Public Hearing (12/15/10)
CEC – Recycled Water
Deadline: 1/10/11 by 12 noon

WATEREUSE CALIFORNIA

ACWA
Vision for the Future
Association of California Water Agencies

CASA

January 10, 2011

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Via Electronic Mail
Charlie Hoppin, Chair
And Members
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100
c/o Jeanine Townsend, Clerk to the Board
commentletters@waterboards.ca.gov

SUBJECT: COMMENT LETTER—CEC MONITORING FOR RECYCLED WATER

Dear Chairman Hoppin and Members of the Board:

The Association of California Water Agencies (ACWA), the California Association of Sanitation Agencies (CASA) and WateReuse California (collectively, the Associations) are pleased to provide comments on the recommendations regarding monitoring of constituents of emerging concern (CECs) in recycled water used for groundwater recharge and landscape irrigation. We appreciate the additional time provided for comments, and offer our suggestions in the spirit of continuing the collaboration that resulted in the Recycled Water Policy and the convening of the Science Advisory Panel (Panel) that developed recommendations for CEC monitoring.

As consistently stated by those testifying at the State Water Resources Control Board's (Board's) December 15, 2010 hearing, the Associations believe the Staff Report on CECs for the most part properly focuses on how to implement the recommendations of the Panel. We urge the Board to adhere as closely as possible to the recommendations of the Panel.

The information and recommendations contained in the Panel's June 2010 report represent the "best available science" on the potential health and environmental effects of CECs related to the use of recycled water for landscape irrigation and groundwater recharge. Basing recycled water permit decisions on the "best available science" is a principle that has been consistently endorsed by the Board and by the Recycled Water

Policy stakeholders group. In addition, relying on the Panel's specialized expertise is the best way for the Board to assure the public that CECs in recycled water are receiving appropriate scrutiny. We concur with the Staff Report that the CEC monitoring program developed by the Panel is very conservative and protective of public health. We also concur with the Panel's decision, as reflected in the Staff Report, to focus its recommendations on toxicological relevance of CECs to human health because most water reuse practices have limited ecological impacts. The Panel's recommended approach ensures that agencies will identify the presence and concentrations of CECs well before those concentrations can pose any risk to public health. This approach, which addresses occurrence in recycled water and treatment plant performance, should give water users, regulators, and the public the confidence that CECs will not pose public health threats.

In short, we believe the Board should implement the Panel's recommendations and not augment or delete provisions from those recommendations. For the most part, we concur with the approach recommended by Board staff, which largely incorporates the Panel's approach. While our detailed comments are attached (as Attachment 1), this letter highlights two issues where we recommend a different course than suggested in the Staff Report: (1) addressing the California Department of Public Health's (CDPH's) September 13, 2010 letter, and (2) the appropriate role of regional water boards.

The Board Should Not Add the CDPH Constituents to the Baseline Monitoring List for Recharge Projects But Rather Should Acknowledge That Regional Boards Are Required to Respect CDPH's Case-by-Case Recommendations.

The September 13, 2010 letter from CDPH appears to recommend that 13 additional constituents be added to the required baseline CEC monitoring list for groundwater recharge spreading projects. The letter provides no scientific or technical basis for requesting that these constituents be included, nor did CDPH representatives offer any rationale for their addition to the list during the Board's December 15, 2010 hearing. Rather than depart from the Panel's transparent and systematic approach and add these constituents to the list at this time, we recommend that CDPH be asked to provide any additional occurrence or effects data that were not available to the Panel so that these additional compounds can be considered under the Panel's framework, which can be applied on a case-by-case basis. Those that emerge as warranting further monitoring should be added to the list as human health indicators. Those that emerge as important for specific projects can also be recommended for inclusion in individual permits. We note that CDPH did submit comments on the Panel's draft report and did not raise the addition of these 13 constituents for the Panel's consideration. In addition, per the Panel's December 2, 2010 comment letter, at least three of the 13 compounds

(bisphenol A, carbamazepine, and tris (2-chloroethyl) phosphate), were considered by the Panel using the framework, but were not included because they were not considered to be meaningful health or performance-based indicators.

CDPH is in the process of finalizing its groundwater recharge regulations, which will include specific provisions for CEC monitoring. Until those regulations are adopted, the Associations understand that CDPH retains its independent authority to recommend CECs for monitoring as part of its case-by-case project review under current law, the Title 22 regulations, and the existing Memorandum of Agreement between the Water Boards and CDPH. We believe the September 13, 2010 letter is best viewed as a candidate list of compounds that CDPH *might* recommend to be included in a monitoring program for a groundwater recharge project that utilizes surface spreading, depending upon the project-specific considerations. Monitoring location and frequencies will also depend upon the project specifics.

The Board cannot – and indeed, should not – constrain CDPH's exercise of discretion in making project specific recommendations as part of the permitting process. This is a very different matter, however, from an action by the Board to disregard the Panel's work and add these constituents as baseline monitoring requirements for all groundwater recharge spreading projects. We recommend that the CECs in the CDPH letter be added only if they meet the test of the Panel framework.

Regional Water Boards Should Participate in the Process of Refining the Baseline CEC Monitoring Program Using the Framework.

The Associations understand and agree that the nine regional water boards should be involved in the process of refining the baseline CEC monitoring program over time. We disagree, however, with the Staff Report's suggestion that it would be appropriate to give the individual regional boards the authority to select and add CECs to be monitored to individual permits, provided that the regional boards at a minimum include in permits the CECs identified for monitoring by the Panel.

One of the key drivers for the formation of the Panel was to bring consistency and clarity to the requirements for monitoring CECs in recycled water, which is exactly what is intended by existing law. Unlike ecosystem concerns, which can vary regionally depending upon the types of waterbodies and watersheds being regulated, the requirements to monitor CEC's in groundwater recharge and irrigation projects are limited to human health effects. CDPH will be addressing individual recharge projects from a human health standpoint and no technical or scientific basis exists to encourage regional boards to second-guess CDPH on this topic.

To the extent that one goal of additional regional board triggered monitoring is to obtain supplementary data on the presence and concentration of CECs, we note those data are currently being collected by numerous research efforts in controlled scientific studies. The Panel recommended this as the most efficient and reliable means of collecting occurrence data that could be used for future modifications to the baseline monitoring program using the proposed framework. We have provided a summary of these ongoing research efforts in Attachment 2. These studies are the best way to ensure good and consistent data upon which to make policy decisions, and we encourage the Board's participation in this work.

The end goal is to ensure protection of public health. The best way to achieve this goal is to use consistent and reliable data for recycled water groundwater recharge projects. Random acts of monitoring do not constitute a useful analytic tool and undermine public confidence. Consistent, rigorous effort to bring the best science to the question at hand is surely the best use of, what we all know, are very limited public resources.

That said, we recognize that regional water boards can add value to the ongoing implementation and updating of the CEC monitoring program using the Panel framework. Instead of delegating authority to individual regional boards to deviate from the Panel's recommendations, we suggest that the Board adopt the Panel's recommendation to conduct a one-year study of a particular class of CEC's for which the Panel felt it had insufficient information on their occurrence in recycled water (Table 8.4 in the Panel Report). These constituents are believed to exhibit toxicity at low concentrations (less than 500 ng/L). These should be studied to gather data to determine if there is need for longer term monitoring. The regional boards should participate in an advisory role to the Panel when this information is presented for review and for a determination if any particular CECs should be added to the monitoring list pursuant to the framework.

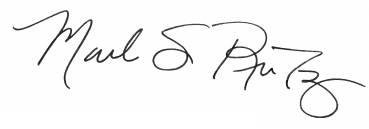
We have additional requests for clarifications and recommendations for future actions, which are included in Attachment 1. We have also provided a summary of ongoing research efforts regarding CECs that can inform future decision making. (Attachment 2.)

