Response to the Independent Science Advisory Panel Workshop No. 4 Report

Questions to the Panel

The following questions were presented to the Panel, and are addressed in this technical letter report:

1. What additional information beyond the current data presented does the panel feel is needed to support regulatory application for a 2.5 log credit for MBR?
2. What additional information beyond the current data presented does the panel feel is needed to demonstrate the product water will be suitable for groundwater recharge in the proposed groundwater basins?
3. Is the secondary MBR testing and monitoring plan sufficient to evaluate the viability of the secondary MBR in this application?

Panel General Comments

The Panel recognizes Metropolitan's substantial effort to move the Project forward since Workshop 3. The Panel also appreciates the quality of the written material and presentations prepared by the Project Team in support of the Panel's Workshop 4 review. However, the Panel is unable to give a consensus opinion on the desirability of secondary versus tertiary MBR alternatives. Therefore, the Panel looks forward to reviewing the results of further evaluation by the Project Team.

The Panel understands that the Project Team intends to present supplemental information related to Questions 1 and 2 at or before Workshop 5. Meanwhile, the Panel offers the following observations, findings, and recommendations.

General Response:

It should be noted that the demonstration facility at the Regional Recycled Water Advanced Purification Center (APC) has been in operation since October 2019. The treatment processes at the demonstration facility are comprised of a membrane bioreactor (MBR), reverse osmosis (RO) membranes, and ultraviolet light/advanced oxidation process (UV/AOP). The ongoing demonstration project is being pursued to build upon work previously completed at the smaller pilot scale and demonstrate the ability to reliably and cost-effectively treat JWPCP effluent while meeting all regulatory requirements and operational objectives. The primary objective of this project continues to be demonstration of pathogen removal through the MBR to ultimately receive pathogen log reduction credits and technology acceptance of the MBR process from the State Water Resources Control Board, Division of Drinking Water (DDW) for a potable reuse treatment train. A secondary objective of the project is ensuring that all required treatment objectives are met through the demonstration facility that would ultimately inform the decision for the full-scale AWT treatment process train.

In 2018, a Nitrogen Management workgroup formed to explore cost-effective and reliable alternatives and identify a comprehensive nitrogen management strategy, considering the potential treatment options at both the JWPCP and AWT Facility. Five potential treatment trains were identified for further consideration, of which, three unique MBR-based train options could be evaluated at the demonstration facility:

1. N-only Tertiary MBR (tMBR) + Two-Pass RO.
2. NdN Secondary MBR (sMBR) + Single-Pass RO
3. NdN tMBR + Single-Pass RO

A decision has not yet been made on the desirability of a secondary versus tertiary MBR configuration. Data generated from demonstration testing at the APC will be one component of the evaluation required to compare the feasibility and desirability of each alternative and its variations. Metropolitan, along with LACSD, submitted to DDW a final Testing and Monitoring Plan (TMP) for the demonstration project at the Advanced Purification Center using the Option 3, NDN tMBR + single-pass RO configuration for this TMP. However, due to demonstration facility configuration limitations, this treatment train was unable to meet key water quality goals, and instead, Option 1, N-only tMBR + Two-Pass RO was evaluated for the first phase of demonstration testing. New results and conclusions from tertiary MBR testing will be shared with the Panel in the upcoming Workshop 5 for further evaluation.

Metropolitan and LACSD developed a TMP for the NDN sMBR + single-pass RO configuration, which was submitted to DDW in August 2021, and are awaiting approval prior to beginning testing this configuration at the demonstration facility. Now that the N-only tMBR testing has concluded, the demonstration facility is undergoing several months for the proper transition to an NDN sMBR configuration, with testing anticipated to start in 2022 upon approval of the TMP from DDW. LACSD's bench- and pilot-scale studies for the biological secondary NDN process discussed further herein will help to ensure that operational and performance targets can be achieved at the demonstration facility upon startup of NDN sMBR.

Question 1: What additional information beyond the current data presented does the panel feel is needed to support regulatory application for a 2.5 log credit for MBR?

Response**.** The Panel appreciates the updated information and agrees with Project staff that more information will help it draw firm conclusions for this question. The investigations and results of the tertiary MBR Log Removal Values (LRVs) are excellent and impressive. The Panel offers the following findings and recommendations:

a. The Panel recommends and encourages the same level of monitoring and analytical effort to investigate secondary MBR LRVs and looks forward to seeing the results of the tertiary MBR LRVs for viruses. The Panel asks the Project Team to:

   i. Present the final recommended operational parameters and performance envelope for both MBR investigations.

