CITY OF SANTA CRUZ
City Hall
809 Center Street
Santa Cruz, California 95060

Water Department

WATER COMMISSION

Regular Meeting

November 06, 2017

7:00 P.M. GENERAL BUSINESS AND MATTERS OF PUBLIC INTEREST, COUNCIL CHAMBERS

*Denotes written materials included in packet.

The City of Santa Cruz does not discriminate against persons with disabilities. Out of consideration for people with chemical sensitivities, please attend the meeting fragrance free. Upon request, the agenda can be provided in a format to accommodate special needs. Additionally, if you wish to attend this public meeting and will require assistance such as an interpreter for American Sign Language, Spanish, or other special equipment, please call Water Administration at 831-420-5200 at least five days in advance so that arrangements can be made. The Cal-Relay system number: 1-800-735-2922.

APPEALS: Any person who believes that a final action of this advisory body has been taken in error may appeal that decision to the City Council. Appeals must be in writing, setting forth the nature of the action and the basis upon which the action is considered to be in error, and addressed to the City Council in care of the City Clerk.

Other - Appeals must be received by the City Clerk within ten (10) calendar days following the date of the action from which such appeal is being taken. An appeal must be accompanied by a fifty dollar ($50) filing fee.

Call to Order

Roll Call

Statements of Disqualification - *Section 607 of the City Charter states that ...All members present at any meeting must vote unless disqualified, in which case the disqualification shall be publicly declared and a record thereof made.The City of Santa Cruz has adopted a Conflict of Interest Code, and Section 8 of that Code states that no person shall make or participate in a governmental decision which he or she knows or has reason to know will have a reasonably foreseeable material financial effect distinguishable from its effect on the public generally.*

Oral Communications - No action shall be taken on this item.

Announcements - No action shall be taken on this item.

Consent Agenda (Pages 1.1 – 7.17)
Items on the consent agenda are considered to be routine in nature and will be acted upon in one motion. Specific items may be removed by members of the advisory body or public for separate consideration and discussion. Routine items that will be found on the consent agenda are City Council Items Affecting Water, Water Commission Minutes, Information Items, Documents for Future Meetings, and Items initiated by members for Future Agendas. If one of these categories is not listed on the Consent Agenda then those items are not available for action.

1. City Council actions affecting the Water Department (Page 1.1)

   Accept the City Council items affecting the Water Department.

2. October 2, 2017 Water Commission Minutes (Pages 2.1 - 2.10)

   Approve the October 2, 2017 Water Commission Minutes

3. Summary of Supply Modeling and Aquifer Storage and Recovery Information presented at October 2, 2017 Water Commission (Pages 3.1 - 3.5)

   Receive information summarizing the Workshop on Water Supply Modeling and Aquifer Storage and Recovery from the October 2, 2017 Water Commission Meeting.

4. 2018 Water Commission Schedule (Pages 4.1 - 4.2)

   Approve meeting schedule for 2018.

5. 4th Quarter FY 2017 Financial Report (continued from October 2, 2017 meeting) (Pages 5.1 - 5.4)

   Receive the updated 4th Quarter FY 2017 Financial Report.

6. 1st Quarter FY 2018 Financial Report (Pages 6.1 - 6.4)

   Receive the 1st Quarter FY 2018 Financial Report.

7. Update to the 2015 State of the Water System (continued from October 2, 2017 meeting) (Pages 7.1 - 7.17)

   Accept the information on the State of the Water System.

Items Removed from the Consent Agenda

General Business (Pages 8.1 – 9.30)
Any document related to an agenda item for the General Business of this meeting

distributed to the Water Commission less than 72 hours before this meeting is available for inspection at the Water Administration Office, 212 Locust Street, Suite A, Santa Cruz, California. These documents will also be available for review at the Water Commission meeting with the display copy at the rear of the Council Chambers.

8. Presentation by Dudek Report Updating the Water Supply Augmentation Strategy, Local Desalination Option (Pages 8.1 - 8.100)

   Receive information regarding the Desalination Feasibility Update Report.

9. Briefing and Refresher on WSAC Change Management/Adaptive Management Framework (Pages 9.1 - 9.30)

   Acknowledge the Water Supply Advisory Committee's Change Management and Decision-Making Framework as the foundation of decision making for a preferred future supplemental water supply project or portfolio of projects that will be implemented to improve the reliability of the Santa Cruz water supply.

Subcommittee/Advisory Body Oral Reports - No action shall be taken on this item.

10. Santa Cruz Mid-County Groundwater Agency

11. Santa Margarita Groundwater Agency

Director's Oral Report - No action shall be taken on this item.

Adjournment

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WATER COMMISSION
INFORMATION REPORT

DATE: 10/31/2017

AGENDA OF: November 6, 2017

TO: Water Commission

FROM: Rosemary Menard, Water Director

SUBJECT: City Council items affecting the Water Department

RECOMMENDATION: That the Water Commission accept the City Council items affecting the Water Department.

BACKGROUND/DISCUSSION:

October 10, 2017

No items from the Water Department.

October 24, 2017

Reconciliation of Private Residential Encroachment on City Watershed Lands
Resolution No. NS-29,309 was adopted to allow a lot line adjustment and property transfer with Erik Gillberg on the city's Laguna watershed property – APN 080-201-32, which will reconcile an encroachment while still preserving the City's watershed protection land management values.

Grant Funding Applications to FEMA Hazard Mitigation Grant Program Administered by CalOES for Flood Risk Reduction Project at the Coast Pump Station and Pipeline Damage Risk Reduction Project at Brackney Landslide
Motion carried authorizing the Water Director to submit grant applications, and accept and appropriate funds if awarded, to the Section 404 FEMA Hazard Mitigation Grant Program administered by the California Office of Emergency Services for a flood risk reduction project at the Coast Pump Station and a pipeline damage risk reduction project at Brackney Landslide.

PROPOSED MOTION: Motion to accept the City Council items affecting the Water Department.

ATTACHMENTS: None.

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CITY OF SANTA CRUZ
City Hall
809 Center Street
Santa Cruz, California 95060

Water Department

WATER COMMISSION

Meeting Minutes

October 02, 2017

7:00 P.M. GENERAL BUSINESS AND MATTERS OF PUBLIC INTEREST, COUNCIL CHAMBERS

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APPEALS: Any person who believes that a final action of this advisory body has been taken in error may appeal that decision to the City Council. Appeals must be in writing, setting forth the nature of the action and the basis upon which the action is considered to be in error, and addressed to the City Council in care of the City Clerk.

Other - Appeals must be received by the City Clerk within ten (10) calendar days following the date of the action from which such appeal is being taken. An appeal must be accompanied by a fifty dollar ($50) filing fee.

Call to Order at 7:02 p.m.

Roll Call
Present: L. Wilshusen (Chair), D. Engfer (Vice-Chair), D. Baskin, J. Mekis, D. Schwarm, W. Wadlow
Absent: A. Schiffrin, with notification

Statements of Disqualification - Section 607 of the City Charter states that "… All members present at any meeting must vote unless disqualified, in which case the disqualification shall be publicly declared and a record thereof made."

The City of Santa Cruz has adopted a Conflict of Interest Code, and Section 8 of that Code states that no person shall make or participate in a governmental decision which he or she knows or has reason to know will have a reasonably foreseeable material financial effect distinguishable from its effect on the public generally.
There were no statements of disqualification.

Oral Communications - No action shall be taken on this item.
There were no oral communications.

Announcements - No action shall be taken on this item.
Administrative Assistant III, Amy Poncato, has accepted employment with the Scotts Valley Water District and this will be her last meeting as Water Commission secretary. Commissioners conveyed their appreciation for Ms. Poncato's service to the Water Commission.

Consent Agenda (Pages 1.1 – 7.10) Items on the consent agenda are considered to be routine in nature and will be acted upon in one motion. Specific items may be removed by members of the advisory body or public for separate consideration and discussion. Routine items that will be found on the consent agenda are City Council Items Affecting Water, Water Commission Minutes, Information Items, and Documents for Future Meetings, and Items initiated by members for Future Agendas. If one of these categories is not listed on the Consent Agenda then those items are not available for action.

1. City Council items affecting the Water Department

2. August 7, 2017, Water Commission Minutes

3. Water Department Glossary

Commissioner Baskin moved to approve the Consent Agenda. Commissioner Engfer seconded.
VOICE VOTE: MOTION CARRIED
AYES: All.
NOES: None.
ABSENT: A. Schiffrin.

Items Removed from the Consent Agenda

4. 4th Quarter FY 2017 Financial Report

- Can you tell us more about the approximately $9 million discrepancy between the adjusted budget amount for "service, supplies, and other" in the 3rd Quarter Financial Report and the 4th Quarter report. As staff was not available to respond, this item will come back for explanation in November.

Commissioner Engfer moved to accept the 4th Quarter Financial Report. Commissioner Schwarm seconded.
VOICE VOTE: MOTION CARRIED
AYES: All.
NOES: None.
ABSENT: A. Schiffrin.

5. Source Water Quality Monitoring Program Update

Do any of the anticipated changes to the Graham Hill Water Treatment Plant (GHWTP) have an impact on moving the estimated maximum total suspended solids (TSS) to meet current solids production limits and if it were to do that, would it be some value in showing another line so we can see what we might capture beneficially by those changes?

- We are looking at pushing that limit up as part of the concrete tanks replacement project. There is a lot of analytical work that needs to go into characterizing the nature of the solids produced during water treatment. We're working to develop what additional solids handling capacity or systems would make sense to include as part of future development. The data set we just collected makes it clear that our current approach to solids handling is an important constraint of the GHWTP.

Commissioner Baskin moved to accept the Source Water Quality Monitoring Program Update. Commissioner Engfer seconded.

VOICE VOTE: MOTION CARRIED
AYES: All.
NOES: None.
ABSENT: A. Schiffrin.

6. Update to the 2015 State of the Water System

Moved to November 6, 2017, Water Commission meeting.

7. Water Supply Augmentation Strategy, Quarterly Work Plan Update

How is information about meter accuracy operationalized? How do we use the information that we have?

- This information is part of our state mandated Distribution System Water Audit.

  In order to accurately predict distribution system losses, we need good data on the amount of water produced. The work described in the quarterly WSAS update focused on how we validated the accuracy of our production metering equipment, which is about 30 years old, and how we have established a protocol for continued testing of this critical equipment.

Do we make any reporting adjustments based on any of the accuracy data developed in this effort?

- We did not make a reporting adjustment because if you bought this meter off the shelf it would say it was accurate within 1% so inside of that we made no adjustments and we stated so in the audit.

In the discussion of the pipe-loop study on page 7.3 there is a reference to understanding the potential impacts of changing source water on water quality in areas served by Asbestos Cement (AC) pipes. What are the issues with this type of pipe material?

- There is a standard for Asbestos in drinking water and it is based on fibers of a particular size or smaller. We don't have a problem meeting the Asbestos standard when we do the testing. Asbestos cement pipe was a pipe material that was used fairly extensively in certain development in the 1960's and early 1970's and then it went out of style, so we do have some in our system. Other systems that were developed during that time period will also have this type of pipe in their system.

Is that something we plan to replace those pipes over time?

- We are planning to replace all of our water mains over time, including AC cement pipe where it exists in our system.

Do we know how much AC pipe we have in our system?

- AC pipe makes up approximately 36% (106 miles) of the treated water distribution system. The pipe was installed starting in the 1960's and into the late 1970's. The Soquel Creek Water District also has a significant amount of AC pipe in their system and one objective of the pipe loop study is to confirm that the City water will not adversely affect the structure of the AC pipe through dissolution of cement fraction of the pipe walls.

What are the concerns with asbestos in drinking water?

- The Environmental Protection Agency (EPA) 1992 asbestos standard is based on concerns consumption of asbestos fibers greater than 10 micrometers in length increasing the occurrence of benign intestinal polyps. One issue that may increase the release of asbestos fibers to drinking water is the result of AC pipe being used in areas where there is a high water table. These conditions may cause the pipe to become spongy, which may result in the release of these asbestos fibers in the water supply.

Are we well within the standard?

- Yes.

Final Comments

- The chart on page 7.10 needs a title and the color scheme on the chart needs improvement to make it more readable.

Commissioner Baskin moved to accept the Water Supply Augmentation Strategy, Quarterly Work Plan Update. Commissioner Engfer seconded.

VOICE VOTE:	MOTION CARRIED
AYES:	All.
NOES:	None.
ABSENT:	A. Schiffrin.

General Business

8. <u>Workshop on Water Supply Modeling and Aquifer Storage and Recovery with Gary Fiske (Gary Fiske and Associates Inc.) and Robert C. Marks (Pueblo Water Resources Inc.)</u>

Ms. Luckenbach introduced Kevin Crossley and Gary Fiske, who provided an overview on water supply modeling and aquifer storage.

What happens if there is not enough water in the system after it's been through the Daily Dispatch Order (slide number 13 in the presentation)?

- If there is not enough water in the system after working through all the sources, then there is a water shortage and an unmet demand for that day. Daily shortages accumulate to an annual shortage number. In the model outputs, you can see how much water, under different hydrologic conditions at different times of the year, are unserved and what shortages we have.

Where does the Felton Diversion Dam fit into the Daily Dispatch Order or is that part of Loch Lomond because it diverts up to Loch Lomond?

- Right now the Felton Diversion diverts to Loch Lomond but looking at the new supply alternatives we are assuming it could divert directly from the Felton Diversion to the Graham Hill Water Treatment Plant to the virtual storage in a groundwater aquifer.

Where does it go in the Daily Dispatch Order?

- Currently it is not dispatched directly to meet demand. The model asks if there is room in Loch Lomond today. If yes, is the water needed downstream at Tait Street to support customer demand? If yes, then water can't be diverted at Felton. If there is excess water in the river that can be diverted and there is room in the reservoir and there is transmission capacity available to move the water from Felton to Loch Lomond, then Felton will divert water up Loch Lomond, which then makes it available to be dispatched to meet customer demand.

- Also, some scenarios being evaluated as part of the current modeling work include meeting in-lieu demand from Soquel Creek, Scotts Valley Water District and San Lorenzo Valley water districts. The way the Confluence model (Confluence) is looking at this is that as it goes through its Daily Dispatch Order every day, it looks at how much demand there is from our partnering agencies to see how much of that demand we can meet. Operationally, we still don't know whether or not any or all of these agencies would participate on a day to day basis, but for those scenarios that include in-lieu, we're evaluating and modeling how the system would operate in the event that they did participate.

The chart on page 25 of the presentation shows the same shortage for the 3 year fill historic and climate change scenarios but different results for the 7 year historic and climate change results. What is causing this difference?

- The flow patterns in the climate change data set are such that, with the 3-year fill cycle, the minimum shortage we can achieve is the same as with the historic. That is coincidental. Note that to achieve the same shortage in the 3-year fill period, more capacity to draw down the water is needed with climate change flows. In the 7-year fill period, with climate change flows, there is just less water to go around. Even with 7 years to fill you are still left with a shortage; but you can eliminate this shortage with historic flows.

Why was a 7-year fill period chosen?

- It was chosen because it was the shortest period of time in which you could make an in-lieu project work.

Then, the 7 year fill cycle time was based on the historical flows and not the climate change flows?

- Yes.

Has any of the Confluence modeling resulted in any change to the 1.2 billion gallons worst-case peak season shortfall developed by the WSAC?

- No.

What assumptions have you been using in the Confluence analysis about how far Loch Lomond can get drawn down? Is there a reserve in Loch Lomond? How big is it? Is there any difference between how the City has been managing the reservoir in recent years?

- The capacity of Loch Lomond is 2.8 billion gallons. Of those 2.8 billion gallons, 1 billion gallons of usable storage is held over in the event that there is something worse than the 1976-1977 drought. So, when Loch Lomond usable storage goes to zero, there is not really zero water in storage; rather there is a billion gallons held over.

Are you modeling the aquifer storage so that it can be drawn down to zero gallons?

- Yes, the model assumes we can exhaust all of what we put into the aquifer except for losses.

How much water would be returned to Santa Cruz from the Soquel Creek Water District under an in-lieu scenario?

- We have demand forecasts for neighboring districts for use in modeling in-lieu in the Confluence. Confluence assumes that once Santa Cruz demands are met, any water that remains can be used to meet in-lieu demand in other systems. Further Confluence assumes that for each gallon Santa Cruz can provide to neighboring districts, that is one less gallon the neighboring agencies would have normally taken that water from the aquifer. Finally Confluence assumes the City could ultimately take back 80% of the amount of water it delivered to the districts via in-lieu when it needed it to help deal with a water shortage.

Does the groundwater model take into account recharge to groundwater from septic systems?

- Yes.

I understand that the Department is developing another climate change projection. What's involved in that, and who is working on it?

- Balance Hydrologics is working on producing an additional local flow set based on a revised global climate model that has been down-scaled to our region. When it is ready it will be used to model system performance in the same way that the existing climate change hydrology has been used.

What is the timeframe for the climate change model?

- We have not received a specific delivery date for the flow set however, we expect the data in the next couple of weeks.

So you don't have a sense of how different it will be?

- No.

Is the Department of Fish and Wildlife also working in different climate parameters and how they might affect fish flows releases?

- The structure of the agreements that we are working on is actually based on the flows in the system, so it is very adaptable to different climate realities.

Ms. Luckenbach then introduced Isidro Rivera and Robert Marks, who provided an overview on groundwater modeling and ongoing work on aquifer storage and recovery.

Since we are going to use these groundwater models to project performance going forward are we also putting climate change data in as we move forward?

- Yes. The groundwater modeling work is evaluating conditions under both historic and climate change weather scenarios. For the climate scenario, the WSAC work will be used in both the Mid-County and Santa Margarita models.

Will the new climate change scenario that is being developed by Balance Hydrologics be used as well?

- We will have to do a scope change to deal with that new climate scenarios.

Regarding water storage losses from groundwater to surface water in the Santa Margarita basin, are there any issues to be concerned about related to if or how increased groundwater flows to surface water might contribute to higher surface water flows and thus greater flooding during winter storms?

- No, generally when we talk about water storage losses, we are talking about water slowly weeping out of the ground, not the seemingly instantaneous rising of a stream during a storm event.

Do the preliminary groundwater model scenarios show significant enough additional contributions of groundwater to surface water such that they could potentially be beneficial for fish flows?

- The potential beneficiary streams of greater base flows from Santa Margarita groundwater are all tributaries to the San Lorenzo. Higher stream flows in these tributaries could greatly improve/expand dry season fish habitat in the upper basin and potentially improve stream flows system wide, which would benefit both water supply and fisheries.

Regarding the chart on page 32, if the increases in the pink (streams) and light blue (springs) are surface flows, does that mean that that flows leaving groundwater aren't contributing to keeping seawater at bay in the Santa Margarita basin?

- Seawater intrusion is not an issue in the Santa Margarita Basin.

Are we making assumptions about what kind of supplemental supply our partnering water districts might be doing?

- The current analysis does not include any assumptions about whether Soquel Creek or Scotts Valley water districts, for example might be pursuing a desal or recycled water project.

When do we start to analyze the impacts of various options on infrastructure costs and operating requirements?

- We'll be talking more about that in November.

When will we have a model for the Purisima basin?

- We should be getting results from the Mid-County groundwater model that are comparable to the Santa Margarita basin results in the next week or two.

What are the similarities and differences between the Santa Cruz ASR project and the Las Posas Basin ASR project?

- Staff from Pueblo had recently met with two hydrogeologists with knowledge of the Las Posas ASR Project design and operational history. Based on those discussions, a few key issues were identified with relevance to the City's ASR project:

    1. First and foremost, the Las Posas project was investigated and designed in the late 1980's/early 1990's, a time when the standards of practice for ASR projects were in relative early stages. Since that time, standards of practice for ASR have evolved significantly, which would directly benefit the City's ASR project development efforts.

    2. With regards to project design, there was a spatial "disconnect" between the locations in the Las Posas groundwater basin where In-Lieu recharge was occurring and the recovery pumping well field. This led to relatively inefficient "capture" of the water recharged via In-Lieu. A

similar phenomenon was observed in the initial groundwater modeling scenarios for the Santa Margarita Groundwater Basin, discussed earlier in the presentation.

3. With regards to project operations, there was a surprising lack of ongoing, rigorous monitoring of project performance during the multi-year recharge phase of the project. Should the City's ASR project become operational, PWR would develop and oversee a routine monitoring and reporting program that would track project performance on an ongoing basis and limit the potential for many of the problems experienced at the Las Posas project.

Subcommittee/Advisory Body Oral Reports - No action shall be taken on this item.

Santa Cruz Mid-County Groundwater Agency (www.midcountygroundwater.org)

- An advisory committee has been appointed to start the Groundwater Sustainability Plan development process. The committee will start the series of four planned orientation sessions, with the first one happening on Thursday, October 05, 2017. The sessions are open to the public.
- The orientation presentations will be video and audio recorded and they will be uploaded to the Mid-County Groundwater Agency website.
- Contracts have been drawn up for HydroMetrics, who will be responsible for technical support and Kearns and West who will assist with facilitation and process support for the Advisory Committee.
- This agency has until January of 2020 to submit its plan.
- The next Mid-County Groundwater Agency meeting is on November 16, 2017.

Santa Margarita Groundwater Agency (www.smgwa.org)

- Commissioner Engfer was appointed to be the City's representative on the Santa Margarita Groundwater Agency Board.
- A meeting of the board was held on August 25th.
- This agency has until January 2022 to submit their plan.
- The next meeting is on October 25, 2017.

Director's Oral Report - No action shall be taken on this item.

- The water year, which ended on Saturday, September 30, 2017, was the wettest on record based on the cumulative discharge of the San Lorenzo River.
- Loch Lomond is only down 5% at this point.
- We are using new agenda software to assemble all agendas, which means in the future, similar functionality for accessing agendas and agenda reports as that available for City Council agendas will be available for Water Commission agendas and materials.

Adjournment - The Water Commission adjourned at 10:43 p.m.

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WATER COMMISSION
INFORMATION REPORT

DATE: 10/31/2017

AGENDA OF: 11/6/17

TO: Water Commission

FROM: Heidi Luckenbach, Deputy Director/Engineering Manager

SUBJECT: Summary of Supply Modeling and Aquifer Storage and Recovery Information presented at October 2, 2017 Water Commission

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RECOMMENDATION: That the Water Commission receive information summarizing the Workshop on Water Supply Modeling and Aquifer Storage and Recovery from the October 2, 2017 Water Commission Meeting.

BACKGROUND: A workshop on water supply modeling and aquifer storage and recovery was presented at the October 2, 2017 Water Commission meeting. Presentations were provided by staff as well as two consultants to the city, Gary Fiske (Gary Fiske and Associates Inc.) and Robert C. Marks (Pueblo Water Resources Inc.). The goal of the meeting was to provide the commission with workable knowledge about how water supply modeling is being performed by Mr. Fiske using the Confluence model and how the information generated through the water supply modeling process is being used in the Aquifer Storage and Recovery work being performed by Mr. Marks. In addition, the current status of the various elements of the ASR and In-Lieu investigations was discussed.

DISCUSSION: The material presented at the October meeting was both dense and complex. This report, and accompanying attachments, attempts to summarize each presentation and draw out key points in a more clear and forthright manner. Looking forward, recognizing that the nature of this work will remain dense and complex, staff will make every effort to provide a clearer summary and key points in the staff reports accompanying each item.

FISCAL IMPACT: None.

PROPOSED MOTION: That the Water Commission accept the information summarizing the Workshop on Water Supply Modeling and Aquifer Storage and Recovery from the October 2, 2017 Water Commission Meeting.

ATTACHMENTS:
Attachment 1: Summary and Key Points, Confluence Model Presentation
Attachment 2: Summary and Key Points, ASR Presentation

Summary and Key Points, Confluence Model Presentation
Gary Fiske, Gary Fiske and Associates Inc.

The first part of Mr. Fiske's presentation was a summary of the Confluence model and how it has supported water resource planning by the City of Santa Cruz over many years. The model structure attempts to mimic the Santa Cruz water system and consists of sources of supplies (e.g., Laguna, Liddell, etc.) and facilities (e.g., Loch Lomond Reservoir, Beltz wells, etc.). The model operates off of a broad set of data inputs: demands, rainfall, fish flows, water rights, etc. The model's input assumptions have been continually updated over the years as better information became available. The goal has always been for the model to most accurately simulate actual system operations.

The Confluence model functions more or less as follows:

1. Supply sources are dispatched as they are in normal system operations. Thus, they are dispatched each day in the order that system operators would utilize them, subject to the various real-world constraints faced by system operators, such as flow availability, diversion/transmission capacity, water rights, turbidity constraints, etc.
2. The model simulation yields a wide assortment of charts and many detailed text files to perform diagnostics. All data can be exported to produce an unlimited variety of charts and tables to address particular questions. Examples of outputs are frequency and magnitude of peak season shortages under a set of input parameters.
3. Confluence outputs are used as inputs to other models, including the groundwater basin models that Pueblo Water Resources is using to examine potential groundwater storage supply options.
4. The Confluence model is a planning tool, not a day to day operations tool; i.e., it is used in combination with other models and data to better understand possible scenarios and solutions; it does not instruct operations of the water system.

The second part of the presentation summarized how Confluence is currently being used to simulate the Aquifer Storage and Recovery (ASR) and In-Lieu groundwater storage alternatives that the City is evaluating. Consistent with the findings of the Water Supply Advisory Committee (WSAC), the initial iteration of these analyses assumes 3 billion gallons (bg) of aquifer storage capacity is available, 20% volumetric losses, resulting in a maximum usable storage volume of 2.4 bg. These assumptions will be tested in the groundwater models of the Mid-County and Santa Margarita Groundwater Basins, and subsequent iterations between the Confluence supply model and groundwater model(s) will be run as needed. The key aim at this point in the analysis is to determine the minimum infrastructure necessary to achieve zero shortages in the worst two-year drought.

The modeling to date has simulated three supply configurations: In-Lieu only, ASR only, and combined In-Lieu/ASR. Each of these was modeled assuming historic flows and the GFDL 2.1/A2 climate change scenario that was used during the WSAC process. In each case, the modeling compared the required infrastructure with an assumed 3-year pre-drought aquifer fill period and with a 7-year pre-drought aquifer fill period.

Key conclusions future considerations of this initial iteration are as follows:

- Infrastructure requirements are generally smaller with an assumed 7-year pre-drought aquifer fill period than with a 3-year fill, i.e., if the period of time prior to a drought is 7 years, the scale of the project in terms of wells, etc., is smaller. (Note that the 7 year timeframe was selected because it was the shortest amount of time that would yield a zero shortage for historic flows.) This finding is likely obvious; however it begins to illuminate the importance of assumptions such as the amount of time a project will be operating before a drought occurs.

- Infrastructure requirements are generally smaller with assumed continuation of historical flow patterns than with climate change.

- The in-lieu only supply configuration (i.e. no direct injection into the aquifers) generally results in insufficient storage volumes to eliminate worst-year shortages. The exception is historical flows with an assumed 7-year fill period.

- With adequate infrastructure, both the ASR-only and the combined in-lieu/ASR configurations can achieve the zero-shortage reliability goal in all cases.

Key outputs of the Confluence modeling are monthly volumes of aquifer inflows and drawdown (extraction) for each scenario (e.g., In-Lieu, ASR, In-Lieu & ASR). This data is the used as inputs to the groundwater models in the Mid-County Groundwater Basin and the Santa Margarita Groundwater Basin. The groundwater modeling runs then test the efficacy of some of the key assumptions made for the Confluence modeling, most notably at this point are the assumptions of an overall 3 bg aquifer storage capacity and a 20% loss rate for all the supply scenarios. As an example, groundwater modeling may show that the loss rate(s) are lower or greater than 20% which would require less or more ASR wells. The results of the groundwater modeling may then lead to additional Confluence modeling iterations with revised assumptions, and so on.

A few assumptions to the model will likely need to be further evaluated moving forward:

- The infrastructure requirements are minimized if the city's surface storage and groundwater storage reservoirs are filled and drawn down in tandem. While this is how these facilities are treated in the current Confluence simulation, it may be more prudent to fill the aquifer before running it in tandem with the reservoir. This will be a decision made based in part on risk tolerance.
- The In Lieu scenario currently assumes partnerships with Soquel Creek, Scotts Valley and San Lorenzo Valley water districts. These partnerships will need to be confirmed.
- In addition to assuming In Lieu partners, the Confluence model dispatches to these partners on a daily basis; i.e. each day of a modeled scenario, the model will dispatch available water to a partner. It is likely that this dispatch will need to be seasonal as opposed to daily.
- Similarly, dispatch to ASR wells is daily and for operational reasons will likely be seasonal.

Summary and Key Points, Aquifer Storage and Recovery
Robert C. Marks, Pueblo Water Resources Inc.

Mr. Robert Marks, Principal Hydrogeologist with Pueblo Water Resources, Inc., provided a status report on the Phase 1 Aquifer Storage and Recovery (ASR) Technical Feasibility Investigation, with emphasis on the groundwater modeling efforts.

Mr. Marks provided an update on the Geochemical Interaction Evaluation, providing a summary of supplemental water sampling performed in June 2017 at the Graham Hill Water Treatment Plant (GHWTP) and from the distribution system at the Beltz 9 and 12 well sites. The results of the sampling and revised geochemical interaction modeling were favorable, indicating that injection source water produced from GHWTP having a pH of less than 7.6 should not result in problematic precipitation reactions (e.g., calcite) that could lead to injection well plugging.

Mr. Marks then provided a summary of the findings from the draft Well Siting Study. The draft study identified several potential ASR well sites in both the Santa Margarita Groundwater Basin (SMGB) and Santa Cruz Mid-County Groundwater Basin (MGB) having sufficient open space and meeting various logistical and technical requirements to support project ASR well facilities. It was noted that evaluating site acquisition was not part of the current study. The identified potential sites will be simulated in the various groundwater modeling scenarios. Future work will include feasibility of site acquisition which is informed by cost, willingness to sell, environmental assessments, etc.

The primary focus of Mr. Marks' discussion was on the groundwater modeling work. Mr. Marks provided a brief overview of the two existing calibrated groundwater models of the SMBG and MGB. He then described how output from the various Confluence Model simulations is translated into specific groundwater modeling scenarios. Three base-case scenarios are being performed with each basin model:

1. In-Lieu Only
2. ASR only
3. In-Lieu plus ASR

These scenarios are being run under both historical and future climate change hydrologies, with future projected pumping by the various Districts in each basin based on their respective most recent Urban Water Management Plans (UWMP). While the groundwater modeling had just gotten underway, Mr. Marks presented very recently received results from the initial modeling scenarios for the SMGB. While emphasizing the preliminary nature of the initial findings, notable key observations included the following:

- The storage capacity of the Lompico Sandstone in the project study area is on the order of approximately 1.5 billion gallons (bg). This volume represents about one-half of the needed storage capacity and is somewhat less than, but generally consistent with the assumptions made by the WSAC (within 25%). For reference, the ASR Recon-Study performed for the WSAC identified the potential storage capacity of the Lompico to be approximately 1.8 bg (based on estimated historical storage depletion).

- Hydraulic losses of stored recharge water range between approximately 20 to 40 percent, depending on the scenario. These loss factors also consistent with the assumptions made by the WSAC.
- The ASR only scenario performed better than either In-Lieu scenarios, with only 20 percent losses for ASR compared to about 30 to 40 percent for In-Lieu; however, it is believed that the storage loss factors for In-Lieu can likely improve with additional wells spread more spatially (horizontally and vertically) in the basin to more efficiently capture recharged water.
- Most of the storage losses occurred to creeks, streams and springs, which would be manifested as increased surface water flows and potentially representing environmental benefits.
- Impacts to other District wells were overall net positive/beneficial; however, during peak recovery drought periods, there is the potential for water levels at proximate District wells to be lower than under No Project conditions. Additional evaluation is planned to determine whether the potential water level impacts would be sufficient to significantly reduce the wells pumping capacities to meet the other District's demands during drought periods.
- Sustainable per-well injection rates ranged between approximately 0.2 to 0.4 million gallons per day (mgd). While these injection rates are somewhat lower than the 0.5 mgd average rate assumed by the WSAC, they are consistent with the refined estimate of 0.3 mgd developed from the Site-Specific Injection Capacity Analyses performed as part of the current Phase 1 investigation (Task 1.2).

Mr. Marks concluded his presentation by saying that the results thus far from the Phase 1 investigation had shown that it appeared likely to be technically feasible to inject treated GHWTP source water into each basin via ASR wells at rates sufficient to meet project needs. However, the analysis is still in the early stages and primary outstanding questions of total aquifer storage capacities, hydraulic losses and potential impacts to other District wells during recovery periods, still need to be evaluated with the planned groundwater modeling. The goal at the end of the Phase 1 investigation is to provide sufficient information for the City to make a "Go, No-Go" decision about proceeding with Phase 2 of the investigation (ASR pilot testing).

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WATER COMMISSION
INFORMATION REPORT

DATE: 11/1/2017

AGENDA OF: November 6, 2017

TO: Water Commission

FROM: Rosemary Menard
Water Director

SUBJECT: Water Commission Meeting Schedule for 2018

RECOMMENDATION: That the Water Commission approve their meeting schedule for 2018.

BACKGROUND/DISCUSSION: All meetings are scheduled for the Santa Cruz City Council Chambers unless otherwise noted.

January 2018
(01-08-18)
Downtown Library, 2nd Fl.

February 2018
(02-05-18)

March 2018
(03-05-18)

April 2018
(04-02-18)

May 2018
(05-07-18)

June 2018
(06-04-18)

July 2018
(07-02-18)

August 2018
(08-06-18)

September 2018
(09-03-18) *Labor Day*
tentatively rescheduled to 9-10-18/Location TBD

October 2018
(10-01-18)

November 2018
(11-05-18)

December 2018
(12-03-18)

FISCAL IMPACT: None

PROPOSED MOTION: Motion to approve the Water Commission meeting schedule for 2018.

ATTACHMENTS: None.

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WATER COMMISSION
INFORMATION REPORT

DATE: 10/31/2017

AGENDA OF: 11/6/17

TO: Water Commission

FROM: Malissa Kaping, Management Analyst

SUBJECT: Updated 4th Quarter FY 2017 Financial Report

RECOMMENDATION: That the Water Commission receive the updated 4th Quarter FY 2017 Financial Report.

BACKGROUND: The 4th Quarter FY 2017 Financial Report provided to the Water Commission at the October 2nd meeting has been updated to correct a double-entry error made in the FY 2017 mid-year budget adjustment. The amount shown as the Adjusted Budget for service, supplies, and other expenses was corrected from nearly $30.5M to $22M because of a double posting of the budget amount for the nearly $8.5M transfer of IBank funds from Fund 711 to Fund 716 and 717. The actual transfer of funds was completed without error and is reflected in the Actual YTD figure of over $19.1M. The following is additional information regarding operational savings between budgeted and actual expenses:

Salary savings: The nearly $1.3M in salary savings is due to vacancies and the time it takes to recruit and hire staff.

Services, Supplies, and Other savings: Over $2.1M was not spent due in part to delays in HCP work and delays in normal maintenance work due to the winter storm response. Over $218K was saved in energy costs due to solar projects and other energy saving endeavors.

Capital Outlay: Other: Capital Outlay purchases made through the City's Fleet division were delayed and such orders were transferred from the FY 2017 budget to the FY 2018 budget.

The following is a review of additional information provided in the October 2nd report:

Water Operations Fund Balance: The Water Operations fund (Fund 711) ended the year on June 30, 2017 with a balance of nearly $10.8M. The FY 2017 Pro-Forma projected an ending balance of nearly $9.6M in Fund 711. The small but positive variance of $1.2M between the Pro-Forma and the actual fund balance is largely due to salary savings and higher than expected revenue at Loch Lomond Reservoir. The target balance of $6.6M for Fund 711 shown in the attached report is the minimum amount needed to maintain 180 days cash on hand when combined with the balance in Water 90-Day Reserve Fund (Fund 716). The other Water Enterprise Funds ended FY 2017 with a fund balance consistent with the targets contained in the FY 2017 Pro-Forma.

Water Sales: The total actual water sales revenue received was $28.4M, 6% less than the $30.3M budgeted. The budget was based on an annual water volume sold of 2.5 BGY (or 3,342,244 CCF) and the total actual volume sold was 2.34 BGY (or 3,131,657 CCF), 6% less than projected. The very wet winter and wet cool spring may explain the lower than expected usage; however, the rate increases and lingering drought effects may also be contributing factors.

Miscellaneous Revenues: As mentioned above, Loch Lomond Recreation Area revenues well exceeded expectations. They had over 47K visitors in calendar year 2016; that number of visitors has not been seen in nearly 10-years and appears to be continuing into calendar year 2017. Combined with the fee increases implemented for the 2016 season, Loch Lomond Recreation Area revenues accounted for the higher than expected miscellaneous fees.

Grants & Other Financing: The Water Department budgeted the proceeds of the $25M I-Bank loan between two fiscal years, $3M in FY 2016 and $22M in FY 2017, based on the timing of the projected disbursements. However, Finance applied the entire loan proceeds to the FY 2016 actuals.

DISCUSSION: None

FISCAL IMPACT: None

PROPOSED MOTION: Accept the updated, un-audited 4th Quarter FY 2017 Financial Report.

