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Jacobs, working in collaboration with the Harquahala Valley Water Project (HVWP), appreciates the opportunity to provide comments on the *Draft Water Quality Guidance for the Introduction of Non-Project Water into the Central Arizona Project* document. Jacobs and HVWP recognize the challenges and complexity faced by CAP and Reclamation in developing the contents of this document to balance a range of policy concerns.

In this context, Jacobs and HVWP has spent considerable time and effort evaluating the document with particular focus on Tables A-1 through A-3. We would like to compliment CAP for the content of Tables A-2 and A-3 and the clarity they have brought relative to the content of Table 4 in the January 2019 Water Quality Standards Task Force document. These changes will allow potential non-project water users to better assess how compliance can be achieved for this significant list of organic compounds.

With regard to Table A-1, we strongly urge CAP to reconsider the proposed use of three times the method reporting limit (3x MRL) as the basis for establishing temporary introduction standards for the sixteen (16) constituents listed under the header "CAP Priority Contaminants – Characterize". We recognize that the concentrations of these constituents were not adequately characterized in the CAP supply prior to the start of temporary introduction standards setting process. However, we firmly believe that setting such stringent a set of standards is contrary to the intent of the CAP Board and other stakeholders to augment (or substitute) the CAP supply with non-project water, including recovered CAP water which has infiltrated through the vadose zone and mixed with in situ groundwater.

Since January 2020, CAP has sampled the CAP system for these and many other constituents. CAP has now developed a preliminary data set (four samples) that can be used in guiding the establishment of temporary introduction standards. Utilizing these data (as made available on the CAP website), we calculated the average and maximum values for each of the sixteen parameters using data for 2015 through 2020 as sampled at the Havasu Pumping Plant. These data, along with the draft temporary introduction standards, are shown in Table 1. Given that data now exists to quantify these sixteen constituents (where levels exceed the MRL), we believe it reasonable to establish temporary introduction standards that consider the CAP water quality data shown in Table 1 along with the approach that was used in establishing introduction

standards for the CAP Priority Constituents listed in Table A-1 of the Draft Water Quality Guidance document.

The CAP Priority Constituents are listed in Table 2, along with their associated drinking water maximum contaminant limits (MCLs), introduction standards, delivery standards and CAP average values over the 2015-2019 monitoring period. In examining the relationship between the introduction standards, the MCLs and the CAP 5-year average values, it is evident that the Water Quality Standards Task Force and CAP set the introduction standards based on either (1) the MCL, or (2) a 'dilution factor'. The MCL approach recognizes that introduction of non-project water should comply with applicable drinking water standards while the 'dilution factor' approach recognizes that the concentration of a priority constituent present in non-project water would be reduced or diluted when mixed with the much greater volume of project water. The dilution factor, or ratio of introduction standard (IS) divided by CAP 5-year average value (CAP), is shown in furthest right column in Table 2 for those constituents for which the introduction standard was not based on the MCL. In either case, the CAP Priority Constituent introduction standards were set to allow a higher concentration in the non-project water while still achieving an acceptable delivery standard. The dilution factors ranged from 1.3 to 320, with most ranging from 1.3 to 8.2.

Table 1.

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Constituent	Units	Draft Temporary Introduction Standard (3x MRL)	Primary or Secondary MCL	CAP Average (2015-2020)	CAP Maximum (2015-2020)
CAP Priority Contaminants - Characterize					
Alpha, Gross	pCi/l	9	15	5.1	6.6
Aluminum, Total, ICAP	µg/l	60	50 - 200	181	480
Beryllium	µg/l	3	4	ND	ND
Beta, Gross	pCi/l	9	50	5.88	7.90
Bromide	µg/l	15	None	81	110
Cadmium	µg/l	1.5	5	ND	ND
Cobalt, Total	µg/l	6	None	ND	ND
Germanium	µg/l	0.9	None	ND	ND
Mercury	µg/l	0.6	2	ND	ND
Molybdenum	µg/l	6	None	4.5	4.9
Nickel	µg/l	15	None	ND	ND
Nitrite	µg/l	0.15	1	ND	ND
Potassium, Total, ICAP	µg/l	3	None	4.82	5.70
Radium-226+228	pCi/l	3	5	ND	ND
Strontium, ICAP	mg/l	0.03	None	1.10	1.30
Vanadium	µg/l	9	None	3.1	6.9