Response: The secondary MBR testing and monitoring plan is currently planned to increase the amount of monitoring and analytical work from the tertiary MBR effort. The same amount of testing will be performed on the Suez MBR, with additional new testing performed on the DuPont MBR pending that system's membrane replacement to return it to factory performance. The virus concentrations will be quantified using molecular and culture based techniques, but the focus remains on securing pathogen credits for the protozoa in the secondary MBR testing as it was in the tertiary MBR testing.

ii. Use the more straightforward analytical method (i.e., empirical method) to present and document LRVs. In addition, the Panel encourages publication of the laboratory methods, including applicable quality assurance and quality control protocols.

Response: Thank you for the feedback. The project team concurs that the analytical method is the preferred method and will continue to present the LRVs with and without recovery corrections. The project team also agrees that a publication would benefit the industry and will be developing a manuscript at the completion of the tertiary MBR testing.

b. The Panel recommends that Metropolitan:

i. Analyze both primary wastewater and MBR samples using an appropriate screening method for pathogens of concern other than enterics. This effort will help determine if cultures should include additional specific microbial or molecular biological tests.

Response: Non-enteric pathogens, such as *Legionella pneumophila*, are the focus of several ongoing Water Research Foundation and EPA sponsored projects. Metropolitan staff serve on the Project Advisory Committees for some of those projects. We are closely watching the development of research in this area and the publication of new data. Outcomes of those studies will be taken into consideration for the development of future research projects at the APC after completion of the sMBR TMP.

ii. Design a study of LRVs for reverse osmosis (RO) using surrogates

Response: Recent studies completed by other AWT facilities have demonstrated the potential increased pathogen LRV through RO using surrogate online monitoring other than conductivity/TOC. As the focus of the current testing phase is pathogen removal through the MBR, increased LRVs through RO is something that would be considered at a future project phase.

c. The Panel finds that aerobic spores with a somewhat lower LRV than the other analytes merits further investigation. It recommends that regrowth of aerobic spores in biological treatment be assessed as a potential cause.

Response: We agree with the Panel that the lower LRV for aerobic endospores observed during the baseline testing was somewhat unexpected. Significant additional data has been obtained during challenge testing with compromised MBR membranes. Data for aerobic endospores, *C. perfringens* (anaerobic) endospores, and several other potential microbial surrogates are currently being analyzed alongside *Cryptosporidium* and *Giardia* data. If aerobic endospores appear to be a useful surrogate for *Cryptosporidium* and *Giardia* removal, further investigation will be discussed.

Question 2: What additional information beyond the current data presented does the panel feel is needed to demonstrate the product water will be suitable for groundwater recharge in the proposed groundwater basins? All of this is outside of sMBR testing but can be pursued in parallel?

Response. The Panel appreciates the updated information and agrees with the Project Team that more information will help it draw firm conclusions to this question. The Panel offers the following findings and recommendations.

d. The Panel recommends evaluating the post-advanced oxidation process (AOP) water treatment strategy and any anticipated modifications that will be necessary for water transport and recharge, including:

   i. Assessing the effects of chemicals used in the AOP process, transport pipeline chlorine residuals, and post-RO water quality adjustments to minimize aggressiveness to concrete and cement mortar.
   ii. Aggressive water can degrade cement and mortar-lined pipe, shortening the life of pipe and lining and suspending sediment that can clog basins or injection wells. The Panel notes that injection wells are more sensitive to the effects of aggressive water.

e. The Panel recommends developing a post-treatment water testing program to help identify cost-effective strategies to manage and mitigate the effects of aggressive water on Project facilities including:

   i. Coupon testing of various potential pipeline materials using conditioned product water.
   ii. Limiting nitrosamine re-formation using treatment options. This should focus on NDMA formation potential when free chlorine is evaluated in lieu of hydrogen peroxide in the AOP system, because free chlorine can oxidize NDMA precursors and beneficially reduce NDMA re-formation in post-AOP-treated water.

f. The Panel recommends assessing dissolution of undesirable chemicals from aquifer materials. It is important to understand the compatibility of recharge water quality with aquifer chemistry in the various recharge basins to ensure that aquifer water quality will not be degraded. Leachate testing on soil samples from the recharge basins using product water will provide information on the effects of recharge water on the aquifer. Experience at Orange County Water District has shown that the water may remain aggressive even with post-AOP water conditioning. Injected water may require redox studies with core samples.

