NATIONAL WATER RESEARCH INSTITUTE

Draft Final Panel Report for Meeting #2:

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

Based on a Technical Advisory Panel Meeting
Held on January 27-28, 2016 (Panel Meeting #2)

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

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March 2, 2016
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http://www.nwri-usa.org/santa-barbara-panel.htm

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ABOUT NWRI

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Publication Number: NWRI-2016-01

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ACRONYMS

AFY	Acre foot per year
ASR	Aquifer storage and recovery
CEQA	California Environmental Quality Act
DPR	Direct potable reuse
FAT	Full advanced treatment
FESA	Federal Endangered Species Act
GHG	Greenhouse gas
gpm	Gallons per minute
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
SSI	Subsurface intake
USFWS	U.S. Fish and Wildlife Service
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. In 1991, City voters elected to make desalination a permanent part of the City's water supply portfolio. The desalination plant was operated between March and June of 1992. Due to sufficient supply of freshwater from other sources, the plant was then placed on long-term standby mode for reactivation when water supply demand cannot be met using all other available supplies, including extraordinary water conservation.

An Environmental Impact Report was certified in May 1994 and, with the approval of the Long Term Water Supply Program in July 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. The permit provided for intermittent and base load operation.

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 desalination 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 Santa Barbara City Council directed the Public Works Department to evaluate the feasibility of (1) replacing the open ocean intake with a subsurface intake (SSI) 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.

[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.

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.
Work Authorization 2: SSI fatal flaw analysis and potable reuse feasibility study.
Work Authorization 3: SSI 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. Information is also available at http://www.nwri-usa.org/santa-barbara-panel.htm.

1.4 Panel Members

The Panel is made up of experts in areas related to drinking water management, desalination and wastewater recycling technologies, 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)
- 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)
- Michael P. Wehner, Orange County Water District (Fountain Valley, CA)
- Eric Zigas, Environmental Science Associates (San Francisco, CA)

It should be noted that Mr. Wehner has replaced former Panel member Heather Collins, P.E., of the Metropolitan Water District of Southern California (Los Angeles, CA). Ms. Collins resigned from the Panel due to a potential conflict of interest with a potable reuse project currently being considered by Metropolitan.

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

2. PANEL MEETING #2

A 2-day meeting of the Panel was held on January 27-28, 2016, in Santa Barbara, California. The first day of the meeting included an open session in which members of the public were invited to attend; it was held at the Santa Barbara City Hall on Anacapa Street. The second day of the meeting was held at the Water Resources Conference Room on Garden Street. This meeting represents the second time the Panel has met to review the *Subsurface Desalination Intake Feasibility Study* and *Potable Reuse Feasibility Study* being undertaken by the City. It is referred to herein as "Panel Meeting #2."

2.1 Background Material

Prior to Panel Meeting #2, the following background material was provided to the Panel:

- Subsurface Desalination Intake Feasibility Study Technical Memoranda:
    - TM-1: Introduction, Background, and Project Alternatives
    - TM-2: Regulatory and Permitting Requirements
    - TM-3: Basis of Design and Initial Screening

- Potable Reuse Feasibility Study Technical Memoranda:
    - TM-1: Introduction, Background, and Project Alternatives
    - TM-2: Regulatory and Permitting Requirements

2.2 Panel Meeting #2 Agenda

Staff from NWRI, the City, and Carollo Engineers collaborated on the development of the agenda for Panel Meeting #2, which is included in Appendix C. The agenda was based on enabling:

- Carollo Engineers to publically present information in the SSI Technical Memoranda on the conceptual design and initial technical screening analysis of SSI options, and (2) preliminary information regarding the potable reuse study.
- Members of the public to have an opportunity to provide comments.
- The Panel to conduct a technical review of the Technical Memoranda and information presented at Meeting #2 regarding both the SSI and potable reuse studies.

Day 1 of Panel Meeting #2 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 that focused mostly on the conceptual design and initial technical screening analysis of SSI options, followed by questions from the Panel. The floor was then open to public comments. Once the public session concluded, the Panel met briefly with City staff and Carollo Engineers for additional clarification

before moving on to a closed Panel session to (1) discuss the information presented and to (2) draft preliminary findings.

Day 2 of Panel Meeting #2 began with a closed discussion with the Panel, City staff, and Carollo Engineers on preliminary information regarding the potable reuse study. The Panel then discussed its preliminary findings regarding the SSI study with City staff and Carollo Engineers. Before adjourning Meeting #2, the Panel met in a closed session to complete a report outline with findings and recommendations, which have been expanded upon in this report.