On balance, we are pleased with the direction the Board is poised to take to embrace the Panel recommendations. We commend the Board for its commitment to a science-based and consistent statewide approach to CEC monitoring in recycled water. Most importantly, we are truly encouraged that this process has not only allowed all of the stakeholders to engage with the best current science, but has established a framework

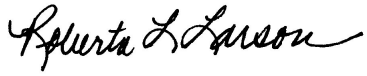
we can all use in the future. We look forward to our continued partnership as we work for our shared goal of a safe, abundant water supply for California.

Sincerely,

David W. Smith, PhD
Managing Director
WateReuse California



Mark Rentz
Director of Regulatory Affairs
ACWA



Roberta Larson
Director of Legal and Regulatory Affairs
CASA

cc: Jonathan Bishop, State Water Resources Control Board
Leah Walker, California Department of Public Health

ATTACHMENT 1
ACWA/CASA/WateReuse

DETAILED COMMENTS
ON STATE WATER BOARD STAFF REPORT RE: CEC MONITORING RECYCLED WATER

Detailed Comment #	Document Reference: (Section #, Page #, Paragraph #)	Issue	Comments
1	Pg. 1, ¶ 1	Incorporation of September 13, 2010 recommendations provided by the California Department of Public Health (CDPH)	CDPH has not provided a scientific or technical basis for requesting that these constituents be included as part of the baseline CEC monitoring program for surface spreading recharge projects. We recommend that CDPH be asked to provide any additional occurrence or effects data that were not available to the Panel so that these additional compounds can be considered under the Panel's framework. Those that emerge as warranting further monitoring should be added to the list as human health indicators. Per the Panel's December 2, 2010 comment letter, at least three of the 13 compounds (bisphenol A, carbamazepine, and tris (2-chloroethyl) phosphate), were considered by the Panel using the framework, but were not included because they were not considered to be meaningful health or performance-based indicators. CDPH is in the process of finalizing its groundwater recharge regulations, which will include specific provisions for CEC monitoring. Until those regulations are adopted, we agree that CDPH must retain its independent authority to recommend CECs for monitoring as part of its case-by-case project review under the Title 22 regulations. We believe the September 13, 2010 letter is best viewed as a candidate list of compounds that CDPH *might* recommend to be included in a monitoring program for a groundwater recharge project that utilizes surface spreading, depending upon the project-specific considerations. Monitoring location and frequencies will also depend upon the project specifics. Thus we recommend that the State Water Board (Board) adopt policy and procedures that reflect the need for further review of the 13 CDPH compounds for baseline monitoring according to the Panel's screening framework.
2	Background, Pg.1, ¶ 1	Clarification of Mandatory CEC Monitoring in the Recycled Water Policy	The Staff Report states that several provisions in the Recycled Water Policy (Policy) mandate the monitoring of CECs in municipal recycled water (section 6.b.(3)(b), section 7.b.(4), and section 8.b.(2)). Any such monitoring requirements must be consistent with actions taken pursuant to paragraph 10(b) of the Policy.
3	Background, Pg. 1, ¶ 2	Clarification of the CEC Advisory Panel Charge	The Staff Report implies that the CEC Advisory Panel (Panel) was charged with providing recommendations on monitoring CECs for various water recycling practices, "including groundwater recharge and urban landscape irrigation."

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			By using the word "including," the Staff Report implies that the Panel's charge was broader and comprised additional recycled water practices. The Policy only addressed these two specific reuse applications. Thus, follow-up Board documents on this matter should clarify this point.
4	CECs and Treatment Performance Surrogates, Pg. 2, ¶ 2	Monitoring Trigger Levels (MTLs)	This paragraph in the Staff Report discusses the screening framework recommended by the Panel and the use of MTLs, and the health-based CECs selected for monitoring. We recommend that two clarifications be made in follow-up Board documents. First, the fact that different MTLs were derived for groundwater recharge projects and for landscape irrigation projects should be clarified. The distinction was the difference in water consumptions rates: 2 L/day for groundwater recharge MTLs and 2 mL/day for landscape irrigation MTLs. Second, follow-up Board documentsneed to clarify that the health-based CECs selected for monitoring (caffeine, 17-beta-estradiol (17β-estradiol), n-nitrosodimethylamine (NDMA), and triclosan) were intended for monitoring groundwater recharge projects only, not irrigation projects.
5	CECs and Treatment Performance Surrogates, Pg. 2, Footnote 4	Monitoring Response Action	The Staff Report states that "For the purpose of evaluating a recycled water project's monitoring data for monitoring response action, MEC is the concentration of a CEC detected in a sample." Reference of the Point of Monitoring (POM) may be more appropriate for this footnote when referring to monitoring responses in follow-up Board documents. The POM for subsurface injection is recycled water after above-ground advanced treatment prior to injection into an aquifer; the POMs for groundwater recharge by surface spreading are 1) recycled water applied to a spreading basin and 2) in the mound of the uppermost groundwater or a lysimeter in the vadose zone.
6	CECs and Treatment Performance Surrogates, Pg. 2, Footnote 5	Future MTLs	The Staff Report defines ADIs as "acceptable" daily intakes. Per the Panel Final Report and referenced studies, ADIs are "allowable daily intakes." Follow-up Board documents should accurately reflect the Panel's terminology.
7	CECs and Treatment Performance Surrogates, Pg. 2-3, ¶ 2	CEC Indicators	The Staff Report states that "The Panel also selected a set of performance-based indicator CECs." It also states that "The six compounds selected to serve as performance-based indicator CECs are caffeine, gemfibrozil, n,n-diethyl-meta-toluamide (DEET), iopromide, NDMA, and sucralose."

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			Follow-up Board documents should clarify that these compounds were selected only for monitoring groundwater recharge projects. In addition, different CECs were selected for surface spreading and direct injection. The Panel recommended 5 CECs as indicators for surface spreading groundwater recharge projects (caffeine, gemfibrozil, DEET, iopromide, and sucralose) and 4 CECs as indicators for injection projects (caffeine, DEET, NDMA, and sucralose).
8	CECs and Treatment Performance Surrogates, Pg. 3, ¶ 2	CDPH Recommended CECs	The Staff Report states that "Additionally, based on consultation with the CDPH, additional CECs were selected for monitoring for surface spreading groundwater recharge/reuse projects using recycled water including bisphenyl A, boron, carbamazepine, chlorate, hexavalent chromium (CrVI), diazinon, 1,4-dioxane, naphthalene, n-nitrosodiethyamine (NDEA), n-nitrosodi-n-propylamine (NDPA), n-nitrosodiphenylamine, n-nitrosopyrrolidine (NPYR), 1,2,3-trichloropropane (1,2,3-TCP), tris(2-carboxyethyl)phosphate (TCEP), and vanadium." See Response to Comment #1
9	CECs and Treatment Performance Surrogates, Pg. 3, Footnote 7, ¶ 3	Regional Water Board Required CECs	The Staff Report states that "Monitoring of additional health-based CECs may be required by a Regional Water Board on a project specific basis. However, the process for selecting additional health-based CECs for monitoring would have to be consistent with the Panel's exposure screening approach (i.e., evaluation of MEC/MTL). The Panel's exposure screening approach is the recommended method for determining health-based CECs." The Staff Report also states that "The health-based CECs and performance-based indicator CECs should be included in recycled water monitoring programs for groundwater recharge/reuse projects," where groundwater recharge/reuse is defined in Footnote 7 as "the practice of recharging groundwater using municipal recycled water." We have the following concerns about this recommendation. a. Assigning Regional Water Boards with the responsibility of making determinations for monitoring health-based CECs contradicts existing law, the existing MOU between the Board and CDPH, the outcome of the stakeholder negotiation process for the Policy and provisions in the Policy. Specifically, permit conditions needed to protect public health (including monitoring for health-based CECs) are in the purview of CDPH and not the Regional Water Boards per Water Code Section 13521, MOA Section II.A, and Sections