ATTACHMENTS: Updated 4th Quarter FY 2017 Financial Report

4th Quarter FY2017
Preliminary, Unaudited, as of 6/30/17 (REVISED)

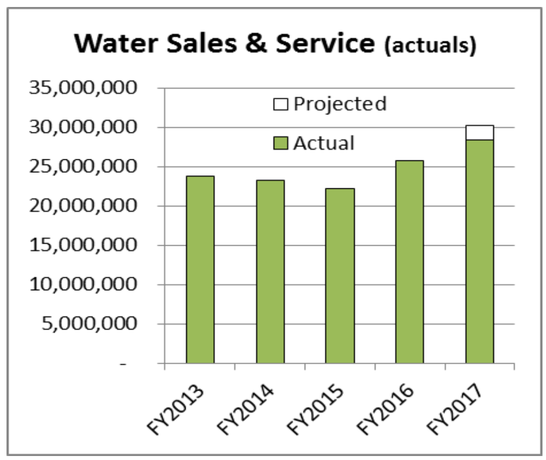
Water Operations, Fund 711

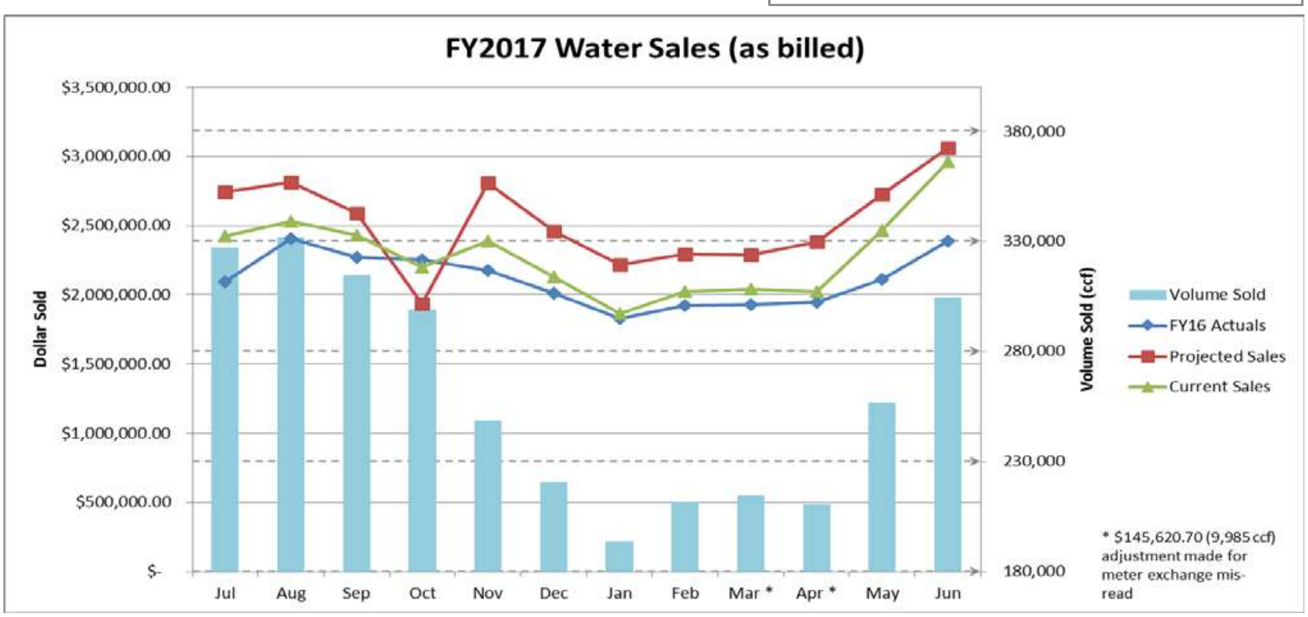
	FY2017 Ado Budget	FY2017 Adj Budget	Actual YTD Thru 6/30/17	Remaining Enc	FY2017 YTD Act + Enc	YTD % of Budget Act + Enc
Revenues						
Water Sales and Service *	30,278,463	30,278,463	28,368,079	-	28,368,079	94%
Miscellaneous	1,045,315	1,045,315	1,325,912	-	1,325,912	127%
Grants & Other Financing	22,008,000	22,008,000	196,400	-	196,400	1%
Total Revenues	**53,331,778**	**53,331,778**	**29,890,391**	**-**	**29,890,391**	**56%**
Expenses			-			
Personnel	12,741,984	12,802,461	11,543,905		11,543,905	90%
Services, Supplies, and Other *	20,794,807	*22,000,897*	19,128,105		19,128,105	87%
Capital Outlay: Other	965,000	1,083,050	369,864		369,864	34%
Debt Service	970,550	1,220,550	1,515,413		1,515,413	124%
Total Expenses	**35,472,341**	**37,106,958**	**32,557,286**	**-**	**32,557,286**	**88%**
Balance		16,224,820	(2,666,895)		(2,666,895)	

FY2017 Fund Balances

	Balance as of 6/30/17	Target Balance
711- Enterprise Operations	10,758,786	6,600,000
713- Rate Stabilization	2,479,026	2,450,000
714- Public Art	288,477	N/A
715-System Devel. Charges	3,321,787	N/A
716- 90-Day Operating Reserve	6,490,700	6,600,000
717- Emergency Reserve	3,042,715	3,100,000
718- MHJB Endowment	143,342	145,000

* Actual revenues received (not as billed)





** Adjusted budget reduced by $8,490,700 due to double-entry error in mid-year budget adjustment.*

CIP Projects Overview, as of 6/30/2017

Rehabilitation or Replacement Projects	Project #	Life of Project Total (Projected) **	Spend Thru 6/30/17 *	Project Duration	Current Status
Aerators at Loch Lomond	c701706	350,000	-	2017-2019	Feasibility
Bay Street Reservoir Reconstruction	c700313 & -027	25,934,172	24,428,785	2007-2017	Wrap-up/Phase 4
Beltz 10 & 11 Rehab & Development	c700026	509,243	64,243	2017-2018	Pre-Design
Coast Pump Station Line Repairs	c701707	550,000	-	2018	Feasibility
Felton Diversion Replac. & Pump Station	c701602	1,200,000	92,036	2016-2020	Pre-Design
Gravity Trunk Main Valve Replacement	c701504	640,000	511,019	2014-2017	Construction
Newell Creek Dam Inlet/Outlet Pipeline	c701606	49,940,744	966,872	2016-2021	Design
Newell Creek Pipeline Rehab/Replacement	c701701	19,782,600	-	2016-2020	Feasibility
N. Coast System Rehab- Laguna Diversion	c701801	1,750,000	-	2018-2021	Feasibility
N. Coast System Rehab- Majors Diversion	c701802	1,750,000	-	2018-2021	Feasibility
North Coast System Rehab - Phases 1-4	c709835	28,686,759	12,659,246	2003-2023	Construction
Pressure Regulating Stations	c701703	490,000	41,229	2017-2020	Pre-Design
San Lorenzo River Diversion & Tait Wells	c709872	2,055,014	1,930,344	2002-2017	Project Wrap-up
Tube Settler Replacement	c701708	2,200,000	47,264	2018	Pre-Design
University Tank No. 4 Rehab/Replace	c701505	3,770,000	-	2014 - 2020	Feasibility
University Tank No. 5 Replacement	c701506	4,028,000	189,608	2014 - 2018	Design
Water Treatment Upgrades	c700025 & -1401	815,547	430,620	On-going	Feasibility
Wharf Water Main Replacement	c701613	193,501	158,188	2016	Completed
WTP Concrete Tanks Replacement	c701501	10,563,320	420,388	2014 - 2020	Design
WTP Filter Rehabilitation and Upgrades	c701303	6,037,300	5,749,366	2013 - 2017	Project Wrap-up
WTP Flocculator Improvements	c701502	2,360,000	-	2018-2019	Feasibility
		163,606,200	**47,689,208**		

Upgrades or Improvement Projects	Project #	Life of Project Total (Projected) **	Spend Thru 6/30/17 *	Project Duration	Current Status
Advanced Metering Infrastructure (AMI)	c701603	8,100,000	5,600	TBD	Feasibility
Loch Lomond Facilities Improvements	c701301	385,000	73,626	2013-2020	Design/Construction
Photovoltaic System Evaluation/Construc	c701607	910,000	807,112	2016-2018	Design/Construction
Security Camera & Building Access Upgrades	c701704	645,000	-	2016-2019	Feasibility
Spoils and Stockpile Handling Facilities	c701508	350,000	176,355	2015-2017	Construction
Water Resources Building	c701702	1,100,000	28,007	2016-2018	Design
		11,490,000	1,090,700		

Water Supply Reliability & Studies	Project #	Life of Project Total (Projected) **	Spend Thru 6/30/17 *	Project Duration	Current Status
Aquifer Storage and Recovery	c701609 & -10	3,635,000	263,673	2016 - 2020	Feasibility
Recycled Water	c701611 & -12	575,000	391,494	2016 - TBD	Feasibility
Source Water Evaluation	c701608	1,100,000	181,451	2016 - 2020	Feasibility
Water Supply Reliability - WSAC	c701402 & -03	2,296,250	2,296,249	2014 - 2016	Completed
Water Supply Augmentation Strategy	c701705	105,078,352	13,166	2020 - 2025	Feasibility
		112,684,602	3,146,033		

Water Main Replacements	Project #	Average Spend Per Year	Spend For 7/1/16 - 6/30/17	Project Duration	Current Status
Main Replacements - Engineering Section	c700002 +	1,298,289	1,096,221	Annual - Ongoing Programs	
Main Replacements - Customer Initiated	c700004	35,759	-		
Main Replacements - Distribution Section	c701507	369,643	27,267		
Main Replace.- Outside Agency Initiated	c700003	172,564	27,128		
		1,876,255	1,150,617		

* Amount includes spent funds from the project start through 6/30/17.

** Non-inflated 2015 dollars, will change as projects move through design process.

CITY OF SANTA CRUZ

WATER COMMISSION
INFORMATION REPORT

DATE: 10/31/2017

AGENDA OF: 11/6/17

TO: Water Commission

FROM: Malissa Kaping, Management Analyst

SUBJECT: 1st Quarter FY 2018 Financial Report

RECOMMENDATION: That the Water Commission receive the 1st Quarter FY 2018 Financial Report.

BACKGROUND: The first quarter report for FY 2018 is attached showing a summary snapshot of our financial status for the first 25% of the fiscal year. The report size was increased to allow for a larger water sales (as-billed) chart and to restore the CIP visual summary charts; in all other aspects, the report is consistent with previous quarterly financial reports.

Difference between Adopted Budget and Adjusted Budget

Generally speaking, purchases should be completed in the same fiscal year as they are budgeted. The City's practice is to issue a Purchase Order (PO) which encumbers budgeted funds matching the amount of a separately executed professional services agreement or a quote for goods or services. When professional services (or capital equipment purchases) extend beyond a single fiscal year, the not-yet-used encumbered funds are transferred from the prior fiscal year to the current fiscal year. The $1.7M variance between the adopted budget and the adjusted budget for Services, Supplies, and Other expenses is due to remaining encumbrances for on-going professional services. Similarly, the nearly $520K variance in capital outlay is due to capital equipment orders that were ordered in FY 2017 but delivered in FY 2018.

Rate Stabilization Fund Balance

The Rate Stabilization Fee of $1 /ccf is effective with the July 1st billings. An oversight in implementing the new fee allowed those revenues to post to Water Operations (Fund 711) instead of Rate Stabilization (Fund 713). Approximately $674K collected in Rate Stabilization Fees in the first quarter appears as revenue for Water Sales and Service. This error has been corrected and the revised balances for the two funds will appear in the 2nd Quarter Report.

New CIP projects

Three CIP projects were added for FY 2018 as Upgrades or Improvement Projects. The Brackney Landslide Risk Reduction and Coast Pump Station Flood Reduction projects are new grant opportunities offered by FEMA (and administered through CalOES). The Water Department is eligible for up to $3M per grant/project for hazard mitigation projects related to damages sustained during the January and February emergency declarations. The grant applications, project scopes, and project budgets are under development. If the grant applications are approved, the Water Department will then seek Council approval of the new projects and a possible new appropriation for the required 25% non-federal funding match.

The new CIP titled Union/Locust Building Expansion takes advantage of the opportunity to expand the Department's footprint on the first floor of 212 Locust Street. The project scope and budget are under development and includes modifying space previously occupied by Library Administration so that Water Administration, Engineering, Customer Service, and Conservation can reorganize within the building at 212 Locust. Tracking this within the CIP budget allows any improvements to the building to be capitalized.

DISCUSSION: None

FISCAL IMPACT: None

PROPOSED MOTION: Accept the un-audited 1st Quarter FY 2018 Financial Report.

ATTACHMENTS: 1st Quarter FY 2018 Financial Report

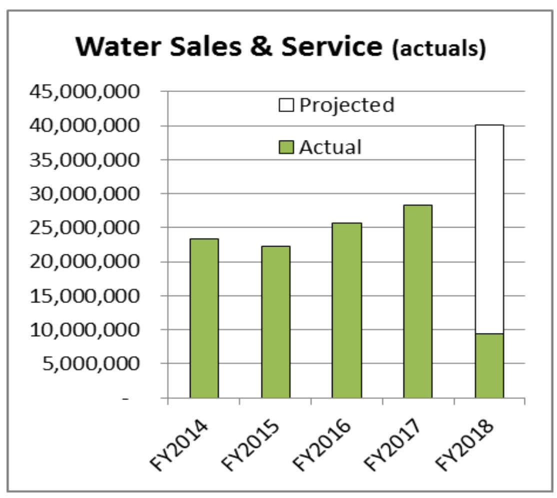
Water Department
1st Quarter FY 2018 Financial Report
Preliminary, Unaudited, as of 9/30/17

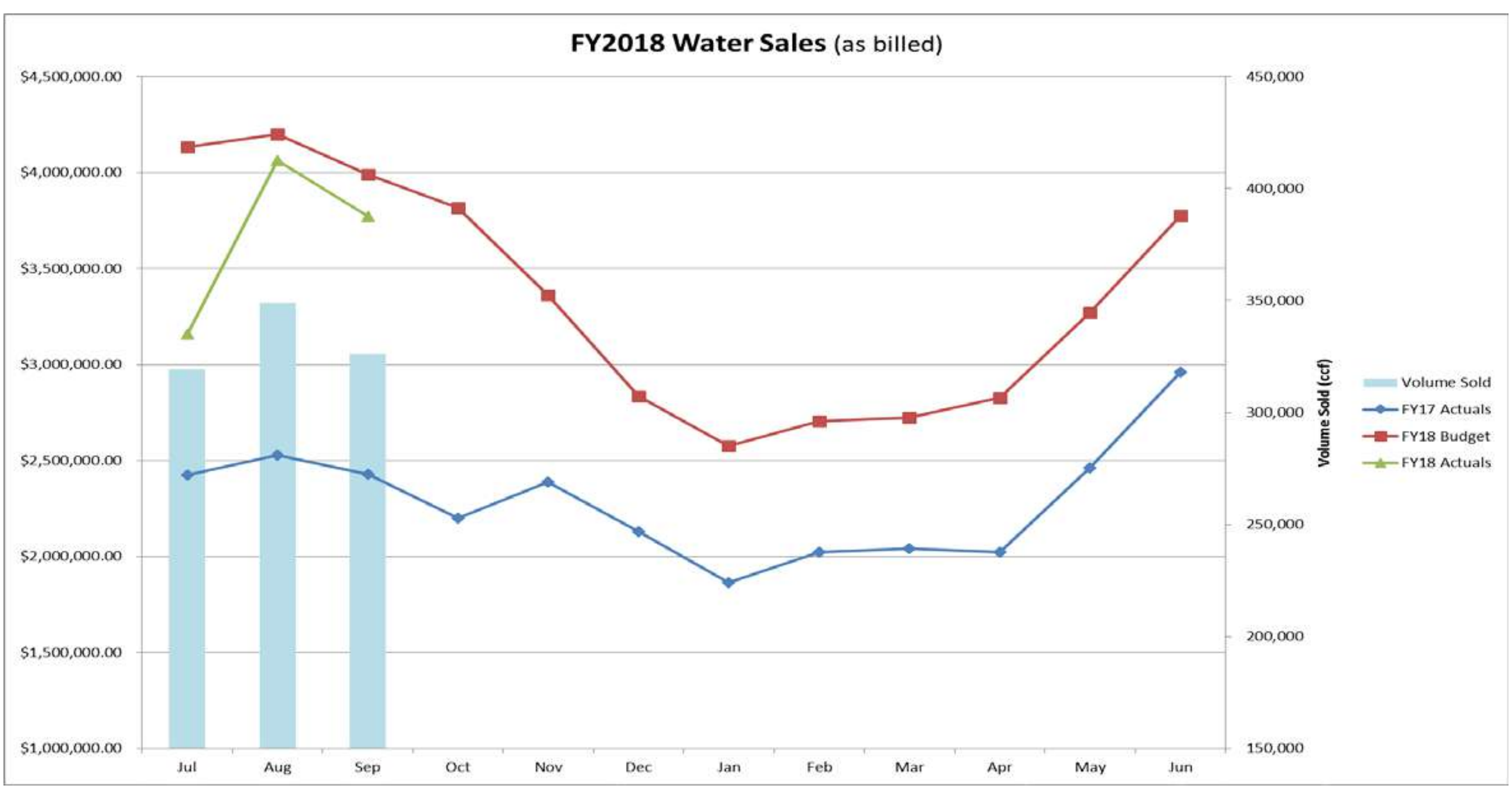
Financial Status for Water Operations, Fund 711

	FY 2018 Ado Budget	FY 2018 Adj Budget	Actual YTD Thru 9/30/17	Remaining Enc	FY 2018 YTD Act + Enc	YTD % of Budget Act + Enc
Revenues						
Water Sales and Service *	40,171,529	40,171,529	9,487,080	-	9,487,080	24%
Miscellaneous	1,193,181	1,536,181	416,204	-	416,204	27%
Grants & Other Financing	-	-	-	-	-	0%
Total Revenues	**41,364,710**	**41,707,710**	**9,903,285**	**-**	**9,903,285**	**24%**
Expenses			-			
Personnel	14,249,469	14,454,386	2,807,940	-	2,807,940	19%
Services, Supplies, and Other	14,667,833	16,374,679	2,288,459	2,563,636	4,852,094	30%
Capital Outlay: Other	175,000	692,680	417,698	108,691	526,389	76%
Debt Service	1,949,327	1,949,327	688,855	-	688,855	35%
Total Expenses	**31,041,629**	**33,471,072**	**6,202,952**	**2,672,326**	**8,875,279**	**27%**
Balance	10,323,081	8,236,638	3,700,332		1,028,006	

Fund Balances

	Balance as of 9/30/17	Target for FY end **
711- Enterprise Operations	12,940,821	7,142,413
713- Rate Stabilization	2,479,026	5,821,270
714- Public Art	331,496	N/A
715-System Devel. Charges	3,293,247	N/A
716- 90-Day Operating Reserve	6,490,700	7,142,413
717- Emergency Reserve	3,042,715	3,100,000
718- MHJB Endowment	143,342	145,000





* Actual revenues received (not as billed)

** Target balance from the Pro Forma and not yet adopted by Council

CIP Projects Overview, as of 9/30/2017

Rehab or Replacement Projects	Project #	Life of Project Total (Projected) **	Spend Thru 9/30/17 *	Project Duration	Current Status
Aerators at Loch Lomond	c701706	350,000	-	2017-2019	Feasibility
Bay Street Reservoir Reconstruction	c700313 & -027	25,934,172	25,359,925	2007-2017	Wrap-up/Phase 4
Beltz 10 & 11 Rehab & Development	c700026	509,243	106,190	2017-2018	Pre-Design
Coast Pump Station Line Repairs	c701707	550,000	-	2018	Feasibility
Felton Diversion Replac. & Pump Station	c701602	1,200,000	92,036	2016-2020	Pre-Design
Gravity Trunk Main Valve Replacement	c701504	640,000	583,519	2014-2017	Construction
Newell Creek Dam Inlet/Outlet Pipeline	c701606	49,940,744	1,456,715	2016-2021	Design
Newell Creek Pipeline Rehab/Replacement	c701701	19,782,600	9,999	2016-2020	Feasibility
N. Coast System Rehab- Laguna Diversion	c701801	1,750,000	-	2018-2021	Feasibility
N. Coast System Rehab- Majors Diversion	c701802	1,750,000	-	2018-2021	Feasibility
North Coast System Rehab - Phases 1-4	c709835	28,686,759	13,739,592	2003-2023	Construction
Pressure Regulating Stations	c701703	490,000	62,930	2017-2020	Pre-Design
San Lorenzo River Diversion & Tait Wells	c709872	2,055,014	1,980,644	2002-2017	Project Wrap-up
Tube Settler Replacement	c701708	2,200,000	98,859	2018	Pre-Design
University Tank No. 4 Rehab/Replace	c701505	3,770,000	-	2014 - 2020	Feasibility
University Tank No. 5 Replacement	c701506	4,028,000	525,355	2014 - 2018	Design
Water Treatment Upgrades	c700025 & -1401	815,547	435,811	On-going	Feasibility
Wharf Water Main Replacement	c701613	193,501	158,188	2016	Completed
WTP Concrete Tanks Replacement	c701501	10,828,320	2,005,362	2014 - 2020	Design
WTP Filter Rehabilitation and Upgrades	c701303	6,037,300	5,969,761	2013 - 2017	Project Wrap-up
WTP Flocculator Improvements	c701502	2,360,000	-	2018-2019	Feasibility
		163,871,200	**52,584,886**		

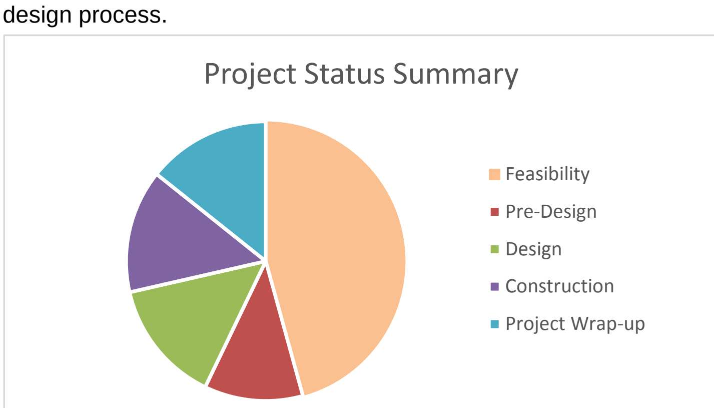
Upgrades or Improvement Projects	Project #	Life of Project Total (Projected) **	Spend Thru 9/30/17 *	Project Duration	Current Status
Advanced Metering Infrastructure (AMI)	c701603	8,100,000	5,600	TBD	Feasibility
Loch Lomond Facilities Improvements	c701301	385,000	73,626	2013-2020	Design/Construction
Photovoltaic System Evaluation/Construc	c701607	910,000	838,082	2016-2018	Design/Construction
Security Camera & Building Access Upgrades	c701704	645,000	-	2016-2019	Feasibility
Spoils and Stockpile Handling Facilities	c701508	350,000	227,432	2015-2017	Construction
Water Resources Building	c701702	1,100,000	206,585	2016-2018	Design
Brackney Landslide Risk Reduction	c701803	TBD	70,100	TBD	Feasibility
Coast Pump Station Flood Reduction	c701804	TBD	67,300	TBD	Feasibility
Union/Locust Building Expansion	c701805	TBD	27,694	2018 - 2019	Design
		11,490,000	1,351,325		

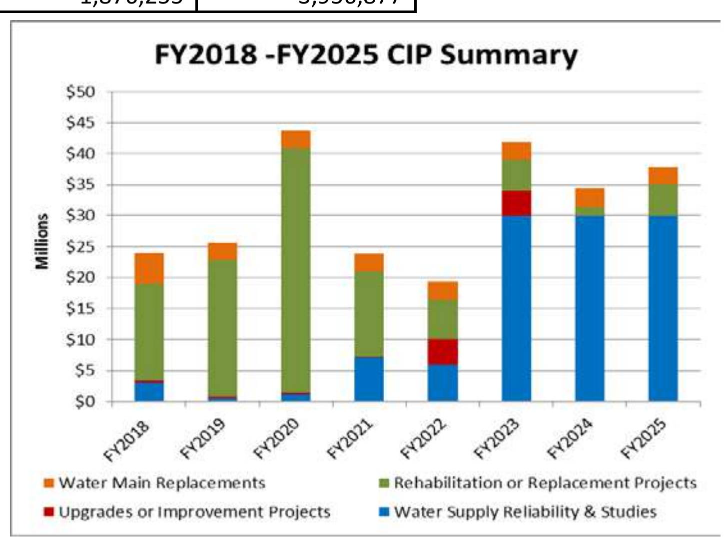
Water Supply Reliability & Studies	Project #	Life of Project Total (Projected) **	Spend Thru 9/30/17 *	Project Duration	Current Status
Aquifer Storage and Recovery	c701609 & -10	3,635,000	839,793	2016 - 2020	Feasibility
Recycled Water	c701611 & -12	575,000	573,807	2016 - TBD	Feasibility
Source Water Evaluation	c701608	1,100,000	327,984	2016 - 2020	Feasibility
Water Supply Reliability - WSAC	c701402 & -03	2,296,250	2,296,249	2014 - 2016	Completed
Water Supply Augmentation Strategy	c701705	105,078,352	155,848	2020 - 2025	Feasibility
		112,684,602	4,193,681		

Water Main Replacements	Project #	Average Spend Per Year	Spend For 7/1/17 - 9/30/17	Project Duration	Current Status
Main Replacements - Engineering Section	c700002 +	1,298,289	3,956,877	Annual - Ongoing Programs	
Main Replacements - Customer Initiated	c700004	35,759	-		
Main Replacements - Distribution Section	c701507	369,643	-		
Main Replace.- Outside Agency Initiated	c700003	172,564	-		
		1,876,255	3,956,877		

* Amount includes spent & current encumbered funds from the project start through 9/30/17.

** Non-inflated 2015 dollars, will change as projects move through design process.





WATER COMMISSION
INFORMATION REPORT

DATE: October 30, 2017

AGENDA OF November 6, 2017

TO: Water Commission

FROM: Kevin Crossley, Senior Engineer

SUBJECT: Update to the 2015 State of the Water System

RECOMMENDATION: That the Water Commission accept the information on the State of the Water System.

BACKGROUND:
In April 2015, the Water Supply Advisory Committee (WSAC) was provided a 10-page memorandum focused on the current condition of raw water diversion and transmission infrastructure, and planned projects contained within the 10-year Capital Improvement Program (CIP). See attached. That document was intended to raise committee awareness surrounding the current condition of the water system and to spur thinking about how existing CIP projects will relate to and intersect with new supply projects.

Noteworthy points made in the 2015 memo were:

- A majority of critical assets, (dams, treatment plants, transmission pipelines) are between 50-100 years old;
- Those assets will require major reinvestment or complete replacement over the 10-15 year horizon; and
- New water supply is just one of many major projects that make up the 10 year CIP.

The quarterly updates to the Water Commission on the progress of the Water Supply Augmentation Strategy (WSAS) have provided a minimal level of detail about these related aspects of the raw water system in the section titled "Other." This information report provides an additional level of detail over the WSAS quarterly updates in the following ways:

1. Provide the Water Commission with a frame of reference for how the supplemental supply projects compare against, and interrelate to other major CIP projects (in each section the "WSAS Nexus" is specifically noted;
2. Comment on how the various components of the water system performed during the 2017 winter;
3. Identify lessons learned during the implementation of several projects over the last two year; and

4. Identify any cause for reprioritizing projects such as regulatory drivers. Moving forward, the quarterly updates the Commission will elaborate on those projects currently captured in the section titled “Other.”

DISCUSSION:
The format and flow of the following is intended to build on and not reiterate the material provided in the attached 2015 report, assets are discussed in a similar order, and new assets or projects are so noted.

North Coast System

North Coast Pipeline: Since 2006, two of the six phases have been completed and a third is nearing completion. Phases 1 and 2 replaced all of the in-city piping, and Phase 3 prioritized the most leak prone section along Highway 1, bringing the installed length of pipe to approximately 6 miles. Despite the progress made the North Coast System continues to experience leaks, and in February 2017, approximately 1,000 feet of pipe was installed on the Liddell Line as part of an emergency repair project. Also during 2017, several landslides damaged the Majors pipeline requiring a second emergency repair project.

The Environmental Impact Report for the North Coast System Replacement Project envisioned reconstruction of the entire system within a 15-20 year time frame or around 2020-25. The Phase 3 Project required nearly 4-years to design, permit, and purchase new right of way from state, local, and private land owners. In addition to the significant work that precedes construction, the North Coast is a challenging environment in which to construct. Most water facilities reside in undeveloped areas, where archeological and biologically protected resources are located, and where access and permits may restrict work to a small seasonal window. In light of the dramatic and numerous leaks that the Newell Creek Pipeline experienced in 2017, staff is revisiting the prioritization of all the raw water main replacement projects. Taken together, North Coast projects competing for priority, funding, and tied to external approvals by regulators, and landowners, means it will likely take at least 10-15 more years to complete replacement the North Coast System.

While the Phase 4 segment has not been defined, it is budgeted in FY2021 – FY2023. The final phases have not been budgeted for in the 10 year CIP.

WSAS Nexus: In the near term-the pilot Water Transfer/In-Lieu project is dependent on North Coast Supplies which have less restrictive water rights. Long term, the North Coast and San Lorenzo are the two sources of water that would supply the In-Lieu/ASR supplemental supply project.

North Coast Diversions: The North Coast Diversions range from 80 to 120 years in age. Despite the age of the diversion structures, they are in generally good condition. The major known deficiencies are related to sediment accumulation behind the dams and improper sizing on inlet screens. The Laguna diversion, in particular, required significant maintenance this winter to keep the screens clear of sediment.

Evaluation of the Major's and Laguna diversion's condition and development of a work plan is scheduled to start in fiscal year 2018. The purpose of this effort is to establish the scope of work for repair and/or replacement of the diversions to meet future needs that include maintaining fish flow requirements established for the Habitat Conservation Plan. Contained within this work will be how best to utilize the sources so as to meet fish and human needs particularly as the latter relates to maximizing winter flows. The timing of the condition assessment and development of the work plan is currently driven by the Habitat Conservation Plan. The work plan for the diversions will be incorporated into the Habitat Conservation Plan, which will be the overarching regulatory approval document that will cover future operations, maintenance, and capital projects at the diversions. As mentioned above North Coast projects for both pipelines and diversions will be reprioritized within the 10 year CIP, and any diversion projects must happen after completion of the Habitat Conservation Plan.

<u>Loch Lomond Reservoir</u>

Newell Creek Dam Inlet/Outlet Project: This project has been defined in three phases:

- Phase 1 – Data Gathering and Concept Determination (Pre-Design). Completed in October 2016.
- Phase 2 – Design, Permitting, and Bidding is scheduled for completion in last quarter of 2019.
- Phase 3 – Construction. Scheduled for completion the last quarter of 2021.

Key/Significant milestones:

- October 2016 – Completed preliminary design of the replacement alternative and testing plans for the rehabilitation alternative. The rehabilitation alternative testing was put on hold until the 50% Replacement Design is developed further in an effort to better understand the cost of the two alternatives and the advantages of replacement.
- June 2017 – Completed the 10% Replacement Design of two tunneling methods and alignments and selected one design to develop future.

Staff is in the process of negotiating the next contract with AECOM to develop the 100% Replacement Design and Construction Bid documents and will re-evaluate the rehabilitation alternative later this year. We are currently seeking an Environmental Permitting and CEQA firm and will also be seeking a Construction Manager to provide input on constructability throughout the remaining design process. Throughout this process, we continue to get input from State of California Division of Safety of Dams (DSOD), our technical advisory consulting board, and other water agencies to help guide us through our decision making process based on their experience in similar projects.

Newell Creek Dam Spillway (new): As a result of the recent spillway incidents at Oroville Dam, on May 20, 2017, the California Division of Safety of Dams (DSOD) requested that all dam owners under the jurisdiction of DSOD perform comprehensive condition assessments of their spillways. The City subsequently contracted with AECOM to perform the condition assessment of NCD which includes a review of existing information, detailed visual inspection of the spillway and identification of any damage requiring immediate repair and recommended next steps. The visual inspection of the spillway was conducted by AECOM on July 26,

2017. AECOM did not find anything of major concern, either in the structural or geologic visual inspections. AECOM did find minor deficiencies that will be addressed in the short term as part of annual and routine maintenance activities at the dam such as filling minor cracks in the concrete, coating exposed rebar, cleaning drains, and cutting back trees hanging over the spillway.

Newell Creek Pipeline: The Newell Creek Pipeline is an approximately 12-mile long, 24 to 27-inch pipe that was constructed in the early 1960's concurrently with the Newell Creek Dam. The principal deficiency with the Newell Creek Pipeline is not its condition; rather it's the pipe's alignment, which bisects a number of mapped and unmapped landslides, and is located in remote, heavily forested settings, sometimes with narrow, unpaved access. The 2017 winter highlighted the pipes susceptibility to damage due to its location, and the City's 100% reliance on the source of water this pipe conveys during heavy rains when all other sources become untreatable and water from Loch Lomond reservoir is needed for supply.

Preliminary engineering was expected to start in Fiscal Year 2017 but was delayed in large part due to the winter emergency projects. The same condition assessment technique used for the Gravity Trunk main may be used for the Newell Creek Pipeline. Work is set to resume in Fiscal Year 2018 and will be one of the major focus areas of the Program Management Team.

Although climatically opposite conditions, the recent drought followed by the second wettest winter on record made it abundantly clear that the system is unreliable in that surface water makes up 90% of supply. Santa Cruz has many sources of water, but fundamentally the system is heavily reliant on the same type of water pumped relatively long distances to a single water treatment plant. One large storm in January 2017 simultaneously made one set of sources untreatable and caused a pipeline break that took out the source of last resort and precipitated waters supply emergency. Recent supplemental supply planning has focused heavily on supply during drought, and this winter emphasized the importance of thinking about managing risk and ensuring supply reliably for both the extreme dry and wet periods.

WSAS Nexus: The Newell Creek Pipeline is central to the "Winter Water" supply strategy. The Newell Creek Pipeline will continue to be used to refill Loch Lomond in the winter, and in the future could be used in a new way to convey surplus winter water from Felton Diversion to treatment as part of an Aquifer Storage and Recovery and in-Lieu strategy. Future design work will consider the sizing and pressure requirements to operate the pipeline in this way.

Graham Hill Water Treatment Plant: The Graham Hill Water Treatment Plant (GHWTP) was originally constructed in 1960, and has remained in service nearly continuously since that time. The last major renovation to the plant was completed in 1986. A relatively comprehensive engineering study was completed by the engineering firm CDM circa 2007. The CDM study laid the groundwork for several major projects including an electrical upgrade, and filter replacement project which was implemented to address specific systems or processes. In the 10 years since the CDM study was completed, there have been a number of significant changes that directly affect the direction of future projects at GHWTP. The **scwd²** Desalination Project was put on hold, and several other supplemental supply projects were identified.

Based on those changes, it is time to update the overall plan for rehabilitating and modernizing GHWTP. The Program Management Consultant will lead the update to that plan, which is expected take 6 to 9 months and will include the following: update water quality objectives, siting and cost estimate for a second surface water treatment plant, review source water data, assessment of the physical condition of the plant superstructure, consideration of different treatment process, and definition and scheduling of packages of projects.

Several projects are currently in different phases of design for the GHWTP, including replacement of tube settlers and several concrete tanks. The tube settlers project scope will likely be reduced to address the immediate operational needs in the near term and will defer the remainder of that project until after the facilities plan is completed. The tanks project is just finishing preliminary design, and will likely move into final design, concurrent with the facilities plan update, or if appropriate the tanks project may be paused until the facilities plan update is finished to ensure the tanks project remains compatible with the overall modernization plan. Concurrently, a feasibility assessment will be prepared for a second surface water treatment plant. A second plant would provide a valuable degree of treatment redundancy, could reduce the potential need for costly process changes at GHWTP, and could avoid the need to operate a surface water plant during logistically challenging, operationally disruptive, and costly construction projects.

WSAS Nexus: Aquifer Storage and Recovery and In Lieu will both require a source of treated water during the winter. Current water supply modeling indicates that winter treatment capacity will need to be around 16 MGD. Operational experience, coupled with raw and finished water quality data suggests that the GHWTP cannot operate over 12 MGD on a sustained basis during winter water quality conditions; therefore, the plant does not currently have capacity or capability to support those supply projects. Surface water treatment regulations have also evolved and strengthened, particularly as they relate to disinfection by-products, and disinfection requirements. During the implementation of several recent projects, staff has gained valuable insight into the significant challenges of implementing major projects while simultaneously keeping the plant online.

Surface Water Diversions

Felton Diversion: The Felton Diversion Project will assess the overall condition of the Felton Diversion Station. Staff has conducted an initial inspection and the inflatable bladder has been prioritized for replacement. An engineering firm inspected the bladder and mounting plates in October 2016, and the bladder is scheduled to be replaced in summer or fall 2018.

The Tait Wells Project (new): In February 2017 the Tait well project was completed. The two new wells have a combined output of 1.5 MGD or roughly 6 times more output than the wells that were retired. The wells provide a consistent source of high quality water year-round, and especially during the winter when other sources become untreatable. The wells were completed just in time, and despite the wells being flooded, were a significant resource during 2017 when the Newell Creek Pipeline was out of service and numerous heavy storms when the San Lorenzo River was too turbid to treat. The department continues to look at the possibility of additional wells in this area and their ability to extract the highest quality water possible to be applied towards winter flow schemes. Higher quality source water will reduce the amount of treatment required at the Graham Hill Water Treatment Plant (GHWTP).

River Bank Filtration Study (new): The River Bank Filtration study is assessing the feasibility of increasing the Water Department's subsurface extraction capacity, currently represented as the Tait Wells (1.5 MGD) up to 3 MGD. The two study areas are the alluvial aquifers in the near vicinity of the Tait Street Intake and Felton Diversion Intake. If output could be increased to 3 MGD, the GHWTP could continue operating continuously at a low level, during storm events when sources would be otherwise untreatable, and the plant would be required to shut down. The study will start in fall 2017.

WSAS Nexus: As described above, GHWTP is currently unable to operate during the winter at the sustained flow rates required to support an ASR/In Lieu project. Riverbank filtration will be considered as part of a pretreatment strategy. A pretreatment strategy would remove or reduce hard to treat constituents in water prior to reaching GHWTP. This strategy will be further defined over the next year as part of the update to the water treatment plan.

Coast Pump Station Hazard Mitigation Project (new): The Coast Pump Station sits immediately adjacent to the Tait St intake on a low-lying bench adjacent to the San Lorenzo River. The pump station lifts water diverted from the San Lorenzo River, as well as the Coast Sources, up to the GHWTP. The pump station's elevation and proximity to the San Lorenzo River make it particularly vulnerable to flooding. Past flooding has been relatively minor, mostly resulting in cleanup and minor equipment repairs. In February 2017, the pump station was flooded and many of the critical pumps, motors, and the emergency backup generator were damaged. Fortunately, repair parts were readily on hand, and staff was able to rapidly return the pumps station to service within 3 days of flooding.

The City has been preliminarily approved for up to $3,000,000 in grant funding to mitigate the threat of flooding at the Coast Pump Station. An engineering study and alternatives analysis are currently in development, and will be submitted to the State in November 2017 as part of the next phase of the grant approval process.

<u>Summary</u>

Although much progress has been made to define and implement projects, there is still a significant amount of work in the future. The Program Management Team will be integral to overall success. The Program Manager will bring new skill sets, additional staff resources, and systems and tools to plan and prioritize projects, and new ways of doing business that are needed to in order to implement a new supply project, concurrent with major reinvestment in the existing system.

The recent drought followed by this last winter's storms brought the relative vulnerability and unreliability of the water system into sharp focus. With one reservoir, and one surface water treatment plant, the lack of redundancy was clear. The collection of CIP projects described above, coupled with a new supply project will add new sources of supply, new treatment capability, and stronger water transmission pipelines, that will collectively ensure a safe clean reliable supply, into the future.

In conclusion, the key points of the 2017 update are:

- New requirements and regulatory changes set by external agencies (Division of Drinking Water, Division of Safety of Dams) can result in new and unanticipated projects. E.g., the Newell Creek Dam inlet/outlet replacement project.
- The timing of certain projects is linked to other long term efforts; e.g. the finalization of several Habitat Conservation Plans.
- The 2017 winter showed the water systems vulnerabilities and relative fragility. Recently completed projects, e.g., the North Coast Phase 3 Project and Tait Wells Project, replaced aging assets, and help to improve overall system reliability. Future projects focusing on the Newell Creek pipeline will reduce but cannot eliminate this critical pipelines risk of failure.
- The water system lacks redundancy in supply and treatment. A supplemental supply project should change that by improving system resilience both during extreme dry and wet conditions.
- Hiring a Program Manager will add staff capacity to manage and implement larger more complex projects but there will still be funding, permitting, and operational constraints that will affect the timing of certain CIP projects and will govern the overall pace of progress.

FISCAL IMPACT: None

PROPOSED MOTION: That the Water Commission accept the information on the Update to the 2015 State of the Water System

ATTACHMENTS: Status of the City of Santa Cruz Water System & Integration of Consolidated Alternatives (April 2015)

TO: WATER SUPPLY ADVISORY COMMITTEE

FROM: HEIDI LUCKENBACH & BILL FAISST

SUBJECT: STATUS OF THE CITY OF SANTA CRUZ WATER SYSTEM & INTEGRATION OF CONSOLIDATED ALTERNATIVES

DATE: APRIL 23, 2015

BACKGROUND

This memo and subsequent presentation outlines to the Water Supply Advisory Committee (WSAC) the status of existing water supply infrastructure including intakes, dams, pipelines, and pump stations. Additionally, the 10-year Capital Improvement Program (CIP) is attached and will be discussed. Both these items will be used to facilitate the thinking about the future water supply options and the opportunity to combine and/or prioritize projects to improve cost effectiveness or leverage needed investments.

Portions of the existing system date back to the early 1900s. While some significant investments have been made over the last century (replacement of portions of the North Coast Pipeline, upgrades to the Graham Hill Water Treatment Plant, and installation of new groundwater wells) along with routine operations and maintenance, a large capital improvement program remains and includes the majority of the system's components. The following list includes the dates of initial construction of the various raw water components. Further below is a description of most of these components, their current condition, and scope/schedule/budget for improvements.

The presentation to the WSAC at their April 30th meeting will include a discussion of the various water supply alternatives (the Consolidated Alternatives, or CAs) and how they may coincide with improvements within the CIP.

<u>North Coast System</u>

- Laguna Creek Diversion – 1890
- Liddell Spring – 1913
- Majors Creek – 1884
- Reggiardo Creek – 1912
- North Coast Pipeline – early 1900s - 1950s

<u>Loch Lomond Reservoir</u>

- Newell Creek Dam – 1960
- Newell Creek Pipeline - 1960

<u>Intakes</u>

- Tait Street Wells and SLR Diversion – 1960s
- Felton Diversion – 1970s

<u>Water Treatment</u>

- Graham Hill Water Treatment Plant – 1960s
- Beltz Water Treatment Plant - 1964

DISCUSSION

Generally speaking, each major component of the raw water system is contained in the 10-year CIP in some form, and as can be seen in the attached table, the finished water system also requires a lot of capital investment. Some components require minimal repair or rehabilitation, some require full replacement, and the condition of some is still unknown and requires a condition assessment. The department is aware of the potential synergy between existing system components and the process currently being undertaken by the Water

Supply Advisory Committee (WSAC). In other words there may be potential to combine future water supply projects with the CIP to be efficient as possible with resources.

The major components are shown below with a preliminary budget estimate and implementation schedule. These planning-level numbers likely will change as more is learned about the project need, funding opportunities, staffing resources, project delivery method, and outcome(s) of the WSAC process.

<u>North Coast System</u>

The Santa Cruz Water Department (SCWD) operates and maintains an 18-mile long pipe network and stream diversion structures, called the North Coast System (NCS). Diversion structures ranging in age from approximately 80 years to over 120 years direct flows from Liddell Spring, Reggiardo, Laguna and Majors creeks into a pipe system, which conveys water, by gravity, to the Coast Pump Station adjacent to the City's San Lorenzo River intake. The Coast Pump Station lifts water up to the Graham Hill Water Treatment Plant (GHWTP) where it is treated and then delivered to SCWD customers. The NCS relies entirely on rainfall runoff and emergent groundwater to furnish up to 30% of the City's water supply.

