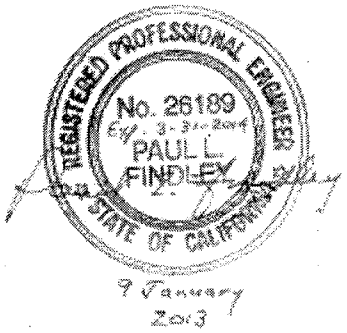
MEMORANDUM



To: Richard Svindland, California American Water

From: Paul Findley, RBF Consulting

Date: January 7, 2013

Subject: Recommended Capacity for the Monterey Peninsula Water Supply Project (MPWSP) Desalination Plant

INTRODUCTION

The purpose of this memorandum is to develop the recommended design capacity for the desalination plant for the Monterey Peninsula Water Supply Project (MPWSP). This desalination plant will become the principal supply for CAW's system, replacing a major portion of the supply which comes from the Carmel River, and also a portion of the supply which is currently pumped from the Seaside Groundwater Basin (SGWB). The desalinated water supply will be supplemented by the ASR system, Sand City desalination plant, and reduced amounts from the Carmel River and SGWB. A Groundwater Replenishment (GWR) Project, which could deliver up to 3,500 AFY of replenishment water to the SGWB, could also be integrated into the MPWSP as an additional supply source. This analysis determines the capacity of the desalination plant that would be required both with and without the GWR Project.

APPROACH

The desalination plant, in combination with other sources, must provide a reliable source of supply to meet demand such that CAW can reduce its diversions of Carmel River Water, and its pumping of the SGWB, to legal limits. The capacity of the plant must be sufficient to allow CAW to meet demand under all conditions. For example, the determination of plant capacity must consider:

- Requirements to return a portion of the desalinated water to Salinas Valley users;
- Variability and reliability of water available from the ASR system and SGWB;
- Reductions in plant production capacity caused by aging membranes;
- Variability of plant output caused by changes in feedwater temperature and salinity,
- The percentage of second pass needed to meet treated water quality objectives;
- Modular design of the RO process; and
- Standby capacity.

As a matter of practice, the rated capacity of a desalination plant is always stated in reference to the output (product water) of the plant, not the input (feedwater) to the plant. Also, the daily

rated capacity (the capacity of the plant in MGD) of the desalination plant typically does not include production modules that are installed as standby capacity. Standby capacity units are typically required to maintain production at rated capacity when production units are be taken out of service for maintenance. In practice, these standby units provide a margin of safety for reliably meeting annual production targets, but they are not included in the determination of reliable capacity of the plant to meet peak day requirements. This memorandum assumes that one module of RO capacity will be provided as standby capacity, and this assumption was carried forward to the cost estimating technical memorandum prepared by RBF.

HISTORICAL AND EXPECTED DEMAND

The Coastal Water Project FEIR addresses the supply and demand issue in Chapter 2, pages 2-9 and 2-10, as follows:

