Regional Water Quality NEWSLETTER

DATE: Report for November 2013
A Tempe, Glendale, Peoria, Chandler, Phoenix, ADEQ, CAP, SRP, Epcor
NSF Central Arizona-Phoenix Long-Term Ecological Research
ASU Regional Water Quality Partnership

http://faculty.engineering.asu.edu/pwesterhoff/research/regional-water-quality-issues/

SUMMARY

1. Thanks for making our September regional water quality workshop a success. Over 70 local water experts attended. Copies of the slides are on our website: http://faculty.engineering.asu.edu/pwesterhoff/research/regional-water-quality-issues/

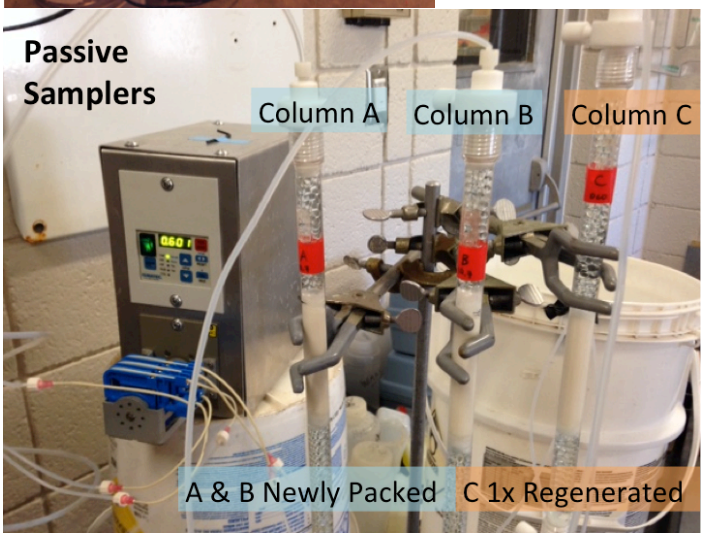
2. MIB levels are low in the lower part of the Arizona Canal, but there is 5-13 ng/L of MIB and geosmin in the upper reaches and it appears as if Geosmin is being produced in the AZ canal between 56th street and Central Avenue.
3. Bartlett lake has high levels of MIB that seem to be decreasing as water flows down the Verde River.
4. Quarterly sampling in all the Salt River lakes was performed. MIB and geosmin occur in all the lakes.
5. As un update on uranium (U238) concentrations. We reported 2 quarters of U238 concentration sin the 20 ug/L range for the CAP system. After purchasing new standards we realize our reported values were 10x high. There is no issue with U238 in the CAP waters, as the updated concentrations in our database are now in the 1 to 5 ug/L range. This is in-line with data from other cities – thanks for sharing the datasets.
6. We demonstrate the validity of a hexavalent chromium passive sampling strategy, and show that it can average out values which if solely collected as grab samples could exhibit a 4x variation (from 0.5 to > 2 ppb).

Table 4 - Reservoir Samples – November 5, 2013

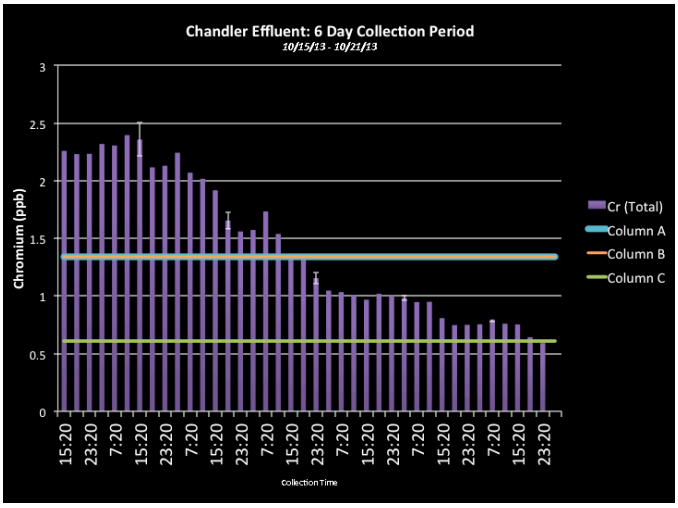
Sample Description	Location	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Lake Pleasant (October)	Eplimnion	13.2	2.4	<2.0
Lake Pleasant (October)	Hypolimnio	2.9	2.4	<2.0
Verde River @ Beeline		6.7	2.3	<2.0
Bartlett Reservoir	Epilimnion	25.6	<2.0	<2.0
Bartlett Reservoir	Epi-near	24.2	<2.0	<2.0
Bartlett Reservoir	Hypolimnio	26.4	<2.0	<2.0
Salt River @ BluePt Bridge				
Saguaro Lake	Epilimnion	7.6	<2.0	<2.0
Saguaro Lake	Epi -	7.2	<2.0	<2.0
Saguaro Lake	Epi-near	7.1	<2.0	<2.0
Saguaro Lake	Hypolimnio	7.1	<2.0	<2.0
Lake Havasu (October)		2.6	4.8	<2.0
Verde River at Tangle Creek (September)		<2.0	<2.0	<2.0
Roosevelt at Salt River Inlet (September)		<2.0	<2.0	<2.0

Time-Dependent Hexavalent Chromium Monitoring

A second round of sampling for metals over 7 days was conducted at Chandler WTP. We compared two sampling approaches. First is an ISCO sampler (see below) and second are passive samplers (below).