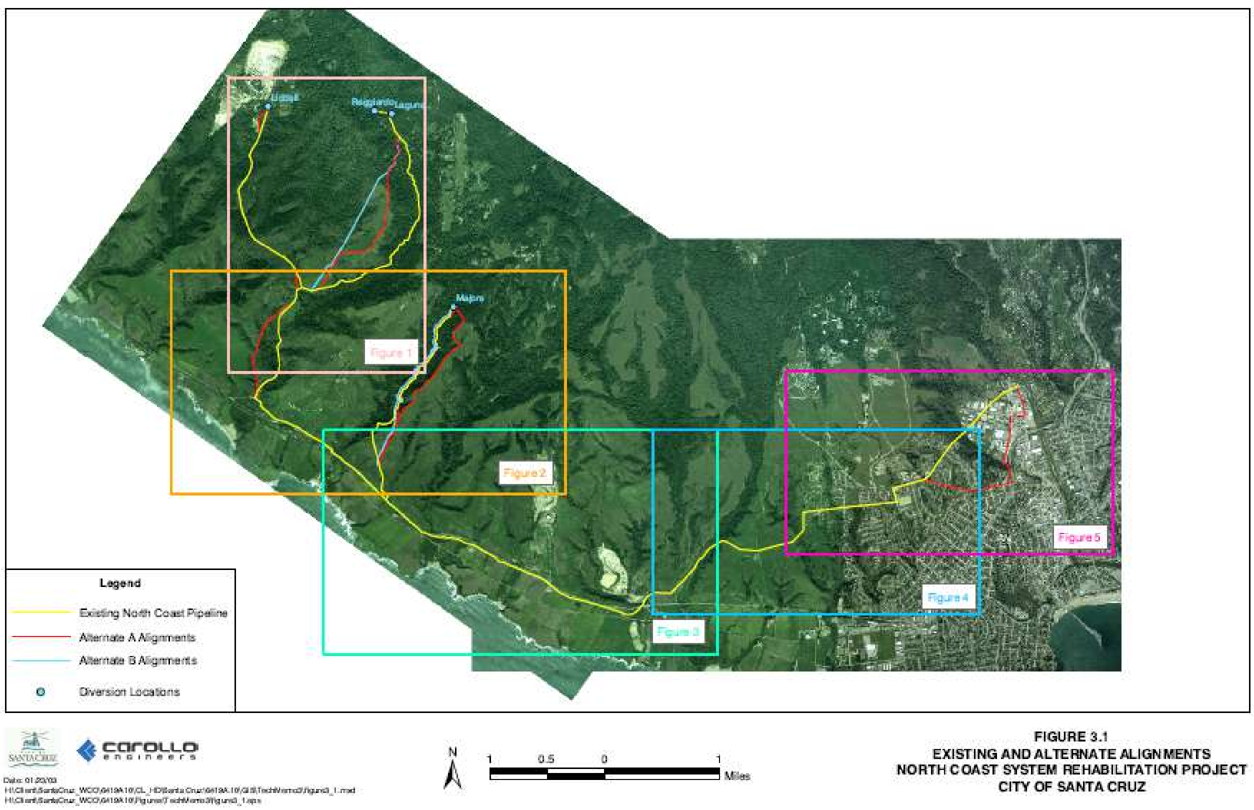


FIGURE 3.1
EXISTING AND ALTERNATE ALIGNMENTS
NORTH COAST SYSTEM REHABILITATION PROJECT
CITY OF SANTA CRUZ

While much of the 18-miles of transmission pipeline was replaced in the 1950s, a significant portion is approaching, or has exceeded its design life, and must be replaced. The diversion and pipeline facilities have historically provided adequate service for the SCWD, however the aging facilities are increasingly prone to leakage and failure, and now require increased routine maintenance and emergency repairs.

Existing Deficiencies and Limitations include:

- Age/Condition – Due to age of the pipelines, deterioration of pipe materials has resulted in increased frequency of leaks and need of emergency repairs.
- Access Constraints – Limited access to many of the pipeline in their current alignments has resulted in increased maintenance requirements, potential damage to the environment, and in some cases, more costly and complicated repairs.

- Hydraulic Constraints: The current configuration of the system limits the diversion capacity during certain operating conditions.

Section Of Phase 3 North Coast Pipeline Project

Key Findings and Recommendations for rehabilitation/replacement of the pipeline are:

- A majority of the piping system needs to be replaced or rehabilitated in the next ~15 years.
- In select locations, the existing pipeline alignment encroaches on environmentally and culturally sensitive areas.
- Certain segments could be replaced in alternate alignments; however easement/access issues, environmental impacts, may limit the viability of the alternate alignments.
- In difficult to access, environmentally sensitive, and geologically active areas, new pipe may need to installed above ground.
- To preserve system capacity, in most locations, existing piping should be replaced with a similar pipe size.
- System pressure and capacity requirements will reduce the number of choices for pipe material, and the feasibility of trenchless rehabilitation methods such as pipebursting, sleeving, and lining.

Two portions of the NC pipeline were completed between 2006 and 2012, and replaced a majority of the raw water system within the City limits. Sequencing of the six phases takes into consideration the following criteria: Environmental/Jurisdictional Setting, Project Cost, Construction Method, Permitting Synergies, System Importance, and Leak History. For practical purposes, each phase has been capped at $10 million total budget, and projects of a similar construction type or with similar permitting needs were grouped into the same phase, where possible. The current project, Phase 3, experiences the highest pressure making it most prone to leakage, is located almost entirely in two jurisdictions: State Parks or Caltrans right of way (ROW), and will be constructed predominantly by a single construction type-open-trench construction.

Construction of Phase 3 is schedule to start summer 2015 with a duration of two years and engineers estimate of approximately $8,000,000. The remaining phases of the North Coast pipeline project is scheduled in fiscal years 2019 – 2032 for an additional ~$30M.

<u>North Coast Diversions</u>
The City maintains diversions on four coastal sources (Liddell Spring, Reggiardo, Laguna and Majors creeks) which range in age from approximately 80 years to over 120 years. Like the pipeline, the diversion structures have historically provided adequate service for the City, but have been increasingly prone to leakage and failure in recent years and have increased routine maintenance and emergency repairs owing to their age and condition.

Creek Diversion Structure

Limitations of the existing diversion structures include:

- Sediment Accumulation – The original design of the diversion structures does not provide sufficient sediment flushing/transport capabilities, resulting in a buildup of rock, sand, and debris, reduction of the upstream pool size, and restrictions to the flow of water into the inlet pipe.
- Lack of Remote Operating and Monitoring Capability – The original design and current configuration of the diversion structures do not provide remote operation and monitoring capability at Reggiardo, Laguna, and Majors creek diversions. Hence, operating these diversions requires considerable staff time and travel.
- Structural Integrity – Despite their age, the main structural elements of the diversion structures are in generally good condition, except for minimal damage at the end wall abutments. However, modifications are necessary for the structures to remain viable into the future.
- Improper Sizing of Inlet Screens – Majors and Laguna creeks support native populations of rainbow trout. The intake screens at Majors and Laguna creeks are too large to eliminate the potential for

entrainment of juvenile fish and other aquatic organisms, potentially causing adverse environmental effects and allowing undesirable material to enter the pipeline.

- Fish Passage – The Majors, Laguna and Reggiardo diversions prevent upstream passage of resident fish. Downstream movement of fish may occur through the slide gate or over the crest of the dam of Laguna and Majors diversions when the water is spilling over it. Downstream flow through the slide gate and from most areas over the dam crest falls into shallow pools, potentially causing stress or injury to fish migrating downstream.

In June 2004, the City undertook the preparation of a program EIR (PEIR) for the project. The City Council certified the PEIR at a Public Hearing held on November 8, 2005.

The CIP now includes two projects, one for Laguna Dam and another Majors Dam. They are separate from the North Coast pipeline replacement for ease of budget tracking; they may be included with a pipeline phase as future phases are developed. Evaluation of each diversion's condition and development of a rehabilitation plan is scheduled to start in fiscal year 2019. Construction work is currently in fiscal year 2021.

Loch Lomond Reservoir

In the early 1960s, the City completed the construction of Newell Creek Dam. The City monitors the dam on a routine basis for overall structural and performance stability and also carries out special monitoring based on various triggers such as earthquakes and high rain events. The dam remains in excellent condition. The California Division of Safety of Dams (DSOD) adopted new seismic stability requirements several years ago requiring dam owners to demonstrate to DSOD that their dams were in compliance with these more stringent requirements. The City collected additional data on the construction materials used and demonstrated that Newell Creek Dam met the new seismic requirements.

Downstream Face of Newell Creek Dam (view from crest)

Downstream Face of Newell Creek Dam (view from toe)

The inlet/outlet pipe that fills and draws from the reservoir is located within the dam, at the bottom of the structural section. This pipeline is a steel-lined concrete encasement structure. At the toe of the dam a large diameter valve called a deluge valve allows the City to dewater the reservoir at a rapid rate under emergency conditions. Several years ago this valve became inoperable and in contemplating a repair the City also discovered that the pipeline within the dam is in questionable condition. The City has worked with DSOD and, while there is no immediate danger or concern with safety (dewatering is met with other valves), the City plans to evaluate the pipeline and valve further and make repairs or fully replace this pipeline.

Based on the experience of other dam owners, budget numbers in the CIP are for full replacement as follows: $1,500,000 starting in fiscal year 2017 for the design, environmental and regulatory work associated with a repair, and $50,000,000 in fiscal year 2019 for the repair. As the City learns more about the condition of the pipeline, it will update these numbers and timeframe.

Outlet vault including deluge valve at Newell Creek Dam.
(Continuous flow of water from reservoir is maintained for downstream environment.)

<u>Newell Creek Pipeline</u>

The pipeline from Loch Lomond Reservoir to the Graham Hill Treatment Plant dates back to 1960s, coincident with the construction of these two facilities. There is approximately 12 miles of large diameter pipe of varying physical condition. While performance issues related to age are an issue (i.e., some sections have required multiple repairs), the primary issue with this pipeline is its physical location. The pipeline is within some existing paved right of way such as Graham Hill Road, but also covers a significant amount of distance in unpaved and/or otherwise undisturbed areas such as Henry Cowell State Park. Similar to the North Coast Pipeline, the pipeline encroaches in some locations on environmentally sensitive areas, and areas that are difficult to access and geologically active.

This project requires further definition and either a program or project level Environmental Impact Report prior to any construction efforts. This work is schedule to begin in fiscal year 2017, with placeholders for construction (either rehabilitation of existing pipeline or replacement) starting in fiscal year 2019. An estimated budget is ~$12,000,000.

Landslide along Newell Creek Pipeline

Graham Hill Water Treatment Plant

The GHWTP is a conventional treatment plant that was commissioned in 1960 as a 12 million gallon per day (mgd) plant and has undergone an expansion to 24 mgd and numerous plant improvements over that last 51 years.

The most recent improvements to the GHWTP were initially identified in the 2007 Water Quality & System Improvements Study (WQ&SIS). The WQ&SIS developed water quality and system reliability goals to meet the City's concerns regarding anticipated water quality regulations, and WTP reliability related to complex water demand and supply issues, along with aging equipment and infrastructure.

Several required improvements include:

- Rehabilitation of existing granular media filters
- Rehabilitation/replacement of existing concrete tanks
- Upgrades to the flocculation/sedimentation basins
- Upgrades or replacement of the existing chemical dosing systems; replacement of the existing chlorine gas system with an onsite sodium hypochlorite generation system
- Replacement of the existing sludge discharge line with a larger diameter pipeline.

The filter rehabilitation project is currently underway and will be completed this calendar year. Subsequent projects as bulleted above are schedule between the current fiscal year and fiscal year 2019. The City has budgeted approximately $14,000,000 for these projects.

Felton Diversion

The City constructed the Felton Diversion structure and pump station in the 1970s. Studies prior to the 1970s, in the vein of continuing development of sources of water supply, opined that the diversion could divert water to Loch Lomond Reservoir, to a yet to be constructed Zayante Dam, a yet to be constructed Doyle Gulch Reservoir, and a pipeline for direct diversion from Felton Diversion to the GHWTP via Scotts Valley. Subsequent decisions resulted in no further consideration of Doyle Gulch Reservoir or the direct diversion pipeline and the ultimate project at Felton Diversion was sized to pump San Lorenzo River water to either Loch Lomond or Zayante, although pumps for the later were never completed.

Felton Diversion, Inflatable Dam

The project currently in the CIP will evaluate the condition of the inflatable dam and the possibility of installing a different type of intake structure to minimize operation and maintenance issues and maximizing total yield from this facility.

Evaluation of the facility is scheduled to start in fiscal year 2016 with construction in 2019. Until the evaluation is complete, it is difficult to put a value to the construction. As a placeholder, $1,200,000 has been put into the CIP.

Summary

As can be seen on the attached table, the projects described above are the major components embedded in a larger list of projects. There are over $200M of projects including placeholders of $45M for a potential new water supply project.

The work of the WSAC will undoubtedly have an impact on the CIP and to the extent contemplated at this time; the CAs relating to each CIP project is included in the attached table. As the CAs are further vetted, the relationship between CAs and the CIP will be better understood and decisions will be made in a more informed way.

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WATER COMMISSION
INFORMATION REPORT

DATE: October 23, 2017

AGENDA OF: November 6, 2017

TO: Water Commission

FROM: Heidi Luckenbach, Deputy Director/Engineering Manager
Sarah Easley Perez, Associate Planner II

SUBJECT: Water Supply Augmentation Strategy, Desalination

RECOMMENDATION: That the Water Commission receive information regarding the Desalination Feasibility Update Report.

BACKGROUND: Following the completion of the Water Supply Advisory Committee (WSAC) process, the City Council accepted the Final Report on Agreements and Recommendations that included a detailed Implementation Plan and Adaptive Management Strategy. The WSAC work was adopted as part of the 2015 Urban Water Management Plan and is currently known as the Water Supply Augmentation Strategy (WSAS) that includes an Implementation Work Plan (Work Plan).

The Work Plan consists of the three fundamental elements recommended by the WSAC as shown below. Evaluation of each is advancing along parallel tracks to allow for them to be comparatively analyzed in terms of various metrics such as cost, timeliness, and yield.

- Water conservation (Element 0)
- Groundwater Recharge by "In Lieu" water transfers (Element 1) or Aquifer Storage and Recovery (Element 2)
- Advanced-treated recycled water, with desalination as a back-up (Element 3)

As the Water Commission is aware, significant progress continues to be made on understanding the feasibility of all the water supply alternatives recommended in the Work Plan. Consistent with the requirements of the work plan, sufficient information about the desalination alternative is required for a comparative analysis and resulting selection of preferred Element 3.

The Work Plan provides guidance on the information likely needed to make this selection:

> "… Complete high level feasibility studies, as-needed demonstration testing, and conceptual level designs of alternatives; define CEQA processes; and continue public outreach and education. "

As discussed at the April 3, 2017 Water Commission Meeting and approved at the April 25, 2017 City Council Meeting, Dudek was contracted to analyze the desalination alternative in a manner that would allow for a comparison with other alternatives. A draft report on the process and findings is attached.

DISCUSSION: Dudek's Desalination Feasibility Update Report provides a review of feasibility, cost, timeliness, and approach for pursuing a seawater desalination facility for use by the City with the purpose of supporting the City's selection of a preferred Element 3. The report describes the water supply planning background and need for the report; provides an assessment of changed conditions that may affect the design, environmental review and permitting of a seawater desalination project; describes a City Seawater Desalination Project based on those changed conditions; provides a CEQA/NEPA compliance and permitting approach; assesses the timeliness of implementation; presents opportunities for regional collaboration; and, provides conclusions about the ability of a City Seawater Desalination Project to meet current City objectives. (CEQA = California Environmental Quality Act; NEPA = National Environmental Protection Act.)

The changed conditions include the following:

1. Project Size. The scwd^2 project was sized at 2.5million gallons per day (mgd) to provide water to the city during drought and to Soquel Creek Water District at other times. Based on the work of the WSAC, ~3.3mgd of water is required to fill the supply-demand gap of 1.2bgy during modeled worst-year conditions. This feasibility update evaluated the larger project which had an impact on cost.

2. Intake Pump Station Locations: The scwd^2 project analyzed eight alternative intake locations in the draft Environmental Impact Report. During the comment period, many neighbors in the Westside of Santa Cruz expressed concern about the seawater intake pump station locations located in neighborhoods along West Cliff Drive. Concerns about noise, vibration, aesthetics, loss of recreational space, and other types of land use conflicts were raised. This study focuses on three intake alternative locations: two around the Santa Cruz Wharf that could potentially support a subsurface intake and one on the west side of Santa Cruz directly offshore of the treatment plant sites.

3. Regulatory Framework: Perhaps the most significant change between the scwd^2 project and this update is the Ocean Plan Amendment, or OPA. In effect since 2016, the State Water Resources Control Board adopted an amendment to the Water Quality Control Plan for Ocean Waters of California (Ocean Plan) to address effects associated with the construction and operation of seawater desalination facilities. The OPA sets forth a very specific approach to analyze and ensure that all proposed or expanded desalination plants utilize the best available site, design, technology and mitigation measures. Project features impacted by the OPA include the intake and brine disposal.

Seawater Intake

The OPA requires subsurface intakes unless they are deemed infeasible based on geotechnical data, hydrogeology, benthic topography, oceanographic conditions, the presence of sensitive habitats and species, energy use for the entire facility, design constraints, and the project's life-cycle cost demonstrating that a subsurface intake would not be economically viable. However, subsurface intakes cannot be determined infeasible by only demonstrating that their individual design capacity would not meet the identified need for desalinated water. Instead, an evaluation is required to determine if subsurface intakes would be feasible to meet a reasonable range of alternative intake design capacities. This analysis may determine that a combination of both subsurface and surface intakes may be the best feasible alternative to minimize intake and mortality of marine life while meeting the identified desalinated water need. Subsurface intakes were analyzed for the scwd^2 project and while radial collector wells (one of several forms of subsurface intakes) were determined to be potentially viable, they were not recommended due to the costs, complexity and risk associated with this technology in the ocean environment. Given the OPA definition of feasible, additional study would likely be required. Radial collectors are included in this study as an intake alternative located in the vicinity of the Wharf.

Brine Discharge

A dilution analysis conducted to support the scwd^2 project concluded that dilution of brine with existing effluent from the City's WWTF would not prompt a modification to the existing NPDES permit. An update to the dilution analysis would be required because

- The project being analyzed here is slightly larger (3.3 vs 2.5mgd);
- There are several reuse projects being promoted that may reduce the effluent available for dilution from the city's WWTF; and,
- The OPA requires studies or modelling to estimate the degradation of all forms of marine life from elevated salinity within the brine mixing zone, including osmotic stresses, and duration of exposure to toxic conditions. And, if high-velocity jets are included, the effect of velocity shear and turbulence on organisms entrained in such jets must also be provided. Additional studies would be needed to meet this requirement and additional mitigation would likely be required.

The report presents findings as noted below. Some, but not all of the WSAC Criteria/Threshold Metrics of cost, yield, and timeliness, and WSAC Guiding Principles of Public Health, Acceptance, Regional Collaboration, Plant Goal, Incremental Implementation are understood and commented on.

- The Project is technically feasible and could provide sufficient water supply capacity to fill the identified supply-demand gap. The Project could meet the timeliness objective as it could be completed and operational by 2025. Seawater desalination can also support system robustness, redundancy and adaptive flexibility. Redundancy can be built into design and capacity can be modified, if needed during design.

- It is not yet known whether the Project would meet the cost-effectiveness objective, as this objective is not evaluated in the report. While an engineer's opinion of probable cost was developed, a subsequent analysis will be prepared by the Water Department to compare seawater desalination to other alternatives using the Annualized Cost per million gallons of Average Year Yield (ACAYY). The ACAYY is a cost metric used by the WSAC that includes the ability of a project to reduce the peak season shortage into its calculation.

- The Project could also be configured as a regional project with Scotts Valley Water District, San Lorenzo Valley Water District and/or Soquel Creek Water District with the inclusion of intertie components, which would meet the objective of promoting regional collaboration to improve water supplies, reversing or slowing seawater intrusion, and supporting habitat restoration. The City could also consider participation in the proposed Deep Water Desal project planned for Moss Landing; although, significant new infrastructure would be require to bring purchased water to the City's distribution system.

Next Steps: As presented and discussed in another item on the agenda, staff is in the process of developing the details of decision making for a preferred future supplemental water supply project or portfolios of projects. Staff anticipates a more detailed plan to be presented to the commission at one of the next several Water Commission meetings.

FISCAL IMPACT: None

PROPOSED MOTION: That the Water Commission accept the information provided regarding the Desalination Feasibility Update Report.

ATTACHMENTS: Revised Draft, City of Santa Cruz Desalination Feasibility Update Review (October 2017)

REVISED DRAFT

City of Santa Cruz
Desalination Feasibility Update Review

Prepared for:

City of Santa Cruz Water Department
212 Locust Street, Suite C
Santa Cruz, California 95060

Prepared by:

DUDEK
725 Front Street, Suite 400
Santa Cruz, California 95060

In Collaboration with:

Kennedy/Jenks Consultants

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
ACAYY	annualized cost per million gallons of average year yield
ACOE	U.S. Army Corps of Engineers
AF	acre feet
AFY	acre-feet per year
APF	area of production foregone
bgy	billion gallons per year
CCC	California Coastal Commission
CCF	100 cubic feet
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
City	City of Santa Cruz
CSLC	California State Lands Commission
EIR	environmental impact report
EIS	Environmental Impact Statement
ETM	Empirical Transport Model
IRP	Integrated Resources Plan
IWP	Integrated Water Plan
JPA	joint powers authority
Master Plan	Santa Cruz Wharf Master Plan
MBNMS	Monterey Bay National Marine Sanctuary
MBRWP	Monterey Bay Regional Water Project
MG	million gallons
mgd	million gallons per day
n/a	not applicable
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OPA	Amendment to the Water Quality Control Plan for Ocean Waters of California Addressing Desalination Facility Intakes, Brine Discharges, and the Incorporation of Other Non-Substantive Changes
RWFPS	Recycled Water Facilities Planning Study
RWQCB	Regional Water Quality Control Board
SCCRTC	Santa Cruz County Regional Transportation Commission
SCWD	Santa Cruz Water Department
$scwd^2$	Santa Cruz Water Department/Soquel Creek Water District
$scwd^2$ DEIR	$scwd^2$ Regional Seawater Desalination Project Draft Environmental Impact Report
SLVWD	San Lorenzo Valley Water District
SqCWD	Soquel Creek Water District
SUP	special use permit
SVWD	Scotts Valley Water District
SWRCB	State Water Resources Control Board
SWRO	seawater reverse osmosis
UWMP	Urban Water Management Plan

Acronym/Abbreviation	Definition
Wharf	Santa Cruz Municipal Wharf
WSAC	Water Supply Advisory Committee
WSAC Final Report	Water Supply Advisory Committee's Final Report on Agreements and Recommendations
WWTF	wastewater treatment facility

EXECUTIVE SUMMARY

This report provides a review of the feasibility, cost, timeliness, and approach for pursuing a seawater desalination facility for use by the City of Santa Cruz (City). This review will support the City's selection of a supplemental or replacement supply according to the City Water Supply Advisory Committee's Final Report on Agreements and Recommendations (WSAC Final Report) (WSAC 2015). The recommended strategies in the WSAC Final Report include conservation to reduce demand, passive and active groundwater recharge, and supply augmentation using advanced-treated recycled water with desalination as a backup if the use of advanced-treated recycled water is not feasible (WSAC 2015).

This report describes the water supply planning background and need for this report (Section 1); provides as assessment of changed conditions that may affect the design, environmental review, and permitting of a seawater desalination project (Section 2); describes a City seawater desalination project based on changed conditions (Section 3); provides a California Environmental Quality Act/National Environmental Policy Act (CEQA/NEPA) compliance and permitting approach (Sections 4 and 5); assesses the timeliness of implementation (Section 6); presents opportunities for regional collaboration (Section 7); and provides conclusions about the ability of a City seawater desalination project to meet current City objectives (Section 8).

As a result of the assessment of changed conditions, a City seawater desalination project would involve construction and operation of a seawater reverse osmosis (SWRO) desalination plant and related facilities to provide up to 3.3 million gallons per day (mgd) of potable water to the City. The water supply from the project would help the City meet its water needs during periods of water supply shortages as a result of drought and reduced surface-water diversions needed to provide improved river and stream flows for fish and to plan for climate change. The four basic functional components of a City seawater desalination project would be similar to those considered for the Santa Cruz Water Department/Soquel Creek Water District (scwd^2) Desalination Program and would consist of the following (see Figure 1):

- A seawater intake and conveyance system consisting of a screened open-ocean intake system, intake piping, pump station, and transfer piping. Because of the requirements of the California Ocean Plan, a subsurface radial collector well system may need to be considered as an intake design option even though it was not previously recommended for the scwd^2 Desalination Program. If such a subsurface intake system were pursued by the City, it would need to be constructed and tested in stages and may need to be augmented with a screened open-ocean intake that would be used to provide supplemental water if the subsurface intake system loses production capacity or requires significant maintenance. Although a number of alternative locations for the seawater intake and conveyance system were evaluated in the scwd^2 DEIR, this report updates and evaluates three intake alternatives based on the assessment of changed conditions provided in Section 2.

- A seawater desalination plant that would provide for pretreatment processing, desalination treatment and energy recovery, post-treatment processing and distribution, brine storage, residuals handling and disposal, chemical systems, and their associated support facilities. The three plant sites considered for the scwd^2 Desalination Program would continue to be considered for a City seawater desalination project.
- A brine storage, disposal, and conveyance system consisting of brine storage at the desalination plant, a new pipeline to the City's wastewater treatment facility (WWTF) outfall, and outfall improvements. An update to the scwd^2 Desalination Program Dilution Analysis would be required to specifically address the California Ocean Plan requirements regarding discharge and reduced wastewater flow associated with potential recycled water projects, as discussed in Section 2. An update to the dilution analysis would also determine the need for a multi-port diffuser on the outfall to provide for adequate mixing at the discharge point.
- Potable water distribution system improvements consisting of a new connection to the City distribution system near the seawater desalination plant site. Interconnections with the Soquel Creek Water District (SqCWD) are not considered for a City seawater desalination project, but such connections with this and other water agencies are reviewed in Section 7 in support of current objectives promoting regional collaboration.

This report provides CEQA/NEPA compliance and permitting approaches and indicates that the primary permitting constraint for the project would be proposing to use an open-ocean intake, because the California Ocean Plan requires a subsurface intake unless such an intake is determined not to be feasible. As indicated above, the project includes options for use of an open-ocean intake only and also for a hybrid system where radial collector wells are used in combination with an open-ocean screened intake. As stated in Section 2, early consultation with the Regional Water Quality Control Board (RWQCB) is recommended to discuss the radial collector well option and the need to pursue additional study to assess the feasibility of this option.

A City seawater desalination project would meet most of the City's WSAC objectives, as described in Sections 3 and 8. Such a project is technically feasible, as previously determined for the scwd^2 Desalination Program, and could provide sufficient water supply capacity to fill the identified supply-demand gap of 1.2 billion gallons per year (bgy), which equates to approximately 3.3 mgd. While such a project is technically feasible, additional feasibility review of radial collector wells may be required for the project, as noted above.

A City seawater desalination project could meet the City's timeliness objective because it could be completed and operational by 2025, as shown in Section 6.

It is not yet known whether a City seawater desalination project would meet the cost-effectiveness objective because this objective is not evaluated in this report. A subsequent analysis will be prepared by the Santa Cruz Water Department (SCWD) to compare seawater desalination to other alternatives under review by the City using the annualized cost per million gallons of average year yield (ACAYY). Also, while the City will consider energy use, public health, and environmental impacts in selecting a supplemental water supply, a comparison of desalination to other alternatives for these factors is not provided in this report.

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1 INTRODUCTION

1.1 Purpose and Organization of Report

This report provides a review of the feasibility, cost, timeliness, and approach for pursuing the final planning and design, construction, and operation of a seawater desalination facility for use by the City. This review will support the City's selection of a supplemental or replacement supply per the WSAC Final Report (WSAC 2015). The WSAC Final Report provides strategies for addressing the identified worst year water supply gap or shortage. The recommended strategies in the WSAC Final Report include conservation to reduce demand, passive and active groundwater recharge, and supply augmentation using advanced-treated recycled water with desalination as a back-up if the use of advanced-treated recycled water not be feasible (WSAC 2015).

The SCWD is currently assessing the feasibility of supply augmentation with advanced-treated recycled water in the event that groundwater recharge strategies prove to be insufficient to meet the WSAC Final Report's stated goals. Because desalination is identified as a backup to the use of advanced-treated recycled water, this report will support the City's selection of its supply augmentation approach (advanced-treated recycled or desalination). Refer to Section 1.2.2 for additional information.

This report is organized to provide the information necessary to support the City's selection of its supply augmentation approach and includes the following sections:

1. **Introduction** – Describes the purpose of the report, the water supply planning background, and the need for the feasibility update for seawater desalination.
2. **Assessment of Changed Conditions** – Provides an assessment of changed conditions since the pursuit of seawater desalination was suspended in 2013 that may affect a possible City seawater desalination project or influence potential environmental review and/or permitting requirements if such a project is pursued by the City.
3. **City Seawater Desalination Project Characteristics** – Presents a City seawater desalination project developed based on review of the changed conditions in Section 2.
4. **CEQA/NEPA Compliance Approach** – Describes the CEQA and NEPA lead agencies for a City seawater desalination project, the CEQA and NEPA compliance approach, and the need for new or updated studies and consultations if such a project is pursued.
5. **Permitting Approach** – Presents a list of required permits for a City seawater desalination project and discusses permitting constraints associated with pursuit of such a project.

6. **Timeliness of Implementation** – Provides a schedule for a City seawater desalination project and assesses whether such a project would meet the City's timeliness objective of having a fully functional water system able to meet the supply-demand gap by 2025.
7. **Opportunities for Regional Collaboration** – Presents regional seawater desalination opportunities consistent with the WSAC Final Report guiding principle regarding promoting regional collaboration to improve water supplies, reverse or slow seawater intrusion, and support habitat restoration.
8. **Conclusions** – Presents the conclusion of the report and the ability of a City seawater desalination project to meet current City objectives.
9. **References** – Provides the cited references used to prepare this report.

1.2 Water Supply Planning Background

1.2.1 Integrated Water Plan

The City has been pursuing possible new water supplies for the past several decades. In 1997, the City initiated an "integrated water planning" approach to consider all practical options for balancing its water supply by decreasing demand and increasing supply. The City Council adopted the City's Integrated Water Plan (IWP) in November 2005 (Gary Fiske & Associates 2003). The City's IWP objectives were to (1) reduce near-term drought shortages, and (2) provide a reliable supply that meets long-term needs while ensuring protection of public health and safety. The IWP components identified to meet these objectives included water conservation, curtailment of water deliveries during drought, and a new supplemental water supply. Water supply alternatives considered in the IWP and related background studies included but were not limited to seawater desalination, reclamation/recycled water, various groundwater options, conjunctive use with SqCWD, maximizing storage in Loch Lomond Reservoir, and reservoir storage in the Olympia Quarry (Gary Fiske & Associates 2003).

Based on the outcome of the IWP and related background studies, seawater desalination was determined to be the most feasible and reliable alternative for a supplemental supply of drinking water. A cooperative operational scenario that involved partnering with SqCWD and constructing a 2.5-mgd seawater desalination plant and related facilities (with the ability to expand the plant up to a maximum of 4.5-mgd to meet future needs through 2030) was selected by the City Council as the preferred alternative. The IWP Program Environmental Impact Report (EIR), certified in 2005, provided a programmatic analysis of a 2.5-mgd desalination facility and incremental expansions up to 4.5 mgd (City of Santa Cruz 2005). The results of the IWP process were incorporated into the City's 2010 Urban Water Management Plan (UWMP) (City of Santa Cruz 2011).

The City and SqCWD partnered to undertake environmental review for the proposed scwd² Desalination Program, which involved the construction and operation of a SWRO desalination plant and related facilities to provide up to 2.5 mgd of potable water. Between 2007 and 2013, desalination background studies on treatment, brine disposal,[1] energy use, intake design, and offshore geophysical conditions, and as well as other studies, were conducted to support the development of the scwd² Regional Seawater Desalination Project Draft EIR (scwd² DEIR) (URS 2013a). The scwd² DEIR (URS 2013a), which evaluated the scwd² Desalination Program, was released for public review and comment in May 2013. The City chose to suspend the pursuit of seawater desalination in late 2013 to allow for a broader public discussion on the topic of water supply for the City.

1.2.2 WSAC Final Report and Urban Water Management Plan

After the pursuit of seawater desalination was suspended in 2013, the City Council approved membership of the WSAC in 2014. The WASC's charge was to "explore, through an iterative, fact-based process, the City's water profile, including supply, demand and future risks; analyze potential solutions to deliver a safe, adequate, reliable, affordable and environmentally sustainable water supply; and, to develop recommendations for City Council consideration" (WSAC 2015). The WSAC developed the WSAC Final Report, which was accepted by the City Council in November 2015. The WSAC Final Report was incorporated by reference into the 2015 UWMP, and the guiding recommendations were presented as the future water supply management strategy for the City (City of Santa Cruz 2016).

The overarching goal of the WSAC Final Report's Water Supply Augmentation Strategy is to provide significant improvement in the sufficiency and reliability of the City water supply by 2025. The recommendations in the WSAC Final Report reflect consensus among WSAC members on how best to address an agreed-upon worst-year gap of 1.2 bgy during modeled worst-year conditions by 2025. As presented in the 2015 UWMP, the Water Supply Augmentation Strategy portfolio elements include the following (WSAC 2015):

- **Element 0:** Additional water conservation with a goal of achieving an additional 200 to 250 million gallons per year of demand reduction by 2035 by expanding water conservation programs.
- **Element 1:** Passive recharge of regional aquifers by working to develop agreements for delivering surface water as an in lieu supply to the SqCWD and/or the Scotts Valley

[1] Brine is the byproduct of desalinated water having a salinity concentration greater than a desalination facility's intake source water (i.e., seawater).

Water District (SVWD) so they can rest their wells, help the aquifers recover, and effectively store water for use by SCWD in drought years.

- **Element 2:** Active recharge of regional aquifers by using existing infrastructure and potential new infrastructure in the regionally shared Purisima aquifer in the Soquel-Aptos Basin and/or in the Santa Margarita/Lompico/Butano aquifers in Scotts Valley area to store water that can be available for use by the City in drought years.
- **Element 3:** A potable water supply using advanced-treated recycled water as its source as a supplemental or replacement supply in the event the groundwater storage strategies described above prove insufficient to meet the goals of cost-effectiveness, timeliness, or yield. In the event advanced-treated recycled water does not meet the City's needs, desalination would become Element 3.

See Section 3 for additional information about the Water Supply Augmentation Strategy's goals and objectives. The Work Plan incorporated in the Water Supply Augmentation Strategy recommends selection of the preferred Element 3 by the end of 2017 (WSAC 2015).

To make the selection of the preferred Element 3, the SCWD is completing high-level feasibility studies, conceptual level design, and definition of environmental permitting processes for each option. To facilitate comparative analysis by metrics such as cost, timeliness, and yield, the SCWD is developing the two Element 3 options in a consistent manner to the extent possible. This report presents the framework for review of the seawater desalination option. Unlike the previously considered $scwd^2$ Desalination Program, the primary focus is on the consideration of a City seawater desalination project to allow for direct comparison with the City's Element 3 recycled water option, review of which is proceeding along a parallel track.

1.3 Need for Feasibility Update

While desalination was previously determined to be feasible by the City during its IWP and $scwd^2$ planning processes, information developed during the WSAC planning process may influence the size and/or viability of a potential desalination facility or components of such a facility. Other changed environmental conditions and/or regulatory requirements may also influence the viability of, or approach to, pursuing such a facility.

Therefore, this report evaluates these and other changed conditions and provides a modified desalination project description and conceptual-level design information, updated cost estimates, a high-level evaluation of environmental review and permitting approaches, and an assessment of the timeliness of implementing such a project. Opportunities for regional collaboration with other water agencies are also presented based on goals identified in the WSAC Final Report. This information will support the City's selection of its backup source of water in late 2017 or early 2018.

2 ASSESSMENT OF CHANGED CONDITIONS

The section includes an assessment of changed conditions since the pursuit of seawater desalination was suspended by the City in late 2013. In considering the pursuit of a possible City seawater desalination project, the scwd^2 Desalination Program is evaluated and considered throughout this section, based on the changed conditions presented, to determine the characteristics of a possible City seawater desalination project. Section 3 presents the City seawater desalination project developed based on review of the changed conditions discussed in this section.

This section also reviews changed conditions that may influence potential environmental review and/or permitting requirements if the City pursues a City seawater desalination project.

2.1 scwd^2 Desalination Program Overview

As indicated in Section 1, the City and SqCWD previously partnered to implement the scwd^2 Desalination Program. The program proposed to construct and operate an SWRO desalination plant and related facilities to provide up to 2.5 mgd of potable water. There were the following four basic functional components of a proposed seawater desalination project as part of the program: (1) seawater intake; (2) pretreatment and salt removal through reverse osmosis filtration; (3) disposal of by-products, including brine and solids that are removed in the pretreatment and SWRO processes; and (4) conveyance and delivery of the product water to existing City and SqCWD water distribution systems. Given these functional components, the scwd^2 Desalination Program consisted of the following (URS 2013a):

1. A seawater intake and conveyance system consisting of an intake structure, intake piping, pump station, and transfer piping
2. A seawater desalination plant that would provide for pretreatment processing, desalination treatment and energy recovery, post-treatment processing and distribution, brine storage, residuals handling and disposal, chemical systems, and their associated support facilities
3. A brine storage, disposal, and conveyance system consisting of brine storage at the desalination plant, a new pipeline to the City's WWTF outfall, and outfall improvements
4. Potable water distribution system improvements consisting of a new connection to the City distribution system and a new intertie system between the City and SqCWD service areas, including new pipelines and pump station improvements

Figures 2 and 3 show an overview of the scwd^2 Desalination Program.

2.2 Project Objectives

The prior objectives of the proposed scwd^2 Desalination Program, as presented in the scwd^2 DEIR, address the need for a supplemental water supply, as identified by the City's IWP and the SqCWD's Integrated Resources Plan (IRP) (ESA 2006). The scwd^2 Desalination Program was designed as a joint project for cooperative use by both agencies. The scwd^2 Desalination Program project objectives were developed primarily to achieve the broad policy and planning objectives of the IWP and IRP. The primary objectives for the two agencies, as presented in the scwd^2 DEIR, are as follows (URS 2013a):

1. Provide for a supplemental water supply in a timely manner that meets the IWP and IRP program objectives and provides for the amount of supplemental water supply identified as necessary in the City and SqCWD 2010 UWMPs and/or in other available City and SqCWD reports that complements on-going and future water conservation and drought curtailment efforts. The City and SqCWD need the supplemental water supply for the following reasons:
    - City – During the dry season of dry and critically dry years, a supplemental supply is needed to limit peak season shortages to 15 percent of normal water needs currently projected through 2030, which is the reliability objective set by the City in the long term. The supplemental supply needs to support potable uses given that irrigation and other outdoor uses will already be restricted during these periods.
    - SqCWD – A supplemental supply is needed in the near term to meet the SqCWD's target groundwater yield during the time period in which the basin recovers from overdraft and in the long term to provide for currently projected water demand through 2030.

The City's water supply planning objectives have changed since the adoption of the IWP and with the completion of the WSAC Final Report and 2015 UWMP:

1. The scwd^2 Desalination Program was a regional project with the SqCWD, whereas the WSAC Final Report and 2015 UWMP consider City supply reliability, although regional collaboration is also supported.
2. The scwd^2 Desalination Program was sized based on an objective of limiting peak season shortage to 15%, whereas WSAC supply alternatives are aimed at eliminating peak season shortages (water supply gap of 1.2 bgy during modeled worst-year conditions) by 2025. It should be noted that, while the WSAC objectives are based on zero peak season shortages, future studies will compare the cost of allowing for shortages with allowing for no shortages.

3. Desalination is being pursued as a supplemental or replacement supply only if the groundwater storage strategies and advanced-treated recycled water prove to be insufficient to meet the WSAC Final Report/2015 UWMP Water Supply Augmentation Strategy's goals, as described in Section 1.2.2.

The City's new objectives, based on the WSAC Final Report and the 2015 UWMP, are presented in Section 3.

