

**MEETING NOTICE AND AGENDA**  
**TECHNICAL ADVISORY COMMITTEE**  
**OF THE**  
**SEASIDE BASIN WATER MASTER**

**DATE: Wednesday, March 13, 2013**

**MEETING TIME: 1:30 p.m.**

**Monterey Regional Water Pollution Control Agency Offices  
5 Harris Court, Building D (Ryan Ranch)  
Monterey, CA 93940**

*If you wish to participate in the meeting from a remote location, please call in on the Watermaster Conference Line by dialing (877)810-9415. Use the Access Code of 4560043. Please note that if no telephone attendees have joined the meeting by 10 minutes after its start, the conference call will be ended.*

**OFFICERS**

**Chairperson: Eric Sabolsice, California American Water Company**

**Vice-Chairperson: Rob Johnson, MCWRA**

**MEMBERS**

California American Water Company	City of Del Rey Oaks	City of Monterey
City of Sand City	City of Seaside	Coastal Subarea Landowners
Laguna Seca Property Owners	Monterey County Water Resources Agency	
Monterey Peninsula Water Management District		

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**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>MEETING DATE:</b>	March 13, 2013
<b>AGENDA ITEM:</b>	2.A
<b>AGENDA TITLE:</b>	Approve Minutes from February 13, 2013
<b>PREPARED BY:</b>	Robert Jaques, Technical Program Manager
<b>SUMMARY:</b>	<p>Draft Minutes from this meeting were emailed to all TAC members. Any changes requested by TAC members have been included in the attached version.</p>
<b>ATTACHMENTS:</b>	Minutes from this meeting
<b>RECOMMENDED ACTION:</b>	Approve the minutes

**D-R-A-F-T**  
**MINUTES**

**Seaside Groundwater Basin Watermaster  
Technical Advisory Committee Meeting  
February 13, 2013**

**Attendees: TAC Members**

City of Seaside – Rick Riedl  
California American Water – Eric Sabolsice  
City of Monterey – Norm Green  
Laguna Seca Property Owners – Bob Costa  
MPWMD – Joe Oliver  
MCWRA – Howard Franklin  
City of Del Rey Oaks – Leon Gomez  
City of Sand City – Leon Gomez  
Coastal Subarea Landowners – No Representative

**Watermaster**

Technical Program Manager - Robert Jaques

**Consultants**

HydroMetrics – Derrick Williams

**Others:**

Jon Lear – MPWMD  
Brian True – MCWD  
Bob Holden - MRWPCA

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The meeting was called to order at 1:44 p.m. when it was learned that the Chair would be arriving late. In the absence of the Chair and Vice-Chair, Mr. Oliver opened the meeting acting as the temporary Chair.

**1. Public Comments**

There were no public comments.

**2. Administrative Matters:**

**F. Approve Minutes from January 9, 2012 Meeting**

On a motion by Mr. Costa, seconded by Mr. Riedl, the minutes were unanimously approved as presented, with Mr. Green abstaining because he had not attended that meeting.

[Note: Agenda item 4 was taken up out-of-order at this point while awaiting arrival of the Chair for item 3]

**4. Update on Seaside Basin Salt and Nutrient Management Plan**

Mr. Oliver explained the purpose of the Seaside Groundwater Basin Salt and Nutrient Management Plan, and explained that it is a prerequisite to getting grant funds for work on the Basin. MPWMD hired HydroMetrics to help prepare the Plan.

The DWR Bulletin 118 boundary was developed in the 1970s. The Adjudication boundary was taken from the 1982 USGS report and was referred to by CH2M in a 2003 report. The "Yates" boundary was developed in 2005.

Mr. Oliver asked if there would be any problems if the newer (Yates 2005) boundary was used in the Plan. Mr. Lear said that the Yates boundary essentially moves the Adjudication boundary somewhat to the south. Mr. Franklin asked if using the Yates boundary could cause potential problems getting funding for the Watermaster to do work on the Basin. Mr. Williams explained that the Plan will come into play when the GWRP seeks permits, and that any groundwater replenishment project would need to be within whatever boundary is used in the Plan. Mr. Jaques asked Mr. Oliver if it would be feasible to show both boundaries in the Plan. Mr. Oliver said that is how he was leaning, but Mr. Lear explained that a single boundary has to be used in the Plan. Mr. Lear said that more public input will be required as part of developing the Plan.

Mr. Oliver said he would be seeking input from the RWQCB (Matt Keeling) on this same topic.

Mr. Williams said that in accordance with DWR Bulletin 118, a separate plan will need to be developed by others for the Salinas Basin. Mr. Oliver said that if the Salinas Basin Plan uses a southerly boundary that does not match the northerly boundary of the Seaside Basin, there could be an area that is not covered by either plan.

There was consensus to table further discussion on this matter until the RWQCB feedback has been received by Mr. Oliver, at which time discussion with the Watermaster TAC should continue.

[Mr. Sabolsice arrived at 1:55 p.m., and Mr. Oliver provided him a brief recap of the discussion on Agenda item 4.]

### **3. Presentation on Results of Modeling of CAW's Replenishment Program**

Mr. Jaques introduced the topic and summarized the agenda transmittal information. Using PowerPoint slides (copies of which are attached) Mr. Williams summarized the Technical Memorandum. He noted that achieving protective water levels and meeting repayment obligations are two separate objectives, although it would be nice if both could be achieved by CAW's replenishment program.

Mr. Williams went on to explain that if seawater can flow more rapidly beneath a well, the protective water level for that well can be lower. The 2009 protective water level calculations used lower horizontal conductivity values (Kh) than the calibrated model, but the low vertical conductivity values (Kv) in the calibrated model led to the conclusion that the 2009 protective water levels could not be lowered by using the calibrated model conductivities.

Mr. Sabolsice reported that the 25 year payback by CAW will be approximately 700 acre feet per year, but the actual annual amounts will be set to achieve full payback in 25 years.

[Mr. Costa had to depart the meeting at this point @ 2:30 p.m.]

Mr. Williams reported that if water injected at the ASR wells were left in the Basin rather than being recovered (approximately 1,445 AFY) the Basin would reach protective water levels in approximately seven years. If injection was closer to the coast, and the water was left in the Basin, protective water levels could be achieved even sooner.

Mr. Lear reported that the ASR permit limits the average ASR injection amount to the 1,445 AFY level.

Mr. Williams explained that the saw tooth shape of the groundwater elevation plots is largely due to the injection and recovery from ASR project. The calculated seawater intrusion rates do not correlate well with the calculated protective water levels, because the model shows higher seawater intrusion rates if the “no flow” water level is not being achieved. The seawater intrusion rate values are averages all along the coastline, so even if the average value is offshore, there can still be onshore flow in some parts of the coastline.

[Mr. Gomez had to depart the meeting at this point @ 2:58 p.m.]

Mr. Sabolsice commented that if additional replenishment water could be brought in, such as additional Groundwater Replenishment Project (GWRP) water, it could help reach protective water levels sooner. Mr. Oliver asked Mr. Holden if more GWRP water could be made available, and Mr. Holden responded that it could. He noted that it would be cheaper using GWRP water to recharge the Paso Robles aquifer than the Santa Margarita aquifer.

Mr. Sabolsice noted that if the desalination plant sizing includes lots-of-record and Pebble Beach Company entitlements, since those demands won't come on in year one of operations, initially there could be some additional replenishment water available from the desalination plant that could potentially be used to help raise levels in the Seaside Basin.

[Mr. Riedl had to depart the meeting at this point @ 3:18 p.m.]

There was much discussion and questions and answers between Mr. Williams and members of the TAC on various issues. Mr. Oliver recommended that acquiring additional artificial replenishment water to augment the CAW program should be looked at by the Watermaster. Mr. Williams noted that seawater intrusion will eventually occur in the Basin if protective water levels are not achieved.

Mr. Jaques reported that money was being saved in the HydroMetrics contract by not performing all of the work to update protective water level calculations, so it might be possible to have HydroMetrics do some additional work to answer questions raised at today's meeting and/or model an additional scenario, without having to increase the authorized cost of HydroMetrics' contract.

Mr. Sabolsice suggested that how much additional water would be needed to supplement the CAW proposal to reach protective water levels in 25 years could be evaluated. Mr. Oliver said that alternatively the annual ASR injected water that would need to stay in the Basin to augment CAW proposal to reach protective water was 25 years could be evaluated.

Following considerable discussion there was a motion by Mr. Franklin, seconded by Mr. Sabolsice, to use the model to evaluate one more scenario, as follows:

"Have HydroMetrics run an additional modeling Scenario with all Producers still pumping at the pumping rates used in the modeling Scenario of CAW's Replenishment Program, and with CAW reducing its Basin pumping by 700 AFY for 25 years, to determine the volume of artificial replenishment water that would need to be injected at the existing ASR well sites and left in the Basin and not pumped back out, in order to raise groundwater levels to Protective Levels at all well sites in the Basin during this 25 year period."

The motion passed unanimously. [Note: To ensure that the intent and scope of the motion was correctly captured for the Minutes, Mr. Jaques emailed out a draft of this additional scenario to all TAC members who attended this meeting for their review. The motion above reflects TAC input on its wording. This is the scenario that was provided to HydroMetrics for modeling.]

## **5. Schedule**

Mr. Jaques reported that there were no significant changes to the Schedule since the last TAC meeting, and there was no further discussion on this item.

## **6. Other Business**

There were no other business items raised for discussion.

## **7. Set Next Meeting Date:**

The next regular meeting was set for Wednesday March 13, 2013 at 1:30 p.m. at the MRWPCA Board Room.

The meeting adjourned at 3:45 p.m.

# Results of Replenishment Repayment Simulations

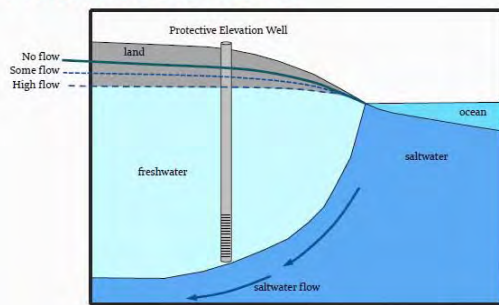
Seaside Groundwater Basin TAC  
February 13, 2013



## Modeling Activities

- Update protective groundwater elevations
- Extend baseline simulation through 2041
- Develop and run Cal-Am's 25 year replenishment repayment scenario
- Iteratively adjust Standard and Alternative Producer pumping until protective groundwater elevations are met at the end of the 25 year period

## Protective Elevations

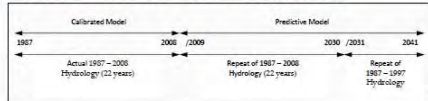


## Update Protective Elevations

- 2009 cross-sectional model based on estimated hydraulic conductivities from other studies
- Purpose of update was to evaluate whether using calibrated conductivity fields from the flow model would indicate that protective elevations should be lowered
- Concluded that the calibrated parameters in the flow model do not suggest protective elevations should be lowered

## Baseline and Two Scenarios

- All simulations use the same hydrology



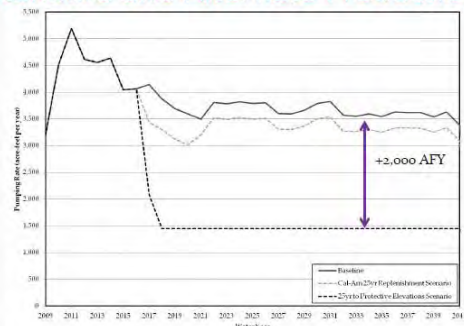
- All simulations use measured pumping through December 2012
- All simulations include 1,445 acre-feet per year of ASR injection beginning in WY2013

