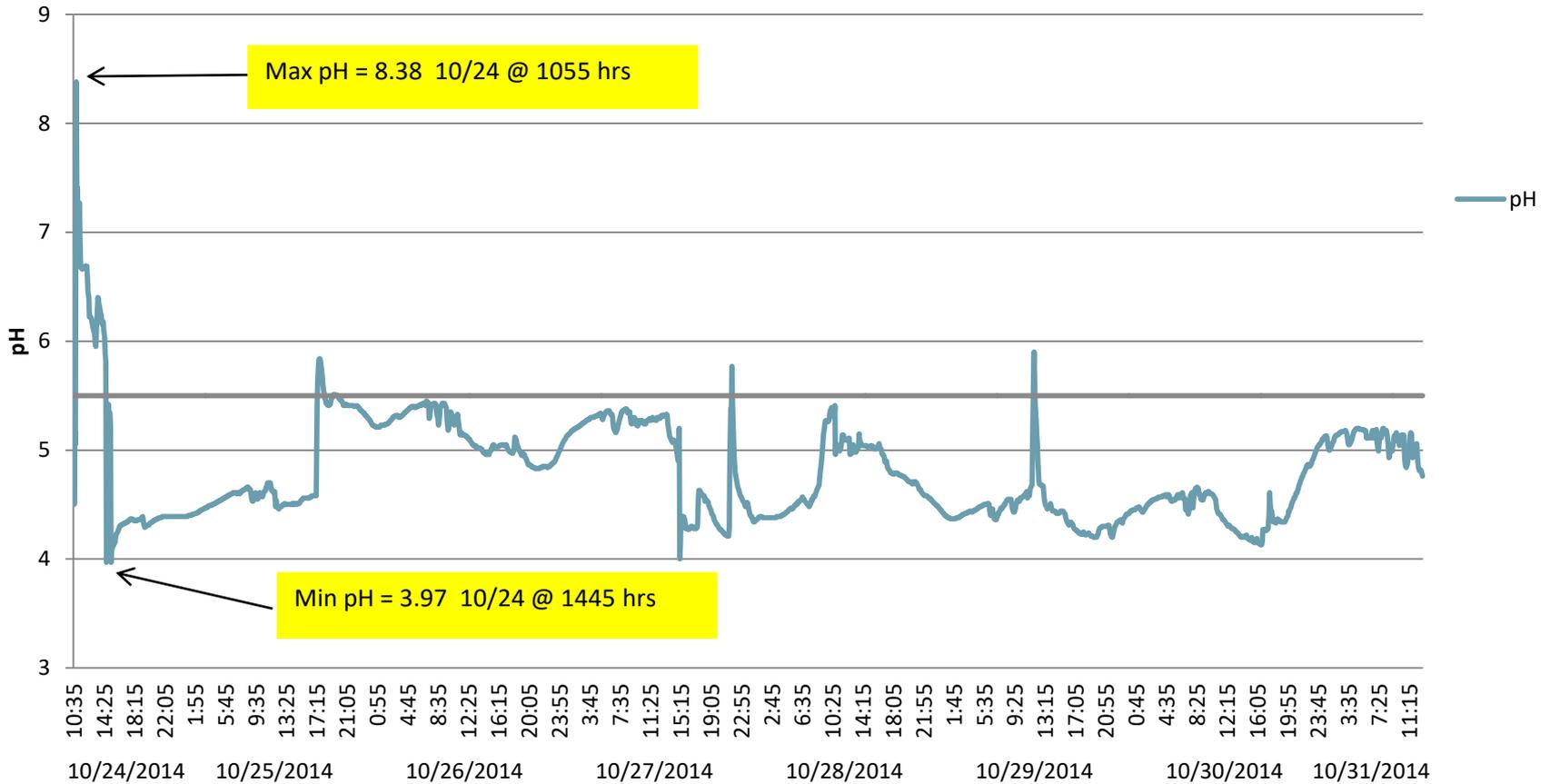
pH Results Round One

Woodinville – A01406



pH Results Round Two

Woodinville - A01406



Winery Survey

WINERIES SUPPLEMENTARY QUESTIONNAIRE

Please complete this industry specific questionnaire and attach it to your completed survey.