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			5.b, 8.c, and 10.c of the Policy[1]. Additionally, recommendations for monitoring would be based on the first expert panel and future expert panels per section 10.b of the Policy. Quite simply there is no legal or policy basis that allows Regional Water Boards to independently establish health-based monitoring requirements. It is again, quite simply, outside of their area of expertise and, as the existing MOA acknowledges, could o result in inconsistent monitoring requirements for groundwater recharge projects. b. The language in the Staff Report could be interpreted to allow Regional Water Boards to establish their own health-based MTLs rather than use the MTLs established in the Panel's Final Report as long as the Regional Water Boards' process for selecting additional health-based CECs for monitoring is consistent with the Panel's exposure screening approach. Not only does the contradict existing law and the existing MOA, it contradicts the outcome of the stakeholder negotiation process for the Policy and provisions in the Policy; namely, that permit conditions needed to protect public health (including monitoring for health-based CECs) would be the purview of CDPH and not the Regional Water Boards per sections 5.b, 8.c, and 10.c of the Policy. It also ignores the Panel's recommendation that future expert panels update the MTLs (see page 72 of the Panel Final Report). c. The language in the Staff Report could be interpreted to allow Regional Water Boards to require recycling agencies to collect CEC occurrence data to compare measured environmental concentrations (MECs) to MTLs, which is inconsistent with the Panel recommendations. As part of the public portion of the Panel's May 21, 2010 meeting, the Panel Chair clearly pointed out that it did not recommend that agencies be required to collect MEC occurrence data for other CECs and instead suggested that the State conduct

[1] Section 5.b: "Regional Water Boards shall appropriately rely on the expertise of CDPH for the establishment of permit conditions needed to protect human health." Section 8.c: "Nothing in this paragraph shall be construed to limit the authority of a Regional Water Board to protect designated beneficial uses, *provided* that any proposed limitations for the protection of public health may only be imposed following regular consultation by the Regional Water Board with CDPH, consistent with State Water Board Orders WQ 2005-0007 and 2006-0001." Section 10.c: "*Permit Provisions.* Permits for recycled water projects shall be consistent both with any CDPH recommendations to protect public health and with any actions by the State Water Board taken pursuant to paragraph 10(b)(2)."

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			another survey or use information in the literature to compile MEC data for evaluation by the next recycled water panel using the framework to modify the monitoring list. In the Final Report, the Panel specifically recommended that collection of additional MEC data be done by the State by conducting ". . . a more thorough review of CECs likely to occur in recycled water using MEC and predicted environmental concentration (PEC) data from the peer-reviewed literature and occurrence studies outside California." Panel Final Report at page v. Also see page 72 (Section 8.4.3 Review/Update of Monitoring and Response Plans) and page 74 (Recommendation 1) of the Panel Final Report. d. The language in the Staff Report could be interpreted so that Regional Water Boards can require CEC monitoring for all discharges to surface waters with groundwater recharge (GWR) as a beneficial use based on the very broad definition of groundwater recharge per Footnote 7 ("For the purpose of this Staff Report, groundwater recharge/reuse is the practice of recharging groundwater using municipal recycled water.") This definition is not consistent with section 13561(c) of the California Water Code: "Indirect potable reuse for groundwater recharge means the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system, as defined in Section 116275 of the Health and Safety Code." For these reasons, we request that the Board respect the intent of existing law, agreements and Policy and work with the CDPH to develop procedures that call for an expert panel, not Regional Water Boards, to evaluate available data to update the baseline CEC monitoring list using the current Panel's framework consistent with the current Panel's recommendation.. We also recommend that the definition of groundwater recharge using recycled water in any future Board document utilize the definition in section 13561(c) of the California Water Code.
10	CECs and Treatment Performance Surrogates, Pg. 3, ¶ 4	Approved Analytical Methods	The Staff Report states that analytical methods for CECs "should be CDPH-approved." No "CDPH approved" methods have yet been established for the CECs recommended by the Panel. To be consistent with the CDPH August 2008 Draft Recharge Regulations, we suggest that follow-up Board documents specify that "methods for CECs should be provided to CDPH for review." See Endnote 2 at page 29.

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11	CECs and Treatment Performance Surrogates, Pg. 3, ¶ 5	Surrogates	The Staff Report states that "Surrogates for use in evaluating treatment system performance may include ammonia, nitrate, dissolved organic carbon (DOC), conductivity, UVA absorption, turbidity, chloride residual, and total coliform." In addition it states that "Table 2 presents a list of recommended surrogate parameters and constituents and their expected removal percentage for groundwater recharge/reuse and landscape irrigation." Follow-up Board documents should also note that different surrogates are recommended for groundwater recharge projects by surface spreading (ammonia, nitrate, DOC, UVA) and injection projects (conductivity and DOC) versus surrogates for landscape irrigation (turbidity, chlorine residual, total coliform). In addition, the surrogates for landscape irrigation do not consider differential removal, but are the requirements included in the Water Recycling Criteria.
12	CECs and Treatment Performance Surrogates, Pg. 4, ¶ 1	Surrogates	The Staff Report states "For monitoring groundwater recharge/reuse projects using surface spreading basins, the selection is a function of the type of additional treatment prior to recycled water recharge to groundwater (i.e., percolation through soil/aquifer material versus reverse osmosis and advanced oxidation processes, respectively)." This statement only applies to surface spreading projects that use tertiary recycled water. A surface spreading project that utilizes advanced treatment would consider surrogates based on the type of advanced treatment as well as soil aquifer treatment. We recommend that this be clarified in follow-up Board documents.
13	CECs and Treatment Performance Surrogates, Pg. 4, ¶ 2	CECs for Landscape Irrigation	The Staff Report states that "Monitoring for health-based CECs and performance-based indicator CECs is not recommended for landscape irrigation projects, because of the low water ingestion rate with landscape irrigation use." This statement is somewhat misleading inasmuch as the low ingestion rate should be tied to the derivation of the MTLs used to screen CECs for monitoring. It would be more appropriate to state that in evaluating CECs for monitoring recycled water used for landscape irrigation, the Panel derived MTLs using a water consumption rate of 2 mL/day. Based on these MTLs and occurrence data, there were no chemicals that were deemed to be of concern for monitoring. We recommend that follow-up Board documents clarify this. .

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14	Monitoring Locations and Frequencies, Page 4	Consistency with Panel Recommendations	We have reviewed the information/recommendations in the Staff Report regarding monitoring locations for health-based and performance-based CEC indicators. We believe that the Board need only acknowledge that monitoring locations will be project specific, taking into consideration the Panel's recommendations, the groundwater recharge criteria, and CDPH case-specific recommendations. Attempts by the Board to capture every possible scenario in follow-up recommendations or documentation will result in monitoring that is not needed, excessive and burdensome. Notwithstanding this recommendation, we have provided more detailed comments on what was presented in the Staff Report in Items 15-17.
14	Monitoring Locations/Points of Monitoring, Pg. 4, ¶ 1	Monitoring Locations for Performance-Based CEC Indicators	The Staff Report states that "Evaluation of treatment performance requires monitoring at specific locations during the treatment process, prior to groundwater recharge, and during retention in an aquifer." The Panel only recommended groundwater monitoring of performance-based CECs to evaluate surface spreading projects using tertiary recycled water. The Panel did not recommend groundwater monitoring of performance-based CECs for projects using advanced treated water (both surface spreading and direct injection). This point needs to be clarified in follow-up Board documents.
15	Monitoring Locations/Points of Monitoring, Pg. 4-5, ¶ 2 - 4	Monitoring Locations for Groundwater Recharge Projects – Surface Spreading and Direct Injection	The Staff Report states "Based on the Panel's recommendations, the appropriate points of monitoring for monitoring and evaluating recycled water quality for CECs for groundwater recharge/reuse projects are as follows: Groundwater recharge/reuse – Surface Spreading Operations: • Final effluent after tertiary treatment and prior to release to the spreading basin; • At monitoring wells representing the uppermost groundwater and/or from shallow lysimeter wells underlying the spreading basin; and • At down-gradient well(s) representing the potable source water prior to the potable water treatment plant. Groundwater recharge/reuse – Direct Injection Operations: • Between tertiary and membrane (reverse osmosis) treatment processes; • Between membrane and advanced oxidation treatment; and • Final effluent after advanced oxidation and prior to injection into an aquifer."