## Pumping Assumptions

Starting in January 2017

	Baseline	Cal-Am's 25 Year Replenishment Scenario	25 Years to Achieve Protective Elevations Scenario
Standard Producers	Pump full right with triennial reductions	Cal-Am only 774 AFY for 25 years from Jan-2017	From Jan-2017 iteratively reduce to zero production. Cal-Am recovers 1,445 AFY ASR water
Alternative Producers	Pump at WY 2011 rates	Pump at WY 2011 rates	From Jan-2017 iteratively reduce to zero production
SNG	Cal-Am pumps SNG required water	Cal-Am pumps SNG required water	From Jan-2017 iteratively reduce to zero production

## Standard and Alternate Production



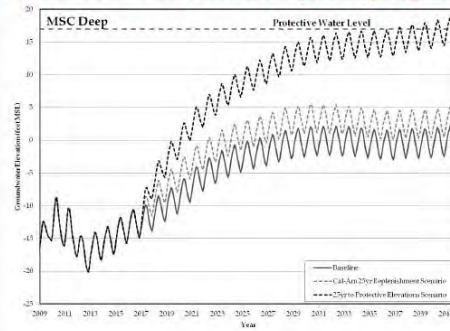
## Protective Elevations

Scenario	MSC Deep	MSC Shallow	PCA-West Deep	PCA-West Shallow	SBWM-3	CDM MW-4
Baseline	Not achieved	Not achieved	Not achieved	Already achieved	Not achieved	Not achieved
25 Year Replenishment Repayment	Not achieved	Not achieved	Not achieved	Already achieved	Not achieved	Not achieved
25 Years to Achieve Protective Elevations	Achieved in 2041	Achieved in 2032	Achieved in 2041	Already achieved	Achieved in 2022	Achieved in 2041

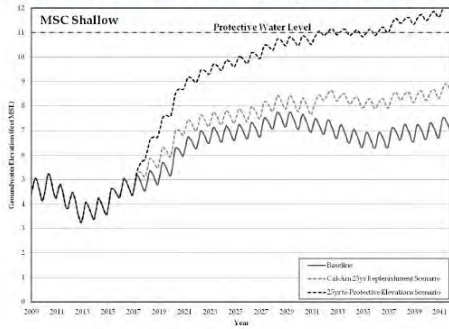
## Groundwater Elevation Difference at End of Simulation (Scenario – Baseline)

Scenario	MSC Deep	MSC Shallow	PCA-West Deep	PCA-West Shallow	SBWM-3	CDM MW-4
25 Year Replenishment Repayment	2.9	1.6	3.0	1.2	3.0	0.05
25 Years to Achieve Protective Elevations	17.1	5.0	19.3	3.7	18.7	0.3

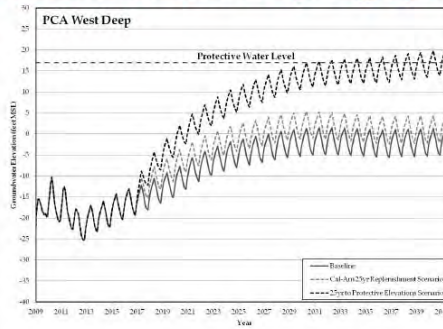
## Protective Elevation Hydrographs



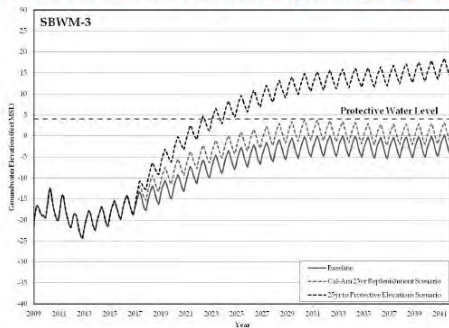
## Protective Elevation Hydrographs



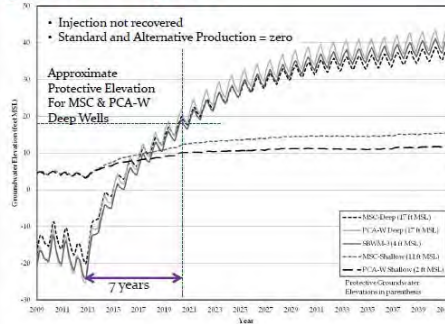
## Protective Elevation Hydrographs



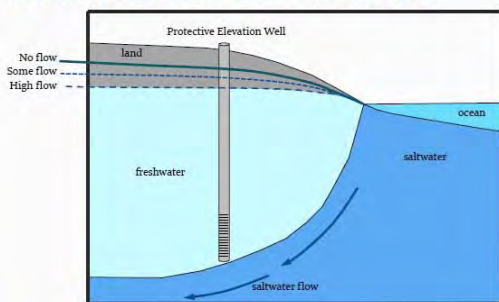
## Protective Elevation Hydrographs



## Injection Impacts



## Protective Elevations don't Exactly Match Zero Modeled Intrusion



## Average Groundwater Flow Rates Cal-Am's 25 Year Replenishment Scenario

	Baseline* (feet/year)		Scenario* (feet/year)	
	2017	2041	2017	2041
1 Aromas and Older Dune Deposits	-147.78	-208.90	-148.87	-228.55
2 Paso Robles	0.52	-1.09	0.48	-1.81
3 Paso Robles	4.04	0.87	3.85	-0.91
4 Paso Robles	30.63	20.21	28.91	12.80
5 Santa Margarita/Purisima	0.57	-0.48	-0.77	-0.82
All Layers	-6.22	-15.27	-7.40	-19.18

\* Negative Baseline or Scenario is offshore flow

\* Positive Baseline or Scenario is onshore flow

\*\* Negative difference indicates velocity of the scenario is less than the baseline

## Average Groundwater Flow Rates 25 Years to Achieve Protective Elev Scenario

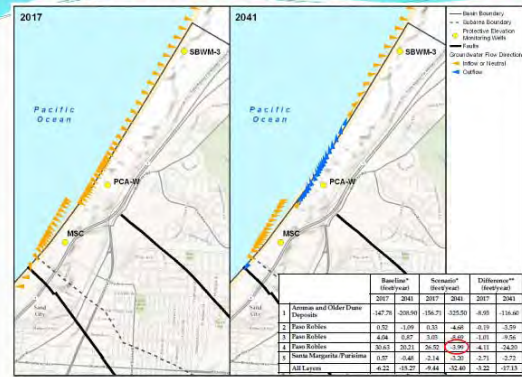
	Baseline* (feet/year)		Scenario* (feet/year)	
	2017	2041	2017	2041
1 Aromas and Older Dune Deposits	-147.78	-208.90	-156.71	-325.50
2 Paso Robles	0.52	-1.09	0.33	-4.68
3 Paso Robles	4.04	0.87	3.03	-8.69
4 Paso Robles	30.63	20.21	26.52	-3.99
5 Santa Margarita / Purisima	0.57	-0.48	-2.14	-3.20
All Layers	-6.22	-15.27	-9.44	-32.40

\* Negative Baseline or Scenario is offshore flow

\* Positive Baseline or Scenario is onshore flow

\*\* Negative difference indicates velocity of the scenario is less than the baseline

## Onshore and Offshore Flows



## Conclusions

- Calibrated parameters in the basinwide model do not suggest protective elevations should be lowered.
- Cal-Am's proposed 25 year replenishment scenario does not achieve protective elevations, but does slow seawater intrusion.
- Eliminating all Standard and Alternative Producer pumping for 25 years starting in January 2017 allows protective elevations to be met at the end of the 25 year period.

## Conclusions cont.

- Protective elevations could be reached after 7 years if the injected water was left in the aquifer.
- Potential intrusion rates for both model scenarios are slower than baseline intrusion rates.
- Recharge through in-lieu storage affects lower aquifers later because recharge is derived from the surface.
- Future ASR or GWRP locations could speed up recovery to protective elevations.

**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>MEETING DATE:</b>	March 13, 2013
<b>AGENDA ITEM:</b>	2.B
<b>AGENDA TITLE:</b>	Progress Update on Abandonment and Conversion of CAW Wells
<b>PREPARED BY:</b>	Robert Jaques, Technical Program Manager

**SUMMARY:**

At previous TAC meetings there has been discussion pertaining to CAW's proposal to abandon four of its Seaside Basin wells and to convert three of these to monitoring wells. The TAC voted to recommend approval of this at its last February 13, 2013 meeting. CAW and MPWMD were to communicate with Monterey County Department of Environmental Health on this matter as a step toward converting the wells for monitoring purposes. The attached plans were prepared by MPWMD for the three wells proposed for converting to monitor wells (Military, Luxton, and Hilby MGT). MPWMD plans to send these for concurrence to the County, along with an explanation of the TAC's recommendation for approval of these conversions. At the time of preparation of this agenda, MPWMD was still coordinating this with CAW, so there may be some revisions to these materials before they go to the County.

MPWMD is also recommending that pressure transducer dataloggers be purchased and installed on these wells to collect data. This would preclude the need to have staff make routine visits to the monitor wells for manual readings, and there would only be periodic (initially once per quarter) downloads of the loggers that MPWMD would be willing to do as part of the other routine monitoring that they are already doing for the Watermaster.

<b>ATTACHMENTS:</b>	Plans for Well Conversions
<b>RECOMMENDED ACTION:</b>	None required – information only

**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>MEETING DATE:</b>	March 13, 2013
<b>AGENDA ITEM:</b>	2.C
<b>AGENDA TITLE:</b>	Progress Update on Investigation of Water Quality Issues at Sand City Public Works Well
<b>PREPARED BY:</b>	Robert Jaques, Technical Program Manager

**SUMMARY:**

Under its contract with the Watermaster (RFS No. 2013-01) MPWMD is compiling historical and current water quality data in the coastal area to provide more in-depth evaluation of conditions in the shallow Dune Sand/Aromas Sand aquifer in the vicinity of the Sand City Public Works well, where unique water quality conditions and variability have been observed.

This well has exhibited chloride fluctuations that got the attention of Judge Randall in his March 7, 2012 Minute Order. This well has somewhat unique water quality characteristics compared with other wells in the Basin, and may reflect a condition that has existed for a long time in this area of the Basin. One of the issues that would be important to help sort out the potential relation of historical water chemistry to the recent observed water quality character at this well would be to evaluate the historical water quality in the area of this well. MPWMD has asked CAW to help locate any of the historical water quality data that may exist in CAW's records from wells in this area that are now long-abandoned and destroyed, but which were once operated for water supply. This would help with investigating the hydrogeology and water quality in this area of the Basin, as a follow up to the Judge's order.

MPWMD had some informal discussions a long time ago with the former CAW Operations Manager, who referred to as "peculiar" the water quality at some of CAW's (or its predecessor's) older wells in Sand City and southern Seaside. MPWMD has asked CAW if it can locate any of this older water quality data for use in performing this investigation.

