Item 11-1

Report: Consider Prioritization of the Construction of Water Treatment Facilities for the Removal of Iron and Manganese at Well Sites

Legistar No. _____

Date: January 29, 2008

To: Madison Water Utility Board

From: Larry D. Nelson, P.E., Interim Water Utility Manager

1.0 Recommendations.

That Madison Water Utility develop a process, with public imput, for the planning and design of treatment facilities for the removal of iron and manganese at those wells that consistently exceed the US EPA's Secondary Standards for those elements (300 µg/l and 50 µg/l, respectively.)

1.2 That the preliminary timeline and priority of the treatment facilities be as follows:

Unit Well	Construction Year	Mn µg/l	Fe µg/l	Color Calls	Date Drilled	Budgetary Cost**	Comment
UW 29	2008	187	372	6	2002	$2,500,000	Construction 2008/2009
UW 8	2009	49	527	86	1945	$3,000,000	Significant facility rebuild/upgrade needed. Park Land impact.
UW 10	2010	117	780		1951	$3,500,000	Significant facility rebuild/upgrade needed. Hillside construction
UW 7	2011	27	356	92	1939	$3,500,000	Significant facility rebuild/upgrade needed.

** Estimated budgetary costs in 2008 Dollars

1.3 That the cost of construction of treatment facilities be recovered from ratepayers on the basis of volume. The cost of the installation and maintenance at the four sites would add about $0.09/CCF or about $8.10 to the average residential user's annual bill.

1.4 If the construction of filters proceeds, that the Water Utility will continue to evaluate the effectiveness of the iron and manganese treatment and the feasibility of filtering other wells that exceed recommended water quality goals.

2.0 Discussion.

The Madison Water Utility operates twenty-three deep wells providing the City of Madison its drinking water. Four of those wells, UW 7, UW 8, UW 10, and UW 29 have manganese (Mn) and/or iron (Fe) levels in excess of the EPA's National Secondary Drinking Water Standard for Aesthetics (Color, Odor or Taste). The USEPA National Secondary Drinking Water Standard for Iron and Manganese is 300 ug/l and 50 ug/l respectively. These standards are not for public

health impacts but rather for "aesthetic" impacts, such as discolored water and staining of laundry and plumbing fixtures.

Other organizations have suggested lower limits for iron and manganese. In 1962 an article in the AWWA Journal based on an AWWA Task Group study suggested limits of 50 ug/l for iron and 10 ug/l for manganese as an "ideal" water quality goal for public use. Other AWWA publications dating back to the 1980's have recommended that reasonable drinking water quality goals for iron and manganese should be 100 ug/l for iron and 20 ug/l for manganese. Compliance with these standards would require filtration at two additional wells, UW 19 and UW 24. UW 19 serves the West Campus of the University of Wisconsin and was placed in service in 1970. UW 24 on the east isthmus and was placed in service in 1979.

While most of the public discussion and media reports regarding discolored water have focused on manganese, it the belief of the Water Utility Staff that iron is the mineral largely responsible for the colored water complaints in the neighborhoods served by UW 7 and UW 8.

A summary of Madison Water Utility Unit Wells, including the median annual Mn and Fe levels is included as Attachment A. A graph indicating the Mn and Fe levels is included as Attachment A1.

Justification for listing and recommended priority:

- UW 29 – This well was constructed in 2004 and went into operation in July 2005. UW 29 is a critical eastside supply point and it is needed to relieve stress on UW 15 and to provide adequate pressure to completely fill the Felland Road Reservoir. It will provide needed redundancy and reliability to the east side of Madison. Water quality concerns with iron and manganese has limited the use of this well.

  In 2002, the Water Utility drilled a well on the east side of the city to serve new developments adjacent to I39/90 and to provide redundant reliable supply to the northeast corner of the City. Although the original test well did not indicated issues with Mn and Fe, the production well was found to produce water that contained Mn and Fe that was substantially higher than the EPA Secondary Standards. Following a review of the cost benefit and risk of either filtering the water at Well 29 or drilling a new well, the Water Board decided to proceed with filtration. This alternative would have the lowest risk to the Utility.

  The 2007 Capital Budget provided funding for the installation of a filtration system to remove those elements with treatment goals of 10 µg/l for manganese and 100 µg/l for iron. Currently, the Water Utility is in the process of reviewing proposals for the supply of the filtration equipment. Following the selection of the filtration equipment, a building will be designed to house the filtration system at the UW 29 site. It is anticipated that it will be under construction in the summer of 2008 and fully operational by the end of the summer of 2009.

- UW 8 – This 63 year old facility located in Olbrich Park will become a critical East Isthmus supply point and a year round well with the abandonment of Well 3. Significant iron concentrations have resulted in many colored water complaints in the well service area even with frequent flushing. Without filtration, these complaints would dictate that the well operation be reduced. With the difficulty in locating an alternative well site in the urban area, preserving existing well sites is becoming essential to maintaining current levels of service. Following a public information program regarding this proposal, it is proposed to conduct a pilot study to determine treatment feasibility at the well site. It is anticipated that the pilot study will be completed in 2008 and the design and permitting will be completed in 2009 with construction scheduled for 2009/2010.

