CITY OF SANTA CRUZ
Water Department

Water Commission Agenda
Regular Meeting
7:00 p.m. – November 7, 2016
Council Chambers
809 Center Street, Santa Cruz

Agenda

Call to Order

Roll Call

Presentation *Organized groups may make presentations to the Water Commission. Presentations that require more than three minutes should be scheduled in advance with Water Department staff.*

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 1-6)

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 Water ☆ (accept info) (Pages 1-2)
2. Approve the October 3, 2016 Water Commission Minutes ☆ (Pages 3-6)

Items Removed from the Consent Agenda

General Business (Pages 7-37)

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 docu-

ments will also be available for review at the Water Commission meeting with the display copy at the rear of the Council Chambers.

3. ASR Workshop ☆(Pages 7-37)

Recommendation: Receive information on Aquifer Storage and Recovery

Subcommittee/Advisory Body Oral Reports

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

Adjournment The next meeting of the Water Commission is scheduled for December 5, 2016 at 7:00 p.m. in Council Chambers.

☆Denotes written materials included in packet

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 the 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.

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 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.

WATER COMMISSION
REPORT

DATE: October 26, 2016

TO: Water Commission

FROM: Rosemary Menard
Water Director

SUBJECT: City Council Items Affecting Water

October 11, 2016

Water Main Replacement on Cedar Street –Authorization to Execute Change Orders with Pacific Underground Construction Inc. (WT)

Motion carried authorizing the Water Director to approve construction change orders with Pacific Underground Construction Inc. for amounts that are within the approved adjusted budget.

University Tank No. 5 Rehabilitation/Replacement Project – Tank Design and Construction Services Contract - Contract Amendment No. 1 (WT)

Motion carried to authorize the City Manager to execute Contract Amendment No. 1 with Robert W. Miles, Consulting Engineer (RWMCE) for design and construction support services for the University Tank No. 5 Rehabilitation/Replacement Project, in a form approved by the City Attorney.

October 25, 2016

Water Rates Consulting – Contract Amendment No. 2 (WT)

Motion carried authorizing the City Manager to execute Contract Amendment No. 2 in the amount of $22,090 for additional consulting tasks for the Water Rate and Fee Issues contract with Raftelis Financial Consultants, Inc. (Pasadena, CA) in a form approved by the City Attorney.

Loch Lomond Recreation Area Cape Seal Project – Phase 2 – Notice of Completion (WT)

Motion carried to accept the work completed by Graham Contractors, Inc. (San Jose, CA) as completed per the plans and specifications and authorize the filing of a Notice of Completion for the Loch Lomond Recreation Area Cape Seal Project – Phase 2.

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Water Department

Water Commission
7:00 p.m. –October 3, 2016
Council Chambers
809 Center Street, Santa Cruz

Minutes of a Water Commission Meeting

Call to Order Chair W. Wadlow called the meeting to order at 7:01 p.m. in the City Council Chambers.

Roll Call

Present: W. Wadlow (Chair), L. Wilshusen (Vice-Chair), D. Baskin, D. Engfer, A. Schiffrin, D. Stearns

Absent: D. Schwarm (with notification)

Staff Present: R. Menard, Water Director; H. Luckenbach Deputy Director/Engineering Manager; H. Dalton, Water Quality Manager; E. Cross, Community Relations Specialist; A. Poncato, Administrative Assistant III.

Others: 6 members of the public.

Presentation – Presentation by S. McGilvray.

Statements of Disqualification – There were no statements of disqualification.

Oral Communications – Oral communications made by E. Popper.

Announcements – There were no announcements.

Consent Agenda

1. City Council Actions Affecting Water
2. Approve the September 12, 2016, Water Commission Minutes

Commissioner Schiffrin moved item 1. City Council Actions Affecting Water of the Consent Agenda. Commissioner Sterns seconded.

VOICE VOTE: MOTION CARRIED
AYES: All.
NOES: None.
ABSENT: D. Schwarm

Commissioner Schiffrin moved item 2. Approve the September 12, 2016, Water Commission Minutes. Commissioner Sterns seconded.

VOICE VOTE: MOTION CARRIED
AYES: All.
NOES: None.
ABSTAIN: L. Wilshusen due to absence from the September 12, 2016, Water Commission meeting.
ABSENT: D. Schwarm

General Business

3. Report on Public Health Goals and Water Quality Discussion

Ms. Menard introduced Mr. Dalton to provide an overview presentation on the purpose and results of the Public Health Goals Report for three year period, 2013-2015.

Please provide an example of when removing a certain type of contaminant would elevate another type of contaminant in our water supply.

- Commissioner W. Wadlow responded: When an air stripping process is used to remove volatile organic compounds, for example, it changes the pH balance which may result in the water being more corrosive and thereby leaching of metals from system piping or home plumbing into the water supply which wouldn't have been there otherwise.

How does the presence of these contaminants in the Soquel Creek Water District wells impact our proposal for storing water in their aquifers? Could it contaminate the water we put into these aquifers?

- In phase one of the Aquifer Storage and Recovery (ASR) work plan, testing will occur to look at the geochemical compatibility of native groundwater and groundwater aquifers and potential sources of recharge water. During the pilot testing phase, which is phase 2 of the evaluation process, a significant amount of work will be done to identify any water quality issues with introducing treated surface water into the various aquifers.

Could you confirm the sources where arsenic was (as reported in the Public Health Goals report)?

- Small amounts of arsenic contaminants were found in ground water samples taken from both the Beltz Wells and Tait Wells. So far water samples taken from Beltz Wells have not detected any hexavalent chromium at levels above 0.02ppb, which is the criterion for reporting the presence of hexavalent chromium levels

If we find unexpected levels of contaminants in the first flush, can the Water Department determine where it came from?

- To some degree, yes. Spikes in microbiological contaminant levels in first flush samples, for example, are common in situations where streams have low water levels and lots of exposed streambeds. When this is the case, animals are crossing

the dewatered streambeds to get to the water and are leaving their waste that will ultimately be washed into the water when the first storm events come.

Where in the water system was the hexavalent chromium found?

- The hexavalent chromium levels were found in the gravity zone leaving the Graham Hill Water Treatment Plant and a small amount was detected on the North Coast near Davenport.

Are their treatment options that we can apply at the Graham Hill Water Treatment plant to remove Hexavalent Chromium from the water supply?