> *As part of its analysis of existing demand, MPWMD reviewed actual monthly water use for water years 1996 to 2006, based on CalAm monthly production reports for its Carmel River and Seaside Basin Coastal Subarea sources, to determine the annual average quantity of water currently used by CalAm customers within MPWMD boundaries. Given the regular occurrence of drought periods on the Monterey Peninsula and the effect of weather on water demand, MPWMD also evaluated weather conditions during the years reviewed, which on average were wetter than normal, and developed demand estimates adjusted to reflect normal, dry, and critically dry conditions. The average annual unadjusted demand and weather-adjusted demand for the years reviewed are as follows (MPWMD, 2006a):*
>
> - *Unadjusted Demand: 14,710 AF*
> - *Normal-year demand: 15,095 AF*
> - *Dry-year demand: 15,474 AF*
> - *Critically-dry-year demand: 15,858 AF*
>
> *MPWMD considers the critically-dry year values to provide a worst-case basis for assessing the effect of weather on water production during the analysis period and that the demand values adjusted to reflect critically dry conditions – rather than the unadjusted values, which do not account for the wetter-than-normal conditions during the period of analysis – should be used for water supply planning (MPWMD, 2006a).* ***Table 2-3*** *shows the breakdown of unadjusted average annual demand and adjusted (by 7.8 percent) critically-dry year demand for the Carmel River system and Seaside Basin Coastal subarea. As shown, the unadjusted average annual production over this period is 14,710 afy, and adjusted critically dry year demand is 15,858. From these totals, MPWMD deducted the quantity of Seaside Basin and Carmel River water to which CalAm has an existing legal right based on the Seaside Basin adjudication and Order 95-10 (4,870 afy) to determine the replacement water supply needed to meet demand under the conditions reflected in the unadjusted and critically dry year scenarios. According to Order 95-10's determination of CalAm's legal right to Carmel River system water and MPWMD's calculation of CalAm's eventual legal right to Seaside Basin groundwater, Cal Am's combined rights from these sources would be 4,870 afy. As shown in Table 2-3, assuming critically-dry year demand for the two areas minus this estimate of CalAm's combined recognized water rights, MPWMD calculated that approximately 10,988 AF of replacement water would be needed to meet current demand in the areas served by these sources. More recently, the Seaside Basin Watermaster calculated*

CalAm's rights to Seaside Basin groundwater for the basin as a whole (rather than by subbasin, as MPWMD had done) and determined that CalAm's eventual right to basin groundwater was 1,474 afy, a slight decrease from MPWMD's estimate of 1,494 afy. Based on this revised calculation, replacement water supply needed to meet critically dry year demand for the Carmel River System and Seaside Basin Coastal Subarea is 11,008 afy, as shown in Table 2-3.

TABLE 2-3
SUMMARY OF AVERAGE ANNUAL PRODUCTION, WATER YEARS 1996-2006
CARMEL RIVER AND SEASIDE BASIN COASTAL SUBAREA
ADJUSTED FOR WEATHER CONDITIONS (afy[a])

	Unadjusted demand (average water year)	Critically-Dry-Year Demand
Carmel River System Demand	11,015	11,874
Seaside Basin Coastal Subarea Demand	3, 695	3,983
Subtotal	**14,710**	**15,858**
Minus Legal Water Rights to Carmel River System and Seaside Basin Water	~~4,870~~ 4,850	~~4,870~~ 4,850
Total Replacement Water Needed	**~~9,840~~ 9,860**	**~~10,988~~ 11,008**

NOTE: Numbers may not sum due to rounding.

[a] afy = acre-feet per year.

SOURCE: MPWMD, 2006a.

According to information provided in a technical memorandum prepared subsequent to the CWP Draft EIR on changes to the DEIR Phase 1 Project (Appendix Q), CalAm's annual normal weather demand is approximately 15,270 afy. This estimate is similar to MPWMD's estimate shown above (between the estimates of normal and dry weather demand)."

The FEIR's analysis was based on water demand data up through the year 2006; Table 1 shows total annual demand in CAW's Monterey system over the 5-year period from 2007 to 2011. Annual demand during this time period ranged from 11,989 AF to 14,644 AF, and averaged 13,291 AF. The maximum annual demand during this time period (14,644 AF in 2007) occurred before the economic downturn and before implementation of additional water conservation measures which were implemented in response to the Cease and Desist Order.

Table 1
CAW System Water Demand

Year (Jan-Dec)	Total Annual Demand (AF)
2007	14,644
2008	14,460
2009	13,192
2010	12,171
2011	11,989
5-Year Average	**13,291**

Pebble Beach Development Company has invested in wastewater reclamation and switched the irrigation demand to reclaimed water system. The reclaimed water use for irrigation allowed Pebble Beach to conserve approximately 380 AF of potable water on an annual basis. Pebble Beach has exercised approximately 55 AF thus far and once CAW implements the desalination plant, Pebble Beach would exercise the remaining 325 AF for developing property. Therefore the full 325 AF is expected to be added to the CAW system demand. The Pebble Beach demand would follow a similar pattern to the existing system demand throughout the year.

