BEFORE THE STATE WATER RESOURCES CONTROL BOARD

In the Matter of the State Water Resources Control Board (State Water Board) Hearing to consider Monterey Peninsula Water Management District's (MPWMD) Petitions to Change Permits 7130B and 20808 (Applications 11674B and 27614)	Hearing Date: September 24, 2007 Carmel River in Monterey County

EXHIBIT DF-14

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

TECHNICAL MEMORANDUM 2006-01

Monterey Peninsula Water Management District
Technical Memorandum 2006-01

Evaluation of the Environmental Benefits of the Proposed MPWMD Phase 1 Aquifer Storage and Recovery Project Under Varying Operational Conditions

Introduction

This technical memorandum summarizes the results of operational modeling that was conducted by the Monterey Peninsula Water Management District (MPWMD or District) in July 2005 and June 2006 to evaluate the environmental benefits of operating the proposed MPWMD Phase 1 Aquifer Storage and Recovery (ASR) Project under varying operational conditions.

The District used a computer-based operations model of the Monterey Peninsula Water Resources System (MPWRS) to evaluate the environmental benefits of the proposed Seaside Basin Phase 1 ASR Project. This system includes surface water in the Carmel River and its tributaries and groundwater in the Carmel Valley Alluvial Aquifer and coastal subareas of the Seaside Groundwater Basin (**Figure 1**). A map showing the aquifer subunits, principal production wells, and a profile of the Carmel Valley Alluvial Aquifer is shown in **Figure 2**. A map showing the boundary and subareas of the Seaside Groundwater Basin and location of the proposed Phase 1 ASR Project is shown in **Figure 3**. Note the boundaries and subareas of the Seaside Basin in **Figure 3** differ from those shown in **Figure 1**. The boundaries and subareas shown in **Figure 3** are based on more recent information and are considered more accurate.

Detailed information on the environmental benefits of the proposed project is provided in the Draft Environmental Impact Report (EIR) and Environmental Assessment (EA) that was prepared for the MPWMD Phase 1 ASR Project and released for public comment in March 2006. This technical memorandum focuses on the benefits from the proposed project on the water resources in the project area with specific attention to increased production from the Seaside Basin in the low-flow season and corresponding decreased production from the Carmel Valley Alluvial Aquifer during this period. Specifically, this technical memorandum describes the changes that were made to the District's operations model for the Final EIR/EA and shows the benefits of the proposed project in terms of increased storage and production from the Seaside Basin and decreased production from the Carmel River system in the June through November period. The Final EIR/EA was certified by the MPWMD Board on August 21, 2006.

This technical memorandum is organized into four sections. The first section provides background on the Carmel Valley Simulation Model (CVSIM) used by the District to evaluate the environmental benefits of the proposed Phase 1 ASR Project. The second section provides a more detailed description of the operating logic used in CVSIM to evaluate the Phase 1 ASR Project and includes key modeling assumptions and proposed "recovery" rules. The third section provides information on the water supply yield attributable to the proposed project and associated reductions in Carmel River diversions during the low flow season and compares the results from the different operations presented in the Draft EIR/EA and Final EIR/EA, respectively. The fourth section provides a summary of the evaluation of benefits from the proposed Phase 1 ASR Project.

Section 1: Carmel Valley Simulation Model

The Carmel Valley Simulation Model (CVSIM) was designed and developed by the District to simulate the performance of the water resources system under varying physical, structural, and managerial conditions. CVSIM operates on a daily time-step and incorporates both surface and groundwater responses and interactions. The model is a dynamic accounting model based on the continuity equation, i.e., inflow - outflow = change in storage. CVSIM accounts for inflows, outflows, and storage changes in two surface reservoirs and five groundwater subunits and subareas.

It should be noted that, although there is no hydrologic connection between the Carmel River Basin and Seaside Groundwater Basin, the two basins are connected hydraulically by the California American Water (Cal-Am) distribution system. Cal-Am is the largest water purveyor in the District and is responsible for approximately 80 percent of the production reported within the District. In addition to simulating the basic hydrologic processes within the MPWRS, CVSIM includes options for simulating the effects of various facilities, operations, demand management programs, and instream flow requirements.

As a "lumped parameter" model, CVSIM aggregates the effects of the different simulations in the Carmel River and underlying alluvial aquifer by river reach. Each of the four designated river reaches – (1) San Clemente Dam to the USGS gaging station at Robles del Rio (Esquiline Road Bridge), (2) USGS gaging station at Robles del Rio to the Narrows (Scarlett Road), (3) Narrows to the USGS gaging station near Carmel (Via Mallorca Bridge), and (4) USGS gaging station near Carmel to Carmel Lagoon – corresponds to a subunit of the alluvial aquifer. As an example, subunit three of the Carmel Valley alluvial aquifer (AQ3) refers to the Carmel River and associated alluvial area between river miles[1] 3.6 and 9.7.

For the EIR, a 45-year period of analysis was selected, i.e., Water Years 1958-2002, based on the measured mean daily flows at the USGS gaging station at Robles del Rio. This record is considered representative of the range of hydrologic extremes expected over the life of the proposed project. Specifically, the 45-year period includes a short-duration, severe drought period (Water Years 1976-1977) and a longer duration, less severe drought period (Water Years 1987-1991). It also includes extremely wet years such as Water Years 1983, 1995, and 1998. In this context, it is believed that the selected

[1] River miles are referenced from the river mouth, i.e., 0.0 mile, and increase as you move upstream.

period of analysis is sufficient to assess the water supply and environmental performance of the proposed project. As defined, water years begin on October 1 and end on September 30 of the following calendar year. For example, Water Year 1958 began on October 1, 1957, and ended on September 30, 1958.