- Yes, we could do something similar to what Soquel Creek Water District is attempting to do. SqCWD does not currently have a treatment in place for hexavalent chromium, but they are looking at a treatment process using a strong base anion exchange resin.

Is there something we could add to the water supply after it has been treated at the GHWTP to delay the formation of hexavalent chromium?

- The approach would be to remove the chromium itself, which is the precursor for the formation of hexavalent chromium. This is the same kind of strategy that is often used to manage disinfection byproducts – remove the organic carbon that supports the formation of disinfection byproducts.

Are the sources of arsenic and hexavalent chromium in our water system natural or man-made?

- The sources for both arsenic and hexavalent chromium are naturally occurring.

Will we be testing our water supply for levels of pharmaceutical contamination in the future?

- Yes. We've completed a years' worth of testing and will be continuing to look test for these constituents in our water supplies.

<u>Final Comments and Requests for Follow Up</u>

- Add measurements to this report when our contaminant levels are between the Maximum Contaminant Levels (MLR) and the Detection Level or Reporting (DLR)

Public Hearing Officially Closed

Subcommittee/Advisory Body Oral Reports No items.

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

- Our water supply condition is good.
- We will be inviting the Soquel Creek Water District to attend our December Water Commission meeting.
- We have extended an invitation to the board directors from the Soquel Creek Water District for a tour of our watershed and hope that one or two Water

Commissioners could be present at that tour; plans for the tour itself will be made after the winter when the weather is better.

Final Comments and Requests for Follow Up

There used to be a list at the end of the agenda that listed upcoming agenda items. Is that item going to return to our agenda?

- We will be submitting an updated Water Commission work plan for next year in December.

Adjournment Meeting adjourned at 8:38 p.m. The next meeting of the Water Commission is scheduled for November 7, 2016, at 7:00 p.m. in Council Chambers.

Respectfully submitted,

Amy Poncato

Digitally signed by Amy Poncato
DN: cn=Amy Poncato, o=Water Department, ou=Administration, email=aponcato@cityofsantacruz.com, c=US
Date: 2016.11.02 08:35:56 -07'00'

Staff

WATER COMMISSION
INFORMATION REPORT

DATE: November 2, 2016

AGENDA OF: November 7, 2016

TO: Water Commission

FROM: Heidi Luckenbach, Deputy Director/Engineering Manager

SUBJECT: Water Supply Augmentation Strategy, Aquifer Storage and Recovery

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RECOMMENDATION: Receive information on Aquifer Storage and Recovery.

BACKGROUND: The City's Water Supply Advisory Committee (WSAC) recommended several strategies in their Final Agreements and Recommendations of the Water Supply Advisory Committee (WSAC) for how best to address an agreed-upon gap of 1.2 billion gallons between water supply and water demand during times of extended drought. In addition to continued water conservation efforts as described in the Long Term Water Conservation Plan (August, 2016), the committee's recommendations include evaluating the potential to use passive and active storage of available San Lorenzo River water during the rainy season (through in-lieu water transfers and/or aquifer storage) followed in preference by the utilization of advanced treated recycled water or desalination.

Staff has been advancing the various elements of the WSAC-recommended work plan (attached as Attachment A and included in the WSAC final report) and, as required by the recommendations, provides quarterly updates to the Water Commission on progress. The third quarterly update was presented to the commission at their October meeting. In addition to the quarterly updates, staff provides informational opportunities to the commission to facilitate their evaluation of the work being done, progress being made, and to engage in needed discussions on the opportunities and limitations of the various strategies being evaluated.

This workshop includes discussions on the two "Elements" of Strategy 1, In Lieu water transfers (Element 1) and Aquifer Storage and Recovery (Element 2); however, the focus will be on Aquifer Storage and Recovery (ASR). (Note that the volume of water transferred to other agencies via an in-lieu strategy impacts the groundwater modeling efforts of ASR and is therefore included in this discussion; however the focus of this workshop is ASR.)

DISCUSSION: In addition to staff, three speakers will present information on ASR as follows.

Jonathan Lear, P.G., C.Hg, Senior Hydrogeologist, Monterey Peninsula Water Management District Mr. Lear has 20+ years of experience in the region working as a hydrologist and hydrogeologist. He specializes in surface water-groundwater interaction,

recharge and aquifer storage and recover, wetland hydrology, groundwater resource assessment, groundwater modeling, design, construction, and rehabilitation of wells and the application of geophysical and aquifer testing methods to evaluate site-specific aquifer parameters. He will share his ongoing experience related to the District's nearly two-decade long ASR project.

Robert C. Marks, P.G., C.Hg, Principal Hydrogeologist, Pueblo Water Resources, Inc: Pueblo Water Resources, Inc. is currently under contract to the city to perform the first phase of ASR work as described in the WSAC report. Mr. Marks is the project lead and will provide background on the technical aspects of ASR, the three phases of this project, and the status of work in the current phase. During his 24+ years of experience Robert has managed numerous projects involving feasibility investigations and implementation of Aquifer Storage and Recovery (ASR) systems; large-scale municipal production well designs, construction inspection and testing; injection and municipal well rehabilitation; seawater intake/brine disposal well assessments for desalination facilities; and investigations of alternative groundwater basin management strategies.

Ryan Bezzera: A partner at the Sacramento law firm of Bartkiewicz, Kronick & Shanahan, Mr. Bezzera has been an attorney for 21 years and has specialized in water and public agency law for the last 17 years. As the City's water rights attorney, he brings experience representing clients in many surface-water and groundwater matters, including three basin adjudications. He was a member of the water-agency attorney team that prepared the first draft of the 2014 Sustainable Groundwater Management Act and was involved in drafting the State Water Resources Control Board's statewide water quality permit for aquifer storage and recovery projects. Ryan will discuss (1) changes to surface water rights to enable injections in the relevant places; (2) rights to store the water in a basin; (3) rights to extract the stored water; and (4) establishing coverage under the statewide water quality permit for ASR injections.

FISCAL IMPACT: None.

PROPOSED MOTION: Accept the information.