g. The Panel recommends identifying an intrinsic tracer or fingerprint for the final product water that can be used to assess travel times in the recharge facilities. The tracer should:

   iii. Be chemically stable.
   iv. Be easy to detect in trace amounts.
   v. Have a higher concentration in the final product water than in the receiving groundwater.
   vi. Not sorb to soil particles.

h. In addition to potential anion tracers, the Panel recommends considering isotopic tracers such as oxygen, deuterium, and strontium, and further recommends collecting weekly post-UV/AOP water samples to characterize seasonal variation.

i. Given the schedule for the RRWP and the expressed intent to expand from groundwater recharge to direct potable reuse (DPR), the Panel recommends planning for DPR alternatives at the same time as the additional MBR process testing efforts. This planning is a necessary and critical element of the environmental documents. The Panel understands that more information on DPR plans will be forthcoming at the next Panel meeting in 2021.

Response: Acknowledged and appreciated for all this input. Post-treatment piloting is underway to investigate these items.

Boron Recommendations

The lowest groundwater criterion for boron appears to be a potential issue in developing groundwater recharge alternatives. Boron concentrations in the advanced water treatment product water range from 0.46 to 0.56 mg/L with a median concentration of 0.49 mg/L (see Slide 120). The Main San Gabriel Basin Plan objective is 0.5 mg/L. The adjustment of pH and implementation of a second-pass RO to remove boron was stated as having a significant cost. Therefore, the Panel:

j. Recommends that Metropolitan more precisely characterize both capital and O&M costs required to meet Project boron criteria.

k. Is interested in hearing more about Metropolitan's boron management strategy. The Panel continues to encourage the Project Team to investigate the Los Angeles Regional Water Quality Control Board (RWQCB) and the State Water Board's technical and public health bases that support the current groundwater basin plan boron water quality criteria.

l. The boron limit was likely established to protect historical agricultural crops. Human health risk is not a factor at levels below 6 mg/L, which is the EPA Lifetime Health Advisory. The WHO Guideline for boron is 2.4 mg/L (increased from 0.5 many years ago), which may be sufficient to avoid second-pass RO costs and provide a larger margin of safety.

m. Recommends that the Project Team consider all available regulatory routes to modify these criteria, assuming the technical and public health rationales warrant a change. One possible route to consider is the availability of new information. Unless the current Main San Gabriel Basin Plan objective for boron is modified, additional costly—and potentially unnecessary—treatment may need to be considered.

n. The Panel further recommends that Metropolitan consider maximum benefit objectives such as were implemented in the Chino Basin. The Chino Basin Watermaster used such an approach for nitrogen and total dissolved solids (TDS). The Watermaster developed higher nitrogen and TDS objectives to replace the lower Basin Plan objectives for these constituents. Chino Basin pursued this Basin Plan amendment with the Santa Ana RWQCB to enable Chino Basin to recharge tertiary treated wastewater with concentrations that exceeded the Basin Plan, because doing so provided maximum benefit to basin water users. Please refer to the order here: https://www.waterboards.ca.gov/santaana/board_decisions/adopted_orders/orders/2004/04_001.pdf.

o. The amendment process included: developing an updated water quality control plan, chartering a task force consisting of water and wastewater agencies, conducting studies, holding public hearings, and Regional and State Board review and approval. The process began in 1994 and culminated in the amended Basin Plan in January 2004.

p. Given the range of observed product water boron concentrations, the Panel recommends

that the Project Team consider negotiating a boron rolling average with the RWQCB. The rolling average should account for fluctuations (quarterly or annual) for discharges to injection wells and recharge basins that may bring it into compliance.

q. This would likely bring the boron concentrations in line with current Basin Plan objectives. Blending may be a fallback approach if amendments to the Basin Plan objectives are unsuccessful and if blending is less expensive than other treatment alternatives, such as ion exchange.

r. The Panel notes, as stated in the Workshop 4 presentation, that the Main San Gabriel Groundwater Basin (Basin) is adjudicated. The adjudication settlement establishes specific rights and duties of basin water producers and beneficiaries and creates a court-appointed Watermaster with substantial scope and authority. The Watermaster has authority over water quality in the Basin and has been granted plenary authority on the volume and quality of any supplemental water added to the Basin via surface spreading. The Watermaster annually produces a one- and five-year Water Quality Supply Plan (WQS Plan). The WQS Plan process officially begins in April each year.