So far we only have total chromium data from this monitoring event in late October, but previously this tracked well with hexavalent chromium (100% of the total chromium was comprised of hexavalent chromium).



We had 3 columns in our passive sampler set-up. Column A and B were replicates using new media and Column C was 1x-regenerated media. The columns were regenerated and based upon a mass balance using an average concentration from the ISCO sampler the following total chromium recoveries were achieved:

- Column A: 93% recovery
- Column B: 93% recovery
- Column C: 42% recovery

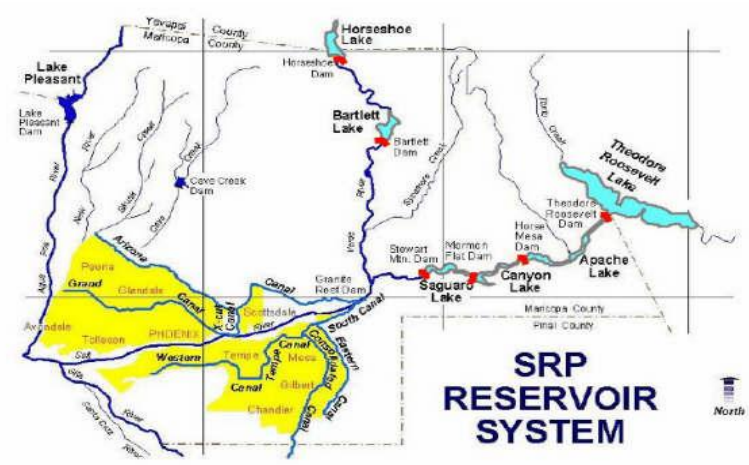
This demonstrates that the passive samplers can be used to get time-weighted chromium, and presumably hexavalent chromium (to be analyzed), data. This type of sampling will be much more relevant than grab samples. As reflected by the ISCO sampling data, grab samples show a nearly 4x variation from 0.5 to > 2 ug/L of chromium. We believe our passive sampling approach is suitable for many types of metal oxo-anions, including arsenic. We will continue to analyze samples and demonstrate this concept.

Quick Update of Water Supplies for November 2013
(during day of sampling – November 4th)

Source	Trend in supply	Discharge to water supply system	Flow into SRP Canal System	Dissolved organic carbon Concentration (mg/L) **
Salt River	Reservoirs at 54% full	8 cfs	419 cfs into **Arizona Canal** 303 cfs into **South Canal** **(98% Verde River Water)** 48 cfs of **CAP water** into Arizona Canal 357cfs **Groundwater Pumping** into SRP Canals	4.5 mg/L
Verde River	Reservoirs At 62% full	550 cfs		3.8 mg/L
Colorado River	Lake Pleasant is 56% full (Lake Powell is 45% full)	Lake Pleasant is being filled from the CAP canal		2.8 mg/L
Groundwater	Generally increasing due to recharge	357 cfs pumping by SRP		0.5 to 1 mg/L

*Concentration of these taste and odor compounds in the upper [lower] levels of the terminal reservoir (Saguaro Lake on the Salt River; Bartlett Lake on the Verde River; Lake Pleasant on the CAP system
**Concentration of DOC in the terminal reservoir
*** On paper cities are receiving CAP water in the SRP canals, but as a method of "paying back" from the last drought for excess CAP deliveries – SRP is delivering wet water only from the Salt and Verde Rivers
Data from the following websites:

- http://www.srpwater.com/dwr/
- http://www.cap-az.com/index.php/departments/water-operations/lake-pleasant
- http://lakepowell.water-data.com/



Dissolved Organic Carbon In Reservoirs and Treatment Plants

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)

Reservoir Samples

Table 4 - Reservoir Samples – November 5th & 6th

Reservoir sampling conducted monthly. CAP is sampling Lake Pleasant and Havasu, and USGS is sampling Verde River at Tangle and Salt River above Roosevelt on slightly different days than the other reservoirs.