ATTACHMENTS:

Attachment A WSAS Recommended Work Plan

Attachment B Scope of Services for Aquifer Storage and Recovery

Attachment C Potential Performance Measures for ASR

Figure 12 Gantt Chart
Implementation Plan and Timeline

	Node	Activity	Duration (years)	2016 Year 1	2017 Year 2	2018 Year 3	2019 Year 4	2020 Year 5	2021 Year 6	2022 Year 7	2023 Year 8	2024 Year 9	2025 Year 10	2026 Year 11	2027 Year 12
				Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1/2 Q3/4	Q1/2 Q3/4	Q1/2 Q3/4
strategy 1	Element 1 - In lieu	Both near term with SqCWD using North Coast & lareger project with SqCWD & SVWD using SLR water													
	1.1D	Near term: Develop Agreements, Complete CEQA, Resolve any Infra. Issues	0.5	1.1											
	1.2M	Evaluate larger project(s) with other agencies; affirm return water volumes & water rights	3			1.2									
	1.3W/D	Completion of agreements, water rights, planning/prelim design, siting study & CEQA.	1					1.3							
	1.4W	Infrastructure Improvements (see below for potential projects) & return water to SCWD	4							1.4					
	1.5D/W	Assess performance	NA										1.5		
	Element 2 - ASR (City, SqCWD and/or SVWD; i.e., Purisima & SM) + shared infrastructure (in lieu & ASR)														
	Phase 1 2.1M	Complete & use groundwater model	0.5-2												
	Higher-level Feasibility	Identify/select existing wells for potential pilot testing	0.25												
		Perform site specific injection capacity & geochemical analyses	0.5												
		Develop Pilot Program & identify potential sites for new ASR well(s)	0.75			2.1									
	Phase 2 2.2D	Retrofit existing wells	0.25												
	Pilot Testing	Perform injection well hydraulic testing	0.25												
		ISR cycle testing	1-2					2.2							
		Develop ASR program	1												
	Phase 3 2.3M/W	Procure properties	1												
	Implementation	Design Project (includes City Administration)	1												
		CEQA	0.5												
		Construct	1.5							2.3					
	2.4D/W	Assess performance	2									2.4			
	2.5W	Storage target achieved	NA												2.5
	Infrastructure Improvements for Long term in lieu and/or ASR														
		Design/build pipeline in Santa Cruz to Beltz Wells	1.5												
		Tait Street Diversion Improvements	3												
		Graham Hill WTP Improvements	4												
		Design & build Soquel Creek transfer (back), Scotts Valley transfer (to) infrastructure	2												
		Pump Station (Soquel to City)	1.5												
		Intertie No. 1 Pipeline (City to Scotts Valley)	2												
		Pump Station (City to Scotts Valley) Intertie No. 1	2												
strategy 2	Element 3 - Advanced Treated Recycled Water or Desalination														
	3.1M	Define Recycled Water project alternatives and status of DPR regulations	1	3.1											
	3.2D	Select preferred Element 3	1		3.2										
	3.3D	Prelim design, CEQA (prepare Draft EIR), permits	3					3.3							
	3.4M	Complete Design , CEQA, permits, property acquistion	2							3.4					
	3.5W	Complete construction/start up	2										3.5		

These items will be evaluated along with Elements 1 and 2 and implemented as needed.

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 Californa 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

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:

January 20, 2016
Project No. 15-0111

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

Attention: Ms. Heidi Luckenbach, P.E., Engineering Manager

Subject: Proposal for Hydrogeologic Services; Santa Cruz ASR Project - Phase 1 Feasibility Investigation

Dear Ms. Luckenbach:

In accordance with your request, Pueblo Water Resources, Inc. (PWR) is pleased to submit this proposal for hydrogeologic services related to the City of Santa Cruz Water Department's (SCWD) Aquifer Storage and Recovery (ASR) Project - Phase 1 Feasibility Evaluation. Presented in this proposal is a detailed scope of work, estimated costs, and a schedule to implement the subject project.

BACKGROUND

ASR is a form of managed aquifer recharge (MAR) that involves the enhanced conjunctive use of existing surface and groundwater resources. ASR is a method of "banking" water in an aquifer during times when excess surface water is available (typically wet periods), and subsequent recovery of the water from the aquifer when needed (typically dry periods). ASR utilizes dual-purpose injection/recovery wells for the injection of water into aquifer storage and the subsequent recovery of the stored water by pumping. In order to feasibly implement ASR, the following four basic project components are required:

1. A supply of excess surface water for injection.
2. A system for the diversion, treatment and conveyance of water between the source and groundwater storage basin.
3. A suitable groundwater basin with available storage space.
4. Wells to inject and recover the stored water.

As conceptually applied to Santa Cruz, ASR would involve the diversion of "excess" winter and spring flows from the San Lorenzo River via the Tait Street Diversion facility, treated to potable standards at the Graham Hill Water Treatment Plant (GHWTP), then conveyed through the existing (and/or improved) water distribution system(s) to ASR wells located in the Soquel-Aptos Groundwater Basin (S-AGB) and/or the Santa Margarita Groundwater Basin

(SMGB) in Scotts Valley. In this context, "excess" flows are those flows that exceed SCWD demands and in-stream flow requirements and are within water rights.

As a subconsultant to the Water Supply Advisory Committee (WSAC) Technical Team, PWR performed an initial reconnaissance-level study (Recon-Study) of the feasibility, potential yields, and costs of ASR for the SCWD. The scope of the Recon-Study was limited to evaluating readily available existing information to develop conceptual components of an ASR project for the WSAC to consider. Based on the available information, the Recon-Study findings indicated that ASR appears to be technically feasible with no obvious fatal flaws. Below are four key findings developed the Recon-Study feasibility evaluation; the main focus of the subject Phase 1 work is to verify these initial findings:

- **Availability of Excess Water.** Analysis of available excess San Lorenzo River flows, as constrained by existing water rights, in-stream flow requirements, and demands shows that approximately 558 million gallons per year (mgy) or more may be available.

- **Diversion / Treatment / Conveyance Capacities.** The existing excess capacity of the Tait Street Diversion and GHWTP is limited to 2 million gallons per day (mgd), equivalent to approximately 145 mgy on average. With significant system modifications and upgrades to the existing Tait Street Diversion and GHWTP, average annual diversions of up to 558 mgy could be achieved.

- **Available Aquifer Storage Space.** Based on existing estimates of historical groundwater storage depletion, approximately 3,290 mg of potentially available aquifer storage space exists in the Purisima Aquifer and approximately 2,355 mg may be available in the Scotts Valley Subarea (approximately 5,645 mg combined).

