Regional Water Quality NEWSLETTER

DATE: Report for March 2008
Sampling conducted March 3 & 4 2008

From the Phoenix, Tempe, Glendale, CAP, SRP – ASU Regional Water Quality Partnership

http://enpub.fulton.asu.edu/pwest/tasteandodor.htm

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SUMMARY: EVALUATION AND RECOMMENDATIONS

1. MIB & geosmin levels are < 5 ng/L throughout the system.
2. Newsprint will come out this week on trace organics in drinking water from the Associate Press – If you want a copy of our AwwaRF final report on EDCs please let me know.
3. DOC is very high in the canal systems and will remain high as long as the Verde River system is being used. DOC in Bartlett Reservoir is ~ 5.5 mg/L with a SUVA of ~ 3.7. As the water begins to warm, this will form considerable levels of DBPs upon chlorination. DOC in Saguaro Lake on the Salt River is comparable to years past. DOC in Lake Pleasant is slowly increasing as more Colorado River and Aqua Fria water enter the lake.
4. An overview on the presence of a significant fraction of TOC as Biogenic Colloids are descried here.

Table 1 Summary of WTP Operations

	Verde WTP	Union Hills	24th Street WTP	N.Tempe J.G. Martinez	Deer Valley	Glendale Cholla WTP [3]	Val Vista	South Tempe	Chandler WTP
Location	**Verde River**	**CAP**	**Arizona Canal System**				**South Canal System**		
PAC Type and Dose	None	None	None	Off-line until April 1st	10.9 ppm Calgon WPH	None	None	None	None
Copper Sulfate			None		None		None	None	None
PreOxidation			None		None		None	None	None
Alum Dose Alkalinity pH			44 142/126 6.9		49 148/126 6.9		60 145-150 7.4	89 144 8.2	45 140 7.1
Finished water DOC DOC removal[2]		2.3 10%	3.9 36%		3.6 40%	3.2 45%	3.8 33%	3.9 32%	
Average turbidity over last 7 days			50-65		48-57		85	45	20
Recommendations									

[1] Ferric chloride instead of alum

[2] Calculated based upon influent and filtered water DOC (note that DOC – not TOC – is used in this calculation)

[3] Sample from finished water includes a blend of surface and ground water sources

Table 2 - Water Treatment Plants – March 3, 2008

Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
24th Street WTP Inlet	**<2.0**	**<2.0**	**<2.0**
24th Street WTP Treated	**<2.0**	**<2.0**	**<2.0**
Deer Valley Inlet	**<2.0**	**<2.0**	**<2.0**
Deer Valley WTP Treated	**<2.0**	**<2.0**	**<2.0**
Val Vista Inlet	**<2.0**	**<2.0**	**<2.0**
Val Vista WTP Treated –East	**<2.0**	**<2.0**	**<2.0**
Val Vista WTP Treated -West			
Union Hills Inlet	**<2.0**	**<2.0**	**12.3**
Union Hills Treated	**<2.0**	**<2.0**	**<2.0**
Tempe North Inlet			
Tempe North Plant Treated			
Tempe South WTP	**<2.0**	**<2.0**	**<2.0**
Tempe South Plant Treated	**<2.0**	**2.4**	**<2.0**
Tempe South Plant Treated (Lab)			
Chandler WTP Inlet			
Chandler WTP Treated			
Glendale WTP Inlet	**<2.0**	**<2.0**	**<2.0**
Glendale WTP Treated	**<2.0**	**<2.0**	**3.6**
Glendale WTP Treated (Lab)			

Table 3 - Canal Sampling – March 3, 2007

System	Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
CAP	Waddell Canal	**<2.0**	**<2.0**	**3.3**
	Union Hills Inlet	**<2.0**	**<2.0**	**12.3**
	CAP Canal at Cross-connect	**<2.0**	**<2.0**	**<2.0**
AZ Canal	Salt River @ Blue Pt Bridge	**6.9**	**2.7**	**<2.0**
	Verde River @ Beeline	**<2.0**	**<2.0**	**<2.0**
	AZ Canal above CAP Cross-connect	**<2.0**	**<2.0**	**<2.0**
	AZ Canal below CAP Cross-connect	**<2.0**	**<2.0**	**<2.0**
	AZ Canal at Highway 87	**<2.0**	**<2.0**	**<2.0**
	AZ Canal at Pima Rd.	**<2.0**	**<2.0**	**<2.0**
	AZ Canal at 56th St.	**<2.0**	**<2.0**	**13.3**
	AZ Canal - Inlet to 24th Street WTP	**<2.0**	**<2.0**	**<2.0**
	AZ Canal - Central Avenue	**<2.0**	**<2.0**	**6.5**
	AZ Canal - Inlet to Deer Valley WTP	**<2.0**	**<2.0**	**<2.0**
	AZ Canal - Inlet to Glendale WTP	**<2.0**	**<2.0**	**<2.0**
South and Tempe Canals	South Canal below CAP Cross-connect	**<2.0**	**<2.0**	**<2.0**
	South Canal at Val Vista WTP	**<2.0**	**<2.0**	**<2.0**
	Head of the Tempe Canal	**<2.0**	**<2.0**	**<2.0**
	Tempe Canal - Inlet to Tempe's South Plant	**<2.0**	**<2.0**	**<2.0**
	Chandler WTP – Inlet			