Are the following processes or activities performed at your facility?

- | | | |
|---------------------|------------------------------|-----------------------------|
| Grape crushing | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Fermentation | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Barrel cleaning | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Bottling | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Equipment washing | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Barrel aging | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Centrifuge/Decanter | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Others (specify) | _____ | |

Is wastewater generated as a result of this process or activity discharged to the sanitary sewer system

- | | | |
|------------------------------|-----------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |

Do you produce? (check all appropriate boxes) Red Wine White Wine Blush Rosé
 Others (specify): _____

Grape crushing operations are performed Indoors Outdoors NA (no crushing)

Which best describes the size of your operation at this location?

- | | |
|--|--|
| <input type="checkbox"/> Greater than 100,000 cases per year | <input type="checkbox"/> Between 5,000 and 25,000 cases per year |
| <input type="checkbox"/> Between 50,000 and 100,000 cases per year | <input type="checkbox"/> Between 1,000 and 5,000 cases per year |
| <input type="checkbox"/> Between 25,000 and 50,000 cases per year | <input type="checkbox"/> Less than 1,000 cases per year |

Are wines produced at this facility available for purchase & consumption off site? Yes No

Which best management practices or treatment processes are used at your facility to treat waste streams that are then discharged into the sanitary sewer?

- Solids filtration Solids Settling Acid/base neutralization NA – No treatment
 Others (specify): _____

Results from Winery Survey

- **Winery Survey-** 150 surveys sent out
 - 111 surveys returned
 - 2 undeliverable
 - 37 non reply
- **Second Round -** 56 surveys sent out
 - facilities that didn't return survey were mailed a second survey and reminder letter.
 - Surveys were mailed to new facilities not in business during the initial effort
- 29 businesses willing to participate in development of BMPs and permitting guidelines.



Brewery Survey

BREWERIES SUPPLEMENTARY QUESTIONNAIRE

Please complete this industry specific questionnaire and attach it to your completed survey.

Are the following processes or activities performed at your facility?

- | | | |
|----------------------------|------------------------------|-----------------------------|
| Brewing | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Bottling | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Kegging | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Equipment sanitizing | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Production area sanitizing | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Others (specify) _____ | | |

Is wastewater generated as a result of this process or activity discharged to the sanitary sewer system

- | | | |
|------------------------------|-----------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |
| <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> NA |

Specify other disposal: _____

Which best describes the size of your operation?

- Greater than 20,000 barrels per year
- Between 5,000 and 20,000 barrels per year
- Between 2,500 and 5,000 barrels per year
- Between 1,000 and 2,500 barrels per year
- Less than 1,000 barrels per year

Are beers produced at this facility available for purchase & consumption off site?

- Yes No _____

Which treatment processes are present at your facility to treat waste streams that are then discharged into the sanitary sewer?

- Solids filtration Solids settling Acid/base neutralization NA – No treatment
- Others (specify): _____

How do you dispose of the following waste streams?

- | | | | | |
|--------------------|---|---------------------------------------|---|--------------------------------|
| Spent Grain/Barley | <input type="checkbox"/> Solid waste (landfill) | <input type="checkbox"/> Compost/farm | <input type="checkbox"/> Sanitary sewer | <input type="checkbox"/> Other |
| Spent yeast | <input type="checkbox"/> Solid waste (landfill) | <input type="checkbox"/> Compost/farm | <input type="checkbox"/> Sanitary sewer | <input type="checkbox"/> Other |
| Kettle hops/Trub | <input type="checkbox"/> Solid waste (landfill) | <input type="checkbox"/> Compost/farm | <input type="checkbox"/> Sanitary sewer | <input type="checkbox"/> Other |