<b>ATTACHMENTS:</b>	None
<b>RECOMMENDED ACTION:</b>	None required – information only

**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>MEETING DATE:</b>	March 13, 2013
<b>AGENDA ITEM:</b>	2.D
<b>AGENDA TITLE:</b>	Progress Update on Seaside Basin Salt and Nutrient Management Plan Basin Boundary Question
<b>PREPARED BY:</b>	Robert Jaques, Technical Program Manager
<b>SUMMARY:</b>	<p>At its February 13, 2013 meeting the TAC it received a presentation from MPWMD and HydroMetrics on their work to prepare a Salt and Nutrient Management Plan for the Seaside Basin. One issue that was discussed was what boundary should be used for the Basin in that Plan.</p> <p>As an update on that topic MPWMD reports that it has had ongoing discussions with HydroMetrics on issues that have come up in order for the Plan to address the RWQCB's requirements. Accordingly, HydroMetrics is in the process of compiling a list of questions that can be sent to the RWQCB staff to get clarification. MPWMD will also be requesting an update regarding the Seaside Basin boundary depiction.</p> <p>Also, as one of the requirements there will be the need for Basin producers to provide information on the use of added salts and/or nutrients via irrigation practices. In the Seaside Basin this would primarily be the golf courses. MPWMD is preparing a draft letter-of-request that would go from the Watermaster to producers in the Basin. Depending on the timing of when MPWMD gets responses from the RWQCB and the Seaside Basin producer survey letter on salt and nutrient application quantities, this topic will likely come back to the TAC for further discussion at the April 2013 meeting.</p>
<b>ATTACHMENTS:</b>	None
<b>RECOMMENDED ACTION:</b>	None required – information only

**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>MEETING DATE:</b>	March 13, 2013
<b>AGENDA ITEM:</b>	2.E
<b>AGENDA TITLE:</b>	Progress Report on Migrating Cross-Aquifer Contamination Study Data into the Watermaster's Database
<b>PREPARED BY:</b>	Robert Jaques, Technical Program Manager
<b>SUMMARY:</b>	<p>Under its contract with the Watermaster (RFS No. 2013-01) MPWMD is migrating data from its previously-performed Cross-Aquifer Contamination Study into the Watermaster's Database.</p> <p>Jon Lear has spent considerable effort recently on incorporation of the additional well records discovered during the cross-aquifer investigation, and these records have now been formatted and added to the Database. Information in the form of a report table will be generated containing a listing of these well records and locations (most are sites that are now abandoned with cement seals, i.e., destroyed), along with digital well forms that go with each of these records (these are mostly DWR records that are not public under the Water Code and therefore should not be distributed for public use).</p> <p>This information will be presented to the TAC at a near-future TAC meeting.</p>
<b>ATTACHMENTS:</b>	None
<b>RECOMMENDED ACTION:</b>	None required – information only

**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>MEETING DATE:</b>	March 13, 2013
<b>AGENDA ITEM:</b>	3
<b>AGENDA TITLE:</b>	Discussion of Updated Results of Modeling of CAW's Replenishment Program
<b>PREPARED BY:</b>	Robert Jaques, Technical Program Manager

**SUMMARY:**

HydroMetrics is under contract to perform groundwater modeling to assess the impacts of CAW's Basin replenishment program. At the January TAC meeting a presentation was made by HydroMetrics regarding their work on revising Protective Water Levels as part of the scope of work for the modeling work. At the February TAC meeting HydroMetrics made a presentation on the full scope of the modeling work. At that meeting the TAC determined to ask HydroMetrics to perform modeling of an additional (third) Scenario which would be run to determine how much water would need to be injected at the existing ASR wells and left in the Basin, i.e. not pumped back out as production water, in conjunction with CAW's 700 AFY replenishment program, in order to raise groundwater levels to protective elevations.

HydroMetrics has now completed this additional modeling work and has updated their previous Technical Memorandum (which was included in the February 13 TAC agenda packet) and will summarize the findings and conclusions of the updated Technical Memorandum at today's meeting. A copy of the Updated Draft of their Technical Memorandum on this work is attached. In order to reduce costs, HydroMetrics will attend today's meeting via the teleconference line, rather than in person, but there will be PowerPoint overheads shown during the meeting to aid HydroMetrics in making their presentation.

As the Updated Technical Memorandum reports, approximately 1,000 AFY of additional injection would be needed to raise groundwater elevations to protective levels in 25 years. This can be compared to the modeling results that showed that if only reducing pumping was done to achieve protective elevations, a pumping reduction of almost 2,000 AFY would be required in order to achieve protective elevations after 25 years. This third Scenario shows that less additional water (1,000 AFY) would be needed if it was injected and left in the Basin, than if it had to be provided to producers to offset reducing their pumping (about 2,000 AFY). The reason that injecting the supplemental water requires less water is that injection gets the water to the necessary areas (deep monitoring wells) quickly. If the producers simply stop pumping, it takes longer for natural percolation from rainfall to replenish the deep zones to raise water levels.

The following are the findings, conclusions, and recommendations that I propose the TAC should report to the Board at the Board's April 3 meeting:

**Principle Findings and Conclusions from the Modeling Work:**

1. The protective groundwater level elevations developed in 2009 remain reasonable targets for groundwater management and cannot be lowered as previously hoped.
2. Cal-Am's proposed 25 year replenishment repayment program of 700 AFY for 25 years increases groundwater elevations in the shallow and deep aquifer coastal wells compared to the Baseline (i.e. no replenishment water), but in almost all locations falls well short of achieving protective elevations in these wells.
3. Eliminating all Standard and Alternative Producer pumping for 25 years starting in January 2017 will allow protective elevations to be met at all of the coastal wells by the end of the 25 year period.

**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>AGENDA ITEM:</b>	3 (Continued)
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4. This will require an overall pumping reduction of just over 2,000 AFY. Presumably additional (outside Basin) water would need to be obtained in order to allow these producers to reduce their pumping by this 2,000 AFY amount.
5. When combined with Cal-Am's replenishment program, protective elevations can be achieved at all of the coastal wells by injecting an additional 1,000 acre-feet per year of water into the existing ASR wells, with this additional water being left in the Basin and not pumped back out under the normal Aquifer Storage and Recovery cycle. Standard Producers, other than Cal Am which under its replenishment program would reduce its annual pumping by 700 AFY for 25 years, would pump at the Decision-allowed levels in accordance with the 10% triennial pumping reductions. Alternative Producers would continue pumping at their 2011 rates. This approach requires less outside Basin water to achieve protective elevations than the pumping reduction approach described above.
6. Potential seawater intrusion rates for each of the three scenarios described above in items 2, 3, and 4 are slower than Baseline intrusion rates. Cal-Am's replenishment program still allows some seawater intrusion to occur in the lower Paso Robles aquifer. The scenario described in items 3 and 4, which achieve protective elevations within 25 years, have seawater intrusion rates of about half the rate Cal-Am's replenishment program and prevent seawater intrusion into all of the Basin's aquifers.

**TAC Recommendations to the Board:**

Since bringing in additional water from outside the Basin for injection via ASR wells appears to be one of the quickest (if not the quickest) ways of raising groundwater levels up to protective elevations, the TAC recommends that the Watermaster undertake work to:

1. Encourage MRWPCA to examine the potential for its GWRP to, at least for an interim period, provide greater quantities of water than the currently projected 3,500 AFY, with the additional water to be used for Basin replenishment to help raise groundwater levels.
2. Determine whether or not the Monterey Peninsula Water Supply Project (CAW's Project) will have excess desalination production capacity in its initial years so that it could provide such additional water for injection.
3. Determine if there are any other potential sources of outside-Basin water that could be acquired and used for injection, e.g. stormwater.
4. Determine if injection sites closer to the coast could (1) more rapidly reach protective levels and/or (2) reach protective levels using less outside-Basin water, than injecting at the existing ASR sites.
5. Determine the relative-magnitude-of-costs for items 3 and 4 above.
6. Determine from this work whether any approach is feasible, and make recommendations on this to the Board.

Some of this work could be done by staff, but some of it (for example items 3 and 4) would likely require the assistance of an outside consultant.

<b>ATTACHMENTS:</b>	Updated Technical Memorandum from HydroMetrics
<b>RECOMMENDED ACTION:</b>	Provide input and direction to the Technical Program Manager on the information and recommendations he should provide to the Board at its April 3, 2013 meeting

## TECHNICAL MEMORANDUM

To: Seaside Groundwater Basin Board of Directors  
From: Georgina King and Derrick Williams  
Date: March 1, 2013  
Subject: Groundwater Modeling Results of Replenishment Repayment in the Seaside Basin

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### 1.0 BACKGROUND AND MODELING OBJECTIVES

Three scenarios were evaluated by the modeling described in this Technical Memorandum: (1) Scenario 1: A 25-year groundwater overpumping replenishment program proposed by California American Water (Cal-Am); (2) Scenario 2: A set of pumping reductions to achieve protective groundwater levels over a 25-year period; and (3) Scenario 3: Cal-Am's replenishment plan coupled with additional managed aquifer recharge to achieve protective elevations in 25 years.

Under Scenario 1 Cal-Am proposes to repay its post-adjudication overpumping by reducing its Seaside Basin pumping for 25 years. During this 25-year period, Cal-Am plans to provide a portion of the water to its customers from a desalination facility in-lieu of pumping. The desalination facility will be commissioned in 2017. Cal-Am's proposal consists of reducing its pumping by 700 acre-feet per year for 25 years, resulting in a total repayment of 17,500 acre-feet of water. Cal-Am and the Seaside Basin Watermaster Board of Directors asked HydroMetrics Water Resources Inc. (WRI) to perform modeling to determine if this repayment schedule would allow groundwater elevations to reach protective levels.

Cal-Am's proposed replenishment program is intended to repay overpumping credits, but may or may not restore coastal groundwater elevations to protective levels. Under Scenario 2, the amount of pumping reduction that would be

necessary to achieve protective elevations in the six coastal protective elevation monitoring wells (if Cal-Am's proposed repayment of replenishment water over 25 years did not achieve protective elevations) was determined.

Similar to the second simulation, the objective of Scenario 3 is to achieve protective groundwater elevations within 25 years. Under Scenario 3, protective elevations are achieved by injecting water in the Santa Margarita aquifer rather than reducing pumping. In this scenario, Cal-Am reduces its pumping by 700 acre-feet per year for 25 years. Additional water is injected into the existing ASR wells to restore groundwater elevations. The amount of water injected into the ASR wells is iteratively adjusted until protective elevations are achieved after 25 years of operation.

## 2.0 UPDATE PROTECTIVE ELEVATIONS

As a preliminary step in these modeling activities HydroMetrics WRI was asked to revisit and update the protective groundwater elevations, if necessary. Groundwater elevations that protect the Seaside Basin from seawater intrusion have been established at coastal monitoring wells SBWM-3, PCA-West deep and shallow, MSC deep and shallow, and CDM MW-4 using cross-sectional models (HydroMetrics LLC 2009). The locations of these wells are shown in Figure 1. These cross-sectional models were developed before the Seaside Groundwater Basin basinwide groundwater model was calibrated and completed. The horizontal ( $K_h$ ) and vertical ( $K_v$ ) hydraulic conductivity fields in the original cross-sectional models were based on estimated conductivities from previous studies. The purpose of this analysis was to evaluate whether incorporating the calibrated conductivity fields from the basinwide model into the cross-sectional models would result in lowering the previously-developed protective elevations. Hydraulic conductivity ( $K_v$  and  $K_h$ ) are parameters that control the rate of flow in aquifers. If the basinwide model has higher hydraulic conductivities occurring below the depth that is being protected from seawater intrusion, the protective groundwater elevations can be lowered.

HydroMetrics WRI analyzed the calibrated conductivity fields in the basinwide model surrounding and offshore of the coastal monitoring wells. Horizontal and vertical conductivity values were identified for all active cells in each layer. Statistics of the conductivities, weighted by basinwide model cell area, were

calculated for layers corresponding to hydrostratigraphic units in the cross-sectional model for each well.

## 2.1 UPDATE CROSS-SECTIONAL MODELING OF WELL SBWM-3

Table 1 compares the original parameter ranges used in the cross-sectional models with the parameter averages calculated from the basinwide model for Sentinel Well 3 (SBWM-3).