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			The Staff Report does not adequately delineate between monitoring to be conducted for health-based CECs and monitoring to be conducted for performance-based indicators and surrogates, which are differential measures used for evaluating performance for groundwater recharge projects. a. For health-based CECs, the monitoring locations for surface spreading groundwater recharge projects are tertiary recycled water (or final product water if advanced treatment is used), which is defined as the POM and groundwater monitoring wells; for direct injection projects, the POMs are final recycled product. b. The sampling locations on pages 4-5 are for "monitoring the surrogates and indicators during start-up and baseline operations," and not for health-based CECs. Panel Final Report at pg. 69; c. For surface spreading projects, the recommended monitoring locations leave out an important Panel recommendation; namely, that the monitoring locations should be selected to be ". . . consistent with DPH regulations." Panel Final Report at pg. 69. These groundwater locations are not consistent with the CDPH August 2008 CDPH Draft Groundwater Recharge Regulations. The Draft Regulations require CEC monitoring to be conducted in monitoring wells (section 60320.047) that are located per section 60320.070(1) and (2): "At a location where the GRRP's recharge water has been retained in the saturated zone for 1-3 months but will take at least three months before reaching the nearest domestic water supply well, (2) At an additional point or points between the surface or subsurface application facility and the nearest downgradient domestic water supply well." CDPH does not require monitoring for CECs in potable wells. In addition, most groundwater systems do not include potable water treatment plants. d. For indirect potable reuse projects, not all projects include tertiary treatment. The Panel recommended that monitoring be performed between "secondary and membrane treatment processes." Panel Final Report at pg. 69. We recommend that follow-up Board documents reflect these clarifications.
16	Monitoring Locations/Points of Monitoring, Pg. 5, ¶ 1	Monitoring Locations	The Staff Report states that "The recommended points of monitoring presented above are for the purposes of monitoring CECs, and are in addition to any other monitoring requirements required by the CDPH and the Regional Water Boards for a groundwater recharge/reuse or landscape irrigation project using recycled water."

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			These points of monitoring are specifically for CEC indicators and surrogates and not health – based CECs. This should be clarified in follow-up Board documents. In addition the phrase ". . . in addition to any other monitoring . . ." is confusing and not necessary for the purposes of implementing section 10.b of the Policy, and we recommend that it not beincluded in follow-up Board documents.
17	Monitoring Frequency for Initial Assessment and Baseline Operations, Pg. 5, ¶ 2 and Footnote 9	Increase in Monitoring Frequency	The Staff Report states "However, the frequency of monitoring could be increased (i.e., more frequent monitoring) to further evaluate the effectiveness of the treatment process or the increased occurrence and/or concentrations of CECs." The Staff Report needs to acknowledge the Panel's recommendation that positive results and changes in monitoring should be considered in a coordinated manner with the Regional Water Board and CDPH. The Panel noted that these types of factors should be considered: "review of the basis of the (initial) MTL; what is known and what is not known about the particular chemical, the chemical's potential health effects at the given concentration, the source of the chemical, as well as possible means of better control to limit its presence, treatment strategies if necessary, and other appropriate actions." Panel Final Report at page 70. We recommend that these factors be included in follow-up Board documents. In addition, consideration of the factors used for determining monitoring frequency for surrogate parameters should be further refined in any follow-up Board documents. The Staff Report cites "Daily or Weekly," monitoring for surrogates for all groundwater recharge projects with a footnote stating that, "Staff considers the frequency of monitoring to be a function of the parameter. Hence, some parameters may be monitored less frequently." While we appreciate this caveat, determination of the monitoring frequency will also be a function of the type of treatment, the monitoring location, and the type of project. For example, for surface spreading projects, daily monitoring of surrogate parameters in monitoring wells is unnecessary and burdensome, while daily monitoring at a water reclamation plant for parameters such as turbidity and coliforms is warranted.
18	Application of Performance-Based Indicator CECs and Surrogates, Pg. 5-6, ¶ 1	Performance-based Indicators and Surrogates for Other Reuse Applications	The Staff Report states "However, the use of performance-based indicator CECs and surrogates would be applicable to other types of recycled water use projects using the same practices and/or treatment methods."

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			This recommendation is problematic for several reasons. First, the Policy only addressed monitoring for groundwater recharge and landscape irrigation – no other applications are applicable. Second, the Panel clearly excluded CEC monitoring for landscape irrigation because ". . . none of the chemicals for which measurement methods and exposure data are available exceeded the threshold for monitoring priority. This is largely attributable to higher MTLs because of reduced water ingestion in a landscape irrigation setting compared to drinking water. For irrigation applications, the Panel recommends monitoring emphasis be placed on the use of surrogate parameters that can demonstrate that the treatment processes employed are effective in removing CECs." Panel Final Report at page iv. For these reasons, we recommend that this sentence not be included in follow-up Board documents.
19	Application of Performance-Based Indicator CECs and Surrogates, Pg. 6, ¶ 2	Monitoring Location for Surrogates	The Staff Report states "Surrogate parameters and constituents should be measured for each unit process during the initial assessment monitoring phase." This could be misinterpreted to mean all unit processes at a water reclamation plant instead of the recommended locations for groundwater recharge projects and landscape irrigation projects (see Comment #15). We recommend that follow-up Board documents reflect this clarification..
20	Application of Performance-Based Indicator CECs and Surrogates, Pg. 6, ¶ 6	Expected Removals for Indicators and Surrogates	The Staff Report states "The expected removal percentages for performance indicator CECs and surrogate parameters and constituents are presented Tables 1 and 2. Measured removal percentages equal to or greater than the expected removal percentages provide an indication that the treatment processes are operating effectively." The use of the term "expected removal percentages" has the potential to be misinterpreted and misused. These are removal rates observed from the cited research reference. An effective and safe project could have actual removal rates that differ from these percentages if the conditions of the project differ from those used under Drewes et al., 2008. For example, if the influent concentration of a CEC was lower, the removal rate would be lower. Thus, we recommend that follow-up Board documents define "expected removal rates as examples of rates that have been observed as part of a research project and may differ from actual project performance. As described on page 67 of the Panel Final Report, performance is initially defined during an individual project's piloting/start-up phase in parallel with an