For the Draft EIR, a new version of CVSIM3[2] (Version 6.3) was developed to assess the impacts of the proposed Phase 1 ASR Project. Version 6.3 is based on a previous version of CVSIM3 that was used for the impact analyses for the District's proposed Sand City Seawater Desalination Plant and is described in an Administrative Draft EIR dated December 2003. For Phase 1 ASR Project Draft EIR, the principal change to CVSIM3 centered on Cal-Am's production sequence. In earlier CVSIM versions, the production needed to meet Cal-Am's simulated daily demand in their main system[3] was met by first operating Cal-Am's production wells in the coastal area of the Seaside Groundwater Basin and then operating Cal-Am's production sources – surface water diversions and groundwater extractions – in the Carmel River Basin. For the Phase 1 ASR Project Draft EIR, Cal-Am's production sequence was reordered so that the daily demand in Cal-Am's main system was first met by sources in the Carmel River Basin, and then from sources in the coastal area of the Seaside Groundwater Basin. The reordering was done to reflect the increased regulatory constraints on diversions from the Carmel River Basin and allow a determination of whether or not there was excess flow in the Carmel River available for diversion and injection into the Seaside Basin.

For the Final EIR, a further revised version of CVSIM3 (Version 6.4) was developed to address concerns expressed by commenters on the Draft EIR. For the Final EIR, two revisions were incorporated into CVSIM3. First, the logic was revised to require that the water diverted from the Carmel River by Cal-Am during the high-flow season for injection would be supplied by wells in the reach between San Clemente Dam and RM 5.5. By moving the diversion point for water for injection from the reach below RM 5.5 to the reach above RM 5.5, less water was available for injection because the bypass flow requirements in the reach above RM 5.5 are greater that the requirements in the reach below RM 5.5. Second, the logic was revised to include more explicit rules governing how and when the injected water in the Seaside Basin would be recovered. The recovery rules were developed to provide assurance that the excess water diverted from the Carmel River by Cal-Am and injected into the Seaside Basin during the high-flow period would be used by Cal-Am to meet customer demand during the low-flow period rather than pumping from Carmel River sources. With the proposed recovery rules, the amount of water that can be recovered each year is tied to the amount of water that was injected

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[2] CVSIM refers to a family of simulation models. CVSIM1 is used to assess the performance of Carmel River mainstem dam alternatives, CVSIM2 is used to simulate unimpaired flow conditions, and CVSIM3 is used to simulate the performance of No-Project and non-dam water supply alternatives.

[3] Cal-Am owns and operates a "main" water distribution system in its Monterey Division. This main system serves approximately 37,000 connections and derives its source of supply from the MPWRS. Cal-Am also owns and operates three smaller and separate water distribution systems in its Monterey Division, i.e., Ryan Ranch, Hidden Hills, and Bishop Units, that are within the District. These units are served from sources of supply outside the MPWRS and are not included in this analysis.

during the current year, i.e., during the preceding injection season, and if necessary, injected water in storage from previous years.

The revised logic for the recovery operations was designed to provide an explicit accounting procedure to track the amount of water injected, stored, and recovered each year. The logic in the original simulation of the proposed project used an implicit method to quantify the increased yield from the Seaside Basin due to the proposed project. This yield was calculated as the difference between the Cal-Am's total production from the coastal area of the Seaside Basin with and without the proposed project. For the Final EIR, the logic for the proposed project was revised to use a more explicit method. In the revised simulation, the amount of water diverted for injection, the amount of water injected, the amount of water recovered, and the amount of injected water in storage in the Seaside Basin were tracked on a daily basis. In this regard, Cal-Am's production of non-ASR water, i.e., naturally occurring water, from the Seaside Basin was tracked separately from Cal-Am's production of ASR water, i.e., injected water from the Seaside Basin. The recovery rules used in the revised simulation for the proposed project were specified so that the results, e.g., streamflow, groundwater storage, production, and months of rationing, from the original and revised simulation runs were the same or similar.

Section 2: Phase 1 ASR Project Operating Logic

For the Phase 1 ASR simulations, it was assumed that diversions from the Carmel River Basin for injection into the coastal area of the Seaside Groundwater Basin would only occur between December 1 and May 31, when flow in the Carmel River was in excess of the bypass flows recommended by the National Marine Fisheries Service (NMFS) in its June 3, 2002, report, *Instream flow Needs for Steelhead in the Carmel River, Bypass Flow Recommendations for Water Supply Projects Using Carmel River Waters.* Similarly, it was assumed that diversions from the coastal area of the Seaside Groundwater Basin by Cal-Am for customer use in its main system would occur primarily between June 1 and November 30. Accordingly, the usual high-flow period (December through May) was considered the "injection" season and the usual low-flow period (June through November) was considered the "recovery" season. No exceptions to the operating logic were made during the injection season. Three exceptions to the logic were made for diversions from the coastal area of the Seaside Basin during the recovery season. First, consistent with State Water Resources Control Board (SWRCB) Order 98-04, during November when flow in the Carmel River at the Highway 1 Bridge exceeded 40 cubic feet per second (cfs), Cal-Am's daily diversions from the Seaside Basin were curtailed. Second, during critically-dry water years when usable storage in subunit three of the Carmel Valley alluvial aquifer (AQ3) was less than 11,000 acre-feet[4], Cal-Am's daily diversions from the Seaside Basin were maximized to preserve groundwater storage in Carmel Valley. Third, during April and May when flow in the

[4] The 11,000 acre-foot usable storage trigger was selected based on a number of simulations. In the simulations, by initiating additional diversions from the Seaside Basin using the ASR wells when usable storage in AQ3 reached 11,000 acre-feet, usable storage in AQ3 was prevented from dropping below the historical minimum of 8,800 acre-feet. This minimum occurred in December 1988.

