DATE: January 7, 2019

TO: Water Quality Introductory and Delivery Standards

SUBJECT: Proposed Numeric Criteria for Broad Suite of Water Quality Constituents

At the June 7, 2018 CAWCD Board meeting, staff and stakeholders presented a consensus proposal for the introduction of non-Colorado River water into the CAP system. The proposal identified standards for six key constituents and an outline for additional components of a full standard to be developed. The recommendation from the June 7 Board meeting is attached for reference.

Following the approval of the consensus proposal, CAP staff and a subset of subject-matter experts[1] from the broader stakeholder group were tasked with developing a full list of numeric criteria for a broad suite of water quality constituents. That work has been ongoing since June and has largely consisted of a review of available water quality data and supporting analysis. Data collected and reviewed included CAP water quality data as well as available water quality data from potential groundwater and surface water sources that may be introduced into the CAP system.

Methodology

The review included a thorough constituent-by-constituent review and discussion, generally regarding three questions:

1. Is there sufficient data available to make a recommendation to establish numeric criteria?
2. Is the given constituent prohibited from introduction into the CAP system at the current detection level?
3. Does a particular constituent require an introduction or delivery numeric standard?

For a broad number (85%) of the constituents reviewed it was proposed to not permit any introduction at current detection limits. The vast majority of these are synthetic or petrochemical volatile and nonvolatile organics that are not commonly found in the CAP system or other natural water(s) and are generally associated with industrial activities.

There was notable discussion on the role of detection limits that could be applied to many of these compounds. Fundamentally, a particular compound may not be detectable with current laboratory technologies, but detection and quantification limits are constantly improving. Changes in technologies that potentially expose the measurement of a particular compound that had previously been non-detectable does not necessarily render the imported water non-compliant. Rather the new detection

[1] Including, Dr. Peter Mock (GRIC); Melodee Loyer, Sandy Elder (Tucson), Brian Biesemeyer Kathy Rall, (Scottsdale), Troy Hayes (Phoenix), Christa McJunkin ,Mike Ploughe (SRP), Chris Connor (Chandler), Warren Tenney (AMWUA)

limit would be reviewed in context of any relevant industry practices or emerging science regarding the compound. This review would be a requirement of the water quality monitoring program going forward.

Discussions for each constituent or constituent group were examined based on those fundamental queries. If there was not sufficient data available, or a current Maximum Contaminant Level (MCL) to recommend a specific introductory or delivery standard, a "characterize" response was noted. Characterization is a request to CAP to collect the needed water quality data for further evaluation. Characterization was limited to only 4% of the constituents in the list. Generally, when characterization was recommended it was determined that it is reasonable to allow sufficient time for data collection and review to occur without a significant impact to the overall water quality of the system. Those constituents identified for additional characterization are listed in Table 1.

Table 1 CHARACTERIZATION & MONITORING[2]	
Aluminum, Total, ICAP	Molybdenum
Antimony	Nickel
Bromide	Nitrite
Beryllium	Potassium, Total, ICAP
Cadmium	Radium-226+228
Cobalt, Total	Strontium, ICAP
Germanium	Tellurium
Gross Alpha	Thallium
Gross Beta	Vanadium
Mercury	

If sufficient data was available for the compound and the review concluded a reasonable basis for developing criteria, the technical group deliberated on an appropriate introductory and/or delivery standard. The result of those efforts are contained in Table 2 and reflect a continued consensus approach among CAP staff and stakeholders.

Table 2 CAP WATER QUALITY STANDARDS FOR NON-PROJECT WATER			
Constituent	**Units**	**CAP Introductory Standard**	**CAP Delivery Standard**
General			
Temperature	°F		Non-degradation
Dissolved Oxygen	mg/L		Non-degradation
pH		6.5 – 9.5	

[2] These compounds are all naturally occurring, changes in detection limits may make these detectable in imported and project water in the future.

