CITY OF SANTA BARBARA

SUBSURFACE DESALINATION INTAKE AND POTABLE REUSE FEASIBILITY STUDIES

WORK PLANS
RESPONSES TO TAP COMMENTS

FINAL
August 2015

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City of Santa Barbara

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RESPONSES TO TAP COMMENTS

1.0 BACKGROUND

On Wednesday, August 5, 2015, Technical Advisory Panel (TAP) Meeting #1 was held at Santa Barbara City Hall. Stakeholders and interested parties were invited to attend the TAP meeting. As presented in the Work Plan documents, the TAP consists of five technical experts in fields related to subsurface desalination intakes and potable reuse. Following the meeting, the panel met to discuss work products and current project status. Findings were summarized in in the Draft Final Panel Report for Meeting #1, presented in Appendix 1. The report is divided into three sections:

1. Purpose and History of the Panel
2. Panel Meeting #1
3. Findings and Recommendations

2.0 OBJECTIVE

The objective of this document is to present responses to each of the TAP comments received regarding material presented at TAP Meeting #1.

3.0 RESPONSES

Refer to Appendix 1 for the Draft Final Panel Report for all comments that were received. Responses to the TAP comments are as follows.

3.1 General Comments

The following comments pertain to the overall Panel review of Work Plans for both the *Subsurface Desalination Intake Feasibility Study* and *Potable Reuse Feasibility Study*.

- The Panel greatly appreciated the high-quality and detailed Work Plans provided by the City and its consultants in advance of the meeting. In addition, the background presentation given by the City was helpful to the Panel in its discussions.
  – Noted.

- The Panel commends the City's effort to evaluate alternative water supply options. Potable reuse and seawater desalination have the potential to play key roles in diversifying the City's water supply portfolio and increasing reliability.
  – Noted.

- The pursuit of solutions to the City's drought and long-term water supply provides a great opportunity to evaluate the best uses of water. The City of Santa Barbara was an innovator, when it came to developing desalination in the 1990s. Twenty-plus years later, the City has another opportunity to be an innovator in its efforts to find alternative water supply sources. The path forward is currently framed around feasibility and is defined by a series of constraints; another option is to frame the path around opportunities, finding and developing realistic and implementable solutions. For example, based on the State's Recycled Water Policy, the City could explore potable reuse options and meet the balance of need with subsurface intakes. Although the current studies are intended to meet the direction from City Council and RWQCB, a broader view could be taken in exploring alternatives that avoid or minimize environmental impacts associated with open ocean intakes while ensuring the City meets its water supply needs.
  - Please see the updated Work Plan language (specifically Section 1.5), clarifying the goals of the study. Results of this study will be useful to inform future studies, which may consider potable reuse alternatives.

- The objective of the subsurface intake study is to identify subsurface intake alternatives that could replace the open ocean intake volume. The basis of the design criteria should specify if seawater desalination operations would occur under drought conditions or full time (as a base supply). Technical constraints will determine if the intake alternatives survive the "fatal flaw" analysis. But it is known that potable reuse options will not meet the goal of replacing the permitted intake volume (i.e., <10,000 AFY) because the City does not generate enough wastewater to do so, especially during a drought. The potable reuse options, therefore, could be approached differently, perhaps by looking at realistic potable reuse opportunities, rather than attempting to meet a goal that cannot be achieved in the feasibility study.
  - The term "fatal flaw" has been updated to "initial screening" to better represent the goals of this study. Terminology has been updated in the Work Plans. Results of this study (even if alternatives do not meet the objectives of this study [initial screening criteria]) will present the maximum capacity that is technically feasible for all subsurface and potable reuse alternatives. For the reasons stated in Section 1.5 (updated) of the Work Plan, the City's position is that it is premature to perform a combined alternative analysis at this time. However, a combined alternative analysis may be included as part of a future study, that will be completed when the City is certain how its water supply needs will be affected by pending environmental and operational decisions that could reduce the availability of water from the Cachuma Reservoir.

- While the feasibility studies are being prepared in direct response to City Council and RWQCB direction to look at two options (i.e., subsurface desalination intakes and potable reuse), the information gathered for these feasibility studies will have a

secondary use: to inform the City's long-term water supply planning efforts. Although an alternative may be flawed in its ability to meet the basis of design criteria for these specific feasibility studies, the same alternative may have utility if the objectives or basis of design criteria are different in future studies; therefore, the Panel recommends the use of another term for "Fatal Flaw," such as "Held from Further Consideration," "Not Carried Forward," or "Does Not Meet Project Objectives."

  – Please see the updated Work Plan language (specifically Section 1.5), clarifying the goals of the study, which consider this comment. Results of this study will be useful to inform future studies.

- It is the Panel's understanding that the City will undertake the technical feasibility "fatal flaw" evaluation first (rather than evaluate obvious constraints, such as the lack of appropriate real estate and conflicting land uses) because:
  – It addresses regulatory requirements set by the RWQCB.
  – It follows the example set by the evaluation of subsurface intakes for a proposed desalination plant in Huntington Beach, California.

  Undertaking the technical feasibility evaluation first may be appropriate for the subsurface desalination intake study, but may not be most appropriate for the potable reuse study because the potable reuse study is being performed solely for the City – not for regulatory needs. Although it seems logical to have similar structures for the two Work Plans, it could artificially force upon the potable reuse study significant technical work and costs that might be avoided if the screening criteria were applied differently.

  – The City's position is that following the same methodology is appropriate because we will obtain useful information that will be used to inform future studies. The information collected during this study provides the City great value in terms of time and resources saved when the future water supply study is required.

- In the feasibility evaluation and/or fatal flaw analysis, how will criteria be scored? Will the criteria be weighted equally?
  – The intent is to only present advantages and disadvantages of potentially feasible alternatives. Scoring alternatives implies that we are identifying the "best alternative" and not, more simply, "what alternatives are feasible". Therefore, since the scope of this study is limited to identifying what alternatives are feasible, the City's position is that scoring alternatives is beyond the scope of this study.

- The maps used for these studies should show the locations of the desalination facility and wastewater treatment facility, as well as include a north arrow and legend.
  – North arrow, locations, and legends have been added to map.

- Real estate acquisition will be needed for water supply project flexibility. Is this being considered in the Work Plans?
  - As indicated in Section 2.2 of the Work Plans, these studies focus on City owned property for potable reuse treatment facilities and subsurface intake facilities. Recharge wells and pipelines may involve property acquisition, but specific properties will not be identified. Generic pipeline alignments will be identified to identify approximately pipeline lengths and complicated easement acquisitions.

3.2 Project Goals

The following comments pertain to the goals and objectives of undertaking the feasibility studies.

- The City is encouraged to seek further clarification on the basis for the feasibility studies. What are the requirements for the permit issued for the desalination plant by the RWQCB? Based on these requirements, the specific objectives of the feasibility studies need to be clearly stated in the Work Plans. The City and its consultants need to consider adding a narrative to both Work Plans that describes primary and secondary objectives. The primary objective would address fulfilling City Council and RWQCB requirements. The secondary objective would address the development, definition, and exploration of component options that could be considered as part of the City's long-term water supply planning efforts.
  - The RWQCB requirements are stated in Section 1.3 of the Work Plans, which defines the scope of the study requirements. A section entitled "Goal of Study" (Section 1.5) has been added to the Work Plans to further clarify the City's goals using the information developed during this study as part of its future water supply planning.

- In the current study, full replacement of the screened open ocean intake is listed as the only option. Subsurface desalination intakes and potable reuse are considered as mutually exclusive rather than combined to develop integrated solutions; however, it is likely that the best solution will include combinations of components and complimentary opportunities. The Panel understands this level of review would be conducted at a later time.
  - The Panel's understanding as stated in the comment is correct - at present, the City intends to limit the scope of this evaluation to the direction given to them by City Council and the RWQCB. However, the City intends to use this information to inform future water supply planning efforts if and when its water supply needs change. Refer to updated Work Plan Section 1.5 for clarification and further response to this comment. This study will identify the maximum yield of subsurface intake and potable reuse alternatives that is technically feasible.

3.3 Subsurface Desalination Intake

The following comments pertain to the *Draft Work Plan on Subsurface Desalination Intake* for the Subsurface Desalination Intake Feasibility Study.

Section 1.0: Introduction

- Clarify whether the desalination facility is intended to provide a base supply (i.e., operated full-time) or be used as an emergency supply (e.g., during periods of drought) as part of the City's long-term water supply options.
  - Currently, the City's Long Term Water Supply Plan refers to the Desalination Plant as a drought supply. The City recognizes that if the operational supply yield from the Cachuma Reservoir is reduced in the future, it would necessitate an update to the Long Term Water Supply Plan to consider either new supplies (such as potable reuse) and/or operation of the desalination plant in another manner other than as a drought supply.