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			occurrence study to confirm the presence of the proposed performance indicator CECs in the feedwater of each unit process (in the case of a surface spreading facility, recycled water prior to and after soil aquifer treatment; in the case of direct injection, recycled water prior to and after reverse osmosis /advanced oxidation.) For full-scale operation, the operational boundary conditions and removal differential for selected surrogate and operational parameters and indicator compounds as observed during piloting/startup would be confirmed. Thus, the last sentence in the Staff Report text quoted above also needs to be revised in any follow-up Board documents to acknowledge that each project will have its own unique performance removal rates that will be documented as part of a project's piloting and/or startup phase.
21	Evaluation and Response to Monitoring Results, Pg. 7, ¶ 1	Measure of Recycled Water Performance	The Staff Report states "A measure of appropriate recycled water treatment plant performance would be the consistent production of recycled water with concentrations (i.e., MECs) of health-based CECs that are less than 5 times the ratio of MEC/MTL. MTL values for the health-based CECs are presented in Table 1." This statement is not correct in terms of the Panel's recommendations. On page 65 of the Panel Final Report, the recommendation regarding comparison's of MEC/MTL ratios was specific to the health-based CECs as follows: "For the purposes of developing the CEC monitoring program (i.e., start-up and baseline defined as the monitoring program conducted after DPH approval of indirect potable reuse project operation), consistent effluent quality is defined as the final recycled source water containing ≤5 times the ratio of the MEC/MTL for the indicator CECs listed in Table 8.1." The distinction is that the Staff Report appears to be defining an appropriate plant performance for regulatory purposes whereas the Panel's recommendation deals with how to define consistent recycled water quality. These are two distinct and separate assessments. In other sections of the Panel's Final Report, the Panel clearly did not intend for comparisons to be used as "preliminary screening evaluations of effluent quality" (Panel Final Report at page 65); that if an MEC at the POM exceeds the MTL, "the finding does not indicate a public health risk exists. The MTLs and their application in the Panel's proposed framework are developed to be conservative and used only for the purpose of prioritizing CECs for monitoring. The Panel's proposed MEC/MTL ratios should not be used to make predictions about risk." Panel Final Report at page iv. Thus we recommend that follow-up Board documents clarify that the comparison of MECs at the POM for health-based CECs to MTLs is for informational purposes only and to discuss with

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			CDPH and Regional Water Boards on potential next steps.
22	Evaluation and Response to Monitoring Results, Pg. 7, ¶ 2 (and items 1 – 5)	Response Actions	The Staff Report states that "For evaluation of health-based CEC monitoring results, the CEC Advisory Panel provided five tiers of thresholds and corresponding response actions. Groundwater recharge/reuse project agencies shall evaluate monitoring results for health-based CECs by comparing MEC/MTL ratio values to Panel recommended thresholds. Tiers of thresholds for evaluating monitoring results and recommended response actions excerpted from the Panel Report are as follows: . . ." We are concerned with this section of the Staff Report because it appears to establish a specified regulatory framework for responses to CEC monitoring results, which is contrary to the Panel's recommendations. • The Panel clarified that the monitoring results ". . . should not be considered for compliance and/or regulatory purposes, but for investigation and potential use for additional follow-up actions only as part of conferring with the CDPH and the RWQCBs." Panel Final Report at page 71. • The Staff Report ignores the Panel's recommendation that any specific response actions to monitoring results should first be reviewed with CDPH and the Regional Water Boards. This is due in part because the Panel's conceptual framework included ". . . a minimum safety factor of approximately 10,000-fold." Panel Final Report at page 70. In addition, the Panel stated that "Should there be positive baseline monitoring results, the recharge agency, RWQCBs and CDPH needs to consider whether the result is of concern. Consideration should entail topics such as: review of the basis of the (initial) MTL; what is known and what is not known about the particular chemical, the chemical's potential health effects at the given concentration, the source of the chemical, as well as possible means of better control to limit its presence, treatment strategies if necessary, and other appropriate actions." Panel Final Report at page 70. • The five response steps specified in the Staff Report are examples of potential responses not the definitive plan. The Panel recommended that a project sponsor should work with CDPH and Regional Water Boards to define a response plan: "The Panel provides the following guidance relative to defining positive monitoring results and the potential associated follow-up action(s). While the Panel provides guidance on thresholds for each

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			of these tiers, conservative values were selected because of the limited toxicological information available. The guidance is provided based on the assumption that the Panel's conceptual framework, utilized within this report, include [sp] a minimum safety factor of approximately 10,000-fold. The Panel recommends that the recharge agency confer with the DPH and the appropriate RWQCB to develop a response plan with specific actions to be implemented by the recharge agency as part of interpreting appropriate responses to the monitoring results." Panel Final Report at page 70). For these reasons, we recommend that follow-up Board documents reflect the Panel's conceptual approach and denote that the responses provided are only examples and specific responses should be developed with CDPH and the Regional Water Boards.
23	Evaluation and Response to Monitoring Results, Pg. 7, ¶ 2, Response Action 1	Response Actions	The Staff Report lists 5 response actions, which as noted in Comment #22 should be presented as examples of actions that can be developed with CDPH. With regard to the first recommended response ("If no more than 25 percent of the sample results (i.e., MECs) for a health-based CEC exceed a MEC/MTL ratio of 0.1, then the CEC should be considered for removal from the monitoring program. In cases where a reduction of monitoring is considered, the MTL should be updated, if feasible, as part of the consideration for reducing monitoring requirements."), the Panel assigned the responsibility of making the decision for deleting compounds to CDPH (Panel Final Report at page 70) and the responsibility for updating the MTLs to future expert panels (Panel Final Report at page 72). Thus follow-up Board documents should provide those clarifications.
24	Evaluation and Response to Monitoring Results, Pg. 7, ¶ 3	Response Actions	The Staff Report states "The recycled water/recharge agency should develop a response plan with specific actions to be implemented by the recycled water/recharge agency as part of interpreting appropriate responses to the monitoring results." Per the Panel Final Report, responses are to be developed with CDPH and the Regional Water Boards. See Responses to Comments #22 and #25
25	Evaluation and Response to Monitoring Results, Pg. 7-8, ¶ 4	Response Actions	The Staff Report states "If CEC concentrations exceed the recommend [sp] tiered thresholds (presented above), the recycled water/recharge agencies should work with the CDPH and the Regional Water Boards to identify the need for increased monitoring to confirm the presence of problematic CEC(s), source identification studies, and toxicological studies. If appropriate, increased monitoring might involve engineering removal studies and/or modification of plant

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			operation if found to be warranted. Consideration should be given to the basis of the MTL; the information available about the particular chemical; the chemical's potential health effects at the given concentration; the source of the chemical; as well as possible means of better control its presence, including treatment strategies if necessary, and other appropriate actions." We are concerned that this section of the Staff Report appears to establish a specified regulatory framework for responses to CEC monitoring results (e.g., the use of the term "recommended tiered thresholds"), which is contrary to the Panel's recommendations. • The Panel clarified that the monitoring results ". . . should not be considered for compliance and/or regulatory purposes, but for investigation and potential use for additional follow-up actions only as part of conferring with the CDPH and the RWQCBs." Panel Final Report at page 71. • The Staff Report incorrectly cites the Panel's recommended actions: "Should there be positive baseline monitoring results, the recharge agency, RWQCBs and CDPH needs to consider whether the result is of concern. Consideration should entail topics such as: review of the basis of the (initial) MTL; what is known and what is not known about the particular chemical, the chemical's potential health effects at the given concentration, the source of the chemical, as well as possible means of better control to limit its presence, treatment strategies if necessary, and other appropriate actions." Panel Final Report at page 70). • We are also concerned that the Board has added toxicological studies to the list of possible responses to monitoring results. This implies that an individual agency would be responsible for conducting studies to determine the toxicological relevance of a detected compound. It is not clear why this would be needed inasmuch as MTLs have been developed for the recommended CECs for monitoring by the Panel and any future review of MTLs or development of MTLs is the responsibility of future expert panels. We recommend that follow-up Board documents be consistent with the Panel's recommendations and that any reference to toxicological studies be removed.
26	CDPH Recommendations, Pg. 8, ¶ 1	CDPH Recommended CECs	The Staff Report refers to the September 13, 2010 letter from CDPH and has included the CECs "recommended" by CDPH for inclusion in the monitoring program.