2.3 OPA Requirements and Project Analysis

2.3.1 Requirements

In effect since 2016, the Amendment to the Water Quality Control Plan for Ocean Waters of California Addressing Desalination Facility Intakes, Brine Discharges, and the Incorporation of Other Non-Substantive Changes (OPA) is now included in the California Ocean Plan (SWRCB and CalEPA 2015). For a RWQCB to make a California Water Code, Section 13142.5(b), determination based on the new requirements under the OPA, it must first analyze a range of feasible alternatives for the following four factors: the best site, design, technology, and mitigation measures. The RWQCB involved in reviewing a particular desalination project (Central Coast RWQCB for a project in the City) will then consider these factors collectively to determine the best combination of feasible alternatives that minimize the mortality of all forms of marine life, including plankton and larvae. While these are permitting requirements, they may influence the location, design, and characteristics of a desalination project and, therefore, are considered here to support the development of the modified desalination project description presented in Section 3.

Site

According to the OPA, a desalination plant's site is the general location of its onshore facilities (e.g., filtration facility) and offshore facilities (e.g., intake and discharge). To determine whether a desalination facility is located at the "best available site feasible," the following questions must be answered:

- Are subsurface intakes feasible at the site?
- Is there an identified need for the desalinated water according to an UWMP or other water planning documents?
- Does the site avoid impacts to sensitive habitats and species, including Marine Protected Areas and State Water Quality Protection Areas, such as Areas of Special Biological Significance?

- What are the direct and indirect effects to all forms of marine life from construction and operation in the cumulative project area?
- Considering the oceanographic, geologic, hydrogeologic, and seafloor topographic conditions, how can the facility be sited to minimize the intake and mortality of all forms of marine life?
- Is there existing discharge infrastructure and sufficient wastewater available to feasibly dilute the desalination plant's brine discharge?

Design

According to the OPA, a desalination facility's design must consider its size, layout, form, and function, as well as the capacities of its intake and discharge facilities. A given site may have several possible configurations for the best available design feasible.

To determine whether a desalination facility's design is the best available design feasible to minimize mortality to all forms of marine life, the OPA requires that the general design configurations be evaluated. For intakes, if subsurface intakes are not feasible, the evaluation must also analyze the design configurations to minimize mortality of all forms of marine life. For outfalls, the brine discharge must be designed so the brine mixing zone does not adversely affect sensitive habitats and the discharge does not cause negatively buoyant plumes and minimizes the suspension of benthic sediments.

Technology

The OPA defines technology as the type of equipment, materials, and methods used to construct and operate a desalination facility's design components. Similar to a facility's design, the OPA requires an evaluation of the technology to determine the "best available technology feasible" to minimize mortality of all forms of marine life.

The OPA specifies particular criteria for determining the best available technology feasible for desalination facility intakes and discharges separately. These criteria are presented below.

Intakes

The OPA requires subsurface intakes unless they are deemed infeasible based on geotechnical data, hydrogeology, benthic topography, oceanographic conditions, the presence of sensitive habitats and species, energy use for the entire facility, design constraints, and the project's life-cycle cost demonstrating that a subsurface intake would not be economically viable.

However, subsurface intakes cannot be determined infeasible by only demonstrating that their individual design capacity would not meet the identified need for desalinated water. Instead, an evaluation is required to determine if subsurface intakes would be feasible to meet a reasonable range of alternative intake design capacities. Additionally, this analysis may determine that a combination of both subsurface and surface intakes may be the best feasible alternative to minimize intake and mortality of marine life while meeting the identified desalinated water need. Surface intakes are referred to as open-ocean intakes in the scwd^2 Desalination Program documents and in this report.

If subsurface intakes are deemed infeasible, the open-ocean intake must avoid disturbing sensitive habitats and species to the maximum extent feasible. If open-ocean intakes are used, they are required to be screened with a 1-millimeter or smaller slot size screen and have a through-screen velocity below 0.5 feet per second, unless it can be demonstrated that an alternative method of preventing entrainment[2] would provide equivalent or better protection of marine life mortality from the intake of seawater.

Discharges

The OPA mandates analyzing the potential to commingle the facility's brine discharge with existing wastewater discharge under two conditions: there is adequate wastewater flow for sufficient salinity dilution, and the discharge does not preclude future wastewater recycling.

If commingling with wastewater is not feasible, a multi-port diffuser must be used for brine discharge and must be designed with sufficient flow velocity to rapidly mix the brine with ambient ocean water and avoid a negatively buoyant plume that could impact the ocean floor. Multi-port diffusers must maximize dilution, minimize the size of the brine mixing zone,[3] minimize suspension of benthic sediments, and minimize the mortality of marine life.

Regardless of the brine discharge technology, studies or modelling must be conducted to estimate the degradation of all forms of marine life from elevated salinity within the brine mixing zone, including osmotic stresses and duration of exposure to toxic conditions. If high-velocity jets are included, the effect of velocity shear and turbulence on organisms entrained in such jets must also be provided.

2 Entrainment is the passage of planktonic organisms through a water intake system (URS 2013a).

3 The brine mixing zone is an allocated impact zone where there may be toxic effects on marine life due to elevated salinity. This zone is the area where salinity may exceed 2.0 parts per thousand above natural background salinity. The standard brine mixing zone shall not exceed 100 meters (328 feet) laterally from the points of discharge and throughout the water column unless an alternative brine mixing zone is approved.

Mitigation Measures

Mitigation involves replacing all marine life or habitats lost from constructing and operating a desalination facility. The OPA requires the best available mitigation measures feasible to minimize the mortality of all forms of marine life after determining the best available site, design, and technology feasible.

To determine the level of mitigation required, a Marine Life Mortality Report must be submitted to the RWQCB that quantifies the construction and operational impacts of the desalination facility on all forms of marine life. For example, for construction impacts, the disturbance of habitat would be quantified. For operational impacts, entrainment- and elevated-salinity-related marine life mortality would also be quantified. The entrainment study and sampling period shall be at least 12 months. The Marine Life Mortality Report will translate the mitigation requirement to the area of production foregone (APF)[4] and mitigate the impacts through a mitigation project or a fee-based mitigation program.

Monitoring and Reporting Plan

Under the OPA, a Monitoring and Reporting Plan must be submitted to the RWQCB to determine the baseline biological conditions before and after constructing and operating the desalination facility. The Monitoring and Reporting Plan must describe ways to monitor for benthic health, aquatic life toxicity, hypoxia, and receiving-water characteristics to demonstrate compliance with receiving-water limitations, including salinity.

2.3.2 Project Analysis of Ocean Plan Amendment

This section evaluates the prior scwd[2] Desalination Program based on the OPA to determine if any modifications need to be considered to pursue a seawater desalination project under current regulatory requirements. The need for additional technical study is also identified, where warranted, to comply with the OPA.

Need for Desalinated Water

The use of desalinated water is identified as a potential supplemental or replacement supply of potable water in the City's 2015 UWMP. As indicated in Section 1.2.2, the WSAC Final Report and the 2015 UWMP identify Water Supply Augmentation Plan portfolio elements to fill the

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[4] APF is an estimate of the area that is required to produce (replace) the same amount of larvae or propagules that are removed through entrainment at desalination facility intakes. APF is calculated by multiplying the proportional mortality by the source water body, which are both determined using an empirical transport model (ETM).

worst-year gap of 1.2 bgy during modeled worst-year conditions by 2025. The elements include expanding water conservation and implementing passive and active recharge of regional aquifers to store water for use by the City in drought years. In the event the groundwater storage strategies prove insufficient to meet the City's goals, a potable water supply using advanced-treated recycled water would be developed as a supplemental or replacement supply. Desalination would become the supplemental or replacement supply if advanced-treated recycled water is determined not to meet the City's needs. See Section 1.2.2 for additional information.

> ***Conclusion – Need for Desalinated Water:*** Adequate information exists in the City's 2015 UWMP (City of Santa Cruz 2016) to show the need for desalinated water as a back-up source of supplemental or replacement supply of potable water. Desalinated water would become the supplemental or replacement supply if advanced-treated recycled water is determined not to meet the City's needs. The City's 2020 UWMP will reflect the City's ultimate determination on this matter and could further document the need for desalinated water, if that is the decision made by the City. It will also report on the status of the preferred approach of using passive and active recharge of regional aquifers and whether this approach can meet the City's needs.

Plant Site Location

To determine whether the desalination plant site is located at the best available site feasible, the OPA looks at whether subsurface intakes are feasible and whether there is existing discharge infrastructure and sufficient wastewater available to feasibly dilute the desalination plant's brine discharge. The plant site location would also be evaluated in terms of the ability to avoid impacts to sensitive habitats and species, including Marine Protected Areas and State Water Quality Protection Areas, and to minimize the intake and mortality of all forms of marine life.

After evaluating three areas in the IWP EIR (Areas A, B, and C), all in the westside of the City (as shown on Figures 4 and 5), the scwd^2 DEIR considered three plant site location alternatives in the Industrial Park Area (Area A) after conducting an expanded site selection technical review (see scwd^2 DEIR, Appendix K). The sites in Area A were in the closest proximity to the City's existing WWTF outfall structure and possible intake locations; were of adequate size; had consistent land use designations, zoning, and surrounding land uses; and avoided environmental constraints and regulatory requirements of Areas B and C. The Area A plant location alternatives allow for the brine from a desalination plant to be blended with the effluent from the City's WWTF and returned to the Monterey Bay through the City's existing outfall to the southeast of Area A, which is an OPA priority. Additionally, Area A is in proximity to screened, open-ocean intake locations and a potentially viable subsurface intake location to the south and east in the Monterey Bay (URS 2013a).

Consideration of other desalination plant sites in the broader region does not appear to be warranted to provide for a desalination plant site considered the best available site feasible. Therefore, the Area A plant location alternatives should continue to be considered if the City pursues a desalination project.

> ***Conclusion – Plant Site Location:*** Adequate analysis of plant sites exists in the scwd^2 DEIR and appendices to support a permitting package for the RWQCB to make a California Water Code, Section 13142.5(b), determination. However, some updating of the information presented may be required to make specific reference to the OPA siting criteria identified above to support the RWQCB findings on whether the plant and intake sites constitute the best available site feasible.

Intake Sites, Design, and Technology

As described in the scwd^2 DEIR (URS 2013a), two fundamental types of intake technologies were evaluated by the scwd^2 Desalination Program: subsurface intakes, and screened, open-ocean intakes.[5] As summarized in the scwd^2 DEIR, a number of studies have been conducted since 2001 that informed the scwd^2 Desalination Program about the types of intake structures and possible locations that could be considered.

In 2001, a conceptual-level hydrogeological study was conducted in support of the IWP to evaluate the potential for vertical beach-well intakes (Black and Veatch Engineers and Hopkins Groundwater Consultants 2002), which is a type of subsurface intake. The report concluded that the City coastline from the beachfront adjacent to the City Boardwalk to Rio Del Mar does not have suitable geology and hydrogeological conditions for vertical beach wells to produce sufficient source water for a 2.5-mgd desalination plant. In 2008, in support of the scwd^2 Desalination Program, a review of new technologies and approaches to subsurface intakes being developed in California and other areas of the world was conducted (Kennedy/Jenks Consultants 2008). Because of the potential advantages of sub-seafloor intake technologies in providing passive protection of marine organisms, the previously referenced study recommended that additional investigation and evaluation of subsurface intake systems be conducted.

In general, deep sand and gravel alluvium that is hydraulically connected to the ocean is required for subsurface intakes to function reliably over time. With that consideration, the scwd^2 Desalination Program conducted a detailed offshore geophysical study to identify the location, dimensions, and depth of the probable offshore portion of an alluvial basin associated with the San Lorenzo River, and to provide an initial characterization of the type of sediment

[5] Subsurface intakes can draw in brackish groundwater and/or seawater from beneath the seafloor. Screened, open-ocean intakes draw seawater from an open-ocean environment through protective, fine-mesh screens.

filling the basin (EcoSystems Management Associates Inc. 2010). The offshore portion of this alluvial basin was the focus of the study, based on the results of the 2001 Hopkins study and consultation with U.S. Geological Survey staff, which excluded areas to the north above Wilder Ranch State Park and to the south down to Capitola.[6] The geophysical and hydrogeological data and information obtained[7] were used in the evaluation of the technical and engineering feasibility of the sub-seafloor intake approaches provided in Appendix H of the scwd^2 DEIR (Kennedy/Jenks Consultants 2011).

The Intake Technical Feasibility Study evaluated the feasibility and site-specific requirements of both sub-seafloor and screened, open-ocean intake approaches. Based on specific design, operational, and/or siting requirements for the type of intake, the Intake Technical Feasibility Study concluded that a screened, open-ocean intake is the "apparent best intake approach" in terms of engineering feasibility (Kennedy/Jenks Consultants 2011). The sub-seafloor options, including vertical beach wells, slant wells, and offshore-engineered infiltration gallery, were determined to be not feasible for the scwd^2 Desalination Program. Criteria used in reaching these conclusions included: production capacity and reliability; proven technology and track record (risk); energy use; permitting; operational flexibility and maintainability; constructability; and project lifecycle costs. scwd^2 DEIR, Section 8.1, and Appendix H provide detailed information about these feasibility determinations.

As described below, offshore radial collector wells were determined to be potentially viable; however, they were not recommended for the scwd^2 Desalination Program. Given that the OPA requires subsurface intakes unless they are deemed infeasible, as previously described, radial collector wells are further reviewed below and in the remainder of this report.

Radial collector wells consist of large, vertical concrete shafts (caissons) sunk down into the seafloor, with well screens extending from the caisson in a radial pattern. Seawater flows through the seafloor alluvial materials and into horizontal well screens that connect to the caisson. The collector pumps at the intake pump station would draw water from the caisson. As noted in the Intake Technical Feasibility Study (Kennedy/Jenks Consultants 2011), an

6 The City and SqCWD staff met with local U.S. Geological Survey scientists to discuss and re-evaluate potential locations for subsurface intakes along the coast near the City. The coastline from above Wilder Ranch State Park down to Capitola was evaluated. To the west of the City and offshore of Wilder Ranch State Park, the streams that discharge into the ocean are too small to have carved out an alluvial channel that could be suitable for a subsurface intake system. Likewise, beaches and locations where streams discharge into the ocean south of the City are also too shallow to have enough sediment for a subsurface intake system. Because of these disadvantages, these locations were not considered further (Kennedy/Jenks Consultants 2011).

7 Seismic reflection data were collected and interpreted to estimate the thickness of alluvial sediment. Sediment vibracores were obtained and tested to identify geotechnical properties (i.e., soil type, grain size, density, and hydraulic conductivity).

offshore sub-seafloor radial collector well system could be constructed in the offshore alluvial basin, off the San Lorenzo River, out past the end of the Santa Cruz Municipal Wharf (Wharf). The Intake Technical Feasibility Study concluded that, although offshore radial collector wells are potentially viable, they are not recommended for the $scwd^2$ Desalination Program, because they (Kennedy/Jenks Consultants 2011):

- May not be able to reliably provide the required production capacity. The mobile sediment layer and the heterogeneous nature of the offshore alluvial channel sediment will limit the vertical and horizontal movement of water to the collectors. Therefore, it is expected that multiple collector wells (two, three, or more) would be needed to provide the required flow rates. Multiple wells would have significant capital costs, and there may not be space for more than two or three collector wells in the offshore alluvial channel. To understand the actual production capabilities from a radial collector well, a full-size system would need to be constructed, operated, and monitored. This very expensive information gathering exercise would carry the risk that, after committing significant resources to construct the system, the intake may not provide the required production capacity.
- Are an unproven technology in an offshore marine environment. While radial collector wells have been used in rivers and on beaches, there have not been any radial collector wells installed in offshore locations. Therefore, there is no long-term radial collector well operational track record in offshore, open seawater locations.
- Provide low operational flexibility. Radial collector wells have limited operational flexibility and relatively complex maintenance requirements if they clog up or lose production capacity because of their buried nature. If a collector well irreversibly clogs up and loses capacity, there is no way to increase production other than through installation of additional new collector wells, which would require significant construction, expense, and time. Such additional new collector wells could also be subject to similar operational problems.
- Are the most complex to construct. Radial collector wells have the highest degree of construction complexity compared to other subsurface intake configurations because this type of system has never been constructed in ocean environments, and it would require the construction and connection of multiple offshore radial wells.

Because of the recent requirements of the OPA, a subsurface radial collector well system may need to be reconsidered as an intake design option even though it was not previously recommended for the $scwd^2$ Desalination Program as described above. For this report, the subsurface radial collector well system has been included as an intake alternative (See Section 3 for additional details). However, significant additional study would be required to confirm the overall feasibility of this potential intake approach. Additionally, the following conclusions about feasibility for all subsurface intake options studied would need to be made within the context of the definition of "feasible" per the OPA (see below):

> ***Conclusions – Intake Sites, Design, and Technology:*** The prior scwd[2] Offshore Geophysical Study (EcoSystems Management Associates Inc. 2010) and Intake Technical Feasibility Study (Kennedy/Jenks Consultants 2011) provide substantive information on which to base future CEQA evaluation and permitting. For permitting through the RWQCB, it is likely that conclusions about feasibility for all subsurface intake options previously studied will need to be made within the context of the definition of "feasible" per the OPA, which is "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors" (SWRCB and CalEPA 2015). For this report, it is assumed that similar conclusions would be reached about the infeasibility of vertical beach wells, slant wells, and offshore-engineered infiltration gallery, as were reached in the Intake Technical Feasibility Study. As indicated above, radial collector wells were determined to be potentially viable, but an assessment of feasibility under the OPA definition will need to be provided. To assess only the technical feasibility of radial collector wells, substantive additional study would be required, which would likely include the following:

1. Conduct offshore geotechnical borings in the areas of the proposed radial collector wells to confirm and better characterize the offshore, sub-seafloor alluvial hydrogeological properties.
2. Drill offshore test wells in the areas of the proposed radial collector wells to conduct pump draw-down and water production testing of the sub-seafloor alluvial basin. (While the Intake Technical Feasibility Study indicated that a full-size system would need to be constructed, operated, and monitored [Kennedy/Jenks Consultants 2011], to understand the actual production capabilities from a radial collector well, the offshore test wells proposed here should provide sufficient information to estimate production capabilities.)
3. Conduct alluvial draw-down and water production testing. These are standard tests that are conducted for onshore radial collector wells, which would need to be modified and adapted for an offshore environment.
4. Analyze the data and prepare a report on the expected production from an offshore radial collector well in the alluvial basin off the Wharf.
5. Conduct water quality testing to understand the constituent makeup of the subsurface water (e.g., salt levels, turbidity, iron, and manganese) and determine source-water suitability and/or any issues.

Regulatory permitting, planning, and conducting of the borings, tests, and reporting could take 2 to 3 years to complete. The testing would provide an indication of how much water could be collected through radial collector wells and whether the system would be reliable. It is likely that if such a system were pursued, an open-ocean screened intake would also need to be installed as part of the overall system to provide supplemental intake water, should the radial collector wells lose production capacity and/or require significant maintenance.

Overall, it is unclear if radial collector wells would be determined by the RWQCB to meet the OPA definition of "feasible," given the substantial investment in time and costs to accomplish the testing, the substantial additional capital costs associated with implementing radial collector wells (35% of capital costs, as shown in Section 3.4), and the lack of confidence about production capabilities and reliability. Early outreach to the RWQCB is recommended to discuss this intake option and the need to pursue additional study to assess feasibility.

Discharge Sites, Design, and Technology

As described in the scwd^2 DEIR (URS 2013a), brine would be generated from the SWRO process and would be approximately twice as saline as seawater or about 60 parts per thousand. The scwd^2 Desalination Program proposed to blend (commingle) the brine with treated wastewater effluent from the City's WWTF and return it to Monterey Bay through the City's existing outfall, which is consistent with the requirements of the OPA.

As indicated above, the OPA mandates commingling the desalination facility's brine discharge with existing wastewater discharge if there is adequate wastewater flow for sufficient salinity dilution, and the discharge does not preclude future wastewater recycling. The adequacy of wastewater flow to provide sufficient salinity dilution in combination with one or more recycled water projects would depend on the size and type of project. The City is reviewing various recycled water projects in the Recycled Water Facilities Planning Study (RWFPS) to determine whether such projects would meet the City's identified worst year gap. Additionally, SqCWD is currently pursuing its Pure Water Soquel Project as its preferred supplemental water supply. These projects would use secondary treated wastewater from the City's WWTF and further treat that wastewater, as specified for each project. There may be adequate wastewater remaining to provide for dilution of brine from a seawater desalination project if the City implements the two recommended smaller projects from the RWFPS,[8] which would use

[8] A seawater desalination project could also be considered in combination with the two recommended smaller projects from the RWFPS.

approximately 0.5 mgd of secondary effluent, and SqCWD implements the Pure Water Soquel Project, which would use approximately 2.0 to 3.0 mgd of secondary effluent.

A Dilution Analysis conducted to support the scwd^2 DEIR concluded that the WWTF National Pollutant Discharge Elimination System (NPDES) discharge permit minimum initial dilution requirement and ambient salinity at the outfall could be maintained with the scwd^2 Desalination Program. An update or revision to the Dilution Analysis would be required to specifically address the OPA requirements regarding discharge and potentially reduced wastewater flow associated with possible City recycled water projects and the SqCWD's Pure Water Soquel Project.

> ***Conclusions – Discharge Sites, Design, and Technology:*** An update or revision of the scwd^2 Dilution Analysis would be required to address OPA requirements and potentially reduced wastewater flow due to implementation of one or more recycled water projects. Such a revised study would also determine whether a multi-port diffuser on the WWTF outfall would be required under the OPA. If secondary effluent is not adequate to provide for dilution of brine on a year-round or seasonal basis, a multi-port diffuser would provide for adequate mixing in no to low wastewater blending conditions.

Mitigation, Monitoring, and Reporting

A Marine Life Mortality Report would be required by the RWQCB if a City desalination project were to go forward to permitting. The OPA calls for the use of an Empirical Transport Model (ETM)/APF approach to estimating entrainment of a broad range of species, species morphologies, and sizes under representative environmental and operational conditions. However, to date, the ETM/APF approach has focused on species of fish eggs and larvae as representative species to provide a conservative approach to the impacts assessment. The methodology for conducting this analysis is currently under review by the RWQCB. An issue is whether and how to quantitatively estimate the mortality of all forms of marine life, including sensitive and special-status species that may not be identified through the ETM/APF approach, as well as meroplankton (non-fish larvae forms of planktonic life) that are not measureable using ETM/APF.

The scwd^2 Desalination Program prepared an Open Ocean Intake Effects Study (Tenera 2010) (see scwd^2 DEIR, Appendix G) that evaluated the impacts to marine life from the previously proposed open-ocean intake, specifically from the intake of raw seawater. Update or expansion of this study would be required to specifically address both the construction and operational impacts of a newly proposed desalination facility based on its specific intake and discharge design. The operational impacts would include those associated with intake (entrainment) and discharge (entrainment/shear and elevated salinity). The need to conduct new source-water sampling at the proposed intake locations will need to be determined in consultation with the RWQCB. As indicated previously, the Marine Life Mortality Report will translate the mitigation requirement to the APF and mitigate the impacts through a mitigation project or a fee-based mitigation program.

> ***Conclusions – Mitigation, Monitoring, and Reporting:*** A Marine Life Mortality Report would be required by the RWQCB if a City desalination project were to go forward to permitting. Update or expansion of the scwd[2] Desalination Program Open Ocean Intake Effects Study would be required to specifically address both the construction and operational impacts of a newly proposed desalination facility based on its specific intake and discharge design. The operational impacts would include those associated with intake (entrainment) and discharge (entrainment/shear and elevated salinity).

Overall Conclusion Related to the OPA

While the OPA is fairly explicit in terms of the information that will be needed to make a determination under California Water Code, Section 13142.5(b), neither the State Water Resources Control Board (SWRCB) nor any of the RWQCBs have completed a determination for a desalination project to date. Additionally, the process for reaching conclusions on feasibility of any of the factors identified in the OPA is not entirely clear. However, there may be precedent established with other desalination projects between the time that this report is issued and submittal of an application to the RWQCB for a potential City desalination project. Such precedent may provide some assistance and clarity about the information required to support the determination. In the interim, early consultation with the RWQCB would need to be conducted if a desalination project is pursued to attempt to confirm and clarify any additional analyses or study needs associated with such a project.

2.4 Review of Other Changed Conditions

This section reviews other changed conditions that may affect the design, location, environmental review, and/or permitting of a City seawater desalination project.

2.4.1 scwd[2] DEIR Public Comments Review

The scwd[2] DEIR was released for public review in May 2013. Approximately 300 separate agencies, organizations, and individuals commented on the scwd[2] DEIR. In total, 18 comment letters were received from agencies, including almost all of the federal, state, regional, and local agencies that would have been involved in the scwd[2] Desalination Program as permitting, trustee, or responsible agencies (listed in Section 5). Comments were also received from non-profit groups, attorneys, businesses, and individuals. A high-level review of these comments was conducted during the preparation of this report to determine whether they may have potential implications for the design, location, environmental review, and/or permitting of a City seawater desalination project. The list below summarizes the key comments made by agencies, organizations, and individuals that may have implications for a City seawater desalination project if pursued. It should be noted that not every topic raised in the comments is reflected in the following list:

1. **Need for the Project/Other Water Supply Alternatives**
   - Exploration/evaluation of other land-based sources of water, including various sources of water or infrastructure improvements alone or in combination. Many individual commenters also disagreed with the conclusions made about the alternatives evaluated in detail in the scwd² DEIR (Monterey Bay National Marine Sanctuary [MBNMS], National Marine Fisheries Service [NMFS], California Department of Fish and Wildlife [CDFW], California Coastal Commission [CCC], and various other public commenters).
   - Consideration of opportunities being investigated by County of Santa Cruz Conjunctive Use Program, a combination of infrastructure improvements and upgrades to the City's water facilities, a smaller desalination project in combination with other sources, use of subsurface intakes if a smaller desalination project is pursued in combination with another source (NMFS, CDFW, CCC, CDFW, and various other public commenters).
   - Many commenters questioned the basis for the stated water supply need for the scwd² Desalination Program, including indicating that the project objectives were too narrowly defined (various public commenters).
2. **Marine Components and Associated Impacts**
   - Use of the Wharf intake site alternatives for the seawater intake (SI-9 and SI-18) is preferred because the area is sandy habitat with less larval densities than rocky reef habitat, provides maximum separation from the Natural Bridges State Marine Reserve, has already been altered by long-standing infrastructure and activity, and provides better protection than the exposed coastline along West Cliff Drive (MBNMS, NMFS, and CDFW).
   - Use of the Wharf intake site alternatives is required to avoid take in the Natural Bridges State Marine Reserve according to the California Fish and Game Code, Section 28 (CDFW).
   - SI-17, constructing a pump station adjacent to the Wharf, was not preferred as the alternative requires new Wharf piles and the other alternatives do not (MBNMS).
   - Clarification on how the 100-foot buffer from the kelp beds was determined to be the appropriate buffer distance for the intake structures. Provision of further analysis of locating the intake in deeper water because this may have less of an impact on

nearshore marine resources. Involved regulatory agencies should be consulted on the buffer distance (CCC and CDFW).

- Provision of additional details about marine construction activities (dredging, drilling, anchoring, tunneling, pipeline armoring, and installation of Red Valves on the WWTF outfall diffuser ports) and quantification of associated impacts and biological loses. The EIR should include proposed plans for addressing impacts, such as Anchoring Plan, Spill Prevention and Response Plan, "Frac-Out" Prevention and Response Plan, Fish and Marine Mammal Hydroacoustic Monitoring Plan, and Rocky Nearshore Habitat Monitoring Plan (MBNMS, CCC, CDFW, and California State Lands Commission [CSLC]).
- Provision of specific analysis of impacts to larvae at a local scale (by intake locations) from entrainment and impingement[9] and quantification of "habitat production foregone." Descriptions of whether locating intakes farther offshore or in deeper areas might reduce entrainment. California Coastal Act, Section 30231, should be cited as the basis for assessing all feasible means for minimizing entrainment (MBNMS, CCC, and CDFW).
- Evaluation of other listed species or species that may be listed, including pinto abalone (*Haliotis kamtschatkana*), Central California Coast coho salmon (*Oncorhynchus kisutch*), Xantus's murrelet (*Endomychura hypoleucus*), and white shark (*Carcharodon carcharias*). Impacts on marbled murrelet (*Brachyramphus marmoratus*), southern sea otter (*Enhydra lutris nereis*), and brown pelican (*Pelecanus occidentalis*) require additional analysis (NMFS, U.S. Fish and Wildlife Service, and CDFW).
- Use of CCC's more stringent underwater noise thresholds for fish and marine mammals in the hydroacoustic analysis of marine construction (MBNM and CCC).
- Assessment of the potential release of buried contaminants into the water column during construction, especially for sites adjacent the Wharf (MBNMS).
- Consideration of the effects of sea-level rise on all resource categories potentially affected by the scwd^2 Desalination Program (CSLC).
- The incorrect depiction of the MBNMS boundary in the DEIR and the Wharf area, located inside the Monterey Bay National Marine Sanctuary (MBNMS).

[9] Impingement occurs when organisms that are sufficiently large enough to avoid going through the screens are trapped against them by the force of the flowing source water. Entrainment occurs when marine organisms enter the desalination plant intake, are drawn into the intake system, and pass through to the treatment facilities (WateReuse 2011).

3. **Desalination Plant Site Locations**
   - Elimination of desalination plant site A-2 from further consideration due to habitat constraints associated with monarch butterfly (*Danaus plexippus*) habitat and the site's proximity to Natural Bridges State Park (CCC and California Department of Parks and Recreation).
4. **Seawater Intake Pump Station Sites in Neighborhoods**
   - Many neighbors in the westside of the City expressed concern about the seawater intake pump station locations located in neighborhoods along West Cliff Drive. Concerns about noise, vibration, aesthetics, loss of recreational space, and other types of land use conflicts were raised (various public commenters).
5. **Terrestrial Biological Resources**
   - Provision of additional mitigation for riparian habitat and San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*) (CDFW).
6. **Greenhouse Gas Reduction Strategy**
   - Inclusion of the Greenhouse Gas Emission Reduction Plan in the EIR that details the greenhouse gas emissions expected to be generated due to the facility and the measures proposed to meet the criteria for reducing those emissions. Additional information about the use of carbon offsets was requested. Methods of calculating greenhouse gas emissions and inclusion of various greenhouse gas emissions reduction projects were also discussed and questioned (CCC, CSLC, and various other public commenters).
7. **Growth Inducement**
   - Comments were received indicating that the $scwd^2$ Desalination Program would be growth inducing and/or disagreeing with all or portions of the growth inducement analysis in the $scwd^2$ DEIR (various public commenters).
8. **Transportation**
   - The City's level of service standard of significance is not appropriate (California Department of Transportation).
   - Potential project increases in vehicles, pedestrians, and bicycles and associated safety impacts at or near at-grade rail crossings should be evaluated (California Public Utilities Commission).
9. **Water Rights**
   - The intertie between the two water systems creates the potential for water diverted under the City's water rights to be delivered to SqCWD's service area,

which is not included in the authorized place of use. This would be a violation of the City's water rights. The City should collect information to show that the amount of water delivered through the intertie would not exceed the amount of water generated by the plant (SWRCB).

10. Water Quality

- Concerns were raised about the quality of the drinking water produced from the scwd^2 Desalination Program (SWRCB).

Conclusions – scwd^2 DEIR Public Comments Review: The comments raised regarding consideration of other water supply alternatives have largely been addressed through the WSAC Final Report and implementation of the Water Supply Augmentation Strategy, which is underway. If the City selects desalination as its supplemental or replacement water supply (see Section 1), the key comments above are useful in the development of a City seawater desalination project and in the environmental review and permitting processes.

There was a strong preference by the regulatory agencies for the seawater intake system to be located near the Wharf to avoid the rocky kelp forest off West Cliff Drive and the Natural Bridges State Marine Reserve. Additionally, many concerns about land use conflicts with pump station locations in neighborhoods along West Cliff Drive were raised by Westside neighbors. Given the above, consideration should be given to reducing the number of seawater intake site alternatives along West Cliff Drive if a desalination project is pursued.

While several commenters indicated that Plant Site Alternative A-2 should be removed from further consideration, it is recommended that this site be retained because the City does not own the properties included in Plant Sites A-1, A-2, and A-3. Flexibility in the siting of a desalination plant on one of these sites will be required going forward if a desalination project is pursued.

The other comments above will be useful in refining the scope of work and study requirements for a CEQA or NEPA document if a desalination project is pursued. See Section 4 for additional information about new and updated studies and consultations that may be required during environmental review and permitting if a desalination project is pursued.

2.4.2 City of Santa Cruz Wharf Master Plan

In July 2013, the City embarked on preparation of the Santa Cruz Wharf Master Plan (Master Plan; Roma Design Group 2014). Because one of the alternative seawater intake and pump station locations (SI-17 as shown in Figure 2) was sited on the Wharf in the scwd^2 DEIR, a discussion of the Master Plan is provided below.

The Master Plan was prepared with federal funds through the U.S. Department of Commerce Economic Development Administration and completed in October 2014, including an engineering review that assessed the condition of the piles; the overall integrity of the Wharf structure; and the paving and substrate condition of roadways, parking areas, and sidewalks. In October 2014, the City Council accepted the Master Plan and directed staff to proceed with environmental review. Environmental review is in progress; release of a Public Review DEIR is expected in fall of 2017. The DEIR and Master Plan will likely go to public hearings for ultimate City Council approval in early 2018. If adopted, it is expected that the City will submit the Master Plan as a Public Works Plan to the CCC for approval since the CCC retains jurisdiction over the Wharf (Roma Design Group 2014).

The Master Plan includes the following elements and recommendations (Roma Design Group 2014):

1. *Policies and actions*
2. *Recommendations for expansion, new construction, and improvements*
    - *Wharf expansion and new facilities.* New proposed facilities include a new promenade on the eastern side of the Wharf, a new walkway on the west side of the Wharf, three new public use buildings, and two new accessible boat landings.
    - *Structural Wharf improvements.* Recommended improvements include installation of new and replacement Wharf support piles, lateral bracing, and roadway and utility improvements (i.e., improvements to the Wharf's pavement, drainage system, and trash collection system).
3. *Circulation/parking circulation/parking.* Improvements are proposed to more efficiently use the existing circulation area and encourage alternative transportation, including relocation of the Wharf entrance further south onto the Wharf. Other improvements include restriping of existing parking areas that would result in approximately 45–65 additional parking spaces, widening of existing sidewalks for improved pedestrian access, and provision for up to 150 bicycle parking spaces.
4. *Design standards.* Design standards that address building design elements, including height, materials, design, windows, roofs, and displays, are included.

A key element of the Master Plan is expansion of the Wharf on the east side for the East Promenade that will provide dedicated pedestrian access. This would expand the Wharf by approximately 2.5 acres, and as a result, sections of the Wharf devoted to public access, recreation, and open space would increase. The East Promenade is one of two near-term projects that the City envisions as the first projects to be implemented. However, funding has not yet been secured for this project.

The Master Plan identifies two Wharf improvements in the area of the SI-17 pump station location that was formerly considered on the Wharf in the scwd[2] DEIR. The East Promenade would require extension of the Wharf approximately 26 to 30 feet along the majority of the east side of the Wharf and in the formerly proposed SI-17 pump station location. The area immediately adjacent to the pump station location on the south is planned for a new boat landing.

> ***Conclusions – City of Santa Cruz Wharf Master Plan:*** The Master Plan does not identify a potential future site for a desalination pump station or related facilities on the Wharf or contain policies or language that support or prohibit water system infrastructure improvements. However, the former SI-17 intake pump station location is within the area of the Wharf on the eastern side proposed for expansion (East Promenade) and the proposed new boat landing (South Landing). Discussions with the City Economic Development staff indicate that a pump station location could potentially be sited adjacent to the East Promenade if it is designed to be visually unobtrusive and not interfere with public uses. An alternate configuration to the one previously considered would be needed to achieve compatibility with the new Wharf improvements.
>
> One constraint would be the timing of design and construction of Wharf improvements and a potential intake pump station. If an intake pump station were designed and constructed prior to the East Promenade, there would be a potential for interruption of pump station use and relocation with future construction of the East Promenade proceeds. Likewise, if the East Promenade were designed and constructed prior to an intake pump station, it could be difficult to achieve compatibility with the new Wharf improvements. While the concept of an intake pump station location on the Wharf has not been fully reviewed by the City at this time, for this report, it remains potentially feasible, as determined during the scwd[2] DEIR preparation process, and will continue to be considered as a possible pump station location. However, an exact site on the Wharf is not known at this time, and as noted above, the Master Plan does not address desalination facility components.

2.4.3 MBNMS Special Use Permit

On September 7, 2017, the National Oceanic and Atmospheric Administration (NOAA) published a final notice in the Federal Register creating a special use permit (SUP) related to the operation of desalination facilities (82 Federal Register 42298–42306). The NOAA Office of National Marine Sanctuaries adopted this new SUP category pursuant to the requirements of

Section 310 of the National Marine Sanctuaries Act. The SUP category is for the continued presence of a pipeline transporting seawater to or from a desalination facility.[10]

Because most proposed desalination activity in sanctuaries occurs in the MBNMS, and the scientific studies used for environmental impact and comparative cost analyses are regionally based, the SUP category only applies to the MBNMS. NOAA determined that pipelines transporting seawater for onshore desalination that have been laid on, attached to, or drilled or bored within the submerged lands of a national marine sanctuary after appropriate environmental review, application of best management practices, and compliance with *MBNMS Desalination Guidelines* (MBNMS and NMFS 2010) could remain in place without causing injury to sanctuary resources. New desalination pipelines are manufactured with high tensile stainless steel to avoid breakage or corrosion in seawater and would be monitored annually under the SUP to evaluate their continued integrity. Submerged pipelines should also have little propensity for movement or shifting.

> ***Conclusions – MBNMS SUP:*** If the City were to pursue a seawater desalination project, a SUP would have to be obtained from the NOAA Office of National Marine Sanctuaries as coordinated through MBNMS. This new requirement is reflected in Section 5.

[10] For this SUP category, NOAA is using "transporting seawater to or from a desalination facility" to mean water being pumped from MBNMS or the submerged lands of MBNMS into a facility and/or concentrated brine water being pumped out of a facility through a pipe and into MBNMS (82 Federal Register 42298–42306).

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3 CITY SEAWATER DESALINATION PROJECT CHARACTERISTICS

This section provides a description of a City seawater desalination project (project) and includes information about project objectives, overview, location, and characteristics. Information in Section 2 was considered in the development of the project.

3.1 Project Objectives

The objectives of the project presented below address the need for a supplemental water supply as identified in the WSAC Final Report. These objectives were developed primarily to achieve the broad policy and planning objectives of providing a reliable water supply for the City. The objectives include the following:

1. Provide for a supplemental water supply that provides approximately 3.3 mgd of supplemental potable water supply identified as necessary for the City and that complements ongoing and future water conservation efforts. The supply should support system robustness, redundancy, and adaptive flexibility.
2. Meet the following cost-effectiveness, yield, and timeliness thresholds identified in the WSAC Final Report (WSAC 2015):

   2.1 Cost-effectiveness – Compare favorably to other alternatives using the ACAYY.

   2.2 Yield – Fill the supply-demand gap of 1.2 bgy during modeled worst-year conditions based on 2015 Confluence modeling of the frequency and severity of shortages, inclusive of DFG-5 fish flows and a plausible estimate of climate change impacts. This equates to approximately 3.3 mgd. Periodic updating of Confluence modeling of the frequency and severity of shortages may result in modifications to the supply-demand gap.

   2.3 Timeliness – Support a fully functional water system able to meet the supply-demand gap by 2025.
3. Consider technical feasibility in selecting a supplemental water supply.
4. Consider energy use, public health, and environmental impacts in selecting a supplemental water supply.
5. Where consistent with the goal of achieving a sufficient water supply, promote regional collaboration to improve water supplies, reverse or slow seawater intrusion, and support habitat restoration.

If the City decides to pursue a desalination project and launches the CEQA process, additional project objectives will likely be developed to support the CEQA document preparation process.

3.2 Project Overview

A City seawater desalination project would construct and operate an SWRO desalination plant and related facilities to provide up to 3.3 mgd of potable water to the City. The water supply from the would help the City meet its water needs during periods of water supply shortages as a result of drought and reduced surface water diversions needed to provide improved river and stream flows for fish and to plan for climate change.

There are the following four basic functional components of the project: (1) seawater intake; (2) pretreatment and salt removal through reverse osmosis filtration; (3) disposal of by-products, including brine and solids that are removed in the pretreatment process; and (4) conveyance and delivery of the product water to existing City water distribution system. Because of these functional components, the project[11] would consist of the following (see Figure 1):

- A seawater intake and conveyance system consisting of a screened open-ocean intake system, intake piping, pump station, and transfer piping. Because of the requirements of the OPA, a subsurface radial collector well system may need to be considered as an intake design option even though it was not previously recommended for the scwd^2 Desalination Program.[12] If such a subsurface intake system were to be pursued by the City, it would need to be constructed and tested in stages and may need to be augmented with a screened open-ocean intake that would be used to provide supplemental water if the subsurface intake system loses production capacity or requires significant maintenance.
- A seawater desalination plant that would provide for pretreatment processing, desalination treatment and energy recovery, post-treatment processing and distribution, brine storage, residuals handling and disposal, chemical systems, and their associated support facilities.