- UW 10 – Well 10 was constructed in 1951 and has provided drinking water supply to the Nakoma neighborhood for 57 years. With the construction of a new well in pressure zone 7 in the Larkin Street or Whitney Way area and the construction of a pipeline and pumping station to transfer water from Well 18, Well 10 will be used as a seasonal well to meet summer peak demands. Construction costs are significant due to the need to rebuild and upgrade the existing facility to meet current standards for operation and staff safety. A replacement well for Well 10 is identified in the Water Master Plan as Well 46. With the anticipated difficulty in siting a well in this old neighborhood, preserving an existing well site would be in the best interests of the utility. A renovated pump station and reservoir with a filter would provide service to the utility for decades.

  The high levels of Mn at UW 10 have resulted in neighborhood concerns and considerable public discussion. The discussion has been largely unfavorable to the Water Utility Board and staff, as well as the City's elected officials. If UW 10 could be filtered and returned to service, the need for a replacement well, identified as UW 46 on the master plan, could be deferred indefinitely. Furthermore, the need for additional capacity to service the Arbor Hills Neighborhood, which is identified in the capital improvement plan, could also be met.

- UW 7 – This 69 year old facility is located on a small lot in a residential neighborhood along Sherman Avenue. With the construction of a filter at Well 29 and Well 8, Well 7 will become a seasonal well used to provide additional supply during the peak summer months. This well is a critical redundant supply point to the system that supplies Oscar Mayer located on Packers Avenue. High quality water is essential to this major Utility customer. Construction costs are significant due to the need to rebuild and upgrade the existing facility and the need to acquire additional property. It is proposed to totally renovate the facility to bring it up to current standards for operation and staff safety. It is expected that the renovation will provide a facility that will serve the utility for decades to come.

Will flushing water mains address the problem of water quality and colored water?

Since 2005, the Water Utility has adopted an aggressive flushing program to remove accumulated sediments and reduce the levels of Mn and Fe in the pipes that distribute the water from the wells and reservoirs to the customer services. During 2007, the Water Utility expended $419,504 to maintain the flushing program, using both unidirectional and conventional flushing operations.

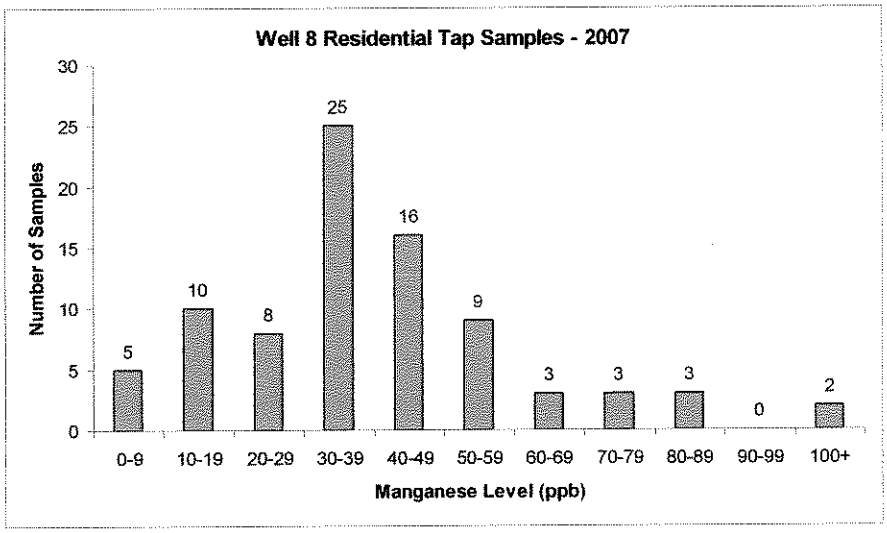
Analyzing the 2007-flushing program, it has become apparent that in areas where wells have significant concentrations of Fe and Mn, flushing only once or twice per year alone will not reduce customer complaints regarding discoloration of the water and problems such as damage to laundered clothing. Sufficient quantities of Mn and Fe are being introduced into the distribution system so that water main breaks, normal maintenance of hydrants and even flushing will result in colored water complaints.

To illustrate this problem, the Water Utility collected 84 residential tap samples from the Well 8 service area during September and October 2007. These samples were tested for manganese and iron. Samples were collected as part of an on-going effort by the utility to better understand and manage the levels of minerals in Madison drinking water. All samples were analyzed at the water quality lab at Public Health – Madison and Dane County.