*Table 1: Well SBWM-3 Cross-sectional Model and Basinwide Model Hydraulic Conductivities*

Hydrostratigraphic Unit	Basinwide Model Layers	Cross-sectional Model Kh Range (feet per day)	Average Basinwide Model Kh (feet per day)	Cross-sectional Model Kv Range (feet per day)	Average Basinwide Model Kv (feet per day)
Seabed	N/A	N/A	N/A	Conductance = 0.01 – 10 day <sup>-1</sup>	N/A
Aromas	1	5 - 20	165	0.05 – 1.0	0.5
Upper & Middle Paso Robles	2-3	2 - 8	5	0.01 – 0.1	0.2
Lower Paso Robles	4	2 - 8	7	0.01 – 0.1	0.003
Purisima	5	2 - 8	19	0.02 - 0.4	0.0002

Note: Kh = horizontal conductivity and Kv = vertical conductivity.

For the SBWM-3 well, the protective elevation is established to protect the aquifer at the well site in the middle of the Purisima Formation. From the cross-sectional model sensitivity analysis (HydroMetrics LLC, 2009; Appendix C), the hydraulic conductivity of the aquifer below the protected depth has the greatest effect on the protective elevation. The basinwide model indicates that horizontal conductivity in the Purisima Formation below the protected location (Layer 5) is greater in the basinwide model than in the original cross-sectional model, suggesting that incorporating the basinwide model parameters will reduce the protective elevation. However, the overall hydraulic conductivity in the Purisima Formation below the protected location is smaller in the basinwide model than in the original cross sectional model due to the much lower vertical

conductivity in the model. Therefore, using the parameters from the basinwide model will not lower the protective elevation from the already low value of 4 feet MSL

## 2.2 UPDATE CROSS-SECTIONAL MODELING OF PCA-WEST WELLS

Table 2 compares the original parameter ranges used in the cross-sectional models with the averages calculated from the basinwide model for the PCA-West wells (shallow and deep).

*Table 2: PCA-West Well Cross-sectional Model and Basinwide Model Hydraulic Conductivities*

Hydrostratigraphic Unit	Basinwide Model Layers	Cross-sectional Model Kh Range (feet per day)	Average Basinwide Model Kh (feet per day)	Cross-sectional Model Kv Range (feet per day)	Average Basinwide Model Kv (feet per day)
Seabed	N/A	N/A	N/A	Conductance = 0.01 – 10 day <sup>-1</sup>	N/A
Aromas	1	5 - 20	165	0.05 – 1.0	0.5
Upper & Middle Paso Robles	2-3	2 - 8	11	0.01 – 0.1	0.3
Lower Paso Robles	4	2 - 8	21	0.01 – 0.1	0.01
Purisima/Santa Margarita	5	5 – 20	144	0.05 – 1.0	0.00003
Monterey	N/A	0.5	N/A	0.025	N/A

Note: Kh = horizontal conductivity and Kv = vertical conductivity.

For the PCA-West deep well, a protective elevation is established to protect the aquifer at the well location at the bottom of the Santa Margarita Formation. From the cross-sectional model sensitivity analysis (HydroMetrics LLC, 2009; Appendix C), the hydraulic conductivity of the Monterey Formation which is the unit below the protected depth has the greatest effect on the protective elevation. However, because the basinwide model does include the Monterey Formation, it cannot be used to lower the protective elevation from 17 feet MSL. Therefore, no

changes to the protective elevation of the deep PCA-West well can be made based on the basinwide model.

A protective elevation is also established for the shallow PCA-West well that protects the aquifer at the well location below the Paso Robles Formation. The basinwide model indicates that the horizontal conductivity in the Purisima and Santa Margarita Formations below the protected location (Layer 5) are greater in the basinwide model than in the original cross-sectional model, suggesting that incorporating the basinwide model parameters will reduce the protective elevation. However, the overall hydraulic conductivity in the Purisima and Santa Margarita Formations below the protected location is smaller in the basinwide model than in the original cross-sectional model due to the much lower vertical conductivity in the basinwide model. Therefore, using the parameters from the basinwide model will not lower the protective elevation of the shallow PCA-West well from the already low value of 2 feet MSL.

## 2.3 UPDATE CROSS-SECTIONAL MODELING OF MSC WELLS

Table 3 compares the original parameter ranges used in the cross-sectional models with the averages calculated from the basinwide model for the MSC wells (shallow and deep).

*Table 3: MSC Well Cross-sectional Model and Basinwide Model Hydraulic Conductivities*

Hydrostratigraphic Unit	Basinwide Model Layers	Cross-sectional Model Kh Range (feet per day)	Average Basinwide Model Kh (feet per day)	Cross-sectional Model Kv Range (feet per day)	Average Basinwide Model Kv (feet per day)
Seabed	N/A	N/A	N/A	Conductance = 0.01 – 10 day <sup>-1</sup>	N/A
Aromas	1	5 - 20	165	0.05 – 1.0	0.5
Upper & Middle Paso Robles	2-3	2 - 8	5	0.01 – 0.1	0.1
Lower Paso Robles	4	2 - 8	6	0.01 – 0.1	0.03
Santa Margarita	5	5 – 20	18	0.05 – 1.0	0.05
Monterey	N/A	0.5	N/A	0.025	N/A

Note: Kh = horizontal conductivity and Kv = vertical conductivity.

For the deep MSC well, a protective elevation is established to protect the aquifer at the well location at the bottom of the Santa Margarita Formation. From the cross-sectional model sensitivity analysis (HydroMetrics LLC, 2009; Appendix C), the conductivity of the Monterey Formation which is the unit below the protected depth has the greatest effect on the protective elevation. However, because the basinwide model does include the Monterey Formation, it cannot be used to lower the protective elevation from 17 feet MSL. Therefore, no changes to the protective elevation of the deep MSC well can be made based on the basinwide model.

A protective elevation is also established for the shallow MSC well that protects the aquifer at the well below the Paso Robles Formation. The basinwide model indicates that the horizontal conductivity in the Santa Margarita Formation

below the protected location (Layer 5) is greater in the basinwide model than in the original cross-sectional model, suggesting that incorporating the basinwide model parameters will reduce the protective elevation. However, the overall hydraulic conductivity in the Santa Margarita Formation below the protected location is smaller in the basinwide model than in the original cross-sectional model due to the lower vertical conductivity in the basinwide model. Therefore, using the parameters from the basinwide model will not lower the protective elevation at the shallow MSC well from 11 feet MSL

## 2.4 UPDATE CROSS-SECTIONAL MODELING OF CDM MW-4 WELL

Table 4 compares the original parameter ranges used in the cross-sectional models with the averages calculated from the basinwide model for the CDM MW-4 well.

*Table 4: CDM MW-4 Well Cross-sectional Model and Basinwide Model Hydraulic Conductivities*

Hydrostratigraphic Unit	Basinwide Model Layers	Cross-sectional Model Kh Range (feet per day)	Average Basinwide Model Kh (feet per day)	Cross-sectional Model Kv Range (feet per day)	Average Basinwide Model Kv (feet per day)
Seabed	N/A	N/A	N/A	Conductance = 0.01 – 10 day <sup>-1</sup>	N/A
Aromas	1	5 - 20	165	0.05 – 1.0	0.5
Paso Robles	2-5	5-20	22	0.05 - 1.0	0.1
Monterey	N/A	0.5	N/A	0.025	N/A

Note: Kh = horizontal conductivity and Kv = vertical conductivity.

For the CDM MW-4 well, a protective elevation is established to protect the aquifer at the well at the bottom of the Paso Robles Formation. From the cross-sectional model sensitivity analysis (HydroMetrics LLC, 2009; Appendix C), the conductivity of the Monterey Formation which is the unit below the protected depth has the greatest effect on the protective elevation. However, because the basinwide model does include the Monterey Formation, it cannot be used to

lower the protective elevation from 2 feet MSL. Therefore, no changes to the protective elevation of the CDM MW-4 well can be made based on the basinwide model.

## 2.5 CONCLUSIONS

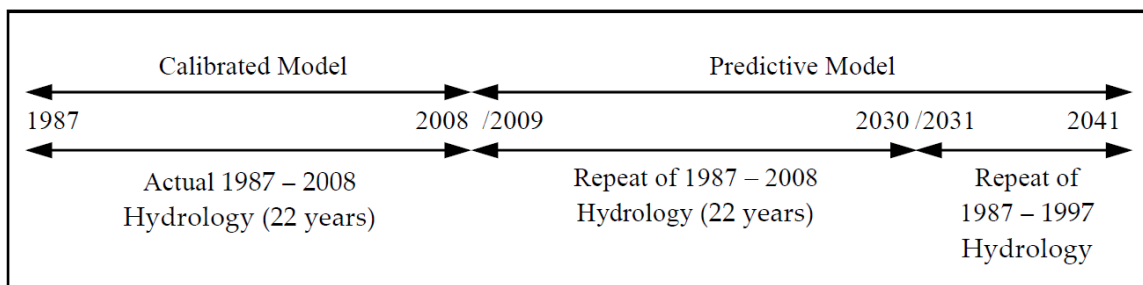
The calibrated parameters in the basinwide model do not indicate that protective elevations should be lowered.

### 3.0 EXTEND GROUNDWATER FLOW MODEL THROUGH 2041

To model the three Scenarios HydroMetrics WRI extended the 2012 TAC baseline model used to previously model temporarily deferring the Adjudication-required ten percent pumping reductions (HydroMetrics WRI, 2012). The baseline model originally simulated the Seaside Basin through 2030. The model was extended from 2030 through 2041 for these simulations. The year 2041 was chosen using the assumption that Cal-Am’s repayment would begin in 2017, and the repayment would take 25 years.

All boundary conditions for the added simulation period are held constant at their 2030 levels. These include the general head boundaries along the coast, constant head boundaries adjacent to the Salinas Basin, and all no flow boundaries.

The same hydrology (rainfall and recharge) used in previous model runs was applied to the baseline scenario and all pumping scenarios. To extend the hydrology through the predictive period, the 1987 through 2008 hydrology data were repeated for model years 2009 through 2030, and 2031 through 2041 (Figure 1). Because there are only 22 years of hydrology data between 1987 and 2008, these 22 years have been repeated in succession through 2041. By using this hydrology, even during the period January 2009 to present when actual hydrology is known, the model runs can be used to compare relative groundwater levels but not to assess absolute Basin conditions.



*Figure 1: Repetition of Hydrology for Predictive Model*

## 4.0 DEVELOP MODEL SCENARIOS

A subgroup of the Watermaster's Technical Advisory Committee (TAC) met by conference call on December 18, 2012 to develop modeling scenarios and discuss modeling assumptions.

Attendees on the conference call were:

Bob Jaques	Seaside Basin Watermaster
Joe Oliver	Monterey Peninsula Water Management District
John Kilpatrick	California American Water
Robert Johnson	Monterey County Water Resources Agency

The assumptions agreed upon during the call are summarized in the following sections.

### 4.1 BASELINE SIMULATION ASSUMPTIONS

#### WATER YEAR 2009 THROUGH WATER YEAR 2012 PUMPING

Actual pumping and injection data for all wells from January 2009 through December 2012 are included in the baseline.

#### STANDARD PRODUCER PUMPING FROM WATER YEAR 2013 ONWARDS

Standard Producer pumping follows the Decision-prescribed triennial reductions. All water injected by ASR wells is pumped from select Cal-Am wells.