Recent discussions in the region indicate that once the economy turns around and the water supply is available the tourism demand will increase approximately 500 AF. This demand is evenly distributed (100 AF/month) to a 5 month period from May through September.

The total water rights allocated to existing lots-of-record (LOR) in the CAW system is approximately 1,180 AF. Once the desalination plant is implemented, LOR demand would be exercised and increase the system demand by 1,180 AF. The LOR demand would follow a similar pattern to the existing system demand throughout the year.

CAW and Seaside Groundwater Basin Water Master has recently reached an agreement on the replenishment of the Seaside Basin water level. The agreement dictates CAW to reduce extraction from the SGWB by 700 AF of water annually on a 5-year average basis. The reduced annual extraction volume from SGWB would be 774 AF. This will not be treated as a "demand" in this technical memorandum. Instead, it will be treated as a reduction in supply.

The additional demands are summarized in the following table.

Table 2
Total MPSWP Demand

Component	Annual Demand (AF)
System Demand	13,291
Pebble Beach	325
Tourism Bounce-Back	500
Lots-of-Record	1,180
Total	15,296

As it can be seen from Table 2, the total demand in the CAW system by adding all above-mentioned additional demands would be 15,296 AF on an annual basis.

DESALINATION PLANT CAPACITY

Utilizing 15,296 AFY as the expected demand, the desalination plant would be sized for a delivery capacity of 9,747 AFY (to CAW), as calculated below:

	15,296 AFY	Demand
Less	3,376 AFY	from Carmel River wells
Less	774 AFY	from SGWB
Less	1,300 AFY	Long-term average ASR capacity
Less	94 AFY	Firm-yield to CAW from Sand City Desalination Plant
Total	9,752 AFY	required from desalination plant

The desalination plant would also need to be sized to deliver an additional 875 AFY (approximately 8 percent of the total desalination plant production) of desalinated water to Salinas Valley users to offset the small amount of fresh water in the feedwater from the desalination plant's slanted coastal intake wells. In theory, the total of 10,627 AFY could be delivered by a desalination plant operating at an annual average of 9.5 MGD. However, RBF is recommending that the plant be designed for a rated capacity of 9.6 mgd for several practical reasons:

- The rated capacity of the plant will be set by the design engineer according to a certain set of assumed feedwater temperature and salinity conditions, and an assumed second pass percentage. The actual day-to-day and year-to-year production of the desalination plant will vary according to actual conditions. Furthermore, it is difficult to operate any facility, much less a desalination plant, at its full rated capacity 100 percent of the time. Any shortfalls in production that result from operations at less than annual average capacity must be matched by production from periods that the plant operates at more than the annual average rate. This will be addressed by the design engineer; however, some of these factors will not be known prior to construction of the plant, and the design assumptions that will be made will be conservative and approximate.

- The recommended module size for a 9.6 MGD desalination plant is 1.6 MGD (six 1.6 MGD duty modules plus one 1.6 MGD standby module). If GWR is implemented (see following discussion), the recommended capacity of the desalination plant is 6.4 MGD capacity, which can be achieved with four 1.6 MGD duty modules plus one 1.6 MGD standby module. Due to the timing of the decision on implementation of GWR, the current plan for design of the desalination plant is to prepare a design that can be bid as both capacities (6.4 MGD or 9.6 MGD), and then to delay the decision on which capacity to construct as long as possible to allow the GWR Project to be developed. Using the same size module for both desalination plant capacities would greatly facilitate implementation of this plan.

- The desalination plant needs to operate in conjunction with the other sources, including the ASR system. This conjunctive use strategy may require the desalination plant to

operate at a rate that is slightly higher than the average annual rate, particularly during late summer months as the SGWB supply approaches its annual limit.