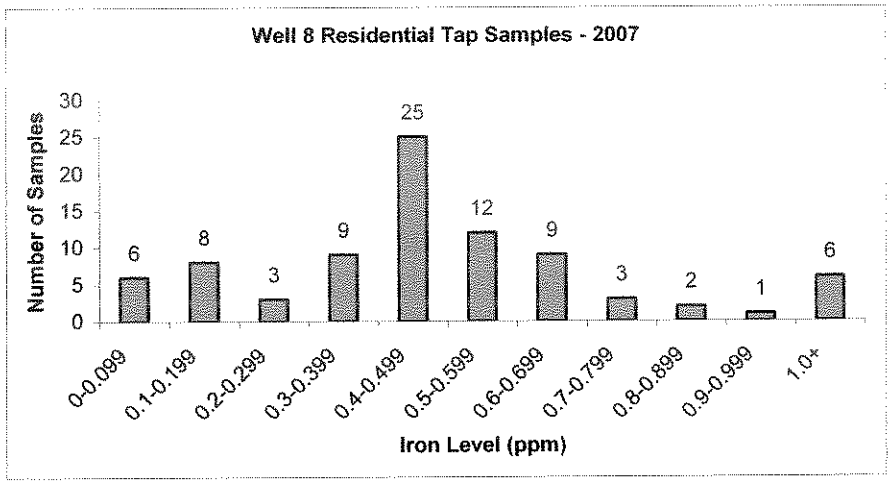
The Well 8 service area was selected for additional sampling because (a) the highest frequency of customer complaints about discolored water come from this service area, (b) manganese and

iron levels are at or exceed the secondary standards for these minerals, and (c) sample collection coincided with the utility's on-going evaluation of the unidirectional flushing program.

The figures below summarize the results for the 84 samples. Tap samples ranged from 1.6-135 ppb of manganese. The mean and median concentrations were 39 and 36 ppb, respectively, with a standard deviation of 22. Two locations tested above 100 ppb and were re-sampled according to the recommendations in the 2006 Manganese Monitoring Report. Manganese levels measured at the well have varied from 46-51 ppb in 2007. The well is currently shutdown for the winter.



The figure below summarizes the iron results for the 84 samples collected in the Well 8 area during September and October 2007. Tap samples ranged from 0.01-2.02 ppm (10 to 2020 µg/l) of iron. The mean and median concentrations were 0.49 and 0.47 ppm, respectively, with a standard deviation of 0.30. Six locations tested above 1 ppm. Iron levels at the well varied from 0.51-0.59 ppm in 2007.



The Well 8 service area was also evaluated in 2006. More than 250 samples were collected one week and one month after unidirectional flushing. One hundred eleven of the two hundred sixty five samples, or 42%, exceeded the secondary standard for iron. In addition, 8 samples tested above 1 ppm. Well 8 tested at 0.53 ppm of iron in 2006.

With the exception of the manganese and iron levels, the water quality of UW 8 is excellent and the well has a rated capacity of 1800 gpm.

What will filtration cost? The installation of filtration equipment on only four wells represents a major investment in the magnitude of $12,500,000 by the Water Utility. These funds would have to be borrowed and the borrowing necessitates increases in rates for water service. Attachment B was prepared to estimate the cost recovery from the ratepayers. The Water Utility is already estimating an increase in rates of 8% to finance the replacement of its aging plant. The installation of filters would increase that annual cost 13 to 14% over the next six years. This represents about $0.09 per hundred cubic feet (CCF) or about $8.10 per year for the average residential user. (The "average residential user" uses 90 CCF of water per year.)

Will the Utility be able to cease the flushing of mains if it filters the water from the four Unit Wells? No, water mains require routine flushing as a part of normal maintenance. It is expected that the frequency of flushing of mains will be reduced following the installation of filters.

Would it not be more economical to just replace the wells rather than install expensive filtration equipment? The experience that the Water Utility gained with UW 29 on the east side of the City indicates that finding a replacement well involves risk that unacceptable iron or manganese levels may be encountered. Just finding a potential well site in a developed area is difficult. Since May of 2007, a work group of citizens, Water Utility Staff and consultants have been looking for potential well sites to replace UW 3, which is located at First and Johnson Streets. Not one acceptable well site was located in Aldermanic Districts 2, 6, and 12 which would justify going to the second level of investigation.

Would it be more economical for individual property owners to install their own filters to remove minerals such as manganese and iron?

Water Utility staff interviewed Mr. Ray Fox, owner of Fox Water regarding iron filters. He did not feel that iron filters were necessary for customers on city water; most filters he sells/installs are for homeowners on private water. It was his opinion that the best remedy for removing iron of 1 ppm or less (Well 8 is ~0.6 ppm) is a water softener. He felt that increasing the frequency of backwash cycle and using salt specialized for iron removal was a successful strategy.

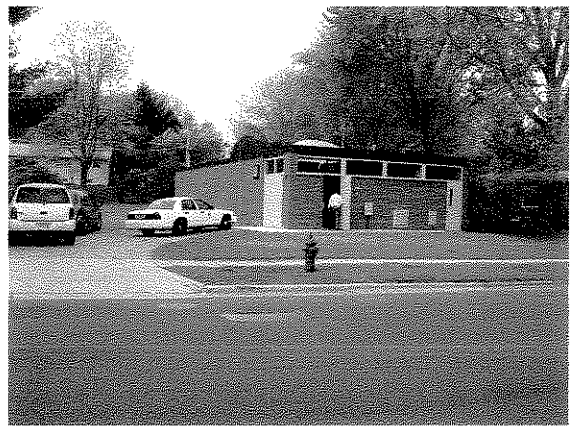
Whole home units remove iron from all water except the outside tap. Fox offers three units that range in cost from $1000-$1900 while Hellenbrand apparently offers the "Iron Curtain" at a cost of $2500-$2800. The technology is based on air injection to oxidize the iron and then remove the solids with filter media - similar to technology employed by utilities that aerate prior to filtering raw water.