Describe other wastes disposal methods: _____

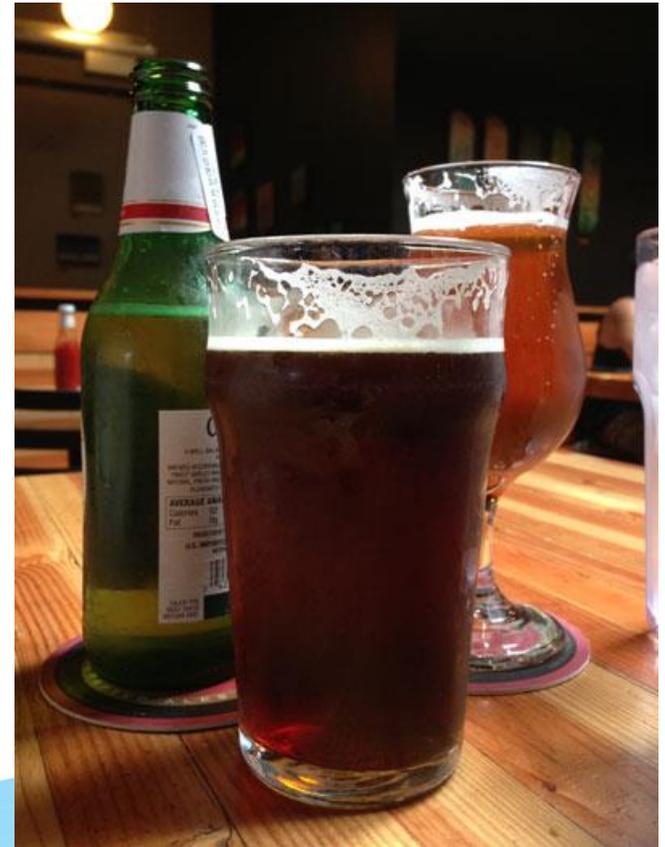
Results from Brewery Survey

- **Brewery Survey** – 67 Surveys sent out
 - 40 surveys returned
 - 7 undeliverable
 - 20 non reply
- **Second Round** – 21 surveys sent out
- 13 businesses willing to participate in development of BMPs and permitting guidelines.



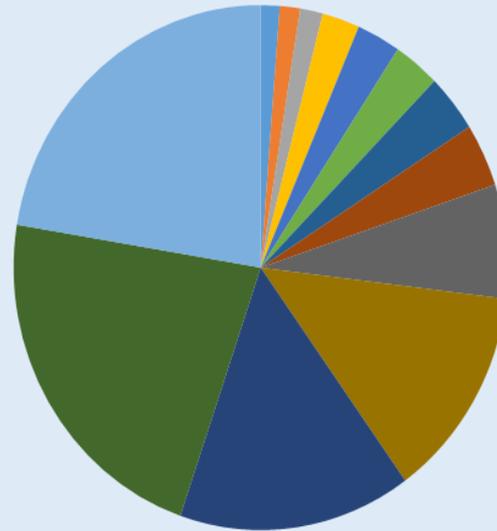
Brewery Permitting

- Requested production data from WSLCB. Required a public records request.
- Looked at brewery production for facilities currently under permit. There was a clear cutoff at 3,000 barrels
- Decided to permit facilities over 3,000 barrels per year or discharging 1,000 gallons per day. (exceptions- Vashon/carnation)
- SIUs will be issued permit, others over 3,000 barrels will be issued brewery specific authorization
- Facilities under 3,000 barrels are required to meet limits. We developed BMPs to help them.