2.3 Panel Meeting #2 Attendees

All Panel members attended Panel Meeting #2 in person. Other meeting attendees included NWRI staff, City staff, Carollo staff and their sub-consultants, members of the public, and others. A complete list of attendees at Panel Meeting #2 is included in Appendix D.

2.4 Panel Response to Public Comments

Because Panel Meeting #2 included an open public session, all interested persons were invited to attend and comment on the matter. Written comments were also accepted via email for two weeks after the meeting. The Panel's written responses to public comments will be included in a separate document; therefore, public comments will not be addressed in this report.

3. PANEL FINDINGS AND RECOMMENDATIONS

The principal findings and recommendations of the Panel, as derived from the material presented and discussed during Panel Meeting #2, are provided in Sections 3.1 to 3.5. The findings and recommendations are organized under the following section headings:

- General Comments
- Update on Activities since Panel Meeting #1
- Subsurface Desalination Intake Feasibility Study
  - Regulatory Summary for Subsurface Intakes
  - Basis of Design for Subsurface Intakes
  - Summary of Alternatives and Conceptual Design
  - Sediment Transport and Coastal Hazards
  - Hydrogeological Analysis of Subsurface Intake Alternatives
  - Initial Screening
- Potable Reuse Feasibility Study

3.1 General Comments

The following comments pertain to the overall Panel review process as related to the materials, presentations, and discussions resulting from Panel Meeting #2.

3.1.1 Overall Thoughts

- The Panel appreciates that the pre-meeting materials and presentation provided at Panel Meeting #2 were well-prepared and informative.

3.1.2 Subsurface Desalination Intake Feasibility Study

- The conceptual designs in the Subsurface Desalination Intake presentation were useful in portraying the anticipated visual impact of subsurface intake installations on the beaches in Santa Barbara.

- Recognizing that the SSI Technical Memoranda will serve as chapters in the final report, the information should be provided in such a manner that a reasonable reviewer would be able to follow the logic and draw similar conclusions. TM-1 presented the Introduction, Background, and Project Alternatives, and TM-2 presented the Regulatory and Permitting Requirements; therefore, TM-3 should present the following (which is similar to the flow and logic of the January 27, 2016, presentation):

  - Summary of Alternatives and Conceptual Design.
  - Sediment Transport and Coastal Hazards.

- Hydrogeological Analysis of Subsurface Intake Alternatives.
- Initial Screening.
- Conclusions and Recommendations.

- Do not comingle the conclusions with background material. For example, the last sentence in the first paragraph of the Sediment Transport Evaluation beginning on page 3-33 of TM-3 states, "Key findings are presented for **each beach site** [emphasis added] considered in the following sections." This section, therefore, should describe the characteristics and physical processes of **each beach site**, and any bullets that draw a conclusion should be reserved for the initial screening discussion section.

- Correct the pagination in TM-3, starting at Table 3.13 (it should be page 3-66, not 3-57).

- The Panel recommends the following information be included to provide better context regarding the SSI study:

  - An explanation as to why the City received the Coastal Development Permit from the California Coastal Commission in 1996 even though the desalination plant had already been operated and put into standby in 1992.

  - Clarification that the Coastal Development Permit was for the existing open ocean intake system.

  - A clear statement as to why the City's desalination facility is exempt from regulatory and permitting requirements in the California Ocean Plan.
    - Include background information provided by Rebecca Bjork, City Public Works Director, about the current permit for the City's desalination facility, which has an open ocean intake.

  - Any consideration given to streamlining the evaluation process since this facility is exempt from the Ocean Plan. For example, costs, land use conflict, or other factors could possibly be included earlier in the assessment.

  - A description of the requirements of the RWQCB amendment to the Waste Discharge Requirements for the El Estero Wastewater Treatment Plant as related to the study.

- Although this facility may be exempt from the California Ocean Plan, the Ocean Plan states that the RWQCB shall require the owner or operator to: "Consider whether the identified need for desalinated water is consistent with an applicable adopted urban water management plan prepared in accordance with Water Code section 10631, or if no urban water management plan is available, other water planning documents such as a county general plan or integrated regional water management plan." (Chapter III.m.2.b.[2]).