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11 The term “project" is used throughout this document to refer to all components of the project, including the desalination plant and the other related components, as described above.

12 Of the subsurface intake design options investigated, an offshore radial collector well system was the only option considered potentially technically feasible based on the results of the Offshore Geophysical Study (EcoSystems 2010) and input from the technical working groups and engineering evaluation in the Intake Technical Feasibility Study (Kennedy/Jenks Consultants 2011). However, it was not recommended for the scwd^2 Desalination Program because it had the lowest production reliability, an unproven approach in the offshore ocean environment, and low operational flexibility; is most complex to construct; and has the highest capital and life-cycle costs. See Section 2 for additional information about this and other subsurface intake options previously considered.

- A brine storage, disposal, and conveyance system consisting of brine storage at the desalination plant, a new pipeline to the City's WWTF outfall, and outfall improvements.
- Potable water distribution system improvements consisting of a new connection to the City distribution system near the seawater desalination plant site.

The following sections describe the various project components and component alternatives. These component alternatives are based on the various alternatives that were presented in the scwd^2 DEIR, as modified, because of the review of changed conditions in Section 2.

The scwd^2 DEIR looked at the construction of a 2.5-mgd seawater desalination plant and related facilities with the ability to expand the plant up to 4.5 mgd. This report is updating the concepts and costs for an approximately 3.3-mgd-capacity project to achieve the updated project objectives. Because the product water capacities are relatively similar, the size of the major components of the project would be similar to the scwd^2 Desalination Program components, and the project design characteristics and cost estimating for the scwd^2 Desalination Program can be updated for this study. The major elements of the project are shown on Figures 4 and 5.

3.3 Project Location and Characteristics

As described above, the project would consist of (1) a seawater intake and conveyance system; (2) a seawater desalination plant; (3) a brine storage, disposal, and conveyance system; and (4) potable water distribution system improvements. These project components include different types of facilities, such as buildings, pumps, pipelines, and other equipment. Alternative sites for the seawater intake system and desalination plant are identified. The location and general characteristics of the facilities are summarized below.

3.3.1 Seawater Intake and Conveyance System

The seawater intake and conveyance system would be composed of a seawater intake structure (or structures) in the Monterey Bay to draw in raw seawater (source water), an intake pipeline to deliver the seawater to the shore, and a pump station to pump the seawater to the desalination plant through transfer piping. To produce approximately 3.3 mgd of treated product water, the seawater intake system would be designed to provide a maximum flow of approximately 8.3 mgd of raw seawater based on an overall facility minimum recovery of 40%. The desalination plant could operate with higher recoveries for periods of time and withdraw lower rates of seawater but would also operate at lower recoveries for some periods. Therefore, the intake conveyance system would be designed to accommodate the larger volumes of intake water to cover the range of production and overall facility recoveries.

The feasibility and site-specific requirements of subsurface and screened, open-ocean intake approaches were investigated during the preparation of the scwd^2 DEIR in the scwd^2 Intake Technical Feasibility Study (Kennedy/Jenks Consultants 2011). Based on specific design, operational, and/or siting requirements for the type of intake, a screened, open-ocean intake was determined to be the apparent best intake approach in terms of engineering feasibility. Recent updates to the California Ocean Plan included in the OPA require that seawater desalination facilities use subsurface intake systems unless they are not feasible, as discussed in Section 2. As discussed previously, a feasibility analysis may determine that a combination of both subsurface and surface intakes may be the best feasible alternative to minimize intake and mortality of marine life while meeting the identified desalinated water need.. Therefore, an offshore radial collector well subsurface intake system, with a supplemental 1-millimeter screened intake component, was re-evaluated as a design option in this report

The seawater intake and conveyance system would be located between an offshore location in the Monterey Bay and the desalination plant site. A number of alternative locations for the seawater intake and conveyance system were evaluated in the scwd^2 DEIR. This report will update and evaluate three intake alternatives based on the assessment of changed conditions provided in Section 2. Only one of the following alternatives would be implemented:

- **Seawater Intake Alternative 1 (SI-1), Screened Open-Ocean Intake (Westside)** – A screened open-ocean intake located offshore on the westside of the City is considered for the project because a subsurface intake in this location is not feasible due to shallow bedrock offshore. The intake screens would have 1-millimeter openings. The intake pump station would be located at the seawater desalination facility. This is similar to seawater intake alternative number SI-14 from the scwd^2 DEIR.
- **Seawater Intake Alternative 2 (SI-2), Screened Open-Ocean Intake (Wharf Area)** – A screened open-ocean intake located offshore near the Wharf is considered for the project. The intake screens would have 1-millimeter openings. The intake pump station would be located at the Santa Cruz County Regional Transportation Commission (SCCRTC) property located south of Depot Park. This is similar to seawater intake alternative number SI-18 from the scwd^2 DEIR.
- **Seawater Intake Alternative 3 (SI-3), Subsurface Intake System (Wharf Area)** – The subsurface intake system would consist of one or two offshore radial collector wells that would draw seawater through the alluvial material beneath the seafloor. The radial collector wells would be constructed in the alluvial channel that is near the Wharf, where there is deep enough sand to make this approach potentially feasible. The subsurface intake would also have an open-ocean screened intake element as part of the overall system that would be used to provide supplemental intake water if the subsurface intake system loses production capacity and/or requires significant maintenance. The

intake pump station would be located at the SCCRTC property located south of Depot Park. This is similar to the location of seawater intake alternative SI-18 from the scwd[2] DEIR but is distinct in design since it includes a subsurface intake with a screened open-ocean intake as a back-up source of raw seawater.

For SI-2 and SI-3, a pump station and raw water pipeline on the Wharf could also be considered as a backup to the pump station location at the SCCRTC property south of Depot Park. However, as indicated in Section 2.4.2, an exact site on the Wharf is no longer known because of planned improvements identified in the City's Master Plan.

3.3.2 Seawater Desalination Plant

As indicated in Section 2, the Industrial Park Area (Area A) would continue to be considered for a desalination plant, and three alternative plant site locations within this area (A-1, A-2, and A-3) are considered in this report, similar to the scwd[2] DEIR. The approximately 4- to 8-acre sites are located on mostly undeveloped, private land on infill parcels. These sites are generally bounded by the Santa Cruz Branch Rail Line tracks to the north, Natural Bridges Drive to the west, Delaware Avenue to the south, and the realigned Arroyo Seco Stream to the east, as shown on Figure 5. Only one of these location alternatives would be implemented.

The 3.3-mgd desalination plant would provide for the equipment used for the desalination process, except for the seawater intake system and pipeline conveyance systems for source water, brine disposal, and potable water. The plant would provide for the following primary systems:

- **Pretreatment Processing** – Pretreatment refers to the removal of suspended solids from ocean source water to reduce fouling, clogging, and scaling of the SWRO membranes used for desalination.
- **Seawater Desalination Treatment** – The plant would use a SWRO system to desalinate raw seawater. SWRO is a pressure-driven process using semi-permeable membranes. SWRO membranes separate water molecules from impurities in the seawater by permitting water to pass and limiting the passage of salts and other constituents. The results are a permeate stream (or product water) and a concentrate stream (or brine). The desalination system would have the ability to operate with a recovery rate from 40% to 50% (40 to 50 gallons of fresh drinking water per 100 gallons of seawater).
- **Post-Treatment Processing and Distribution –** Reverse osmosis removes many of the minerals from the water. Lack of hardness and alkalinity makes the water more corrosive to the water delivery system. Post-treatment is required to control the

corrosiveness of the water and provide adequate disinfection prior to distribution, which is common for potable water generated from surface and/or groundwater sources.

- **Residuals Handling and Disposal** – Operation of the desalination plant would generate solids from the pretreatment processing. Two options for handling solids, including sanitary sewer disposal and landfill disposal, are considered for the project.
- **Chemical Systems** – A variety of chemicals would be required for treatment, disinfection, and membrane cleaning at the desalination plant. The chemicals would be stored in accordance with applicable building and seismic codes and applicable regulatory requirements for hazardous materials storage.

Similar to the proposed scwd^2 Desalination Program, the final desalination plant design will consider space for other related and support uses, including but not limited to (1) operations and control systems, (2) maintenance and facilities storage, (3) electrical operations and utility connections, (4) parking and access, (5) stormwater detention and treatment, (6) landscaping, and (7) outdoor viewing and gathering areas. A photovoltaic system could also be included at the proposed plant, as contemplated for the scwd^2 Desalination Program.

3.3.3 Brine Storage, Disposal, and Conveyance System

During the SWRO process at the desalination plant, brine would be generated and approximately twice as saline as seawater. Brine storage would be provided on the desalination plant site to allow for controlled release of the brine. A pipeline would convey the brine from the desalination plant to the City's WWTF outfall pipeline where it would be blended with effluent from the City's WWTF and returned to Monterey Bay through the City's existing outfall. The WWTF outfall diffuser ports would be improved by adding new valves (Red Valves) to the ports. A Dilution Analysis conducted to support the scwd^2 DEIR concluded that the WWTF NPDES discharge permit minimum initial dilution requirement and ambient salinity at the outfall could be maintained with the above improvements. An update to the Dilution Analysis would be required to specifically address the OPA requirements regarding discharge and reduced wastewater flow associated with the SqCWD's Pure Water Soquel Project and possible City recycled water projects, as discussed in Section 2. An update to the Dilution Analysis would also determine the need for a multi-port diffuser on the outfall to provide for adequate mixing at the discharge point.

3.3.4 Potable Water Distribution System

The pipeline to convey the product water from the plant to the City's existing potable water distribution system would run from the desalination plant location in Area A (see Figure 5) to the existing adjacent potable water distribution pipe located within Delaware Avenue or Natural Bridges Drive adjacent to the alternative plant site locations. Recent analysis has been conducted to begin to re-examine the impacts to the City's existing potable water distribution system of introducing desalinated seawater at plant location Area A (see Figures 4 and 5). For the purpose of this initial analysis, it was assumed that the connection point would be in Natural Bridges Drive.

Hydraulic modeling was performed for a variety of scenarios including a 3.3 mgd desalination plant that would serve the City's needs during drought, a 4.6 mgd plant which includes meeting the SqCWD's needs as well, and a 5.6 mgd plant which adds to this the needs of SVWD and SLVWD. (It should be noted that should such a project be pursued, it is likely that a smaller facility could be designed that met the seasonal demands of participating agencies much like the $scwd^2$ Desalination Program.) For the majority of the scenarios it was assumed that the City would not operate its Beltz groundwater well system. Findings for a regional project, which would require service area interconnections with other water agencies, are described in more detail in Section 7.

For the City seawater desalination project operating at 3.3 mgd, the City's system appears to be able to function within normal operating parameters without modifications. That being said, it appears the system pressures, velocities and water age in the nearby Bay Street Tanks would increase due to this project. Additional analysis would be warranted to determine what system modifications (e.g., new transmission mains) and/or operational changes (e.g., operating the Beltz well system) would reduce and potential negative impacts.

3.4 Engineers Opinion of Probable Costs

Table 1 provides the engineer's opinion of probable cost, which is based on information and costs developed in technical studies conducted by the City and SqCWD as part of the $scwd^2$ Desalination Program (Kennedy/Jenks 2011; CDM Smith 2012; URS 2013b) and supplemented with cost estimates from similar projects and professional experience. These studies were used to generate estimated construction costs for the project, assuming the three seawater intake alternatives being considered. Costs from these prior studies are updated to current day using Engineering News-Record cost indices and are scaled to reflect a capacity of 3.3 mgd. All costs are conceptual and order of magnitude type costs at an Association for the Advancement of Cost Estimating Class 5 level, representing planning to feasibility level information with an estimated accuracy range between −30% and +50%. These costs are intended to be used for comparison purposes between alternatives.

The detailed cost table templates and assumptions applied herein are consistent with those developed for the RWFPS to allow for a comparison of costs for desalination and recycled water projects. Soft costs, including design, environmental review, permitting, and construction bidding, are not included in the cost estimates. Appendix A provides the detailed cost estimates, which were prepared by Kennedy/Jenks Consultants, that support the cost summary in Table 1.

Table 1. Summary of Costs for Desalination Facility Components (2017 Dollars)

Project Components (3.3 MGD Facility)	Alternative 1 Screened Open-Ocean Intake (Westside)	Alternative 2 Screened Open-Ocean Intake (Wharf Area)	Alternative 3 Subsurface Intake System (Wharf Area)
Seawater Intake and Conveyance System			
Open Ocean Intake[1]	$60,100,000	$58,900,000	$52,800,000
Radial Well Collectors	n/a	n/a	$76,600,000
Seawater Desalination Plant	$77,800,000	$77,800,000	$77,800,000
Brine Storage, Disposal, and Conveyance System	$10,500,000	$10,500,000	$10,500,000
Potable Water Distribution System Improvements	*(Included in Desalination Plant costs)*		
Total Capital Cost ($)	**$148,400,000**	**$147,200,000**	**$217,700,000**
Estimated Capital Cost ($mil)	**$148.4**	**$147.2**	**$217.7**
Annualized Capital Cost ($mil/yr)	$7.8	$7.7	$11.9
Desalinated Water Produced (AFY)	3,696	3,696	3,696
Annual Unit Capital Cost ($/AF)	**$2,100**	**$2,100**	**$3,200**
Annual O&M Cost ($mil/yr)	$5.4	$5.6	$5.7
Annual O&M Cost ($/AF)	$1,470	$1,510	$1,530
Life Cycle Unit Cost ($/AF)	**$3,570**	**$3,610**	**$4,730**
($/MG)	**$11,000**	**$11,100**	**$14,500**
($/CCF)	**$8.20**	**$8.30**	**$10.90**

Source: Appendix A.

Notes: AF = acre feet; AFY = acre feet per year; CCF = 100 cubic feet; MG = million gallons; n/a = not applicable

[1] Includes intake structure, screens, pipelines and pump station.

4 CEQA/NEPA COMPLIANCE APPROACH

4.1 Lead Agencies

4.1.1 CEQA Lead Agency

When more than one public agency is, or may, be involved in a project subject to CEQA, the "lead agency" is the public agency that has the primary responsibility for approving a project and, therefore, oversees the CEQA process.

The City and SqCWD were joint lead agencies under CEQA for the scwd^2 DEIR since both agencies were sponsoring the scwd^2 Desalination Program, and there was mutual interest in acting as joint lead agencies. If the project (see Section 3) goes forward as a City project, the City would be the CEQA lead agency. If there is regional participation in the project (see Section 7), the City would still likely be the CEQA lead agency unless there was strong interest by SqCWD or SVWD to participate as a lead agency with the City. A list of other state and local agencies that would be involved in the project is provided in Section 5.

4.1.2 Federal Lead Agency for NEPA

For the scwd^2 Desalination Program, the federal lead agency under NEPA was initially determined, and assumed to be, the U.S. Army Corps of Engineers (ACOE) because they had two federal permits to issue for the scwd^2 Desalination Program. These included a Clean Water Act, Section 404, permit for the discharge of dredged or fill material into waters of the United States and a Rivers and Harbors Act, Section 10, permit for the building of pipelines or other in-water structures in navigable waters. These permits would have been required for the components of the scwd^2 Desalination Program that would be installed in the marine environment. Initial consultation with the ACOE during the scwd^2 DEIR preparation process seemed to confirm that initial determination; however, the ACOE had not yet received a permit application for the scwd^2 Desalination Program and had not conducted interagency consultations related to NEPA compliance because the scwd^2 Desalination Program was put on hold.

The MBNMS was not previously considered to be a likely federal lead agency for NEPA compliance because they authorize other agencies' approvals and, at the time, did not issue their own permit. However, since 2013, the MBNMS has taken the federal lead agency role under NEPA for two desalination projects in the Monterey Bay area including the CalAm Monterey Peninsula Water Supply Project EIR/Environmental Impact Statement (EIS) and the DeepWater Desal LLC Monterey Regional Water Project EIR/EIS. Additionally, as of September 2017, there is a SUP pursuant to the National Marine Sanctuaries Act that would need to be obtained from the MBMNS for the project to approve the operation of desalination pipelines in the MBNMS, as described in Section 2. Therefore, the MBNMS has a permit that must be issued for the project.

After consulting with MBNMS staff in September 2017 during the preparation of this report, it is understood that the MBNMS's more recent role came after consultation with the ACOE, where it was determined that the MBNMS would take the federal lead agency role for the previously mentioned projects (Grimmer and Hoover, pers. comm. 2017). If the project was to go forward, a similar consultation between the MBNMS and ACOE would likely be conducted to determine which agency would serve as the federal lead agency role for the project. Because the MBNMS's current role in other desalination projects in this region, it is likely that they would also serve as the federal lead agency for the project. The ACOE would likely act as a cooperating agency under NEPA due to their discretionary approvals for construction of the marine portions of the project. A list of other federal agencies that would be involved in the project is provided in Section 5.

4.2 CEQA and NEPA Compliance

4.2.1 CEQA and NEPA Compliance Approach

A stand-alone CEQA document (i.e., EIR) was being prepared for the prior $scwd^2$ Desalination Program. The ACOE was expected to prepare their own NEPA document during permitting if they were to serve as the NEPA lead agency, which was the likely case for the $scwd^2$ Desalination Program. For the project, and based on recent precedent as described previously, the MBNMS would likely serve as the NEPA lead agency. The City would serve as the sole CEQA lead agency for a City seawater desalination project.

After consulting with MBNMS staff during the preparation of this report, the following two options exist for CEQA and NEPA compliance for the project if the MBNMS were to serve as the NEPA lead agency:

1. Prepare a joint CEQA/NEPA document (EIR/EIS) with the MBNMS
2. Prepare a stand-alone CEQA document (i.e., EIR) before or while the MBNMS prepares the NEPA document (EIS) for the project

While the joint EIR/EIS may take longer to prepare than a stand-along EIR and may take more time to launch initially, a joint EIR/EIS approach has the following advantages:

- Provides for efficiency in effort and may save time overall through the permitting process
- Results in one set of mitigations to implement and monitor

- Involves MBNMS oversight of evaluation and documentation process in collaboration with the City, which could improve public confidence regarding the results
- Potentially improves the usefulness of the document for CCC and RWQCB in their subsequent CEQA responsible agency actions (i.e., issuing a coastal development permit and making the California Water Code, Section 13142.5(b), determination)

4.2.2 CEQA and NEPA Compliance Actions

If a joint CEQA/NEPA document is pursued for the project, the following likely actions would be completed during the compliance process. Some actions may take place concurrently.

1. **Agency Consultations/NEPA Lead Agency Confirmation**. The City would meet with the MBNMS and ACOE to confirm the MBNMS's role as the NEPA federal lead agency and to confirm study requirements for the EIR/EIS. The City and MBNMS would conduct other consultations with RWQCB, CCC, and potentially other regulatory agencies to confirm study requirements.
2. **MBNMS Application.** The City would submit an application to the MBNMS for the marine portion of the project that includes activities that are prohibited in the MBNMS. The City would work with the MBNMS to provide any additional required information for them to deem the application complete. The City would coordinate with the MBNMS to determine whether a separate application is required for the SUP and, if so, whether it should be completed at the same time.
3. **Notice of Preparation, Notice of Intent, Public Scoping**. The City and MBNMS would prepare the Notice of Preparation of an EIR and Notice of Intent to prepare an EIS, which would launch the CEQA and NEPA compliance processes, respectively. The Notice of Preparation would be filed with the State Clearinghouse, and the Notice of Intent would be published in the Federal Register. Federal and state scoping requirements would be implemented, and a scoping period of 30 days would be held to provide an adequate opportunity for agencies and other interested parties to comment on the scope of the EIR/EIS.
4. **Draft EIR/EIS**. The City and MBNMS would prepare, file, and distribute a Draft EIR/EIS document and related notices. The Draft EIR/EIS, along with a Notice of Completion, would be filed with the State Clearinghouse for CEQA compliance. A Notice of Availability is also sent to agencies and interested parties to notify them of the availability of the document, the public review period, and public meetings. The Draft EIR/EIS would also be filed with the U.S. Environmental Protection Agency and a federal Notice of Availability would be published in the Federal Register. These notices would start a minimum 45-day public review and comment period.

5. **Final EIR/EIS**. The City and MBNMS would prepare the Final EIR/EIS based on assessment and consideration of the comments received during the public review period. The Final EIR/EIS would be posted on the City's website in advance of any consideration of certifying the document under CEQA, and a Notice of Availability of the Final EIR/EIS would be sent to involved agencies and interested parties. The Final EIR/EIS would be filed with the U.S. Environmental Protection Agency. The U.S. Environmental Protection Agency would publish a Notice of Availability for the Final EIR/EIS, and the MBNMS may recommend other notification methods.
6. **Notice of Determination and Record of Decision.** Once the City has approved the project and certified the Final EIR, it would file a Notice of Determination with the State Clearinghouse and the County Clerk's office. Once the SUP and permit authorizations are approved, a Record of Decision and a notice of the Record of Decision availability would be provided to the public. Although not required, the publication of the notice in the Federal Register would be encouraged (NOAA 2017).

4.2.3 Need for New/Updated Studies and Consultations

Substantial information was presented as the basis for the scwd^2 DEIR. This information includes design-related studies, studies that support the evaluation of alternatives, and technical environmental studies. The preparation of an EIR/EIS for the project would involve the use of the prior scwd^2 information to the extent possible. However, the following new or updated studies or information would likely be required to complete an EIR/EIS because the data for the scwd^2 DEIR was developed during 2011 and 2012:

- Conduct new biological resource records searches and terrestrial surveys.
- Determine the need for and timing of additional marine studies/surveys to support the EIR/EIS in consultation with the MBNMS. As indicated in Section 2, a Marine Life Mortality Report would be required under the OPA if a City seawater desalination project were to go forward to permitting. Update or expansion of the scwd^2 Desalination Program Open Ocean Intake Effects Study would be required to specifically address the construction and operational impacts of a newly proposed desalination facility based on its specific intake and discharge design.
- Conduct new cultural resource records searches, surveys, and Native American consultations adequate for National Historic Preservation Act, Section 106, compliance, which is required when federal agencies are issuing permits for a project or are otherwise involved. Assembly Bill 52 consultations related to tribal cultural resources may also be required.
- Conduct new ambient noise measurements and updated noise impact analysis.

- Conduct updated air quality and greenhouse gas impact analyses based on the project and updated and refined construction assumptions.
- Coordinate with various City departments and gather information to update topics related to population, land use, transportation, and public service and utilities for the EIR/EIS.
- Determine the need for, and timing of completion of, updated design studies (e.g., dilution analysis) to support the CEQA/NEPA process in consultation with the MBNMS. As indicated in Section 2, update or revision of the $scwd^2$ Dilution Analysis would be required to address OPA requirements, including the availability of wastewater for blending because of one or more recycled water projects that may go forward and the need for a multi-port diffuser on the WWTF outfall.

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5 PERMITTING APPROACH

5.1 Potential Permits

Table 2 provides an updated list of permits likely to be required for the project.

5.2 Permitting Constraints

The primary permitting constraint for the project would be pursuing an open-ocean intake because the OPA requires a subsurface intake unless such an intake is determined not to be feasible under the OPA definition of "feasible" (see Section 2). The project includes options for use of an open-ocean intake only and for a hybrid system where radial collector wells are used with an open-ocean screened intake if the radial collector wells lose production capacity and/or require significant maintenance. As indicated in Section 2, early consultation with the RWQCB is recommended to discuss the radial collector well option and the need to pursue additional study to assess feasibility of this option. If this option does need to be pursued further, substantial additional testing in the marine environment would be required. See Section 2 for additional information.

Table 2. Potential Permits, Authorizations, or Approvals

Regulatory Agency	Potential Regulatory Permit, Authorization, or Approval	Reason Permit/Approval is Required	Relevant Project Components
FEDERAL AGENCIES			
Monterey Bay National Marine Sanctuary	Authorization of relevant federal permits under the MBNMS Management Plan and the National Marine Sanctuary Program	Required for proposed facilities located in the MBNMS.	Intake pipelines and intake structure Installation of new valves on the WWTF outfall diffuser ports Discharge of brine in WWTF effluent Project construction, operation, and maintenance related to the project components
	Review and potentially condition renewals/amendments of the Section 402 of the Clean Water Act NPDES permit for ongoing ocean discharges from the WWTF (see Central Coast RWQCB permits below)	Required for discharge of brine into the City's WWTF outfall and for maintenance of the seawater intake. The City's existing NPDES permit could potentially be used or modified to address the above.	Brine discharge Seawater intake maintenance
	SUP	Required for ongoing operation of desalination pipelines and facilities in the MBNMS.	Intake pipelines and intake structure
U.S. Army Corps of Engineers	Section 404 Clean Water Act Nationwide or Individual Permit	Required for discharges of dredged or fill material into waters of the United States. ACOE would establish the basis of the permit and scope of their analysis depending upon the area and extent of fill.	Intake pipelines and intake structure (all alternatives) Installation of new valves on the WWTF outfall diffuser ports Plant Site A-3
	Section 10 Rivers and Harbors Act Individual Permit	Required for building any pipelines, piers, wharfs, or other in-water structures in navigable waters.	Intake pipelines and intake structure (all alternatives) Installation of new valves on the WWTF outfall diffuser ports
National Oceanic and Atmospheric Administration /National Marine Fisheries	Section 7 Consultation under the Endangered Species Act	Required for any federal permitting agency that may adversely affect federally listed marine species or designated critical habitat. MBNMS and ACOE would conduct Section 7	Intake pipelines and intake structure (all alternatives) Discharge of brine in WWTF effluent

Table 2. Potential Permits, Authorizations, or Approvals

Regulatory Agency	Potential Regulatory Permit, Authorization, or Approval	Reason Permit/Approval is Required	Relevant Project Components
Service		Consultation with NMFS for their permits.	Installation of new valves on the WWTF outfall diffuser ports
	Section 305(b) Consultation under the Magnuson-Stevens Fishery Conservation and Management Act (also known as the Sustainable Fisheries Act)	Required for any federal or state approval that may adversely affect designated essential fish habitat.	Intake pipelines and intake structure (all alternatives) Discharge of brine in WWTF effluent Installation of new valves on the WWTF outfall diffuser ports
U.S. Fish and Wildlife Service	Section 7 Consultation under the Endangered Species Act	Required for any federal permitting agency that may adversely affect federally listed terrestrial or freshwater species or their designated critical habitat. ACOE and MBNMS would conduct Section 7 Consultation with U.S. Fish and Wildlife Service for their permits.	Potentially warranted if Plant Site A-2 is selected.
STATE AGENCIES			
California Coastal Commission	Coastal Development Permit Federal Consistency Review	Required for the portions of the project that lie within the CCC's areas of retained jurisdiction, such as the offshore components of the project.	Pump station on Wharf (Intake Site SI-17), if pursued Intake pipelines and intake structure (all alternatives) Installation of new valves on the WWTF outfall diffuser ports Project construction, operation, and maintenance related to the project components

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Table 2. Potential Permits, Authorizations, or Approvals

Regulatory Agency	Potential Regulatory Permit, Authorization, or Approval	Reason Permit/Approval is Required	Relevant Project Components
California State Lands Commission	Land Use Lease (Right-of-Way Permit) or modification of an existing lease	Required for the use of state tidelands and submerged lands within 3 nautical miles seaward of the ordinary high water mark. CSLC has granted public trust lands to the City near the Wharf so facilities in this area would not require CSLC approval.	Intake pipelines and intake structure (Intake Sites SI-1) Installation of new valves on the WWTF outfall diffuser ports Project construction, operation, and maintenance related to the project components
California Department of Fish and Wildlife	Incidental Take Permit under the California Endangered Species Act	Required if "take" of state-listed endangered, threatened, or candidate species may occur.	Not anticipated to be required for the project
	Streambed Alteration Agreement	Required if a project would alter the flow, bed, channel, or bank of a stream or lake.	Not anticipated to be required for the project
California Department of Transportation	Encroachment Permit	Required if the project would encroach upon any portion of a state highway right-of-way, such as State Highway 1.	Not anticipated to be required for the project
California Department of Public Health	Permit to Operate a Public Water System	Required to operate a public water system.	Applies to project overall, not individual components
California Department of Parks and Recreation, Office of Historic Preservation	Section 106 of the National Historic Preservation Act Coordination	Required for any federal permit or project that may adversely affect properties listed or eligible for listing on the National Register of Historic Places. MBNMS and ACOE would conduct Section 106 Coordination with California Department of Parks and Recreation, Office of Historic Preservation for their permits.	Intake pipelines and intake structure (all alternatives) Installation of new valves on the WWTF outfall diffuser ports Plant Site A-3
REGIONAL AGENCIES			
Central Coast Regional Water Quality Control Board	NPDES General Permit For Stormwater Discharges Associated With Construction Activity	Required for stormwater discharges associated with construction activity over 1 acre.	All components involving ground-disturbing activities

Table 2. Potential Permits, Authorizations, or Approvals

Regulatory Agency	Potential Regulatory Permit, Authorization, or Approval	Reason Permit/Approval is Required	Relevant Project Components
	Section 402 of the Clean Water Act, NPDES Permit Amendment	Required for discharge of brine into the City's WWTF outfall and for maintenance of the seawater intake. The City's existing NPDES permit could potentially be used or modified to address the above.	Brine discharge Seawater intake maintenance
	Section 401 of the Clean Water Act, Water Quality Certification	Required for Section 404 permits (see above) to certify that the activity meets water quality standards.	Intake pipelines and intake structure (all alternatives) Installation of new valves on the WWTF outfall diffuser ports Plant Site A-3
Monterey Bay Unified Air Pollution Control District	Authority to Construct and Permit to Operate	Required for backup sources of power that could emit air contaminants.	Emergency generators would be located at the desalination plant
LOCAL AGENCIES			
County of Santa Cruz	Encroachment Permit	Required where the project would encroach upon any portion of a County of Santa Cruz right-of-way. This would include any right-of-way encroachments of the SCCRTC Branch Line.	City-SqCWD intertie pipeline on County right-of-way Seawater intake and transfer pipelines under SCCRTC rail lines in the beach area (Intake Sites SI-2 and SI-3)
	Grading Permit	Required for grading in areas under County jurisdiction for which an EIR was prepared.	Seawater intake and transfer pipelines under SCCRTC rail lines in the beach area (Intake Sites SI-2 and SI-3)
City of Santa Cruz	Coastal Permit under the City's Local Coastal Program	Required for development in the Coastal Zone where the City has jurisdiction under its adopted Local Coastal Program.	Plant Sites A-1, A-2, and A-3 Pump stations for Intake Sites SI-1, SI-2, and SI-3 Onshore piping within Coastal Zone

Table 2. Potential Permits, Authorizations, or Approvals

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Regulatory Agency	Potential Regulatory Permit, Authorization, or Approval	Reason Permit/Approval is Required	Relevant Project Components
	Administrative Use Permit or SUP	Required for the authorization of land uses in accordance with the City's Municipal Code.	Plant Sites A-1, A-2, and A-3 Intake pump stations Onshore piping
	Design Permit	Required review of architectural and site development proposals for buildings.	Plant Sites A-1, A-2, and A-3 Intake pump stations
	Building, Electrical, Grading Permit, Fire Department Approvals	Required for authorization of building, electrical, and grading activities.	Plant Sites A-1, A-2, and A-3 and intake pump station sites
	Heritage Tree Removal Permit	Required for removal or pruning of heritage trees or shrubs under the City's Municipal Code.	Plant Site A-2
	Sewer Connection Permit	Required for connection to the City's sanitary sewer system under the City's Municipal Code.	Plant Sites A-1, A-2, and A-3
	Wastewater Discharge Permit	Required for discharge of process wastewater under the City's Municipal Code.	Plant Sites A-1, A-2, and A-3
		Required for discharge of groundwater from construction dewatering under the City's Municipal Code.	All onshore project components within the City requiring ground disturbance

Source: URS 2013a, as updated by Dudek in 2017.
Notes: CCC = California Coastal Commission; CDFW = California Department of Fish and Wildlife; CSLC = California State Lands Commission; EIR = environmental impact report; MBNMS = Monterey Bay National Marine Sanctuary; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; NPDES = National Pollutant Discharge Elimination System; RWQCB = Regional Water Quality Control Board; SCCRTC = Santa Cruz County Regional Transportation Commission; SUP = special use permit; ACOE = U.S. Army Corps of Engineers; WWTF = wastewater treatment facility

6 TIMELINESS OF IMPLEMENTATION

6.1 Initial Schedule

Table 3 provides an anticipated schedule for major milestones related to design, environmental review, permitting, construction bidding, and construction of a City seawater desalination project. The WSAC Water Supply Augmentation Strategy Implementation Plan and Timeline is also provided in Table 3 to allow for a comparison of the two timelines.

6.2 Timeliness of Implementation

According the Table 3, design, environmental review, permitting, and construction bidding would occur over a 5-year period between 2018 and 2022, which aligns with the WSAC Water Supply Augmentation Strategy Implementation Plan and Timeline for these tasks. Construction of a City seawater desalination project would likely take longer than anticipated in the WSAC timeline—3 years instead of 2 years. However, according to the schedule, a City seawater desalination project could be operational by 2025, which would meet the City's timeliness objective of having a fully functional water system able to meet the supply-demand gap by that date.

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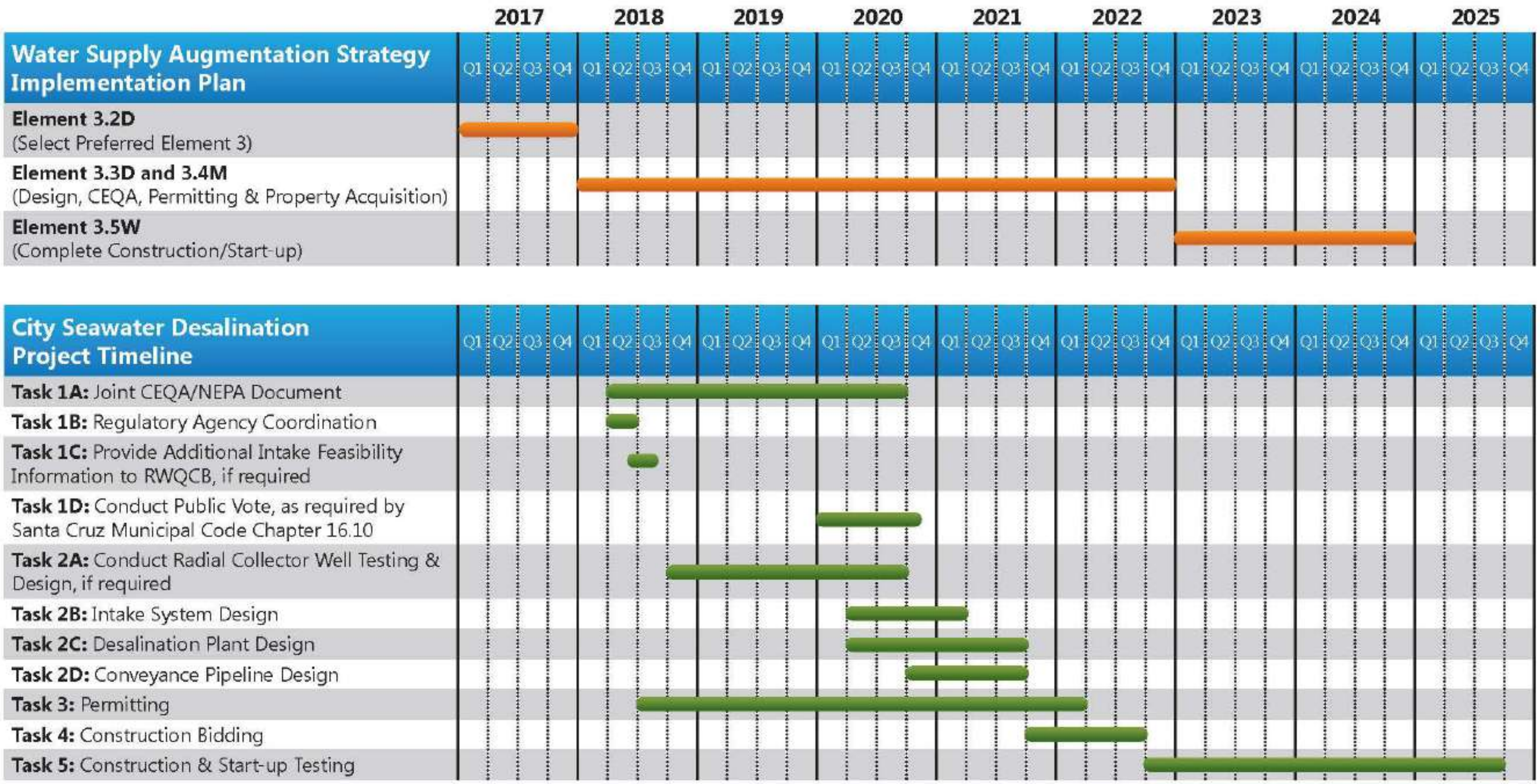
Table 3. City Seawater Desalination Project Schedule



7 OPPORTUNITIES FOR REGIONAL COLLABORATION

7.1 Background

As discussed in Section 1, the SCWD is completing high-level feasibility studies, conceptual level design, and definition of environmental permitting processes for both recycled water and desalination to support the City's selection of the preferred Element 3 of the Water Supply Augmentation Strategy. This report provides this assessment for a City seawater desalination project to meet the City's identified need and to allow for direct comparison with the City's Element 3 recycled water option, review of which is proceeding along a parallel track.

At the direction of the City Water Commission, the SCWD is also evaluating regional seawater desalination opportunities as a component of this report. This is consistent with the following WSAC Final Report guiding principle (WSAC 2015): "Where consistent with the goal of achieving a sufficient water supply, the City should promote regional collaboration to improve water supplies, reversing or slowing seawater intrusion, and support habitat restoration."

While it will be more difficult to directly compare analytical metrics for these opportunities, they provide real potential for collaborative solutions to widely recognized regional water supply challenges. Additionally, the Guidelines for Desalination Plants in the MBNMS emphasizes collaborations with other water agencies considering water supply options in the area to evaluate the potential for an integrated regional water supply project (MBNMS and NMFS 2010).

The SCWD recognizes that additional information, agreements, and time would be needed to more fully understand the opportunities and limitations to providing improved regional connectivity and long-term resiliency through seawater desalination. Due to the recent drought, regional water suppliers have an increased interest and need to work together to optimize collaborative use of resources and infrastructure. However, the current water systems for the City, SqCWD, SVWD, and San Lorenzo Valley Water District (SLVWD) are not sized for, or in some cases, not connected for, water exchanges across service area boundaries. Varying levels of regional infrastructure improvements would be required for any of the regional collaboration opportunities considered here.

A regional desalination project would require cooperation and coordination between multiple agencies regarding interagency infrastructure challenges related to ownership, operations, and construction. However, this type of project would also offer the potential for cost-sharing and opportunities for pursuing funding as a region. Similar to other regional water supply concepts, there may be challenges associated with distribution system compatibilities, operational complexities, and potentially high-energy requirements for conveyance of water to distant places of use. Water transfer agreements would need to be developed along with future studies to confirm project feasibility. This section is intended to support future consideration of potential opportunities for regional collaboration in seawater desalination.

7.2 Regional Participation in City Seawater Desalination

The project could be scaled up to offer additional supply above City requirements to offer desalinated seawater for purchase to neighboring water districts. Conceptually, each agency would provide this water for customer use, allowing for decreased use of currently over-used groundwater or surface-water sources. Two potential scenarios are described below and shown on Figure 6.

An option for scaling up the capacity of the project would be to enter into operations agreements, similar to the scwd[2] Desalination Program, that would allow for the size of the plant to be maintained at approximately 3.3 mgd. Deliveries to interested agencies would take first priority unless there was a drought, in which case deliveries to the City would take first priority. This would involve the same components and associated sizing described in Section 3, with the addition of the interconnections described below, as part of the potable water distribution systems.

7.2.1 SqCWD, SVWD, and SLVWD Participation

If the project plant capacity were increased from the proposed 3.3 mgd to 5.6 mgd, desalinated seawater could be made available to regional water suppliers as follows: 3.3 mgd for City use, 1.3 mgd for SqCWD use, and 1.0 mgd for SVWD use with a portion provided for SLVWD use. These quantities are consistent with the amounts being considered by the SCWD for regional recycled water alternatives. The SqCWD amount of 1.3 mgd is consistent with their proposed Pure Water Soquel Project.