#### GOLF COURSE PUMPING

Golf course wells pump at rates based on the hydrologic year. For example, pumping in January 2015 equals the amount pumped in January 1993, because the simulated 2015 hydrology is based on 1993 hydrology. This ensures that the demand corresponds to the hydrology. If the amount pumped by a Producer pre-adjudication exceeded the Producer's adjudicated right, pumping was capped at the Producer's adjudicated amount.

Additional golf course pumping adjustments accounted for in the baseline simulation are:

- The Bayonet and Blackhorse golf courses pump no water until September, 2016. This is based on an in-lieu replenishment program the City of Seaside has with its golf course pumping. Under this program, Marina Coast Water District provides water in-lieu of the City pumping from the Seaside Basin. The City expects to start pumping its golf course wells again starting September 2016.
- In 2007, Bayonet and Black Horse golf courses had irrigation upgrades that have reduced irrigation demand by approximately 10% from historical amounts.
- The City of Seaside expects to begin pumping an average of 360 AFY from its wells for golf course supply starting in September 2016. These projected quantities were used rather than basing demand on the hydrology year.

## **ALTERNATIVE PRODUCER AND PRIVATE PUMPING**

Alternative Producers, excluding golf courses, pump at their Water Year (WY) 2011 volumes from WY 2013 onwards. All other pumpers that are not covered by the Decision, including Cal Water Service and private wells, also pump at WY 2011 volumes from WY 2013 onwards.

Pumping exceptions taken into account in the baseline are:

- Water for SNG, which is an Alternative Producer, is supplied from Cal-Am wells under an agreement with Cal-Am. When the SNG site is developed they will be supplied with water by Cal-Am, who will use SNG's water right of 149.7 acre-feet/year. Currently there is no production from the SNG well. Based on input from the property owner, Ed Ghandour, project construction is planned to start in 2013 with 25 AFY water usage. Water usage thereafter is estimated to be:
  - 2014 - 30 AFY
  - 2015 - 50 AFY
  - 2016 onwards - 70 AFY

## **INJECTION AND EXTRACTION OF INJECTED WATER**

From WY 2013 onwards, a combined volume of 1,445 acre-feet per year was injected into four aquifer storage and recovery (ASR) wells in accordance with their permitted amounts. The same amount of 1,445 acre-feet per year is extracted back out annually by Cal-Am production wells in the Northern Coastal subarea.

### **4.2 SCENARIO 1: CAL-AM'S TWENTY-FIVE YEAR REPLENISHMENT REPAYMENT SIMULATION ASSUMPTIONS**

The 25 year replenishment scenario includes the same pumping rates as the baseline with the exception of Cal-Am's wells. Beginning in January 2017, Cal-Am pumps only 774 AFY of its allotted natural safe yield of 1,474 AFY. The 700 AF not being pumped over a 25 year period is Cal-Am's replenishment repayment. The reduced pumping is distributed among Cal-Am wells relative to the amount each well pumps as a percentage of monthly pumping. Table 5 summarizes the production information for each scenario.

All other model assumptions are identical to those of the baseline scenario as summarized in Table 5.

### **4.3 SCENARIO 2: TWENTY-FIVE YEARS TO ACHIEVE PROTECTIVE ELEVATIONS SIMULATION ASSUMPTIONS**

In this simulation, pumping is iteratively reduced throughout the basin to estimate the annual pumping that allows groundwater levels to reach protective elevations in the four coastal monitoring well locations after 25 years. Pumping is first reduced for all Standard Producers, in proportion to their pumping amounts. If Standard Producers production reaches zero without protective elevations being met, Alternative Producer pumping is reduced in proportion to their pumping amounts. The pumping reductions do not affect the annual recovery of injected water: Cal-Am continues to recover 1,445 acre-feet per year of water injected by the ASR wells.

The pumping assumptions for this scenario are summarized in Table 5.

### 4.4 SCENARIO 3: REDUCED CAL-AM PUMPING WITH INJECTION SIMULATION ASSUMPTIONS

In this simulation, injection is iteratively added to existing ASR wells to estimate the amount of injection that allows groundwater levels to reach protective elevation in the four coastal monitoring well locations after 25 years. Beginning with the pumping rates defined in Scenario 2: Cal-Am Twenty-Five Year Replenishment, injection is iteratively added in existing ASR wells 1 through 4 until protective levels are reached after 25 years. The increased injection begins in December of 2016 and is applied at a constant rate in ASR wells 1 through 4 for the months of December through May. The injected water is divided evenly between the four injection wells.

The pumping assumptions for the three scenarios are summarized in Table 5.

*Table 5: Model Simulation Summary*

	<b>Baseline</b>	<b>Scenario 1: Cal-Am's 25 Year Replenishment Scenario</b>	<b>Scenario 2: 25 Years to Achieve Protective Elevations Scenario</b>	<b>Scenario 3: Reduced Cal-Am Pumping with Injection Scenario</b>
<b>Standard Producers</b>	Pump full adjudicated right with triennial reductions	Cal-Am pumps only 774 AFY for 25 years, starting in January 2017	Iteratively reduce production. Cal-Am continues to recover 1,445 AFY of injected water	Cal-Am pumps only 774 AFY for 25 years, starting in January 2017. Iteratively increase ASR well injection
<b>Alternative Producers</b>	Pump at WY 2011 rates	Pump at WY 2011 rates	Iteratively reduce to zero production	Pump at WY 2011 rates
<b>SNG</b>	Cal-Am pumps SNG required water	Cal-Am pumps SNG required water	Iteratively reduce to zero production	Cal-Am pumps SNG required water

## 5.0 MODEL RESULTS

The model assumptions discussed above were integrated into the Seaside Basin groundwater flow model, and the model was run separately for each simulation. Results of the model runs are presented in the sections below. The first section below discusses the ability of each simulation to reach protective elevations at coastal monitoring wells. The second section below discusses each simulation's impact on seawater intrusion rates.

### 5.1 GROUNDWATER LEVELS AT COASTAL MONITORING WELLS

The simulated groundwater elevations for each scenario were evaluated in six monitoring wells used for establishing protective elevations against seawater intrusion (HydroMetrics LLC, 2009). These monitoring wells are: MSC Deep, MSC Shallow, PCA-West Deep, PCA-West Shallow, Sentinel Well 3, and CDM MW-4 (Figure 2).

The protective elevations at each well were used as a benchmark for comparing the relative success of each scenario at achieving protective elevations. Simulated hydrographs for the baseline scenario and three model scenarios are provided in Figure 3 through Figure 5. In these figures, the hydrographs for well CDM MW-4 appear significantly different from the other hydrographs because well CDM MW-4 is very shallow and is located in a different model layer and hydrostratigraphic layer than the other wells. The spikes observed in the CDM MW-4 hydrograph are a response to recharge occurring during winter months. This behavior is not observed in the deeper wells where groundwater levels are less sensitive to seasonal and inter-annual variations in rainfall and recharge. Additionally, the groundwater elevation scale is different than the scales on the other plots.

#### SCENARIO 1: CAL-AM'S 25 YEAR REPLENISHMENT SCENARIO

Under Cal-Am's 25 year replenishment scenario, the model predicts some additional recovery above the baseline scenario, but not enough to bring any groundwater levels up to protective elevations (Table 6). Groundwater levels recover 1 to 1.5 feet in the shallow wells and approximately 3 feet in the deep wells by the end of this scenario (Table 7). As expected, there is almost no

recovery in CDM-MW-4 because it is very shallow and Cal-Am’s pumps from deeper aquifers.

## SCENARIO 2: ACHIEVING PROTECTIVE ELEVATIONS SCENARIO

Significant pumping reductions were required for the model to achieve protective elevations in all six monitoring wells. This could only be attained by ceasing all pumping from both Standard and Alternative Producers, with the exception of 1,445 AFY recovered by Cal-Am from injection. Under this scenario, the MSC Deep well, PCA-W Deep well, and CDM-MW-4 well all just reach protective levels in the final year (2041) of the simulation. The MSC Shallow well and Sentinel Well 3 reach protective elevations sooner than the end of the simulation period. Table 6 summarizes the approximate dates protective elevations are met in each monitoring well. The average groundwater level differences between the scenarios and baseline at the end of the simulations are shown in Table 7.

*Table 6: Summary of Protective Elevation Achievement*

Scenario	MSC Deep	MSC Shallow	PCA-West Deep	PCA-West Shallow	Sentinel-3	CDM MW-4
Baseline	Not achieved	Not achieved	Not achieved	Already achieved	Not achieved	Not achieved
Scenario 1: 25 Year Cal-Am Replenishment Scenario	Not achieved	Not achieved	Not achieved	Already achieved	Not achieved	Not achieved
Scenario 2: 25 Years to Achieve Protective Elevations Scenario	Achieved in 2041	Achieved in 2032	Achieved in 2041	Already achieved	Achieved in 2022	Achieved in 2041
Scenario 3: 25 Year Cal-Am Replenishment Scenario with Additional Water Injection	Achieved in 2030	Achieved in 2041	Achieved in 2034	Already achieved	Achieved in 2022	Achieved in 2041

*Table 7: Average Groundwater Elevation Difference at the End of Simulation  
 (Scenario- Baseline)*

Scenario	MSC Deep	MSC Shallow	PCA- West Deep	PCA- West Shallow	Sentinel-3	CDM MW-4
<b>Scenario 1: 25 Year Cal-Am Replenishment Scenario</b>	2.9	1.6	3.0	1.2	3.0	0.05
<b>Scenario 2: 25 Years to Achieve Protective Elevations Scenario</b>	17.1	5.0	19.3	3.7	18.7	0.3
<b>Scenario 3: 25 Year Cal-Am Replenishment Scenario with Additional Water Injection</b>	18.8	3.9	22.2	2.6	21.3	0.1

Ceasing pumping in all Standard and Alternative Producer wells has the greatest effect on the deep monitoring wells’ groundwater levels, allowing them to recover substantially. This is because the production wells with the greatest production are completed in the deeper aquifers.

### **SCENARIO 3: REDUCED CAL-AM PUMPING WITH INJECTION SCENARIO**

An additional 1,000 AFY of water injected in ASR wells 1 through 4 was found to achieve protective elevations in all six coastal monitoring wells by 2041. This amount is in addition to the 1,445 AFY currently injected in ASR wells 1 through 4, for a total injection rate of 2,445 AFY. Unlike the 1,445 AFY stored and recovered in the aquifer by Cal-Am, the additional 1,000 AFY is allowed to remain in the aquifer without being pumped out.

The timing of the groundwater level recovery under this scenario is very similar to that predicted in Scenario 2: 25 Years to Achieve Protective Elevations, with the most noticeable difference being in the greater seasonal fluctuations that occur with the greater rates of injection.

The similar groundwater level responses seen under the reduced pumping and increased injection scenarios are achieved with different amounts of water. Under Scenario 2: 25 Years to Achieve Protective Elevations, pumping was reduced by just over 2,000 AFY before protective levels were met, while Scenario 3: Reduced Cal-Am Pumping with Injection requires only 1,000 AFY of additional injection to meet protective elevations. The greater efficiency of the injection approach is likely due to its placement of water directly into the layer in which the most slowly recovering monitoring wells are located.