s. In developing the Plan, the Watermaster considers RWQCB Basin Plan objectives and, "…shall also balance the need to maintain adequate water supplies with the need to preserve basin water quality." The Watermaster's current WQS Plan includes an objective to "…collaborate in the Metropolitan Water Districts Regional Recycled Water Program." Two of the three Basin producers are member agencies of the Metropolitan Water District of Southern California and use imported water to meet certain groundwater replenishment and quality obligations under the settlement. Accordingly, the Watermaster is an influential and essential ally in efforts to modify the boron criteria for the Basin.

The Panel recommends that Metropolitan consider appealing to the Watermaster for reconsideration of the current boron limit, consistent with accepted public health standards, applicable Basin water quality goals, and needed Basin water production, beginning in the next WQS planning cycle.

Any plan to change the boron limit may be a 2- to 10-year process. Decisions will need to be made sooner for boron treatment. Second-pass RO is a technical option to achieve this. The panel is not advocating second-pass RO, but provides technical considerations therein. Many benefits could be gained from second-pass RO beyond boron removal, for example: removal of other inorganic/organic solutes, more pathogen removal potential, and production of non-potable water (second-pass RO retentate) for on-site uses instead of going to discharge. These benefits should be articulated more clearly and potentially assigned an economic value. The Panel agreed that the non-technical, management/policy approach of encouraging recharge into the Basin should have priority.

Response: Acknowledged and agreed. Significant effort has been made to evaluate options for addressing boron. An extensive boron source investigation was conducted by LACSD in 2018, which discovered that the combined boron loading from the top ten industrial categories accounted for approximately 97% of the total industrial boron contribution to the JWPCP. The industrial category that was the largest boron contributor was identified as oil fields. Follow-up studies showed that pretreatment for boron source control would be very cost-prohibitive and recommended that further boron management strategies be revisited following demonstration plant evaluations. Approximately 40% boron removal was observed at the demonstration

plant through the double pass RO system, without any pH adjustment for increased removal. Since demonstration testing was conducted with new RO membranes, it is expected that boron rejection would decrease over time with membrane degradation, and with a single pass RO system. Therefore, a lower boron rejection of 30% was estimated for a future AWT facility, based on boron rejection anticipated with single pass RO (using actual boron profile data through the double pass RO system), and minimum rejection levels projected by RO membrane suppliers. Using these low boron removals, levels observed at the demonstration plant influent during tertiary MBR testing, and historical levels at JWPCP, conservative boron concentrations expected from a future AWT facility was estimated to be 0.6 to 0.8 mg/L. At these concentrations, the RRWP would utilize approximately 40% of the assimilative capacity within the basin. In consultation with the Main San Gabriel Watermaster, it was decided to work within the existing Salt and Nutrient Management Plan (SNMP) process using the available assimilative capacity. Since there are no other recycled water projects anticipated within the basin, an addendum to the basin's current SNMP will be prepared by Watermaster staff to address introduction of purified water from the RRWP.

Question 3: Is the secondary MBR Testing and Monitoring Plan sufficient to evaluate the viability of the secondary MBR in this application?

Response. The Panel has the following recommendations as to the general sufficiency of the MBR Testing and Monitoring Plan:

t. Fully explain the introduction of primary treated wastewater into the treatment process to account for potential reduction or elimination of a treatment barrier or introduction of a new critical control point (CCP) to account for shock loading and less hydraulic residence time to respond to incoming flow variability. Also, evaluate the effects of changing the secondary treatment modality from pure oxygen and potentially having an impact on VOCs or other pollutants. Other pollutants could include odor compounds such as natural compounds (geosmin), synthetic fragrances, or anything with high Henry's constant.

Response: The text of the TaMP will be updated to incorporate the potentially reduced treatment barriers. Semi-volatile compounds will be added to routine testing to account for the potential loss in stripping from eliminating the high purity oxygen secondary treatment.

u. Quantify additional benefits of second-pass RO, for example, for nitrate or boron. If/when used for nitrogen management, consider adding a nitrate sensor before the AOP process as a CCP. A target of 2.4 mg NO3-N/L can be achieved by different percentage flows being treated by the second-pass RO system. There is no regulatory benefit of lower nitrate levels and a nitrate sensor here could help manage energy consumption. This nitrate sensor would also indicate membrane performance as nitrate rejection differs from most other solutes. The Project Team may also identify other benefits of second-pass RO, such as improved removal of other pollutants or a lower CO2 footprint compared to nitrification/denitrification (NDN).