Table 2 CAP WATER QUALITY STANDARDS FOR NON-PROJECT WATER			
Constituent	**Units**	**CAP Introductory Standard**	**CAP Delivery Standard**
Turbidity	NTU	9	6
Total Dissolved Solids (TDS)	mg/L	1150	747
Minor and Trace Metals			
Antimony	µg/L	6	Characterize
Arsenic	µg/L	10	5
Barium, Total, ICAP/MS	µg/L	2000	230
Chromium	µg/L	100	10
Copper, Dissolved[3]	µg/L	64	64
Hexavalent Chromium	µg/L	16	3
Iron, Dissolved ICAP	µg/L	1000	100
Lead	µg/L	15	3
Manganese, Total, ICAP	µg/L	250	27
Selenium	µg/L	50	20
Silver Total ICAP/MS	µg/L	100	20
Thallium, Total	µg/L	0.5	Characterize
Uranium	µg/L	30	5
Zinc	mg/L	1	0.03
Common Inorganic Compounds / Ions			
Alkalinity in CaCO3 units	mg/L	250	170
Calcium, Total, ICAP	mg/L	200	160
Chloride	mg/L	450	170
Fluoride	mg/L	4	0.7
Perchlorate	µg/L	15	No standard set
Sulfate	mg/L	400	250
Agricultural Concerns			
Boron	mg/L	1	0.15
Sodium, Total, ICAP	mg/L	350	110
Nutrients			
Ammonia Nitrogen	mg/L	Not allowed	Non Detect
Nitrate as Nitrogen	mg/L	10	1
Phosphorus, Total-P	mg/L	0.1	0.025
Total Organic Carbon	mg/L	6	4
Rows in grey were previously approved with June 7, 2018 consensus proposal.			

[3] Standards based on the ADEQ standards for aquatic, warm, ephemeral surface water

Temperature and Dissolved Oxygen (DO)

For Temperature and DO, no specific standards were identified, but the objective is non-degradation of existing canal water quality. While there is general concern about localized effects on canal biology from imported water that is anoxic or at extreme temperatures, it was concluded that any localized effects would be addressed in the project approval water quality review process.

Turbidity

Natural variability in turbidity, particularly at lower levels, is common and caused by biological activity and/or short-term event driven circumstances. For example, sensors reading turbidity in real-time can often show a range of 3-15 NTU in a 24 hour period due to algal activity alone. This pattern will generally mimic that of the 24 hour dissolved oxygen cycle observed in shallow surface waters. Additionally, short-term disturbance near a sensor from fish and or floating debris can often show elevated turbidity for several minutes and then pass. Brief rainfall events can also result in short-term but localized higher turbidity events. As such, the introductory standard for turbidity is offered as a guideline to be met by operational controls and/or daily averaging. Discharges during events such as significant storms or flooding that are expected to result in turbid waters would by nature result in operational decisions to discontinue discharges until such events pass.

Alkalinity

Significant discussion occurred with respect to alkalinity. The City of Tucson raised specific concerns with the long-term median of alkalinity increasing over time in their regional aquifer, and the impacts that are projected to occur in their distribution system unless pH adjustment is implemented. Tucson objects to having to implement any treatment process due to the introduction of non-project water to the canal, and contends that the entity introducing non-project water to the canal should bear the cost of treatment. Consequently, they requested that introduced waters not increase the alkalinity median in the CAP source water.

After further discussions and evaluation, it was determined that historically CAP water has a very narrow band of fluctuation relative to alkalinity. The narrow band suggests the possibility that there is significant alkalinity buffering occurring in the CAP water supply, and that introduced supplies with higher alkalinity may not raise the median level. CAP staff will continue to analyze the buffering potential. Given this discussion, and commitment for further evaluation of buffering potential, Tucson suspended its objections to the proposed introductory and delivery standards. If it is found that buffering in the canal is not effective, pH adjustment of non-project water may be necessary.