- **Per Well Injection Capacities.** Based on the results of a screening-level analysis of the theoretical injection capacities of existing wells, per-well injection capacities of 350 gpm (0.5 mgd) for new ASR wells in both the Purisima Aquifer and Scotts Valley Subarea appear feasible.

Understanding the following is also required to determine the technical feasibility of ASR and included in the Phase 1 work.

- The hydraulic capacity of the existing distribution system(s) to convey the required diverted San Lorenzo River flows from GHWTP to potential ASR wells sites in the various distribution systems under consideration.

- The potential for adverse geochemical interactions between the source waters, native groundwater, and aquifer mineral matrices.

- The potential for, and quantification of, hydraulic losses to either the ocean or local creeks that would result from increased aquifer water levels / piezometric head that could limit overall project yields.

Based on the findings of the Recon-Study and consideration of the other available supply alternatives, the WSAC developed a water supply augmentation plan that combined in-lieu recharge (Element 1) in either or both the Soquel Creek Water District (SqCWD) and the Scotts Valley Water District (SVWD) with ASR (Element 2) in SCWD, SqCWD and SVWD service areas. The plan is part of an overall strategy to address the identified worst-year supply gap of 1.2 billion gallons during an extended drought.

The full-scale ASR system, as assumed and considered by the WSAC, is envisioned to consist of a total of eight (8) 0.5 million gallon per day (mgd) ASR wells; four (4) wells are planned within the SCWD service area (i.e., the Beltz well field) and two (2) wells each are tentatively planned for the SqCWD and SVWD service areas.

Based on these recommendations, an implementation strategy for the ASR element was developed through the WSAC that consisted of three basic phases:

- **Phase 1 – Higher-Level Feasibility Analyses**: Performance of higher-level technical feasibility investigations that were beyond the scope of the Recon-Study, including the use of groundwater modeling, completion of site-specific injection capacity and geochemical interaction analyses, and development of a pilot ASR testing program.

- **Phase 2 – Pilot ASR Testing**: Performance of pilot ASR testing program and assessment of probable ASR system performance, cost and schedule to complete build-out of the ASR system.

- **Phase 3 – Project Implementation**: Development of full-scale ASR project basis-of-design, construction of ASR system facilities (perhaps incrementally), establishment of ASR project operational parameters, and long-term operation of project to achieve target storage volumes.

The subject of this proposal is to implement the above-noted Phase 1 higher-level feasibility investigation. It is important to note that ASR program development is necessarily an iterative process – continuing to be refined in response to investigative findings and input from the City (and other interested parties) and in response to more focused (or re-focused as needed) data analyses. The scope of work described in this proposal represents the next step in that process, and (assuming no fatal flaws emerge) will form the basis for developing the scope of Phase 2 needed for advancing the investigation.

PURPOSE AND SCOPE

The overall purpose of the Santa Cruz ASR Feasibility – Phase 1 Project is to confirm and/or refine the initial ASR feasibility findings developed from the Recon-Study of ASR performed for the WSAC and to develop the technical information necessary for planning of pilot ASR testing operations at selected existing wells (Phase 2). The Phase 1 scope of work consists of the following main tasks:

1. Screening and selection of existing wells for potential pilot ASR testing (Phase 2)
2. Detailed site-specific analyses of the theoretical ASR capacities of selected wells
3. Geochemical interaction analysis
4. Development of ASR pilot testing work plans
5. Groundwater modeling of various ASR project scenarios
6. Project management and meetings

Upon completion of the subject Phase 1 Feasibility Investigation, sufficient information will have been developed that will allow the City to make "Go No-Go" decisions regarding the advancement of the project. A detailed scope of work to perform the above tasks is presented below.

Scope of Services

Task 1.1 – Existing Wells Screening and Selection for Pilot ASR Testing

The purpose of this task it to identify three (3) existing wells (one in each service area) as candidates for Phase 2 pilot ASR testing. Combined, there are approximately twenty (20) existing wells in the three service areas. Each of the existing well sites will be evaluated and ranked based on a variety of factors, including (but not limited to) the following:

- Aquifer completion/screen intervals
- Theoretical injection capacity
- Well age
- Well construction features
- Hydraulic abilities of distribution systems to deliver/accept water for pilot ASR testing
- Proximity to suitable existing monitoring wells
- Proximity to backflush water disposal lines/pits
- Availability of retained drill cutting samples (for laboratory mineralogy analyses)
- Other site logistical factors

It is assumed that PWR will be provided access to existing well data (well logs, as-builts, water-levels, production/aquifer testing, etc.,) and well site facility information (site plans, piping and instrumentation diagrams, etc.) for all three service areas.

Deliverable: Technical Memorandum (TM) documenting the results and providing recommendations for existing wells identified as potential candidates for Phase 2 pilot ASR testing.

Task 1.2 – Site-Specific Injection Capacity Analyses

This task consists of in-depth analyses of the various site-specific factors affecting potential ASR well capacity at the three selected well sites within the SCWD, SqCWD and SVWD service areas (i.e., the wells identified in Task 1.1). The purpose is to establish theoretical sustainable injection rates for the selected wells, which will be used as a basis for developing ASR pilot testing work plans (Task 1.4). Site-specific factors to be analyzed include (but not limited to) the following:

- Well and aquifer hydraulic response under pressurized and non-pressurized casing scenarios
- Downhole velocity constraints
- Backflush pumping capacity
- Aquifer "Hydrofracturing" potential
- Offsite impact limitations

Deliverable: TM documenting the results and providing recommendations for anticipated pilot testing injection rates at each of the three (3) identified wells.

Task 1.3 – Geochemical Interaction Analysis

This task consists of evaluating the potential for adverse geochemical interactions to occur due to mixing of injected surface waters and native groundwaters. Potential reactions of concern generally fall into two categories: 1) precipitation reactions that can lead to well plugging, and 2) dissolution reactions that can negatively impact water-quality in the storage zone and/or recovered water. Specialized water-quality sampling will be performed at the GHWTP and each of the three (3) candidate wells identified/selected in Task 1.1 for pilot ASR testing. Utilizing these data, 3-component geochemical interaction modeling (PHREEQC-2) will be performed simulating various mixes of native groundwater and injected surface water within the target aquifer mineral matrices. If geochemical incompatibility is indicated, source water enhancement options or operational alternatives will be evaluated and discussed. The overall purpose of this task is to ensure that adverse geochemical reactions at the selected pilot testing wells are unlikely to occur prior to any injection testing.