To implement a regional project with SqCWD, SVWD, and SLVWD, necessary infrastructure would include the following modified project components compared to the project:

- **Seawater System and Conveyance System** – These systems could be constructed as proposed in Section 3 but would need to be designed for increased capacity to produce 5.6 mgd. To produce approximately 5.6 mgd reliably, the seawater intake system would need to be designed to provide maximum flow of approximately 14.1 mgd of raw seawater based on an overall desalination facility minimum recovery of 40%.
- **Seawater Desalination Plant** – A larger capacity plant could be constructed within the space provided at any of the three identified alternative sites. The treatment capacity would need to be increased above the proposed 3.3 mgd capacity to an

increased total capacity of up to 5.6 mgd. Two-story facilities may be required to accommodate the additional equipment for a 5.6-mgd facility.

- **Brine Storage, Disposal, and Conveyance System** – Brine disposal would still occur through blending with effluent from the City's wastewater treatment plant and returned to the Monterey Bay through the existing outfall. An updated Dilution Analysis per the requirements of the OPA would be required to ensure minimum dilution requirements and other OPA requirements would be met
- **Potable Water Distribution System** – This component includes the following:
  - A new pipeline would be required to convey the desalinated water to the City's potable water distribution system.
  - As described in the scwd^2 DEIR, interconnection to provide 1.3 mgd to SqCWD could be provided by the SCWD upgrading approximately 12,000 linear feet of existing pipeline capacity to 24-inch diameter pipes. SqCWD would also need to upgrade approximately 4,000 linear feet of existing pipeline to 16-inch diameter pipes and approximately 2,500 linear feet of existing pipeline to 12-inch diameter. The Soquel Drive intertie between the two service areas may require an upgrade. Although no new pump stations would be required, upgrades to the SCWD's Morrissey pump station and the SqCWD's McGregor and Aptos pump stations would be needed as described in the scwd^2 DEIR (URS 2013a).

    Since the analysis that informed the scwd^2 DEIR was completed, several actions have occurred that would reduce the additional infrastructure improvements required to deliver water to SqCWD. First, many of the recommended improvements in the SqCWD service area have been implemented; SqCWD proceeded with these improvements to overall system operations. Second, water demands in the City's service area have declined. This affected the ability to meet the SqCWD demands with fewer improvements in the City's service area. For example, recent hydraulic modeling has shown that, without any improvements related to the interconnection, the City could deliver 1.1 mgd under 2035 average day demand conditions. However, additional analyses would be required if there is interest in pursuing this alternative to refine pipeline improvements to intertie flows and any other operational issues in the City's service area that may result from such a regional project.
  - Interconnection to provide 1.0 mgd to SVWD could be provided by installation of approximately 8,000 linear feet of new 12-inch diameter intertie and construction of a new pump station, based on the 2012 Scotts Valley Multi-Agency Regional Intertie Project Technical Report (Kennedy/Jenks Consultants 2012).

- Interconnection of the SVWD and SLVWD systems has already been constructed and permitted for emergency use. Additional permitting would be required to use the existing intertie for non-emergency use.

7.2.2 SqCWD-Only Participation

If the project were increased to a capacity of 4.6 mgd, desalinated seawater could be provided as follows: 3.3 mgd for City use and 1.3 mgd for SqCWD use. This distribution would match the City's expected yield considered by the SCWD for the regional recycled water alternatives and the yield planned for SqCWD's Pure Water Soquel Project.

To implement a regional project with SqCWD only, necessary infrastructure would include the following modified project components compared to the project:

- **Seawater System and Conveyance System** – These systems could be constructed as proposed in Section 3 but would need to be designed for increased capacity to produce 4.6 mgd. To produce approximately 4.6 mgd reliably, the seawater intake system would need to be designed to provide maximum flow of approximately 11.5 mgd of raw seawater based on an overall facility minimum recovery of 40%.
- **Seawater Desalination Plant** – A larger capacity plant could be constructed within the space provided at any of the three identified alternative sites. The treatment capacity would need to be increased above the proposed 3.3 mgd capacity to an increased total capacity of up to 4.6 mgd.
- **Brine Storage, Disposal, and Conveyance System** – Brine disposal would still occur through blending with effluent from the City's wastewater treatment plant and returned to the Monterey Bay through the existing outfall. A revised Dilution Analysis per the requirements of the OPA would be required to ensure minimum dilution requirements and other OPA requirements would be met.
- **Potable Water Distribution System** – This component includes the following:
  - A new pipeline would still be required to convey the desalinated water to the City's potable water distribution system.
  - As described in the scwd[2] DEIR, interconnection to provide 1.3 mgd to SqCWD could be provided by the SCWD upgrading approximately 12,000 linear feet of existing pipeline capacity to 24-inch diameter pipes. SqCWD would also need to upgrade approximately 4,000 linear feet of existing pipeline to 16-inch diameter pipes and approximately 2,500 linear feet of existing pipeline to 12-inch diameter. The Soquel Drive intertie between the two service areas may require upgrade. While no new pump stations would be required, upgrades to the SCWD's

Morrissey pump station and the SqCWD's McGregor and Aptos pump stations would be needed as described in the scwd^2 DEIR (URS 2013a).

As described in Section 7.2.1, the SqCWD demands could be met with fewer improvements in the City's and SqCWD's service areas because many of the recommended improvements have already been implement by the SqCWD, and demand in the City's service area has declined. However, additional analyses would be required if there is interest in pursuing this alternative to refine pipeline improvements to improve intertie flows and any other operational issues in the City's service area that may result from such a regional project.

7.3 City Participation in MBRWP

Deepwater Desal LLC has proposed the Monterey Bay Regional Water Project (MBRWP) at Moss Landing in Monterey County. As described on the Deepwater Desal website (DeepWater Desal 2017), the project would consist of an SWRO desalination facility, a colocated data center, intake and outfall facilities, a power substation, and a hydroacoustic water quality monitoring system. One of MBRWP's stated goals is to make a new supply of potable water available north to the City, east to Salinas, and south to the Monterey Peninsula. It would initially have an annual production capacity of approximately 10,000 acre-feet (9 mgd), with potential future expansion of an annual capacity of up to 25,000 acre-feet (22 mgd). The capacity of intake and outlet facilities would be initially sized to accommodate future expansion capacity (Deepwater Desal 2017). SCWD staff reviewed existing sources of information to develop the information in this section and coordinated with DeepWater Desal LLC to get a current assessment of schedule and costs.

The MBRWP is proposed as a public-private partnership. Deepwater Desal LLC would form a joint powers authority (JPA) composed of public water agencies to finance and operate the desalination facility. They also propose to privately design, finance, construct, and operate a colocated, seawater-cooled data center that would share infrastructure and provide high-speed Internet servers for the region. The intake and outfall infrastructure would be financed with the data center and would not fall under the JPA. Warmed seawater from the data center would feed the desalination facility, which may lower the operating costs of each facility (Kennedy/Jenks Consultants 2014a).

The JPA structure for the desalination facility would be consistent with the Monterey County requirement that water providers be public agencies. Under this model, Deepwater Desal LLC and an engineering/construction partner would fund permitting, design, and construction of the desalination facility. The JPA would be responsible for financing the desalination facility capital costs of construction, as well as operation and maintenance costs. Deepwater Desal

LLC would plan to operate the facility for an agreed upon amount of time before selling to a JPA or wholesale agency that would then take ownership of the facility (Kennedy/Jenks Consultants 2014a).

For the City to purchase water from the MBRWP, the City would need to become part of a successfully formed JPA and pay associated costs. Deepwater Desal LLC and the JPA would in turn need to be successful in financing, designing, permitting, constructing, and operating the project. Negotiation would be necessary to determine if supply of 3.3 mgd would be available to the City and at what cost. City costs would also include pumping and conveyance of the treated water from Moss Landing to the City's distribution system. If SqCWD and the City were both to purchase water from the MBRWP, there would be some potential for shared conveyance infrastructure costs.

Based on recent input provided to SCWD by DeepWater Desal LLC, the current schedule indicates a 2020 construction date, with water available in 2022. Current price for water is $2,000–$2,500 per acre-foot at the fence. This price assumes no data center participation in the project; therefore, cost sharing for the data center could possibly lower the cost (Adamson, pers. comm. 2017).

In addition to JPA financial commitments for water delivery at the fence, necessary infrastructure for water delivery to the City would include the following:

- **Potable Water Distribution System** – This component includes the following:
  - Interconnection from the lower portion of SqCWD's distribution system to the MBRWP would require up to approximately 15.2 miles (approximately 80,000 linear feet) of new pipeline and a pump station (see Figure 6). Pipeline capacity for this intertie would need to be determined based on ultimate delivery requirements.
  - Additional system improvements, including pipe capacity upgrades, intertie upgrade, and new/upgraded pump stations, may also be necessary to transfer the water through the SqCWD distribution system to the City's distribution system and to move the desalinated water through the City's service area (Kennedy/Jenks Consultants 2014b).

8 CONCLUSIONS

As shown in this report, a City seawater desalination project would meet most of the City's WSAC objectives as presented in Section 3 and Table 4. The project is technically feasible and could provide sufficient water supply capacity to fill the identified supply-demand gap of 1.2 bgy during modeled worst-year conditions, which equates to approximately 3.3 mgd. While the project is technically feasible, additional feasibility review of radial collector wells may be required for the project to determine the feasibility of this subsurface intake approach.

Seawater desalination can also support system robustness, redundancy, and adaptive flexibility. Redundancy can be built into design, and capacity can be modified, if needed, during design with updated Confluence modeling. A City seawater desalination project could meet the City's timeliness objective since it could be completed and operational by 2025, as shown in Section 6. Such a project could also be a regional project with SVWD and/or SqCWD with the inclusion of intertie components, which would meet the objective of promoting regional collaboration to improve water supplies, reversing or slowing seawater intrusion, and supporting habitat restoration.

It is not yet known whether the project would meet the cost-effectiveness objective because this objective is not evaluated in this report. A subsequent analysis will be prepared by the SCWD to compare seawater desalination to other alternatives using the ACAYY. Also, while the City will consider energy use, public health, and environmental impacts in selecting a supplemental water supply, a comparison of desalination to other alternatives for these factors is not provided in this report.

Table 4. Ability of City Seawater Desalination Project to Meet Objectives

Objective	Does Project Meet Objective?
1. Provide for a supplemental water supply that provides approximately 3.3 mgd of supplemental potable water supply identified as necessary for the City and that complements ongoing and future water conservation efforts. The supply should support system robustness, redundancy, and adaptive flexibility.	Yes
2. Meet the following cost-effectiveness, yield, and timeliness thresholds identified in the WSAC Final Report:	
2.1 Cost-effectiveness – Compare favorably to other alternatives using the ACAYY.	To Be Determined
2.2 Yield – Fill the supply-demand gap of 1.2 bgy during modeled worst-year conditions based on 2015 Confluence modeling of the frequency and severity of shortages, inclusive of DFG-5 fish flows and a plausible estimate of climate change impacts. This equates to approximately 3.3 mgd. Periodic updating of Confluence	Yes

Table 4. Ability of City Seawater Desalination Project to Meet Objectives

Objective		Does Project Meet Objective?
	modeling of the frequency and severity of shortages may result in modifications to the supply-demand gap.	
2.3	Timeliness – Support a fully functional water system able to meet the supply-demand gap by 2025.	Yes
3.	Consider technical feasibility in selecting a supplemental water supply.	Yes Additional feasibility review of radial collector wells may be required.
4.	Consider energy use, public health, and environmental impacts in selecting a supplemental water supply.	To Be Determined
5.	Where consistent with the goal of achieving a sufficient water supply, promote regional collaboration to improve water supplies, reverse or slow seawater intrusion, and support habitat restoration.	Yes If the project is expanded to include interties with other water districts.

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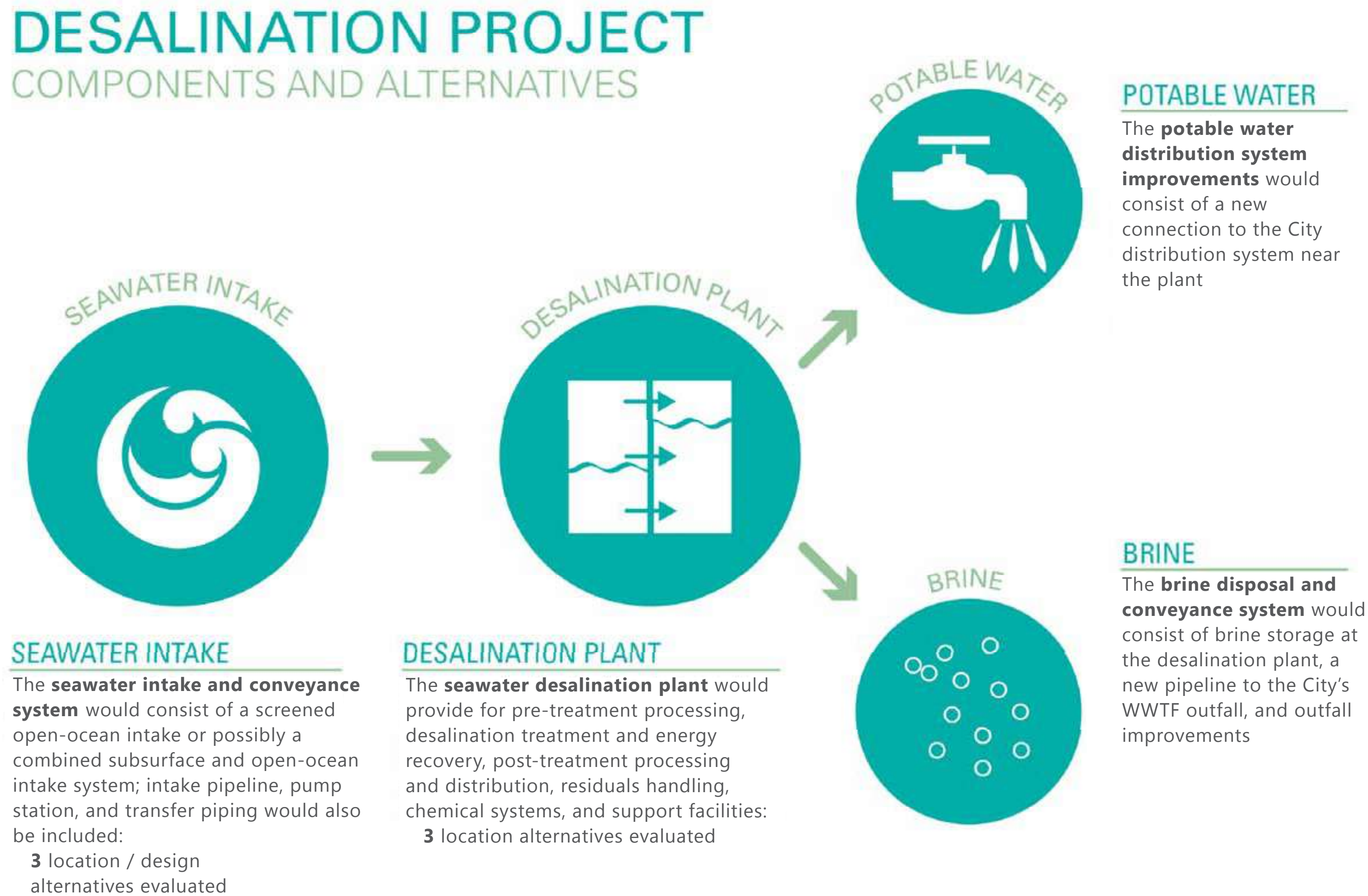

SOURCE: URS 2013; Updated by Dudek in 2017

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FIGURE 1
Desalination Project Components and Alternatives
City of Santa Cruz Seawater Desalination Project

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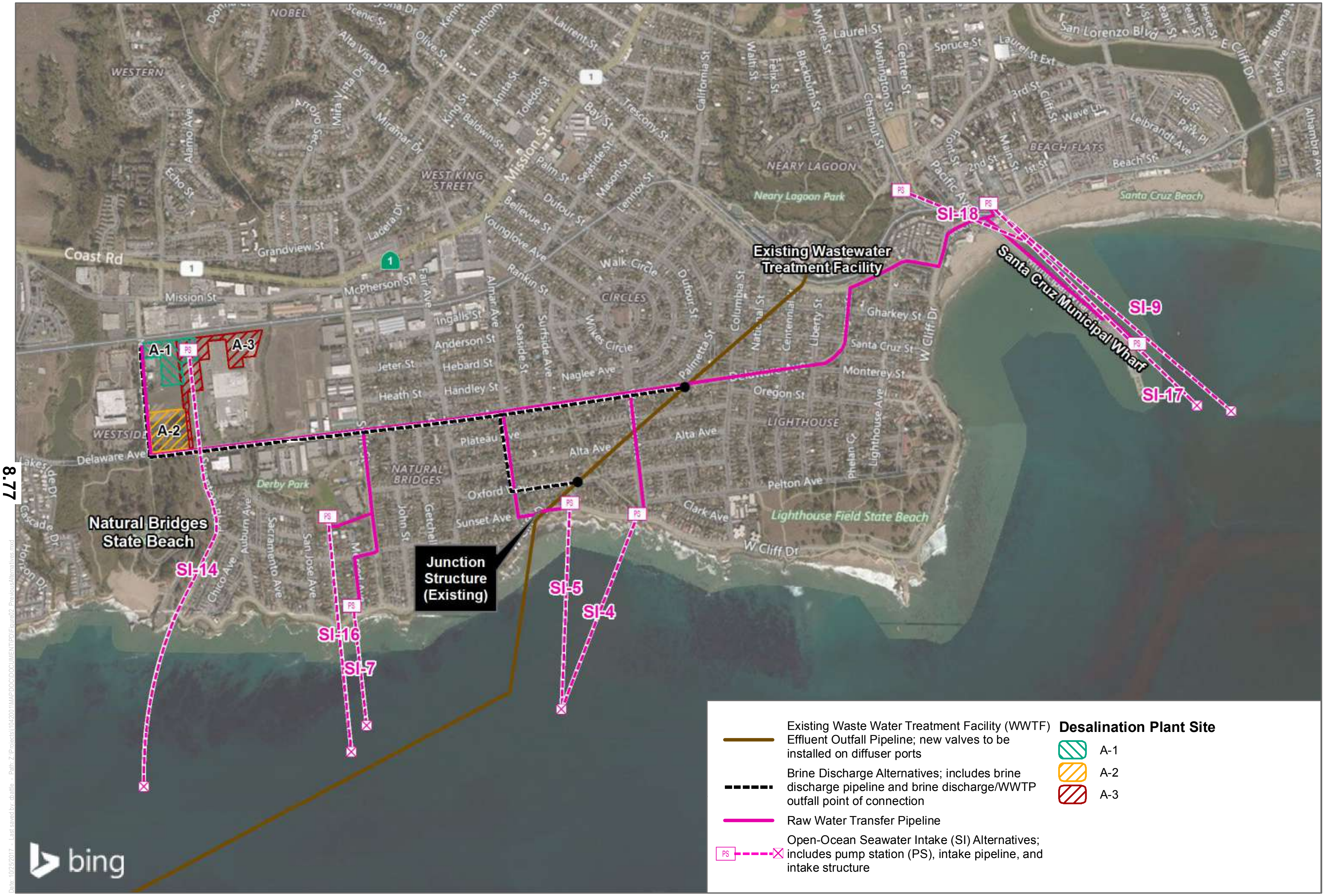

SOURCE: URS 2013, Bing 2017

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0 750 1,500 Feet

FIGURE 2

Previously Proposed scwd[2] Regional Seawater Desalination Project Overview

City of Santa Cruz Seawater Desalination Project

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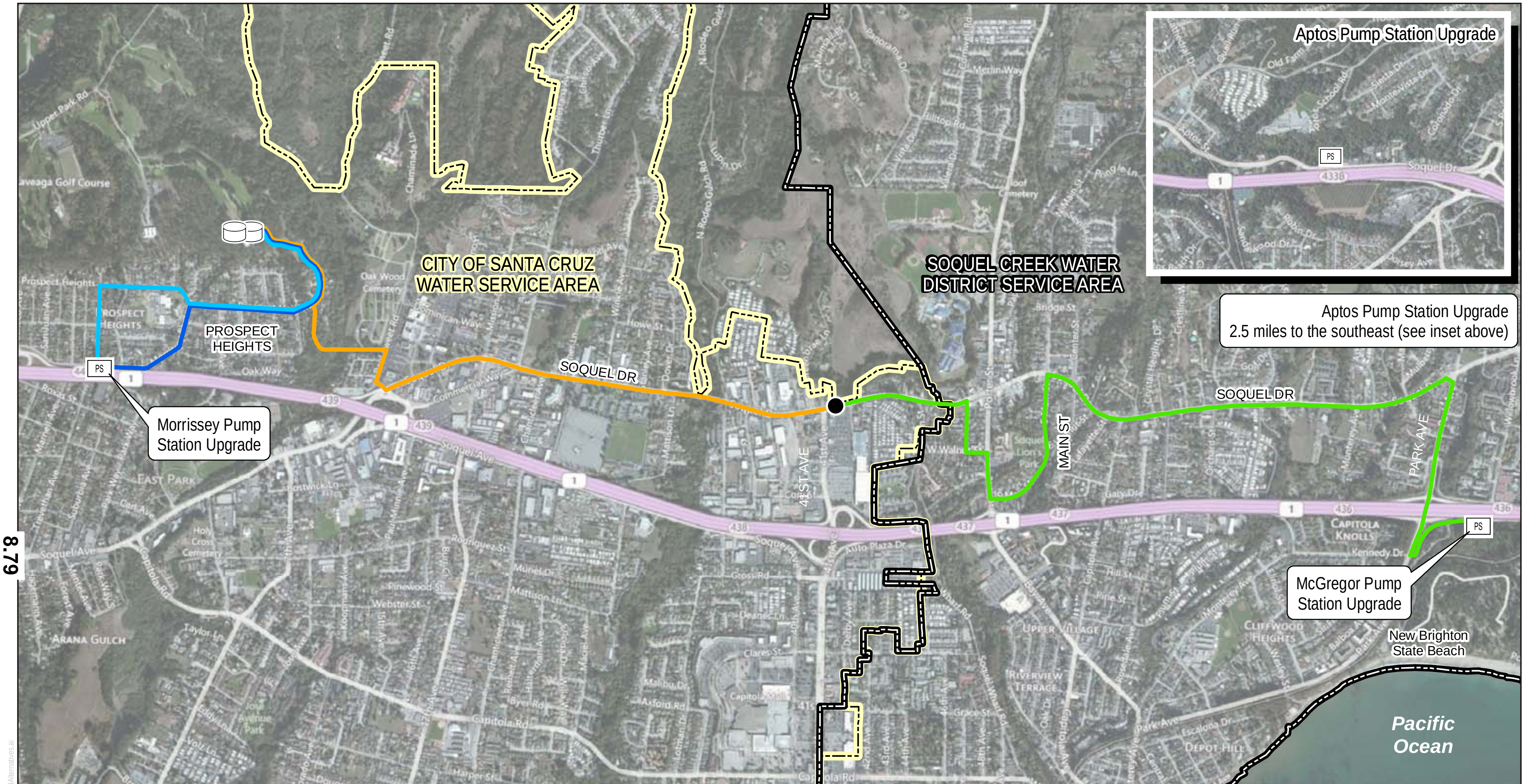

Potable Water Pipeline Alignments

- Morrissey PS to DeLaveaga Tanks - Morrissey Alignment Option
- Morrissey PS to DeLaveaga Tanks - Trevethan Alignment Option
- DeLaveaga Tanks to City-District Intertie
- City-District Intertie to McGregor PS

DeLaveaga Tanks
Pump Station (PS)
Intertie location at Soquel Dr
Soquel Creek Water District Service Area Boundary
City of Santa Cruz Water Service Area Boundary

N
0 0.5 1
SCALE IN MILES

Base map source:
Microsoft Bing Maps

SOURCE: URS 2013

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FIGURE 3
City-District Intertie Systems Area
City of Santa Cruz Seawater Desalination Project

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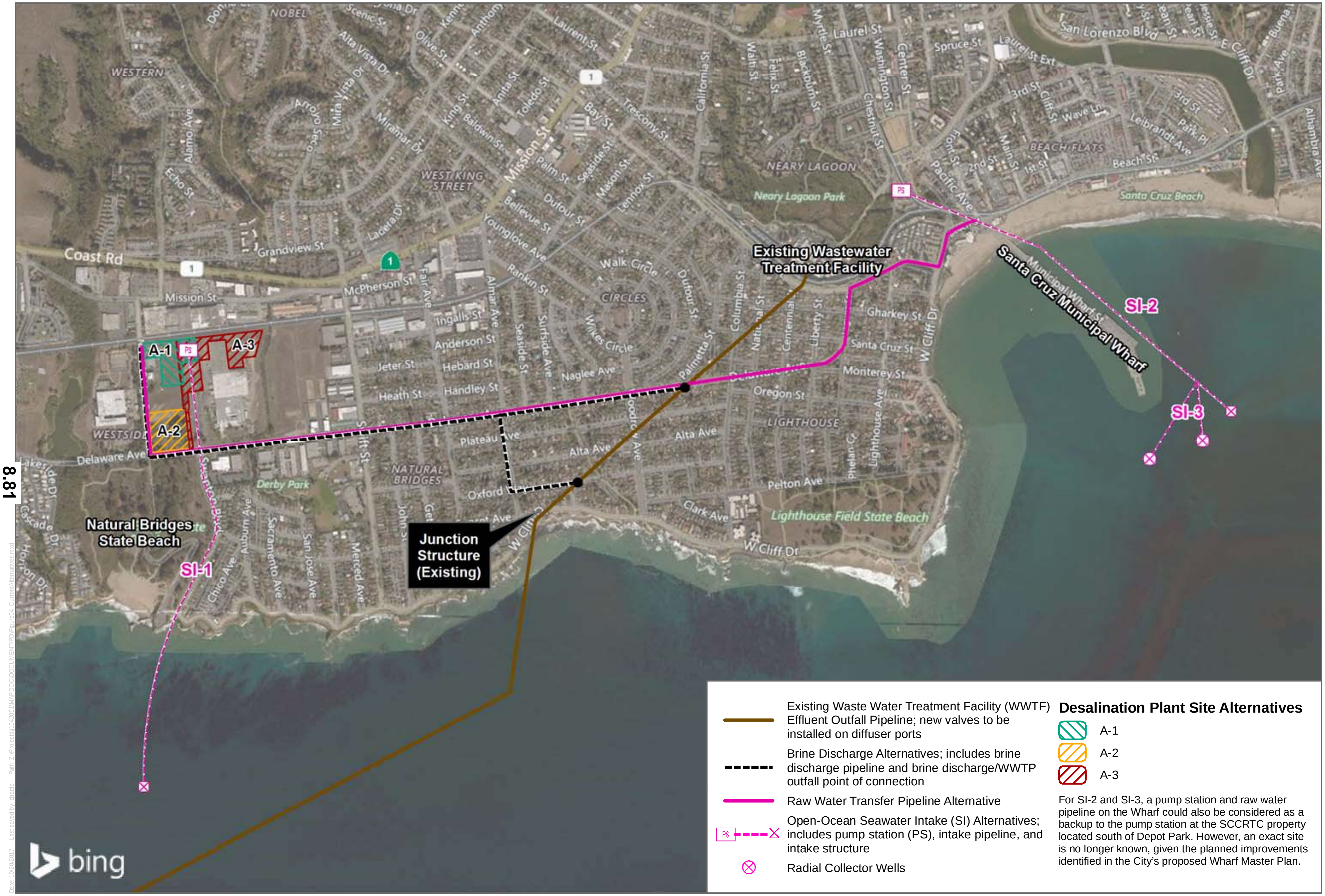

SOURCE: URS 2013; Updated by Dudek in 2017, Bing 2017

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0 750 1,500 Feet

FIGURE 4

Updated Seawater Desalination Project Overview

City of Santa Cruz Seawater Desalination Project

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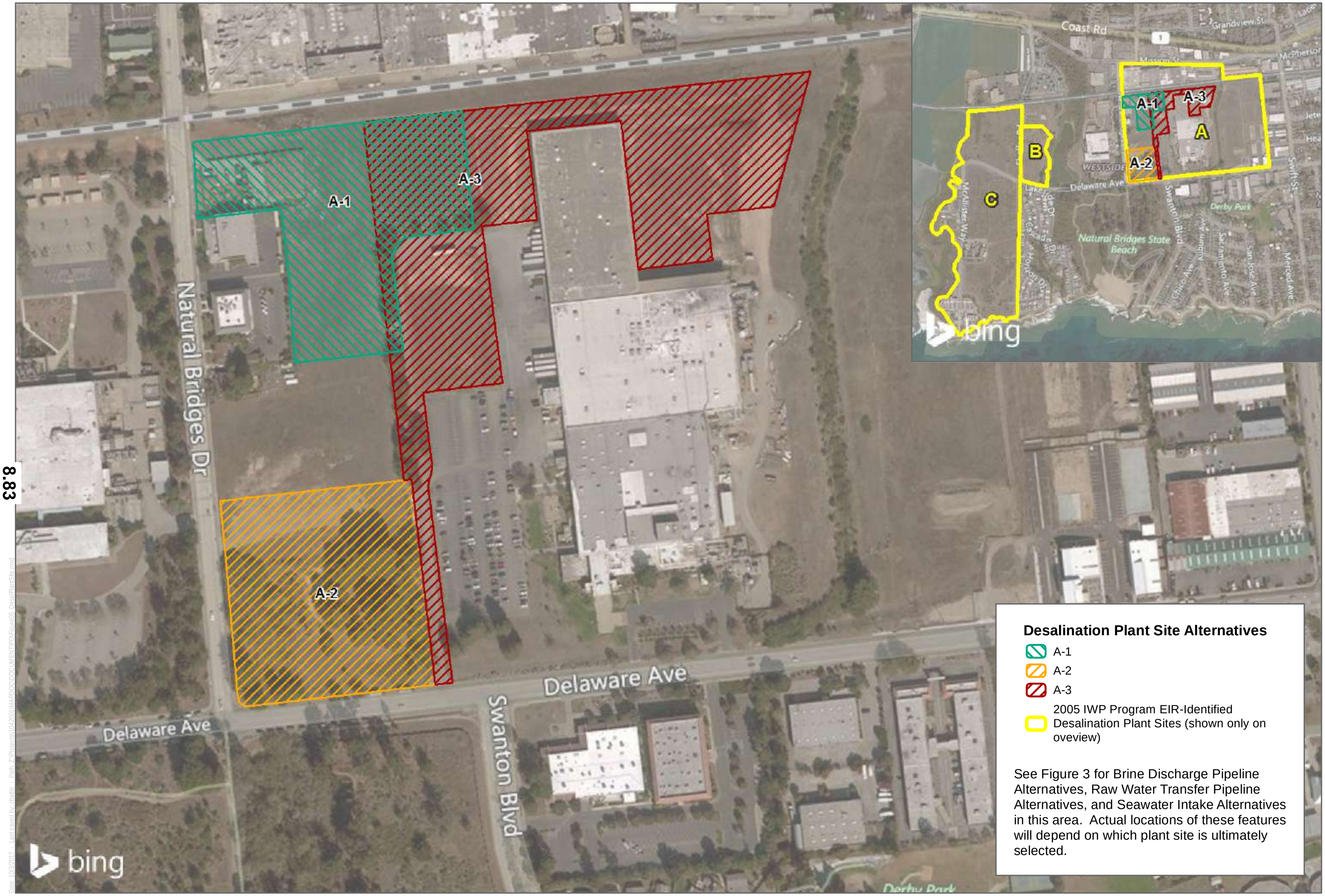

SOURCE: URS 2013, Bing 2017

DUDEK

0 145 290 Feet

FIGURE 5

Desalination Plant Site Alternatives

City of Santa Cruz Seawater Desalination Project

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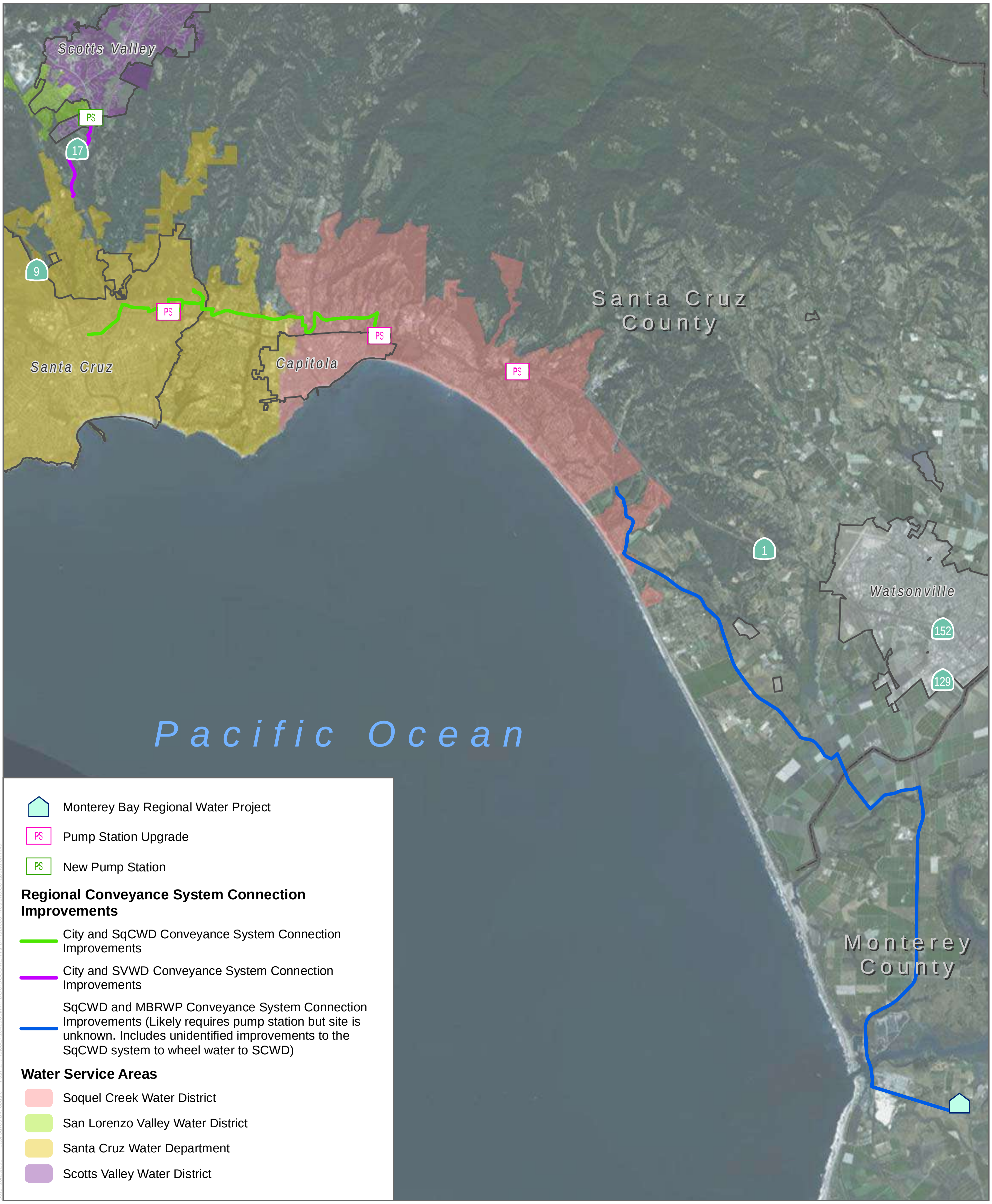

SOURCE: Bing Maps (Accessed 2017); Kennedy/Jenks Consultants (2012 and 2014); URS (2013)

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FIGURE 6

Opportunities for Regional Participation

City of Santa Cruz Seawater Desalination Project

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APPENDIX A

Engineer's Opinion of Probable Costs

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23 October 2017

Technical Memorandum – SCWD Desal Update Cost Estimates

To: Heidi Lukenbach, PE, City of Santa Cruz
Ann Sansevero, AICP, DUDEK

From: Dawn Taffler, PE and Alex Page, Kennedy/Jenks Consultants

Review: Todd Reynolds, PE, Kennedy/Jenks Consultants

Subject: City of Santa Cruz Desalination Feasibility Update Review - Cost Estimates
K/J 1768015*00

The City of Santa Cruz (City) is reviewing the facility, cost, timeliness and approach for pursuing the construction and operation of a City Seawater Desalination Project. This effort will support the City's selection of a supplemental or replacement supply per the City Water Supply Advisory Committee's Final Report on Agreements and Recommendations (WSAC's Final Report) (WSAC 2015). The overarching goal of the WSAC's Final Report is to provide significant improvement in the sufficiency and reliability of the Santa Cruz water supply by 2025. The recommended strategies in the WSAC's Final Report include conservation to reduce demand; passive and active groundwater recharge; and supply augmentation using advanced-treated recycled water with desalination as a back-up, should the use of advanced-treated recycled water not be feasible.

This Technical Memorandum (TM) supports the Desalination Feasibility Update Review Report by providing cost estimates for desalination alternatives being investigated for the City Seawater Desalination Project.

1. Overview

The City Seawater Desalination Project consists of four major project components:

(1) a seawater intake and conveyance system;
(2) a seawater desalination plant;
(3) a brine storage, disposal, and conveyance system; and
(4) potable water distribution system improvements.

These project components include different types of facilities, such as buildings, pumps, pipelines, and other equipment. Three desalination alternatives being investigated for the City Seawater Desalination Project. Each alternative considers the same facility location, brine disposal conveyance and potable water distribution system improvements. The alternatives differ on the type of seawater intake system to extract seawater for desalination.

For the purpose of this TM, costs estimates are developed for three alternatives based on different seawater intake design options:

- Alternative 1 - Screened Open-Ocean Intake (Westside)
- Alternative 2 - Screened Open-Ocean Intake (Wharf Area)
- Alternative 3 - Subsurface Intake System (Wharf Area)

Cost estimates are prepared based on prior conceptual design drawings, assumptions from prior studies and adherence to project objectives. Facilities are sized to accommodates a 3.3 MGD desalination facility, seawater intake, and brine disposal conveyance system. No new component site locations (e.g., plant sites, intake locations), over those previously considered, are identified or assessed for the three alternative cost estimates.

2. Project Component Characteristics

The general characteristics for each project component are summarized in the following sections.

2.1 Seawater Intake and Conveyance System

The seawater intake and conveyance system would be comprised of a seawater intake structure or structures in the Monterey Bay to draw in raw seawater (source water), an intake pipeline to deliver the seawater to the shore, and a pump station to pump the seawater to the desalination plant via transfer piping. To produce approximately 3.3 mgd of treated product water reliably, the seawater intake system would be designed to provide a maximum flow of approximately 8.3 mgd of raw seawater, based on an overall facility minimum recovery of 40%. The desalination plant could operate with higher recoveries for periods of time and withdraw lower rates of seawater, but would also operate at lower recoveries for some periods. Therefore, the intake conveyance system would be designed to accommodate the larger volumes of intake water to cover the range of production and overall facility recoveries.

The seawater intake and conveyance system would be located between an offshore location in the Monterey Bay and the desalination plant site. A number of alternative locations for the seawater intake and conveyance system were evaluated in the scwd² Draft Environmental Impact Report (DEIR) (URS 2013). Thee intake options were evaluated and updated, based on the assessment of changed conditions. Only one of these options would be implemented:

- **Seawater Intake Alternative 1, Screened Open-Ocean Intake (Westside)** – A screened open-ocean intake located offshore on the Westside of Santa Cruz is considered for the Project, as a sub-surface intake in this location is not feasible due to shallow bedrock offshore. The intake screens would have 1-mm openings. The intake pump station would be located at the seawater desalination facility. This is similar to seawater intake alternative number SI-14 from the scwd[2] DEIR.

- **Seawater Intake Alternative 2, Screened Open-Ocean Intake (Wharf Area)** – A screened open-ocean intake located offshore near the City Wharf is considered for the Project. The intake screens would have 1-mm openings. The intake pump station would be located at the Santa Cruz County Regional Transportation Commission (SCCRTC) property located south of Depot Park. This is similar to seawater intake alternative number SI-18 from the scwd[2] DEIR.

- **Seawater Intake Alternative 3, Subsurface Intake System (Wharf Area)** – The sub-surface intake system would consist of one or two offshore radial collector wells that would draw seawater through the alluvial material beneath the seafloor. The radial collector well(s) would be constructed in the alluvial channel that is near the Wharf, where there is deep enough sand to make this approach potentially feasible. The sub-surface intake would also have an open-ocean screened intake element as part of the overall system that would be used to provide supplemental intake water, should the sub-surface intake lose production capacity and/or require significant maintenance. The intake pump station would be located at the SCCRTC property located south of Depot Park. This is similar to the location of seawater intake alternative number SI-18 from the scwd[2] DEIR, but is distinct in design given that it includes a sub-surface intake, with a screened open-ocean intake as a back-up source of raw seawater.

2.2 Seawater Desalination Plant

The desalination plant is assumed to be located in the Industrial Park on the westside of the City on approximately 4- to 8-acres of mostly undeveloped private land on infill parcels bounded by the Santa Cruz Branch Rail Line tracks on the north, Natural Bridges Drive on the west, Delaware Avenue on the south, and the realigned Arroyo Seco stream on the east. Though three locations are being considered only one would be implemented.