Based on this requirement, the demand projections in the Long-Term Water Supply Planning process may need to be updated to justify the 10,000 AFY that is stated. To do so, the Panel suggests:

- Providing a description of the current baseline water use.
- Providing stacked bar or pie charts showing what comprises the 10,000 AFY of demand; one chart should be for drought conditions and another for non-drought conditions. Clearly document the source of the demand projections.
- Ensuring the potential use of desalination for drought and non-drought conditions is not lost in the presentation.

3.1.3 Final Report

- The Panel encourages the preparation of an Executive Summary for the final report, as discussed during Panel Meeting #2, and recommends the following:

    - Define the permit deadline driving the project schedule. Is it CCRWQCB Order No. R3-2010-001?

    - Clarify the possible roles of desalination (using subsurface intakes or open ocean intakes) and potable reuse in the Long-Term Water Supply Planning process. Explain the timing of the planning process and how these studies will fit into that process.

3.2 Update on Activities since Panel Meeting #1

The Panel requests that the City and project team provide a written response to the Panel Report for Meeting #2 that includes brief comments on how the Panel's findings and recommendations will be addressed.

3.3 Subsurface Desalination Intake Feasibility Study

The following comments pertain to the Technical Memoranda (TM-1, TM-2, and TM-3) and information presented on the *Subsurface Desalination Intake Feasibility Study*.

3.3.1 Regulatory Summary for Subsurface Intakes

TM-2 does not refer to the California Ocean Plan or the National Environmental Policy Act (NEPA). Reiterate why the California Ocean Plan does not apply to this desalination plant. If NEPA is not applicable and the City will need to consult with the U.S. Fish and Wildlife Service (USFWS) under the Federal Endangered Species Act (FESA), then please revise the FESA "Section 7" consultation process with the USFWS that is described in Section 2.5.2 of TM-2, to reflect how consultation under the FESA would work (as well as the scheduling implications) without a federal lead agency ("Section 10" consultation).

3.3.2 Basis of the Design for Subsurface Intakes

- Identify how SSI alternatives would work for both drought and non-drought conditions.

- Consider including a sensitivity analysis that would result from releasing some of the design constraints (e.g., property ownership, half-mile boundary).

- On Presentation Slide #14 ("Design, Construction, and Operational Criteria that must be evaluated when implementing a subsurface intake project"), a blend of seawater and groundwater was listed as a design requirement. Clarify what is meant by a "blend of seawater and groundwater."

3.3.3 Summary of Alternatives and Conceptual Design

- In TM-3, Table 3.4 (Feasible Yield and Ocean/Inland Water Contribution Summary) and Table 3.6 (Conceptual Design: Vertical Wells) have similar but inconsistent information. For example:

    - The "capacity, total" for vertical wells is 1,500 gallons per minute (gpm) in Table 3.4 and 1,400 gpm in Table 3.6.
    - The Well Spacing is 560 feet for the low k value in Table 3.4 and 600 feet in Table 3.6.

    Please be consistent.

- TM-3 is inconsistent as to whether the drilling equipment required for slant wells is specialized or not:

    - Page 3-17 states: "Specialized drilling equipment must be employed...."
    - Page 3-20 states: "Although the drilling equipment is the same used for vertical wells...."
    - Page 3-21 refers to "...the custom drilling equipment that is required."

    Please be consistent.

- On Slide #46 ("Construction of a Subsurface Infiltration Gallery is more complex than any subsurface intake alternative"), reference is made to greenhouse gas (GHG) emissions during the construction phase. The Panel feels it is not necessary to discuss GHG emissions for one alternative unless it is discussed for all alternatives.

3.3.4 Sediment Transport and Coastal Hazards

The following comments pertain to the final report titled *Coastal Hazards and Sediment Transport Analysis for the City of Santa Barbara Subsurface Desalination Intake Study*, dated December 29, 2015, and submitted by Scott A. Jenkins, Ph.D., of Michael Baker International.

The report was provided as Appendix C in TM-3. An overview of the report was also presented at Panel Meeting #2.

- The Panel felt the study and overview of sediment transport and coastal hazards were informative and useful.

- The Panel would like clarification as to where the City's future shoreline will be located. Please see the "City of Santa Barbara Sea-Level Rise Vulnerability Study" prepared for the California Energy Commission by the University of California, Santa Cruz (July 2012) at http://www.energy.ca.gov/2012publications/CEC-500-2012-039/CEC-500-2012-039.pdf, which includes a discussion of the vulnerability of and previous damage to City beaches and facilities from high tides and winter storms (e.g., impacts to West Cabrillo Boulevard from overtopping waves in 1914 and 1983).