This task assumes PWR will be provided with the following:

- Access to City historical water-quality data to evaluate recharge source water-quality variability during the injection season.
- Access to City GHWTP product water and selected Beltz well for specialized field and laboratory water-quality testing and analyses.
- Access to SqCWD and SVWD selected wells for specialized field and laboratory water-quality testing and analyses.
- Samples of representative target aquifer cuttings and/or cores (as available) from existing wells in all three service areas for laboratory mineralogy analyses.

Deliverable: TM documenting results and providing conclusions and recommendations regarding geochemical compatibility.

Task 1.4 – Pilot ASR Testing Program Development

Based on results of above Tasks 1.1 – 1.3, PWR will develop pilot ASR testing work plans for each of the three (3) identified wells. Work plans will include identification of temporary facility improvements needed for testing (e.g., piping/valving modifications, test pumps, backflushing settling tanks/pits, etc.,) and ASR pilot testing programs designed to demonstrate/verify ASR well operational viability and parameters. The overall purpose of this task is to develop the information required to scope, budget and permit the pilot ASR testing program (Phase 2).

This task assumes PWR will be allowed to make site visits to the selected well facilities to evaluate site logistics for pilot testing for all three service areas.

Deliverable: Three (3) individual site-specific pilot ASR work plans. Each work plan will include the following minimum components:

- Overview of site-specific data and findings developed from Tasks 1.1 – 1.3.
- Facility preparation needs for pilot ASR testing
- Pilot ASR testing operational plans
- Monitoring programs (water-quality and hydraulic)

Task 1.5 – Groundwater Modeling Assistance

This task consists of coordinating and overseeing the utilization of existing calibrated three-dimensional groundwater flow models of the S-AGB and SMGB to simulate various ASR project operational scenarios (pilot testing and full-scale permanent project). This includes the performance of a well siting study to identify potential ASR well locations. The overall purpose of this task is to evaluate the ability of target aquifer systems to:

1. Receive recharge water via injection wells at the required rates and durations,
2. Temporarily store the recharged water until needed without unacceptable hydraulic losses (e.g., outflow to the ocean and/or local streams), and,
3. Allow recovery of the stored water when needed without unacceptable negative impacts to other basin users (e.g., compromise the ability to pump at needed rates).

It is noted that the actual modeling is outside this scope and is assumed will be performed by the consultants who are currently engaged with the existing S-AGB and SMGB model development and calibration activities (under separate contracts with the City and/or the other agencies). PWR's role as part of this task includes the following subtasks:

Task 1.5.1 - Well Siting Study. This subtask consists of performing a Well Siting Study for permanent full-scale ASR wells in each of the three service areas. The identified ASR well

site location options will then be utilized in various ASR model scenarios to evaluate / define the most favorable locations.

Task 1.5.1.1 – Review Hydrogeologic Literature. Literature regarding the regional and site-specific geology and hydrogeology in the three service areas will be obtained and reviewed as a basis for identifying available data and data gaps.

Task 1.5.1.2 – Prepare Existing Water Well Database. Available lithologic and geophysical logs from wells constructed in the area will be compiled. Well depths, construction details, and well performance data will be tabulated in a spreadsheet format. Aquifer parameter data including transmissivity and storativity data will be collected and tabulated from available data sources. Available water quality data will be tabulated and reviewed. Where adequate data is available, seasonal and spatial variations (both vertically and horizontally) in physical and chemical parameters will be identified.

Task 1.5.1.3 – Compile and Review GIS Databases. Available GIS coverages from our and City, SqCWD and SVWD databases will be compiled and reviewed. Existing and potential well locations will be plotted on an appropriate scale base map using GIS databases. This is anticipated to include, at a minimum; property boundaries/parcel maps, existing well locations, infrastructure information (i.e., water and sewer distribution systems, roadways, etc.,), and topographic information. The GIS information will be utilized to prepare appropriate base maps and to assist in the site screening process.

Task 1.5.1.4 – Possible Contaminating Activities Assessment. This task will include the review of potential sources of groundwater contamination in the areas where potential well sites might be considered. This review would be limited to screening of the State and local databases on areas of known release. This would include listings of underground storage tanks (UST and LUST), hazardous material generators (RCRIS), Superfund (CERCLIS) sites, and other reported waste sites. Areas with potential contamination risk will be identified and, if not discarded from further consideration, be subject to additional investigation.

Task 1.5.1.5 – Field Surveys. This task consists of a field survey of potential well sites identified. Each potential parcel will be visited to assess the feasibility of drilling and well construction at the site. Logistical factors to be considered include; potential for noise nuisance, access for drilling and pump rig equipment, discharge location for development and test pumping water, and source of water for construction. Other factors to be considered include the compatibility of a municipal production well on the parcel with the existing use.

Task 1.5.1.6 – Potential Well Site Ranking. Based on the developed data and analyses, siting criteria will be developed and each of the potential ASR well sites will be ranked. The potential sites will be initially ranked based on hydrogeologic favorability, and then from this ranking the other identified factors will be considered. The selection of potential well sites will involve the balancing of logistical, infrastructural, and hydrogeologic considerations; as such, we envision that the siting process will be iterative, being progressively refined in responding to input from the City and other agencies, and in response to more focused data analysis.

Task 1.5.2 – Groundwater Modeling Coordination. This subtask consists of coordinating and overseeing the utilization of existing calibrated three-dimensional groundwater flow models of the S-AGB and SMGB to simulate various ASR project operational scenarios (pilot testing and full-scale permanent project).

Task 1.5.2.1 – Confluence Model Coordination. This task consists of coordinating with Gary Fiske to develop the needed information regarding the timing and availability of excess surface water flows from the Confluence Model. This will include determining the timing, duration and rates of injection/storage/recovery (ISR) cycles to be simulated with the groundwater models.

Task 1.5.2.2 – ASR Model Scenario Development. This task consists of the development of various ASR system operational scenarios to be simulated with the groundwater models. It is noted that groundwater modeling is often an iterative process, with scenarios being developed and refined in response to initial model results. For budgetary purposes, it is assumed that three (3) variants of ASR system operational scenarios will be developed for each basin / model (6 scenarios total).