If the GWR Project is implemented, CAW would receive 3,500 AFY of GWR water that would be injected in the GWR wells in the SGWB, and then extracted by new ASR wells. If this 3,500 AFY is also subtracted from the 15,291 AFY project delivery requirement (along with the assumed delivery of 6,244 AFY from the Carmel River ASR water, Carmel River direct delivery, SGWB, and Sand City Desalination Plant sources), the resulting required desalination plant delivery capacity (to CAW) would be approximately 6,300 AFY. However, it was assumed this desalination plant would also need to produce an additional 550 AFY (8 percent of plant production) to return to Salinas Valley users This increases the total required annual production of the desalination plant to 6,850 AFY, which is an average of 6.1 MGD. As mentioned above, the rated capacity of the desalination plant with GWR would be 6.4 MGD, which would provide an additional 5% capacity, which would allow some flexibility if dry years occur in the early years of Project operation and if it is not possible to deliver 1,300 AFY of Carmel River ASR water.

ANALYSIS OF SUPPLY SOURCES

Once the annual desalination plant production requirement was determined, an analysis was performed to check the adequacy of the desalination plant on a month-by-month basis. This detailed analysis, including all CAW supply sources and their average condition operations, is presented in Tables 2 and 3, and is described in this section in further detail.

Demand

The total demand used for the purposes is 15,296 AFY, as previously described. The percentage of annual demand that occurs in each month was developed based on analysis of recent CAW system demand data. These percentages were then applied against the assumed annual demand of 15,296 FY to develop the monthly demands that were used in the analysis.

Carmel River

It was assumed that the Carmel River production will be a long term annual average of 4,676 AFY. For purposes of analysis this total amount has been distributed over the 12-month period, and this distribution is very similar for the 9.6 MGD desalination plant scenario and the 6.4 MGD desalination scenario. It should be recognized that in the early years of project operation, the amount of Carmel River water available may be only 3,376 AFY, and the amount of Carmel River water that is delivered through the ASR may be significantly less than 1,300 AFY. In these years, additional supplies may be available from the SGWB and the Sand City Desalination Plant.

Table 2 Monthly Analysis of 5.4 mgd Desalination Plant with GWR Project

	Monthly Average Flow in MGD												Acre-feet
	D	J	F	M	A	M	J	J	A	S	O	N	Total for Year
System Demand	9.28	9.24	9.44	10.23	11.49	12.99	13.94	14.57	14.39	14.12	11.99	10.64	13,290
Pebble Beach	0.27	0.26	0.27	0.29	0.33	0.37	0.40	0.42	0.41	0.40	0.34	0.30	325
Lots-of-Record	0.78	0.78	0.80	0.86	0.97	1.09	1.17	1.23	1.21	1.19	1.01	0.90	1180
Tourism	0.00	0.00	0.00	0.00	0.00	1.07	1.07	1.07	1.07	1.07	0.00	0.00	500
Desalination to Salinas Valley	0.00	0.00	0.00	0.00	0.00	0.90	1.15	1.13	1.11	1.11	0.44	0.00	550
Total Demand	**10.32**	**10.28**	**10.50**	**11.39**	**12.79**	**16.42**	**17.73**	**18.41**	**18.19**	**17.89**	**13.78**	**11.84**	**15,840**
System Supply:													
Carmel River to System	2.39	2.34	2.57	1.77	0.63	2.18	1.00	1.00	1.00	1.00	1.00	1.00	1,671
Seaside Wells to System	0.00	0.00	0.00	0.00	1.00	1.10	1.10	1.10	1.10	1.10	1.10	0.64	774
Sand City to System	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	95
ASR Extraction to System	3.75	3.75	3.75	5.45	6.56	7.00	9.45	10.13	9.90	9.60	6.90	5.86	7,700
Desalination to System	4.10	4.10	4.10	4.08	4.51	5.17	4.95	4.97	4.99	4.99	4.26	4.26	5,100
Total Supply to CAW System	**10.33**	**10.28**	**10.51**	**11.39**	**12.79**	**15.54**	**16.59**	**17.29**	**17.08**	**16.78**	**13.35**	**11.85**	**15,300**
Desalination Plant:													
Desalination to System	4.10	4.10	4.10	4.08	4.51	5.17	4.95	4.97	4.99	4.99	4.26	4.26	5,101
Desalination to ASR	2.00	2.00	2.00	2.00	1.58	0.00	0.00	0.00	0.00	0.00	1.40	1.84	1,194
Desalination to Salinas Valley	0.00	0.00	0.00	0.00	0.00	0.90	1.15	1.13	1.11	1.11	0.44	0.00	550
Total Desalination	**6.10**	**6.10**	**6.10**	**6.08**	**6.09**	**6.07**	**6.10**	**6.10**	**6.10**	**6.10**	**6.10**	**6.10**	**6,845**
Injection (to SGWB):													
GWR	5.00	5.00	5.00	4.40	4.40	0.00	0.00	0.00	0.00	4.40	4.40	5.00	3,500
Carmel River	7.72	7.17	5.95	6.83	4.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,008
Desalination	2.00	2.00	2.00	2.00	1.58	0.00	0.00	0.00	0.00	0.00	1.40	1.84	1,194
Total Injection													**7,700**