- Page 4, bullet 1, states: "A full replacement of the City's open ocean intake using a subsurface intake." Is there any consideration of "partial replacement"? Some regulatory agencies are suggesting that subsurface intake be maximized to the extent feasible, with the remainder of intake water subsidized by open ocean intake water.
  - The Ocean Plan Amendments (adopted in May 2015) require evaluation of combined screened open ocean and subsurface intakes for "new and expanded facilities" only. The City's desalination plant and its intake are existing. The intake is permitted for a flow up to 15,898 gpm which is the flow necessary to produce 10,000 AFY of desalinated water.

    However, this study will determine potentially feasible alternatives and the City may evaluate partial replacement during future studies, such as an update to the City's Long Term Water Supply Plan.

- Regarding Figure 2 on the "Project Schedule," it appears that the schedule focuses more time on the field work item rather than the permitting. The City of Santa Cruz conducted a similar study in which the offshore geophysical study required about 6 months to permit and less than 1 month to conduct the field work.
  - At this point, the City does not fully understand the environmental requirements that may occur. The City has included an allowance of time in the schedule for permitting and field work to account for unknown restrictions.

- Provide a brief summary of precedent studies.
  - We have included a section 2.4 in the Work Plan that identifies literature that will be reviewed; additionally, we are actively collecting new literature. Work Authorization 2 (TM 2) will include a critical analysis of this literature data.

Section 2.0: Basis of Design

- Project Site Alternatives: The Panel is concerned that the City has limited itself with the criteria for the project site locations. It may be too narrow to start with this reduced suite of only onshore locations. As an example, the City of Santa Cruz evaluated approximately 18 different onshore locations that could accommodate a pump station and an almost equal number of offshore locations for the intake (i.e., slant wells, horizontal wells, infiltration gallery, and open ocean intake). The exercise of culling feasible sites was valuable to the City of Santa Cruz.
  - The location of the desalination plant is existing and proximity to existing infrastructure is an important feasibility criteria, as presented in the Work Plan. We are evaluating approximately 3 miles of City-owned beachfront in proximity to the desalination plant for the scope of this study.

- Subsurface Properties: The section on "Field Program Permitting" (page 13) should include the National Environmental Policy Act (NEPA).
  - Noted. Added CEQA/NEPA to Section 2.4.3. We agree that NEPA will likely be required based upon project funding options.

- Water Quality and Treatment Needs: The Panel is interested in learning more about the consideration of carbon dioxide in the subsurface source water and its contribution towards greenhouse gases (page 16).
  - In some rare conditions (such as a deep slant well), events of carbon dioxide emissions can be an important consideration. However, the basis of our design will be to obtain source water that is all (or mostly) seawater, which should not contribute towards greenhouse gas emissions. Seawater with high concentrations of dissolved carbon dioxide exists in ancient aquifers, which exist in limited volumes. These sources generally cannot be used as a sustainable supply, and will not be considered as the basis of our design.

- Subsurface Intake System Analysis: In general, the methodologies listed in the Work Plan seem appropriate for the study's objectives; however, as an exception:
  - It is proposed that the existing U.S. Geological Survey (USGS) groundwater flow model may be used to assess the performance of subsurface intake technologies and impacts to groundwater contamination migration and wetlands depletion. The discretization, layering, and ocean boundary condition of the existing USGS model is inappropriate for the evaluation of subsurface intake performance and impacts. The existing model has a very large cell size, does not have an apron under the seafloor such that seafloor infiltration can be simulated, and does not simulate groundwater flow in the surficial sediments that are hydraulically connected to the ocean. It is understood that the USGS model is currently being updated; however, these limitations are not slated for correction in the new model. Initial analysis of the performance of the

subsurface intake likely will need to be performed with analytical methods. If a subsurface intake meets performance criteria, the impacts could be later addressed by inserting a more refined model into the regional USGS model and using the regional model for boundary heads.

- The City has verified that the USGS model referenced in the comment is outdated, and a new USGS model will be used for this study. The new updated USGS model has 250 ft grid spacing with 56 vertical layers and may provide information to address some of the topics included in the scope of this study.

- Reliability Features: Address the frequency and complexity of maintenance for subsurface intakes.
  - The Work Plan sets a feedwater goal for the subsurface intake of approximately 16,000 gallons per minute. Some amount of redundancy should be built into this estimate. The Huntington Beach evaluation used a 20-percent redundancy, which seems appropriate for systems with small pumps operating in a seawater environment.
    - Section 2.9 indicates our study will incorporate safety factors based upon industry practice. This will be summarized in our critical review of literature data used to justify and establish these safety factors (i.e., review to be presented as work product resulting from Work Authorization 2).
  - Address how maintenance procedures (e.g., pump replacement and well rehabilitation) will occur and the frequency of these efforts.
    - We have added Section 2.2.1 that addresses beach sites and access for maintenance and other security features.
  - Clarify why a 20-year service lifespan has been adopted.
    - The 20-year service life is the duration of the City's loan. For sustainability purposes, the City's goal is to not replace facilities before they are paid for.

Section 3.0: Feasibility Criteria and Fatal Flaws

- The Panel appreciates the inclusion of economics as part of the definition of "feasibility" for this study (page 23); however, economics needs to be understood in the context of the other metrics (i.e., environmental, social, technical) and perhaps have a role that, at least at this stage of the study, is not weighted as heavily. Similarly, the Panel is concerned about use of the California Environmental Quality Act (CEQA) definition of "feasible" at this point in the evaluation, particularly with respect to environmental metrics, since the permitting thresholds required for project implementation will be more stringent than the CEQA thresholds.
  - As mentioned previously and in Section 6.0 of the Work Plan, the City intends to present advantages and disadvantages of alternatives based upon the feasibility metrics identified in Section 3.0, Table 3.1. Weighted comparison of

social, economic, and environmental criteria implies that the City is seeking to evaluate the "best alternative", which is beyond the scope of this study but may be considered for future studies. The scope of this study is only to identify what alternatives are feasible.

- The Panel recommends that the first sentence of Section 3.1 (which references CEQA) be deleted.
  - Deleted the first sentence and changed “feasibility” to “factors” in next sentence. See updated Section 3.1.

- The feasibility criteria listed in the Work Plan seem appropriate for the study’s objectives with the following exceptions:
  - Geotechnical Factors #1b – Proper operation and maintenance procedures should reduce the risk of well clogging and should be considered as part of the component definition rather than considered a potential flaw.
    - There are various geochemical or well construction related conditions where operation and maintenance methods may not be able to effectively prevent or remediate well clogging. This will be explained based upon literature data that will be critically reviewed as part of the scope for Work Authorization 2.
  - Hydrogeology Factors #3 – Please confirm that the potential impact on freshwater aquifers resulting from additional drawdown might cause groundwater to flow seaward, as stated, and not inland.
    - The statement may or may not be true, depending on the specific characteristics of the aquifer and the subsurface intake method/location. This will be evaluated as part of the scope for Work Authorization 2.
  - Energy Use #13 – CEQA does not include a threshold for energy use to determine potential impacts. The question is whether the project will use energy efficiently (i.e., would the project exclude wasteful, inefficient, and unnecessary consumption of energy during project construction, operation, maintenance, and/or removal that cannot be feasibly mitigated?)
    - Under NEPA, is there a threshold? What is it for greenhouse gases?
      - The City has its own Climate Action Plan. This study will quantify the additional or reduced difference in energy use from the current condition.
    - What is the “project” referenced in #13 and #14? Is it the subsurface intake? The subsurface intake less the energy of the open ocean intake? Less the pretreatment (that a subsurface intake may eliminate?) Is the carbon dioxide of the subsurface intake incorporated here?
      - The scope of this study will consider the difference between current conditions and potential subsurface intake alternatives. The purpose of

this study is to state advantages and disadvantages based upon a quantifiable difference in energy use or greenhouse gas emission.

  - Reliability and Performance #22a/b – Performance Risk (#22b) is associated with "a large amount of uncertainty with regard to likelihood of successful implementation," while Precedent of Technology (#22a) could be used as an indicator of uncertainty and, therefore, performance risk. Will the use of both criteria address the same issue?
    - #22a refers mainly to risks associated with the use of unproven subsurface intake technologies. #22b focuses on performance risks associated with proven subsurface intake technologies in specific conditions/locations.