Task 1.5.2.3 – Outside Modeling Consultant Coordination. This tasks consists of coordinating with the outside groundwater modeling consultants on the development and implementation of model scenarios and the interpretation of results.

It is noted the development of ASR operational model scenarios will necessarily need to consider other MAR activities planned in each of the basins. For example, the in-lieu recharge component of the WSAC recommendations (Element 1) will need to be simulated as occurring simultaneously with ASR operations. Similarly, both SqCWD and SVWD are evaluating the potential for Indirect Potable Reuse (IPR) of recycled water via injection wells within their service areas. All of these projects are intended to utilize portions of the same available groundwater storage space as ASR would; therefore, the potential for interference between these projects to result in unacceptable injection rate limitations and/or hydraulic losses needs to be evaluated with the groundwater models. PWR will not develop the information regarding the other planned MAR activities independently (e.g., rates, duration, locations, etc.), but will rely on existing information and/or information provided by others about these planned activities in developing the ASR model scenarios.

It is currently assumed that ASR would be limited to the Purisima Aquifer in the S-AGB and the Scotts Valley subarea in the SMGB; however, it is noted that the results of the Phase 1 work may find that the recharge capacity of these two aquifers is too limited to achieve the project goals and that additional local aquifer systems may be recommended to be pursued further (e.g., the Aromas aquifer in the S-AGB).

Deliverables: Two (2) Well Siting TM's will be prepared, one for each groundwater basin. The Well Siting TMs will document the development of siting criteria and the methods utilized, and will provide conclusions and recommendations regarding the availability of sites for ASR well facilities required to meet the full-scale ASR project objectives.

Two (2) Modeling Results TMs will be also prepared (one for each basin / model) documenting ASR modeling scenario development and evaluating the modeling results.

Conclusions and recommendations will be provided regarding the modeling findings and their implications on the scope of the Phase 2 investigation as well as the technical hydrogeologic feasibility of the full-scale permanent ASR project envisioned by the WSAC.

Task 1.6 – Project Management and Meetings

This task consists of overall project management, coordination of subconsultants, budget and schedule tracking, invoicing, and attendance at various project-related meetings. The overall purpose is to ensure effective management of project implementation, schedule and budget. This will include the coordination and attendance at various meetings over the course of the project to facilitate cooperation among project participants and communicate progress and findings to the City and other interested parties. For budgetary purposes, the following meetings are assumed:

- Project Kick-Off (1)
- Draft Task Deliverable Reviews (5)
- Technical Working Group (3)
- Pilot ASR Testing Plans Coordination with SqCWD and SVWD (2)
- Water Commission Quarterly Updates (8)
- Enrichment Session Presentations (4)

Each meeting will be attended by one to two PWR Principal Hydrogeologists, depending on the meeting agenda.

Services Not Included

Services which are (or may be) necessary for the completion of this project, which are not included in our proposal include the following:

- Distribution system hydraulic modeling (assumed provided by others)
- Groundwater flow and transport modeling (assumed provided by others).
- Cost of water, electricity, or other utilities;
- Any others items not specifically included in PWR's scope of services.

Estimated Fees and Schedule

Based on the scope of services presented herein, we estimate the fees for our services will be approximately $446,370, which will be billed on a time-plus-expenses basis in accordance with our current Fee Schedule (attached). An estimated fee summary worksheet is attached summarizing the estimated man-hours and costs per task/work item.

We understand that in order to authorize this work, your City Council must first approve a formal contract. Based on our current workload, we believe that we can commence work

within two weeks of your authorization. An estimated task-by-task schedule is presented in the table below:

Estimated Project Schedule

Task No.	Description	Task Duration	
		Start	Finish
1.1	Existing Wells Screening for Pilot ASR Testing	2016 Q1	2016 Q2
1.2	Site-Specific Injection Capacity Analyses	2016 Q2	2016 Q2
1.3	Geochemical Interaction Analyses	2016 Q2	2016 Q3
1.4	Pilot ASR Testing Program Development	2016 Q4	2017 Q1
1.5	Groundwater Modeling Assistance	--	--
1.5.1	Well Siting Study	2016 Q3	2016 Q4
1.5.2	Groundwater Modeling Coordination	2016 Q1	2017 Q4
1.6	PM and Meetings	2016 Q1	2017 Q4

As shown, the estimated project duration is approximately two years. The project schedule is generally consistent with the implementation schedule developed by PWR through the WSAC, with the work anticipated to be completed by the end of the calendar year 2017. It is envisioned that a more detailed Gantt Chart project schedule will be developed cooperatively between PWR and City staff as part of the Project Kickoff Meeting, which will be maintained and routinely updated by PWR during execution of the project.

We appreciate the opportunity to provide assistance to the City on this important community water supply project. If you require additional information regarding this or other matters, please contact us.

Sincerely,

PUEBLO WATER RESOURCES, INC.

Robert C. Marks, P.G., C.Hg
Principal Hydrogeologist

RCM:msb:mbf

Attachments: Cost Estimation Spreadsheet
2016 Fee Schedule

EXHIBIT A

CITY OF SANTA CRUZ WATER DEPARTMENT

Professional Services for Santa Cruz ASR Project

Phase 1 Feasibility Investigation

PWR Project No.: 15-0111

ESTIMATED FEE SUMMARY

LABOR		Principal Professional	Senior Professional	Project Professional	Illustrator	WP	Hours by Task	Estimated Task Cost
	Hourly Fee	$195	$180	$165	$110	$90		
Task No.	Task Description							
1.1	Existing Wells Screening for Pilot ASR Testing	40	60	20	8	2	130	$22,960
1.2	Site-Specific Injection Capacity Analyses	150	60	20	4	2	236	$43,970
1.3	Geochemical Interaction Analysis	350	150	100	20	2	622	$114,130
1.4	Pilot ASR Testing Program Development	150	50	20	30	6	256	$45,390
1.5	Groundwater Modeling Assistance	-	-	-	-	-	-	-
1.5.1	Well Siting Study	150	60	20	10	2	242	$44,630
1.5.2	Groundwater Modeling Coordination	310	40	30	30	6	416	$76,440
1.6	Project Management and Meetings	250	50	-	20	10	330	$60,850
		-	-	-	-	-		
		-	-	-	-	-		
		-	-	-	-	-		
		-	-	-	-	-		
Hours by Labor Category:		1400	470	210	122	30		
Costs by Labor Category:		$273,000	$84,600	$34,650	$13,420	$2,700		
						Total Labor Hours:	2232	
						Total Labor Costs:	$408,370	