With the availability of both MCLs and CAP quality data, we believe the same approach should be considered in setting temporary introduction standards for the sixteen "Characterize" contaminants listed in Table 1. To this point, we have listed the 'Characterize' contaminants in Table 3 along with the draft temporary introduction standard, MCLs and the CAP average quality over the 2015-2020 monitoring period. Using this information, and the approach used for the Priority constituents, we have developed proposed temporary introduction standards that reflect the application of (1) the drinking water MCL (where available) or a (2) dilution factor (listed under the column 'Proposed NpW:CAP Ratio'). The proposed temporary introduction standards and NpW:CAP ratios are shown in Table 3. The use of the MCL/dilution factor approach would allow introduction of HVWP and other recovered groundwater supplies into the canal while still maintaining Project water quality within historic quality ranges. The proposed dilution factors range from 1 to 13 and certainly fall within the IS:CAP ratio range in Table 2.

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Table 2.

Constituent	Units	Primary[1] or Secondary[2] MCL	Introduction Standard	Delivery Standard	CAP 5 Year Average (2015-2019)	IS:CAP Ratio
CAP Priority Constituents						
Alkalinity in CaCO3 units	mg/l	none	250	170	122	2.0
Ammonia Nitrogen	mg/l	none	0.05	0.05	0.04	1.3
Arsenic	µg/l	10[1]	10	5	2.9	3.4
Barium, Total, ICAP/MS	µg/l	2000[1]	2000	230	123	16
Calcium, Total, ICAP	mg/l	none	200	160	73	2.8
Chloride	mg/l	none	450	170	92	4.9
Hexavalent Chromium	µg/l	100[1*]	16	3	0.05	320
Manganese, Total, ICAP	µg/l	50[2]	250	27	5.7	44
Nitrate as Nitrogen	mg/l	10[1]	10	1	0.12	83
Phosphorus, Total-P	mg/l	none	0.1	0.025	0.02	5.0
Sodium, Total, ICAP	mg/l	none	350	110	93	3.8
Sulfate	mg/l	250[2]	400	250	237	1.7
Total Dissolved Solids (TDS)	mg/l	500[2]	1150	747	630	1.8
Turbidity	NTU	none	9	6	1.1	8.2
Uranium	pCi/l	30[1]	30	5	4.1	7.3
*MCL is for total chromium which includes hexavalent chromium						

Table 3.

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Constituent	Units	Draft Temporary Introduction Standard (3x MRL)	Primary[1] or Secondary[2] MCL	CAP Average (2015-2020)	Proposed NpW:CAP Ratio*	Proposed Temporary Introducton Standard**
CAP Priority Contaminants - Characterize						
Alpha, Gross	pCi/l	9	15[1]	5.1	MCL	15
Aluminum, Total, ICAP	µg/l	60	50 - 200[2]	181	3x MRL	60
Beryllium	µg/l	3	4[1]	ND	MCL	4
Beta, Gross	pCi/l	9	50[1]	5.88	MCL	50
Bromide	µg/l	15	None	81	8.0	648
Cadmium	µg/l	1.5	5[1]	ND	MCL	5
Cobalt, Total	µg/l	6	None	ND	3x MRL	6
Germanium	µg/l	0.9	None	ND	3x MRL	1.8
Mercury	µg/l	0.6	2[1]	ND	MCL	2
Molybdenum	µg/l	6	None	4.5	3	15
Nickel	µg/l	15	None	ND	3x MRL	15
Nitrite	ug/L	0.15	1000[1]	ND	MCL	1000
Potassium, Total, ICAP	µg/l	3	None	4.82	2	11.6
Radium-226+228	pCi/l	3	5[1]	ND	MCL	5
Strontium, ICAP	mg/l	0.03	None	1.10	1	1.3
Vanadium	µg/l	9	None	3.1	13	40

*NpW = Non-Project Water
**Where MCL is in place, proposed value is based on MCL. Where no MCL is established or value for CAP is ND, proposed value is based on 3x MRL.