Depending on accessibility and application, installation could be as little as $80. If installation required significant changes to the plumbing, the cost could be several hundred dollars. Annual maintenance cost would be minimal.

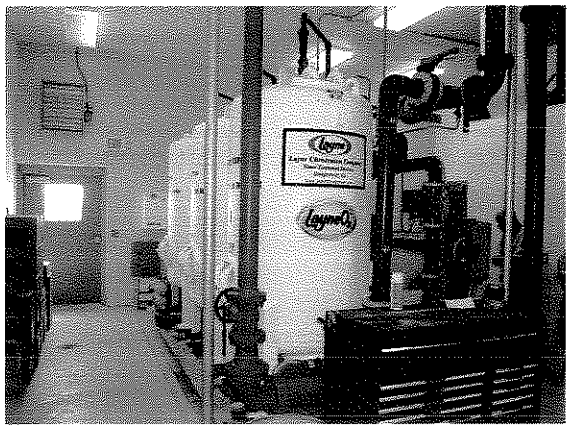
This information is summarized in Attachment C. We conclude that filtration by the Water Utility would be less expensive than an investment by individual property owners of home filtration units.

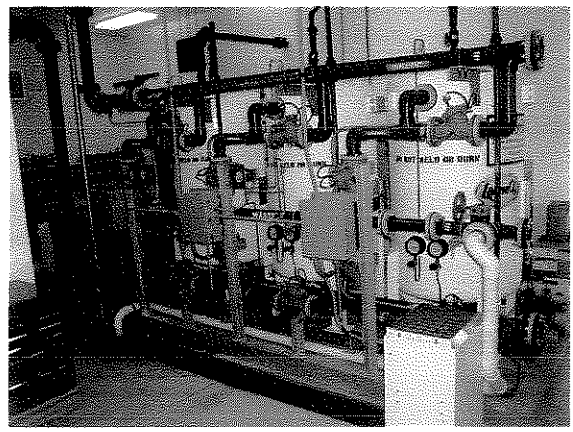
Do any other communities have experience with filtration system? Filtration systems for removing Fe and Mn are common across the country and have been used for over 100 years. Fe and Mn filters can be found all across Wisconsin, Illinois, and Minnesota. Communities that filter in Wisconsin include but are certainly not limited to; Watertown, Walworth, Germantown, Darien, Waterford, New Berlin, Black River Falls, and the City of Middleton. (Middleton installed and has been successfully operating a filtration plant on two of its wells since the 60's.)

Photos of Middleton, WI Plant toured by Utility Staff



Photos of Black River Falls, WI plant toured by Utility Staff





Are their other issues that the Water Utility Board needs to be aware of?

Yes. Of particular concern is the installation of filtration equipment will require the updating of the Unit Wells to conform to current building and Department of Natural Resources Codes. The filtration systems will require a larger building footprint, which will require architectural changes to the exterior of the structure and site impacts. For example, UW 8 is located adjacent to Olbrich Park. On the balance, these structures are in need of periodic updating and renovation.

Water Utility Board Member Dan Melton posed a number of questions regarding filtration. Those questions and response by staff are included as Attachment D.

In order to realize the goal of reducing the risk of colored water, it is necessary for both staff and the public to exhibit restraint in the design of the buildings to house the filtration equipment. The Water Utility Board will need to counsel all parties that the goal is to improve water quality and not embark on excessive and unnecessary expenditures.

Attachment A
Staff Recommendation for Iron and Manganese Filtration
City of Madison Water Utility

	MANGANESE (ppb)			IRON (ppm)			COMBINED	COLOR CALLS		Date
	Median	> SMCL*	Rank	Median	> SMCL*	Rank	RANK	All Calls	Primary Well	Drilled
UW 10	117	Yes	2	0.780	Yes	1	3	0	0	1951
UW 29	187	Yes	1	0.372	Yes	3	4	6	0	2002
UW 8	49		3	0.572	Yes	2	5	86	58	1945
UW 7	27		8	0.356	Yes	4	12	92	82	1939

* SMCL - Secondary Maximum Contaminant Level - EPA's National Secondary Drinking Water Standard for Aesthetics - Color, Odor, or Taste