- Please explain the 150-foot setback to protect against erosion and how it was determined.

3.3.5 Hydrogeological Analysis of Subsurface Intake Alternatives

- The hydrogeologic analysis approach and methods of evaluating the yield of the proposed SSI alternatives and then addressing the land requirements within the limitations of the available land are appropriate.

- Analysis of the groundwater-based SSI alternatives (i.e., vertical wells, slant wells, collector wells, and infiltration galleries) was performed with a groundwater model created for this purpose. Although details of the model in the report are limited, it appears that the model uses overly optimistic hydraulic parameters and boundary conditions; therefore, it likely overestimates the hydraulic connection between the nearshore groundwater system and the ocean. This overestimation increases individual SSI yields and reduces inland impacts.

- It is understood that the overly optimistic hydrogeologic assumptions were used to provide a "best case" estimate for the performance of SSI alternatives. This may be appropriate if only one SSI alternative is to be implemented to meet demand; however, the Panel understands that the rejected alternatives may survive to be reevaluated as part of future water supply planning. If the rejected approaches are to survive as possible components of future supply, it is recommended that the SSI alternatives be evaluated with more realistic hydrogeologic parameters.

- The Panel had several concerns with the modeling assumptions:

    - The offshore geology is unknown; however, given that seafloor materials were deposited during a transgressive period, it can be assumed that the offshore/seafloor materials are, at least in part, finer grained and certainly significantly more heterogeneous and stratified than the beach deposits. The assumption that offshore hydraulic conductivities are similar to beach hydraulic conductivities is unsupported

and may significantly overestimate the volume of seawater that will infiltrate and the amount of water that will move horizontally from the constant head boundary.

- The assumed horizontal/vertical hydraulic conductivity ratio (K_h/K_v) is very low and likely significantly overestimates the amount of water that is moving vertically through the seafloor. The ratio of 5 that is used is much lower than default textbook values, which are typically around 100 for heterogeneous layered systems (Freeze and Cherry, 1979, Anderson and Woessner, 2002). The ratio of 5 is also significantly lower than the values (10 to 100) used by the U.S. Geological Survey (USGS) for the existing model of the Santa Barbara basin. For Huntington Beach SSI analyses, ratios between 10 and 100 were used in sensitivity analyses. In the calibrated groundwater model developed for the Marina slant well analyses, ratios between 34 and 450 were adopted for dune sand and terrace deposit layers, respectively. Given the sensitivity of the results to this ratio, the use of the very low ratio of 5 should be justified. Also, sensitivity analysis should be performed over a greater range for this parameter. If further refinement of the vertical conductivity value is considered important, a series of vibracores should be taken from the seafloor and evaluated for vertical conductivity.

- Equivalent freshwater heads should be used offshore to account for the greater density of seawater.

- The use of a constant-head boundary in the lower layers offshore needs justification. The shallow offshore geology is poorly understood. Whether and where the lower layers outcrop on the seafloor are unknown. It is possible these layers are truncated by offshore faulting. The use of the constant-head boundary condition at this location results in unlimited horizontal flow of water into the model. A general-head boundary condition with a conductance that approximates the geometry of the flow path may be preferred. The conductance could be adjusted to approximate differing assumed geometries.

- Although it is implied that the groundwater-based SSI alternatives derive their offshore flow from vertical leakage through the seafloor, the use of constant-head boundary conditions offshore may result in unlimited horizontal water flow. A detailed narrative is needed to describe and quantify the anticipated horizontal and vertical offshore flows.

- In general, more documentation of the model assumptions and configuration is needed. An appendix that includes the following information would help the reader understand how the analysis was performed:

    - A generalized conceptual hydrogeologic model and how it was captured in the grid/layer configuration.
    - A map of the model domain that shows boundaries (e.g., constant-head, no flow).
    - A cross-section of the model showing the layers, layers thickness, and relationship to seafloor.

- A water budget that details the volume of water derived from leakage through the seafloor vs. the volume of water supplied from the offshore constant-head or general-head boundary. (i.e. constant-head fluxes)
- Particle tracking and presentation of these results to visualize sources and sinks and to help explain to the reader the nature of the flow regime.