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			See Response to Comment #1 .
27	Recommended Research, Pg. 8, ¶ 1	Responsibility for Conducting the Recommended Research	The Staff Report states that "The Panel Report provided recommendations for research that could be done to further establish monitoring protocols for CECs in recycled water. These are stated on Page 74 of the Panel Report." The Staff Report fails to mention that the Panel's research recommendations were directed at actions to be taken by the State using a future expert panel: ". . . the State can undertake several activities to improve the quality of future monitoring and toxicological information that feeds into the process that the Panel has identified for this inaugural CEC monitoring effort. The State should utilize a Science Advisory Panel to conduct and oversee these activities." Panel Final Report on page 74. We request that follow-up Board documents clarify these responsibilities.
28	Recommended Research, Pg. 9, ¶ 2	Options for Implementing Research	The Staff Report states that "Staff has reviewed the recommendations and has identified two paths the State Water Board could take." Based on our review of the Expert Panel recommendations, the Board could consider a third path (see Comment #29).
29	Recommended Research, Pg. 9, ¶ 2 - 4	Options for Implementing Research	The first pathway identified in the Staff Report to implement the research recommendations is to develop toxicity data and analytical methods for all the chemicals for which no water quality objectives have been established. The Staff Report characterizes this as too slow and too difficult based on the huge universe of chemicals that would have to be addressed. We agree that per the description of this particular pathway in the Staff Report, this approach is not practicable. However, it is also overstated. The State need not assume sole responsibility for such research. While the Board has already provided $2.65 million for recycled water research and we commend Board for its intent to continue in this regard, we wish to make the Board aware that that considerable additional research is ongoing that will inform the future panel about MECs and MTLs for key CECs. Specifically, we provide a summary of relevant research as Attachment 2 for the Board's consideration. For the Panel's research recommendations Numbers 1 through 5 that deal with chemical specific monitoring (presented on page 8 of the Staff Report), these can be logically addressed by existing and

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			ongoing research and monitoring activities some of which are summarized in Attachment 2. The Board's role for this option would be to provide technical support for staff to assist with data and information collection efforts and support for convening future expert review panels. We recommend that the Board adopt this approach.
30	Recommended Research, Pg. 9, ¶ 5-6	Options for Implementing Research	The second and recommended pathway identified by the Board to implement the research recommendations is to further develop the bioanalytical screening techniques described in research recommendation Number 6. The fully developed screening techniques could be used to evaluate whether recycled water has chemicals that produce biological responses with further tests used to identify the responsible chemical or chemicals. Per the Staff Report: "Staff recommends the second path as being the more productive route for expending research money. It sees the first path, the chemical-by-chemical approach, as being never ending, given the large number of chemicals in use. Hence, staff recommends seeking funding only for research recommendation Number 6 at this time. Further research may later be needed, however, to develop analytical methods and evaluate risk of those chemicals identified by the bioanalytical screening tests." The advantages and disadvantages of bioanalytical screening techniques are fully characterized by the Panel in the Final Report. While the Panel is hopeful that techniques may be available in three to five years, there is no guarantee that this will occur or that the tests will useful for identifying chemicals of concern. Research in this area has been conducted for over 40 years with no definitive methods. We have always faced the reality that the universe of chemicals is large and impossible to fully characterize. Yet, we have continued to come up with approaches to reasonably characterize the safety of water. While we believe that bioanaltyical methods may at some point in the future be of great utility, a considerable amount of research is needed , which may be well beyond the means of the State of California to undertake on its own. While it is not entirely apparent what the staff recommendation entails (". . . seeking funding only for research recommendation Number 6"), it is clear that the Board and future expert panels do need to be attentive and knowledgeable about the status and utility of bioanaltyical methods. Fortunately, the WateReuse Research Foundation is launching a project that will help fill this gap in time for the next expert panel review: *Bio-analytical Techniques to Assess*

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			the Potential Human Health Impacts of Reclaimed Water (WRF 10-007). This project will review currently available *in vitro* or short-term *in vivo* bio-analytical tools to identify those with the greatest promise for near-term application or further development toward application to assess the mechanisms of action that may lead to potential human health effects through exposure to recycled water. Based on the review, the project will select a suite of bioanalytical tools and outline a validation plan to perform the selected bio-assay/s to an operational stage that will include 1) validation of results by multiple laboratories using a diversity of reuse water matrices, and 2) develop guidelines for successful bioanalytical techniques. The project will begin in 2011 and will likely take 3 years to complete. This particular project provides the next logical step for moving forward with assessing bioanalytical tools. We recommend that the Board not independently proceed with funding research in this area until WRF 10-007 is completed and its results and the results of other relevant bioassay studies have been reviewed by the next expert panel.
31	Table 1 CECs For Monitoring in Recycled Water For Groundwater Recharge/Reuse Projects, Pg. 10	Table 1	a. This table in the Staff Report includes 15 compounds per the September 13, 2010 letter from CDPH (bisphenyl A, boron, carbamazepine, chlorate, hexavalent chromium (CrVI), diazinon, 1,4-dioxane, naphthalene, n-nitrosodiethyamine (NDEA), n-nitrosodi-n-propylamine (NDPA), n-nitrosodiphenylamine, n-nitrosopyrrolidine (NPYR), 1,2,3-trichloropropane (1,2,3-TCP), tris(2-carboxyethyl)phosphate (TCEP), and vanadium). We believe that the SWRCB has misinterpreted the CDPH September 13, 2010 letter. We recommend that reference to these CECs be deleted from Table 1. See Response to Comment #1. Notwithstanding this comment, if these CECs are retained in Table 1 then the recommended MRL for naphthalene should be changed from 0.5 ug/L to at least 1 ug/L, to allow use of GC/MS methods for quantification. b. We believe the format and information in Table 8.2 in the Expert Panel Final Report (page 66) would, with an additional column for the MTLs for all of the compounds, be a more understandable format for use in follow-up Board documents. If not, then the following need to be clarified in Table 1: • The performance-based CEC indicators for surface spreading and direct injection projects need to be delineated – as currently show it is not clear. • The "expected" removal rates for surface spreading and direct injection projects need to be delineated – as currently shown it is not clear. For example the expected

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			removal rate for sucralose for SAT is < 25% while for direct injection it is > 90%, while the table shows this for both groundwater recharge applications as <25%/>90% with a footnote 9: Surface Spreading/Direct Injection. This is not totally clear, particularly for anyone who has not read or has ready access to the Panel Final Report. Also see response to Comment #20. • Footnote 3 states: "Expected removal from waste stream by reverse osmosis/advanced oxidation units for direct injection, or by the subsurface for surface spreading with a travel time of two weeks and no dilution, see details in Drewes et al., 2008." Since this is a differential removal, the footnote needs to indicate what is meant by "waste stream." See Comment #20. • MRLs are Method Reporting Levels and not Method Reporting Limits as used in the table. • The analytical methods are not shown in the table for the Panel's list of recommended CECs. Table 8.2 in the Panel Final Report presents the methods (as Standard Methods). • The MTLs should be included for the performance-based CECs.
32	Table 2: Surrogate Parameters and Constituents for Recycled Water Use Practices, Pg. 11	Table 2	We believe the format and information in Table 8.2 in the Panel Final Report (page 66) would be more understandable than that in Table 2 of the Staff Report for use in follow-up Board documents. If not, then the following need to be clarified/revised in Table 2: • Clarification must be provide that the "expected" differential removal rates are example values only; the actual expected differential removal rates are to be determined during pilot studies and project start-up. Also see response to Comment #20. • The example "expected" removal rates for surface spreading and direct injection projects need to be delineated – as currently shown it is not clear. For example the expected removal rate for DOC for SAT is >30% while for direct injection it is > 90%, while the table shows this for both groundwater recharge applications as >30%/>90% with a footnote 4: Surface Spreading/Direct Injection. This is not totally clear, particularly for anyone who has not read or has ready access to the Panel Final Report. Also see response to Comment #20. • Footnote 1 states: "Expected removal from waste stream by reverse osmosis/advanced oxidation units for direct injection, or by the subsurface for surface spreading with a travel time of two weeks and no dilution, see details in Drewes et al., 2008." Since this is

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			a differential removal, the footnote needs to indicate what is meant by "waste stream." Also see response to Comment #20. • Footnote 5 - UVA is Ultraviolet Absorbance not Ultraviolet light A.