- Regarding the "Design and Construction Constraints" listed in Table 3.2 on "Fatal Flaw Criteria," the Panel notes that land issues with respect to adequate land onshore are difficult to assess because one could argue that some or all of the onshore facilities could be moved further onshore to a suitable location (requiring a longer tunnel or trench).
  - As discussed in the Work Plan, the scope of this work focuses on use of City-owned land for installation of new subsurface intake technologies. There are other City lands that are further onshore that may be used depending upon the intake technology (e.g., HDD wells, infiltration galleries). These locations will be evaluated during Work Authorization 2 where appropriate based upon the intake technology.

- If land-based subsurface intake technologies other than those producing from the surficial beach deposits (i.e., slant wells or deeper vertical wells) are to be considered, a much better understanding of the near-shore subsurface hydrogeology will be essential. Currently, significant consequential conflict exists in published literature regarding the location of the offshore boundary between the producing zones of the groundwater basin and the consolidated sediments underlying the ocean floor. Understanding the location and nature of this boundary is fundamental to estimating volumes of seawater that can be induced through seafloor leakage and to characterize the sources and blend of the resulting feedwater. Resolving this conflict may require extensive geophysical and/or exploratory work.
  - The study will utilize existing data to conduct initial screening (e.g., USGS test wells located along Cabrillo Blvd, available technical reports, soils data associated with pier installation at Stearns Wharf, etc.); however, extensive geophysical and/or exploratory work may be required to address this issue if respective technologies are found to be feasible or potentially feasible. The need for this additional geophysical data collection will be determined as a result of Work Authorization 2, and conducted as part of Work Authorization 3.

- The subsurface intake feasibility evaluation will begin with technical aspects (i.e., Will it work? Can it be built?); however, for most land-based subsurface intake approaches, yield, produced water quality, and inland impacts are extremely sensitive to the setback distance from the shoreline. It may be unavoidable to not address the siting constraints of land availability and sea level rise before determining performance feasibility.
  - As presented in the Work Plan, Sections 2.2 and 2.5, we are considering site alternatives and the impact of sea level rise. As stated in Section 2.2, land availability will be City owned beach front and City owned lands inland but in close proximity to the desalination plant.

- The feasibility should consider sea level rise and its implications for coastal erosion. It is recommended that the study avoid using the coastal erosion analysis to determine "if any control features can be provided to protect the facilities." If sea level rise is going to affect the facility during its useful life, then the facility is being sited in a location that will be impacted. The inclusion of protective measures (rather than locating the facility out of the hazard zone) may not be acceptable to the California Coastal Commission.
  - As indicated in the Work Plan, Section 2.5, we have incorporated a study (to be completed as part of Work Authorization #2) that seeks to determine if coastal erosion or deposition is a threat for subsurface intake alternatives. We agree that if erosion or sea level rise are determined to influence a particular site alternative, then the threat cannot be mitigated through design. Refer to the initial screening criteria identified in Table 3.2, oceanographic hazards.

- Other studies have shown that wells at the coastal margin can impact groundwater basins or induce seawater intrusion. The criteria need to address this issue.
  - As indicated in Section 2.7.3, various methodologies are presented for evaluating impacts to local groundwater supplies and sensitive habitats. Consideration of seawater intrusion resulting from use of subsurface intake technology alternatives is addressed in this section of the Work Plan.

Section 5.0: Cost Estimating Methodology

- Consider if the feasibility analysis, environmental review/permitting/public process, property and easement acquisition, and design fees can or should be included in the costs to compare with other alternatives (e.g., open ocean intake or potable reuse). Ensure the costs are truly comparable.

This comment is addressed in Section 5 of the Work Plan. Each of these costs (i.e., feasibility analysis, environmental review, etc.) will be included in the cost estimate to provide comparison.

3.4 Potable Reuse

The following comments pertain to the *Draft Work Plan on Potable Reuse* for the Potable Reuse Feasibility Study.

Section 1.0: Introduction

- More emphasis appears to be given to IPR for groundwater injection than other options for recycled water usage (e.g., DPR, aquifer storage and recovery, or reservoir augmentation). Are the other options being considered as much as IPR for groundwater injection? For example, the activities to assess and ascertain the feasibility of DPR (e.g., using treated wastewater effluent as desalination feedwater) could present project opportunities for the City.
  - As presented in the Work Plan, the City will consider the entire range of potable reuse alternatives, including indirect and direct potable reuse (IPR/DPR). At the time of creation of the Work Plan, regulations exist for IPR in California, but do not exist for DPR. There is more information currently with regards to IPR, however, the City intends to consider both IPR and DPR in this study.

    Note that the City's team conforms to industry standard nomenclature as we refer to IPR and DPR alternatives. For example - Title 22 refers to two types of IPR applications: "Groundwater Replenishment - Subsurface Application" (Title 22, Article 5.2), which includes Full Advanced Treatment (as defined by Title 22, §60320.201**)** followed by groundwater injection wells; and "Groundwater Replenishment - Surface Application" (Title 22, Article 5.1), which includes advanced treatment (as defined by Title 22, §60301.320) followed by groundwater spreading basins or areas.

- Please clarify who owns the wastewater from the El Estero Wastewater Treatment Plant (e.g., is it the City of Santa Barbara?).
  - The City of Santa Barbara owns and operates El Estero Wastewater Treatment Plant (WWTP), the collection system that delivers sewage to the WWTP, and the Title 22 Recycled Water Treatment Plant (that produces 1400 AFY) and recycled water delivery system. The tertiary effluent that leaves the El Estero WWTP is the City's to use.

- Provide a brief summary of precedent studies.
  - Section 2.4 in the Work Plan identifies literature that will be reviewed; additionally, the City's team is actively reviewing new literature. Work Authorization 2 (TM 3) will include a critical analysis of this literature data.

Section 2.0: Basis of Design

- Why is the discharge of advanced treated wastewater into Lauro Canyon Reservoir considered DPR?
  - The determination of whether discharge of advanced treated wastewater into a reservoir is considered IPR or DPR is determined by the State Water Resources Control Board, or their delegate agency. Currently, Title 22 does not address this type of potable reuse. These rules are in development - the state has required the Division of Drinking Water (DDW) to develop proposed guidelines by December 31, 2016. However, the state has recognized in the existing Title 22 regulations that an environmental buffer (i.e., travel time) is important for protecting public health and safety when potable reuse is practiced. The presence of an environmental buffer has become, in some circles, the determination between if an application is considered "direct" or "indirect" potable reuse.

    Lauro Canyon Reservoir has a capacity of approximately 550 AF and is used primarily to equalize flows before treatment. Because the reservoir may have an uncertain buffer (travel time), for this project, we initially assumed that it will be considered DPR and will require Full Advanced Treatment plus engineered storage. As stated in Section 2.3 of the Work Plan, the City will continue to follow the State's (DDW) DPR regulatory development and update the treatment requirements (and nomenclature) for application of potable reuse water to the Lauro Canyon Reservoir.

- Production Capacity: The average daily flow needs to be augmented with an understanding of diurnal flow.
  - Equalization can be used to address diurnal flows.
    - Acknowledged. Section 2.1 of the Work Plan discusses the diurnal flow characteristics associated with the wastewater plant. Equalization will be used to address diurnal flows, which will be considered during the conceptual design performed in Work Authorization 2.
  - Include the storage options for buffering or for equalization, conveyance, treatment, and distribution.
    - Acknowledged. Storage options for buffering or equalization, conveyance, treatment, and distribution will be considered during the conceptual design performed in Work Authorization 2. We have added a statement to Section 2.1 to clarify this.

- Water Quality: The City will need an appropriate source control program if potable reuse is to be implemented. Please provide a brief narrative on the present source control program for the El Estero Wastewater Treatment Plant.

  - Section 2.3 of the Work Plan states that the water quality and treatment requirements will conform to Title 22. Article 5.1 §60320.106 and Article 5.2 §60320.206 state that a source water control program is required. We believe that the reference to Title 22 provided in Section 2.3 of the Work Plan addresses this question. The Wastewater Source Control Program will be described as part of the basis of design that is completed during Work Authorization #2.

- Optimization of the El Estero Wastewater Treatment Plant process operations and water quality should be considered.
  - Acknowledged. The City is currently implementing a number of upgrades to the El Estero WWTP. These upgrades and their impact to the potential for potable reuse will be addressed as part of the basis of design development - specifically related to the treatment requirements specified in Section 2.3 of the Work Plan. If additional upgrades are recommended, these upgrades will be identified and incorporated into the potable reuse project description and costs.

- Treatment: As proposed in the Work Plan, full advanced treatment (FAT) will be used to produce recycled water for IPR; however, the FAT treatment train needs to be specified in the Work Plan, including a schematic.
  - Acknowledged. Text explaining full advanced treatment was added to Section 2.3 of the Work Plan. Additionally, a conceptual schematic of a FAT train was added. Note that FAT as defined in Article 5.2 §60320.201 is required for subsurface application while advanced treatment as defined in Article 5.1 §60301.320 and §60301.230 is required for surface application. This difference is clarified in Section 2.3 of the revised Work Plan.