Carmel River at the Highway 1 Bridge was less than 40 cfs, Cal-Am's daily diversions from the Seaside Basin were maximized to provide increased flow in the Carmel River for steelhead smolt emigration. Based on this logic, Cal-Am production from the coastal area of the Seaside Basin was distributed uniformly during the six-month recovery season.

This operating logic was chosen to facilitate comparisons between the No-Project and Phase 1 ASR Project simulation results. In response to future hydrologic conditions, actual operations may vary in certain periods as determined by an interagency management group. For example, more water could be extracted from the Seaside Basin in April and May and less in October and November to provide increased flows for steelhead smolt emigration in the spring and less flow for juvenile rearing in the fall.

Key Modeling Assumptions: For the Phase 1 ASR Project simulation, it was assumed that 7,200 acre-feet of additional usable storage capacity would be available in the coastal subarea of the Seaside Basin for injection purposes. This usable storage capacity is in addition to the 7,500 acre-feet of usable capacity assumed for the No-Project alternative. Therefore, the total usable storage capacity in the coastal area of the Seaside Basin with the Phase 1 ASR Project was assumed to be 14,700 acre-feet. For both simulations, initial usable storage in the coastal area of the basin was assumed to be approximately 5,000 acre-feet.

It was also assumed that two ASR wells would be available with a combined injection capacity of 3,000 gallons per minute (gpm) or 13.3 acre-feet per day. Specifically, it was assumed that the existing Santa Margarita Test Injection Well (SMTIW or ASR #1) would be able to inject up to 1,250 gpm and a new larger ASR well at the existing site (ASR #2) would be capable of injecting up to 1,750 gpm. It was assumed that both wells would operate at the same time during the injection season.

Similarly, it was assumed that ASR #1 well would be able to recover up to 2,500 gpm and ASR #2 well would be able to recover up to 3,500 gpm. For this analysis, it was assumed that only one well would operate at a time during the recovery season to avoid interference effects. Accordingly, the maximum recovery or production capacity with ASR #2 would be 3,500 gpm or 15.5 acre-feet per day. Cal-Am's total production capacity from the coastal area of the Seaside Basin with ASR #2 in maximum recovery mode would be almost 35 acre-feet per day.

In addition, it was assumed that Cal-Am would be able to transmit up to 3,000 gpm or 13.3 acre-feet per day to and from the proposed ASR Project site, while meeting customer water demand throughout their main water distribution system. The 13.3 acre-feet per day transmission capacity is based on the proposed 16-inch, above-ground, 6,800-foot pipeline that is planned to connect the existing ASR site with the existing Cal-Am distribution system at the east end of Hilby Avenue in Seaside. The maximum transmission capacity of this pipeline is estimated to be 3,000 gpm or 13.3 acre-feet per day.

In the Phase 1 ASR simulation, outflow from the coastal area of the Seaside Basin to the offshore area was increased to reflect the increased gradient that would result from increased storage in the coastal area. The increases were calculated based on Darcy's Law. As an example, when simulated usable storage in the coastal area is between 5,880 and 7,350 acre-feet, simulated outflow is estimated to be 2.86 acre-feet per day. However, when usable storage is between 13,320 and 14,700 acre-feet, simulated outflow is estimated to be 6.43 acre-feet per day.

For the Phase 1 ASR Project simulations, it was assumed that annual inflow into the coastal area from upgradient, inland areas would be 4,955 acre-feet and that this inflow would be uniformly distributed throughout the year, i.e., 413 acre-feet per month. This assumption is the same as used in previous simulations, but differs from inflow estimates recently developed for the District. Yates and others[5] (Yates) estimated that the amount of inflow from inland areas to the coastal area was 2,330 acre-feet per year. In their water budget analysis, Yates also estimated that an additional 1,670 acre-feet per year would recharge the coastal area from rainfall, irrigation and pipe leaks. Altogether, Yates estimated that an average of 4,000 acre-feet per year would recharge the coastal area of the Seaside Basin.

In a separate calculation, Yates estimated a range of average annual inflow values into the coastal area using Darcy's Law. Yates "best" estimates for inflows into the northern and southern coastal subareas were 5,060 acre-feet and 680 acre-feet, respectively. Therefore, based on Darcy's Law and available hydraulic conductivity values, the average annual inflow into the coastal area of the Seaside Basin is estimated to be approximately 5,740 acre-feet. Given the uncertainty associated with these inflow estimates and the fact that the new inflow estimates bracket the previous estimate, it was decided to retain the previous subsurface inflow estimate in the Phase 1 ASR Project simulations.

Proposed Recovery Rules: As modeled in Version 6.4 of CVSIM3, recovery of the injected water would be governed by a set of predetermined "recovery" rules. These rules were developed cooperatively with staff from the California Department of Fish and Game (CDFG) and the National Marine Fisheries Service (NMFS) and are intended to be included as permit conditions of the water right for Carmel River diversions sought by the District and Cal-Am for the Phase 1 ASR Project. These proposed conditions are shown below and are presently being negotiated. The final conditions will be prepared and approved by the Water Rights Division of the SWRCB and may differ.