- With the exception of the use of equivalent freshwater heads, the adoption of more realistic assumptions (as discussed above) will reduce the hydraulic connection of the subsurface groundwater system with the ocean. It will also reduce estimated yields and increase onshore impacts. Model results, however, will be more realistic and defensible and have residual value to the City.

3.3.6 Initial Screening

- Please number the screening criteria in Table 3.11, in a similar fashion to how they are numbered in Table 3.12.

- There are three screening criteria that seem to use the same logic to draw the same (infeasible) conclusion. In fact, two of the screening criteria listed in Table 3.11 (Initial Screening Criteria) and Table 3.12 (Subsurface Desalination Intake Initial Screening Results) are essentially the same:

    - Hydrogeologic Factors
        - Criterion 4: Insufficient length of beach available for replacing full yield derived from existing open ocean intakes.
    - Design and Construction Constraints
        - Criterion 9: Lack of adequate linear beach front for technical feasibility.

  "Criterion 8: Adequate Capacity" states that "subsurface material lacks adequate transmissivity to meet target yield of at least 15,898 gpm (i.e., build-out intake capacity necessary to produce 10,000 AFY)." While the failure to meet this criterion is stated to be transmissivity, it appears the conclusion is really being drawn because there is insufficient beach (criterion 4) or lack of adequate linear beach front (criterion 9) that causes the lack of adequate capacity, not the transmissivity of the aquifer. Consider how this criterion is used for drought versus non-drought needs, especially since the Ocean Plan states that "design capacity in excess of the need for desalinated water . . . shall not be used by itself to declare subsurface intakes as not feasible."

- The screening table could be misinterpreted. Regardless of what conclusions are reached for meeting current project goals (with 10,000 AFY demand), the conclusions should also include alternatives to meet partial demand.

    - Create another table that addresses the potential feasibility of the SSI alternatives to be components of a long-term future water supply.

- The unclear terminology in the tables is likely to become clearer once the table is broken up into two tables.
- The first sentence of TM-3 Section 3.6 states that, "This section presents the basis of design, conceptual design, and initial screening analysis for each of the six SSI alternatives considered in this study." This sentence may be misplaced since the section does not do that.
- The Panel agrees there are significant risks associated with moving forward with Neodren due to the lack of precedent studies and unproven constructability. One city should not take the risk on an unproven technology. If pursued, the City should seek grant funding and collaborate with Montecito and others to construct a demonstration project.

3.4 Potable Reuse Feasibility Study

The following comments pertain to the *Potable Reuse Feasibility Study*.

3.4.1 General Comments from Panel Report #1

Please address the potable reuse questions and comments in the Panel report from Meeting #1. General comments from the Panel begin on page 4 of the report (and are repeated here):

- "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 (1) it addresses regulatory requirements set by the RWQCB, and (2) 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 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.

3.4.2 Specific Comments from Panel Report #1

Specific comments from the Panel on the Potable Reuse Feasibility Study begin on page 9 of Panel Report #1 (and are repeated here):

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? Is the DPR assumption based on an inability to meet retention time and blending requirements in Lauro Canyon? Could the retention time requirement in the draft surface water augmentation criteria be met by an alternative treatment process to supplement shorter retention time? This question may not be answerable until after DDW has decided whether to include an alternatives provision in the draft regulations.

- 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. Water quality and public health concerns raised by some community members will need to be addressed directly in the outreach program.

- 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.

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.

Michael P. Wehner
Assistant General Manager
Orange County Water District (Fountain Valley, CA)

Mike Wehner has almost 40 years of experience in water quality control and water resources management. Initially, he spent 20 years with the Orange County Health Care Agency. Since 1991, he has worked for the Orange County Water District (OCWD), where he currently serves as Assistant General Manager. Among his responsibilities, he directly manages the Water Quality and Technology Group, including Laboratory, Water Quality, Hydrogeology, Research and Development, and Health and Regulatory Affairs Departments. In this capacity, he is involved with numerous aspects with OCWD's Groundwater Replenishment System (the nation's largest IPR project), including providing technical guidance on treatment and quality, as well as managing monitoring programs for the purification facility and receiving groundwater. He was also manager of OCWD's 8-year Santa Ana River Water Quality and Health Study, which evaluated the impact of using effluent-dominated river waters for groundwater recharge. At present, Wehner serves on the Advisory Group on the "Feasibility of Developing Criteria for Direct Potable Reuse" for the California State Water Resources Control Board, as well as expert panels on groundwater replenishment projects for both the Los Angeles Department of Water and Power (California) and Monterey Regional Water Pollution Control Agency (California). He received a Masters of Public Administration from California State University Long Beach and a B.S. in Biological Sciences from the University of California, Irvine

