☞ 11hr_AC-NR_ab0023_pt02

☞

(FORM UPDATED: 08/11/2010)

WISCONSIN STATE LEGISLATURE ...
PUBLIC HEARING - COMMITTEE RECORDS

2011-12

(session year)

Assembly

(Assembly, Senate or Joint)

Committee on Natural Resources...

COMMITTEE NOTICES ...

- Committee Reports ... **CR**
- Executive Sessions ... **ES**
- Public Hearings ... **PH**

INFORMATION COLLECTED BY COMMITTEE FOR AND AGAINST PROPOSAL

- Appointments ... **Appt** (w/Record of Comm. Proceedings)
- Clearinghouse Rules ... **CRule** (w/Record of Comm. Proceedings)
- Hearing Records ... bills and resolutions (w/Record of Comm. Proceedings)
  (**ab** = Assembly Bill) (**ar** = Assembly Resolution) (**ajr** = Assembly Joint Resolution)
  (**sb** = Senate Bill) (**sr** = Senate Resolution) (**sjr** = Senate Joint Resolution)
- Miscellaneous ... **Misc**

* Contents organized for archiving by: Stefanie Rose (LRB) (August 2013)

Testimony of Madeline Gotkowitz regarding SB19 and AB23 (to prohibit DNR from requiring a municipal water system to provide continuous disinfection of the water that it provides, unless continuous disinfection is required under federal law.)

March 30, 2011

Good morning. My name is Madeline Gotkowitz. I am a hydrogeologist with the Wisconsin Geological and Natural History Survey, UW-Extension. I hold a Master of Science degree in Hydrology and have over 15 years of professional experience in Wisconsin's groundwater quality issues. I am a member of the City of Madison Water Utility Board, but I am speaking on my own behalf today.

I am strongly against the bill to prohibit requirement of continuous disinfection of municipal water supplies. I urge you not to approve it on the basis that disinfection of drinking water is one of the most successful advancements in public health in the history of human civilization.

Why does groundwater pumped from wells require disinfection prior to human consumption? *Because sanitary sewer pipes leak, sending raw sewage seeping into the ground* (Osenbruck et al., 2007). The sewage travels remarkably quickly, reaching water supply wells in time periods of less than two years (Borchardt et al., 2004). Why does sewage leaked from pipes travel towards wells? Because when a pump is switched on in a well, the withdrawal of groundwater lowers the water pressure in and around the well. Groundwater, including that contaminated with raw sewage, moves along pressure gradients *from* areas of high pressure (at the top of the "water table", the saturated portion of the subsurface) *to* areas of low pressure (wells with operating pumps).

Groundwater pumped from wells should be disinfected prior to human consumption to avoid human consumption of water containing diluted raw sewage. Why are municipal water supplies particularly susceptible to contamination by raw sewage? Because Wisconsin's towns and villages have sanitary sewers in close proximity to their water supply wells.

Why do tests for pathogenic bacteria routinely carried out by all municipal water utilities not detect the presence of dilute raw sewage in pumped water? Because some *viruses* are not detected by tests designed to enumerate *bacteria*. Testing for viruses is difficult and time-consuming (Lambertini et al., 2008). Until the testing becomes easier and cheaper, it is *not feasible* for water utility operators to routinely perform these tests. However, *every well I have tested for such viruses has at some point in time been virus positive* (Borchardt et al., 2007; Bradbury et al., 2010).

Will water taste differently following disinfection? Yes, if chlorination is the selected treatment option. What are the primary responsibilities of a municipal water utility? 1) Provide sufficient water for fire protection and 2) provide safe drinking water.

Will water utility operators receive phone calls from customers dis-satisfied with a change in taste? Maybe. Feel free to give them my phone number—I am good at explaining the consequences of consuming drinking water tainted by raw sewage.

What about consumers and utility managers concerned about the long-term health risk associated with trihalomethanes (these are by-products of chlorine disinfection)? All utilities that disinfect are required to do so at levels that result in disinfection by-products at or below regulatory standards. These standards are based on long-term human health risks. So, *disinfection avoids acute gastro-intestinal illness, which is a much more serious threat to citizens than the very small risk related to low levels of disinfection by-products in drinking water.* Although the concept of relative risk is not particularly complicated, it is not widely explained to water customers. Let's not confuse ignorance with irrelevance: please understand that *voting against this bill favors supplying safe drinking water to all of Wisconsin's citizens.*

I am happy to respond to any questions you may have.

References

Lambertini E., Spencer S.K., Bertz P.D., Loge F.J., Kieke B.A. and Borchardt M.A. 2008. Concentration of enteroviruses, adenoviruses, and noroviruses from drinking water with glass wool filters. *Applied and Environmental Microbiology* 74:2990-2996.

Borchardt, M.A., Bradbury, K.R., Gotkowitz, M.B., Cherry, J.A. and Parker, B.L., 2007. Human enteric viruses in groundwater from a confined bedrock aquifer. Environmental Science & Technology, 41: 6606-6612.

Borchardt, M.A., Haas, N.L. and Hunt, R.J., 2004. Vulnerability of Drinking-Water Wells in La Crosse, Wisconsin, to Enteric-Virus Contamination from Surface Water Contributions. Applied and Environmental Microbiology, 70(10): 5937-5946.

Bradbury, K.R., Borchardt, M.A., Gotkowitz, M.B. and Spencer, S.K., 2010. Human viruses as tracers of wastewater pathways into deep municipal wells, Wisconsin Geological and Natural History Survey Open File Report 2010-04. Available at http://www.uwex.edu/wgnhs/wofrs/WOFR2010-04a.pdf

Osenbrück, K., et al. (2007), Sources and transport of selected organic micropollutants in urban groundwater underlying the city of Halle (Saale), Germany, Water Research, 41, 3259-3270.