Permittee shall produce water from groundwater storage in the Seaside Basin under this permit in accordance with the following protocol:

a. The amount of water to be produced from groundwater storage for recovery each year shall be calculated by the Memorandum of Agreement/Quarterly Budget

[5] Yates, Eugene B. (Gus), Feeney, Martin B., and Rosenberg, Lewis L., *Seaside Groundwater Basin: Update on Water Resource Conditions*, Prepared for the Monterey Peninsula Water Management District, April 14, 2005.

group following the procedures specified in paragraphs b through k. This group is composed of representatives from CDFG, NMFS, MPWMD, and Cal-Am.

b. Whenever water is delivered from the ASR wells to the Cal-Am distribution system, Cal-Am shall, to the maximum extent operationally feasible, reduce water production from its wells in the upstream portion of Aquifer Subunit 3 of the Carmel Valley Alluvial Aquifer (River Mile 6.0 through 9.0), proportionate to the water produced by the ASR wells and delivered to the Cal-Am distribution system.

c. The target amount of water to be produced from groundwater storage for recovery each year shall be 1,500 acre-feet.

d. The target recovery season shall begin on June 1 and end on November 30.

e. The actual amount of water to be produced from groundwater storage for recovery each year shall be determined by June 1 of each year.

f. The actual amount of water to be produced from groundwater storage for recovery each year shall be uniformly distributed over the recovery season, unless modified by the Memorandum of Agreement/Quarterly Budget group.

g. Each year at the end of the current injection season, the amount of water injected and stored in the Seaside Basin during the current injection season shall be totaled. If this total equals or exceeds the recovery target (1,500 acre-feet), then the target amount of water for recovery shall be produced and provided to Cal-Am for customer service. Any water injected during the current injection season that is in excess of the recovery target shall be added to "carryover" storage.

h. If the total amount of water injected and stored during the current injection season is less than the recovery target (1,500 acre-feet) and there is <u>sufficient</u> carryover storage from previous injection seasons, then the target amount of water for recovery shall be produced and provided to Cal-Am for customer service. In this case, water from carryover storage shall be produced to supplement water injected during the current season to satisfy the recovery target. Any water that is produced from carryover storage to meet the recovery target shall be subtracted from carryover storage.

i. If the total amount of water injected and stored during the current injection season is less than the recovery target (1,500 acre-feet) and there is <u>insufficient</u> carryover storage from previous injection seasons, then the target amount of water for recovery shall be reduced to account for the amount of water injected during the current injection season and carryover storage from previous injection seasons.

j. If no water is injected in the current injection season and there is no carryover storage from previous injection seasons, then the target amount of water for recovery shall be 0 acre-foot.

k. If carryover storage exceeds 5,000 acre-feet at the end of the preceding injection season, then the amount of water in carryover storage that exceeds 5,000 acre-feet shall be added to the target amount of water to be produced for recovery in the upcoming recovery season. Any excess water that is produced from carryover storage to augment the recovery target shall be subtracted from carryover storage.

Section 3: Water Supply Yield Attributable to Phase 1 ASR Project

Draft EIR: For the Draft EIR, the annual yield for the Phase 1 ASR Project was determined by comparing Cal-Am's average annual production from the coastal area of the Seaside Groundwater Basin with the Phase 1 ASR Project and Cal-Am's average annual production from the Seaside Basin without the Phase 1 ASR Project, i.e., the No-Project Alternative. Based on this comparison, the average annual increase in yield from the coastal area of the Seaside Basin due to the Phase 1 ASR project is 1,050 acre-feet per year. Specifically, Cal-Am's simulated average annual yield from the coastal area of the Seaside Basin for the 45-year period of analysis with the Phase 1 ASR Project is 4,720 acre-feet per year, compared to 3,670 acre-feet per year without the project. The difference is 1,050 acre-feet per year and is attributable to the excess water diverted from the Carmel River system during the December through May period and injected into the coastal area of the Seaside Basin for recovery during the June through November period.

For the Draft EIR, the increased yield in the coastal area of the Seaside Basin was determined heuristically through a series of CVSIM3 simulations. The reference simulation was the No-Project Alternative, in which an annual production target of 3,500 acre-feet was specified for Cal-Am's diversions from the coastal area of the Seaside Basin. This target equates to an average diversion of 480 to 530 acre-feet per month during the six-month recovery season. For the Draft EIR, the annual production target from the coastal area of the Seaside Basin was incrementally increased to 4,300 acre-feet. At this production level, simulated monthly diversions would average between 650 and 720 acre-feet during the six-month recovery period. The 4,300 acre-foot production target was selected based on maintenance and recovery of usable groundwater storage in the coastal area of the Seaside Basin.

Figure 4 shows the simulated end-of-year usable groundwater storage values for the coastal area of the Seaside Basin with and without the proposed project, based on Version 6.3 of CVSIM3. As shown, end-of-year usable storage in the coastal area would be significantly greater with the proposed project and would range from a low of 510 acre-feet in Water Year 1991 to a high of 10,920 acre-feet at the end of Water Year 1983. The 4,300 acre-foot production target was chosen so that end-of-year usable storage values with the proposed project would approximate the end-of-year usable storage values without the proposed project during extended drought periods, e.g., Water Years 1959-1961 and Water Years 1987-1991.

Figure 5 shows a comparison of the simulated annual amount of water injected and stored in the coastal area of the Seaside Basin and the annual amount of water recovered that would be attributable to the Phase 1 ASR project, based on Version 6.3 of CVSIM3. As shown, the amount of water stored during a year would not necessarily match the amount of water recovered. For example, in simulated Water Year 1961, no water would be stored and 1,140 acre-feet would be recovered. Conversely, in simulated Water Year 1983, 2,370 acre-feet would be stored and 870 acre-feet would be recovered. Over time, however, the average amount of stored water would approximate the average amount of recovered water.

Figure 6 shows a comparison of the simulated average monthly amounts of water that Cal-Am would divert from the coastal area of the Seaside Basin with and without the Phase 1 ASR Project, based on Version 6.3 of CVSIM3. As shown, the diversions amounts during the injection season, i.e., December through May, are essentially the same with the No-Project and Phase 1 ASR Project. These diversions during the injection season reflect the exceptions to the operating logic and were made to provide increased municipal supply during drought periods and increased streamflows in the lower reaches of the Carmel River for steelhead smolt emigration. Diversions during the recovery season, i.e., June through November, are significantly greater with the Phase 1 ASR Project. Specifically, diversions during the recovery season would be between 130 and 200 acre-feet greater each month with the Phase 1 ASR Project.