Table 4 - Reservoir Samples – March 4, 2008

Sample Description	Location	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Lake Pleasant (Feb08)	Eplimnion	<2.0	<2.0	3.0
Lake Pleasant (Feb08)	Hypolimnio	<2.0	<2.0	17.8
Verde River @ Beeline		<2.0	<2.0	<2.0
Bartlett Reservoir	Epilimnion	<2.0	<2.0	2.4
Bartlett Reservoir	Epi-near dock	<2.0	<2.0	<2.0
Bartlett Reservoir	Hypolimnio	<2.0	<2.0	<2.0
Salt River @ BluePt Bridge		6.9	2.7	<2.0
Saguaro Lake	Epilimnion	<2.0	2.3	<2.0
Saguaro Lake	Epi - Duplicate	<2.0	<2.0	<2.0
Saguaro Lake	Epi-near doc	<2.0	<2.0	<2.0
Saguaro Lake	Hypolimnio	<2.0	<2.0	<2.0
Verde River at Tangle Creek				
Havasu				

Table 5 - SRP/CAP OPERATIONS

Values in cfs, for March 3, 2008

System	SRP Diversions	CAP
Arizona Canal	467	0
South Canal	486	0
Pumping	55	0
Total	1008	0

SRP is releasing water from both Verde and Salt River Systems. Salt River release from Saguaro Lake: 8 cfs; Verde River release from Bartlett Lake: 3200 cfs.

Lake Roosevelt is 91% full and the Verde River system is >97% full as of March 3, 2008. Flow over Granite Reef dam into the Salt River Channel = 2350 cf.

Table 6 - Water Treatment Plants – March 03, 2008

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
24th Street WTP Inlet	6.15	0.233	3.8	1.916
24th Street WTP Treated	3.91	0.083	2.1	1.809
Deer Valley Inlet	5.89	0.238	4.0	1.573
Deer Valley WTP Treated	3.56	0.078	2.2	1.428
Val Vista Inlet	5.64	0.253	4.49	1.498
Val Vista WTP Treated –East	3.77	0.088	2.33	1.366
Val Vista WTP Treated -West				
Union Hills Inlet	2.60	0.039	1.50	0.710
Union Hills Treated	2.33	0.023	0.99	0.653
Tempe North Inlet				
Tempe North Plant Treated				
Tempe South WTP	5.69	0.237	4.17	1.448
Tempe South Plant Treated	3.87	0.089	2.30	1.471
Chandler WTP Inlet				
Chandler WTP Treated				
Glendale WTP Inlet	5.85	0.229	3.9	1.572
Glendale WTP Treated	3.22	0.068	2.1	2.350

DOC = Dissolved organic carbon
UV254 = ultraviolet absorbance at 254 nm (an indicator of aromatic carbon content)
SUVA = UV254/DOC
TDN = Total dissolved nitrogen (mgN/L)

Table 7 - Canal Sampling – March 3, 2008

System	Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
CAP	Waddell Canal	2.73	0.039	1.4	0.750
	Union Hills Inlet	2.60	0.039	1.50	0.710
	CAP Canal at Cross-connect	3.64	0.040	1.10	0.330
AZ Canal	Salt River @ Blue Pt Bridge	3.99	0.083	2.08	0.334
	Verde River @ Beeline	5.88	0.272	4.63	1.464
	AZ Canal above CAP Cross-	5.65	0.229	4.05	1.431
	AZ Canal below CAP Cross-	5.88	0.229	3.89	1.916
	AZ Canal at Highway 87	5.88	0.223	3.79	1.467
	AZ Canal at Pima Rd.	5.87	0.229	3.90	1.680
	AZ Canal at 56th St.	6.04	0.237	3.92	1.859
	AZ Canal - Inlet to 24th Street	6.15	0.233	3.79	1.916
	AZ Canal - Central Avenue	6.15	0.236	3.84	2.331
	AZ Canal - Inlet to Deer Valley	5.89	0.238	4.04	1.573
	AZ Canal - Inlet to Glendale WTP	5.85	0.229	3.91	1.572
South and Tempe Canals	South Canal below CAP Cross-	5.45	0.238	4.37	1.395
	South Canal at Val Vista WTP	5.64	0.253	4.49	1.498
	Head of the Tempe Canal	5.72	0.228	3.99	1.506
	Tempe Canal - Inlet to Tempe's	5.69	0.237	4.17	1.448
	Chandler WTP – Inlet				