WISCONSIN STATE LEGISLATURE

MEMORANDUM

AYRES ASSOCIATES

To: Legislative Review Committee

From: Sarah Nunn

Date: March 30, 2011 Project No.:

Re: Water System Chlorination

The Wisconsin Department of Natural Resources has recent passed changes to NR 811 that require that "all municipal water systems shall provide continuous disinfection of the water prior to entry to the distribution system." Communities were given 3 years or until December 2013 to comply with this requirement. The City of Cumberland does not continually chlorinate at this time, but has standby chemical feed equipment available in case of an emergency. My purpose today is to explain the engineering and financial implications of the rule on Cumberland's municipal water system. At this point, we expect the implementation of the rule would result in a 20% increase in Cumberland's water system budget.

Cumberland's system is composed of four wells and one water tower. In 2009, the wells pumped approximately 179,500,000 gallons of water. The average daily pumping was approximately 255,800 gallons November through May and approximately 984,400 gallons June through October. While some seasonal fluctuations occur, most of the four-fold increase in water use during summer can be attributed to increased water use by Seneca Foods Corporation's green bean canning factory in the City.

Three of the City's four municipal wells have manganese levels that exceed the secondary containment level established by NR 809. According to NR 809, these levels of manganese are not hazardous but may be objectionable to the public. If the water is chlorinated, the manganese would become oxidized, which can cause brownish-black staining. The oxidized particles may also settle out in the distribution system piping, which can restrict flow through the pipes and plug water services. If the City of Cumberland were to continually chlorinate its water, it is my opinion that a phosphate would need to be added to sequester the manganese, leaving it suspended in the water.

An assessment of each existing well station was completed. It is my opinion that three well stations are not large enough to incorporate chemical feed equipment for both sodium hypochlorite and polyphosphate. Piping alterations could be completed in one of these three to provide additional floor space. The other two buildings would most likely require building additions to comply with the proposed code. Existing piping in the well stations would need to be altered to provide proper injection of the chemicals and location of sample taps. Some alterations might be achieved by reorienting the pipes in the building; others may require exterior piping alterations.

At each well station, separate chemical feed systems will be needed for sodium hypochlorite and polyphosphate. The NR 811 rule directs that each chemical feed system should be composed of a pump, scale, day tank, storage tank, chemical containment, and injector. In my opinion, other improvements will be required, including installation of a safety shower/eyewash station, controls upgrades, and plumbing alterations.

Based on these equipment and building modifications, it is estimated that the capital cost to implement continual chlorination at each of Cumberland's four well stations will be between $40,000 and $60,000. Additional equipment such as chemical transfer pumps, a chlorine analyzer, and SCADA reprogramming may be required to aid in operation of the water system. Additional laboratory testing will most likely be required by the DNR. Accounting for these costs, plus engineering fees, increases the capital cost of continual chlorination for the City of Cumberland to approximately $211,300.

Operational costs such as labor, chemical usage, and electrical consumption also need to be considered, along with day-to-day maintenance and replacement costs. Because the operator currently visits each well station daily, day-to-day operations should not require considerable amounts of additional time. However, approximately once every two weeks, chemicals will need to be transferred from the storage tanks into the day tanks on the scale. Using an estimated time of 30 minutes at each well station, this increased labor time is approximately 52 hours per year, or $1,820.

Chemical costs were estimated using a dosage rate of 1 ppm sodium hypochlorite to maintain a systemwide residual and 7 ppm LPC-5 polyphosphate as recommended by Hawkins Chemical. Based on approximate costs from Hawkins Chemical and 2009 average pumping rates, it is estimated that chemical costs for the City of Cumberland would be approximately $22,000 per year.

Electrical costs to operate a chemical feed system are relatively minimal in comparison to the cost of operating the well pump and are believed to be less than $100 per year per well station.

Finally, the annual replacement cost of each piece of equipment was estimated by dividing the estimated capital cost by the life expectancy. This resulted in an annual replacement budget of approximately $870 per well station.

Based on these calculations, total operation and maintenance expenditures are estimated to be an additional $27,475 per year.

During the public hearing prior to the new code being implemented, the Department stated that they would allow alternate forms of disinfection, including the use of UV. The code language specifically states that a chlorine residual must be maintained in the distribution system. Thus, the previously mentioned chemical feed equipment and expenditures would be necessary even if UV was utilized making installation of UV disinfection not economical.

According to the Public Service Commission Annual Report for the City of Cumberland, the operating expenditures for the water utility in 2009 were $199,064, excluding taxes and depreciation. If the City receives a Safe Drinking Water Program Loan at the current interest rate of 2.2% for the total estimated capital cost of $211,300, yearly payments would be approximately $13,070. Including an annual O&M budget increase of approximately $27,475, future expenditures can be expected to rise by at least $40,545 per year -- about 20% -- due to the installation of chemical feed equipment.

The current revenue generated by the water utility does not appear to be adequate to offset these additional costs. If a rate increase of greater than 3% is needed, as it appears to be, the City would be required to file a rate case with the PSC, creating even more costs for the City.

WISCONSIN STATE LEGISLATURE

ERIK SEVERSON
STATE REPRESENTATIVE • 28TH ASSEMBLY DISTRICT

Testimony on Assembly Bill 23
Assembly Committee on Natural Resources
March 30, 2011

I would like to thank Chairman Mursau and the members of the committee for holding a hearing on Assembly Bill 23. Also I would like to thank Senator Harsdorf for her testimony as well.

The purpose of this bill is to prohibit the Department of Natural Resources (DNR) from mandating the continuous disinfection of municipal water supplies. While the intent of this rule is to increase public safety, people throughout my district view this as another unfunded mandate coming from Madison. Given the current economic outlook for most local municipalities, now is not the time to force them to spend more money.

This rule goes above and beyond federal regulations, and comes in spite of the fact that people in these local communities have not experienced any negative effects due to their quality of water. In my district alone there are nine municipalities that will be affected by this unfunded mandate.

Certainly if a community decides they would like to continuously disinfect their water supply, they are free to do so. But we need to let our local communities make that decision and to budget and plan for these changes. Not simply mandating from Madison how they should spend their limited resources, which are only getting tighter during these tough economic times.