Table 3 Monthly Analysis of 9.0 mgd Desalination Plant without GWR Project

	Monthly Average Flow in MGD												Acre-feet
	D	J	F	M	A	M	J	J	A	S	O	N	Total for Year
System Demand	9.28	9.24	9.44	10.23	11.49	12.99	13.94	14.57	14.39	14.12	11.99	10.64	13,290
Pebble Beach	0.27	0.26	0.27	0.29	0.33	0.37	0.40	0.42	0.41	0.40	0.34	0.30	325
Lots-of-Record	0.78	0.78	0.80	0.86	0.97	1.09	1.17	1.23	1.21	1.19	1.01	0.90	1180
Tourism	0.00	0.00	0.00	0.00	0.00	1.07	1.07	1.07	1.07	1.07	0.00	0.00	500
Desalination to Salinas Valley	0.00	0.00	0.00	0.00	0.00	2.40	1.40	1.40	1.40	1.40	1.30	0.00	875
Total Demand	**10.32**	**10.28**	**10.50**	**11.39**	**12.79**	**17.92**	**17.98**	**18.68**	**18.48**	**18.18**	**14.64**	**11.84**	**16,170**
System Supply:													
Carmel River to System	6.01	5.93	5.22	5.73	5.12	2.18	1.00	1.00	1.00	1.00	1.00	1.00	3,376
Seaside Wells to System	0.00	0.00	0.00	0.00	0.95	1.13	1.13	1.13	1.13	1.13	1.13	0.50	774
Sand City to System	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	95
ASR Extraction to System	0.00	0.00	0.00	0.00	0.00	5.03	6.27	6.97	6.76	6.46	2.93	1.77	3,407
Desalination to System	4.23	4.26	5.20	5.57	6.63	7.10	8.10	8.10	8.10	8.10	8.20	8.49	7,685
Total Supply to CAW System	**10.33**	**10.28**	**10.51**	**11.39**	**12.79**	**15.53**	**16.59**	**17.29**	**17.08**	**16.78**	**13.35**	**11.85**	**15,337**
Desalination Plant:													
Desalination to System	4.23	4.26	5.20	5.57	6.63	7.10	8.10	8.10	8.10	8.10	8.20	8.49	7,685
Desalination to ASR	5.27	5.24	4.30	3.93	2.87	0.00	0.00	0.00	0.00	0.00	0.00	1.01	2,106
Desalination to Salinas Valley	0.0	0.0	0.0	0.0	0.00	2.40	1.40	1.40	1.40	1.40	1.30	0.00	880
Total Desalination	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**9.50**	**10,671**
Injection (to SGWB):													
GWR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Carmel River	4.10	3.78	3.30	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,300
Desalination	5.27	5.24	4.30	3.93	2.87	0.00	0.00	0.00	0.00	0.00	0.00	1.01	2,106
Total Injection													**3,406**

The analysis assumes that the 9.6 MGD and 6.4 MGD desalination options would use the 4,676 AF of Carmel River production differently. In the 9.6 MGD desalination plant project, 3,376 AF of Carmel River water would be diverted directly to the customers and the remaining 1,300 AF would be diverted to ASR injection. The river diversions are mostly concentrated during the winter months, December through May. A minimum maintenance diversion of 1.0 MGD has been assumed through BIRP in June through November.