Table 8 - Reservoir Samples – March 03, 2008

Sample Description	Location	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Lake Pleasant	Eplimnion				
Lake Pleasant	Hypolimnio				
Verde River @ Beeline		**5.88**	**0.272**	**4.63**	**1.464**
Bartlett Reservoir	Epilimnion	**6.20**	**0.242**	**3.90**	**1.494**
Bartlett Reservoir	Epi-near dock				
Bartlett Reservoir	Hypolimnio	**6.58**	**0.255**	**3.88**	**1.600**
Salt River @ BluePt Bridge		**3.99**	**0.083**	**2.08**	**0.334**
Saguaro Lake	Epilimnion	**5.82**	**0.130**	**2.23**	**1.122**
Saguaro Lake	Epi - Duplicate	**5.69**	**0.138**	**2.43**	**1.105**
Saguaro Lake	Epi-near doc				
Saguaro Lake	Hypolimnio	**5.24**	**0.119**	**2.27**	**1.305**
Verde River at Tangle					
Havasu					

DOC values in the Bartlett Lake System are considerably higher now than in previous years:

Year	Feb 2008	Feb 2007	Feb 2006
DOC (mg/L)	5.4	2.1	3.1
SUVA $((mg/L)^{-1}m^{-1})$	3.9	2.7	2.7

DOC values in the Saguaro Lake System are similar now than in previous years:

Year	Feb 2008	Feb 2007	Feb 2006
DOC (mg/L)	5.4	5.0	4.9
SUVA $((mg/L)^{-1}m^{-1})$	2.2	2.1	2.4

Trace Organics update

The Associated Press story will apparently be coming out next week. The letter from AP to local newspapers announcing the story is shown below. We are sending a notice to all subscribers so they are aware of this

LETTER FROM AP TO LOCAL NEWSPAPERS:

Dear Managing Editor:

Utility and local officials are reluctant to say it, but it's true: America's drinking water contains traces of the contents of Americans' medicine cabinets.

A five-month-long inquiry by the Associated Press National Investigative
Team has determined that minute concentrations of a vast array of pharmaceuticals _ including antibiotics, anti-convulsants, mood stabilizers and sex hormones _ have been found in the drinking water supplies of at least 41 million Americans.

The water is screened for drugs by some suppliers, but they usually don't tell their customers that they have found medication in it, the AP
found. One major city _ which screens for more drugs than most _ found 56 pharmaceuticals or byproducts in treated drinking water.

In a three-part series moving in advance this week for use next Monday,
Tuesday and Wednesday, the AP shows how drugs _ mostly the residue of medications taken by people, excreted and flushed down the toilet _ have
gotten into the water supplies of at least 24 major metropolitan areas.

And it details growing concerns among scientists that this pollution has
adversely affected wildlife, and may threaten human health.

"We recognize it is a growing concern and we're taking it very seriously," says an environmental official in the Bush administration.
I'm proud to commend this series to your attention. Here's a look at the
component parts:

PART ONE, for Monday, March 10: A 2,800-word overview. Among the sidebars: a piece on scientific studies; a look at a major city that found pharmaceuticals in its watershed but failed to test its drinking water; and a list of metropolitan areas and the drugs found in each.

PART TWO, for Tuesday, March 11: There is more and more evidence that some animals that live in or drink from streams and lakes are seriously
affected. Pharmaceuticals in the water are being blamed for severe reproductive problems in many types of fish, and problems with other wildlife as well. About 2,100 words. Accompanied by a sidebar on the secrecy that shrouds the test results.

PART THREE, for Wednesday, March 12: Though U.S. waterways coast to coast are contaminated with residues of prescription and
over-the-counter drugs, there's no national strategy to deal with them
no effective mandates to test, treat, limit or even advise the public.
About 2,500 words. Among the sidebars, a piece that looks at how water can be treated.

The series, written by Jeff Donn, Martha Mendoza and Justin Pritchard working with AP's national investigative editor, Richard Pienciak, is accompanied by photos, graphics, multimedia and video. Abridged versions of all three parts also will be transmitted.