According to the Fiscal Estimate prepared by the DNR, this will save local communities a combined upfront cost of $634,800, which is at a modest estimate of 10,000 per well. Now is not the time to tie up the hands of our local communities with unfunded mandates.

Capitol Office: Post Office Box 8953 • Madison, WI 53708-8953 • (608) 267-2365 • Toll-Free: (888) 529-0028 • Fax: (608) 282-3628
Home: (715) 755-4857 • Rep.Severson@legis.wi.gov


FORWARD
E PLURIBUS UNUM

122 W. Washington Avenue
Suite 300
Madison, Wisconsin 53703-2715

608/267-2380
800/991-5502
Fax: 608/267-0645

E-mail: league@lwm-info.org
www.lwm-info.org

To: Assembly Committee on Natural Resources

From: Curt Witynski, Assistant Director, League of Wisconsin Municipalities

Date: March 30, 2011

Re: AB 23, Repealing Mandatory Continuous Disinfection of Municipal Water Systems Served by Groundwater

The League of Wisconsin Municipalities supports AB 23 and the proposed amendment to the bill.

DNR recently promulgated NR 810.09(2), a rule requiring municipal drinking water systems served by groundwater to provide continuous disinfection of the water that they provide, beginning no later than December 1, 2013.

AB 23 prohibits DNR from requiring a municipal water system served by groundwater to provide continuous disinfection of the water that it provides, unless continuous disinfection is required under federal law or unless water quality data indicates a potential health hazard.

We opposed the mandatory disinfection rule when it was promulgated because it would apply even if tests consistently show no bacterial or viral contamination of the water supply. The mandate would apply even if, historically, the community's water was colorless, great tasting, and free of bacterial or viral contamination.

The Department passed the rule despite the fact that federal rules do not require continuous disinfection of groundwater systems. Moreover, none of our neighboring states, except Illinois, require mandatory disinfection of municipal water systems served by groundwater.

The mandatory disinfection rule will require 71 municipal water systems that do not currently disinfect to do so. According to department estimates, complying with the mandatory disinfection rule will force these 71 communities to spend at least $700,000 towards new equipment and other one-time costs. Annual costs for these 71 systems will increase by $40,000.

The burden of paying these additional costs will fall on municipal water customers, who very likely are already paying higher property taxes, stormwater utility fees, and sewer charges. The mandated additional costs could not come at a worse time for these communities which are facing shared revenue cuts and are barely beginning to recover from the worst economic downturn since the Great Depression.

Municipal governing bodies and utility commissions are in the best position to weigh the health benefits gained against the cost, impact on taste, and potential risks of continuously chlorinating the water supply. Absent specific evidence that a municipal water system is vulnerable to bacterial or viral contamination, the decision to continuously disinfect should remain a local decision.

We urge you to recommend passage of AB 23 as amended by Senate Amendment 1.

Thanks for considering our comments.

WISCONSIN STATE LEGISLATURE

Process
Research
Solutions,
LLC

Chemical Engineering/
Software Development

State Representative Jeff Mursau
PO Box 8953
Madison, WI 53708

April 9, 2011

Re: AB 23—Disinfection of municipal water supplies

Dear Representative Mursau,

Thank you for the opportunity to provide additional information about disinfection of drinking water regarding Assembly Bill 23 (and Senate Bill 19).

I want to present my perspective of the need for water system disinfection based on 17 years as a water treatment process design engineer plus 14 years as a drinking water quality investigator.

Role of Non-pathogenic Microorganisms In Water Distribution Systems

The issue of disinfection is more complex than just preventing human illness directly caused by microorganisms. There are many types of microorganisms that live in water systems, some cause human illness (pathogenic) while many other types do not (non-pathogenic). It is the role of these non-pathogenic microorganisms in drinking water systems that I am most concerned about because the problems are widespread and many times misinterpreted.

I first became aware of the microbiological factor in 2002 when I investigated the cause of pinhole leaks in copper water service lines in Brown Deer, Wisconsin. Brown Deer had experienced a major change in water chemistry that tipped the balance toward greater growth of microorganisms. The water system also historically did not have an adequate disinfection dosage, with many areas receiving no disinfection. These factors allowed populations of microorganisms to increase and create biofilms on pipe walls.

Biofilms are colonies of microorganisms that attach to water pipe walls and encase themselves in a protective enzyme secretion. Once the biofilms are established, even disinfection chemicals have difficulty in penetrating them. It is the enzymes in the biofilms that create an acidic environment and corrode the metal pipe and piping components.

608-233-3911
P.O. Box 5593
Madison, WI 53705
www.processresearch.net
acantor@processresearch.net

In the case of Brown Deer, the corrosive activity created small holes in the copper pipes leading to income loss to the utility from lost water and major loss of public and private property. The problem was remedied by efficient flushing of water mains and boosting disinfection concentrations throughout the distribution system.

Since that project, I always look for a microbiological factor in any water quality problem. Based on my water quality investigations in municipal drinking water systems of all sizes, in privately-owned water systems, and in large and small buildings connected to municipal water systems, I have found that, in most cases, elevated copper concentration in drinking water and small holes in copper pipes are caused by microbiological activity. In some cases, increased iron and lead concentrations can also be found as a result of the microbiological activity. The remedy is always cleaning and disinfection and keeping an appropriate continuous disinfection residual to prevent the problem from re-occurring.

Increased concentrations of metals in water stain sinks, laundry, and even hair. Increased copper levels can cause gastrointestinal upsets and other flu-like symptoms as well as liver and kidney damage. The Federal drinking water Maximum Contaminant Level Goal for copper is 1300 parts per billion; this is a non-enforceable standard. Increased lead levels can cause damage to the brain, kidneys, nervous system, red blood cells, and reproductive system. The Federal Maximum Contaminant Level Goal for lead is 0 parts per billion; this is a non-enforceable standard.