Sample Description	Location	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Havasu (Oct)			0.054		
Lake Pleasant (Oct)	Epilimnion	2.9	0.054	1.8	0.5
	Hypolimnion	3.6	0.045	1.2	0.3
Verde River (Oct)	@ Tangle	not collected due to government shutdown			
Verde River	@ Beeline Hwy	3.8	0.109	2.9	0.4
Bartlett Reservoir	Epilimnion	3.5	0.097	2.8	0.3
	Hypolimnion	3.9	0.097	2.5	0.4
Saguaro Lake	Epilimnion	4.1	0.071	1.7	0.4
	Epi - Duplicate	3.8	0.071	1.9	0.3
	Hypolimnion	4.7	0.071	1.5	0.5
Salt River	@ Blue Point Bridge	dry river bed			

Table 5 - Upper Reservoir Samples – November 5th & 6th

Sample Description	Location	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Roosevelt	inlet (Oct)	3.7	0.080	2.2	0.31
Point 1	Epilimnion	3.7	0.079	2.1	0.31
	Hypolimnion	3.6	0.077	2.1	0.29
Point 2	Epilimnion	3.7	0.075	2.0	0.34
	Hypolimnion	3.6	0.075	2.1	0.31
Apache					
Point 1	Epilimnion	3.8	0.065	1.7	0.36
	Hypolimnion	4.1	0.066	1.6	0.46
Point 2	Epilimnion	3.6	0.067	1.9	0.40
	Hypolimnion	3.5	0.065	1.8	0.36
Canyon					
Point 1	Epilimnion	3.5	0.068	2.0	0.36
	Hypolimnion	4.2	0.071	1.7	0.42
Point 2	Epilimnion	4.0	0.069	1.7	0.39
	Hypolimnion	3.7	0.069	1.9	0.44

Organic Matter in Canal

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Waddell Canal	3.6	0.050	1.4	0.5
Anthem WTP Inlet	3.0	0.048	1.6	0.5
Union Hills Inlet	2.7	0.049	1.8	0.5
CAP Salt-Gila Pump Station (Oct)	2.9	0.052	1.8	0.4
CAP Mesa Turnout (Oct)	2.8	0.055	2.0	3.8
CAP Canal at Cross-connect	2.7	0.048	1.8	0.5
Salt River @ Blue Pt Bridge	dry river bed			
Verde River @ Beeline	3.8	0.109	2.9	0.4
AZ Canal above CAP Cross-connect	3.3	0.087	2.6	0.4
AZ Canal below CAP Cross-connect	3.3	0.087	2.6	0.4
AZ Canal at Highway 87	3.7	0.097	2.6	0.4
AZ Canal at Pima Rd.	3.7	0.099	2.7	0.5
AZ Canal at 56th St.	3.6	0.098	2.7	0.5
AZ Canal - Central Avenue	3.5	0.100	2.8	0.6
AZ Canal - Inlet to Glendale WTP	3.2	0.089	2.8	1.9
AZ Canal - Inlet to GreenwayWTP	3.4	0.086	2.5	1.8
South Canal below CAP Cross-connect	3.5	0.104	3.0	0.4
Head of the Tempe Canal	1.1	0.035	3.3	0.4
Tempe Canal - Inlet to Tempe's South Plant	0.8	0.023	3.1	3.1
Head of the Consolidated Canal	1.0	0.034	3.3	1.7
Middle of the Consolidated Canal	0.6	0.020	3.5	3.8
Chandler WTP – Inlet	0.6	0.022	3.7	3.5

Organics at the Water Treatment Plants

Table 2 - Water Treatment Plants – November 4, 2013

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN	DOC removal (%)
Union Hills Inlet	2.7	0.049	1.8	0.5	
Union Hills Treated	3.0	0.029	1.0	0.5	-11
Tempe North Inlet	3.7	0.099	2.7	0.5	
Tempe North Plant Treated	not available				
Tempe South Inlet	0.8	0.023	3.1	2.5	
Tempe South Plant Treated	0.8	0.008	1.0	2.7	-7
Greenway WTP Inlet	3.4	0.086	2.5	1.8	
Greenway WTP Treated	2.0	0.032	1.6	1.7	41
Glendale WTP Inlet	3.2	0.089	2.8	1.9	
Glendale WTP Treated	2.9	0.036	1.2	0.9	9
Anthem WTP Inlet	3.0	0.048	1.6	0.5	
Anthem WTP Treated	2.5	0.046	1.8	0.5	18
Chandler WTP Inlet	0.6	0.022	3.7	3.5	
Chandler WTP Treated	0.4	0.012	2.7	4.5	24

Taste and Odor

MIB, Geosmin and Cyclocitral are compounds naturally produced by algae in our reservoirs and canals, usually when the water is warmer and algae are growing/decaying more rapidly. They are non toxic, but detectable to consumers of water because of their earthy-musty-moldy odor. The human nose can detect these in drinking water because the compounds are semi-volatile. Since compounds are more volatile from warmer water, these tend to be more noticable in the summer and fall. The human nose can detect roughly 10 ng/L of these compounds. Our team collects samples from the water sources and raw/treated WTP samples.