The 3.3-mgd capacity desalination plant would provide for all the equipment used for the desalination process, except for the seawater intake system and pipeline conveyance systems for source water, brine disposal, and potable water. The plant would provide for the following primary systems:

- **Pre-treatment Processing -** Pretreatment refers to the removal of suspended solids from ocean source water to reduce fouling, clogging, and scaling of the seawater reverse osmosis (SWRO) membranes used for desalination.

- **Seawater Desalination Treatment -** The plant would use a SWRO system to desalinate raw seawater. SWRO is a pressure-driven process using semi-permeable membranes. SWRO membranes separate water molecules from impurities in the seawater by permitting water to pass, and limiting the passage of salts and other constituents. The results are a permeate stream (or product water) and a concentrate stream (or brine). The desalination system would have the ability to operate with a recovery rate ranging from 40 to 50 percent (40 to 50 gallons of fresh drinking water per 100 gallons of seawater).

- **Post-treatment Processing and Distribution** - Reverse osmosis removes many of the minerals from the water. Lack of hardness and alkalinity makes the water more corrosive to the water delivery system. Post-treatment is required to control the corrosiveness of the water and provide adequate disinfection prior to distribution, as is common for potable water generated from surface and/or groundwater sources.

- **Residuals Handling and Disposal** - Operation of the desalination plant would generate solids from the pre-treatment processing. Two options for handling solids are considered (1) sanitary sewer disposal and (2) landfill disposal.

- **Chemical Systems -** A variety of chemicals would be required for treatment, disinfection, and membrane cleaning at the desalination plant. The chemicals would be stored in accordance with applicable building and seismic codes, and applicable regulatory requirements for hazardous materials storage.

Similar to the proposed scwd² Desalination Program, the final desalination plant design would consider space for other related and support uses, including but not limited to: (1) operations and control systems; (2) maintenance and facilities storage; (3) electrical operations and utility connections; (4) parking and access; (5) stormwater detention and treatment; (6) landscaping; and (7) outdoor viewing and gathering areas. A photovoltaic (PV) system could also be included at the proposed plant, as was contemplated for the proposed scwd² Desalination Program.

2.3 Brine Storage, Disposal and Conveyance System

During the SWRO process at the desalination plant, brine would be generated, and would be approximately twice as saline as seawater. Brine storage would be provided on the desalination plant site to allow for controlled release of the brine. A pipeline would convey the brine from the desalination plant to the City's wastewater treatment facility (WWTF) outfall pipeline where it would be blended with effluent from the City's WWTF and returned to Monterey Bay via the City's existing ocean outfall. The WWTF outfall diffuser ports would be improved by adding new valves (Red Valves) to the ports. A Dilution Analysis conducted to support the scwd² DEIR concluded that the WWTF National Pollutant Discharge Elimination System (NPDES) discharge permit minimum initial dilution requirement and ambient salinity at the outfall could be maintained with the above improvements. An update to the Dilution Analysis would be required to specifically address the California Ocean Plan Amendment (OPA) requirements regarding discharge and reduced wastewater flow associated with the Soquel Creek Water District's Pure Water Soquel Project.

2.4 Potable Water Distribution System

The pipeline to convey the product water from the desalination facility to the City's existing potable water distribution system would run from the desalination plant location to the existing adjacent potable water distribution pipe located within Delaware Avenue or in Natural Bridges Drive.

Given that the WSAC Final Report focuses on meeting the City's water supply needs, the previously contemplated intertie system between the City and Soquel Creek Water District service areas, consisting of new and replacement pipelines and pump station improvements, would not be a component of the Desalination Project.

3. Engineers Opinion of Probable Costs

The engineer's opinion of probable cost is based on information and costs developed in technical studies conducted by the City and Soquel Creek Water District as part of their integrated water plans and the **scwd²** Desalination Program (Kennedy/Jenks 2011, CDM 2012, URS 2012 and Kennedy/Jenks 2013), and supplemented with cost estimates from similar projects and professional experience. These studies are used to generate estimated construction costs for the three desalination alternatives being considered.

Costs from these prior studies are updated to current day using ENR cost indices and are scaled to reflect a capacity of 3.3 mgd. All costs are conceptual and order of magnitude type costs at an Association for the Advancement of Cost Estimating (AACE) Class 5 level, representing Planning to Feasibility level information with an estimated accuracy range between -30 percent and +50 percent. These costs are intended to be used for comparison purposes between alternatives.

The detailed cost table templates and assumptions applied herein are consistent with those developed for the City's Regional Recycled Water Facilities Planning Study (RWFPS) to allow for a comparison of costs for desalination and advanced-treated recycled water projects. Planning-level opinions of capital, operations and maintenance (O&M), and lifecycle unit costs are developed to facilitate an economic comparison of the three desalination alternatives to the other recycled water alternatives.

Capital, annual and life cycle unit costs are estimated based on the following assumptions.

- **Capital Cost:** based on unit construction costs, prior studies and recent project experience were used to estimate desalination facility costs, sea water intake pipelines, radial collector wells and brine disposal pipelines.
    - **Additional facility costs** apply the following percentages to the subtotal of facility costs: site development costs at 5%, yard piping at 5% and electrical, instrumentation and controls (I&C) at 15%.

   - **Sales tax** of 8.75% is applied to materials (estimated at 40% of the total facility cost).
   - **Allowance for unlisted items** includes a markup of 5% for mobilization, bonds and permits and 15% for contractor overhead and profit are applied to the facility direct costs.
   - **An estimate contingency** of 35% has been applied to the facility direct costs. The assumed contingency is in the range of contingencies associated with an AACE Class 5 level opinion of probable cost, and is also comparable to the contingency percentage utilized for the RWFPS.
   - **Escalation to midpoint of construction** is not assumed at this time.
- **O&M Cost:** The estimated O&M costs include energy cost, labor costs, chemical costs and maintenance costs associated with the desalination facility operation (CDM 2012) and for the operation of the intake facility (Kennedy/Jenks 2011), with a contingency of 10% applied to all O&M costs.
- **Life Cycle Unit Cost:** Costs are then converted to annualized lifecycle costs using basic assumptions about discount rates (estimated at 4%) and the life expectancy of project components (30-years for desalination facility and radial collector wells and 50-years for all other components). Total annualized costs are divided by the desalinated water delivered over the life of the project to obtain a uniformly derived unit cost of water in dollars per acre-foot ($/AF), dollars per million gallons ($/MG) and dollars per one hundred cubic feet ($/CCF).

Table 1 summarizes the engineer's opinion of probable costs for the three desalination alternatives. Project component costs listed are loaded based on the markups and contingency assumptions described above.

Detailed summary sheets for each alternative can be found in Attachment A to this technical memorandum.

Table 1 - Summary of Costs for Desalination Facility Components (2017 dollars)

Project Components (3.3 MGD Facility)	Alt 1 Screened Open-Ocean Intake (Westside)	Alt 2 Screened Open-Ocean Intake (Wharf Area)	Alt 3 Subsurface Intake System (Wharf Area)
Seawater Intake and Conveyance System			
Open Ocean Intake System[1]	$60,100,000	$58,900,000	$52,800,000
Radial Well Collectors	n/a	n/a	$76,600,000
Seawater Desalination Plant	$77,800,000	$77,800,000	$77,800,000
Brine Storage, Disposal and Conveyance System	$10,500,000	$10,500,000	$10,500,000
Potable Water Distribution System Connection	(*Included in Desalination Plant costs)*		
Total Capital Cost ($)	**$148,400,000**	**$147,200,000**	**$217,700,000**
Estimated Capital Cost ($mil)	**$148.4**	**$147.2**	**$217.7**
Annualized Capital Cost ($mil/yr)	$7.8	$7.7	$11.9
Desalinated Water Produced (AFY)	3,696	3,696	3,696
Annual Unit Capital Cost ($/AF)	**$2,110**	**$2,090**	**$3,210**
Annual O&M Cost ($mil/yr)	$5.4	$5.6	$5.7
Annual O&M Cost ($/AF)	$1,470	$1,510	$1,530
Life Cycle Unit Cost ($/AF)	**$3,570**	**$3,610**	**$4,730**
($/MG)	**$11,000**	**$11,100**	**$14,500**
($/CCF)	**$8.20**	**$8.30**	**$10.90**

[1] Includes intake structure, screens, pipelines and pump station.

References

CDM Smith. 2012. scwd² Regional Desalination Plant, Phase I Preliminary Design Report. October 2012. CDM Smith, Walnut Creek, CA.

Kennedy/Jenks Consultants (Kennedy/Jenks), 2011. scwd² Seawater Desalination Intake Technical Feasibility Study. prepared by Kennedy/Jenks Consultants for the City of Santa Cruz Water Department. September 2011.

Kennedy/Jenks, 2013. Technical Memorandum - Conceptual-Level Cost Comparison of Water Supply Alternatives. Prepared for City of Santa Cruz and Soquel Creek Water District scwd² Desalination Program. April 17, 2013

URS, 2013. scwd² Regional Seawater Desalination Project Draft Environmental Impact Report (DEIR), prepared by URS for the City of Santa Cruz, May 2013.

Water Supply Advisory Committee (WSAC). 2015. "City of Santa Cruz – Water Supply Advisory Committee- Final Report on Agreements and Recommendations ". October 2015. http://www.santacruzwatersupply.com/sites/default/files/resource-files/WSAC%20Final%20Report%20October%202015.pdf

Attachment A: Detailed Cost Sheets

This attachment includes detailed cost sheets for the following desalination project alternatives:

- Alternative 1 - Screened Open-Ocean Intake (Westside)
- Alternative 2 - Screened Open-Ocean Intake (Wharf Area)
- Alternative 3 - Subsurface Intake System (Wharf Area)

Engineers Opinion of Probable Cost
Alternative 1 - Screened Open-Ocean Intake (Westside)

KENNEDY/JENKS CONSULTANTS

Study:	Santa Cruz Desalination Update (3.3 MGD)	**Prepared By:**	AP, DTT, TKR		3.30 mgd
Project:	Alternative 1 - Screened Open-Ocean Intake (Westside)	**Date Prepared:**	Sep-2017	**Average Annual Ocean Water Delivered**	3696 AFY
Supply:	Ocean Water	**K/J Proj. No.**	1768015.00	**August 2017 ENR**	**12,037.27**
Estimate:	Conceptual Level Cost-Analysis	**ENR**	2017	**February 2012 ENR**	**10,207.79**
				June 2014 ENR	**10,899.59**

Item No.	Description	Qty	Units	$/Unit	Total Costs (w/o mark-up) Capital Cost (2.5 MGD, 2012 USD)	Capital Cost (3.3 MGD, 2012 USD)	Capital Cost (3.3 MGD, 2017 USD)	Notes/Source
Facility Capital Costs								
								Source: (CDM, 2012) scwd2 Regional Desal Report
1.0	**Desalination Facility**				**$ 28,460,000**	**$ 33,460,000**	**$ 39,450,000**	Scaled to reflect increased flow and ENR index (as shown)
1.1	Site Work	1	LS	$ 1,728,024	$ 1,728,024	$ 1,728,024	$ 2,037,727	
1.2	Landscape	1	LS	$ 600,000	$ 600,000	$ 600,000	$ 707,534	
1.1	Control Building	1	LS	$ 1,144,391	$ 1,144,391	$ 1,144,391	$ 1,349,493	Assumed same size building for 2.5 MGD or 3.3 MGD facility
1.2	DAF Basins	1	LS	$ 2,229,269	$ 2,229,269	$ 2,675,123	$ 3,154,569	
1.3	Membrane Building (and Chemical Storage Area)	1	LS	$ 16,383,930	$ 16,383,930	$ 19,660,716	$ 23,184,386	
1.4	Calcite Contactors	1	LS	$ 1,240,895	$ 1,240,895	$ 1,489,074	$ 1,755,952	
1.5	Chlorine Contact Tank/Clearwell and HSPS	1	LS	$ 1,265,587	$ 1,265,587	$ 1,518,704	$ 1,790,893	
1.6	Concentrate EQ Basin and Pump Station	1	LS	$ 1,860,070	$ 1,860,070	$ 2,232,084	$ 2,632,127	
1.7	Clarifiers/Thickeners	1	LS	$ 927,039	$ 927,039	$ 1,112,447	$ 1,311,824	
1.8	Pump Station	1	LS	$ 1,079,011	$ 1,079,011	$ 1,294,813	$ 1,526,875	
2.0	**Sea Water Intake (Site 14)**				**$ 21,470,000**	**$ 25,830,000**	**$ 30,450,000**	Source: (URS, 2012)
2.1	Microtunnel/HDD two 36-in pipes in 8-ft casing	4,875	LF	$ 2,500	$ 12,187,500	$ 14,625,000	$ 17,246,150	Scaled to reflect increased facility size and ENR index (as shown)
2.2	Intermediate Shafts	2	EA	$ 500,000	$ 1,000,000	$ 1,200,000	$ 1,415,069	
2.3	Landside Mobilization	1	LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,179,224	
2.4	Waterside Mobilization	1	LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,179,224	
2.5	Intake Screen and Structure	1	LS	$ 800,000	$ 800,000	$ 1,920,000	$ 2,264,110	Ratio increase and doubled original 2012 cost due to decrease in screen
2.6	Excavation and Anchorage in Bedrock	1	LS	$ 200,000	$ 200,000	$ 200,000	$ 235,845	opening from 2mm to 1mm
2.7	Intake Pump Station - Rock Excavation	80	FT (depth)	$ 27,000	$ 2,160,000	$ 2,160,000	$ 2,547,124	
2.8	Intake Pump Station - Rock Disposal	80	FT (depth)	$ 1,500	$ 120,000	$ 120,000	$ 141,507	
2.9	Intake Pump Station Facility and Equipment	1	LS	$ 3,000,000	$ 3,000,000	$ 3,600,000	$ 4,245,206	
	Transfer Pipeline to the Plant	0	LF	$ 500	$ -	$ -	$ -	No transfer pipeline for alternative 1
3.0	**Radial Well Collectors**						**$ -**	
	None for this alternative	0			$ -			not included
4.0	**Brine Disposal**				**$ 4,190,000**	**$ 4,630,000**	**$ 5,310,000**	Source: (URS, 2012)
4.1	Brine Line Installation	7,300	LF	$ 300.00	$ 2,190,000.00	$ 2,628,000.00	$ 3,099,000.43	Brine Line length from URS Figure 4-3. Assumed same unit cost as Transfer
4.2	Intertie with WWTP Effluent Outfall Pipeline	1	LS	$ 2,000,000.00	$ 2,000,000.00	$ 2,000,000.00	$ 2,208,756.48	Pipeline to Plant cost for other location
	Subtotal Facility Costs				**$54,120,000**	**$63,920,000**	**$75,210,000**	
Additional Facility Capital Costs								
5.0	Site Development Costs	@	5%		2,706,000	3,196,000	3,760,500	% of Subtotal facility, sea water intake, and brine costs
								(Includes grading, erosion control, cut/fill, etc.)
6.0	Yard Piping	@	5%		2,706,000	3,196,000	3,760,500	% of Subtotal facility, sea water intake, and brine costs
7.0	Electrical, I&C, and Remote (low-tech) Control	@	15%		8,118,000	9,588,000	11,281,500	% of Subtotal facility, sea water intake, and brine costs
	Subtotal Additional Facility Costs				**$13,530,000**	**$15,980,000**	**$18,802,500**	
	Facility Direct Costs				**$67,650,000**	**$79,900,000**	**$94,012,500**	
	Taxes	@	8.75%		1,894,200	2,237,200	2,632,350	apply taxes to 40% of the Subtotal Facility Costs
	Mobilization/Bonds/Permits	@	5%		3,382,500	3,995,000	4,700,625	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		10,147,500	11,985,000	14,101,875	% of Facility Direct Costs
	Estimate Contingency	@	35%		23,677,500	27,965,000	32,904,375	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$106,751,700**	**$126,082,200**	**$148,351,725**	
								Escalation to Midpoint of Construction not applied
	Escalation to Midpoint of Construction				0	0	0	assume 2% percent over 10
								construction start = 2025 end = 2027
	Project Capital Cost Total				**$106,800,000**	**$126,100,000**	**$148,400,000**	2012 Cost is comparable to CDM Desal Construction Cost ($66mil) + URS Intake Construction Cost ($42mil). Eng/Design and Environmental Permitting not included.
	Annualized Capital Cost ($mil/year)						**$7.8**	assume discount rate (i = 4%) and facility life (n = 30 to 50 years)

Annual Operations and Maintenance Costs

Item No.	Description	Lump Sum Annual Costs ($/year)	
			Source: (CDM, 2012), Includes escalation to 2017; scaled to reflect increased flow
8.0	**Energy Costs**		CDM Report (Table 5-4)
8.1	Energy Costs - Facility	$2,690,000	CDM Report (Table 5-4) - not incl raw water pumping
8.2	Raw Water Pumping Cost (from intake)	$200,000	CDM Report (Table 5-4)
9.0	**Labor Costs (Facility)**	$670,000	CDM Report (Table 5-5)
10.0	**Maintenance (Facility)**		
10.1	Consumable Replacements	$350,000	CDM Report (Table 5-7)
10.2	Solids Disposal	$270,000	CDM Report (Table 5-8)
10.3	Intake Component - Open Screen	$240,000	K/J Report (Table 12-3) - incl cleaning, maintenance, inspections
11.0	**Chemicals (Facility)**	$530,000	CDM Report (Table 5-6)
12.0	**Contingency**	$495,000	at 10% of above O&M costs
	Annual O&M Costs ($/year)	**$5,445,000**	
	Annual Unit O&M Costs ($/AF)	**$1,470**	

Engineers Opinion of Probable Cost
Alternative 2 - Screened Open-Ocean Intake (Wharf Area)

KENNEDY/JENKS CONSULTANTS

Study:	Santa Cruz Desalination Update (3.3 MGD)	**Prepared By:**	AP, DTT, TKR	**Average Annual Ocean Water**	3.30	mgd
Project:	Alternative 2 - Screened Open-Ocean Intake (Wharf Area)	**Date Prepared:**	Sep-2017	**Delivered**	3696	AFY
Supply:	Ocean Water	**K/J Proj. No.**	1768015.00	**August 2017 ENR**	**12,037.27**	
Estimate:	Conceptual Level Cost-Analysis	**ENR**	2017	**February 2012 ENR**	**10,207.79**	
				September 2011 ENR	**10,192.79**	
				June 2014 ENR	**10,899.59**	

Item No.	**Description**	**Qty**	**Units**	**$/Unit**	**Total Costs (w/o mark-up)** *Capital Cost (2.5 MGD, 2012 USD)*	*Capital Cost (3.3 MGD, 2012 USD)*	*Capital Cost (3.3 MGD, 2017 USD)*	**Notes/Source**
Facility Capital Costs								
								Source: (CDM, 2012) scwd2 Regional Desal Report
								Scaled to reflect increased flow and ENR index (as shown)
1.0	**Desalination Facility**				**$ 28,460,000**	**$ 33,460,000**	**$ 39,450,000**	
1.1	Site Work	1	LS	$ 1,728,024	$ 1,728,024	$ 1,728,024	$ 2,037,727	
1.2	Landscape	1	LS	$ 600,000	$ 600,000	$ 600,000	$ 707,534	
1.1	Control Building	1	LS	$ 1,144,391	$ 1,144,391	$ 1,144,391	$ 1,349,493	Assumed same size building for 2.5 MGD or 3.3 MGD facility
1.2	DAF Basins	1	LS	$ 2,229,269	$ 2,229,269	$ 2,675,123	$ 3,154,569	
1.3	Membrane Building (and Chemical Storage Area)	1	LS	$ 16,383,930	$ 16,383,930	$ 19,660,716	$ 23,184,386	
1.4	Calcite Contactors	1	LS	$ 1,240,895	$ 1,240,895	$ 1,489,074	$ 1,755,952	
1.5	Chlorine Contact Tank/Clearwell and HSPS	1	LS	$ 1,265,587	$ 1,265,587	$ 1,518,704	$ 1,790,893	
1.6	Concentrate EQ Basin and Pump Station	1	LS	$ 1,860,070	$ 1,860,070	$ 2,232,084	$ 2,632,127	
1.7	Clarifiers/Thickeners	1	LS	$ 927,039	$ 927,039	$ 1,112,447	$ 1,311,824	
1.8	Pump Station	1	LS	$ 1,079,011	$ 1,079,011	$ 1,294,813	$ 1,526,875	
2.0	**Sea Water Intake (Site 18)**				**$ 20,900,000**	**$ 25,320,000**	**$ 29,850,000**	Source: (URS, 2012)
2.1	Microtunnel/HDD two 36-in pipes in 8-ft casing	2,000	LF	$ 2,500	$ 5,000,000	$ 6,000,000	$ 7,075,343	Scaled to reflect increased facility size and ENR index (as shown)
2.2	Dredging for two 36-in pipes	2,750	LF	$ 1,000	$ 2,750,000	$ 3,300,000	$ 3,891,439	
2.3	Landside Mobilization	1	LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,179,224	
2.4	Waterside Mobilization	1	LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,179,224	
2.5	Intake Screen and Structure	1	LS	$ 800,000	$ 800,000	$ 1,920,000	$ 2,264,110	Ratio increase and doubled original 2012 cost due to decrease in screen
2.6	Intake Pump Station - Rock Excavation	56	FT (depth)	$ 27,000	$ 1,512,000	$ 1,512,000	$ 1,782,987	opening from 2mm to 1mm
2.7	Intake Pump Station - Rock Disposal	56	FT (depth)	$ 1,500	$ 84,000	$ 84,000	$ 99,055	
2.8	Intake Pump Station Facility and Equipment	1	LS	$ 3,000,000	$ 3,000,000	$ 3,600,000	$ 4,245,206	
2.9	Transfer Pipeline to the Plant	11,500	LF	$ 500	$ 5,750,000	$ 6,900,000	$ 8,136,645	
3.0	**Radial Well Collectors**						**$ -**	
	None for this alternative	0			$ -			
4.0	**Brine Disposal**				**$ 4,190,000**	**$ 4,630,000**	**$ 5,310,000.00**	
4.1	Brine Line Installation	7,300	LF	$ 300.00	$ 2,190,000.00	$ 2,628,000.00	$ 3,099,000.43	Brine Line length from URS Figure 4-3. Assumed same unit cost as Transfer Pipeline to Plant cost for other location b/c in same area
4.2	Intertie with WWTP Effluent Outfall Pipeline	1	LS	$ 2,000,000.00	$ 2,000,000.00	$ 2,000,000.00	$ 2,208,756.48	ENR Index 2014; Source (Power, 2014)
	Subtotal Facility Costs				**$53,550,000**	**$63,410,000**	**$74,610,000**	
Additional Facility Capital Costs								
5.0	Site Development Costs	@	5%		2,677,500	3,170,500	3,730,500	% of Subtotal facility, sea water intake, and brine costs
								(Includes grading, erosion control, cut/fill, etc.)
6.0	Yard Piping	@	5%		2,677,500	3,170,500	3,730,500	% of Subtotal facility, sea water intake, and brine costs
7.0	Electrical, I&C, and Remote (low-tech) Control	@	15%		8,032,500	9,511,500	11,191,500	% of Subtotal facility, sea water intake, and brine costs
	Subtotal Additional Facility Costs				**$13,387,500**	**$15,852,500**	**$18,652,500**	
	Facility Direct Costs				**$66,937,500**	**$79,262,500**	**$93,262,500**	
	Taxes	@	8.75%		1,874,250	2,219,350	2,611,350	apply taxes to 40% of the Subtotal Facility Costs
	Mobilization/Bonds/Permits	@	5%		3,346,875	3,963,125	4,663,125	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		10,040,625	11,889,375	13,989,375	% of Facility Direct Costs
	Estimate Contingency	@	35%		23,428,125	27,741,875	32,641,875	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$105,627,375**	**$125,076,225**	**$147,168,225**	
								Escalation to Midpoint of Construction not applied
	Escalation to Midpoint of Construction				0	0	0	assume 2% percent over 10
								construction start = 2025 end = 2027
	Project Capital Cost Total				**$105,600,000**	**$125,100,000**	**$147,200,000**	2012 Cost is comparable to CDM Desal Construction Cost ($66mil) + URS Intake Construction Cost ($36mil). Eng/Design and Environmental Permitting not included.
	Annualized Capital Cost ($mil/year)						**$7.7**	assume discount rate (i = 4%) and facility life (n = 30 to 50 years)

Item No.	**Description**	**Lump Sum Annual Costs ($/year)**	
Annual Operations and Maintenance Costs			
			Source: (CDM, 2012), Includes escalation to 2017; scaled to reflect increased flow
8.0	**Energy Costs**		Intake Source: (K/J, 2011) Inflated using ENR CI; sclaled to reflect increased flow
8.1	Energy Costs - Facility	$2,690,000	CDM Report (Table 5-4) - not incl raw water pumping
8.2	Raw Water Pumping Cost (from intake)	$300,000	K/J Report (Table 12-3)
9.0	**Labor Costs**	$670,000	CDM Report (Table 5-5)
10.0	**Maintenance**		
10.1	Consumable Replacements	$350,000	CDM Report (Table 5-7)
10.2	Solids Disposal	$270,000	CDM Report (Table 5-8)
10.3	Intake Component - Open Screen	$260,000	K/J Report (Table 12-3) - incl cleaning, maintenance, inspections
11.0	**Chemicals**	$530,000	CDM Report (Table 5-6)
12.0	**Contingency**	$507,000	at 10% of above O&M costs
	Annual O&M Costs ($/year)	**$5,577,000**	
	Annual Unit O&M Costs ($/AF)	**$1,510**	

Engineers Opinion of Probable Cost
Alternative 3 - Subsurface Intake System (Wharf Area)

KENNEDY/JENKS CONSULTANTS

Study:	Santa Cruz Desalination Update (3.3 MGD)	**Prepared By:**	AP, DTT, TKR	**Average Annual Ocean Water**	3.30 mgd
Project:	Alternative 3 - Subsurface Intake System (Wharf Area)	**Date Prepared:**	Sep-2017	**Delivered**	3696 AFY
Supply:	Ocean Water	**K/J Proj. No.**	1768015.00	**August 2017 ENR**	**12,037.27**
Estimate:	Conceptual Level Cost-Analysis	**ENR**	2017	**February 2012 ENR**	**10,207.79**
				September 2011 ENR	**10,192.79**
				June 2014 ENR	**10,899.59**

Item No.	Description	Qty	Units	$/Unit	Total Costs (w/o mark-up): *Capital Cost (2.5 MGD, 2012 USD)*	*Capital Cost (3.3 MGD, 2012 USD)*	*Capital Cost (3.3 MGD, 2017 USD)*	Notes/Source
Facility Capital Costs								
								Source: (CDM, 2012) scwd2 Regional Desal Report
								Scaled to reflect increased flow and ENR index (as shown)
1.0	**Desalination Facility**				**$ 28,460,000**	**$ 33,460,000**	**$ 39,450,000**	
1.1	Site Work	1	LS	$ 1,728,024	$ 1,728,024	$ 1,728,024	$ 2,037,727	
1.2	Landscape	1	LS	$ 600,000	$ 600,000	$ 600,000	$ 707,534	
1.1	Control Building	1	LS	$ 1,144,391	$ 1,144,391	$ 1,144,391	$ 1,349,493	Assumed same size building for 2.5 MGD or 3.3 MGD facility
1.2	DAF Basins	1	LS	$ 2,229,269	$ 2,229,269	$ 2,675,123	$ 3,154,569	
1.3	Membrane Building (and Chemical Storage Area)	1	LS	$ 16,383,930	$ 16,383,930	$ 19,660,716	$ 23,184,386	
1.4	Calcite Contactors	1	LS	$ 1,240,895	$ 1,240,895	$ 1,489,074	$ 1,755,952	
1.5	Chlorine Contact Tank/Clearwell and HSPS	1	LS	$ 1,265,587	$ 1,265,587	$ 1,518,704	$ 1,790,893	
1.6	Concentrate EQ Basin and Pump Station	1	LS	$ 1,860,070	$ 1,860,070	$ 2,232,084	$ 2,632,127	
1.7	Clarifiers/Thickeners	1	LS	$ 927,039	$ 927,039	$ 1,112,447	$ 1,311,824	
1.8	Pump Station	1	LS	$ 1,079,011	$ 1,079,011	$ 1,294,813	$ 1,526,875	
2.0	**Sea Water Intake**				**$ 20,900,000**	**$ 22,710,000**	**$ 26,780,000**	Source: (URS, 2012) and (K/J, 2011)
2.1	Microtunnel/HDD two 36-in pipes in 8-ft casing	2,000	LF	$ 2,500	$ 5,000,000	$ 6,000,000	$ 7,075,343	Scaled to reflect increased facility size and ENR index (as shown)
2.2	Dredging for two 36-in pipes	2,750	LF	$ 1,000	$ 2,750,000	$ 1,650,000	$ 1,945,719	Cost halved because only for back up screened intake
2.3	Landside Mobilization	1	LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,179,224	
2.4	Waterside Mobilization	1	LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,179,224	
2.5	Intake Screen and Structure	1	LS	$ 800,000	$ 800,000	$ 960,000	$ 1,132,055	Overall Cost is Halved from Alt 1 and 2 b/c assumed half of the screen structure would be installed with the Radial Collector Wells
2.6	Intake Pump Station - Rock Excavation	56	FT (depth)	$ 27,000	$ 1,512,000	$ 1,512,000	$ 1,782,987	
2.7	Intake Pump Station - Rock Disposal	56	FT (depth)	$ 1,500	$ 84,000	$ 84,000	$ 99,055	
2.8	Intake Pump Station Facility and Equipment	1	LS	$ 3,000,000	$ 3,000,000	$ 3,600,000	$ 4,245,206	
2.90	Transfer Pipeline to the Plant	11,500	LF	$ 500	$ 5,750,000	$ 6,900,000	$ 8,136,645	
3.0	**Radial Well Collectors**				**$ 32,880,000**	**$ 32,880,000**	**$ 38,830,000**	Source (K/J, 2011)
3.1	Radial Well Collector Installation	1	LS	$ 19,600,000	$ 19,600,000	$ 19,600,000	$ 23,146,802	
3.2	Offshore Intake Pipeline	1	LS	$ 7,400,000	$ 7,400,000	$ 7,400,000	$ 8,739,099	
3.4	Radial Well Collector Installation Contingency	30%			$ 5,880,000	$ 5,880,000	$ 6,944,041	30% Contingency for installing collector wells in a manner they have not been installed before
4.0	**Brine Disposal**				**$ 4,190,000**	**$ 4,630,000**	**$ 5,310,000**	Brine Line length from URS Figure 4-3. Assumed same unit cost as Transfer Pipeline to Plant
4.1	Brine Line Installation	7,300	LF	$ 300	$ 2,190,000	$ 2,628,000	$ 3,099,000	cost for other location b/c in same area
4.2	Intertie with WWTP Effluent Outfall Pipeline	1	LS	$ 2,000,000	$ 2,000,000	$ 2,000,000	$ 2,208,756	ENR Index 2014; Source (Power, 2014)
	Subtotal Facility Costs				**$86,430,000**	**$93,680,000**	**$110,370,000**	
Additional Facility Capital Costs								
5.0	Site Development Costs	@	5%		4,321,500	4,684,000	5,518,500	% of Subtotal treatment, pump station, storage, discharge facility and well costs
								(Includes grading, erosion control, cut/fill, etc.)
6.0	Yard Piping	@	5%		4,321,500	4,684,000	5,518,500	% of Subtotal treatment, pump station, storage, discharge facility and well costs
7.0	Electrical, I&C, and Remote (low-tech) Control	@	15%		12,964,500	14,052,000	16,555,500	% of Subtotal treatment, pump station, storage, discharge facility and well costs
	Subtotal Additional Facility Costs				**$21,607,500**	**$23,420,000**	**$27,592,500**	
	Facility Direct Costs				**$108,037,500**	**$117,100,000**	**$137,962,500**	
	Taxes	@	8.75%		3,025,050	3,278,800	3,862,950	apply taxes to 40% of the Subtotal Facility Costs
	Mobilization/Bonds/Permits	@	5%		5,401,875	5,855,000	6,898,125	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		16,205,625	17,565,000	20,694,375	% of Facility Direct Costs
	Estimate Contingency	@	35%		37,813,125	40,985,000	48,286,875	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$170,483,175**	**$184,783,800**	**$217,704,825**	
								Escalation to Midpoint of Construction not applied
	Escalation to Midpoint of Construction				0	0	0	assume 2% percent over 10
								construction start = 2025 end = 2027
	Project Capital Cost Total				**$170,500,000**	**$184,800,000**	**$217,700,000**	2012 Cost is comparable to CDM Desal Construction Cost ($66mil) + URS Intake Construction Cost ($36mil) + K/J Redial Well Construction Cost ($37mil). Eng/Design and Environmental Permitting not included.
	Annualized Capital Cost ($mil/year)						**$11.9**	assume discount rate (i = 4%) and facility life (n = 30 to 50 years)

Item No.	Description	Lump Sum Annual Costs ($/year)	
Annual Operations and Maintenance Costs			
			Source: (CDM, 2012), Includes escalation to 2017, scaled to reflect increased flow
8.0	**Energy Costs**		Intake Source: (K/J, 2011) Inflated using ENR CI; sclaled to reflect increased flow
8.1	Energy Costs - Facility	$2,690,000	CDM Report (Table 5-4) - not incl raw water pumping
8.2	Raw Water Pumping Cost (from intake)	$300,000	K/J Report (Table 12-3) - based on conveyance from Warf area
9.0	**Labor Costs - Facility**	$670,000	CDM Report (Table 5-5)
10.0	**Maintenance**		
10.1	Consumable Replacements	$350,000	CDM Report (Table 5-7)
10.2	Solids Disposal	$270,000	CDM Report (Table 5-8)
10.3	Intake Component - Radial Wells	$200,000	K/J Report (Table 12-3) - incl cleaning, maintenance, inspections
10.4	Intake Component - Open Screen	$130,000	K/J Report (Table 12-3) - redundant smaller open screen area assumed
11.0	**Chemicals**	$530,000	CDM Report (Table 5-6)
12.0	**Contingency**	$514,000	at 10% of above O&M costs
	Annual O&M Costs ($/year)	**$5,654,000**	
	Annual Unit O&M Costs ($/AF)	**$1,530**	

CITY OF SANTA CRUZ

WATER COMMISSION
INFORMATION REPORT

DATE: 10/31/2017

AGENDA OF:	November 6, 2017
TO:	Water Commission
FROM:	Rosemary Menard
SUBJECT:	Water Supply Advisory Committee Change Management and Decision-Making Framework

RECOMMENDATION: That the Water Commission acknowledge the Water Supply Advisory Committee's Change Management and Decision-Making Framework as the foundation of decision making for a preferred future supplemental water supply project or portfolio of projects that will be implemented to improve the reliability of the Santa Cruz water supply.

BACKGROUND: As the Santa Cruz Water Supply Advisory Committee (WSAC) developed its recommendations to the City Council, Committee members realized that their recommendations were going to shift final decision-making about a preferred approach to improving the reliability of the Santa Cruz water supply to a date beyond the end of their work together. This outcome was the result of their recommendation to complete "level playing field" technical feasibility and cost analyses for the three main supply augmentation strategies being recommended for further evaluation. The WSAC believed it was important to the success of its recommendations and the community agreements that were reflected in those recommendations to provide specific direction on how to deal with change management if and as needed while the analytical work was proceeding as well as to provide a framework to inform the ultimate decision-making process.

The change management and decision-process section of the WSAC Final Report on Agreements and Recommendations is included as Attachment 1 and the full report can be accessed and reviewed at http://www.santacruzwatersupply.com/meeting/wsac-final-reportrecommendation-appendices . Attachment 2 is a PowerPoint summary presentation of the material presented in Attachment 1.

DISCUSSION: Over the last two years, the Water Commission has been receiving regular reports on the Water Department's progress in implementing the work plan developed by the WSAC and approved by the City Council in November 2015. In the coming three years, the Water Department will both continue to implement the technical, engineering and cost analyses described in the work plan and begin to set up and develop the data needed to support the "level playing field" comparison of all of the supplemental supply that will occur as part of the eventual decision-making process.

The goal of this Agenda item is to provide a briefing to the Water Commissioners on the basic decision-making approach the WSAC laid out as well as the ways that the WSAC's recommended and Council adopted values and preferences will shape both the analyses and the ultimate decision. This discussion is timely because in the months ahead the Water Department will be setting up the technical and analytical framework for this work and will be bringing these proposals to the Water Commission for its review and discussion.

FISCAL IMPACT: None

PROPOSED MOTION: Motion to acknowledge the Water Supply Advisory Committee's Change Management and Decision-Making Framework as the foundation of decision making for a preferred future supplemental water supply project or portfolio of projects that will be implemented to improve the reliability of the Santa Cruz water supply.

ATTACHMENTS:

Attachment 1 –	Excerpt of Section 3.24 of the WSAC's Final Report on Agreements and Recommendations on Change Management
Attachment 2 –	PowerPoint summary presentation on the WSAC's Change Management and Decision-Making Process

[redacted]

Section 3.24 WSAC's Change Management Strategy

A major goal of the WSAC's Change Management Strategy is to establish clearly defined mechanisms for dealing with changes that will need to be made to the Plan over time. The success of whatever is done to implement the proposed recommendations is dependent upon a high degree of both transparency and accountability. The Change Management Strategy the WSAC has developed is specifically designed to facilitate that success.

(a) The Plan-Do-Check-Act Cycle[22]

The basic premise of the WSAC's Change Management Strategy is that developing and implementing any Plan, and the projects within a plan, is a cyclic activity of continuous improvement that involves planning, doing, checking and acting (PDCA). Figure 9 shows this cycle and describes each part.

Figure 9 – Plan, Do, Check, Act Cycle

Plan–Do–Check–Act Procedure

1. Plan. Recognize an opportunity and plan a change.
2. Do. Test the change. Carry out a small-scale study.
3. Check. Review the test, analyze the results and identify what you've learned.
4. Act. Take action based on what you learned in the study step: If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate what you learned from the test into wider changes. Use what you learned to plan new improvements, beginning the cycle again.

This cycle is designed to incorporate new information and well adapted to the circumstances involved in implementing the Water Supply Augmentation Plan (Plan).

The elements of the WSAC's Change Management Strategy include the following:

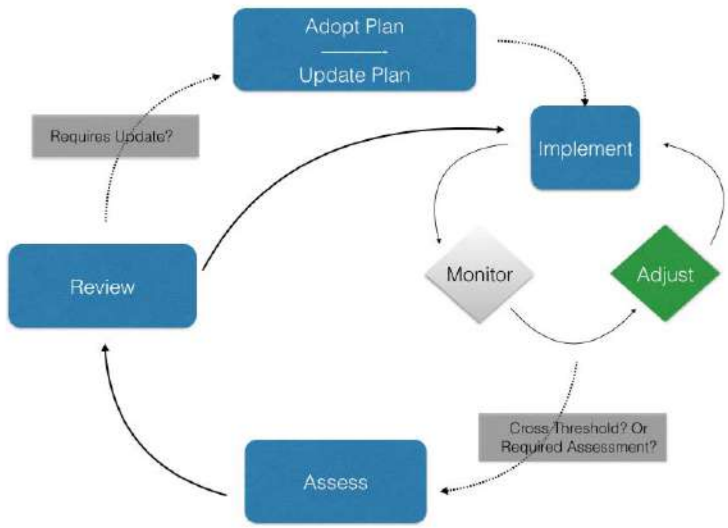
1. A Plan-Do-Check-Act model specifically adapted to the work being planned;
2. An Adaptive Pathway framework for implementing the three main supply augmentation elements;
3. Guiding Principles reflecting the WSAC's values and priorities;

[22] From: http://asq.org/learn-about-quality/project-planning-tools/overview/pdca-cycle.html

4. Procedures for implementing the strategy, including roles and responsibilities for Water Department staff and the Water Commission as they work with the Council on the issues and initiatives covered by the plan; and
5. Guidance for Decision-Making.

Figure 10 shows the Change Management Process WSAC developed:

Figure 10 – WSAC Change Management Process



This framework actually incorporates a smaller PDCA cycle within the larger PDCA cycle. The larger PDCA framework functions in concert with the adaptive pathways and mostly relates to adaptive decisions that would need to be made to switch from one path to another. The smaller PDCA cycle is shown on the upper right of the figure above as the "Implement, Monitor, Adjust" cycle and would be used to make needed adjustments while implementing the various Plan Elements that are part of the Plan. For example, as in lieu and ASR are being developed, their progress in meeting their project goals would be monitored. An adjustment would be needed if, for example, eight wells were needed to produce the desired yield instead of the six originally estimated. The sections below present the parameters and mechanisms the WSAC developed to guide the implementation of the Water Supply Augmentation Plan.