Unfortunately, some types of biofilms that have been established in buildings are not easily removed because they resist disinfection chemicals and the interior of the pipes cannot be physically cleaned. With these situations, I use a strategy of continuous low potable dosages of disinfection to kill off the biofilm slowly over time. The plumbing system treatment is similar to treating a chronic disease that will quickly grow worse if the treatment is stopped. I have seen new expensive buildings found to be ruined on their first day of occupancy from this problem. This is to say, once the microorganisms have gotten out of control, it is difficult, if not impossible, to resolve the problem in a building's complex piping system.

In addition to factors from the municipal water system, it should also be mentioned that there are certain modern plumbing design and construction practices that can tip the microbiological growth balance. This has become a widespread problem and is typically misunderstood. I am in the process of communicating this information to contractor associations so that contractors can do their part to prevent the biofilm problem from occurring in buildings. However, a municipal water utility is responsible for delivering safe water up to each building connected to the distribution system. In any investigation of a building's water quality problem, I first look to see if the municipal water utility is providing adequately disinfected water. If it is not, I typically can show the utility management that the problem is more widespread than the one building that is under investigation.

To summarize, microorganisms, prevalent in water distribution systems, secrete acidic enzymes that can cause corrosion of metals such as copper, iron, and lead. The corrosion increases the concentration of these metals in the water that consumers drink, possibly causing health effects. The corrosion can proceed to holes in metal pipe. These pinhole leaks in pipes increase unaccounted for water loss with its loss of income for the water utility and can possibly create liability issues for a water utility in terms of private property water damage.

Role of Pathogenic Microorganisms in Water Distribution Systems

The historical reason that the water industry added disinfection was to prevent waterborne illness. The Total Coliform Rule of the Federal drinking water regulations uses a test for coliform bacteria as an indicator of the presence of pathogenic bacteria. The regulation requires sampling sites throughout a water distribution system that must be visited once a month and sampled for Total Coliform.

However, there are illnesses caused by bacteria outside of the coliform family, such as cholera. Cryptosporidium are types of protozoa famous for the waterborne illness experienced in the Milwaukee water system in the 1980's. In a 2008 landmark study by Dr. Mark Borchardt on groundwater, viruses were found to be present in groundwater and the cause of a variety of gastrointestinal symptoms in consumers.

To summarize, there are many types of disease-causing microorganisms that can cause illness from drinking water. The Total Coliform test, the only regulatory test for microorganisms performed by water systems, is used as an indicator of the safety of the water. However, just because members of the coliform family are not present in the water does not mean that other types of pathogenic microorganisms are not present. The only defense that modern water systems have for fighting pathogenic microorganisms is to keep a continuous and appropriate disinfection residual in the water.

It Can't Happen in My Water System Syndrome

Some people may feel that the water system is totally safe from intrusion by microorganisms. It may especially be beyond their imagination as to how pathogenic microorganisms from sewage could enter a closed piping system under pressure.

First of all, it starts with the aquifer. Both pathogenic and non-pathogenic microorganisms can be present in the soil that the groundwater flows through. In terms of pathogenic microorganisms from sewage, no one really knows the integrity of the privately-owned sewer lines connecting homes to sewer systems; any leaks lead to the soil and the aquifer.

Next, wells are known to harbor pathogenic and non-pathogenic microorganisms and their biofilms. The water system can be inoculated with the microorganisms from the wells.

There are other avenues of microbiological intrusion into water systems. Contaminants can be sucked into the water system if there is a cross-connection between contaminated water and the water system and no backflow preventer. Any hose in a bucket can be a source of contamination and inoculation of the water system.

There has also been a recent study on the prevalence of negative pressure events in water distribution systems and the fact that contaminants have the opportunity to be sucked through pipe connections into the water system. The research studied the susceptibility of distribution systems to contamination during these localized events and found that the intrusions can and do occur.

Once the microorganisms are in the distribution system, environments conducive to the growth of microorganisms can encourage their growth and establishment of biofilms. An environment that is conducive to the growth of microorganisms is one that has no disinfectant to fight the first microbiological pioneers that show up.

Negative Effects of Disinfecting

Everything in water chemistry and microbiology is a balancing act. There are many different aspects of water quality and all of them are connected together in one way or another. The increase of one chemical to solve one water quality issue may cause a negative side-effect on another water quality issue.

With disinfection, there is the potential of the disinfection chemical reacting with naturally-available carbon compounds in the water and forming carcinogenic disinfection by-products. The by-products are monitored and if they exceed Federal drinking water limits, they must be controlled.

In addition, in water systems with iron and manganese in the source water, the disinfectant, which is an oxidant, will oxidize the iron and manganese. The iron and manganese will precipitate out as solids in the piping system causing other water quality issues that are complex and won't be discussed here. Even without disinfection, the oxidation and precipitation of these metals occurs anyway in the distribution system to varying degrees; it will just happen faster and closer to the well house with chlorine added. Depending on the initial concentrations of iron and manganese, the metals may need to be removed from the water. This brings up more decisions that must be made on behalf of water quality. A traditional technique of dealing with high iron and manganese concentrations is to add polyphosphate to hold iron and manganese in solution. There are many problems associated with this method. They are:

- The phosphorus in the chemical can be used for food for microorganisms and it becomes harder to fight the growth of microorganisms with this growth enhancer in the water.
- The polyphosphate dissolves and holds other metals besides iron and manganese, including lead and copper. This can affect compliance with the Lead and Copper Rule.
- The polyphosphate can break apart into smaller pieces depending on factors in the water system environment and drop all of the metals that were being held.

Because of the uncontrollable factors associated with the chemical, it is better to invest in a physical removal system for iron and manganese. That typically consists of oxidation of the metals with air and/or chlorine and filtration of the solids out of the water.