Sincerely,
Mike Silverman

ASU is working with several local consulting companies and the City of Phoenix to characterize dissolved Organic Matter (DOM) in the Watershed. Key points include:

- **Organic matter fractionation**
- **DOM characterization**
- **DOM reactivity**
-

Over the next few months these results will be presented in this Newsletter series. The first installment is based upon DOM characterization of one particular, less studied, fraction of organic matter – namely Organic Colloids.

Biogenic colloids are a fraction of dissolved organic matter that comprise of material between 1 nanometer and 1 micrometer in size which are isolated according to Leenheer, Dotson, and Westerhoff (2007). During the spring of 2007, biogenic colloids were isolated from water samples collected at Saguaro Lake, upstream of the Greenway WTP, and within the distribution system served by the Greenway WTP. This study focused on the character of the biogenic colloids.

Fourier transform infrared (FTIR) spectroscopy was used to qualitatively determine the molecular structure of the biogenic colloids associated with the Greenway WTP. Table 1 presents the FTIR wavenumber and associated chemical bonds. The FTIR spectra acquired (Figure 1) show that treatment significantly reduced the signal in the amide II region and of the CH_3 peak located at 1380 cm^{-1}. Reduction of the signal in these regions allude to removal of n-acetyl aminosugars found in bacterial cell wall peptidoglycan, previously identified by other researchers (Leenheer et. al, 2000; Croue, 2004). The remaining biogenic colloids chemical structure, dominated by signal representing carbohydrates, remained the unchanged.

Table 1. Important FTIR Wavenumbers and Associated Chemical Bonds

Compound Class	**Approximate Wavenumber (cm^{-1}) and Associated Chemical Bonds**
Carbohydrates	3400-3300 (O-H), 1100-1000 (C-O)
Hydrocarbons	2960 (CH_3), 2940(CH_2), 1460(CH_2), 1380(CH_3)
Proteins	1660 (Amide I, N-C=O), 1540 (Amide II, N=C-O)
N-Acetyl Amino Sugars	1660 (Amide I, N-C=O), 1555 (Amide II, N=C-O), 1380(CH_3)
Silicon Grease (from isolation equipment)	1260 & 800 ($Si(CH_3)$ and $Si(CH_3)_2$)

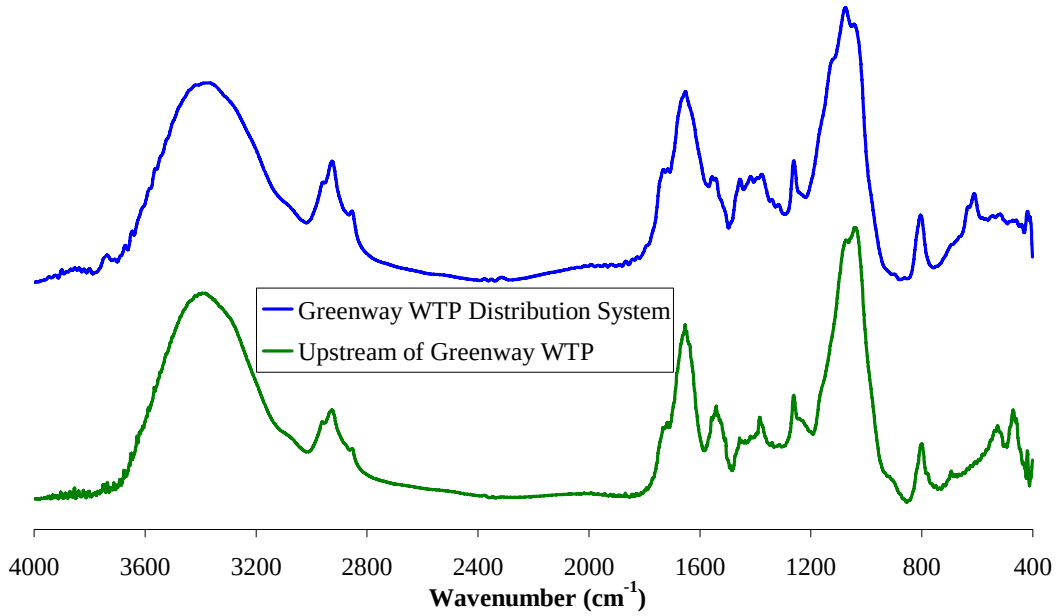

Figure 1. Biogenic Colloids FTIR Spectra of Raw and Treated Water (Greenway WTP)

Advanced spectroscopy techniques provide a significant amount of structural information, conformation of these findings can be observed by advanced microscopy techniques. Upon isolation and lyophilization of biogenic colloids from a bulk water sample they appear to be fibrous and cotton-like in appearance (Figure 2). Further examination of the material by transmission electron microscopy using uranyl acetate negative staining techniques reveals a variety of materials suspected to be biologically derived (Figure 3). Biogenic colloids contain an array of cellular debris such as vesicles, cell fragments, and fibrils. The fibrous material was present as independent fibers that are less than 10 nanometers in width to fiber bundles that appear to have a number of fibers bound together. The relative dimensions of these biological colloids place them in the realm of nanomaterials which are quickly becoming a concern of the environmental industry.