The Phase 1 ASR Project, by increasing Cal-Am's reliable yield from the coastal area of the Seaside Basin during the June through November period, would allow Cal-Am to decrease its diversions from the Carmel River basin during this low-flow season. **Figure 7** shows a comparison of Cal-Am's simulated mean monthly diversions from the Carmel Valley alluvial aquifer with and without the Phase 1 ASR Project, based on Version 6.3 of CVSIM3. As shown, Cal-Am's monthly diversions from the Carmel Valley alluvial aquifer would be reduced by 90 to 240 acre-feet per month during the June through November period. The total average reduction in diversions during this period would be 1,120 acre-feet.

<u>Final EIR:</u> As discussed above, a revised version of CVSIM3 (Version 6.4) was developed to address concerns expressed by commenters on the Draft EIR. These revisions resulted in less water being available for diversion for injection and, as a consequence, less yield for the Proposed Project. Based on the revised simulation, the increased yield from the coastal area of the Seaside Basin due to the Proposed project is 916 acre-feet per year. Annual injections during this period would average 918 acre-feet per year. During the six-month recovery season, approximately 100 to 120 acre-feet per month would be recovered from the Seaside Basin and not diverted from the Carmel River by Cal-Am.

Figure 8 shows the simulated end-of-year usable groundwater storage values for the coastal area of the Seaside Basin with and without the proposed project, based on Version

6.4 of CVSIM3. As shown, end-of-year usable storage in the coastal area would generally be greater with the proposed project and would range from a low of 740 acre-feet in Water Year 1991 to a high of 6,530 acre-feet at the end of Water Year 1983. Similar to **Figure 4**, the proposed project would be operated so that end-of-year usable storage values with the proposed project would approximate the end-of-year usable storage values without the proposed project during extended drought periods, e.g., Water Years 1959-1961 and Water Years 1987-1991.

Figure 9 shows a comparison of the simulated annual amount of water injected and stored in the coastal area of the Seaside Basin and the annual amount of water recovered that would be attributable to the Phase 1 ASR project, based on Version 6.4 of CVSIM3. Similar to **Figure 5**, the amount of water stored during a year would not necessarily match the amount of water recovered. For example, in simulated Water Year 1976, no water would be stored and 580 acre-feet would be recovered. Conversely, in simulated Water Year 1983, 2,350 acre-feet would be stored and 1,410 acre-feet would be recovered. Over time, the average amount of stored water would approximate the average amount of recovered water.

Figure 10 shows a comparison of the simulated average monthly amounts of water that Cal-Am would divert from the coastal area of the Seaside Basin with and without the Phase 1 ASR Project, based on Version 6.4 of CVSIM3. Similar to **Figure 6**, the diversions amounts during the injection season, i.e., December through May, are essentially the same with the No-Project and Phase 1 ASR Project. These diversions during the injection season reflect the exceptions to the operating logic and were made to provide increased municipal supply during drought periods and increased streamflows in the lower reaches of the Carmel River for steelhead smolt emigration. Diversions during the recovery season, i.e., June through November, are significantly greater with the Phase 1 ASR Project. Specifically, diversions during the recovery season would be between 100 and 120 acre-feet greater each month with the Phase 1 ASR Project.

Figure 11 shows a comparison of Cal-Am's simulated mean monthly diversions from the Carmel Valley alluvial aquifer with and without the Phase 1 ASR Project, based on Version 6.4 of CVSIM3. Similar to **Figure 7**, Cal-Am's monthly diversions from the Carmel Valley alluvial aquifer would be reduced by 100 to 120 acre-feet per month during the June through November period. The total average reduction in diversions during this period would be 920 acre-feet.

Section 4: Summary

Table 1, which is taken from the Draft EIR for the Phase 1 ASR Project, summarizes the potential impacts on aquatic resources and surface and groundwater resources from the Phase 1 ASR Project. As shown, all of the potential impacts on aquatic resources are considered beneficial. The impacts include the change in Carmel River flow needed for adult steelhead migration, juvenile steelhead rearing, Fall/Winter downstream migration, and Spring emigration, as well as the change in habitat for red-legged frogs and other aquatic species. All of these changes would result from operation of the proposed Phase 1 ASR Project.

Similarly, all of the impacts on surface and groundwater resources in the Carmel River and Seaside Groundwater Basins are considered beneficial or less than significant. The most immediate benefit to the Carmel River system from the Phase 1 ASR project would be an increase in groundwater storage in the lower Carmel Valley Alluvial Aquifer during the low-flow period from July through November. The increased storage during these months would be due to the reduced pumping from the Carmel Valley Alluvial Aquifer. In addition, the impact on Seaside Basin groundwater storage is considered beneficial. As shown in **Figure 8**, the end-of-year usable groundwater storage in the coastal area of the Seaside Basin with the Phase 1 ASR Project would be between 360 and 2,710 acre-feet greater than without the project. On average, the end-of-year usable groundwater storage in the coastal area of the Seaside Basin with the Phase 1 ASR Project would be 1,320 acre-feet greater than without the project. This increased storage in the coastal area on the Seaside Basin would reduce the risk of seawater intrusion.