Response: It is acknowledged that a second-pass RO system could be beneficial for full-scale design considerations and it is agreed that this could be a good research project, depending on target water quality goals.

v. Improve net water recovery by putting second-pass RO retentate water to beneficial use,

such as for on-site, non-potable water uses—or return it to the head of the plant. This is desalinated water and may account for two to four percent of the total plant capacity.

Response: Acknowledged as a beneficial use for full-scale design.

w. Review and purge chemical monitoring lists of unnecessary components to reduce costs and focus on chemicals of direct local interest. For example, many of the pesticides on the Priority Pollutants List were banned more than 20 or 30 years ago, such as endrin, heptachlor, DDT and derivatives, and PCBs. The Panel notes that caffeine, sucralose, and several others are not chemicals of emerging concern (CECs) because they are not toxic, and caffeine is biodegradable. Sucralose is persistent but not toxic. Sucralose is a possible surrogate for treatment performance and for possible use as a tracer.

Response: Caffeine and sucralose will still be monitored despite not being CECs as potential indicators with low implementation costs. Other priority pollutants will still be measured, as a non-detect is still significant for the Title 22 Engineering Report.

x. Identify locally relevant potential chemicals of concern for tracking based on California's Recycled Water Policy, information derived from regulation of significant industrial users in the sewershed as part of the pretreatment program, and the NWRI Emerging Contaminant report.

y. Identify the presence of nitrosamine precursors in MBR permeate and RO concentrates (such as dimethylamine, or methylamine moities).

Response: The scope of nitrosamines being measured across the board has been increased, along with other potential CECs, which may address the Panel's comments in x & y.

z. Increase the frequency and timing of targeted CEC monitoring to quantify diurnal or weekend impacts, such as from industrial discharges. Consider moving from grab to composite samples.

Response: Composite sampling will be added for some constituents, and sampling days can be varied slightly, but will be limited to weekdays.

aa. Demonstrate that the sampling program is representative of the quality you are likely to see. Consider diurnal/weekly variation in key industrial chemicals, for example, when DOC is greater than 0.5 or 1 mg/L. brine for PFAS/OA and similar next-generation chemicals.

Response: This would be an interesting potential future research project.

bb. Verify that drinking water analytical methods (not wastewater methods) are being used for drinking water analytes of interest, such as bromate. Cite detection limits/methods used when reporting.

Response: Acknowledged. Will verify test methods and report the detection limits and methods.

cc. Accelerate secondary MBR evaluation activities. Secondary MBR initially appears to have demonstrated benefits over tertiary MBR; for example, there is no need to supplement carbon substrate and it may cost less.

Response: Acknowledged.

dd. Conduct a preliminary design process for the secondary MBR system before conducting the process via the demonstration plant. This preliminary design process would include a computational design that can be heavily informed by data that the team already has from the demonstration, lab, and pilot plants.

Response: A preliminary design and modeling was previously performed for the demonstration plant design and will be updated for full-scale design. A process model was prepared in BioWin during the demonstration facility design process and has been updated based on the results from Sanitation Districts' bench and pilot testing of secondary NdN. Feed water (primary effluent) characteristics will be updated in the model based on more recent sampling, if any, conducted by the Sanitation Districts. Kinetic parameters in the model will also be updated based on observed nitrification and denitrification rates. The need for supplemental carbon dosing will also be assessed based on primary effluent TKN concentrations and target MBR effluent nitrate goals.

i. Calibrate and validate a simulation model (such as SUMO, BioWin, or GPS-X), especially for nitrification, with the data on hand. For the secondary MBR to perform NDN, identifying kinetic parameters and stoichiometric coefficients for cases when primary effluent is used will be heavily supported by the literature. This process has been done elsewhere, such as the Loudoun County, Virginia, MBR pilot plant from the early 2000s.

Response: See previous comment.

ii. Verify the aerobic and anoxic solids retention time needed to achieve the level of total nitrogen (TN) removal desired. This design guideline can be demonstrated at the lab and/or pilot scale to help validate the model. Verification should be done before summer so that the secondary MBR NDN demonstration can hit the ground running and maximize the time available for the team to do the range of testing it wants with this particular system option.