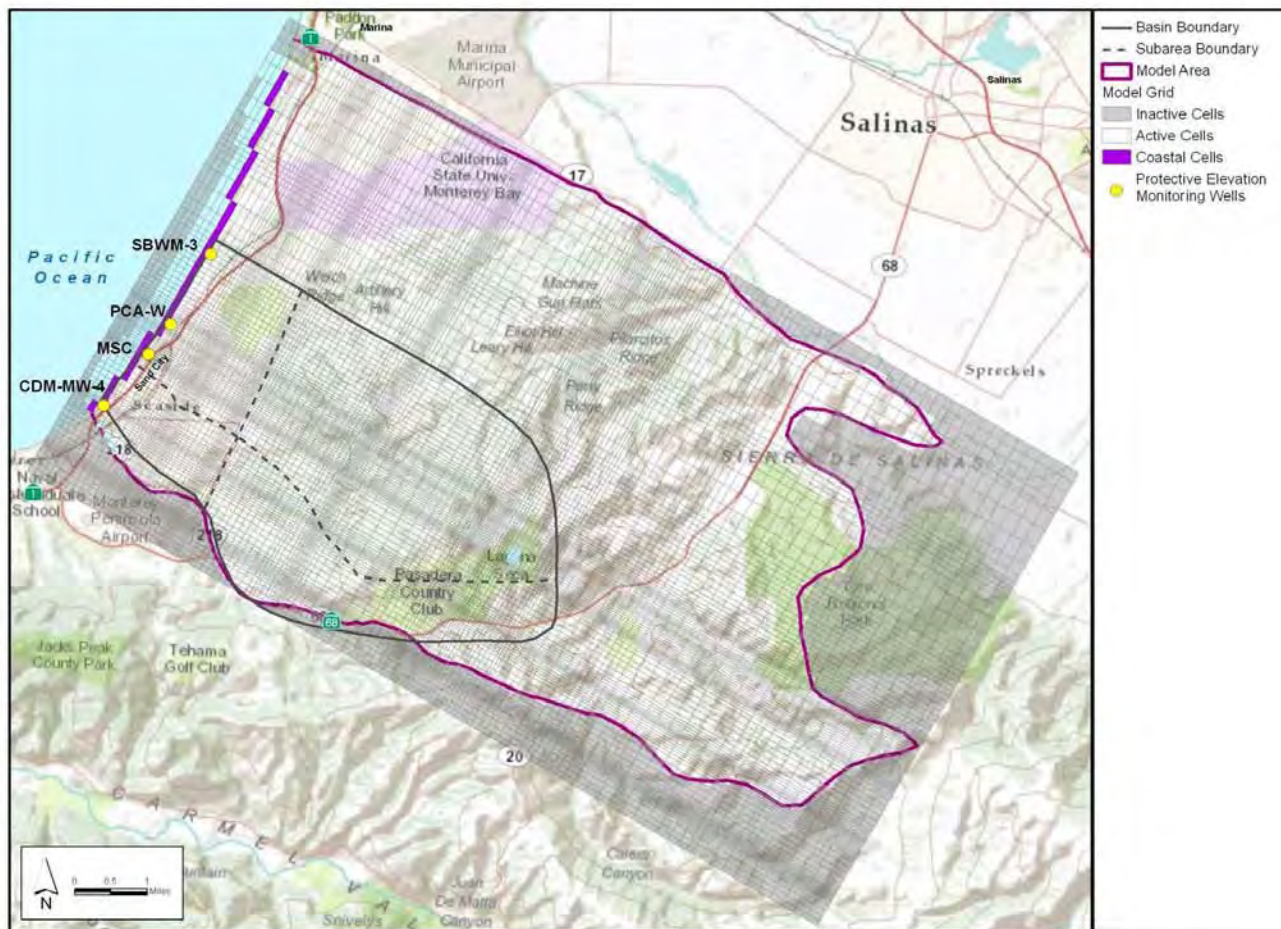


Figure 2: Location of Coastal Cells and Protective Elevation Monitoring Wells

HydroMetrics Water Resources Inc. • 519 17<sup>th</sup> Street, Suite 500 • Oakland, CA 94612  
 (510) 903-0458 • (510) 903-0468 (fax)

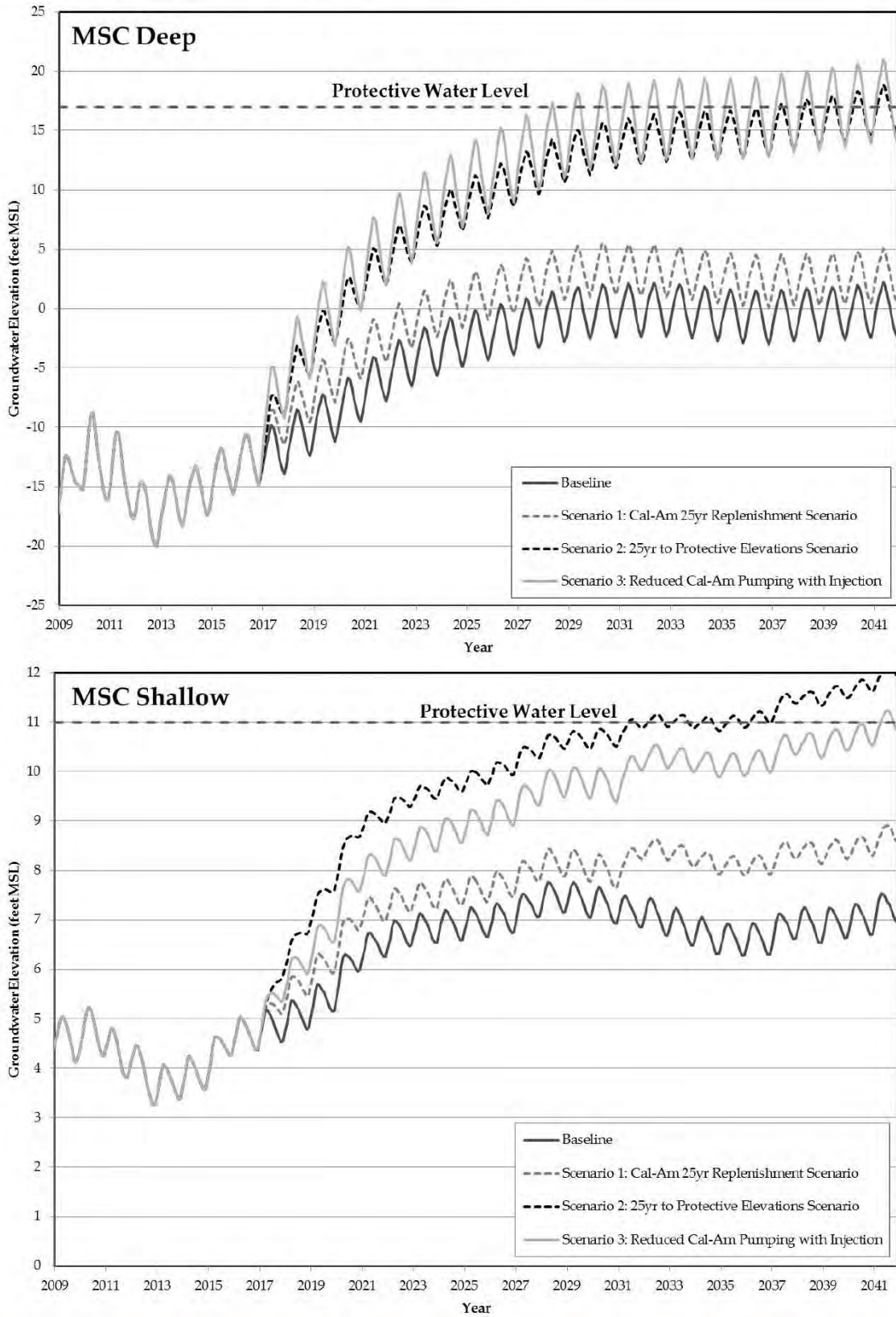
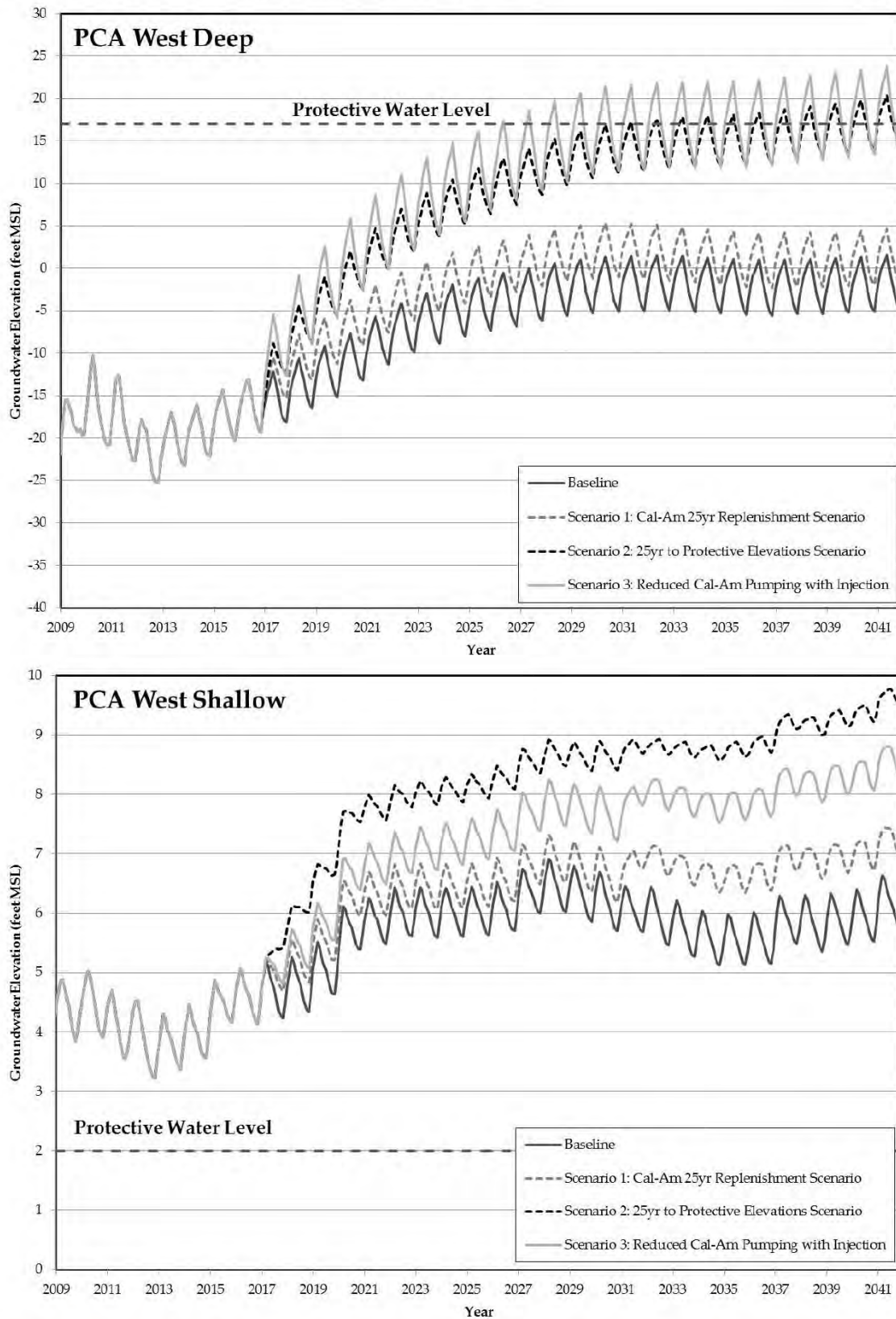
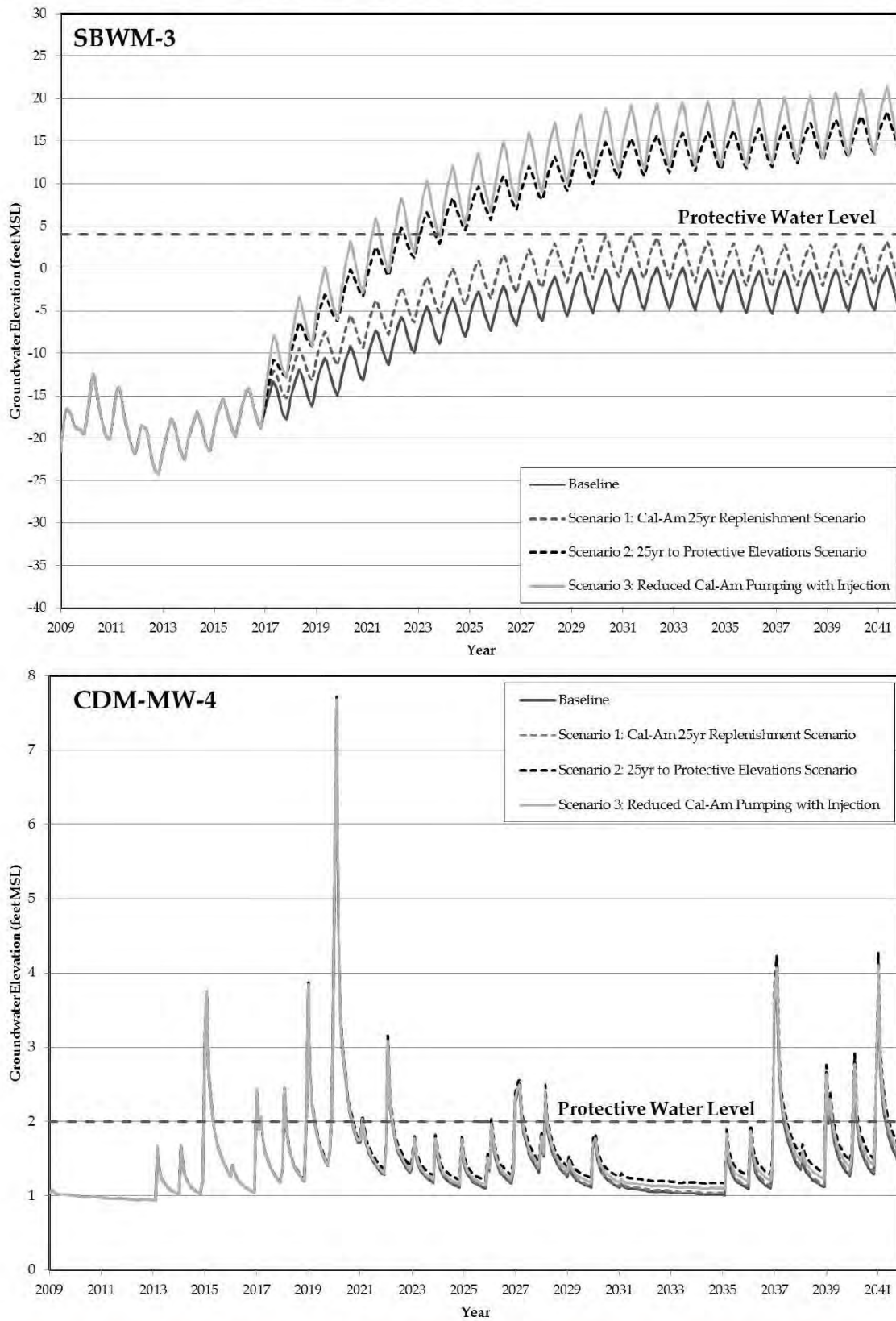