This technical memorandum details the changes that were made to the District's operations model, CVSIM, to simulate the performance of the proposed Phase 1 ASR Project and its potential impacts on the water resources in the project area. It is intended that the logic used in the simulations will be incorporated into the real-time operation of the proposed project. All of the changes in CVSIM and resulting simulations for the Phase 1 ASR Project analyses were made based on direction from CDFG and NMFS that to be acceptable[6]:

1. all diversions for the Phase 1 ASR Project from the Carmel River would need to comply with the daily bypass flow requirements recommended by NMFS in 2002, and

2. over time, all of the water injected, stored, and subsequently recovered from the Seaside Basin would be used to offset a portion of the current pumping from the Carmel Valley Alluvial Aquifer during the low-flow season. In this latter regard, the recovery and use of the water injected into the Seaside Basin would comply with the protocol specified in the water rights for the proposed Phase 1 ASR project.

As simulated in the Final EIR/EA, operation of the MPWMD Phase 1 ASR Project would produce an average of 920 acre-feet per year of reliable and lawful supply. This supply would be used during the low-flow season to reduce Cal-Am's current unlawful pumping from the Carmel River Alluvial Aquifer and improve habitat conditions in the Carmel River. Additional Phases of the MPWMD ASR Project are planned and will be documented as they are developed.

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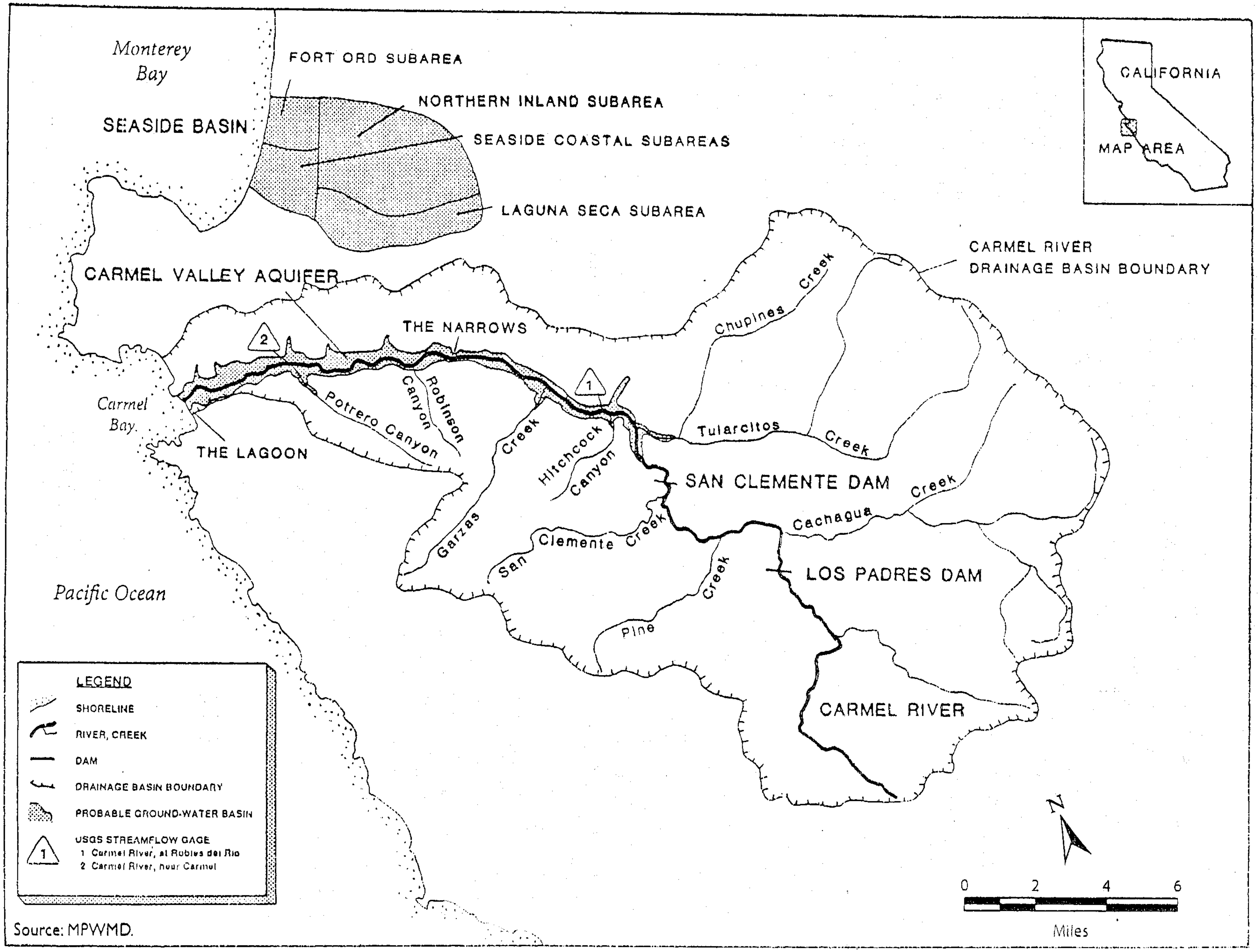
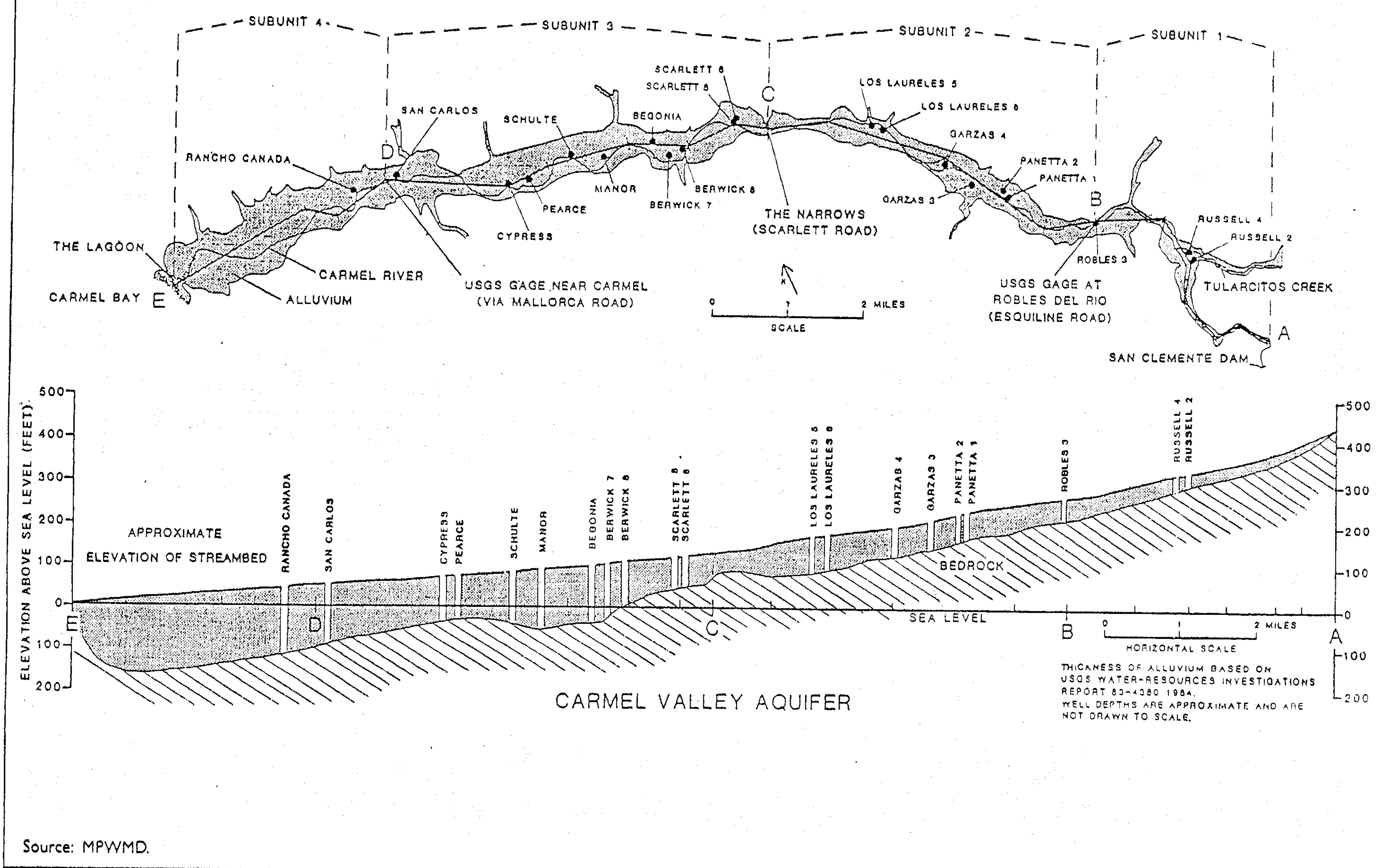
[6] Both CDFG and NMFS have protested the District's petitions to change two existing water rights (Permits 7130B and 20808) to serve the proposed Phase 1 ASR Project.