Response: Bench scale work the Sanitation Districts have performed are being used to confirm the parameters for TN removal and the startup process to ensure the secondary MBR starts up quickly and stably.

iii. The Project Team has shown that highly efficient nitrogen removal is possible with the indigenous biomass using lab-scale systems. The Panel has confidence that the Project Team can get TN removal to work with the secondary NDN system in the demonstration plant using this approach.

Response: Acknowledged, agreed, and appreciated.

iv. Consider reaching out to the National Alliance for Water Innovation for simulation models that are under development that link the bioreactor to desalination facilities and may have applicability here. Having the model will help for future work when tertiary NDN is

reevaluated (noted as planned in the slides) and with whatever scaled-up design approach is ultimately used.

Response: Acknowledged, agreed, and appreciated.

Recommendations Specific to RO Concentrate Toxicity

The RO concentrate toxicity (acute and chronic) investigations are reasonable and appropriate.

ee. The Panel recommends the Project Team consider potential issues that may arise from blending and modifications to the final effluent water quality that might affect the approved mixing zone dilution ratio. For example, does the Project Team anticipate any density changes that could affect the estimate of the minimum diffuser initial dilution and/or modification to the dispersion-based dilution estimates? Consider using hydraulic modeling to assess.

Response: LACSD appreciates the Panel's comment to consider potential issues related to blending and mixing zone dilution ratio as this is important in evaluating permitting implications of the RO concentrate in the future. In 2016, hydraulic modeling was completed with potential reuse scenarios taken into consideration, for both flow and density changes to the discharged effluent. This report was submitted to the Los Angeles Regional Water Quality Control Board (Regional Board), which is the agency responsible for regulating discharges from the JWPCP. The Regional Board has also expressed interest in toxicity testing of the RO concentrate looking at a variety of secondary final effluent blends so impacts of these can be assessed. Over the past ten years JWPCP has had an average salinity value of 1.4 practical salinity units (psu). Based on recent calculations, the predicted salinity value used for the RO concentrate during the modeling exercise was about 9.10 psu with flow values of 81 mgd and 87 mgd for 2025 and 2035, respectively (Table 1). With these values in mind, the calculated dilution values were approximately 245:1 and 240:1 for each of the two scenarios; significantly higher than the current 166:1 ratio. Since conducting these modeling efforts, salinity observations at the APC have averaged 5.9 (±0.5) psu. These observations have not been explicitly modeled at this time, but would only serve to increase the dilution value of the conservative estimate by lowering the density of the discharged effluent to 2.87 psu and 2.77 psu. We will continue working with the Regional Board on these issues which are important to assess the impact of the RO concentrate to receiving waters.

Table 1: JWPCP Modeled Dilutions for Projected Flow Scenarios using 90" and 120" Outfalls

Scenario	Total Flow (mgd)	Calculated Dilution
2025 Flow	228	195/244
Water Reuse 2025 Flow	81 (26.5 mgd RO reject + 54.5 mgd unused effluent)	245/337
Water Reuse 2035 Flow	87 (26.5 mgd RO reject + 60.5 mgd unused effluent)	240/331

ff. Based on the results presented by the Project Team at Workshop 4, the Panel supports the Project Team opinion that disinfecting the RO concentrate before discharge via the outfall system is not necessary.

Response: Acknowledged.

gg. The project partners should be prepared for stakeholders to raise the bioaccumulation/food chain issue for compounds that have the potential to bioaccumulate but currently do not have water quality criteria for potential effects from bioaccumulation. Some of the PFAS/OA would fall into that category. It is possible that the combination of low concentrations in the effluent and high dilution at the discharge mitigate this concern; this is not, after all, a release to an inland water with extended periods of low flow and little dilution during summer and fall. However, a proactive back-of-the-envelope screening evaluation could prove helpful in allaying stakeholder concerns. For example, estimate a receiving water concentration and then either compare that to a predicted no-effect concentration (PNEC) that accounts for effects associated with bioaccumulation or, if such a PNEC is not available, develop a PNEC based on bioaccumulation factors and toxicity thresholds for relevant receptors of potential concern.