Production of permitted facilities

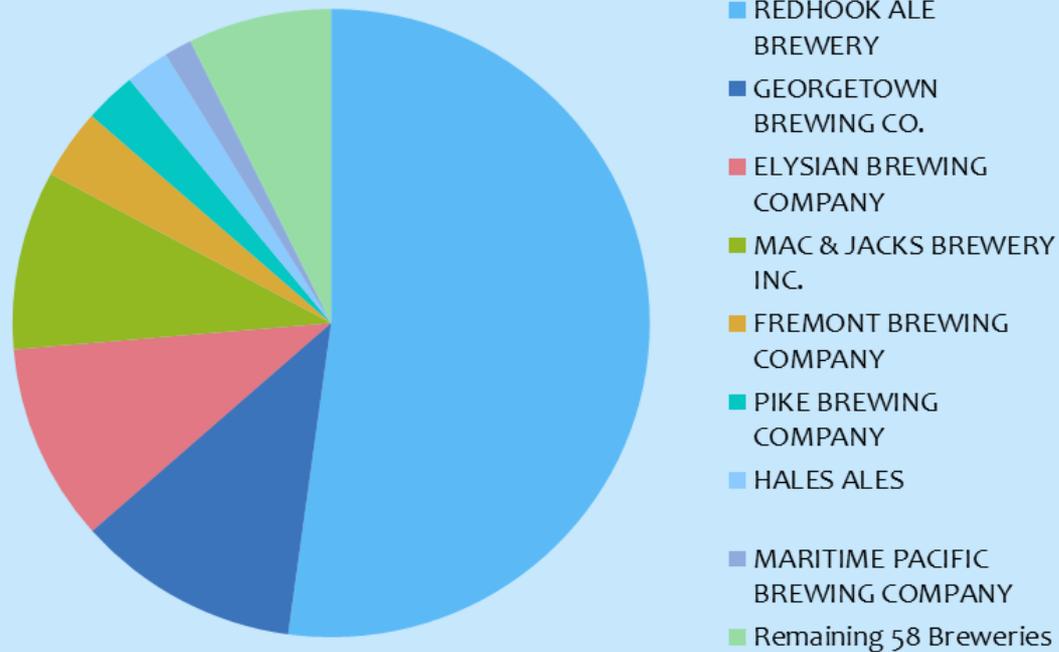
Permitted Breweries Production in Barrels per Year 2017



- | | |
|------------------------------------|--|
| ■ ODIN BREWING COMPANY | ■ STOUP BREWING |
| ■ MARITIME PACIFIC BREWING COMPANY | ■ TWO BEERS BREWING COMPANY |
| ■ REUBENS BREWS | ■ HALES ALES |
| ■ BLACK RAVEN BREWING COMPANY | ■ PIKE BREWING COMPANY AND LIBERTY MALT SUPPLY |
| ■ REDHOOK ALE BREWERY | ■ MAC & JACKS BREWERY INC. |
| ■ FREMONT BREWING COMPANY | ■ ELYSIAN BREWING COMPANY |
| ■ GEORGETOWN BREWING CO. | |

Production can change quickly

Production in barrels from October 2013 to October 2014



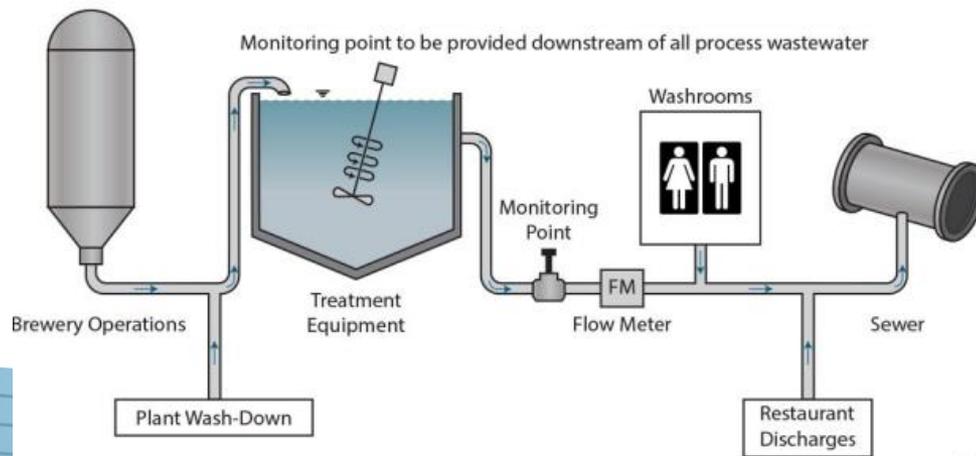
Brewery Discharge Authorization

- Special conditions specific to breweries
- Requires submittal of plans for flow measurement, treatment system, and monitoring point.
- Prohibits discharge of grains and yeast. Requires screening and sump/settling tank management.
- Prohibits bad batch discharge without prior approval and surcharge worksheet.
- Prohibits sanitary wastewater entry prior to monitoring point.