OTHER DIRECT COSTS (ODC's)	Units	Unit Price	No. of Units	Fee
Vehicle	Daily	$75	25	$1,875
Travel Per Diem	Daily	$185	25	$4,625
Field WQ Meter	Daily	$75	5	$375
ORP/pH/Temp Probe	Daily	$75	5	$375
			Subtotal ODCs:	$7,250

OUTSIDE SERVICES	Units	Unit Price	No. of Units	Fee
Outside Lab Analyses - WQ	Each	$2,500	6	$15,000
Outside Lab Analyses - Mineralogy	Each	$1,750	9	$15,750
			Subtotal Outside Services:	$30,750
			Subtotal Outside Services w/ Markup (0%):	$30,750

COST SUMMARY	
Labor	$408,370
Other Direct Costs	$7,250
Outside Services	$30,750
TOTAL ESTIMATED PROJECT COST:	$446,370

PUEBLO WATER RESOURCES, INC
2016 FEE SCHEDULE

Professional Services

Principal Professional.....$195/hr
Senior Professional.....$180/hr
Project Professional.....$165/hr
Staff Professional.....$135/hr
Technician.....$125/hr
Illustrator.....$110/hr
Word Processing.....$90/hr

Other Direct Charges

Subcontracted Services..... Cost Plus 15%
Outside Reproduction..... Cost Plus 15%
Travel Expenses.....Cost Plus 15%
Per Diem*.....$185/day
Vehicle $75/day

Equipment Charges

Drilling Fluid Test Kit..... $100/day, $400/week
Field Water Quality Meter (Hach DR890) $75/day, $275/week
Orion ORP/pH/Temp Probe..... $75/day, $275/week
Water Level Probes (In-Situ Mini-Troll/Level Troll) $100/day, $300/week
Fuji Ultrasonic Flowmeter.....$200/day, $750/week

*Regionally specific to project.

Potential Performance Measures for ASR

August 13, 2015

Robert Marks

Pueblo Water Resources

Implementing ASR

- Implementing ASR typically involves three phases:
  - Phase I – Higher-Level Feasibility Analysis
  - Phase II – Pilot ASR Testing
  - Phase III – Project Implementation
- The time estimated for completing all three phases may range from as few as 6 years to 11 years or longer, depending on assumptions about CEQA and permitting processes timelines

What Happens In Each Phase?

- Phase I: Higher Level Feasibility Analysis Tasks:
  - Develop and use groundwater model to support various ASR analytical and planning tasks in this phase and in the pilot testing phase
  - Identify/select existing wells for potential pilot ASR testing
  - Perform site-specific injection capacity analysis (paper evaluation)
  - Perform geochemical interaction modeling for three components
  - Develop a Pilot ASR testing Program
  - Identify sites for potential new ASR well

What Happens In Each Phase?

- Phase 2: Pilot Testing of ASR
  - Retrofit existing wells for pilot testing of ASR (add temporary facilities to do this)
  - Perform injection well hydraulic testing
  - Use results of injection well hydraulic testing to develop a multiple cycle injection-storage-recovery (ISR) testing program
  - Implement ISR testing program
  - Additional groundwater modeling of ASR scenarios
  - Develop basis-of-design for permanent ASR well facilities

What Happens In Each Phase?

- Phase 3: Project Implementation
  - Procurement of properties and rights of way for ASR facilities
  - Engineering design of ASR wells and facilities and infrastructure improvements that might be needed for the program
  - Complete CEQA for permanent ASR facilities and infrastructure
  - Drill and do production testing for ASR wells
  - Perform site-specific ASR demonstration testing and develop operational parameters

Phase I Performance Metrics
Page 1 of 3

Task	Focus for Potential Performance Measure
Develop and use groundwater model to support various ASR analytical and planning tasks in this phase and in the pilot testing phase	Model effectively predicts observed results based on historical data and operations (i.e., model is well calibrated and thus considered a dependable representation of what will actually happen) Modeling results show the target aquifers can sustain injection rates of up to 5 mgd without undesirable results, injected water will not be subject to excessive (greater than 20%?) loss due to leakage; and that the target aquifers can sustain the required recovery pumping without undesirable impacts to the aquifer or other private or municipal pumpers
Identify/select existing wells for potential pilot ASR testing	Suitable existing wells for pilot testing in target aquifers do not exist or cannot be identified

Phase I Performance Metrics
Page 2 of 3

Task	Focus for Potential Performance Measure
Perform site-specific injection capacity analysis (paper evaluation)	Results show that a preliminary average injection capacity of 250 gallons per minute (gpm) (360,000 per day) is unrealistic. A result that is 10% or more less than 250 gpm becomes a key constraint due to needing to increase the a potential increase in the number and potential siting challenges of wells required to achieve program goals and also associated costs
Perform geochemical interaction modeling for three components	Results show that undesirable geochemical reactions are likely. Undesirable reactions would include calcite precipitation or iron oxide development that could form and result in well plugging that impedes water flow to the well. Well fouling due to plugging is a fatal flaw. Addition issues would be dissolution of minerals in the aquifer soil matrix (due to introduction of low mineral surface water) that could result in water quality or treatment issues. The geochemical interaction modeling would need to be done for each target aquifer.

Phase I Performance Metrics
Page 3 of 3

Task	Focus for Potential Performance Measure
Develop a Pilot ASR testing Program	This task doesn't have a performance metric because it is an program design step.
Identify potential sites for new ASR well	Up to 10 to 15 sites may be needed The Beltz 12siting study included 4 main criteria for site selection: • Hydrogeological suitability, • Constructability, link to existing infrastructure, and operating requirements (e.g., power availability) • Environmental considerations • Ease of acquisition Another key criteria is no injury to or interference with other municipal or private pumpers. The map on the next page shows the locations of wells in the Soquel-Aptos basin.

Phase II Performance Metrics
Page 1 of 3

Task	Focus for Potential Performance Metric
Retrofit existing wells for pilot testing of ASR (add temporary facilities to do this)	No performance metric required for this step
Perform injection well hydraulic testing	Results show that a preliminary average injection capacity of 250 gallons per minute (gpm) (360,000 per day) is unrealistic. A result that is 10% or more less than 250 gpm becomes a key constraint due to needing to increase the a potential increase in the number and potential siting challenges of wells required to achieve program goals and also associated costs of additional wells. Unacceptable well plugging rates are observed. Typical impacts would be water level in the well rises too rabidly. Causes could include rapid particulate loading, gas evolution, chemical reactions creating precipitates. Back-flushing cannot fully mitigate plugging and maintain well performance.