Cost of Disinfecting

A fiscal estimate was made by the State of Wisconsin to determine the cost of disinfecting but I am not familiar with that type of economic analysis. So, I have translated the same economic assumptions used by the State into a life-cycle cost analysis technique that engineers depend on to make decisions. For the analysis, I assumed a twenty year life of the equipment with a 7% interest rate. Based on the State's assumptions, the capital and operating costs include:

- Annual chemical costs of $145 per month per water system for disinfection
- Cost of disinfection by-product sampling of two samples at $350 per sample every three years per system
- The cost to install the chemical feed equipment at $10,000 per well. For this estimate, assume two wells and then four wells per water system.
- The cost of preliminary monitoring for disinfection by-products at two samples four times a year for the first year at $350 per sample.
- The cost of iron and manganese removal which will vary based on water system size and need. A newspaper article cited a cost estimate for one water system as being $2.9 million dollars. This life cycle cost estimate will use a range of capital costs and include annual operating costs of $10,000 per year for systems serving less than 500 people and $25,000 per year for systems serving greater than 500 people.

These costs, especially for the iron and manganese removal systems, are gross assumptions used here only to demonstrate the cost analysis technique. It is hoped that this analysis will be performed again using realistic costs from vendors and engineers and based on the population served. See the attached sheets for the economic calculations and graphs.

No matter what, the smaller populations will pay more per person than the larger populations. Perhaps, the legislative question is not 'should small water utilities be forced to pay for disinfection' but should be 'how can small water utilities be assisted in paying for disinfection'.

But, the economics of small water utilities does not stop at disinfection; there are many present and future water treatment requirements that will raise the same dilemma of cost for these smaller utilities. The real question is: Should people in small communities have access to water of the same quality as people in larger communities?

Cost of Not Disinfecting

The cost to not disinfect the water is difficult to calculate. The State's Fiscal Estimate states: "The Department is uncertain of the cost to communities should water borne illnesses occur due to a lack of municipal water disinfection."

It may be that no issues will ever arise. It may be that no issues will arise until suddenly one day they do. It may be that some issues are actually occurring now but have not been discovered.

In my water quality investigations, I am called in after a major water quality problem has occurred. It is very expensive to take care of a full blown water quality problem. Costs have included lost revenue from pipe leaks, liability for ruined buildings and personal property, costs of falling out of compliance with Federal drinking water regulations, investigative costs, and remediation costs. It is more cost effective to spend money proactively to prevent water quality problems.

21st Century Drinking Water Issues

I have met people in Wisconsin who seem to be nostalgic for the good old days when you could just drill a well and drink the water. Those days are gone for many reasons:

- We have a larger population desiring the use of the water.
- We have greater drawdowns in the wells because of more water demands and more wells interfering with each other; this changes the water chemistry in the well and adjacent aquifer.
- We have had more years of civilization's interaction with the water supply – more years of sewage leaks and industrial chemical leaks and discharges.
- We have older and dirtier infrastructure in our water systems.
- We are able to measure and identify more contaminants in the water that we were ignorant of in the past.
- We have more scientific knowledge about water and water systems.
- We have more years of experience and mishaps to learn from.

It is not cost effective to use 20th Century techniques to deal with 21st Century problems and we need to figure out a way that even the small water system customers can drink safe water. The disinfection issue is just the tip of the iceberg in terms of water treatment that may be required at small water systems in the future.

Legislative Action

Before moving ahead with AB23 as written, please acquaint yourselves with the issues that surround the need for disinfection as summarized in this letter. There are excellent resources available from the American Water Works Association, the Rural Water Association, the Water Research Foundation, and the Wisconsin Geological and Natural History Survey.

Please gather realistic equipment and operational costs for disinfection equipment and iron/manganese removal equipment from vendors and engineers based on population served. Then, calculate the life-cycle costs for these water systems as demonstrated in this letter. Translate results to cost per year per person served.

If costs per capita for small water systems still remain out of reach, consider what existing financial resources are available to water utilities in terms of low interest loans or grants.

Finally, use the calculated per capita costs and determine if it is worth that amount of money per year as an insurance policy to potentially save one life or one building from ruin.

There are many aspects of water system operation that should not be written into the regulations and should be encouraged as a non-enforceable standard of practice instead. Regulations should be reserved for those basic steps that protect public health and give Americans confidence that they can drink the municipal water in any community. Keeping a continuous and appropriate disinfection concentration throughout a distribution system is the most fundamental of steps to take in providing water that is safe to drink.

As stated before, the real legislative question is: Should people in small communities have access to water of the same quality as people in larger communities?