- Groundwater Recharge (Section 2.5): On Page 13, consider including “impact to other wells” as a feasibility screening criteria.
  - Feasibility Criteria 3 considers impact to freshwater aquifers, local water supplies, and existing water users. Impact to other wells is included under this criteria and will be considered during Work Authorization 2. We have updated definition of Feasibility Criteria 3 in Section 3 of the Work Plan to include “water quality and hydraulic impacts to other wells”.

- Groundwater Recharge (Section 2.5.1): On page 14, the Work Plan suggests an assumed injection rate of 75 percent of the extraction rate. What is the basis for the 75-percent injection rate? Experience has shown that injection well performance in finer-grained sediments can be better maintained with injection rates closer to 50 percent of the extraction rate.
  - We have updated Section 2.5.1 to indicate that a range of 50 to 75 percent is possible, and that an estimated rate will be determined when site specific data is available.

- Groundwater Recharge (Section 2.5.2): On page 14, fourth line, should this sentence begin with “This project will *review* available…” and not “This project will *provide* available…”?
  - Noted. Correction made.

- Groundwater Recharge: The existing USGS groundwater model is adequate for the assessment and quantification of the volume of recycled water that might be cyclically stored in a put-and-take operation; however, even though the new USGS model is proposed to have transport capability, the cell size is too large to use the model to simulate flow between wells and defensibly predict residence times. Again, analytical methods might be used as a first cut.
  - The use of analytical methods as a first cut will be explored during the basis of design performed in Work Authorization 2. However, the City has verified that the USGS model referenced in the comment is outdated, and has been through several updates. The new updated model has 250 ft grid spacing with 56 vertical layers and may provide enough information to simulate flow between wells and adequately predict residence times.

- Groundwater Recharge: Consideration should be given to optimizing the management of the groundwater basin to create storage. Further detail on groundwater contamination and seawater intrusion issues will be necessary.
  - Acknowledged. The City realizes that optimization of the groundwater basin to create storage may benefit groundwater replenishment projects. Section 2.4.2 presents additional data collection that may be necessary for potentially feasible alternatives. If groundwater replenishment alternatives are found to be potentially feasible, further detail on groundwater contamination and seawater intrusion may be necessary. The City has the option to obtain additional data as part of Work Authorization 2 for this project.

- Additional Production Wells (Section 2.6, Page 18): The narrative leading up to this section reads as if only IPR (i.e., groundwater injection using treated wastewater) is being considered. This section implies that existing production wells will be used for this concept. The Panel believes it is inconsistent with current regulations to use the same well for injection and production with recycled water.
  - Acknowledged. The wording presented in Section 2.6 was unclear - it was not the City's intent to indicate that recharge wells (i.e., subsurface application) would also be used for recovery. We have clarified this point in Section 2.6 of the updated Work Plan.

- Additional Well Sites: The Work Plan should include a preliminary inventory of possible sites for the numerous injection and extraction wells necessary to inject and recover the water.

- Acknowledged. Section 2.2 of the Work Plan has been updated to discuss location for new production wells. The location for recharge wells (i.e., subsurface application) was already discussed.

- Reliability Features (Section 2.8, page 19): The Panel suggests rewriting the paragraph to provide more clarity about project reliability.
  - Acknowledged. Section 2.8 of the Work Plan has been revised to provide more clarity about project reliability.

Section 3.0: Feasibility Criteria

- The Panel noted that the work authorizations do not include a fatal flaw analysis for potable reuse; however, it is listed in Figure 1.
  - As noted, the subsurface intake and potable reuse studies are delivered through three separate work authorizations to facilitate completion of both studies within the aggressive schedule required by the RWQCB and to allow for peer technical review at key project intervals. For the potable reuse study, both the fatal flaw analysis (renamed "initial screening analysis") and the feasibility analysis are components within Work Authorization 2. This differs from the subsurface intake study, where the fatal flaw analysis is the subject of Work Authorization 2 and the feasibility analysis is the subject of Work Authorization 3. The purpose of separating the two is because it is anticipated that adequate hydrologic data will be available for assessing the potable reuse alternatives that involve groundwater replenishment and recovery. However, it is possible that additional hydrologic data may be required for the subsurface intake study. Therefore, the City has separated the subsurface intake study feasibility assessment into a separate work authorization so that they can consider the cost and value of collecting this additional information for "potentially feasible" alternatives. Both the subsurface intake and potable reuse studies involve "initial screening" based upon technical feasibility criteria before feasibility (as defined by CEQA) is assessed for those alternatives that are potentially or technically feasible.

- The fatal flaw analysis should consider the treatment train and specific requirements of the Groundwater Recharge regulations.
  - As stated in Section 2.3 of the Work Plan, the treatment requirements will be determined by regulatory requirements such as Title 22, Article 5.1 and 5.2. Refer Section 2.3 and to prior responses herein for further clarification.

- Please clarify how Oceanographic Factors #8 and #9 in Table 3.1 are relevant to recycled water.
  - Oceanographic Factor #8: This factor relates primarily to sea level rise, which can affect potable reuse facilities, depending on the site location. The City

cannot receive funding for a facility located in an area susceptible to inundation from rising sea water. Furthermore, sea level rise can affect quality and capacity of groundwater aquifers (i.e., mainly related to IPR by surface and subsurface application).

  - Oceanographic Factor #9: This factor relates to an alternatives susceptibility to tsunamis. Similarly, the City cannot receive funding for a site that is likely to be inundated by a tsunami. Such a site would render the site alternative to be infeasible, that is, if impacts from these threats cannot be mitigated by engineering design.

- For Energy Use #13 in Table 3.1, does the City's 2012 Climate Action Plan provide for mitigation/offsets to meet the Plan's thresholds? Consider providing for this as a way to achieve comparable emissions between alternatives.
  - The City's desalination plant has been evaluated against the City's 2012 Climate Action Plan for compliance. As discussed in the Work Plans, incremental differences in Energy Use and Greenhouse Gas Emissions (positive or negative) will be evaluated when subsurface intakes are used. Potable reuse will be considered by itself for the time being since it is considered a new supply by the City's existing Long Term Water Supply Plan. Costs for mitigation (off-sets) would need to be evaluated (as a line item) for those alternatives that are determined potentially or technically feasible through initial screening.

Additional Recommendations:

- If pursuing potable reuse, the City should begin outreach to the community about recycled water as a water supply option.
  - Acknowledged. The City understands the importance of community outreach regarding potable reuse projects and shall investigate implementation plans as reuse alternatives are further studied as part of an update to the City's Long Term Water Supply Plan.

- The implications of using recycled water for brine dilution should be considered. This should include the environmental implications of discharging the mixed recycled water and brine to the ocean, as well as the reduction in wastewater volume that is available for recycling.
  - Acknowledged. As part of the desalination plant reactivation project, the City has already considered the impact of little or no effluent flow. Based upon the City's success in conservation, there are already times of the year when, at night, the City does not discharge effluent. If the Desalination Plant operates, the City has demonstrated to the RWQCB that it can do so without the need for effluent for dilution and mixing.

APPENDIX 1 – DRAFT FINAL PANEL REPORT

NATIONAL WATER RESEARCH INSTITUTE

Draft Final Panel Report for Meeting #1:

Review of the City of Santa Barbara's Subsurface Desalination Intake and Potable Reuse Feasibility Studies

Based on a Technical Advisory Panel (TAP) Meeting on August 5, 2015
(Panel Meeting #1)

Prepared by:
Technical Advisory Panel (TAP)
for the City of Santa Barbara's Subsurface Desalination Intake
and Potable Reuse Feasibility Studies

Prepared for:
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City of Santa Barbara
Public Works Department
630 Garden Street
Santa Barbara, CA 93101

August 19, 2015
Fountain Valley, CA

DISCLAIMER

This report was prepared by an NWRI Independent Advisory Panel, which is administered by the National Water Research Institute (NWRI). Any opinions, findings, conclusions, or recommendations expressed in this report were prepared by the Panel. This report was published for informational purposes.

ABOUT NWRI

A 501c3 nonprofit organization, the National Water Research Institute (NWRI) was founded in 1991 by a group of California water agencies in partnership with the Joan Irvine Smith and Athalie R. Clarke Foundation to promote the protection, maintenance, and restoration of water supplies and to protect public health and improve the environment. NWRI's member agencies include Inland Empire Utilities Agency, Irvine Ranch Water District, Los Angeles Department of Water and Power, Orange County Sanitation District, Orange County Water District, and West Basin Municipal Water District.