Response: LACSD acknowledges the need to monitor compounds that have the potential to bioaccumulate but do not currently have water quality criteria for potential effects. Based on available RO concentrate data from the APC, concentrations of PFOS and PFOA are around 1 ng/L (with the current dilution factor applied). According to a 2011 article on aquatic PNECs for PFOS, aquatic toxicity thresholds for PFOS are between 0.61 and 6.66 ug/L, significantly higher than RO concentrate results[1]. Based on a 2012 article, the PNEC for PFOS and PFOA in marine water derived from acute toxicity values are 1.1 ug/L for PFOS and 119 ug/L for PFOA, also higher than RO concentrate results[2]. LACSD will continue to monitor these compounds, both in the influent to the plant (for source control opportunities) and in the RO concentrate, and will keep track of available water quality bioaccumulation criteria. Fish tissue is regularly monitored along the southern California coast to assess the presence and distribution of bioaccumulating compounds and could provide the opportunity to evaluate the presence of compounds of concern to help assess bioaccumulation issues.

Enhanced Source Control Recommendations

The Panel is impressed with the level of collaboration between Metropolitan and Los Angeles County Sanitation Districts. The Panel is interested in the status of cooperative/institutional efforts between the partners to establish enhanced source control that reflects the fact that the community's wastewater is now a source of the community's drinking water. Enhanced source control that supports potable reuse goes beyond the traditional management, operational, and permitted discharge limitations.

[1] *Qi, Ping et al. (2011) Aquatic predicted no-effect-concentration derivation for perfluorooctane sulfonic acid. Available at https://pubmed.ncbi.nlm.nih.gov/21207445/#:~:text=By%20comparison%20of%20the%20different%20PNECs%2C%20the%20recommended,to%20pose%20a%20serious%20threat%20to%20aquatic%20organisms.

[2] Mhadhbi, Lazhar et al. (2012) Ecological risk assessment of perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) in marine environment using Isochrysis galbana, Paracentrotus lividus, Siriella armata and Psetta maxima. Available at https://digital.csic.es/bitstream/10261/50081/1/Ecological%20risk%20assessment.pdf.

hh. Given that this project will support achievement of the region's 2035 water supply goals, the Panel recommends that the partners continue to work together to enhance source control and respectfully requests that the partners present their strategies for enhancements to the existing regional pretreatment program at Workshop 5.

Response: LACSD has a well-established pretreatment and source control program that not only addresses the needs of the NPDES permitting program, but also provides for the protection of our recycled water product. The Sanitation Districts are continuing to collaborate with Metropolitan on enhancing the source control program to provide for a future reliable water supply. We look forward to presenting an overview of the enhanced source control program of today and tomorrow at the next workshop.

ii. The Panel is also interested in learning more about the partners' plans for continued and/or expanded public outreach, even as Covid-19 continues to limit on-site visits and in-person outreach.

Response: One of the main objectives of the Regional Recycled Water Advanced Purification Center is to provide a platform to introduce the public to the project and gain their support for this potential new supply of water. Metropolitan and LACSD have been giving tours of the facility to many audiences, including students, elected officials, industry professionals, business organizations, environmental groups, and other community members. An onsite learning center welcomes visitors with displays, videos, and engaging presentations about the project. Exhibits are also located throughout the facility to explain the facility and purification process.

Since March 2020, tours of the facility are conducted virtually over Zoom and livestreamed on YouTube. Participants may join live or watch a recorded tour. The live tours are interactive where the participants can ask questions. Public tours, student tours, and custom tours for groups are offered. Since February 2021, tours in Spanish are also provided. Due to the ease in attending, these virtual tours are popular with high attendance and levels of engagement.

A brochure, facility videos, and a robust website with project information (mwdh2o.com/rrwp) are also available to those interested in learning more. Furthermore, Metropolitan and LACSD regularly post photos and progress on demonstration testing on social media platforms and write articles on the project for publication. Recent articles were published in Water Environment and Technology and the Journal of the American Water Works Association. Staff also presents project information to the public, stakeholders, and industry professionals at state, national and international conferences such as the WateReuse Symposium and Singapore International Water Week. These presentations continue over Zoom during the pandemic and are also quite popular.

To date, Metropolitan has conducted 172 tours and over 6,000 visitors have toured the facility either in-person or virtually. Hundreds of thousands more have visited the website, engaged with information on social media, watched videos, read an article and/or attended a presentation on the project. Surveys and feedback indicate a strong level of interest and support for the project.

Both Metropolitan and LACSD plan to continue with the current public outreach strategies and expand offerings as the project continues.