In the 6.4 MGD desalination plant project, only 1,671 AFY would be diverted directly to customers, with 3,005 AF being injected at the GWR injection wells along with the GWR Project water. This injected water could be counted as dilution water if necessary for regulatory purposes; however, even if it is not necessary for regulatory purposes, the assumption is that it will be injected at the GWR injection wells in order to allow the ASR wells to operate throughout the year in the extraction mode. Similar to the 9.6 MGD desalination plant project, 1.0 MGD of Carmel River water would be produced during June through November in order to maintain BIRP operations throughout the year.

Seaside Wells

The capacity analysis has been performed for the year 2021. In year 2021, the SWGB adjudication would be in full effect and the extraction from the Seaside wells would be limited to 1,474 AF. However, as explained above, CAW recently agreed to leave 700 AF annually in the ground for replenishing Seaside groundwater levels and the total extraction has been reduced to 747 AF annually. For purposes of analysis, it was assumed that the Seaside wells are operated only during the months of April through November for both the 9.6 MGD and 6.4 MGD desalination plant alternative.

Sand City Desalination Plant

The Sand City desalination plant is assumed to operate at a constant 0.09 MGD throughout the year, totaling 94 AFY for both the 9.6 MGD and 6.4 MGD desalination plant projects.

GWR Injection

For the 6.4 MGD desalination plant project, 3,500 AFY of GWR Project water would be injected into GWR injection wells. The location and the configuration of the injection wells are yet to be determined, but do not affect the analysis. As previously discussed, it has also been assumed that 3,500 AFY of Carmel River water would be injected at the same GWR injection wells or at nearby new injection wells, even if this is not required to meet regulatory dilution requirements. It has been assumed that GWR water would be available for injection only during the 8-month period of September through April.

ASR Extraction

For the 9.6 MGD desalination plant project, the ASR extraction would be equal to the injected Carmel River water amount (1,300 AFY) plus the injected desalination water (which is 2,106 AFY in the analysis). The stored water would be extracted during the dry season, peaking in June, July and August.

For the 6.4 MGD desalination plant project, the ASR wells would be operated in extraction mode throughout the year to extract the injected GWR water along with the stored Carmel River water. The total volume of water extracted from the ASR wells would be equal to the sum of the injected GWR water (3,500 AFY) and the injected water from the Carmel River (3,000 AFY) pus the injected desalination water (1,194 AFY), totaling approximately 7,700 AF.

Desalination Plant

In the analysis, the average daily production of desalinated water for the CAW system for each month was determined by subtracting the total average daily production from the other sources from the average daily demand. The desalination plant production requirement was then increased to account for the annual amount of water to be returned to Salinas Valley during the 7-month irrigation season. The resulting average total desalinated water production requirements, shown in Tables 2 and 3, confirm the adequacy of the 6.4 MGD and 9.6 MGD size desalination plant sizes that were determined in the previously discussed annual analysis.

RECOMMENDATION

Based on the above analysis of annual and monthly delivery requirements, RBF recommends a rated capacity of 9.6 MGD for the MPWSP desalination plant. If the GWR project is implemented, with a delivery capacity of 3,500 AFY, RBF recommends a reduction of the rated capacity of the plant to 6.4 MGD. At either capacity, RBF recommends that the RO process at the plant be designed with 1.6 MGD modules, in order to accommodate development and integration of the GWR Project into the MPWSP, to preserve Project schedule, and to minimize design and construction costs for associated changes to the Project.

The Design Engineer for the plant will make the final recommendations regarding standby capacity; however, for the purposes of preparing Project capital cost estimates, RBF has assumed that one full 1.6 MGD RO module will be provided as standby capacity.