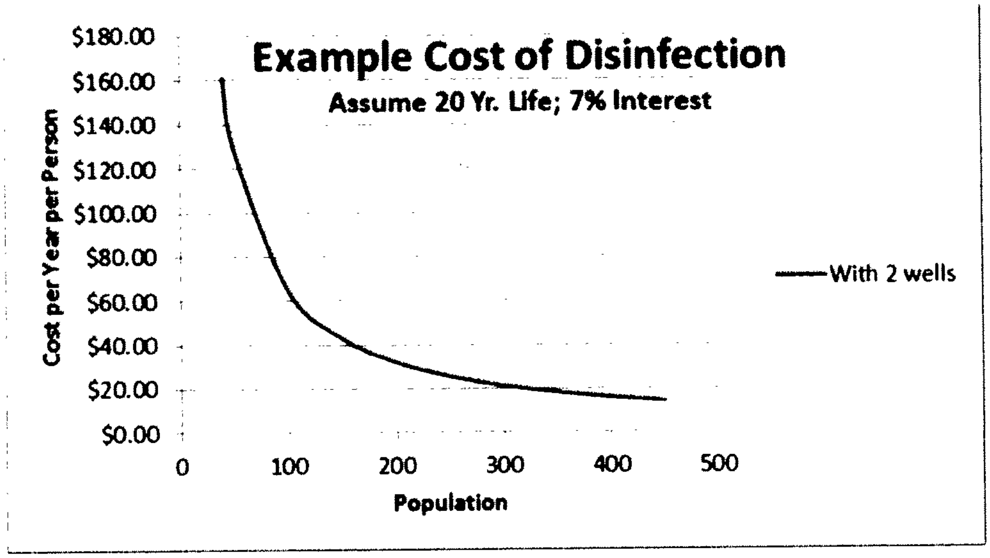
Sincerely,

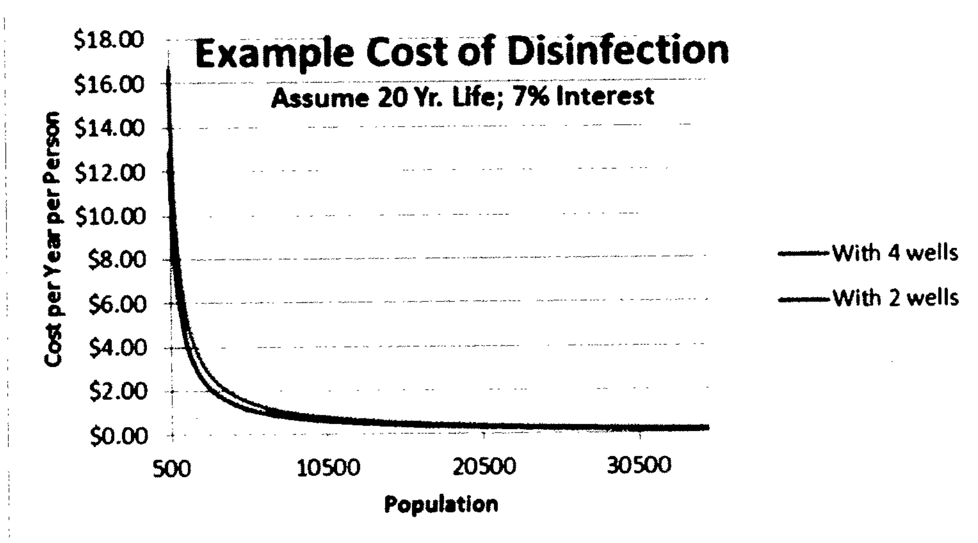
Abigail F Cantor

Process Research Solutions, LLC

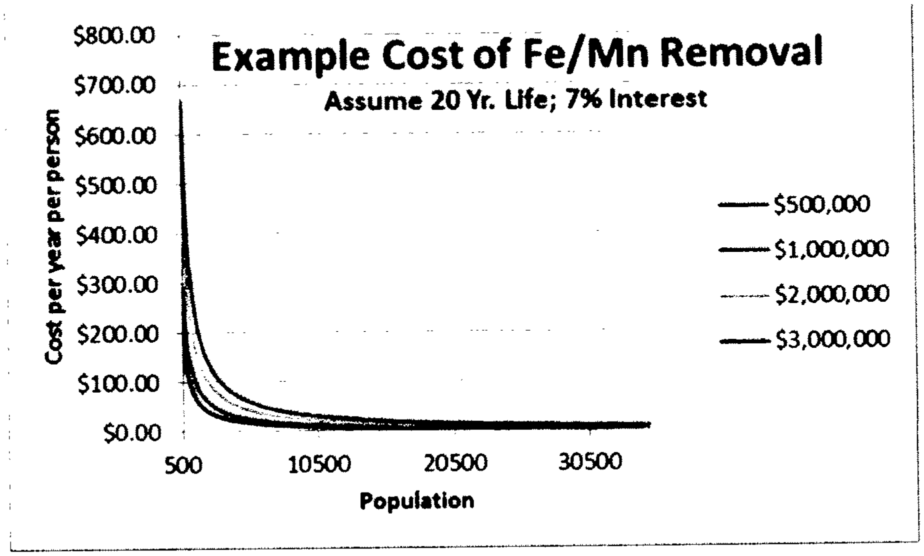
Abigail F. Cantor, P.E.
Chemical Engineer

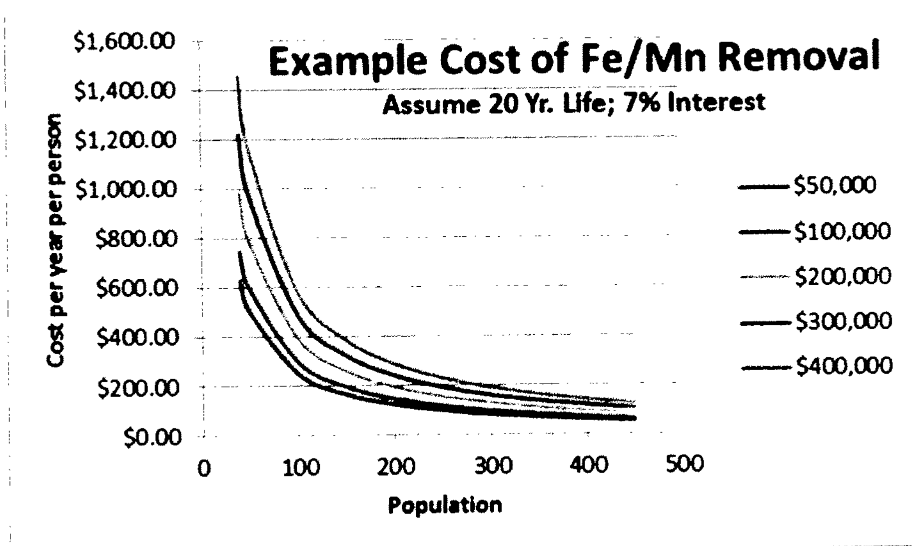
Example Life Cycle Cost Economic Analysis





Example Life Cycle Cost Economic Analysis





Example Life Cycle Cost Economic Analysis

Cost analysis begins with determining the total cost over life of equipment if the capital costs are covered with a loan at a set interest rate.

Economic factors used in this analysis are from *Engineering Economic Analysis*. San Jose: Engineering Press (1977).