BMPs – Pretreating Brewery Wastewater

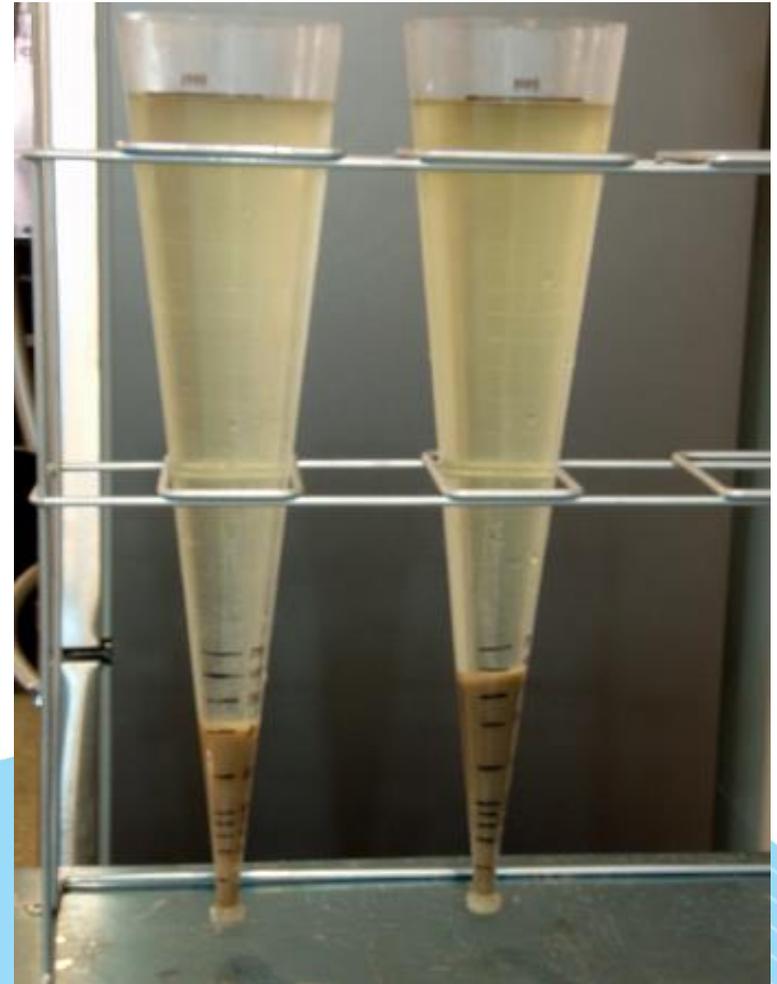
- Looked at several different municipalities. Decided on requirements:
- All facilities are required to meet discharge limits.
- If necessary apply for discharge authorization and install sample site:



Scale: NTS

King County Local Limits

- pH of 5.5 to 12 may go between 5.0 and 5.5 for less than 15 min.
- Settleable Solids less than 7.0 ml/L.
- Temperature at connection to POTW less than 150°F.
- No limits on BOD/TSS, but recover surcharge.



BMPs for Solids

- Prevent spent yeast, grains, hops, and trub from entering the sewer. Collect them from all filters, mashtuns, whirlpools, and kettles by settling, straining, screening or filtering them. Prevent them from entering the sanitary sewer.
- Collect spent yeast slurry for offsite disposal or beneficial reuse. If possible reuse the yeast for multiple generations. This is important because spent yeast slurry from fermentation / maturation tanks has high nutrient and high solids content. Large quantities of yeast lead to organic acids formation, which affects the pH (makes the effluent more acidic).



BMPs for Solids Cont.

- Use the correct gauge screen to maximize solids removal and install screens that are easy to access and service.
- Dewater collected solids and dispose off-site. Consider beneficial reuse.
- Collect used filter media (e.g. diatomaceous earth) and dispose off-site or consider beneficial reuse.
- Control solids at the source; don't let the solids hit the ground, sweep up and collect spills, and avoid rinsing them down the drain.
- Train employees on solids management practice
- Install screens, filters or baskets on all floor drains and trenches to capture solids.