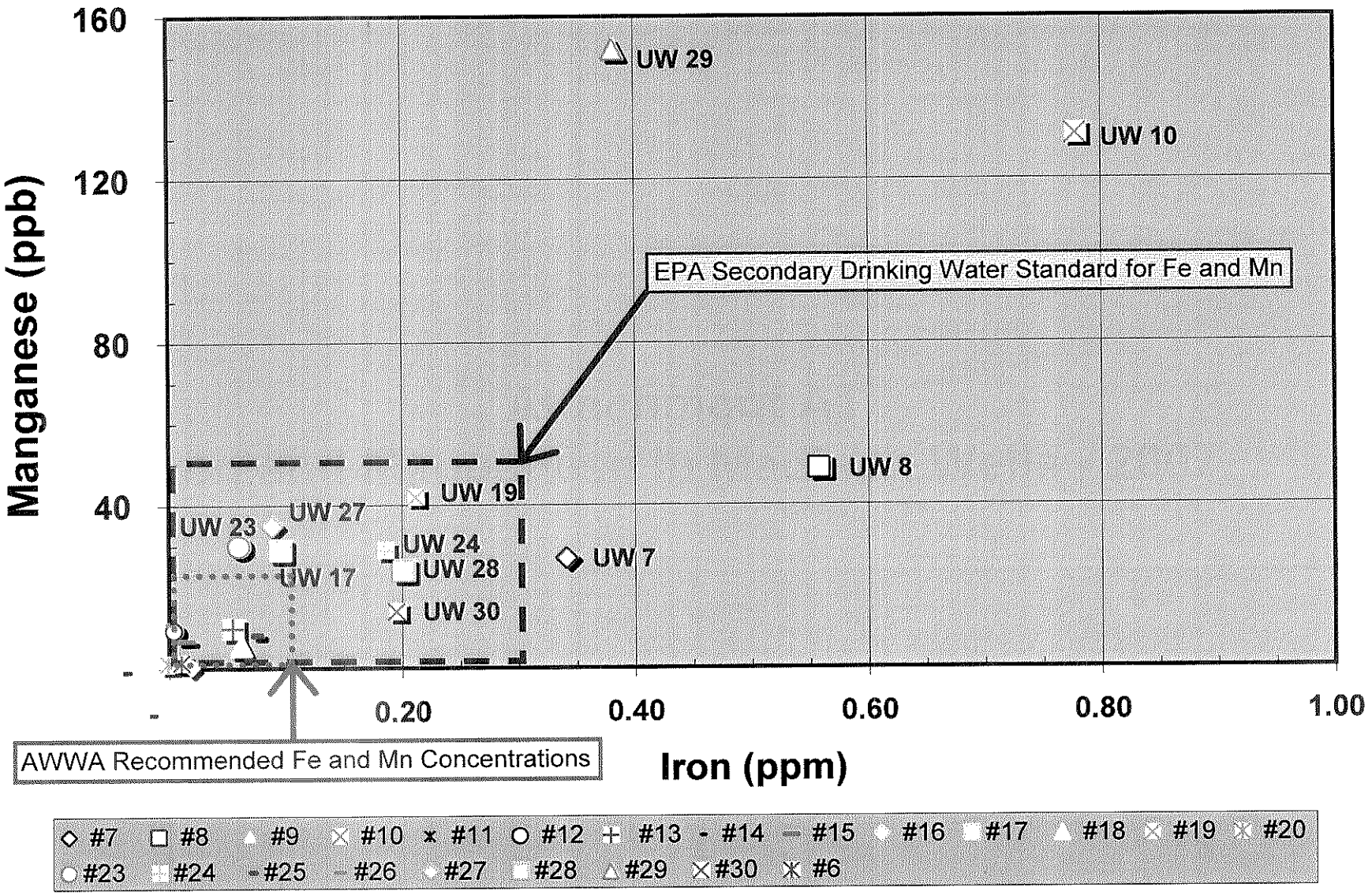
For Consideration of Filtration after Unit Wells 7, 8, 10, and 29

	MANGANESE (ppb)			IRON (ppm)			COMBINED	COLOR CALLS		Date
	Median	> SMCL*	Rank	Median	> SMCL*	Rank	RANK	All Calls	Primary Well	Drilled
UW 19	41		4	0.207		5	9	19	0	1970
UW 27	33		5	0.138		9	14	8	2	1989
UW 24	28		7	0.186		8	15	29	7	1979
UW 28	22		10	0.204		6	16	17	17	1998
UW 17	29		6	0.100		10	16	32	17	1966
UW 30	14		11	0.196		7	18	42	26	2003
UW 23	27		8	0.070		11	19	57	18	1958

Filtration Not Recommended

	MANGANESE (ppb)			IRON (ppm)			COMBINED	COLOR CALLS		Date
	Median	> SMCL*	Rank	Median	> SMCL*	Rank	RANK	All Calls	Primary Well	Drilled
UW 6	1.5		18	0.022		15	33	16	1	1938
UW 9	0.5		21	0.002		21	42	2	2	1951
UW 11	6.8		15	0.004		20	35	122	16	1956
UW 12	0.6		20	0.005		19	39	17	17	1957
UW 13	10		12	0.054		14	26	124	17	1959
UW 14	0.2		23	0.002		21	44	22	17	1960
UW 15	6.3		16	0.015		17	33	65	13	1965
UW 16	0.2		22	0.012		18	40	17	0	1967
UW 18	5.5		17	0.055		13	30	19	6	1968
UW 20	0.9		19	0.002		21	40	5	0	1973
UW 25	7.6		14	0.068		12	26	50	11	1982
UW 26	9.2		13	0.018		16	29	25	8	1987

Attachment A1
Iron and Manganese in Madison Wells - 2007



ATTACHMENT B
Filter Cost Forcast and Estimated Ratepayer Cost
City of Madison Water Utility