Assume 7% interest rate	**Chemical feed equipment**	
Capital cost	$40,000	$20,000
Factor to determine uniform annual cost	0.0944	0.0944
Year 0		
1	$3,776	$1,888
2	$3,776	$1,888
3	$3,776	$1,888
4	$3,776	$1,888
5	$3,776	$1,888
6	$3,776	$1,888
7	$3,776	$1,888
8	$3,776	$1,888
9	$3,776	$1,888
10	$3,776	$1,888
11	$3,776	$1,888
12	$3,776	$1,888
13	$3,776	$1,888
14	$3,776	$1,888
15	$3,776	$1,888
16	$3,776	$1,888
17	$3,776	$1,888
18	$3,776	$1,888
19	$3,776	$1,888
20	$3,776	$1,888
Cost over 20 years	**$75,520**	**$37,760**

Example Life Cycle Cost Economic Analysis

Assume 7% interest rate	Iron and manganese removal system for population 40 to 500				
Capital cost	$50,000	$100,000	$200,000	$300,000	$400,000
Factor to determine uniform annual cost	0.0944	0.0944	0.0944	0.0944	0.0944
Year 0					
1	$4,720	$9,440	$18,880	$28,320	$37,760
2	$4,720	$9,440	$18,880	$28,320	$37,760
3	$4,720	$9,440	$18,880	$28,320	$37,760
4	$4,720	$9,440	$18,880	$28,320	$37,760
5	$4,720	$9,440	$18,880	$28,320	$37,760
6	$4,720	$9,440	$18,880	$28,320	$37,760
7	$4,720	$9,440	$18,880	$28,320	$37,760
8	$4,720	$9,440	$18,880	$28,320	$37,760
9	$4,720	$9,440	$18,880	$28,320	$37,760
10	$4,720	$9,440	$18,880	$28,320	$37,760
11	$4,720	$9,440	$18,880	$28,320	$37,760
12	$4,720	$9,440	$18,880	$28,320	$37,760
13	$4,720	$9,440	$18,880	$28,320	$37,760
14	$4,720	$9,440	$18,880	$28,320	$37,760
15	$4,720	$9,440	$18,880	$28,320	$37,760
16	$4,720	$9,440	$18,880	$28,320	$37,760
17	$4,720	$9,440	$18,880	$28,320	$37,760
18	$4,720	$9,440	$18,880	$28,320	$37,760
19	$4,720	$9,440	$18,880	$28,320	$37,760
20	$4,720	$9,440	$18,880	$28,320	$37,760
Cost over 20 years	**$94,400**	**$188,800**	**$377,600**	**$566,400**	**$755,200**

Example Life Cycle Cost Economic Analysis

Assume 7% interest rate	Iron and manganese removal system for population 500 to 33,000			
Capital cost	$500,000	$1,000,000	$2,000,000	$3,000,000
Factor to determine uniform annual cost	0.0944	0.0944	0.0944	0.0944
Year 0				
1	$47,200	$94,400	$188,800	$283,200
2	$47,200	$94,400	$188,800	$283,200
3	$47,200	$94,400	$188,800	$283,200
4	$47,200	$94,400	$188,800	$283,200
5	$47,200	$94,400	$188,800	$283,200
6	$47,200	$94,400	$188,800	$283,200
7	$47,200	$94,400	$188,800	$283,200
8	$47,200	$94,400	$188,800	$283,200
9	$47,200	$94,400	$188,800	$283,200
10	$47,200	$94,400	$188,800	$283,200
11	$47,200	$94,400	$188,800	$283,200
12	$47,200	$94,400	$188,800	$283,200
13	$47,200	$94,400	$188,800	$283,200
14	$47,200	$94,400	$188,800	$283,200
15	$47,200	$94,400	$188,800	$283,200
16	$47,200	$94,400	$188,800	$283,200
17	$47,200	$94,400	$188,800	$283,200
18	$47,200	$94,400	$188,800	$283,200
19	$47,200	$94,400	$188,800	$283,200
20	$47,200	$94,400	$188,800	$283,200
Cost over 20 years	**$944,000**	**$1,888,000**	**$3,776,000**	**$5,664,000**

Example Life Cycle Cost Economic Analysis

Operating costs are projected into the future over the life of the equipment. A set interest rate is considered because if the money had not been used for operating costs, it could have been invested and earned interest.

Assume 7% interest rate	Annual chemical costs	Preliminary DBP monitoring	Routine DBP monitoring
Factors to project costs into future	40.995	3.87	3.380,2.759,2.252,1.838,1.501,1.225
Year 0			
1	$1,740	$2,800	
2	$1,740		
3	$1,740		$700
4	$1,740		
5	$1,740		
6	$1,740		$700
7	$1,740		
8	$1,740		
9	$1,740		$700
10	$1,740		
11	$1,740		
12	$1,740		$700
13	$1,740		
14	$1,740		
15	$1,740		$700
16	$1,740		
17	$1,740		
18	$1,740		$700
19	$1,740		
20	$1,740		
Cost over 20 years	**$71,331**	**$10,836**	**$9,069**

Example Life Cycle Cost Economic Analysis

Assume 7% interest rate	Annual operating costs for Fe/Mn Removal	
Factors to project costs into future	40.995	40.995
Year 0		
1	$25,000	$10,000
2	$25,000	$10,000
3	$25,000	$10,000
4	$25,000	$10,000
5	$25,000	$10,000
6	$25,000	$10,000
7	$25,000	$10,000
8	$25,000	$10,000
9	$25,000	$10,000
10	$25,000	$10,000
11	$25,000	$10,000
12	$25,000	$10,000
13	$25,000	$10,000
14	$25,000	$10,000
15	$25,000	$10,000
16	$25,000	$10,000
17	$25,000	$10,000
18	$25,000	$10,000
19	$25,000	$10,000
20	$25,000	$10,000
Cost over 20 years	**$1,024,875**	**$409,950**

Example Life Cycle Cost Economic Analysis

Capital and operating costs for disinfection scenarios are calculated for the life of the equipment. The result is divided by the number of years to calculate 'Cost per Year'.

Finally, the Cost per Year is divided by the population served to determine 'Cost per Year per Person'.