Jones & Stokes

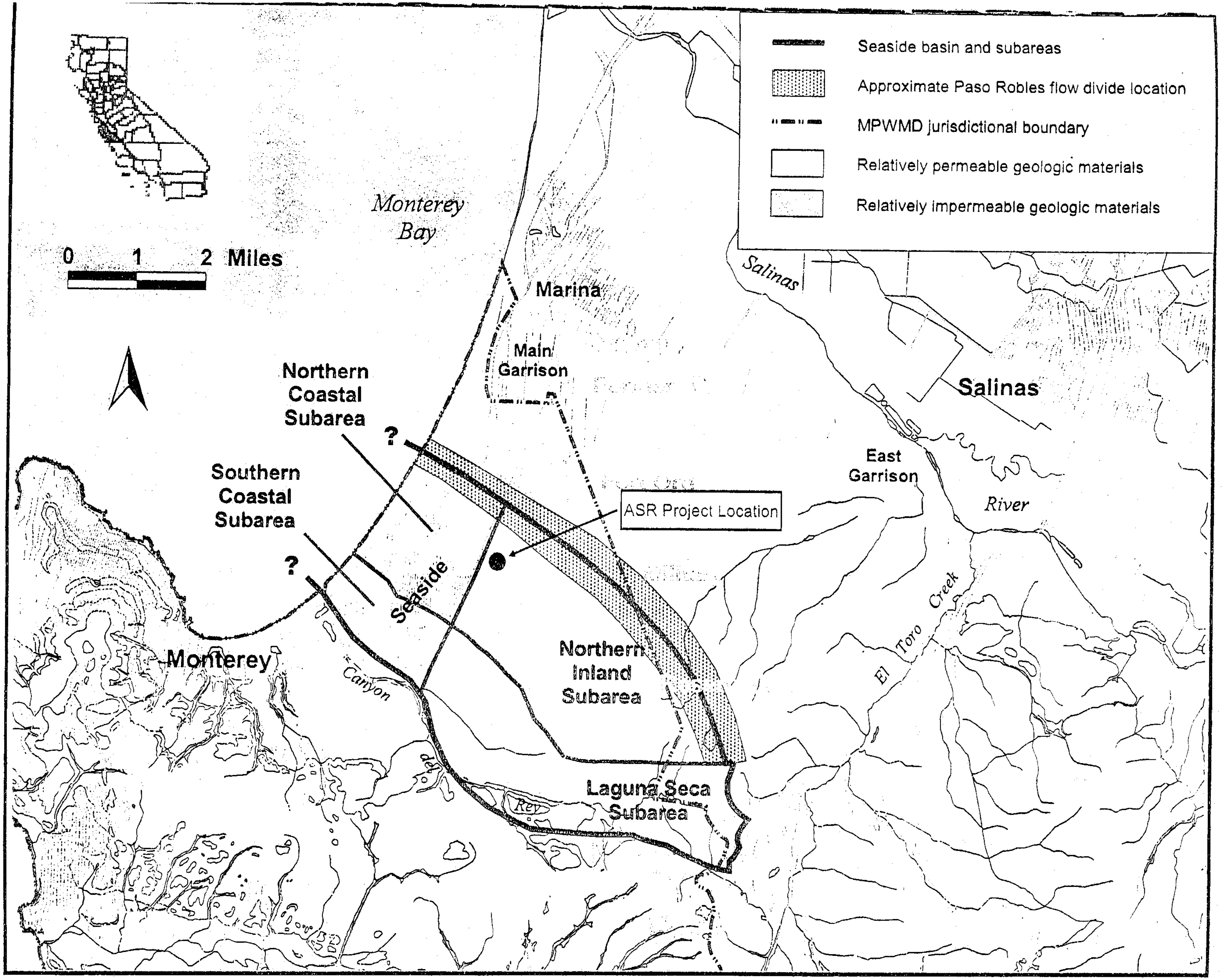
Figure 1. Water Resources System for the Monterey Peninsula Area, Including Carmel River, Carmel Valley Alluvial Aquifer, and Seaside Groundwater Basin