Many groundwaters in central and southern Arizona have higher concentrations of the "Characterize" contaminants compared to levels in the CAP supply. This reflects well-understood differences between Arizona groundwaters and Colorado River water. Reducing groundwater levels of these constituents to their 3x MRLs, or even background CAP levels, will very likely result in the need for reverse osmosis treatment for many introduced groundwater supplies—including recovered CAP water. Use of the proposed MCL and dilution factor approach will help CAP achieve the balance of important policy goals mentioned above.

Moreover, the use of dilution factors for the introduction of non-project water is further justified by the degree of dilution that will occur when non-project water is mixed with CAP water. To illustrate this, we have calculated the impact on CAP water quality for the following CAP & HVWP groundwater blending scenarios:

Blend 1: 1 million acre feet of CAP water with 5,000 acre feet of groundwater
Blend 2: 1 million acre feet of CAP water with 20,000 acre feet of groundwater
Blend 3: 1.347 million acre feet of CAP water with 5,000 acre feet of groundwater
Blend 4: 1.347 million acre feet of CAP water with 20,000 acre feet of groundwater

The volumes used in this analysis are based on the following:

- 1 million acre feet represents the estimated annual volume of CAP water that would be available under a shortage condition.
- 1.347 million acre feet represents the volume of CAP delivered in 2019
- 5,000 acre feet represents the volume of water to be supplied to the first customer of the HVWP
- 20,000 acre feet represents the production capacity of Phase 1 of the HVWP

The quality of the blended waters for each of the sixteen "Characterize" constituents were compared with the maximum values measured in the CAP system from 2015-2020. The results are shown in Table 4. Based on the high degree of dilution, the addition of HVWP groundwater under all four blending scenarios results in negligible increases in the concentration of all "Characterize" constituents with blend water concentrations well below the maximum concentrations seen in the six-year period of water quality monitoring at the Havasu Pumping Plant.

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Table 4.

Parameter[1]	Units	MRL	CAP Average[2]	CAP:HVWP Blend 1[a]	CAP:HVWP Blend 2[b]	CAP:HVWP Blend 3[c]	CAP:HVWP Blend 4[d]	CAP Maximum[2]	Blends > CAP Maximum?
Alpha,Gross	pCi/L	3	5.1	5.1	5.1	5.1	5.1	6.6	No
Aluminum Total ICAP	ug/L	20	181	180	178	181	179	480	No
Beryllium	ug/L	1	ND	ND	ND	ND	ND	ND	No
Beta, Gross	pCi/L	3	5.9	5.9	5.9	5.9	5.9	7.9	No
Bromide	ug/L	5	81	84	92	83	89	110	No
Cadmium	ug/L	0.5	ND	ND	ND	ND	ND	ND	No
Cobalt	ug/L	2	ND	ND	ND	ND	ND	ND	No
Germanium	ug/L	0.3	ND	ND	ND	ND	ND	ND	No
Mercury	ug/L	0.2	ND	ND	ND	ND	ND	ND	No
Molybdenum	ug/L	2	4.5	4.5	4.6	4.5	4.6	4.9	No
Nickel	ug/L	5	ND	ND	ND	ND	ND	ND	No
Nitrite Nitrogen	mg/L	0.05	ND	ND	ND	ND	ND	ND	No
Potassium Total ICAP	mg/L	1	4.82	4.82	4.82	4.82	4.82	5.70	No
Radium 226+228	pC/L	3	ND	ND	ND	ND	ND	ND	No
Strontium , ICAP	mg/L	0.01	1.1	1.1	1.1	1.1	1.1	1.3	No
Vanadium	ug/L	3	3.1	3.2	3.7	3.2	3.5	6.9	No

[1]At the Havasu Pumping Plant

[2]2015 - 2020

[3]ND = not detect (less than the MRL)

[a]Blend of 1 Million AF of CAP water with 5000 AF of HVWP Water

[b]Blend of 1 Million AF of CAP water with 20000 AF of HVWP Water

[c]Blend of 1.347 Million AF of CAP water with 5000 AF of HVWP Water

[d]Blend of 1.347 Million AF of CAP water with 20000 AF of HVWP Water