	Disinfection assuming 4 wells	**Disinfection assuming 2 wells**
Chemical feed equipment	$75,520	$37,760
Annual chemical costs	$71,331	$71,331
Preliminary DBP monitoring	$10,836	$10,836
Routine DBP monitoring	$9,069	$9,069
Total cost over 20 years	**$166,756**	**$128,996**
Cost per year	**$8,338**	**$6,450**

Population	**With 4 wells**	**With 2 wells**
40	$208.45	$161.25
50	$166.76	$129.00
100	$83.38	$64.50
150	$55.59	$43.00
200	$41.69	$32.25
250	$33.35	$25.80
300	$27.79	$21.50
350	$23.82	$18.43
400	$20.84	$16.12
450	$18.53	$14.33

Example Life Cycle Cost Economic Analysis

Population	With 4 wells	With 2 wells
500	$16.68	$12.90
550	$15.16	$11.73
600	$13.90	$10.75
650	$12.83	$9.92
700	$11.91	$9.21
750	$11.12	$8.60
800	$10.42	$8.06
850	$9.81	$7.59
900	$9.26	$7.17
950	$8.78	$6.79
1000	$8.34	$6.45
1500	$5.56	$4.30
2000	$4.17	$3.22
2500	$3.34	$2.58
3000	$2.78	$2.15
3500	$2.38	$1.84
4000	$2.08	$1.61
4500	$1.85	$1.43
5000	$1.67	$1.29
5500	$1.52	$1.17
6000	$1.39	$1.07
6500	$1.28	$0.99
7000	$1.19	$0.92
7500	$1.11	$0.86
8000	$1.04	$0.81
8500	$0.98	$0.76
9000	$0.93	$0.72
9500	$0.88	$0.68
10000	$0.83	$0.64
15000	$0.56	$0.43
20000	$0.42	$0.32
25000	$0.33	$0.26
30000	$0.28	$0.21
35000	$0.24	$0.18

Example Life Cycle Cost Economic Analysis

Capital and operating costs for iron and manganese removal scenarios are calculated for the life of the equipment.

	Iron and manganese removal system for population 500 to 33,000			
Capital Cost	**$500,000**	**$1,000,000**	**$2,000,000**	**$3,000,000**
Amortized capital cost	$944,000	$1,888,000	$3,776,000	$5,664,000
Operational cost	$1,024,875	$1,024,875	$1,024,875	$1,024,875
Total over 20 years	**$1,968,875**	**$2,912,875**	**$4,800,875**	**$6,688,875**
Cost per year	**$98,444**	**$145,644**	**$240,044**	**$334,444**

	Iron and manganese removal system for population 40 to 500				
Capital Cost	**$50,000**	**$100,000**	**$200,000**	**$300,000**	**$400,000**
Amortized capital cost	$94,400	$188,800	$377,600	$566,400	$755,200
Operational cost	$409,950	$409,950	$409,950	$409,950	$409,950
Total over 20 years	**$504,350**	**$598,750**	**$787,550**	**$976,350**	**$1,165,150**
Cost per year	**$25,218**	**$29,938**	**$39,378**	**$48,818**	**$58,258**

Population	**$50,000**	**$100,000**	**$200,000**	**$300,000**	**$400,000**
40	$630.44	$748.44	$984.44	$1,220.44	$1,456.44
50	$504.35	$598.75	$787.55	$976.35	$1,165.15
100	$252.18	$299.38	$393.78	$488.18	$582.58
150	$168.12	$199.58	$262.52	$325.45	$388.38
200	$126.09	$149.69	$196.89	$244.09	$291.29
250	$100.87	$119.75	$157.51	$195.27	$233.03
300	$84.06	$99.79	$131.26	$162.73	$194.19
350	$72.05	$85.54	$112.51	$139.48	$166.45
400	$63.04	$74.84	$98.44	$122.04	$145.64
450	$56.04	$66.53	$87.51	$108.48	$129.46

Example Life Cycle Cost Economic Analysis

Population	$500,000	$1,000,000	$2,000,000	$3,000,000
500	$196.89	$291.29	$480.09	$668.89
550	$178.99	$264.81	$436.44	$608.08
600	$164.07	$242.74	$400.07	$557.41
650	$151.45	$224.07	$369.30	$514.53
700	$140.63	$208.06	$342.92	$477.78
750	$131.26	$194.19	$320.06	$445.93
800	$123.05	$182.05	$300.05	$418.05
850	$115.82	$171.35	$282.40	$393.46
900	$109.38	$161.83	$266.72	$371.60
950	$103.63	$153.31	$252.68	$352.05
1000	$98.44	$145.64	$240.04	$334.44
1500	$65.63	$97.10	$160.03	$222.96
2000	$49.22	$72.82	$120.02	$167.22
2500	$39.38	$58.26	$96.02	$133.78
3000	$32.81	$48.55	$80.01	$111.48
3500	$28.13	$41.61	$68.58	$95.56
4000	$24.61	$36.41	$60.01	$83.61
4500	$21.88	$32.37	$53.34	$74.32
5000	$19.69	$29.13	$48.01	$66.89
5500	$17.90	$26.48	$43.64	$60.81
6000	$16.41	$24.27	$40.01	$55.74
6500	$15.15	$22.41	$36.93	$51.45
7000	$14.06	$20.81	$34.29	$47.78
7500	$13.13	$19.42	$32.01	$44.59
8000	$12.31	$18.21	$30.01	$41.81
8500	$11.58	$17.13	$28.24	$39.35
9000	$10.94	$16.18	$26.67	$37.16
9500	$10.36	$15.33	$25.27	$35.20
10000	$9.84	$14.56	$24.00	$33.44
15000	$6.56	$9.71	$16.00	$22.30
20000	$4.92	$7.28	$12.00	$16.72
25000	$3.94	$5.83	$9.60	$13.38
30000	$3.28	$4.85	$8.00	$11.15
35000	$2.81	$4.16	$6.86	$9.56