Phase II Performance Metrics
Page 2 of 3

Task	Focus for Potential Performance Measure
Use results of injection well hydraulic testing to develop a multiple cycle injection-storage-recovery (ISR) testing program	No performance metric required for this step
Implement ISR testing program	Results show that long-term injection rates are not sustainable, and/or injection results in unacceptable aquifer water level response, and/or long-term recovery rates are not sustainable, and/or recovery results in unacceptable impacts to other basin pumpers and/or recovered water does not meet water quality standards and potential treatment requirements substantially increase program costs.

Phase II Performance Metrics
Page 3 of 3

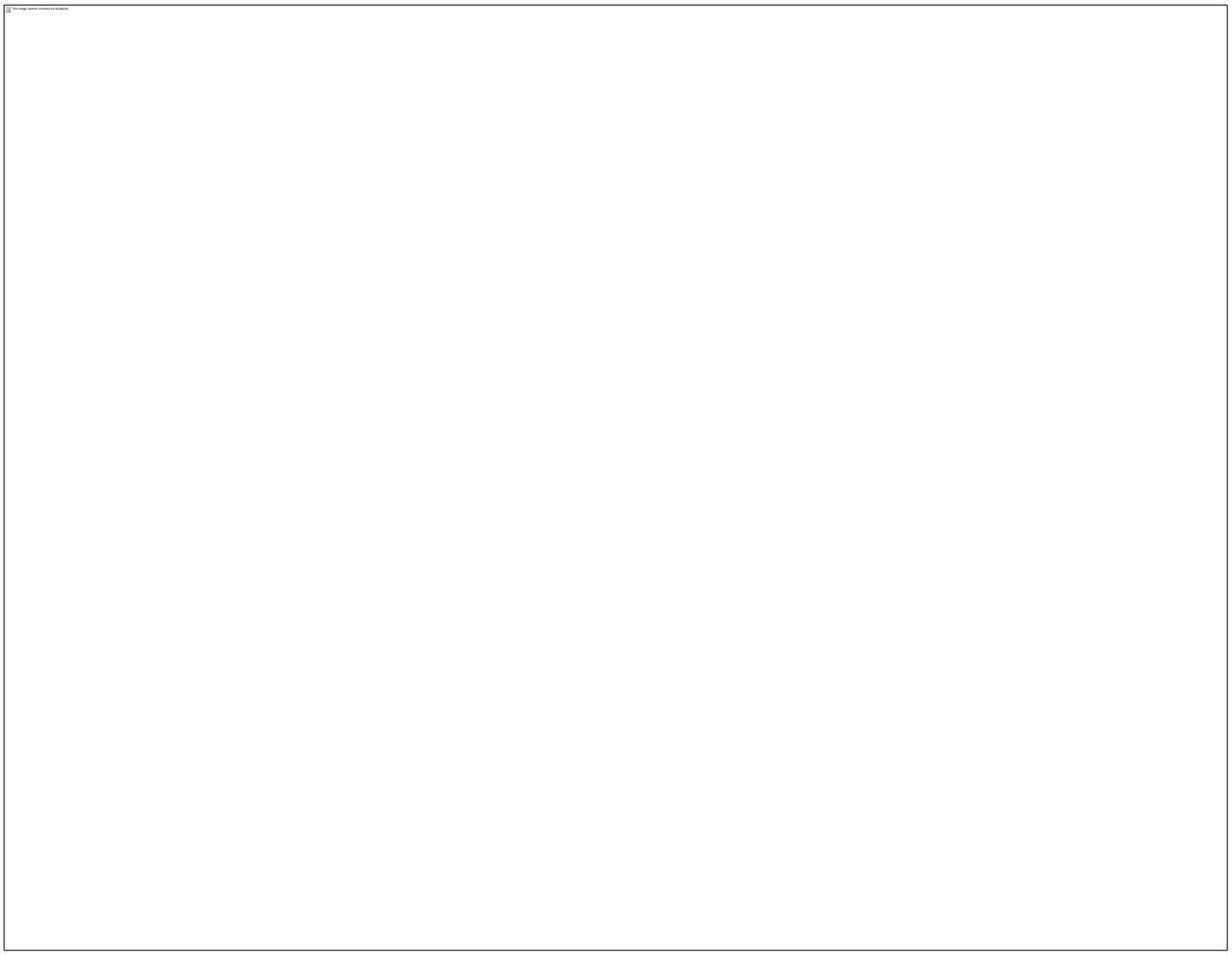
Task	Focus for Potential Performance Measure
Additional groundwater modeling of ASR scenarios	Results show the target aquifers cannot sustain the required injection rates without undesirable impacts, and/or the target aquifers cannot store the required recharge volumes over the necessary duration without excessive losses, and/or the target aquifers cannot sustain the required recovery pumping without undesirable impacts
Develop basis-of-design for permanent ASR well facilities	Projected program costs developed in the basis-of-design work are significantly higher than projected.

See also companion document: "Example of ASR Pilot Test Program Operation Plan" for additional details about what occurs during some of the steps of pilot testing.

Phase III Performance Metrics
Page 1 of 2

Task	Focus for Potential Performance Measure
Procurement of properties and rights of way for ASR facilities	Sufficient number of suitable well sites can not be located and/or cumulative cost of needed sites exceeds some affordability threshold
Engineering design of ASR wells and facilities and infrastructure improvements that might be needed for the program	Needed facilities can't be sited and/or exceed some affordability threshold
Complete CEQA for permanent ASR facilities and infrastructure	CEQA process cannot be completed without exceeding some affordability threshold for mitigation or litigation
Drill and do production testing for ASR wells	Well performance for some portion of recharge system is insufficient for program needs

Municipal and Private Wells in Mid and Northern Santa Cruz County



Phase III Performance Metrics
Page 2 of 2

Task	Focus of Potential Performance Metric
Perform site-specific ASR demonstration testing and develop operational plans and parameters	Drilling and production testing produce new information about feasibility or productivity at specific sites