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CONTENTS

ACRONYMS

AFY	Acre foot per year
ASR	Aquifer storage and recovery
CEQA	California Environmental Quality Act
DPR	Direct potable reuse
FAT	Full advanced treatment
IPR	Indirect potable reuse
mgd	Million gallons per day
NEPA	National Environmental Policy Act
NWRI	National Water Research Institute
RWQCB	Central Coast Regional Water Quality Control Board
USGS	United States Geological Survey

1. PURPOSE AND HISTORY OF THE PANEL

In 2015, the National Water Research Institute (NWRI) of Fountain Valley, California, a 501c3 nonprofit, appointed water industry experts to a Technical Advisory Panel (Panel) to provide expert peer review of both the *Subsurface Desalination Intake Feasibility Study* and *Potable Reuse Feasibility Study* being undertaken by the Public Works Department of the City of Santa Barbara, California. Carollo Engineers is the lead consultant on this effort.

1.1 Project Background[1]

In the late 1980s, the City constructed the Charles E. Meyer Desalination Plant, a seawater desalination facility, as an emergency supply. The production capacity of the desalination plant was 7,500 acre feet per year (AFY) with the potential for expansion up to 10,000 AFY. The plant was operated between March and June of 1992, and then placed on long-term standby mode due to sufficient supply.

In 1991, City voters elected to make desalination a permanent part of the City's water supply portfolio. With the approval of the Long Term Water Supply Program in 1994, the City added the desalination plant to its permanent sources of water. In 1996, the California Coastal Commission issued a Coastal Development Permit to the City for permanent desalination facilities up to a maximum capacity of 10,000 AFY.

On July 24, 2015, the City Council issued a contract to reactivate and operate the Charles E. Meyer Desalination Plant. As part of recommissioning, the plant will use state-of-the-art technology and design practices to reduce its impact on the environment, including possibly replacing the screened open ocean intake.

1.2 Purpose of the Project

The City Council directed the Public Works Department to evaluate the feasibility of (1) replacing the open ocean intake with a subsurface intake and/or (2) implementing potable reuse options, including indirect potable reuse (IPR) and direct potable reuse (DPR).

In addition, the Central Coast Regional Water Quality Control Board (RWQCB) adopted an amendment to the City's Waste Discharge Requirements for the El Estero Wastewater Treatment Plant that included a condition that the City should report back to the RWQCB by August 2015 with a Work Plan that will result in completed feasibility studies by June 2017.

The City retained Carollo Engineers, Inc. to complete these feasibility studies under the following three work authorizations:

Work Authorization 1: Work Plans for both studies.

[1] For more information about the feasibility studies, please visit the City of Santa Barbara website at http://www.santabarbaraca.gov/gov/depts/pw/resources/system/sources/desalination.asp.

Work Authorization 2: Subsurface intake fatal flaw analysis and potable reuse feasibility study.

Work Authorization 3: Subsurface intake feasibility study.

The work products for the feasibility studies will be developed to accomplish the following:

- Satisfy the requirements of the City's amended Waste Discharge Requirements for the El Estero Wastewater Treatment Plant.
- Support a future update to the City's Long Term Water Supply Plan to include alternatives considered in the studies.

1.3 Role of the Technical Advisory Panel

In 2015, Carollo Engineers requested that NWRI form and coordinate the activities of a Technical Advisory Panel to provide expert peer review of the technical and scientific aspects of the two feasibility studies. Specifically, the Panel will review the work products (i.e., draft Work Plans, technical memos, reports, etc.) for both feasibility studies and consider public comments on these proposed efforts. The Panel's findings and recommendations will be documented in Panel reports. Background information about the NWRI Panel process can be found in Appendix A.

1.4 Panel Members

The Panel is made up of experts in areas related to drinking water management, desalination and wastewater reclamation technology, hydrogeology, water policy and regulations, and other areas relevant to the two feasibility studies. Panel members include:

- Chair: Amy Childress, Ph.D., University of Southern California (Los Angeles, CA)
- Heather Collins, P.E., Metropolitan Water District of Southern California (Los Angeles, CA)
- Martin B. Feeney, P.G., CHg, Consulting Hydrogeologist (Santa Barbara, CA)
- Heidi R. Luckenbach, P.E., City of Santa Cruz Water Department (Santa Cruz, CA)
- Eric Zigas, Environmental Science Associates (San Francisco, CA)

Brief biographies of the Panel members can be found in Appendix B.

2. PANEL MEETING #1

A 1-day public meeting of the Panel was held on August 5, 2015, at the Santa Barbara City Hall in Santa Barbara, California. This meeting represents the first time the Panel has met to review the *Subsurface Desalination Intake Feasibility Study* and *Potable Reuse Feasibility Study* being undertaken by the City.

2.1 Background Material

Prior to the meeting, the following background material was provided to the Panel:

- *Draft Work Plan on Subsurface Desalination Intake*, prepared for the City of Santa Barbara by Carollo Engineers, Inc., and dated July 2015.
- *Draft Work Plan on Potable Reuse*, prepared for the City of Santa Barbara by Carollo Engineers, Inc., and dated July 2015.

2.2 Meeting Agenda

Staff from NWRI, the City, and Carollo Engineers collaborated on the development of the agenda for the meeting, which is included in Appendix C. The agenda was based on meeting the following specific objectives:

- The City and Carollo Engineers will present an overview of the Work Plans on both the *Subsurface Desalination Intake Feasibility Study* and *Potable Reuse Feasibility Study*.
- The Panel will conduct a technical review of the Work Plans.
- Members of the public will have an opportunity to provide comments on the Work Plans.

The meeting began with a brief closed session in which the Panel, City staff, and Carollo Engineers discussed meeting objectives. After the closed session, a public meeting was held in which a presentation was given by Carollo Engineers on the purpose, objectives, and other aspects of the Work Plans for both feasibility studies, followed by questions from the Panel. The floor was then open to public comments.

Once the open public session concluded, the Panel met briefly with the City and Carollo for additional clarification before moving on to a closed Panel session to discuss the information presented. Before the meeting adjourned, the Panel prepared a report outline and drafted preliminary findings and recommendations, which have been expanded upon in this report.

2.3 Meeting Attendees

All Panel members attended this meeting in person except Heidi Luckenbach, who was able to participate in the closed Panel session by conference call. Other meeting attendees included NWRI staff, City staff, Carollo staff and their sub-consultants, and others. A complete list of Panel meeting attendees is included in Appendix D.

3. FINDINGS AND RECOMMENDATIONS

The principal findings and recommendations derived from the material presented and discussed during the Panel meeting are provided below. The findings and recommendations are organized under the following categories:

- General Comments
- Project Goals
- Subsurface Desalination Intake
- Potable Reuse
- Other Comments

3.1 General Comments

The following comments pertain to the overall Panel review of Work Plans for both the *Subsurface Desalination Intake Feasibility Study* and *Potable Reuse Feasibility Study*.

- The Panel greatly appreciated the high-quality and detailed Work Plans provided by the City and its consultants in advance of the meeting. In addition, the background presentation given by the City was helpful to the Panel in its discussions.
- The Panel commends the City's effort to evaluate alternative water supply options. Potable reuse and seawater desalination have the potential to play key roles in diversifying the City's water supply portfolio and increasing reliability.
- The pursuit of solutions to the City's drought and long-term water supply provides a great opportunity to evaluate the best uses of water. The City of Santa Barbara was an innovator, when it came to developing desalination in the 1990s. Twenty-plus years later, the City has another opportunity to be an innovator in its efforts to find alternative water supply sources. The path forward is currently framed around feasibility and is defined by a series of constraints; another option is to frame the path around opportunities, finding and developing realistic and implementable solutions. For example, based on the State's Recycled Water Policy, the City could explore potable reuse options and meet the balance of need with subsurface intakes. Although the current studies are intended to meet the direction from City Council and RWQCB, a broader view could be taken in exploring alternatives that avoid or minimize environmental impacts associated with open ocean intakes while ensuring the City meets its water supply needs.
- The objective of the subsurface intake study is to identify subsurface intake alternatives that could replace the open ocean intake volume. The basis of the design criteria should specify if seawater desalination operations would occur under drought conditions or full time (as a base supply). Technical constraints will determine if the intake alternatives survive the "fatal flaw" analysis. But it is known that potable reuse options will not meet the goal of replacing the permitted intake volume (i.e., <10,000 AFY) because the City does not generate enough wastewater to do so, especially during a drought. The potable

reuse options, therefore, could be approached differently, perhaps by looking at realistic potable reuse opportunities, rather than attempting to meet a goal that cannot be achieved in the feasibility study.