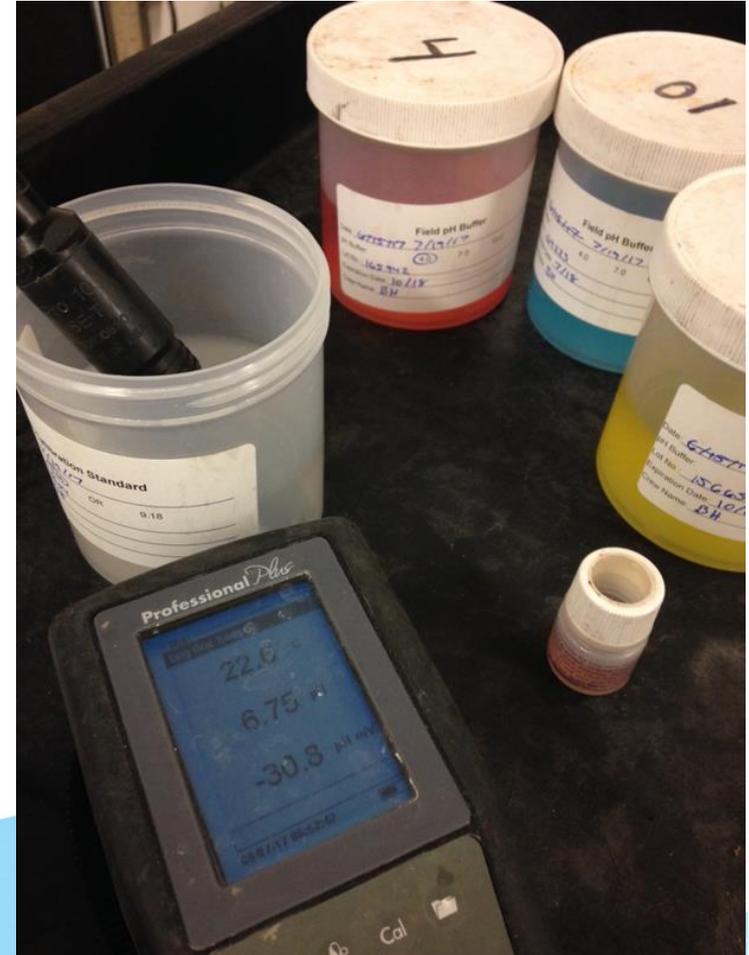
BMPs for pH Control

- Install totes, tanks or containers to adjust the pH of individual waste streams.
- Install a sufficiently sized tank to collect wastewater from all brewery operations for the purpose of self neutralization and if necessary to adjust the pH to meet these limits.
- For small batches with slight excursions above pH 12, mild acids such as acetic acid (i.e., vinegar) or citric acid can be used to neutralize the wastewater.
- For small batches with slight excursions below pH 5.5, mild alkaline solutions, such as calcium carbonate (lime) can be used to neutralize the wastewater.



BMPs for pH Control

- Stronger acidic or alkaline neutralization chemicals may be needed based on the pH of the effluent and the volume of the wastewater to be neutralized.
- Provide a mechanical mixer in the wastewater tank to promote self-neutralizing of low and high pH wastewaters. Please note that adequate mixing is essential when using neutralizing chemicals.
- Reuse and recycle chemicals wherever possible through automated approaches (e.g., clean in place).
- Train employees on effluent pH management practices.



Other BMPs

- **Offspec product:** high strength and low pH best to dispose offsite
- **Chemical storage:** Store chemicals properly to minimize chance of spills
- **Records:** Keep all disposal records and monitoring for three years – per KC Code
- **Planning for new remodel operation:** don't forget to plan around wastewater
- **Water conservation:** measure and minimize use