(b) Definitions and Context

The WSAC's Change Management Strategy was built around several specific definitions and application of concepts. This section provides the definitions and context used in the Change Management Strategy and the circumstances under which the various adaptation approaches would be used.

1. An **Adjustment** is a change in implementation that helps the Plan stay on track. In a continuous feedback loop, the Water Department will make adjustments to help achieve (or exceed) performance targets for the various Plan Elements.

2. A**n Adaptation** is a shift from an Element or a set of Elements to another Element or set of Elements within the Plan's Adaptive Pathway. An adaptation may be recommended when certain thresholds are reached.
3. **Guiding Principles** are qualitative policy and value-based provisions that are taken into account in decision-making along with quantitative information that will be available.
4. A T**hreshold** is the set of information that leads to an Assessment of the Plan and possible adaptation. The Committee identified thresholds for the key issues that need to be considered during decision-making about a possible Adaptation. The goal was to avoid trying to address each possible eventuality, and to focus on overall program goals rather than implementation specifics. Once a threshold issue has prompted an assessment, other considerations captured in the Guiding Principles, such as regional collaborations or the collateral benefits of an approach, may be taken into consideration. The thresholds are:
   - Cost
   - Yield
   - Timeliness
5. **Performance Metrics** are developed and used to assess how well individual Elements are tracking against their performance targets. As work on implementing the Plan Elements goes forward, tracking performance will generate information that will be used in several ways:
   a. Deliver greater understanding about the system from management activities, technical work, pilot testing and modeling results and other work.
   b. Ongoing cycles of monitoring and adjusting may help the Department keep the Elements moving forward to achieve their goals and determine when and how Adjustments might affect overall goals or when Adaptation may be appropriate.

   The Committee had a chance to learn about the potential Performance Metrics that would be used in assessing Element 2, ASR, through all of its developmental phases. Further work will be needed to develop Performance Metrics for other Plan Elements.
6. **Catastrophic Events** (or other exogenous events), such as earthquakes or wildfire could disrupt the plan. Catastrophic Events are low probability/high consequence events.

(c) Guiding Principles

The Committee recommends that the following Guiding Principles be taken into account in all applications of the Change Management Strategy:

- **Public Health** – public health protection is every water utility's most fundamental duty. The SCWD, as an organization, and as individual employees, work every day to produce and deliver an adequate and high quality supply of water that complies with numerous public health-based regulatory standards and is used for human consumption, sanitation, for other domestic and commercial use and for fire protection.

  WSAC recommends that, prior to reaching a decision on a potential preferred supply augmentation project; the City will consult with experts (recommended by the Water Department and approved by City Council) in public health, endocrinology and water chemistry to evaluate and report on local water quality data and the public health implications of the preferred choice. This consultation would take place with ample opportunity for public review and input.

- **Public Acceptance** –The Committee was aware that the most important reason for convening the WSAC was to address the public's concerns about the proposed desalination plant. The Committee notes public acceptance issues were raised during the WSAC process about costs, including overall costs and costs to rate-payers, energy consumption, schedule for implementation and public health concerns.

  The WSAC has, throughout its process, created and applied criteria reflecting the community's values. Along with the yield, costs, timeliness and technical feasibility of various supply augmentation alternatives (including conservation), the Committee also considered energy use, and environmental impacts of the alternatives. Accordingly, these considerations and criteria should be taken into account in any future decision-making.
- **Regional Collaboration** – Where consistent with the goal of achieving a sufficient water supply, the City should promote regional collaboration to improve water supplies, reversing or slowing seawater intrusion, and support habitat restoration.
- **Plan Goal** – The Committee agrees that, to improve the sufficiency and reliability of Santa Cruz's supply using groundwater storage, an additional 2.4 billion gallons of water needs to be accessible from regional aquifers in a timely manner which will require storage of a larger volume. This additional storage, along with other key infrastructure modifications outlined in the Plan, would provide water needed to meet a worst year peak season shortage of 1.2 billion gallons under forecasted climate change and DFG5 flows.
- **Incremental Implementation** – An important premise of the Water Supply Augmentation Plan is incremental implementation. The Committee worked to develop a phased approach to develop the additional water supply needed and to integrate this approach into the Adaptive Pathway and Change Management Strategy. A significant benefit of this approach is that it will help the City avoid investing resources before they are needed and justified based on performance and other metrics.

(d) Change Management Strategy

As the Water Department implements this Plan, the Committee recommends that staff apply the following Committee agreements in making adjustments and recommending adaptations:

For Adjustments:

1. Diligently implement the groundwater storage strategy: when implementing Plan Elements related to groundwater storage, the City will take all reasonable and necessary steps to explore and demonstrate the technical feasibility of these approaches.
2. In addition, the City will adopt and implement communication practices that support the goals of transparency and accountability about Adjustments or Adaptations.

For Adaptations:

1. Prefer groundwater storage strategies: before making a choice to move away from groundwater storage, diligently pursue all reasonable measures to make the groundwater strategies work.
2. Should the choice need to be made between options available within Element 3, the Committee's preference is for advanced treated recycled water, rather than desalination, which is estimated to cost more and use more energy than advanced treated recycled water. The Committee viewed recycled water as more sustainable than desalinating seawater and therefore more aligned with the community's values. However, if the City determines that recycled water cannot provide sufficient yield then desalination should be pursued.
3. System robustness, resilience, redundancy, and adaptive flexibility are important values.

Thresholds are an important element of the overall Change Management Strategy. The Committee developed its agreements based on assumptions and information available to it at the time it did its work and recognized that new information would be developed as the Plan is implemented. Establishing thresholds (which could, themselves, be updated as new information is developed and analyzed) gave the Committee a way to provide parameters within which to continue developing an Element as well as clear sign posts for when the Plan or an Element might be failing to perform as anticipated. Exceeding a threshold value would not necessarily result in stopping work on an Element, but would trigger an Assessment. There are three key types of thresholds:

1. Cost
2. Yield
3. Timeliness

For several of these thresholds there is no fixed number or value. This is because for items such as cost and timeliness, the threshold value is necessarily relative to the other options available at the time the threshold is reached. The achievable schedule for implementing the Elements will become clearer as additional work is done. At a decision node, the most up-to-date information should be considered.

The Committee understood that new information would be developed as the Plan was implemented and therefore what was important was to set the threshold metric rather than the threshold value. And, in addition, the Committee understood that numbers produced by planning level analyses cannot be considered exact and thus applying an acceptable range around a threshold metric would be an appropriate way to express the Committee's values and provide flexibility in implementing the Plan.

While thresholds may operate as independent triggers for an assessment, once an assessment is undertaken it would look at each Plan Element's status as it relates to each of the thresholds as well as to the Guiding Principles. Taking this more comprehensive approach to the Assessment is intended to avoid unintended consequences that could result from applying a more narrow focus.

(i) Cost Metric

Cost-effectiveness is an important consideration in making pathway changes. Any decision on cost-effectiveness will require comparing the costs of available alternatives at the time a decision is made.

After considering the range of possible cost metrics to evaluate cost-effectiveness, the Committee recommends the threshold Cost Metric be the Annualized Cost per million gallons of Average Year Yield (ACAYY). This is the cost identified in Line k of the Project Elements Summary Table included in Appendix 8, Cost Data and Cost Analysis, which table is incorporated by reference.

This metric adds the amortized annual cost of capital investments and the annual operating and maintenance cost and divides it by the estimated project average year yield.

Amortized annual cost is preferred because it takes into account the amortized capital investment as well as operation and maintenance costs. *Average year yield* is preferred because *yield* focuses on benefits to the overall system and *the average year yield* allows comparison among options. While other costs may be considered in future decision-making, this Cost Metric was favored because it focuses on the cost of the yield produced in an average year.

(ii) Committee Preference Statement Related to Cost

Recognizing the cost differential between some of the strategies the Committee considered in developing its recommendations, the WSAC agreed to express its preference for Strategy One over Strategy Two, and has agreed that as long as the ACAYY for implementing Strategy One is not more than 130% of the ACAYY for Strategy Two, Strategy One should be pursued provided Strategy One meets other threshold metrics.

(iii) Yield Metric

The Yield Metric is the most straight-forward, the most quantifiable, and the least flexible of the thresholds. As described earlier in this document, the supply-demand gap has been established at 1.2 billion gallons per year (bgy) for the worst year, based on Confluence modeling of the frequency and severity of shortages. The analysis takes into account DFG-5 fish flows and a plausible estimate of climate change impacts.

Updating the supply-demand gap requires both new demand forecasts and the kinds of analyses described earlier in Section 3.05 and Section 3.06. This analysis will be refreshed every five years as part of the Urban Water Management Plan update.

(iv) Timeliness Metric

For the Timeliness Metric, the Committee has agreed that a 10-year window is a reasonable target for achieving water supply sufficiency, defined as having a fully functional water system able to meet the supply-demand gap forecasted during extended droughts. Assessments, Reviews and Update to Plan

1. Procedural Steps
    a. An **Assessment** is performed by the Water Department and includes updated information and a recommendation about whether a change to the Plan is needed.

   b. The Water Department submits a report to the Water Commission for its **Review, including development of recommendations to the Council**. Following Water Commission action, the recommendation is forwarded to the Council for its consideration.
   c. If the Council so chooses, the Plan will be **updated**.

2. Information Sharing
   a. The Water Department will report to the Water Commission and the City Council
      i. At all decision nodes identified in the Plan;
      ii. Informally, as part of the Water Director's Oral Report at each Water Commission meeting, providing specific information about work in progress, successes and failures, and challenges and opportunities;
      iii. Quarterly in the spring, summer and fall, as an agenda item with accompanying staff report on the Water Commission agenda for discussion, public comment, and action as needed; and
      iv. Formally and annually to the Water Commission and the City Council in the winter of each year during the budget cycle, including Plan performance and significant adjustments
   b. As part of the Water Commission's and City Council's review of an updated Urban Water Management Plan, including
      i. Performance
      ii. Significant adjustments
      iii. Updated Plan Goals and Assumptions (including demand, climate change, systems improvements etc.)
3. If the Water Department recommends an adaptation, such a report must contain a synthesis of each Strategy and/or Element's actual performance or most current projected performance against the most current Thresholds and an evaluation of whether the performance of individual Elements warrants making a change to the Plan as a whole, or to one or more Elements within the Plan.

(e) Staggered Adaptive Pathway and Decision Nodes

At its September 10, 2015 meeting, the Committee agreed to use a staggered implementation approach. Figure 11 shows the agreed-upon adaptive pathway map, and Table 16 lists the numbered decision nodes and provides descriptions about the expected information, decision, or result anticipated at that node.

Figure 11 – Agreed-Upon Adaptive Pathway Map

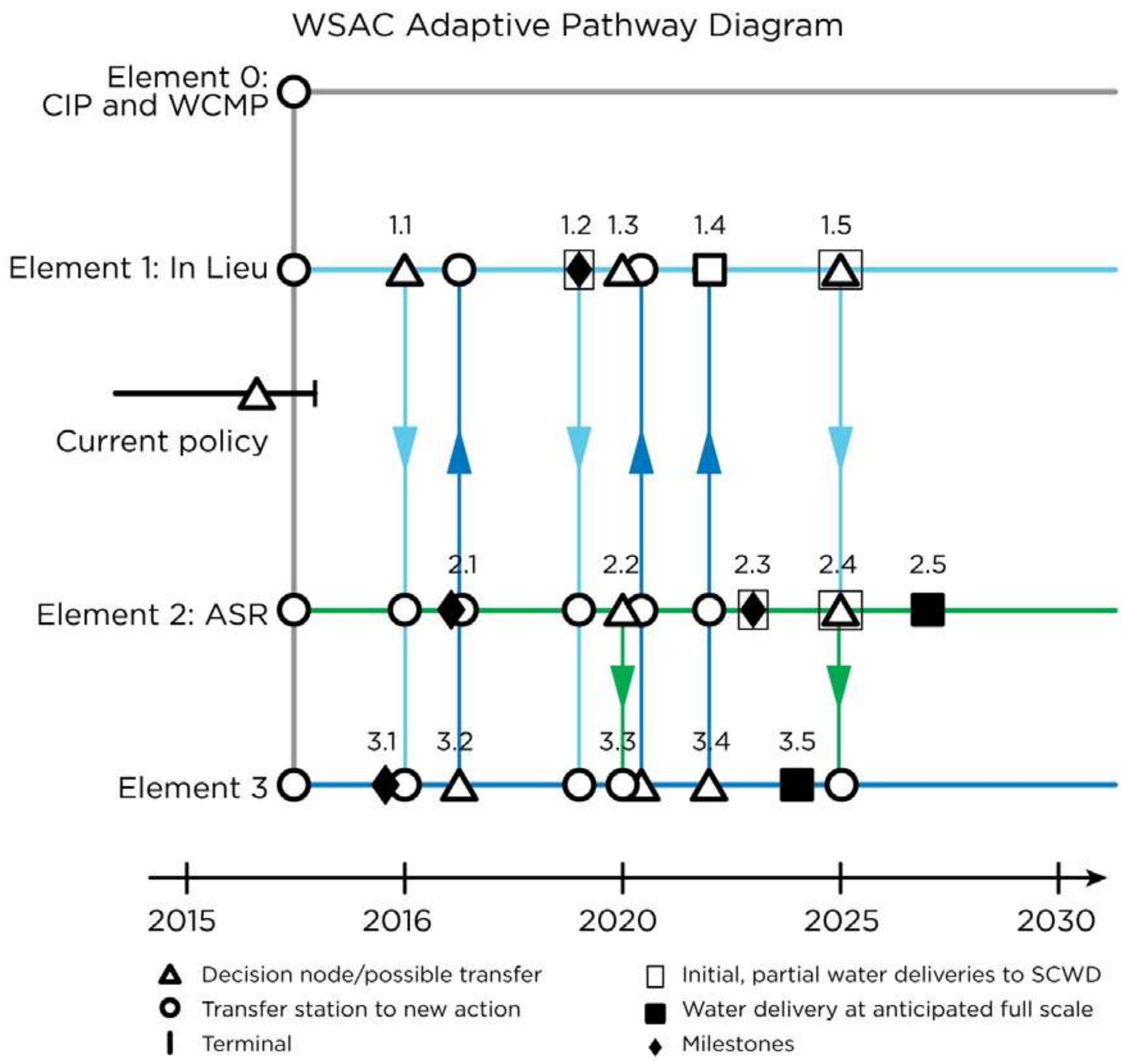


Table 16 – Table of Decision Nodes and Related Milestones

NODE	ABBREVIATED DESCRIPTION	ENDING YEAR
In Lieu (Element 1)		
1.1D △	Near Term: Initiation of near term water transfer/sale to SqCWD using North Coast water; agreements in place, and CEQA completed.	c. 2016
1.2M ◇	Larger Project: Understanding the feasibility of a potentially larger water transfer/exchange project with SqCWD and/or SVWD using North Coast and San Lorenzo River waters. Includes quantifying return water (using groundwater models) from SqCWD and/or SVWD to Santa Cruz as well as understanding of water rights and inter-agency collaboration.	c. 2018
1.3W/D □ △	Larger Project: Completion of agreements specifying terms of transfers to/from SqCWD and/or SVWD, water right modifications, planning/prelim design; complete assessments of cost, yield and schedule; and define CEQA. Decision point for proceeding on final design of associated infrastructure improvements.	c. 2019 c. 2020
1.4W □	Larger Project: Potential for return of water from SqCWD, and/or SVWD, to SCWD with the construction of infrastructure/treatment improvements.	c. 2022
1.5D/W △ ■	Assess in lieu performance: amount to SqCWD, SVWD, and SCWD; reduced groundwater pumping, groundwater elevations, etc.	c. 2025
Aquifer Storage and Recovery, ASR (Element 2) Includes evaluation of Purisima and Santa Margarita		
2.1M ◇	High level feasibility work: use of groundwater model; completion of site specific injection capacity and geochemical analyses; development of pilot program.	c. 2017
2.2D △	Completion of all administrative items to conduct pilot testing (e.g., CEQA/permits/agreements and well modifications), completion of pilot testing, and assessment of probable ASR system performance, cost and schedule to complete build out of ASR system.	c. 2020
2.3M/W ◇ □	Develop/construct ASR wells, ready to operate.	c. 2022
2.4D/W △ □	Assess ASR performance against projections and ability to meet project goals.	c. 2024
2.5W ■	Aquifer storage target attained (ability to sustain return flows to SCWD at desired levels).	c. 2027
Advanced Treated Recycled Water or Desalination (Element 3)		
3.1M ◇	Identify recycled water alternatives; increase understanding of recycled water (regulatory framework, feasibility, funding opportunities, public outreach and education)	c. 2016

3.2D	Complete high level feasibility studies, as-needed demonstration testing, and conceptual level designs of alternatives;, define CEQA processes; and continue public outreach and education. Select preferred Element 3.	c. 2017
3.3D	Preliminary design, CEQA (including preparation of draft EIR), and apply for approvals and permits (except building permit).	c. 2020
3.4M	Complete property acquisition, final design, complete CEQA and all permits.	c. 2022
3.5W	Construction completed: plant start-up, water production begins	c. 2024

Abbreviations

ASR = Aquifer Storage and Recovery
CEQA = California Environmental Quality Act
DDW = Division of Drinking Water
DPR = Direct Potable Reuse
GHWTP = Graham Hill Water Treatment Plant
IPR = Indirect Potable Reuse
SCWD = Santa Cruz Water Department
SqCWD = Soquel Creek Water District
SVWD = Scotts Valley Water District

Notes

- This table is intended as a companion piece to the implementation Gantt chart and subway map. Gantt chart contains additional activity detail(s) for each node.
- Node types
  - D = decision node (triangle on subway chart)
  - M = milestone (diamond on the subway chart), furthering the understanding of feasibility.
  - W = water production potentially available (squares on the subway chart; open square indicates some water; solid square represents full goal being met).
- Node types have been assigned based on a set of assumptions as to how the implementation will proceed. However, if a threshold is being tripped, the node becomes a decision node regardless of its current designation.
- Ending Year refers to when all work associated with reaching node and/or achieving goal(s) will be accomplished. Dates shown are approximate based on current information and project understanding. Dates may adjust depending on: volumes of water available due to winter precipitation levels (which may limit amount of in lieu and ASR); ability to establish agreements, permits, etc.; and ability to implement workload.

As noted in earlier discussions, thresholds represent "special decision nodes" that can be reached by any Element, at any time.

(f) Guidance for Decision-Making at Decision Nodes

This section provides guidance for decision-making.

When a decision node on the adaptive pathway map is reached, or when the Plan or any Element appears it will fail to meet any threshold value at any time, the Committee's Change Management Strategy recommends a "pause and assess" step. At this juncture, there are three basic kinds of decisions:

1. A decision to stay on the same path;
2. A decision to add another path or paths; or
3. A decision to switch to a different path or paths.

A decision to stay on the same path may include consideration of a range of actions. A decision to continue to the next phase in the Plan's development could involve, for example:

- Moving from preliminary engineering to design, or
- Expanding an element by deciding to make additional infrastructure investments, or
- Deciding not to put additional money into an element or approach that is struggling but to maintain the production already developed.

In general the possible decisions associated with the staying on the same pathway include:

- Start planning and/or pilot testing,
- Start preliminary engineering and/or regulatory and permitting processes,
- Start final design,
- Start construction,
- Build out or scale up,
- Stop further investment,
- Operate and maintain, and
- Stop pursuing altogether.

A decision to switch to a different path or paths may result from concluding that a particular task cannot be accomplished, for example not reaching agreement with other regional water providers for in lieu recharge, or from a failure to meet any threshold.

Recommended factors to be taken into account in decision-making about Plan implementation include the Guiding Principles as well as how well Plan Elements are performing relative to their Performance Metrics or Thresholds.

(i) Examples of Decision Guidance

This section provides several specific examples of decision guidance or special considerations for adjustments, adaptation or decision-making at specific decision nodes. Refer to Table 16 for details about decision nodes.

- **Element 1, Decision Node 1.3**
  - Build Out Element 1 – If agreements with one or more regional partners are reached, water rights issues have been resolved, assumptions about the availability of river flows are confirmed, and groundwater modeling indicates sufficient water will be returned to Santa Cruz in a cost-effective and timely manner, then proceed to build out water transfers up to the original design limits of Element 1, adding additional infrastructure as needed to optimize project effectiveness.

  - Stop Element 1 – If no agencies choose to participate with the City in pursuing in lieu recharge, including return of sufficient stored water in a cost-effective and timely manner, the City will evaluate whether Element 1 should be pursued further or abandoned.
- **Element 2, Decision Node 2.2**
  - Build Out Element 2 – Use results of pilot testing and estimates of cost-effectiveness and schedule for final system build-out to decide whether to continue implementing ASR up to the original design limits of Element 2.
  - Stop Element 2 – Consider stopping Element 2 if the solution is not working within acceptable performance parameters, for example, something systemic to the aquifer appears to make too many test sites unsuccessful in effecting aquifer recharge, or costs greatly exceed budget, or the schedule for final build-out exceeds the target completion date, and other Elements can meet or exceed their performance parameters, such that the Plan can meet its goals without Element 2.
- **Element 3, Decision Node 3.2** – Select preferred approach for Element 3 (e.g., DPR, IPR, desalination), initiate high level feasibility studies, as needed demonstration testing, and conceptual designs, define CEQA process; continue public outreach and education, and select preferred alternative.
  - Start Preliminary Design Engineering and Regulatory Process for selected Element 3 – (start work outlined in 3.3). Initiate preliminary design, prepare a draft EIR, and continue public discussions about the selected Element 3. This effort involves activity up to, but not including, site acquisition, final design and EIR (Draft EIR only at this stage). A key goal of the work would be to have Element 3 ready to go into the final design stage at node 2.2.
  - Stopping Element 3 -- Decide to stop or pause Element 3 if other Elements can meet or exceed their performance parameters, such that the Plan can meet its goals without Element 3.

As each decision is made, thresholds, performance metrics developed for each Strategy and/or Element, including budget, schedule, and yield, objective results-oriented measures, would be reviewed and changes made either within the **Adjustment** framework by the Water Department, or within the **Adaptation** framework in collaboration with the Water Commission and under the direction of the City Council. In both cases, communication about progress, issues, and actions would be open, frequent and data-based.

[redacted]

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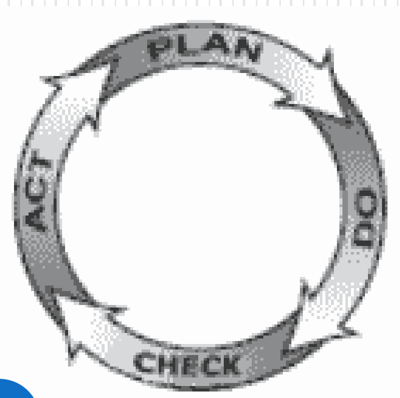
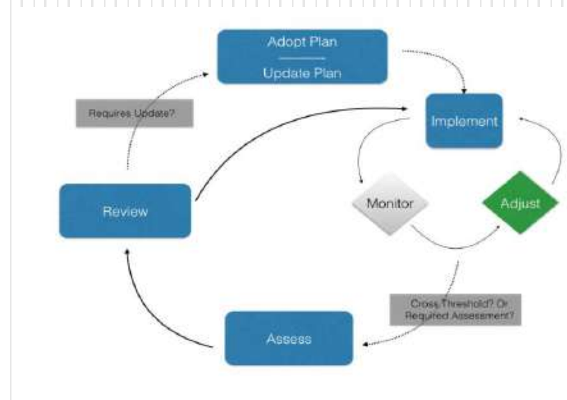
Presentation on WSAC
Change Management and Decision Making Process
for Supplemental Supply Project(s)

9.15

Santa Cruz Water Commission

November 6, 2017





WSAC Agreements and Recommendations Included Both the What and the How

- The What –
  - Exploration of two strategies to determine technical feasibility, costs, yields, time to implementation, energy use, and environmental impacts for use in quantitative comparisons.
    - Strategy 1 – Groundwater Storage
      - Element 1 – In lieu recharge of local aquifers through water transfers and exchanges
      - Element 2 – Active recharge through aquifer storage and recovery
    - Strategy 2 – Other Local Sources Requiring Advanced Purification Technology
      - Element 3 – Advanced treated recycled water or desalinated water
- The How –
  - A Change Management Strategy
  - A Decision-Making Framework with Key Performance Metrics

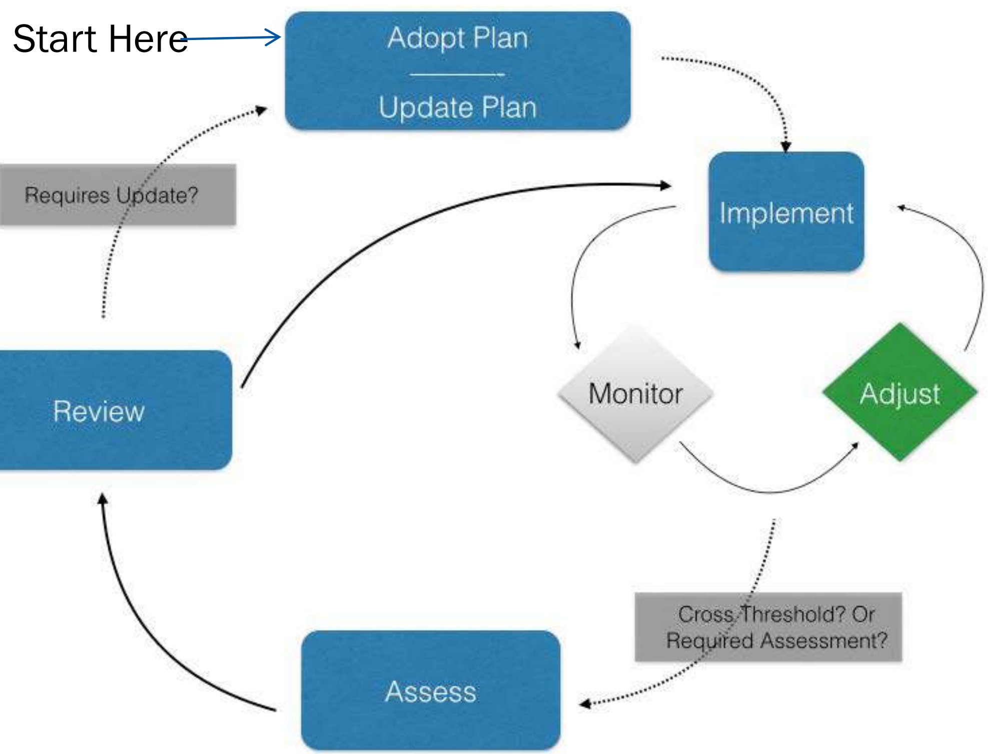
9.17

Elements of the WSAC's Change Management Strategy and Decision Process

1. A Plan-Do-Check-Act model specifically adapted to the work being planned;
2. An Adaptive Pathways framework for implementing the three main supply augmentation elements;
3. Guiding Principles reflecting the WSAC's values and priorities;
4. Procedures for implementing the Change Management Strategy, including roles and responsibilities for Water Department staff, and for the Water Commission; and
5. Guidance for Decision-Making.

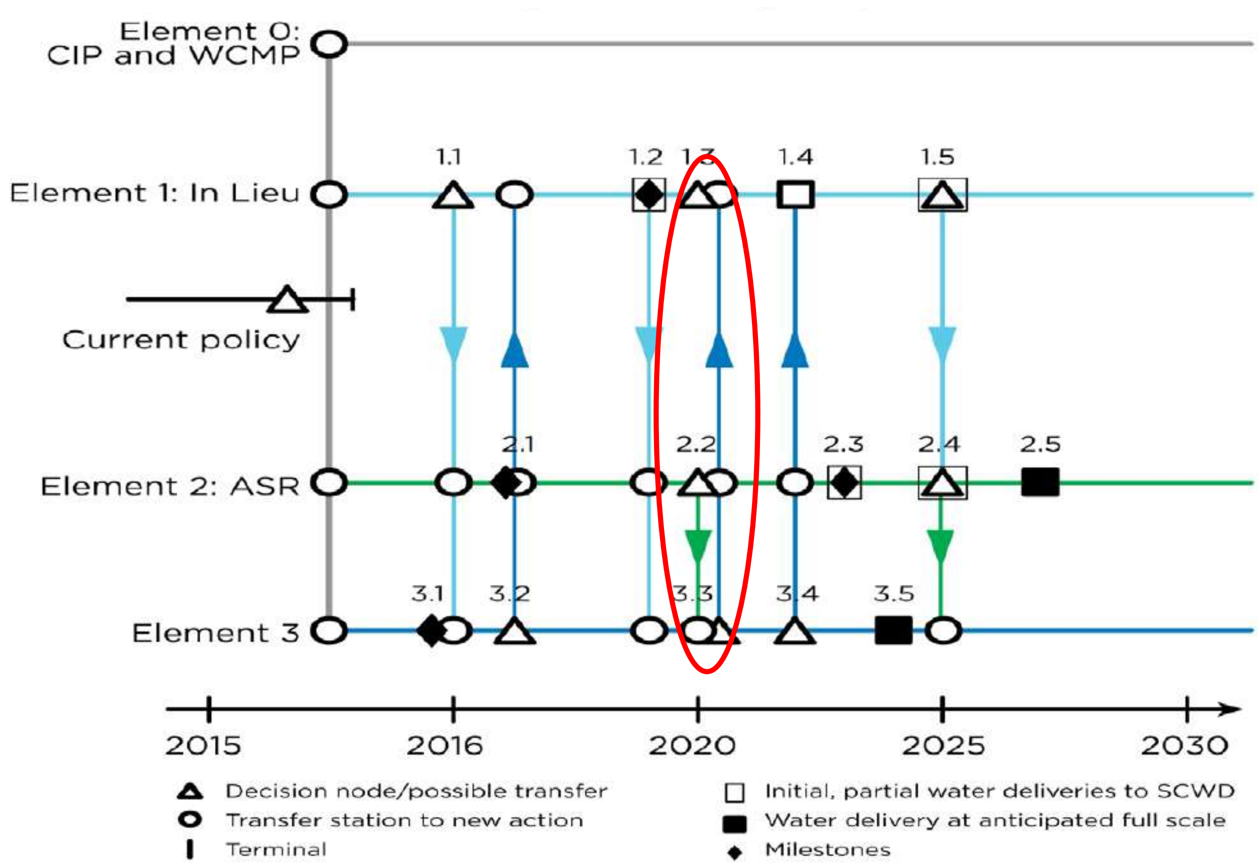
9.18

WSAC's Plan-Do-Check- Act Model



9.19

WSAC's Adaptive Pathways Diagram



9.20

WSAC's Guiding Principles

- Public Health
  - Consult with experts in public health, endocrinology and water chemistry on local water quality data related to preferred supply option(s).
- Public Acceptance
  - Consider yield, cost, timeliness, technical feasibility, energy use, environmental impacts of the various supply alternatives.
- Regional Collaboration
  - Promote regional collaboration to improve regional water reliability.
- Plan Goal
  - The selected preferred supply option(s) should meet the plan goal of meeting a 1.2 billion gallon shortage during worst year hydrology.
- Incremental Implementation
  - Plan for incremental implementation to allow the City to avoid investing resources before they are needed and justified based on performance and other metrics.

9.21

WSAC Implementation Strategy

- Explore the key alternative supply augmentation strategies in parallel during the first five year period to produce comparable information on all supply augmentation options for:
  - Technical Feasibility
  - Cost
  - Yield
  - Timeliness
- In late 2020, apply the Guiding Principles and Threshold Metrics (discussion follows) to information developed for all the options and identify a preferred project to recommend to the City Council.

Change Management and Decision Process Definitions and Context

Change Management

- An Adjustment:
  - A change that helps the plan stay on track.
- An Adaptation:
  - A change to the basic plan after exceeding a threshold.
- A Threshold
  - Information on one or more key metrics that leads to an assessment and possible adaptation of the plan.

Decision Making

- Guiding Principles:
  - Qualitative and value based provisions that are used in decision-making along with quantitative information.
- Performance Metrics:
  - Objective measures that are used to gage how well plan elements are tracking with expected or needed performance parameters.

9.23

Procedure for Adjustments and Adaptations

- Adjustments
  1. The Water Department will use a continuous feedback loop (small PDCA circle in figure on slide 4) to make adjustments to help achieve (or exceed) performance targets for the various Plan Elements.
- Adaptations
  1. Thresholds are sign posts that provide key performance parameters that are applicable to Plan Elements.
  2. If a Threshold is reached, initiate an assessment of the status of each Plan Element as it relates to all of the Thresholds and Guiding Principles.
  3. To Adapt the plan as a result of an assessment the Water Department must prepare and submit a report recommending the Adaptation to the Water Commission and the Water Commission must make a recommendation regarding the proposed Adaptation to the City Council for its consideration.

9.24

Example of An Adjustment

9.25

Figure 12 Gantt Chart
Implementation Plan and Timeline

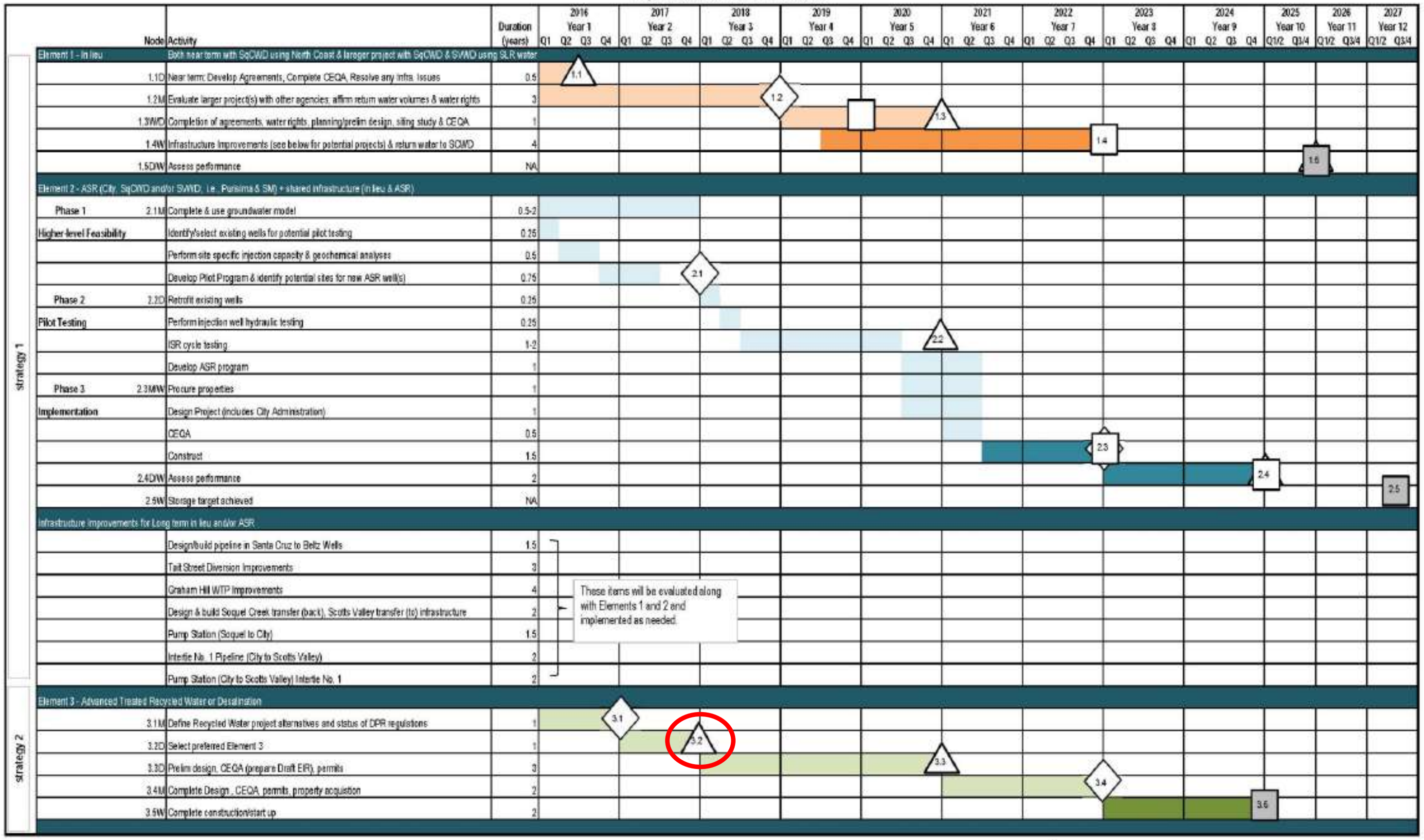


Table Notes & Select Assumptions

This table approximates activities, costs, durations and sequencing of each element, all of which are subject to change.
Elements are shown to start in Q1 - 2016. This may or may not occur depending upon agreements, contracts, etc.
Rehab/replacement of the Newell Creek Pipeline is part of the existing CIP and not shown here.
Some infrastructure improvements may not be required if other pursuits are successful. E.g., evaluation of Ranney collectors may substitute GHWTP Improvements.
CEQA is used generically; implies compliance with California Environmental Quality Act.
Pilot ASR work assumes major infrastructure not required. E.g., intertie to Scotts Valley or new well(s).
Element 2 includes 8 wells for in lieu plus 8 additional wells for ASR.

Legend

ASR = Aquifer Storage and Recovery
CEQA = California Environmental Quality Act
DDW = Division of Drinking Water
DPR = Direct Potable Reuse
EIR = Environmental Impact Report
GHWTP = Graham Hill Water Treatment Plant
IPR = Indirect Potable Reuse
ISR = Injection, Storage, Recovery
SCWD = Santa Cruz Water Department
SqCWD = Soquel Creek Water District
SVWD = Scotts Valley Water District

△ Decision Node
◇ Milestone Node
□ Some amount of water returned to SCWD
■ Full required amount of water returned to SCWD

Thresholds for Adaptation and Decision-Making

- Cost
  - Choose to pursue groundwater storage strategies (Strategy 1) as long as the Annual Cost per million gallons of Average Year Yield (ACAYY) is not more than 130% of the ACAYY for Strategy 2 options and the groundwater strategies meet other threshold metrics.
- Yield
  - Preferred project(s) must produce the required yield of 1.2 billion gallons of water for the worst year shortage.
- Timeliness
  - The preferred project(s) must be implemented to achieve water supply sufficiency by implementing the required project(s) within 10 years (i.e., 2025)

9.27

WSAC Preferences and Values

1. Prefer groundwater storage strategies. Move away from these strategies only in the event that all reasonable steps to demonstrate technical feasibility of these strategies indicate that they cannot meet the plan goal or are exceeding key thresholds.
2. Prefer advanced treated recycled water over desalination.
3. Consider how preferred supply project(s) will contribute to system robustness, resiliency, redundancy and adaptive flexibility.

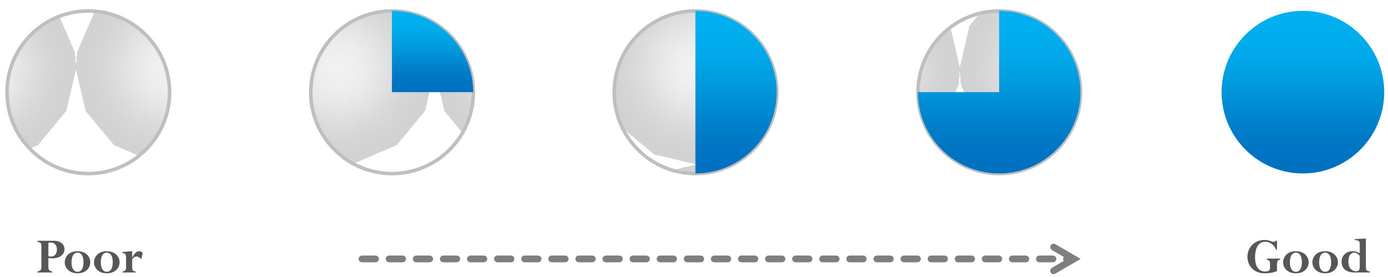
9.28

Example of One Type of Presentation of Level Playing Field Evaluation Results

		Strategy 1 Element 1 – In Lieu	Strategy 1 Element 2 – ASR	Strategy 2 Element 3 – Purified Recycled Water	Strategy 2 Element 3 – Desalination
Threshold Metrics (quantitative indicators)	Technical Feasibility	Y/N	Y/N	Y/N	Y/N
	Cost (ACAYY)	Annual $/mg of yield	Annual $/mg of yield	Annual $/mg of yield	Annual $/mg of yield
	Yield	Billion gallons	Billion gallons	Billion gallons	Billion gallons
	Timeliness	Meets/Does Not Meet	Meets/Does Not Meet	Meets/Does Not Meet	Meets/Does Not Meet
Guiding Principles (qualitative, consumer report type indicators)	Public Health				
	Public Acceptance				
	Regional Collaboration				
	Plan Goal				
	Incremental Implementation				

9.29

Consumer Report Type Symbols



9.30

What's Next?