- While the feasibility studies are being prepared in direct response to City Council and RWQCB direction to look at two options (i.e., subsurface desalination intakes and potable reuse), the information gathered for these feasibility studies will have a secondary use: to inform the City's long-term water supply planning efforts. Although an alternative may be flawed in its ability to meet the basis of design criteria for these specific feasibility studies, the same alternative may have utility if the objectives or basis of design criteria are different in future studies; therefore, the Panel recommends the use of another term for "Fatal Flaw," such as "Held from Further Consideration," "Not Carried Forward," or "Does Not Meet Project Objectives."
- It is the Panel's understanding that the City will undertake the technical feasibility "fatal flaw" evaluation first (rather than evaluate obvious constraints, such as the lack of appropriate real estate and conflicting land uses) because:
    - It addresses regulatory requirements set by the RWQCB.
    - It follows the example set by the evaluation of subsurface intakes for a proposed desalination plant in Huntington Beach, California.

  Undertaking the technical feasibility evaluation first may be appropriate for the subsurface desalination intake study, but may not be most appropriate for the potable reuse study because the potable reuse study is being performed solely for the City – not for regulatory needs. Although it seems logical to have similar structures for the two Work Plans, it could artificially force upon the potable reuse study significant technical work and costs that might be avoided if the screening criteria were applied differently.
- In the feasibility evaluation and/or fatal flaw analysis, how will criteria be scored? Will the criteria be weighted equally?
- The maps used for these studies should show the locations of the desalination facility and wastewater treatment facility, as well as include a north arrow and legend.
- Real estate acquisition will be needed for water supply project flexibility. Is this being considered in the Work Plans?

3.2 Project Goals

The following comments pertain to the goals and objectives of undertaking the feasibility studies.

- The City is encouraged to seek further clarification on the basis for the feasibility studies. What are the requirements for the permit issued for the desalination plant by the RWQCB? Based on these requirements, the specific objectives of the feasibility studies need to be clearly stated in the Work Plans. The City and its consultants need to consider adding a narrative to both Work Plans that describes primary and secondary objectives. The primary objective would address fulfilling City Council and RWQCB requirements.

The secondary objective would address the development, definition, and exploration of component options that could be considered as part of the City's long-term water supply planning efforts.

- In the current study, full replacement of the screened open ocean intake is listed as the only option. Subsurface desalination intakes and potable reuse are considered as mutually exclusive rather than combined to develop integrated solutions; however, it is likely that the best solution will include combinations of components and complimentary opportunities. The Panel understands this level of review would be conducted at a later time.

3.3 Subsurface Desalination Intake

The following comments pertain to the *Draft Work Plan on Subsurface Desalination Intake* for the Subsurface Desalination Intake Feasibility Study.

Section 1.0: Introduction

- Clarify whether the desalination facility is intended to provide a base supply (i.e., operated full-time) or be used as an emergency supply (e.g., during periods of drought) as part of the City's long-term water supply options.
- Page 4, bullet 1, states: "A full replacement of the City's open ocean intake using a subsurface intake." Is there any consideration of "partial replacement"? Some regulatory agencies are suggesting that subsurface intake be maximized to the extent feasible, with the remainder of intake water subsidized by open ocean intake water.
- Regarding Figure 2 on the "Project Schedule," it appears that the schedule focuses more time on the field work item rather than the permitting. The City of Santa Cruz conducted a similar study in which the offshore geophysical study required about 6 months to permit and less than 1 month to conduct the field work.
- Provide a brief summary of precedent studies.

Section 2.0: Basis of Design

- Project Site Alternatives: The Panel is concerned that the City has limited itself with the criteria for the project site locations. It may be too narrow to start with this reduced suite of only onshore locations. As an example, the City of Santa Cruz evaluated approximately18 different onshore locations that could accommodate a pump station and an almost equal number of offshore locations for the intake (i.e., slant wells, horizontal wells, infiltration gallery, and open ocean intake). The exercise of culling feasible sites was valuable to the City of Santa Cruz.
- Subsurface Properties: The section on "Field Program Permitting" (page 13) should include the National Environmental Policy Act (NEPA).

- Water Quality and Treatment Needs: The Panel is interested in learning more about the consideration of carbon dioxide in the subsurface source water and its contribution towards greenhouse gases (page 16).
- Subsurface Intake System Analysis: In general, the methodologies listed in the Work Plan seem appropriate for the study's objectives; however, as an exception:
    - It is proposed that the existing U.S. Geological Survey (USGS) groundwater flow model may be used to assess the performance of subsurface intake technologies and impacts to groundwater contamination migration and wetlands depletion. The discretization, layering, and ocean boundary condition of the existing USGS model is inappropriate for the evaluation of subsurface intake performance and impacts. The existing model has a very large cell size, does not have an apron under the seafloor such that seafloor infiltration can be simulated, and does not simulate groundwater flow in the surficial sediments that are hydraulically connected to the ocean. It is understood that the USGS model is currently being updated; however, these limitations are not slated for correction in the new model. Initial analysis of the performance of the subsurface intake likely will need to be performed with analytical methods. If a subsurface intake meets performance criteria, the impacts could be later addressed by inserting a more refined model into the regional USGS model and using the regional model for boundary heads.
- Reliability Features: Address the frequency and complexity of maintenance for subsurface intakes.
    - The Work Plan sets a feedwater goal for the subsurface intake of approximately 16,000 gallons per minute. Some amount of redundancy should be built into this estimate. The Huntington Beach evaluation used a 20-percent redundancy, which seems appropriate for systems with small pumps operating in a seawater environment.
    - Address how maintenance procedures (e.g., pump replacement and well rehabilitation) will occur and the frequency of these efforts.
    - Clarify why a 20-year service lifespan has been adopted.

Section 3.0: Feasibility Criteria and Fatal Flaws

- The Panel appreciates the inclusion of economics as part of the definition of "feasibility" for this study (page 23); however, economics needs to be understood in the context of the other metrics (i.e., environmental, social, technical) and perhaps have a role that, at least at this stage of the study, is not weighted as heavily. Similarly, the Panel is concerned about use of the California Environmental Quality Act (CEQA) definition of "feasible" at this point in the evaluation, particularly with respect to environmental metrics, since the permitting thresholds required for project implementation will be more stringent than the CEQA thresholds.
- The Panel recommends that the first sentence of Section 3.1 (which references CEQA) be deleted.

- The feasibility criteria listed in the Work Plan seem appropriate for the study's objectives with the following exceptions:
    - Geotechnical Factors #1b – Proper operation and maintenance procedures should reduce the risk of well clogging and should be considered as part of the component definition rather than considered a potential flaw.
    - Hydrogeology Factors #3 – Please confirm that the potential impact on freshwater aquifers resulting from additional drawdown might cause groundwater to flow seaward, as stated, and not inland.
    - Energy Use #13 – CEQA does not include a threshold for energy use to determine potential impacts. The question is whether the project will use energy efficiently (i.e., would the project exclude wasteful, inefficient, and unnecessary consumption of energy during project construction, operation, maintenance, and/or removal that cannot be feasibly mitigated?)
        - Under NEPA, is there a threshold? What is it for greenhouse gases?
        - What is the "project" referenced in #13 and #14? Is it the subsurface intake? The subsurface intake less the energy of the open ocean intake? Less the pretreatment (that a subsurface intake may eliminate?) Is the carbon dioxide of the subsurface intake incorporated here?
    - Reliability and Performance #22a/b – Performance Risk (#22b) is associated with "a large amount of uncertainty with regard to likelihood of successful implementation," while Precedent of Technology (#22a) could be used as an indicator of uncertainty and, therefore, performance risk. Will the use of both criteria address the same issue?
- Regarding the "Design and Construction Constraints" listed in Table 3.2 on "Fatal Flaw Criteria," the Panel notes that land issues with respect to adequate land onshore are difficult to assess because one could argue that some or all of the onshore facilities could be moved further onshore to a suitable location (requiring a longer tunnel or trench).
- If land-based subsurface intake technologies other than those producing from the surficial beach deposits (i.e., slant wells or deeper vertical wells) are to be considered, a much better understanding of the near-shore subsurface hydrogeology will be essential. Currently, significant consequential conflict exists in published literature regarding the location of the offshore boundary between the producing zones of the groundwater basin and the consolidated sediments underlying the ocean floor. Understanding the location and nature of this boundary is fundamental to estimating volumes of seawater that can be induced through seafloor leakage and to characterize the sources and blend of the resulting feedwater. Resolving this conflict may require extensive geophysical and/or exploratory work.
- The subsurface intake feasibility evaluation will begin with technical aspects (i.e., Will it work? Can it be built?); however, for most land-based subsurface intake approaches, yield, produced water quality, and inland impacts are extremely sensitive to the setback distance from the shoreline. It may be unavoidable to not address the siting constraints of land availability and sea level rise before determining performance feasibility.