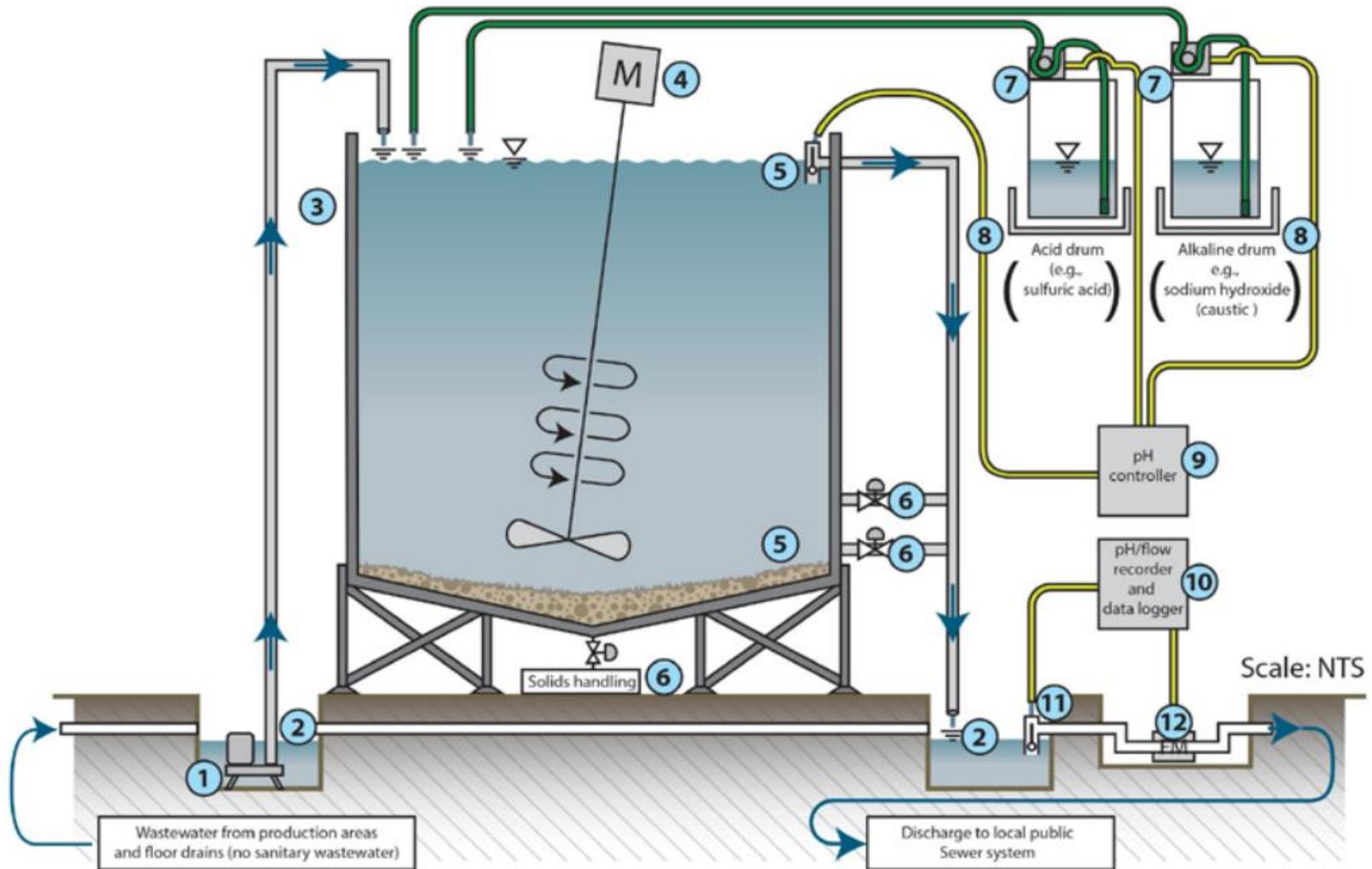


Wastewater Pretreatment

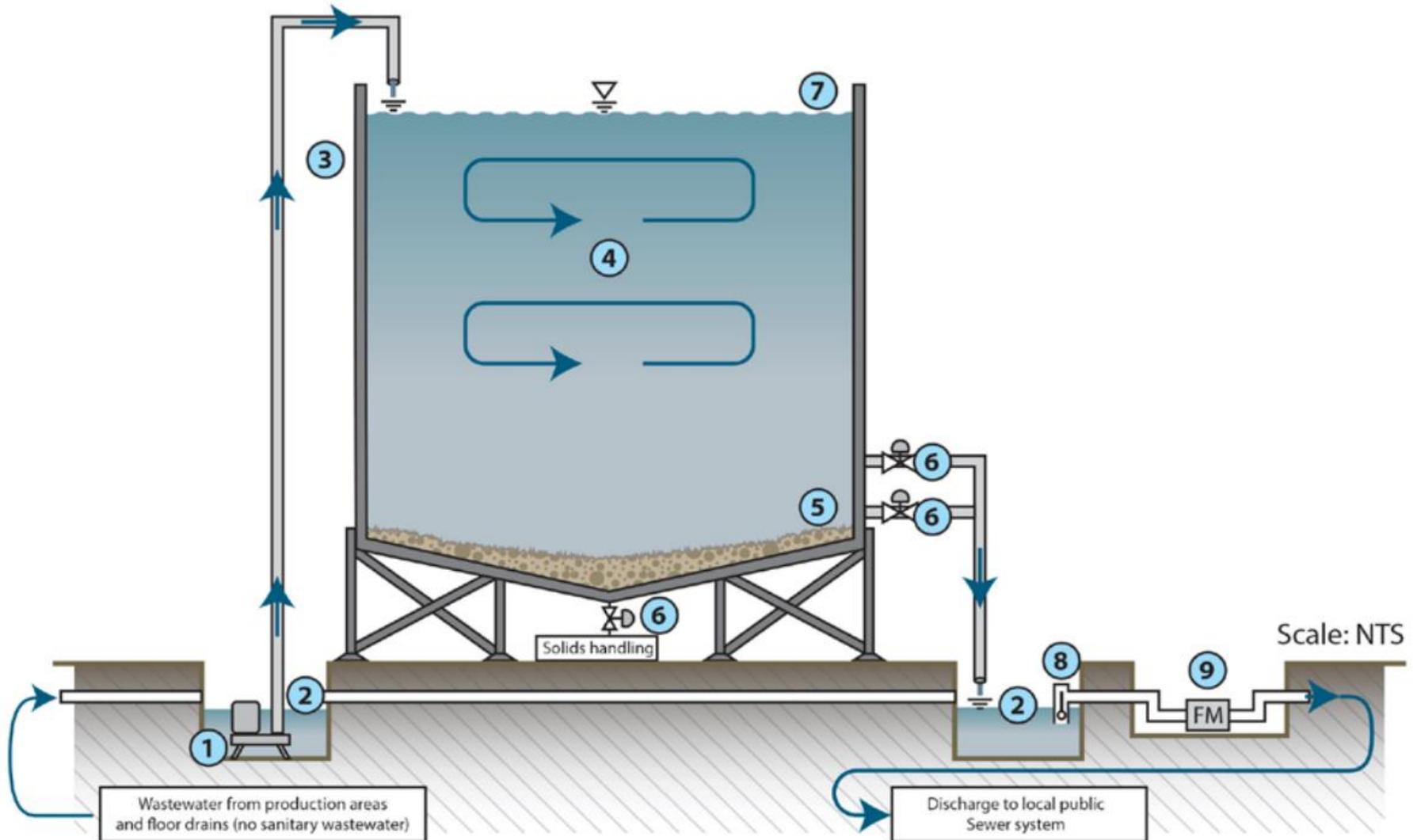
- Our program is non-prescriptive. We generally require the submittal of plans for approval.
- Two types of systems: flow through and batch treatment.
- Basic systems that include pH neutralization and solids settling.



Brewery Wastewater BMP Guidance - Example pH Neutralization Schematic - Flow-Through or Multiple Batch



Brewery Wastewater BMP Guidance - Example pH Neutralization Schematic - Single Daily Batch



Challenges

- Breweries that were in existence prior to rule development or have production increase to over 3,000 barrels/year. Most need extensive plumbing work.
- Finding breweries – WSLCB public records request data is from previous year.
- Outreach – what is the best way to get information to breweries?
- How to handle cideries?



Next Steps

- Develop permitting guidelines and BMPs for wineries
- Seasonal in nature
- Coop – many share equipment
- Variances between companies – red vs. white, crush on site vs. purchase processed.



Questions?



Industrial Waste Program

Working cooperatively with businesses to protect people, the environment, and the economy since 1969.

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