	Filter Budgetary Cost Estimate		2008	2009	2010	2011	2012	2013	2014	2015
UW 29	$2,500,000	Principal		$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000
		Interest	$ 54,797	$ 104,115	$ 98,635	$ 93,155	$ 87,676	$ 82,196	$ 76,716	$ 71,237
		Operating Cost		$ 50,000	$ 51,500	$ 53,045	$ 54,636	$ 56,275	$ 57,964	$ 59,703
UW 8	$3,000,000	Principal			$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000
		Interest		$ 65,757	$ 124,938	$ 118,362	$ 111,787	$ 105,211	$ 98,635	$ 92,060
		Operating Cost			$ 51,500	$ 53,045	$ 54,636	$ 56,275	$ 57,964	$ 59,703
UW 10	$3,500,000	Principal				$ 175,000	$ 175,000	$ 175,000	$ 175,000	$ 175,000
		Interest			$ 76,716	$ 145,761	$ 138,089	$ 130,418	$ 122,746	$ 115,074
		Operating Cost				$ 53,045	$ 54,636	$ 56,275	$ 57,964	$ 59,703
UW 7	$3,500,000	Principal					$ 175,000	$ 175,000	$ 175,000	$ 175,000
		Interest				$ 76,716	$ 145,761	$ 138,089	$ 130,418	$ 122,746
		Operating Cost					$ 54,636	$ 56,275	$ 57,964	$ 59,703
		Total	$ 54,797	$ 344,872	$ 678,289	$ 1,043,130	$ 1,326,858	$ 1,306,016	$ 1,285,370	$ 1,264,927

Cost per gallon *	$ 0.00000522	$ 0.00003284	$ 0.00006460	$ 0.00009935	$ 0.00012637	$ 0.00012438	$ 0.00012242	$ 0.00012047
Cost per CCF	$ 0.00390365	$ 0.02456793	$ 0.04831989	$ 0.07431035	$ 0.09452252	$ 0.09303776	$ 0.09156701	$ 0.09011069

Current Rate per CCF	$ 1.20							
Anticipated Rate Increase in %	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Increase in rates per CCF		$ 0.10	$ 0.10	$ 0.11	$ 0.12	$ 0.13	$ 0.14	$ 0.15
New Rate per CCF		$ 1.30	$ 1.40	$ 1.51	$ 1.63	$ 1.76	$ 1.90	$ 2.06
New Rate with Filter Cost per CCF		$ 1.32	$ 1.45	$ 1.59	$ 1.73	$ 1.86	$ 2.00	$ 2.15
Ratepayer Increase per CCF		$ 0.02	$ 0.05	$ 0.07	$ 0.09	$ 0.09	$ 0.09	$ 0.09

% Increase in Rates with Filtration		10.05%	11.73%	13.31%	14.25%	13.70%	13.19%	12.73%

Assumptions and Notes

Cost to build:		See Filter Budgetary Cost Estimate Column
Cost to Operate:		$ 50,000.00 Plus a 3% inflation factor after 2009
Principal:		Building cost borrowed and capitalized using level debt service
Interest:		Use average of last two Revenue Bond Issues 2006 True Interest Cost - 4.4298719% , 2007 TIC - 4.3377042%, Average = 4.38378805%
Gallons of Water Sold in 2006		10,500,035,000