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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 #2 Agenda

January 27-28, 2016

Meeting Location:

Santa Barbara City Hall
735 Anacapa Street
Santa Barbara, CA 93101

Contacts:

Jeff Mosher, NWRI
(714) 705-3722 (mobile)

Jaime Lumia, NWRI
(714) 378-3278 (NWRI office)

Wednesday, January 27, 2016

CLOSED SESSION begins at 8:30 am in Room 15. Attended by Technical Advisory Panel (TAP), City of Santa Barbara (City), and Carollo Engineers (Carollo).

8:30 am	Welcome and Introductions	Jeff Mosher, NWRI
8:40 am	Review Agenda and Meeting Objectives	Amy Childress, Panel Chair
8:50 am	Discuss the presentations to be delivered by City and Carollo during the Open Session	Moderated by Panel Chair

OPEN SESSION begins at 9:30 am in Council Chambers Room. Attended by TAP, City, Carollo, and members of the public.

9:30 am	Welcome and Introductions	Jeff Mosher, NWRI
9:45 am	Presentation on (a) Conceptual Design and Initial Technical Screening Analysis of Subsurface Desalination Intake Options and (b) Regulatory and Permitting Requirements for Potable Reuse Alternatives	City and Carollo
10:30 am	Questions from Technical Advisory Panel	Moderated by Panel Chair

11:00 am	Public Comments	Moderated by Jeff Mosher
12:00 noon	**ADJOURN OPEN SESSION**	

CLOSED SESSION begins at 12:00 noon in Room 15. Attended by TAP, City, and Carollo.

12:00 noon	**LUNCH with TAP, City, and Carollo**	
12:30 pm	Discussion on Subsurface Desalination Intakes	Moderated by Panel Char
2:00 pm	**BREAK**	
2:15 pm	TAP ONLY. Continue discussion.	Moderated by Panel Char
4:30 PM	**ADJOURN DAY ONE OF MEETING**	

Thursday, January 28, 2016

CLOSED SESSION begins at 8:30 am in the Water Resources Conference Room, 619 Garden Street, Floor 3. Attended by TAP, City, and Carollo.

8:30 am	Discussion on Regulatory and Permitting Requirements for Potable Reuse Alternatives	Moderated by Panel Chair
9:30 am	TAP ONLY. Continue discussion.	Moderated by Panel Chair
12:00 noon	**LUNCH** and debriefing with TAP, City, and Carollo	
1:00 pm	TAP ONLY. Continue discussion.	Moderated by Panel Chair
2:00 pm	**ADJOURN DAY TWO OF MEETING**	

APPENDIX D: PANEL MEETING #2 ATTENDEES

Panel Members:

- Chair: Amy Childress, Ph.D., University 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)
- Michael P. Wehner, Orange County Water District (Fountain Valley, CA)
- 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:

- Rebecca Bjork, Public Works Director
- Joshua Haggmark, Water Resources Manager
- Robert Roebuck, Project Manager II

Carollo Engineers:

- Eric Cherasia
- Tom Seacord

Sub-Consultants:

- Austin Melcher, Dudek
- Joe Monaco, Dudek

Others:

- John Ackerman, Medical Reserve Corp
- Lindsey Baker, League of Women Voters of Santa Barbara
- Jordan Clark, University of California, Santa Barbara
- Rick Frickmann, Santa Barbara Urban Creeks Council
- Diane Gatza, West Basin Municipal Water District
- Garrett Haertel, Monterey Regional Water Pollution Control Agency
- Hillary Hauser, Heal the Ocean
- James Hawkins, Heal the Ocean
- Emily Iskin, Water Systems Consulting, Inc.
- Kathy King, CEC
- Robert Marks, Pueblo Water Resources
- Edward McGowan, Medical Geohydrology
- Charles Newman, Montecito Water District
- Steve Nipper, Sol Wave Water
- Rebecca Nisslay, Water Systems Consulting
- Ken Oplinger, Chamber of Commerce of the Santa Barbara Region

- Corey Radis, Heal the Ocean
- Kira Redmond, Santa Barbara Channelkeeper
- Dick Shaikewitz, Montecito Water District
- Robert Ziegler