Salinity (TDS)

Salinity was one of the set of six standards addressed under the June 7th consensus proposal, and the delivery standard of 723 mg/L was tied to the standard adopted by the Colorado River Basin Salinity Control Forum at Hoover Dam. However, the Forum's standard at Parker Dam (Lake Havasu, where CAP's intake is located) is 747 mg/L. It was acknowledged that the consensus proposal was intended to conform to the standard established by the Forum at the point of CAP diversion, consequently the delivery standard was adjusted to align with the criteria at Parker Dam of 747 mg/L.

Algal Toxins

Algal toxins will be monitored and measured as needed. Data collected from regional sources will also be incorporated.

Pathogens

No specific standards on pathogens were set but generally pathogens should not be allowed. The group recommends that pathogens should be addressed in the specific project approval process and continually be part of the water quality review program which would include monitoring. Specific Pathogens reviewed are identified in Table 3

Table 3 PATHOGENS	
Cryptosporidium	E. Coli
Giardia	HPC
Coliform, Total	L. Pneumophilia

Prohibited Compounds

Compounds that are prohibited from introduction into the CAP system at current detection limits are listed below in Table 4.

Table 4 NOT ALLOWED / NON-DETECT		
1,1,1,2,-Tetrachloroethane	Bromoethane	Metolachlor oxanilic acid (OA)
1,1,1-Trichloroethane	Bromoform	Molinate
1,1,2,2-Tetrachloroethane	Bromomethane (Methyl Bromide)	MonoBromoaCetic Acid
1,1,2-Trichloroethane	Butylated hydroxyanisole	MonoChloroAcetic Acid
1,1-Dichloroethane	Captan	Naphthalene
1,1-Dichloroethylene	Carbaryl	N-ButylBenzene
1,1-Dichloropropene	Carbofuran (Furadan)	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
1,2,3-Trichlorobenzene	Carbon Disulfide	Nitrobenzene
1,2,3-Trichloropropane	Carbon Tetrachloride	Nitroglycerin
1,2,4-Trichlorobenzene	Chloramben	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
1,2,4-Trimethylbenzene	Chlordane	N-Methyl-2-pyrrolidone
1,2-Dibromo-3-Chloropropane	Chlorobenzene	N-nitrosodiethylamine (NDEA)
1,2-Dichlorobenzene	Chlorodibromoacetic Acid	N-nitrosodimethylamine (NDMA)
1,2-Dichloroethane	Chlorodibromomethane	N-nitroso-di-n-propylamine (NDPA)
1,2-Dichloropropane	Chloroethane	N-Nitrosodiphenylamine
1,3,5-Trimethylbenzene	Chloroform (Trichloromethane)	N-nitrosopyrrolidine (NPYR)
1,3-Butadiene	Chloromethane(Methyl Chloride)	Nonylphenol2
1,3-Dichlorobenzene	cis-1,2-Dichloroethylene	Norethindrone (19-Norethisterone)
1,3-Dichloropropane	Clethodim	N-PropylBenzene
1,3-DichloroPropene	Cumene hydroperoxide	Ortho-Xylene
1,4 DichloroBenzene	Cyanotoxins	o-Toluidine
1,4-Dioxane	Dacthal	Oxamyl
17alpha-estradiol	Dalapon	Oxirane, methyl
1-Butanol	Di-(2-Ethylhexyl)adipate	Oxydemeton-methyl
2,2-Dichloropropane	Di(2-Ethylhexyl)phthalate (AKA Bis (2-ethylhexyl) phthalate, DEHP)	Oxyfluorfen
2,4,5-T	Dibromoacetic Acid	ParaQuat
2,4,5-TP (Silvex)	Dibromochloromethane	p-Chlorotoluene
2,4-D	Dibromomethane	p-Dichlorobenzene (1,4-DCB)
2,4-DB	Dicamba	PentaChloroPhenol
2-Butanone (MEK)	Dichloroacetic Acid	Perfluorobutanesulfonic acid (PFBS)
2-ChloroToluene	Dichlorodifluoromethane	Perfluorodecanoic acid (PFDA)