ATTACHMENT C, MADISON WATER UTILITY: IRON FILTRATION FOR PRIVATE HOMES

Company	Type of Filter	What It Does	Professional Install/DIY	Cost of Install	Cost of Unit	Maintenance Required	Annual Maintenance Cost	Source of Information
CAPITAL	Water Softener	If dissolved iron=>1ppm, can program softener to remove it	Professional install recommended	Included in unit cost	$750 - $1150	Regular addition of new salt when necessary	Minimal	Joel Wick, sales
	Cartridge Filter	Sifts particles by size, generally 30-50 microns	Professional install recommended	Included in unit cost	$150 - $300	Replace filters every 2-3 months; $25 - $50 each	Replacement filters $25 - $50 each ($100 - $300/year)	
	Oxidizing Filter	If iron <1ppm, stains laundry, etc., use at point of entry to treat whole house. Draws in air to turn iron to particle, backwashes to filter particles down drain.	Professional install recommended	Included in unit cost	$1750 - $2250	Maintenance call once every 1-2 years	Maintenance call = $75 - $150, not needed annually	
CULLIGAN	Water Softener	Removes small amount of dissolved iron	Professional install recommended	Included in unit cost	$800 - $1800	Regular addition of new salt when necessary	Minimal	Carl, sales Ken, sales
	Carbon Prefilter	Filters iron particles and sediment from water	Professional install recommended	Included in unit cost	$200 - $300	Replace filters every few months	Replacement filters $20 - $30 each ($60 - $120/year)	
	"Iron Curtain"	Filters more than carbon filter; similar in function to water softener, lasts longer, less maintenance	Professional install recommended	Included in unit cost	$1700 - $2000	Maint. call once every several years	Maintenance call = $185, not needed annually	
FOX	Water Softener	Will remove iron if backwash cycle frequency increased and salt specialized for iron removal is used	Professional install recommended	$80-several hundred $	$535 - $895	Regular addition of new salt when necessary	Minimal	Ray Fox, owner Phil, sales
	Air-Injection System	Air injected to oxidize iron into solids then removed by filter media; similar to utilities which aerate prior to filtering raw water	Professional install recommended	$80-several hundred $	$1000 - $1900	Self-cleaning, minimal maintenance	Minimal	
HELLENBRAND	Water Softener	Cation resin attracts and removes ferrous (dissolved/clear) iron (most common type found in Madison water)	Professional install recommended	$85 trip charge + approx. $100 labor charge	$899 - $1399	Regular addition of new salt when necessary	Minimal	Jo McDonald, technician Juan Lopez, sales
	Sediment Filter	Removes ferric (oxidized/particulate) iron sediments; 5-30 micron filters catch most particles (can go as low as 1 micron but that size easily plugged)	Professional install recommended	$85 trip charge + approx. $100 labor charge	$149 - $279	Rinse or change filter when plugged, at least once a year	3/4" pipe filter = $6 each; 1" pipe filter = $14 each	
	"Iron Curtain"	Patented 2-tank system for both kinds of iron: first tank aerates to oxidize dissolved iron into particles; second tank filters out particles with 10-micron filter. (Usually used for well water; 99% of iron in city water can be remedied by softener/sediment filter)	Professional install recommended	$85 trip charge + approx. $100 labor charge	$1300 - $2100	Self-cleaning, minimal maintenance	If service call needed, $185 each; not needed annually	
RAINSOFT	Oxidizing Filter	Potassium permanganate (up to 15 lbs/year) used as oxidant, greensand filter media filter out oxidized particles	Installation by master plumber required	$600 - $800	$1800 - $3000	Regular addition of potassium permanganate; quarterly service plan available	$75 - $150 for potassium permanganate; if opting for quarterly service calls, each is additional $99	Scott Murray, Chicago office

Attachment D
Response to Water Utility Board Member Dan Melton
Regarding Fitration of Selected Unit Wells
January 21, 2008

DM: Do we know if we want to abandon Well 8 or Well 10? We don't know, do we? What written criteria would we use to determine if 'this is a good well that we want to keep'? Or this is an old well whose days are numbered, let's plan on abandoning it by Year___?

LDN: *I don't think we should abandon these UW sites. UW 8 produces good quality water but for the Mn and Fe. We don't have alternate sites. What we need to do to is evaluate if the wells on the sites can outlive the live of the filtration systems. If necessary, we could drill another well at the UW 8 site.*

We can drill another well at the site but I think we need to evaluate the well borehole. As you are aware, our master plan suggests we abandon UW 10 in 2023.

I would caution the WU to not give up a UW site without having a replacement well on line.

DM: What are we going to do about our older wells where the upper and lower aquifers are connected? Have we considered casing all our older wells down to the lower? Costs-benefits? If we did that, would we lose too much water volume - how much? 10%? 20%? - because we weren't tapping the upper anymore?

LDN: *The feasibility of re-casing each well would have to be investigated and evaluated. Many of our existing wells have small diameter casing that would make re-casing uneconomical and possibly technically impossible. We would have to study each well to determine the benefits and risks of this idea. The overall feasibility would depend on the water quality. UW 12 is not fully cased but produces great water but we have had three positives for virus. I suspect that you could case the borehole but a specific need would have to be established.*

DM: Have we discussed the filter question with people outside the MWU? The UW? DNR? Other WUs? WWA? AWWA?

LDN: *Yes, in the case of UW 29. Again, we are talking about a pretty conventional water treatment action. I have discussed the issue with the WDNR regulator and his only concern was that we have Waterworks operators certified for the filtration equipment.*

DM: What role, if any, does the DNR play in this decision? Do DNR staff simply sign off - or not sign off - on proposals we bring them? Or do DNR staff have a recommended (preferred) course of action?

LDN: *Again, we are talking about a conventional water treatment action. WDNR will enforce the code on the system but WDNR has not required us to take action to address the current Mn and Fe levels. Its our customers that have raised the concerns.*

DM: Public health factors. - If we're going to discuss the need to filter or not filter, I'd like to discuss public health factors, not just 'aesthetic' standards.

LDN: *That is pretty much the position of the former Water Utility Managers. They never appreciated that the public's concern for colored water was a "water quality issue" that may be indicative of a "public health factor". I have lived in my house served by UW 12*

since 1971. I have never…my wife concurs…ever had colored water. It happens daily in your neighborhood. I don't think that disparity is appropriate.

That is not to say that we don't have to monitor and address VOC issues at UW 9 and 15. Furthermore, our knowledge is expanding regarding the measurement of compounds and virus in wells. The Water Utility needs to be able to address future issues and the concerns of the customer that may be generated in other communities. For example, the problems of radon on the Waukesa Water Utility generate questions from the customer in Madison.

DM: Do we know if iron and manganese are the only substances we should be thinking about filtering out? Or are there other substances we should be thinking about filtering out, as well? If Yes, What are they? If No, when and how did we decide that?