- The feasibility should consider sea level rise and its implications for coastal erosion. It is recommended that the study avoid using the coastal erosion analysis to determine "if any control features can be provided to protect the facilities." If sea level rise is going to affect the facility during its useful life, then the facility is being sited in a location that will be impacted. The inclusion of protective measures (rather than locating the facility out of the hazard zone) may not be acceptable to the California Coastal Commission.
- Other studies have shown that wells at the coastal margin can impact groundwater basins or induce seawater intrusion. The criteria need to address this issue.

Section 5.0: Cost Estimating Methodology

- Consider if the feasibility analysis, environmental review/permitting/public process, property and easement acquisition, and design fees can or should be included in the costs to compare with other alternatives (e.g., open ocean intake or potable reuse). Ensure the costs are truly comparable.

3.4 Potable Reuse

The following comments pertain to the *Draft Work Plan on Potable Reuse* for the Potable Reuse Feasibility Study.

Section 1.0: Introduction

- More emphasis appears to be given to IPR for groundwater injection than other options for recycled water usage (e.g., DPR, aquifer storage and recovery, or reservoir augmentation). Are the other options being considered as much as IPR for groundwater injection? For example, the activities to assess and ascertain the feasibility of DPR (e.g., using treated wastewater effluent as desalination feedwater) could present project opportunities for the City.
- Please clarify who owns the wastewater from the El Estero Wastewater Treatment Plant (e.g., is it the City of Santa Barbara?).
- Provide a brief summary of precedent studies.

Section 2.0: Basis of Design

- Why is the discharge of advanced treated wastewater into Lauro Canyon Reservoir considered DPR?
- Production Capacity: The average daily flow needs to be augmented with an understanding of diurnal flow.
    - Equalization can be used to address diurnal flows.
    - Include the storage options for buffering or for equalization, conveyance, treatment, and distribution.

- Water Quality: The City will need an appropriate source control program if potable reuse is to be implemented. Please provide a brief narrative on the present source control program for the El Estero Wastewater Treatment Plant.
- Optimization of the El Estero Wastewater Treatment Plant process operations and water quality should be considered.
- Treatment: As proposed in the Work Plan, full advanced treatment (FAT) will be used to produce recycled water for IPR; however, the FAT treatment train needs to be specified in the Work Plan, including a schematic.
- Groundwater Recharge (Section 2.5): On Page 13, consider including "impact to other wells" as a feasibility screening criteria.
- Groundwater Recharge (Section 2.5.1): On page 14, the Work Plan suggests an assumed injection rate of 75 percent of the extraction rate. What is the basis for the 75-percent injection rate? Experience has shown that injection well performance in finer-grained sediments can be better maintained with injection rates closer to 50 percent of the extraction rate.
- Groundwater Recharge (Section 2.5.2): On page 14, fourth line, should this sentence begin with "This project will *review* available…" and not "This project will *provide* available…"?
- Groundwater Recharge: The existing USGS groundwater model is adequate for the assessment and quantification of the volume of recycled water that might be cyclically stored in a put-and-take operation; however, even though the new USGS model is proposed to have transport capability, the cell size is too large to use the model to simulate flow between wells and defensibly predict residence times. Again, analytical methods might be used as a first cut.
- Groundwater Recharge: Consideration should be given to optimizing the management of the groundwater basin to create storage. Further detail on groundwater contamination and seawater intrusion issues will be necessary.
- Additional Production Wells (Section 2.6, Page 18): The narrative leading up to this section reads as if only IPR (i.e., groundwater injection using treated wastewater) is being considered. This section implies that existing production wells will be used for this concept. The Panel believes it is inconsistent with current regulations to use the same well for injection and production with recycled water.
- Additional Well Sites: The Work Plan should include a preliminary inventory of possible sites for the numerous injection and extraction wells necessary to inject and recover the water.
- Reliability Features (Section 2.8, page 19): The Panel suggests rewriting the paragraph to provide more clarity about project reliability.

Section 3.0: Feasibility Criteria

- The Panel noted that the work authorizations do not include a fatal flaw analysis for potable reuse; however, it is listed in Figure 1.
- The fatal flaw analysis should consider the treatment train and specific requirements of the Groundwater Recharge regulations.
- Please clarify how Oceanographic Factors #8 and #9 in Table 3.1 are relevant to recycled water.
- For Energy Use #13 in Table 3.1, does the City's 2012 Climate Action Plan provide for mitigation/offsets to meet the Plan's thresholds? Consider providing for this as a way to achieve comparable emissions between alternatives.

Additional Recommendations:

- If pursuing potable reuse, the City should begin outreach to the community about recycled water as a water supply option.
- The implications of using recycled water for brine dilution should be considered. This should include the environmental implications of discharging the mixed recycled water and brine to the ocean, as well as the reduction in wastewater volume that is available for recycling.

APPENDIX A: PANEL BACKGROUND

About NWRI

For over 20 years, NWRI – a science-based 501c3 nonprofit located in Fountain Valley, California – has sponsored projects and programs to improve water quality, protect public health and the environment, and create safe, new sources of water. NWRI specializes in working with researchers across the country, such as laboratories at universities and water agencies, and are guided by a Research Advisory Board (representing national expertise in water, wastewater, and water reuse) and a six-member Board of Directors (representing water and wastewater agencies in Southern California).

Through NWRI's research program, NWRI supports multi-disciplinary research projects with partners and collaborators that pertain to treatment and monitoring, water quality assessment, knowledge management, and exploratory research. Altogether, NWRI's research program has produced over 300 publications and conference presentations.

NWRI also promotes better science and technology through extensive outreach and educational activities, which includes facilitating workshops and conferences and publishing White Papers, guidance manuals, and other informational material.

More information on NWRI can be found online at www.nwri-usa.org.

About NWRI Panels

NWRI also specializes in facilitating Independent Advisory Panels on behalf of water and wastewater utilities, as well as local, county, and state government agencies, to provide credible, objective review of scientific studies and projects in the water industry. NWRI Panels consist of academics, industry professionals, government representatives, and independent consultants who are experts in their fields.

The NWRI Panel process provides numerous benefits, including:

- Third-party review and evaluation.
- Scientific and technical advice by leading experts.
- Assistance with challenging scientific questions and regulatory requirements.
- Validation of proposed project objectives.
- Increased credibility with stakeholders and the public.
- Support of sound public-policy decisions.

NWRI has extensive experience in developing, coordinating, facilitating, and managing expert Panels. Efforts include:

- Selecting individuals with the appropriate expertise, background, credibility, and level of commitment to serve as Panel members.

- Facilitating hands-on Panel meetings held at the project's site or location.
- Providing written report(s) prepared by the Panel that focus on findings and recommendations of various technical, scientific, and public health aspects of the project or study.

Over the past 5 years, NWRI has coordinated the efforts of over 20 Panels for water and wastewater utilities, city and state agencies, and consulting firms. Many of these Panels have dealt with projects or policies involving groundwater replenishment and potable (indirect and direct) reuse. Specifically, these Panels have provided peer review of a wide range of scientific and technical areas related water quality and monitoring, constituents of emerging concern, treatment technologies and operations, public health, hydrogeology, water reuse criteria and regulatory requirements, and outreach, among others.

More information about the NWRI Independent Advisory Panel Program can be found on the NWRI website at http://nwri-usa.org/Panels.htm.

APPENDIX B: PANEL BIOGRAPHIES

Amy Childress, Ph.D. (Chair)
Professor and Director of Environmental Engineering
University of Southern California (Los Angeles, CA)

Amy Childress has more than 20 years of experience researching membrane processes for water treatment, wastewater reclamation, and desalination. Most recently, she has investigated membrane contactor processes for innovative solutions to contaminant and energy challenges; pressure-driven membrane processes as industry standards for desalination and water reuse; membrane bioreactor technology; and colloidal and interfacial aspects of membrane processes. Dr. Childress has directed research funded by federal, state, and private agencies. Current research projects are funded by US Environmental Protection Agency, the Strategic Environmental Research and Development Program, and California Department of Water Resources. Dr. Childress has received several awards including the Association of Environmental Engineering and Science Professors Outstanding Publication Award and a National Science Foundation CAREER Award, and has served as President of the Association of Environmental Engineering and Science Professors and an editorial board member for several journals. She holds a Ph.D. from the University of California, Los Angeles.