Table 4 NOT ALLOWED / NON-DETECT		
2-Methoxyethanol	Dichloromethane	Perfluorododecanoic acid (PFDoA)
2-Propen-1-ol	Dichlorprop	Perfluoroheptanoic acid (PFHpA)
3,5-Dichlorobenzoic acid	Dicrotophos	Perfluorohexanesulfonic acid (PFHxS)
3-Hydroxycarbofuran	Dieldrin	Perfluorohexanoic acid (PFHxA)
4,4'-DDD	Di-isopropyl ether	Perfluorononanoic acid (PFNA)
4,4'-DDE	Dimethipin	Perfluorooctanesulfonic acid (PFOS)
4,4'-DDT	Dinoseb	Perfluorooctanoic acid (PFOA)
4,4'-Methylenedianiline	Diquat	Perfluorotetradecanoic acid (PFTA)
4-Chlorotoluene	Diuron	Perfluorotridecanoic acid (PFTrDA)
4-IsopropylToluene	Endothall	Perfluoroundecanoic acid (PFUnA)
4-Methyl-2-Pentanone (MIBK)	Endrin	Permethrin
4-Nitrophenol (qualitative)	Equilenin	Picloram
Acephate	Equilin	p-Isopropyltoluene
Acetaldehyde	Erythromycin	Profenofos
Acetamide	Estradiol (17-beta estradiol)	ProPoxur
Acetochlor	Estriol	Quinoline
Acetochlor ethanesulfonic acid (ESA)	Estrone	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
Acetochlor oxanilic acid (OA)	Ethinyl estradiol (17-alpha ethynyl estradiol)	sec-Butylbenzene
Acifluorfen	Ethoprop	Silicone
Acrolein	Ethyl benzene	Simazine
Alachlor	Ethylene Dibromide	Styrene
Alachlor ethanesulfonic acid (ESA)	Ethylene glycol	Tebuconazole
Alachlor oxanilic acid (OA)	Ethylene oxide	Tebufenozide
Aldicarb (Temik)	Ethylene thiourea	Tert-ButylBenzene
Aldicarb sulfone	Fluorotrichloromethane-Freon11	TetraChloroEthene
Aldicarb sulfoxide	Formaldehyde	ThioBenCarb
Aldrin	Gamma-BHC	Thiodicarb
Alpha-Chlordane	Gamma-Chlordane	Thiophanate-methyl
alpha-Hexachlorocyclohexane	Glyphosate	Toluene
Aniline	HCFC-22	Toluene diisocyanate
Aroclor 1016	Heptachlor	Tot DCPA Mono&Diacid Degradate
Aroclor 1221	Heptachlor Epoxide (isomer B)	Total HaloAcetic Acids (HAAS)
Aroclor 1232	Hexachlorobenzene	Total Kjeldahl Nitrogen
Aroclor 1242	Hexachlorobutadiene	Total PCB
Aroclor 1248	Hexachlorocyclopentadiene	Total TRiHaloMethanes

Table 4 NOT ALLOWED / NON-DETECT		
Aroclor 1254	Hexane	Toxaphene
Aroclor 1260	Hydrazine	Trans-1,2-DichloroEthene
Atrazine	Isopropylbenzene	Trans-1,3-Dichloropropene
Baygon	Lindane	Trans-NonAchlor
Bensulide	M/P-Xylenes	Tribufos
Bentazon	m-Dichlorobenzene (1,3-DCB)	TriChloroAcetic Acid
Benzene	Mestranol	TriChloroEthene
Benzo(a)pyrene	Methamidophos	TriChloroFluoroMethane
Benzyl chloride	Methanol	Triethylamine
Bis(2-Ethylhexyl) Phthalate	Methiocarb	Triphenyltin hydroxide (TPTH)
Bromobenzene	Methomyl	Urethane
Bromochloroacetic Acid	Methoxychlor	Vinclozolin
Bromochloromethane	Methyl Tert-butyl ether (MTBE)	Vinyl Chloride
Bromodichloroacetic Acid	Metolachlor	Xylenes (total)
Bromodichloromethane	Metolachlor ethanesulfonic acid (ESA)	Ziram