Figure 3: Predicted Groundwater Elevations and Protective Elevations for the MSC Wells



*Figure 4: Predicted Groundwater Elevations and Protective Elevations for the PCA West Wells*



*Figure 5: Predicted Groundwater Elevations and Protective Elevations for Sentinel Well 3 (SBWM-3) and CDM MW-4 Wells*

The total production by Water Year for the baseline and the three scenarios is shown on Figure 6. Scenario 2 (25 years to achieve Protective Elevations) found that a reduction of just over 2,000 acre-feet per year in baseline pumping is required over a 25 year period to achieve protective groundwater elevations in all wells. The baseline and Scenario 1 (Cal Am’s 25 year replenishment) vary year to year because of golf course pumping which varies due to hydrologic demand (see Section 4.1). A constant pumping rate occurs for Scenario 2 (25 year to achieve protective elevations) because the only pumping taking place is to extract 1,445 acre-feet per year of injected ASR water. Scenario 3 (Cal Am’s 25 year replenishment with additional injection water) has the same pumping rates as Scenario 1, but 1,000 AFY of additional water is injected at the existing ASR wells and left in the basin.

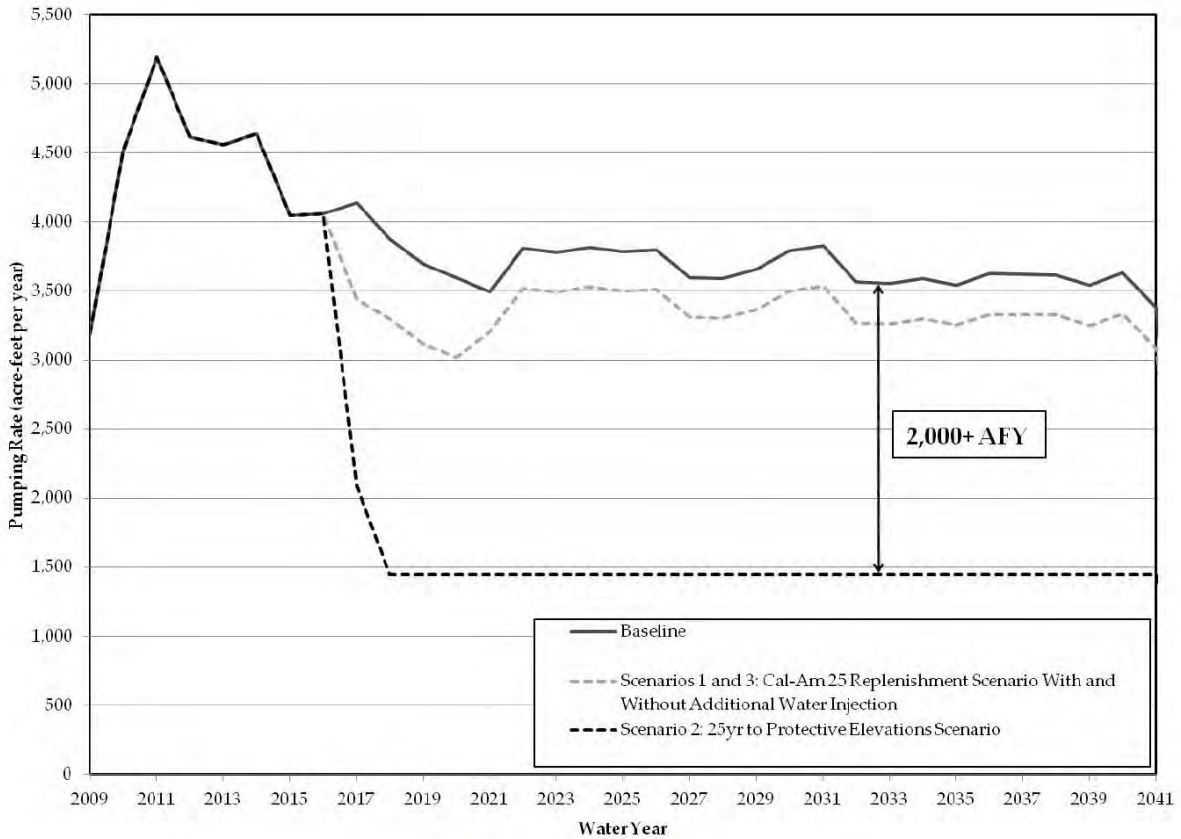


Figure 6: Modeled Production for Baseline and Scenarios

## 5.2 POTENTIAL SEAWATER INTRUSION RATE

Although no seawater intrusion has occurred in the basin, potential seawater intrusion rates were determined based on groundwater velocities along the coastline. The following calculations were used to estimate average groundwater velocities from the groundwater flow model for Scenarios 1 and 2:

- Model cells that represent the coastline were identified. These cells are shown on Figure 2.
- To establish the change in coastal groundwater velocities between the first year of pumping reductions (2017) and the end of the simulation period (2041), the onshore and offshore velocities for the 12 months comprising each of the years (2017 and 2041) were averaged. This approach rather than averaging the entire simulation was taken so as to highlight the actual change in velocities. An average for the 25 year period would be too generalized and not provide an understanding of the velocities achieved by the end of the simulations. This is particularly important for the 25 year to achieve protective elevations scenario.
- The average groundwater flows were combined with an assumed effective porosity of 0.20 to obtain average groundwater velocities.
- The difference in potential seawater intrusion rates from 2017 to 2041 are shown in Table 8 (Scenario 1: Cal-Am's 25 year replenishment) and Table 9 (Scenario 2: 25 years to achieve protective elevations). These tables summarize the velocities for each model layer and for all layers combined.

For Scenario 1 (Cal-Am's 25 year replenishment), the average flow direction in each model layer changes from onshore to offshore flows, except in Layer 4 (Table 8). For Scenario 2 (25 years to achieve protective elevations), the average flow direction in each model layer changes from onshore to offshore flow (Table 9). The offshore flows in this simulation are greater than the offshore flows Scenario 1.

Although as summarized in Table 9, the average flows for Layer 4 are offshore in this scenario, there is still some onshore flow occurring along the coast. This is illustrated in Figure 7 where Layer 4's (Paso Robles Formation) coastal flows in 2017 are shown on the left panel and 2041's on the right panel. At the end of the simulation when protective elevations are achieved, onshore flow is not

completely eliminated. The reason for the perceived discrepancy between the maps and the average is due to the averaging process which averages onshore and offshore velocities. Even if the number of cells with onshore flow outnumber the number of cells with offshore flow, the average flows can still be calculated as offshore if the offshore velocities are greater than the onshore velocities.

Another complication with interpreting the flow velocity results is that the groundwater flow model determines onshore and offshore flows based on different criteria than the cross-sectional models that were used to develop the protective groundwater elevations. Theoretically, there should be no onshore flows in the vicinity of the protective elevation wells for it to achieve protective elevations. But because Figure 7 shows onshore flow occurring when the groundwater levels in the cross-sectional model are protective, it proves that using the groundwater flow model to quantify flow velocity is not a suitable metric when groundwater levels are at protective elevations. Due to these reasons, velocities for Scenario 3: Cal Am's 25 year replenishment with additional injection water, were not estimated and included in this report.