Heather Collins, P.E.
Water Treatment Manager
Metropolitan Water District of Southern California (Los Angeles, CA)

Heather Collins has more than 24 years of experience in water resource and treatment management. Currently she oversees the operation and maintenance of five water treatment plants with a total capacity of 2.6 billion gallons per day for Metropolitan Water District, a consortium of 26 cities and water districts that provide drinking water to nearly 19 million people. Prior to joining MWD, Ms. Collins served in the California Department of Public Health as Section Chief of the Drinking Water program. She is Vice Chair of the American Water Works Association (CA-NV Nevada Section) and is a past Chair for the Young Professionals Committee and Section Trustee. Ms. Collins currently serves as Delegate-at-Large on the Technical and Education Council, and liaison to the Water Utility Council, which reviews policy statements and develops regulatory and legislative initiatives for the Association. She holds a master's degree in Civil Engineering from Loyola Marymount University and an undergraduate degree in civil and environmental engineering from Cal State Polytechnic University in Pomona. She is a professional engineer and a Certified Water Treatment Operator in California.

Martin B. Feeney, P.G., C.E.G., C.Hg.
Consulting Hydrogeologist (Santa Barbara, CA)

Martin Feeney has more than 34 years of experience as a hydrogeologist. Since 1997 he has worked as an independent consulting hydrogeologist, providing services to water agencies,

private industry, and engineering firms. Previously he worked at several consulting firms including Staal, Gardner, & Dunne, Inc.; Fugro Wes, Inc.; and Balance Hydrologics, Inc., where he provided analysis of groundwater basins, developed groundwater flow and transport models, sited and designed municipal wells, developed injection wells/artificial recharge programs, and performed underground storage tank site assessment and remediation. Mr. Feeney's work in desalination has focused on development of subsurface seawater feedwater intakes, and his projects include: evaluation of subsurface intake feasibility for cities of Oxnard, Ventura, Marina and Monterey; design of the intake and reject disposal systems for the now-operational Sand City desalination facility; and development of feedwater wells on numerous Caribbean islands. He also is a member of the Hydrogeologic Working Group evaluating the proposed slant wells feedwater concept to support a 12 million gallon per day (MGD) desalination facility in the Monterey Bay area and previously sat on the Independent Scientific Technical Advisory Panel that reviewed subsurface feedwater concepts for the proposed 50 MGD desalination facility in Huntington Beach, California, for the Coastal Commission and Poseidon. Mr. Feeney received a BS in Earth Sciences from the University of California, Santa Cruz, and an MS in Environmental Planning from California State University.

Heidi Luckenbach, P.E.
Deputy Director/Engineering Manager
City of Santa Cruz Water Department (Santa Cruz, CA)

Heidi Luckenbach is a civil engineer with more than 20 years of experience in water supply planning, drinking water treatment, and distribution. She has worked for the City of Santa Cruz Water Department for 17 years. As Deputy Director, she manages engineering services for maintenance, operation, and improvement of the water utility, including long-range water supply planning. Ms. Luckenbach previously served as Desalination Program Coordinator for seven years, during which she developed and implemented the work plan for the scwd2 Regional Seawater Desalination Project. Program elements included a seawater desalination pilot study, evaluation of intake alternatives, analysis of brine dilution, comparison of water supply alternatives, and engagement with regulatory agencies. The 2.5-million gallon per day supplemental water supply would serve several communities in North Santa Cruz County. Luckenbach received her BS in Civil Engineering from California State University, Northridge, and an MS in Environmental Engineering from University of California, Los Angeles. She is a Registered Civil Engineer in California, serves as Vice Chair of the Desalination Committee for the California Nevada Section of American Water Works Association, and was recently a board member for the American Membrane Technology Association.

Eric Zigas
Director, Bay Area Water Group
Environmental Science Associates (San Francisco, CA)

Eric Zigas has more than 35 years of experience in water resources planning and management. Since joining ESA in 2002, he has focused on developing and evaluating water resource projects related to the supply, treatment and distribution of potable water, wastewater, and stormwater.

He has worked on Raising Los Vaqueros Dam for Contra Costa Water District, and the development of a water supply solution for the Monterey Peninsula. His work in desalination includes the Coastal Water Project Environmental Impact Report and the Monterey Peninsula Water Supply Project DEIR. Previously Mr. Zigas spent 22 years at EDAW Inc., (now AECOM), a global firm that specializes in urban planning and design, landscape architecture, economics, and cultural and environmental services, where he worked on water policy assignments and long range water supply plans. He holds a degree in Geography from SUNY at Buffalo.

NATIONAL WATER RESEARCH INSTITUTE

Technical Advisory Panel for
City of Santa Barbara
Subsurface Desalination Intake and
Potable Reuse Feasibility Studies

Meeting #1
AGENDA
Wednesday, August 5, 2015

LOCATION
Santa Barbara City Hall
Council Chambers Room and Room 15
735 Anacapa Street
Santa Barbara, CA 93101

CONTACTS
Jeff Mosher, NWRI
(714) 705-3722 (Mobile)
Jaime Lumia, NWRI
(714) 378-3278 (NWRI Office)

CLOSED SESSION with Technical Advisory Panel (TAP), City of Santa Barbara, and Carollo Engineers
Begins 8:30 am in Council Chambers Room

8:30 am	Welcome and Introductions	Jeff Mosher Executive Director, NWRI
8:40 am	Review Agenda and Meeting Objectives	Panel Chair
8:50 am	Discuss Work Plans on Subsurface Desalination Intake and Potable Reuse	Moderated by Panel Chair

OPEN PUBLIC SESSION
Begins 9:30 am in Council Chambers Room

9:30 am	Welcome and Introductions	
9:45 am	Presentation on Work Plans on Subsurface Desalination Intake and Potable Reuse	City of Santa Barbara and Carollo Engineers
10:30 am	Questions from Technical Advisory Panel	Moderated by Panel Chair

11:00 am	Public Comments	Moderated by Jeff Mosher Executive Director, NWRI
12:00 pm	**OPEN SESSION ADJOURNS**	

12:00 pm **LUNCH**

CLOSED SESSION (TAP Only)
Begins 1:00 pm in Room 15

1:00 pm	Discussion on Subsurface Desalination Intake	Moderated by Panel Chair
2:30 pm	**BREAK**	
2:45 pm	Discussion on Potable Reuse	Moderated by Panel Chair

CLOSED SESSION with TAP, City of Santa Barbara, and Carollo Engineers
Begins 4:00 pm in Room 15

4:00 pm	Briefing Session with City of Santa Barbara and Carollo Engineers	Moderated by Panel Chair
4:30 pm	**ADJOURN**	

APPENDIX D: MEETING ATTENDEES

Panel Members:

- Chair: Amy Childress, Ph.D., University of Southern California (Los Angeles, CA)
- Heather Collins, P.E., Metropolitan Water District of Southern California (Los Angeles, CA)
- Martin B. Feeney, P.G., CHG, Consulting Hydrogeologist (Santa Barbara, CA)
- Heidi R. Luckenbach, P.E., City of Santa Cruz Water Department (Santa Cruz, CA) (on phone)
- Eric Zigas, Environmental Science Associates (San Francisco, CA)

National Water Research Institute:

- Susanne Faubl, Water Resources Scientist and Project Manager
- Jeff Mosher, Executive Director
- Gina Vartanian, Outreach and Communications Manager

City of Santa Barbara:

- Jason Bryan
- Kelley Dyer
- Joshua Haggmark
- Bob Roebuck
- Cathy Taylor

Carollo Engineers:

- Eric Cherasia
- Tom Seacord

Sub-Consultants:

- Jeff Barry, GSI
- Austin Melcher, Dudek
- Joe Monaco, Dudek
- Paul Sorensen, Fugro
- Tim Thompson, GSI

Others:

- Alex Alonzo, Montecito Sanitary District
- Lindsey Baker, League of Women Votes Santa Barbara
- Jordan Clark, University of California, Santa Barbara
- Mariah Clegg, University of California, Santa Barbara
- Jeff Densmore, Division of Drinking Water, State Water Resources Control Board
- John Fletcherman
- Chris Gabriel, Goleta Water District
- Diane Gabriel, Montecito Sanitary District
- Diane Gatza, West Basin Municipal Water District

- Hillary Hauser, Heal the Ocean
- James Hawkins, Heal the Ocean
- Barry Keller, Santa Barbara Water Commission
- Robert Marks, Pueblo Water Resources
- Edward McGowan
- Warner Owens, Montecito Sanitary District
- Carrie Poytress, Stantec
- Kira Redmond, Santa Barbara Channelkeeper
- Monica Van Natta, Eurofins Eaton Analytical
- Brian Villalobos, GEOSCIENCE Support Services, Inc.