Table 4 - Reservoir Samples – November 5, 2013

Sample Description	Location	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Lake Pleasant (October)	Eplimnion	**13.2**	**2.4**	**<2.0**
Lake Pleasant (October)	Hypolimnio	**2.9**	**2.4**	**<2.0**
Verde River @ Beeline		**6.7**	**2.3**	**<2.0**
Bartlett Reservoir	Epilimnion	**25.6**	**<2.0**	**<2.0**
Bartlett Reservoir	Epi-near	**24.2**	**<2.0**	**<2.0**
Bartlett Reservoir	Hypolimnio	**26.4**	**<2.0**	**<2.0**
Salt River @ BluePt Bridge				
Saguaro Lake	Epilimnion	**7.6**	**<2.0**	**<2.0**
Saguaro Lake	Epi -	**7.2**	**<2.0**	**<2.0**
Saguaro Lake	Epi-near	**7.1**	**<2.0**	**<2.0**
Saguaro Lake	Hypolimnio	**7.1**	**<2.0**	**<2.0**
Lake Havasu (October)		**2.6**	**4.8**	**<2.0**
Verde River at Tangle Creek (September)		**<2.0**	**<2.0**	**<2.0**
Roosevelt at Salt River Inlet (September)		**<2.0**	**<2.0**	**<2.0**

Quarterly Lake Sampling - November 5-6, 2013

Sample Description	Site	Location	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Roosevelt Lake	Site 1A	Eplimnion	4.0	<2.0	<2.0
Roosevelt Lake	Site 1B	Hypolimnion	2.9	<2.0	<2.0
Roosevelt Lake	Site 2A	Eplimnion	3.5	<2.0	<2.0
Roosevelt Lake	Site 2B	Hypolimnion	3.4	<2.0	<2.0
Apache Lake	Site 1A	Eplimnion	7.0	<2.0	<2.0
Apache Lake	Site 1B	Hypolimnion	6.2	<2.0	<2.0
Apache Lake	Site 2A	Eplimnion	7.5	<2.0	<2.0
Apache Lake	Site 2B	Hypolimnion	7.5	<2.0	<2.0
Canyon Lake	Site 1A	Eplimnion	8.9	<2.0	<2.0
Canyon Lake	Site 1B	Hypolimnion	7.1	<2.0	<2.0
Canyon Lake	Site 2A	Eplimnion	10.0	2.2	<2.0
Canyon Lake	Site 2B	Hypolimnion	8.1	2.1	<2.0

Table 2 - Water Treatment Plants – November 4, 2013

Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Union Hills Inlet	<2.0	<2.0	<2.0
Union Hills Treated	<2.0	<2.0	<2.0
Tempe North Inlet	6.0	11.6	<2.0
Tempe North Plant Treated			
Tempe South WTP	<2.0	<2.0	<2.0
Tempe South Plant Treated	<2.0	<2.0	<2.0
Anthem Inlet	<2.0	<2.0	<2.0
Anthem Treated	<2.0	<2.0	<2.0
Chandler Inlet	<2.0	<2.0	<2.0
Chandler Treated	<2.0	<2.0	<2.0
Greenway WTP Inlet	<2.0	<2.0	<2.0
Greenway WTP Treated	<2.0	<2.0	<2.0
Glendale WTP Inlet	3.5	2.7	<2.0
Glendale WTP Treated	<2.0	<2.0	<2.0
24th St. WTP Inlet			
24th St. WTP Outlet			

Table 3 - Canal Sampling – November 4, 2013

System	Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
CAP	Waddell Canal	2.0	<2.0	<2.0
	Union Hills Inlet	<2.0	<2.0	<2.0
	CAP Canal at Cross-connect	2.4	<2.0	<2.0
AZ Canal	Salt River @ Blue Pt Bridge			
	Verde River @ Beeline	6.7	2.3	<2.0
	AZ Canal above CAP Cross-connect	7.5	5.7	<2.0
	AZ Canal below CAP Cross-connect	6.4	4.3	<2.0
	AZ Canal at Highway 87	7.9	5.1	<2.0
	AZ Canal at Pima Rd.	7.7	9.7	<2.0
	AZ Canal at 56th St.	8.6	13.2	<2.0
	AZ Canal - Central Avenue	6.1	11.6	<2.0
	AZ Canal - Inlet to Glendale WTP	3.5	2.7	<2.0
	Head of the Consolidated Canal	<2.0	<2.0	<2.0
	Middle of the Consolidated Canal	<2.0	<2.0	<2.0
	Tempe Canal - Inlet to Tempe's South Plant	<2.0	<2.1	<2.0
	Mesa Turnout (October)	3.0	2.2	<2.0
	Salt-Gila Pump (October)	3.6	2.7	<2.0
	ISTB4	4.6	6.0	<2.0