*Table 8: Average Groundwater Flow Rate Differences for Scenario 1: Cal-Am's 25 Year Replenishment*

		Baseline*		Scenario 1*		Difference**	
		(feet/year)		(feet/year)		(feet/year)	
		2017	2041	2017	2041	2017	2041
1	<b>Aromas and Older Dune Deposits</b>	-147.78	-208.90	-148.87	-228.55	-1.09	-19.65
2	<b>Paso Robles</b>	0.52	-1.09	0.48	-1.81	-0.04	-0.72
3	<b>Paso Robles</b>	4.04	0.87	3.85	-0.91	-0.19	-1.06
4	<b>Paso Robles</b>	30.63	20.21	28.91	12.80	-1.72	-7.41
5	<b>Santa Margarita/Purisima</b>	0.57	-0.48	-0.77	-0.82	-1.34	-0.34
	<b>All Layers</b>	<b>-6.22</b>	<b>-15.27</b>	<b>-7.40</b>	<b>-19.18</b>	<b>-1.18</b>	<b>-3.91</b>

\* Negative Baseline or Scenario is offshore flow, positive Baseline or Scenario is onshore flow

\*\* Negative difference indicates velocity of the scenario is less than the baseline

*Table 9: Average Groundwater Flow Rate Differences for Scenario 2: 25 Years to Achieve Protective Elevations*

		Baseline*		Scenario 2*		Difference**	
		(feet/year)		(feet/year)		(feet/year)	
		2017	2041	2017	2041	2017	2041
<b>1</b>	<b>Aromas and Older Dune Deposits</b>	-147.78	-208.90	-156.71	-325.50	-8.93	-116.60
<b>2</b>	<b>Paso Robles</b>	0.52	-1.09	0.33	-4.68	-0.19	-3.59
<b>3</b>	<b>Paso Robles</b>	4.04	0.87	3.03	-8.69	-1.01	-9.56
<b>4</b>	<b>Paso Robles</b>	30.63	20.21	26.52	-3.99	-4.11	-24.20
<b>5</b>	<b>Santa Margarita/Purisima</b>	0.57	-0.48	-2.14	-3.20	-2.71	-2.72
	<b>All Layers</b>	<b>-6.22</b>	<b>-15.27</b>	<b>-9.44</b>	<b>-32.40</b>	<b>-3.22</b>	<b>-17.13</b>

\* Negative Baseline or Scenario is offshore flow, positive Baseline or Scenario is onshore flow

\*\* Negative difference indicates velocity of the scenario is less than baseline



Figure 7: Layer 4 Average Flow in 2017 and 2041 for Scenario2 to Achieve Protective Elevations within 25 Years

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## 6.0 CONCLUSIONS

1. The calibrated parameters in the basinwide model do not indicate that protective elevations should be lowered. The protective elevations developed in 2009 remain reasonable targets for groundwater management.
2. Scenario 1: Cal-Am's proposed 25 year replenishment repayment, increases groundwater elevations by 1 to 1.5 feet in the shallow aquifer coastal wells and 3 feet in the deep aquifer coastal wells. These increases do not achieve protective elevations.
3. Scenario 2: Eliminating all Standard and Alternative Producer pumping for 25 years starting in January 2017 will allow protective elevations to be met at the end of the 25 year period. This will require an overall pumping reduction of just over 2,000 acre-feet per year.
4. Scenario 3: When combined with Cal-Am's 25 year repayment schedule, protective elevations can be realized by injecting an additional 1,000 acre-feet per year of water into the existing ASR wells. Recharged water is left in the basin, and not pumped by Standard or Alternative producers. This approach requires less water to implement than the pumping reduction approach of Scenario 2.
5. Potential intrusion rates for Scenarios 1 and 2 are slower than baseline intrusion rates. Scenario 2, which achieve protective elevations within 25 years, has onshore flow rates of about half the rate Scenario 1.
6. For Scenario 1, all model layer average flows changed from onshore to offshore, except Layer 4. For Scenario 2 average flows are offshore for all model layers.
7. Using the groundwater flow model to quantify flow velocities and direction is not an accurate metric when groundwater levels are at protective elevations because it simulates flow direction based on different criteria than the cross-sectional model that was used to estimate protective groundwater elevations.

## 7.0 REFERENCES

HydroMetrics LLC. 2009. Groundwater modeling and protective groundwater elevations. Prepared for Seaside Basin Watermaster. November 2009.

HydroMetrics WRI. 2012. Groundwater modeling results of temporary suspension of triennial pumping reductions. Technical memorandum to the Seaside Groundwater Basin Board of Directors. September 28.

**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>MEETING DATE:</b>	March 13, 2013
<b>AGENDA ITEM:</b>	4
<b>AGENDA TITLE:</b>	Schedule
<b>PREPARED BY:</b>	Robert Jaques, Technical Program Manager
<b>SUMMARY:</b>	<p>As a regular part of each monthly TAC meeting, I will provide the TAC with an updated Schedule of the activities being performed by the Watermaster, its consultants, and the public entity, MPWMD, which is performing certain portions of the work.</p> <p>Attached is the most recent update of the Work Schedule for FY 2013.</p>
<b>ATTACHMENTS:</b>	Schedule of Work Activities for FY 2013
<b>RECOMMENDED ACTION:</b>	Provide Input to Technical Program Manager Regarding Any Corrections or Additions to the Schedule

# Seaside Basin Watermaster Monitoring and Management Program 2013 Work Schedule

ID	Task Name	2013												2014								
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	<b>CRITICAL PROJECT MILESTONES ASSOCIATED WITH TAC, BOARD, AND/OR CONSULTANT WORK</b>																					
2	<b>2014 Administration, Operations and Replenishment Budgets</b>																					
3	Prepare M&MP Draft Budgets (Same as Task 19)																					
4	TAC Approves M&MP Budgets (Same as Task 20)																					
5	Board Approves M&MP Budgets (Same as Task 21)																					
6	<b>Watermaster Prepares Quarterly Water Production, Water Level, and Water Quality Reports</b>																					
7	Watermaster Prepares Combined Quarterly Water Production, Water Level, and Water Quality Reports for 1st & 2nd Quarters (Same as Task 41)																					
8	Watermaster Prepares Quarterly Water Production, Water Level, and Water Quality Reports for 3rd and 4th Quarters (Same as Task 42)																					
9	Watermaster Prepares Annual Water Production, Water Level, and Water Quality Report for 2013 (Same as Task 43)																					
10	<b>Replenishment Assessment Unit Costs for Water Year 2014</b>																					
11	B&F Committee Develops Replenishment Assessment Unit Cost for 2014 Water Year																					
12	If Requested, TAC Provides Assistance to B&F Committee in Development of 2014 Water Year Replenishment Assessment Unit Cost																					
13	Board Adopts and Declares 2014 Water Year Replenishment Assessment Unit Cost																					
14	<b>Replenishment Assessments for Water Year 2013</b>																					
15	Watermaster Prepares Replenishment Assessments for Water Year 2013																					
16	Watermaster Board Approves Replenishment Assessments for Water Year 2013 (At November Meeting)																					
17	Watermaster Levies Replenishment Assessment for 2013																					

# Seaside Basin Watermaster Monitoring and Management Program 2013 Work Schedule

ID	Task Name	2013												2014									
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
18	<b>Monitoring &amp; Management Program (M&amp;MP) Budgets for 2012 and 2013</b>																						
19	Preliminary Discussion of Potential Scope of Work for 2014 M&MP												◆ 8/14										
20	Prepare Draft 2014 and 2015 M&MP O&M and Capital Budgets											■											
21	TAC approves Draft 2014 and 2015 M&MP O&M and Capital Budgets												◆ 9/11										
22	Board approves 2014 and 2015 M&MP O&M and Capital Budgets													◆ 10/2									
23	<b>2013 Annual Report (Note: Schedule Reflects Court Approval of Later Submittal Date for Annual Report)</b>																						
24	Prepare Preliminary Draft 2013 Annual Report																						
25	TAC Provides Input on Draft 2013 Annual Report																						
26	Prepare Revised Draft 2013 Annual Report (Incorporating TAC Input)																						
27	Board Provides Input on Revised Draft 2013 Annual Report (At November Board Meeting)																						
28	Prepare Final 2013 Annual Report (Incorporating Board Input)																						
29	Watermaster Submits Final 2013 Annual Report to Judge																						
30	<b>MANAGEMENT</b>																						
31	<b>M.1 PROGRAM ADMINISTRATION (All Work Performed by Watermaster Staff)</b>																						
32	Prepare Initial Consultant Contracts for 2014																						
33	TAC Approval of Initial Consultant Contracts for 2014													■									
34	Board Approval of Initial Consultant Contracts for 2014 (At November Board Meeting)													◆ 10/9									
35	<b>IMPLEMENTATION</b>																						
36	<b>I.2.a DATABASE MANAGEMENT</b>																						

ASSUME NOV. BOARD MEETING SET FOR TWO WEEKS AFTER NOV. TAC

## Seaside Basin Watermaster Monitoring and Management Program 2013 Work Schedule

ID	Task Name	2013												2014									
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
37	I.2.a.1 Conduct Ongoing Data Entry/Database Maintenance																						
38	I.2.b DATA COLLECTION PROGRAM																						
39	I.2.b.2 Collect Monthly Water Levels (MPWMD)																						
40	I.2.b.3 Collect Quarterly Water Quality Samples (MPWMD)																						
41	I.2.b.6 Reports (from MPWMD)																						
42	Watermaster Prepares Combined Quarterly Water Production, Water Level, and Water Quality Reports for 1st & 2nd Quarters																						
43	Watermaster Prepares Annual Water Production, Water Level, and Water Quality Report for 2013																						
44	I.3.a ENHANCED SEASIDE BASIN GROUNDWATER MODEL																						
45	I.3.a.2 Develop Protective Water Levels																						
46	Board Approves RFS to HydroMetrics																						
47	HydroMetrics Revises Protective Water Levels																						
48	HydroMetrics Progress Report to TAC																						
49	HydroMetrics Presents Draft Revised Protective Water Levels Report to TAC																						
50	HydroMetrics Presents Report to Board																						
51	I.3.a.3 Evaluate Replenishment Scenarios and Develop Answers to Basin Management Questions																						
52	Board Approves RFS to HydroMetrics																						
53	HydroMetrics Models Replenishment Scenarios																						
54	HydroMetrics Presents Draft Replenishment Modeling Report to TAC																						

## Seaside Basin Watermaster Monitoring and Management Program 2013 Work Schedule

ID	Task Name	2013												2014									
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
55	HydroMetrics Presents Replenishment Modeling Report to Board																						
56	<b>I.3.c Refine and/or Update the BMAP</b>																						
57	<b>I.3.d Evaluate Coastal Wells for Cross-Aquifer Contamination Potential</b>																						
58	MPWMD Migrates Well Data from Newly Identified Wells into Watermaster's Database																						
59	<b>I.4.a HydroMetrics &amp; MPWMD Provide Oversight of Seawater Intrusion Detection and Tracking</b>																						
60	<b>I.4.b MPWMD Performs Focused Hydrogeologic Investigation in Vicinity of Sand City Public Works Well</b>																						
61	<b>I.4.c Annual Seawater Intrusion Analysis Report (SIAR)</b>																						
62	HydroMetrics Provides Draft SIAR to Watermaster																						
63	TAC Approves Annual Seawater Intrusion Analysis Report (SIAR)																						
64	Board Approves Annual Seawater Intrusion Analysis Report (SIAR)																						
65	I.4.c Annual Seawater Intrusion Analysis Report (SIAR)																						
66	<b>I.4.d Complete Preparation of Seawater Intrusion Response Plan (SIRP)</b>																						
67	<b>I.4.e Refine and/or Update the SIRP</b>																						

◆ 4/3

NO WORK SCHEDULED UNTIL TAC DIRECTION PROVIDED TO RESUME DISCUSSION

◆ 11/8

◆ 11/13

◆ 11/27

WORK COMPLETED - NO FURTHER WORK PLANNED IN 2013

NOT NECESSARY

**SEASIDE BASIN WATER MASTER  
TECHNICAL ADVISORY COMMITTEE**

**\*\*\* AGENDA TRANSMITTAL FORM \*\*\***

<b>MEETING DATE:</b>	March 13, 2013
<b>AGENDA ITEM:</b>	5
<b>AGENDA TITLE:</b>	Other Business
<b>PREPARED BY:</b>	Robert Jaques, Technical Program Manager
<b>SUMMARY:</b>	<p>The "Other Business" agenda item is intended to provide an opportunity for TAC members or others present at the meeting to discuss items not on the agenda that may be of interest to the TAC.</p>
<b>ATTACHMENTS:</b>	None
<b>RECOMMENDED ACTION:</b>	None required – information only