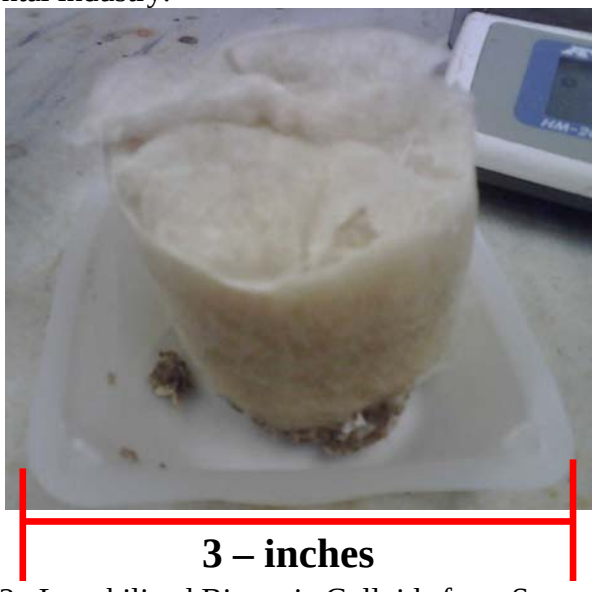

Figure 2. Lyophilized Biogenic Colloids from Saguaro Lake

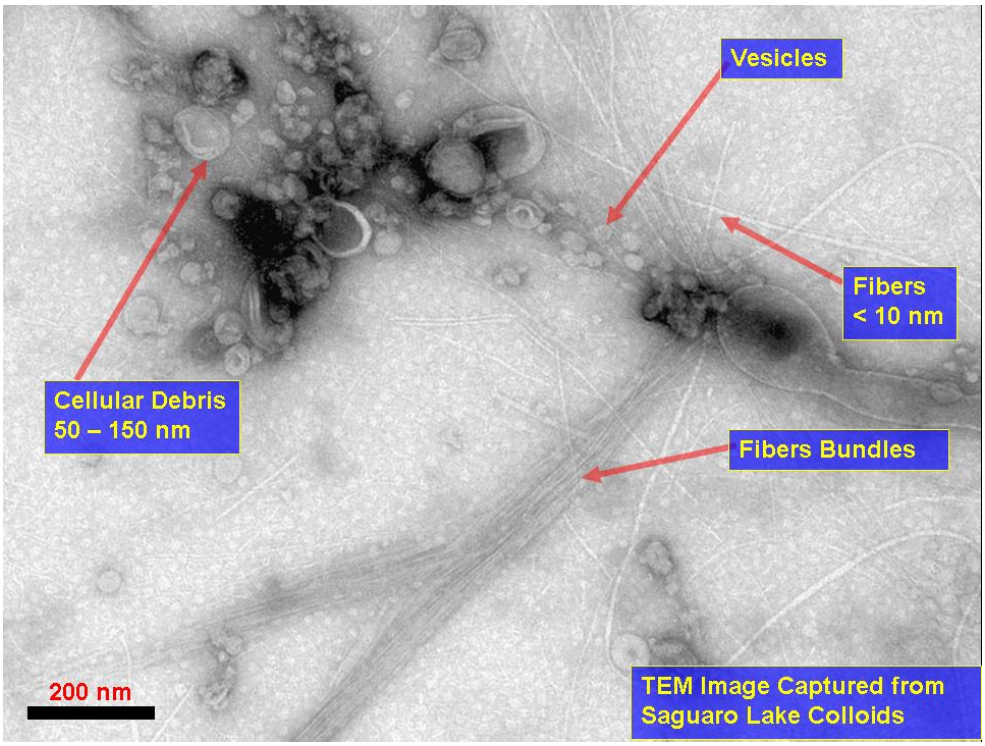

Figure 3. TEM Image of Biogenic Colloids from Saguaro Lake

Here is a picture of the influent (left) and the distribution system (right) from Peoria Greenway WTP. There are often silicates present with the samples. Here Biogenic organic colloids were removed during treatment, but also changed color and texture. Previously we found that biogenic colloids react with chlorine to form DBPs (regulated and non-regulated).