LDN: *Our emphasis is on Mn and Fe but we could also remove radium and arsenic in this process, if these compounds ever prove to be present. If VOCs are determined to be an issue, they can be removed by passing the water through aeration or activated carbon filter bed. This would be an additional step that could be added to a filtration plant.*

DM: Do we know if we want to install filters at each individual well? If Yes, how do we know that? When and how was that decision made? vs., for example, a filter for more than one well - Pipe the water from more than one well to a filter plant - Have several 'regional' filter plants or one citywide? vs. at each individual well? Costs-benefits?

LDN: *The filters are prefabricated package units. The low bid for just the filter for UW 29, which we opened on January 18, 2008 was $301,000, considerably less than the estimate. Now we need to put a building to house the filter at another $250,000 plus add a backwash water basin. We can certainly look at the options of a central plant, but it probably isn't economical to pump water for the distances between Unit Wells.*

DM: IF we're considering a filter at an individual well, to what extent is the decision whether to filter or not a site-by-site, well-by-well decision - that could be effected, for example, by the topography of the site, the soil conditions, amount of sand, amount of clay, age of the well? vs. Discussing filters in general, in the abstract?

LDN *I suspect that we are going to have to bring the UW up to current codes and standards and that will drive costs with site impacts.*

DM: To what extent does the Gruber resolution come into play here? If we're considering a filter at an individual well, we need to have a process where we talk to the neighbors about the site - building footprint, type of building, site planning - placement of the building.

LDN: *That is correct. I would hope that the public will be supportive but I know Madison and expect that we will have some critics. What is going to be a challenge for the Board is to hold the line on costs. Often times, the City is put in the position of having to give people something in order to help them.*

DM: How much do we know about each of the wells listed? How much information have we analyzed about each individual well? For example, has a well begun to plug up, in the past? If Yes, are there things we did about that? Has the steel casing begun to rot away? Have we replaced the casing? When? What is the condition of the casing? Is it corroding? (iron and manganese shorten the life of a casing, don't they?) Have we lowered a camera down the well so we can see what is down there?
Is the current casing big enough that we could put a liner down and case it down to the lower aquifer?

Would this reduce our capacity too much? Do we know where the substance is coming from? The upper? Lower? Both? If it is just coming from part of the aquifer, can we seal off that part?

LDN: *We routinely monitor the performance of all of our wells. On occasion we have needed to chemically treat the well and bail out the sand to restore it to its original condition. If we proceed with the filtration project, it would only be prudent to view the well with closed circuit TV and perhaps consider a study of the well borehole to determine if Mn and Fe is entering the well at specific elevations. (RMT and Montgomery have suggested further study of the wells.) According to a study performed by Earthtech for the MWU in 1999, Water System Master Planning Study, "the life expectancy of a majority of Madison's wells appears to be indefinite".*

DM: Have we accounted for ALL the costs that may be involved? Not just the filter itself? For example, If we put in a filter we might need to put in a larger pump, which means we might need a larger motor, which means we might need to change the electrical service, and also maybe the backup generator. It's one thing to install a filter on a brand new well; it's another thing to retrofit an old well. (Like the cost of getting a bigger pump)

LDN: *The $2.5M to $3.5M per well for filtration is only an estimate. I suspect that how much we have to renovate an existing site is the most significant variable and the cost of the filter the least. Again, we have to keep our focus on the goal – filter the water – and not allow costs to get out of hand. We need clean water, not architectural monuments.*

DM: Do the pros and cons of a particular filter technology change depending on the volume of water being filtered? Higher-volume, like 29? vs. Lower-volume, like 8?

LDN: *The technology is the same for a 100 gpm filter or a 2100 gpm filter. There are some economies of scale, but the difference between rated capacity of UW 29 (2100 gpm) vs. UW 18 (1800 gpm) is only 15% and may not be enough to reduce our costs.*

DM: If we're going to consider a filter building at a well, we should leave room for additional filtration facilities that might be necessary in the future (for other contaminants).

LDN: *We should consider it but it may prove to be subordinate to other site factors, such as the building footprint in a public site.*

DM: We could use existing reservoirs and turn them into gravity filtration systems; or we could build a filter on top of the reservoir. There are prefab facilities for that.

LDN: *That could be considered but it would be a design and code issue.*

DM: For manganese or iron, is it an option to sequester it instead of filtering it out. What would that involve? Costs-benefits?

LDN: *Sequestering the Fe and Mn is a process that temporarily prevents it from being oxidized. The Fe and Mn remain dissolved in the water and you don't get the colored water or staining complaints. Typically speaking you use poly-phosphate for this, something that was proposed and rejected for the lead problem due to surface water pollution issues. There would be other issues to consider in applying this in Madison. Sequestering may be possible in some cases; we would have to test the process on each particular well water to determine its effectiveness. Burke Utility District No. 1 used sequestering to control the iron and manganese in their well located out by the airport. The attraction of sequestering is the low capital costs of the process. It only requires a simple chemical feed system prior to chlorination. It is a temporary fix typically working about 72 to 96*

hours. After that time the Fe and Mn are oxidized and will show up in the system. We would not recommend using this process where we have large capacity reservoirs. I would think that most Madison residents would want the Fe and Mn removed from their water not hidden or covered up.