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Research Summary

Research Recommendation	Examples of Research
1. In order to populate a recycled water database of CECs with measured environmental concentrations and predicted environmental concentration data, conduct a comprehensive review of CECs likely to occur in recycled water based on peer-reviewed literature and occurrence studies outside California	**<u>Completed</u>** **Muir and Howard (2006) *ES&T 40* (23), pp 7157–7166.** This project reviewed recent screening and categorization studies of chemicals in commerce and addressed the question of whether there is sufficient information to permit a broader array of chemicals to be determined in environmental matrices. The project used data from the Environment Canada categorization: 30 chemicals with high predicted bioconcentration and low rate of biodegradation and 28 chemicals with long range atmospheric transport potential. **A Reconnaissance-Level Quantitative Comparison of Reclaimed Water, Surface Water, and Groundwater (WRF 02-008).** This project investigated and documented the water quality associated with: 1) surface and groundwaters that have minimal or no direct influence from treated municipal wastewater and/or reclaimed water discharges; 2) surface and groundwaters that are known to be influenced by treated municipal wastewater and/or reclaimed water discharges; and 3) reclaimed water. **Removal of Endocrine Disrupting Compounds in Water Reclamation Processes (WERF 01-HHE-20T).** This study evaluated analytical tools for quantifying endocrine disrupting chemicals (EDCs) in wastewater matrices, including conventional water reclamation treatment and advanced treatment in terms of their ability to reduce EDCs and biological activity using bioassays. **Toxicological Relevance of EDCs and Pharmaceuticals in Drinking Water (Water Research Foundation #3085**). This study conducted an extensive literature review on the known toxicity of EDCs and pharmaceuticals including naturally occurring EDCs and pharmaceutically active compounds. It analyzed various raw and finished drinking waters for a suite of EDCs and pharmaceuticals, and screened various bottled waters, beverages, and food products. It also used an *in vitro* bioassay to assess the estrogenicity of various waters, beverages, and foods. It conducted risk assessments for chemicals of interest based on findings. **Development of Indicators and Surrogates for Chemical Contamination Removal During Wastewater Treatment (WRF 03-014).** The objectives of this project were to identify surrogates and indicators for wastewater derived chemical contaminants that might be useful in the assessment of indirect potable reuse systems, to identify and assess the performance of analytical methods for the chosen surrogates and indicators, and to validate the ability of chosen surrogates and indicators to predict the occurrence and removal of wastewater derived contaminants in indirect potable water reuse systems. **Development of Surrogates to Determine the Efficacy of Soil Aquifer Treatment Systems for the Removal of Organic Chemicals (WRF 05-004).** The main objective of this project was to determine appropriate organic

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Research Recommendation	Examples of Research
	surrogates for groundwater recharge projects that use reclaimed water. The technical approach included tasks to identify an appropriate surrogate or group of surrogates for recharge projects where biodegradation is the major removal mechanism, and to identify an appropriate surrogate or group of surrogates for direct injection projects where membrane treatment before injection is the major removal process. **Identifying Health Effects Concerns of Water Reuse Industry and Prioritizing Research Needs for Nomination of Chemicals for Research to Appropriate National and International Agencies (WRF-06-004)** This project developed a prioritized approach for federal agencies to perform health effects studies on contaminants of interest to the water reuse community, such as: contaminants known to occur, but for which there is limited health effects information; or mode of action studies on chemicals whose regulation might result in changes to utilization of the chemical or changes in water reuse treatment. It also collected CEC data from water reclamation facilities throughout the country. **Contributions of Household Chemicals to Sewage and their Relevance to Municipal Wastewater Systems and the Environment (WERF 03-CTS-21UR).** This study identified high-volume production (HVP) chemicals and organic compounds from household products, and provided information on the occurrence and fate of HVP chemicals in wastewater systems and the environment. **Source, Fate, and Transport of Endocrine Disruptors, Pharmaceuticals, and Personal Care Products in Drinking Water Sources in California (NWRI).** EDCs, pharmaceuticals, and personal care products (PPCPs) may enter water through agricultural runoff, leaching from landfills, or wastewater discharges. In California, data is limited on the occurrence of EDCs and PPCPs in major watersheds. This study assessed the source, fate, and transport of these contaminants on three major drinking water sources in California, with the goal of providing water agencies with information about the impact of wastewater on drinking water supplies. **<u>In Progress</u>** **Trace Organic Compounds Removal during Wastewater Treatment – Categorizing Wastewater Treatment Processes by Their Efficacy in Reduction of a Suite of Indicator TOrC (WERF CEC4R08).** The primary objective of this study is to identify suitable CEC indicator compounds that can be used to validate fate models and allow for a rapid characterization of performance efficiency of conventional wastewater unit operations. The project will generate performance data at full-scale that allow an assessment of mechanisms responsible for CEC

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	attenuation in individual unit operations. Expected completion date: 2011. **Attenuation of PPCP/EDCs through Golf Courses Using Reuse Water (WERF 1C08).** The intent of this research program is to examine the fate and transport of PPCP/EDCs in turf systems, when recycled water is used as the sole source of irrigation. This will be accomplished by reviewing and identifying the most prevalent PPCP/EDCs in recycled water, developing reliable sampling and analytical methods, and carrying out laboratory, plot-scale, and field studies. Expected completion date: 2011. **Comparisons of Chemical Composition of Recycled and Conventional Waters (WRF 06-006).** The objective of this project is to develop a data set that compares the quality of water and the chemical composition of water produced by planned water reuse projects with the quality and chemical composition of conventional water produced from surface and ground sources that are impacted by waste discharges. Expected completion date: 2011. **Risk Assessment Study of PPCPs in Recycled Water to Support Public Review (WRF 09-007).** The objective of this research is to provide quantitative human health risk assessment results for pharmaceuticals and personal care products (PPCPs) in recycled water for a representative set of treatment and non-potable use cases. The proposed effort will develop communication strategies and messages to advance the public understanding of relative risks associated with recycled water use. Expected completion date: 2011. **Advanced Oxidation of Pharmaceuticals and Personal Care Products: Preparing for Indirect and Direct Water Reuse (Water Research Foundation #4213**). This project will determine and characterize the impact of background organic matrices on the efficiency of advanced oxidation processes for removal of pharmaceutically active compounds (PhACs). It will develop a strategy that employs bioassays for assessing the ability of treatment processes to remove PhACs and the potential of the bioassay residual testing strategy to predict the impact of background organic matter on treatment performance. Expected completion date: 2012.
2. Develop robust and reproducible analytical methods to measure CECs in recycled water	**In Progress**

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	completion date: 2012.
3. Perform laboratory performance and analytical method validation studies for CECs adopted by the State as monitoring priorities	**In Progress** **Evaluation of Analytical Methods for EDCs and PPCPs via Inter-Laboratory Comparison (Water Research Foundation #4167).** The project is evaluating the performance of several existing analytical methods for the analysis of EDCs and PPCPs by multiple laboratories in various water matrices. It will also establish performance-based QA/QC criteria and guidelines to help utilities assess the most appropriate use of the methods. Expected completion date: 2012.
4. Develop a detailed procedure to estimate predicted environmental concentrations for CECs for which MECs are currently not available based on production, use and environmental fate	**Completed** Hannah, R.; D'Aco, V.J.; Anderson, P.D.; Buzby, M.E.; Caldwell, D.J.; Cunningham, V.L.; Ericson, J.F.; Johnson, A.C.; Parke, N.J.; Samuleian, J.H.; and Sumpter, J.P. (2009) Exposure Assessment of 17a-Ethinylestradiol in Surface Waters of the United States and Europe. Environmental Toxicology and Chemistry, Vol. 28, No. 12, pp. 2725–2732. As part of this study, the researchers used simple mass balance calculations to estimate the mass of 17a-Ethinylestradiol (EE2) reaching wastewater treatment plants. The methodology included estimates of the total annual mass of EE2 sold in Belgium, France, Germany, Italy, The Netherlands, the United Kingdom, and the United States from IMS Health (IMS MIDAS Quantum, Year End, March 2007) for all products containing EE2. For the U.S., an indirect annual mass was derived using demographic data and the average daily therapeutic dose of EE2 (26.25 mg/d; 35 mg/tablet 3 21 tablets/28 d). Approximately 11.6 million women in the United States (8.1% of all women in the United States) used EE2 for contraception in 2002. In 2007, the population of women in the U.S. increased to approximately 155 million. Assuming that the percent of women using EE2 has remained the same since 2002, the mass of EE2 used in 2007 would be approximately 120 kg/year. The researchers assumed that 50% of the EE2 dose (23% in feces plus 27% in urine) is excreted by patients as EE2 or as conjugates subject to deconjugation in wastewater treatment plants. Using this information, the predicted environmental concentrations (PECs) were generated for European and U.S. watersheds using the GREAT-ER and PhATETM models, respectively. **In Progress** **Tools to Assess and Understand the Relative Risks of Indirect Potable Reuse and Aquifer Storage and Recovery Projects (WRF-06-18).** The objective of this research is to use existing risk assessment tools that can be used by sponsors of indirect potable reuse projects to evaluate and explain the relative human health risks related to the use of reclaimed water. The study is comprised of three tasks. Task 3 predicting future chemicals of emerging

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Research Summary

Research Recommendation	Examples of Research
	concern (CECs) and their treatability, including the top 1,000 2007 high production chemicals. Expected completion date: 2011.
5. The State Water Board should convene and charge a science advisory panel to scope out an investigative, short-term monitoring study (e.g. quarterly sampling over a one-year period) for CECs that exhibit relatively low MTLs (e.g. < 500 ng/L), but for which no or little MEC or predicted effluent concentration information is available for secondary/tertiary effluents used for the water reuse practices of interest[1]	**Panel Recommendation** The Panel suggested monitoring select CCL3 CECs for which currently no California MECs are available in secondary/tertiary treated effluent representing the feed water quality to either surface spreading or advanced water treatment (i.e., RO/AOP) ahead of direct injection: 1,2,3-Trichloropropane, Hydrazine, and Quinoline. Monitoring should occur quarterly for one year. **Completed** **Comparison of Analytical Results for the Trace Organics in the Santa Ana River at the Imperial Highway to Health Risk Based Screening Levels, Intertox, June 2009.** This study compared detected data from the study, **Source, Fate, and Transport of Endocrine Disruptors, Pharmaceuticals, and Personal Care Products in Drinking Water Sources in California** (NWRI), to acceptable daily intakes (ADIs) and drinking water equivalent levels (DWELs) developed by Intertox as part of the Water Research Foundation 3085/WateReuse Foundation (WRF)-04-003 "Toxicological Relevance of Endocrine Disruptors and Pharmaceuticals in Drinking Water" study, the WRF-06-018 "Development and Application of Tools to Assess and Understand the Relative Risks of Drugs and Other Chemicals in Indirect Potable Reuse Water" study, and other work, and to health risk-based screening levels published by other agencies. ***Also See Research Under Recommendation No.1***

[1] For example using the data collected from these types of research project, the SWRCB could: Review the non-CCL3 compounds with MTLs < 500 ng/L based on the MTLs in Appendix J or updated MTLs; review research to identify additional compounds with MTLs < 500 ng/L; based on these reviews, prepare a tentative candidate list of compounds for short term monitoring; determine if robust methods are available to analyze the compounds on the candidate list; for those compounds with suitable methods, prepare a recommended list of low-MTL compounds and methods for a short-term monitoring program; convene a panel to consider the low-MTL compounds and recommended methods, and a recommend the scope of work for the short term study. Some of the compounds may be priority pollutants or have Notification Levels, and therefore data are already being collected; the results can provide the basis for revising the proposed initial monitoring list during the next, and each, triennial review for compounds where the MEC/MTL ratio is >1.

Attachment 2
ACWA/CASA/WateReuse Comments
CEC Monitoring

Research Summary

Research Recommendation	Examples of Research
6. Encourage development of bioanalytical screening techniques that include CECs currently not identified but potentially present in recycled water ("unknown" chemicals). Develop appropriate trigger levels for these bioanalytical screening techniques that correspond to a response posing a concern from a human health standpoint	**Completed** **Online Methods for Evaluating the Safety of Reclaimed Water (WERF 01-HHE-4a)** The objective of this research was to develop an online bioassessment platform (such as Japanese medaka) to evaluate the safety of reclaimed water. Evidence exists that indicates the presence of unregulated organic contaminants (such as pharmaceuticals and personal care products) in municipal wastewater effluents, surface waters, groundwater, and drinking water sources are at concentrations that adversely affect endocrine and reproductive systems of fish. **Tools to Detect Estrogenic Activity in Environmental Waters, 2008 (GWRC)** This report describes an international effort to evaluate the performance of five *in vitro* bioassays to assess estrogenic activity in a variety of water matrices (http://www.edctoolbox.info). The project evaluated a selected set of bioassays, including yeast estrogen screen (YES), ER-CALUX, MELN, T47D-KBluc and E-Screen assays. Spiked artificial (tap water spiked with known estrogenic chemicals such as hormones, alkylphenols, phthalates, pesticides and phytosterols) and real samples from sewage, river, groundwater and drinking water were tested. This study shows that some bioassay techniques are now sufficiently advanced that they can be used either as a cost-effective first-pass detection system or in combination with standard analytical methods to measure estrogenic pollutants in environmental waters. Standardization of bioassay data analysis and methodology were identified as a crucial steps forward towards accurate bioassay-derived estrogenicity measurements. **In Progress** **Adaptation of the Minimum Anticipated Biological Effect Level (MABEL) Approach to Developing Acceptable Daily Intakes for Emerging Compounds of Interest (Water Research Foundation #4214**) Will develop and apply an innovative scientifically-based method to develop health-protective Acceptable Daily Intakes (ADIs) for new compounds of emerging interest to the water industry that have the potential for significant toxicity to sensitive population groups, including pharmaceutical and personal care product (PPCP) ingredients, hormonally active compounds, and nanomaterials. Expected completion date: 2011. **Bio-analytical Techniques to Assess the Potential Human Health Impacts of Reclaimed Water (WRF 10-007)** Review currently available in vitro or short-term in vivo bio-analytical tools to identify those with the greatest promise for near-term application or further development toward application to assess the mechanisms of action that may lead to potential human health effects through exposure to recycled water. Based on the review, select a suite of bio-analytical tools and outline a validation plan to progress the application of the selected bio-assay/s to an operational stage that will include validation of results by multiple laboratories using a diversity of reuse water

Attachment 2
ACWA/CASA/WateReuse Comments
CEC Monitoring

Research Summary

Research Recommendation	Examples of Research
	matrices. Undertake laboratory research to realize a guidelines for bio-analytical techniques. Expected completion date: to be determined (project will begin in 2011).