Source: MPWMD.

Jones & Stokes

Figure 2. Profile of Carmel Valley Aquifer Showing Cal-Am Production Wells



Source: Yates, April 2005. Figure 3. Location of the Seaside Groundwater Basin

Figure 4. Simulated End-of-Year Usable Storage in Coastal Area of Seaside Groundwater Basin

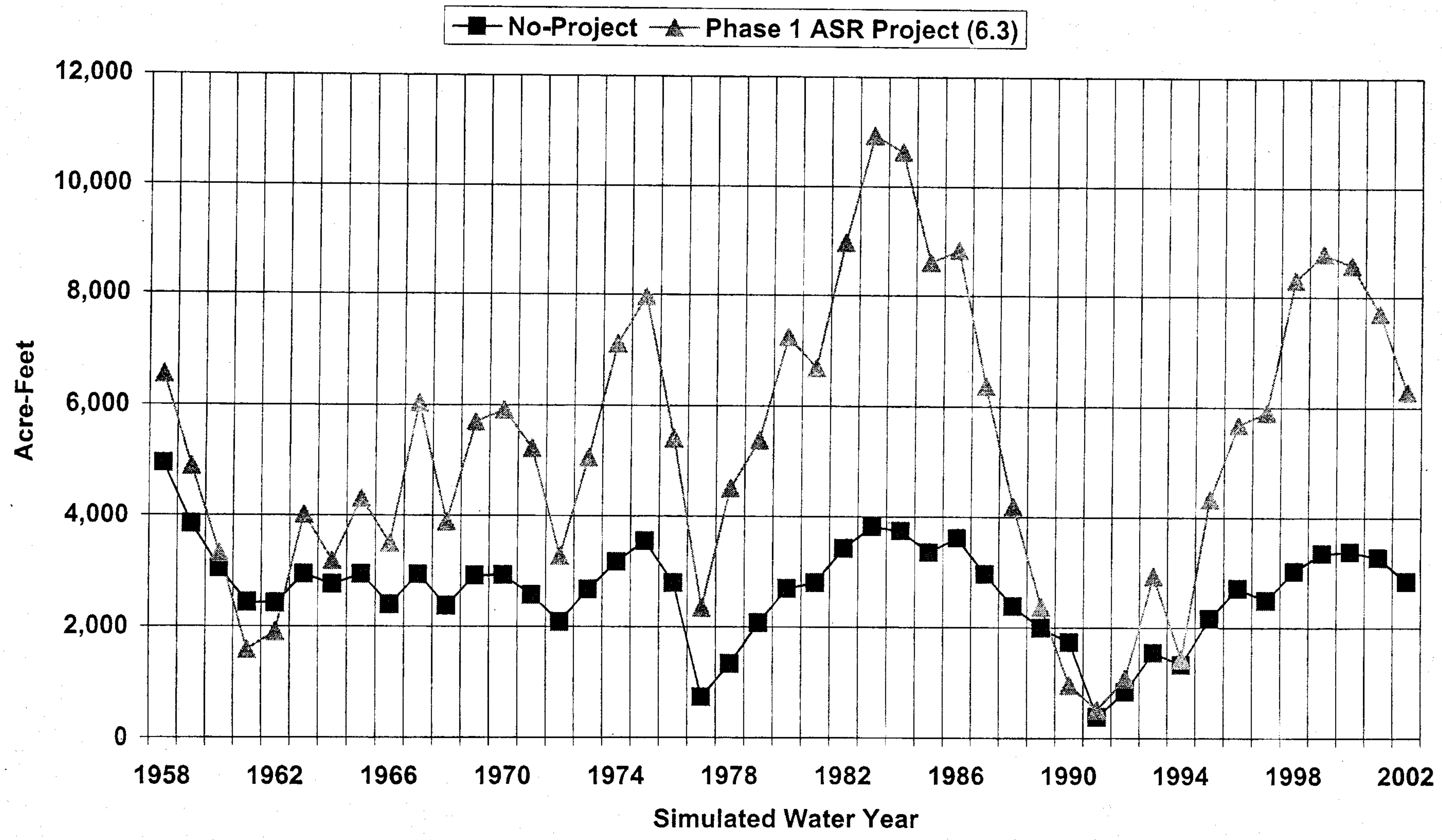


Figure 5. Simulated Annual Amounts of Water Stored and Recovered with the Phase 1 ASR Project Based on Version 6.3 of CVSIM3: Water Years 1958 - 2002

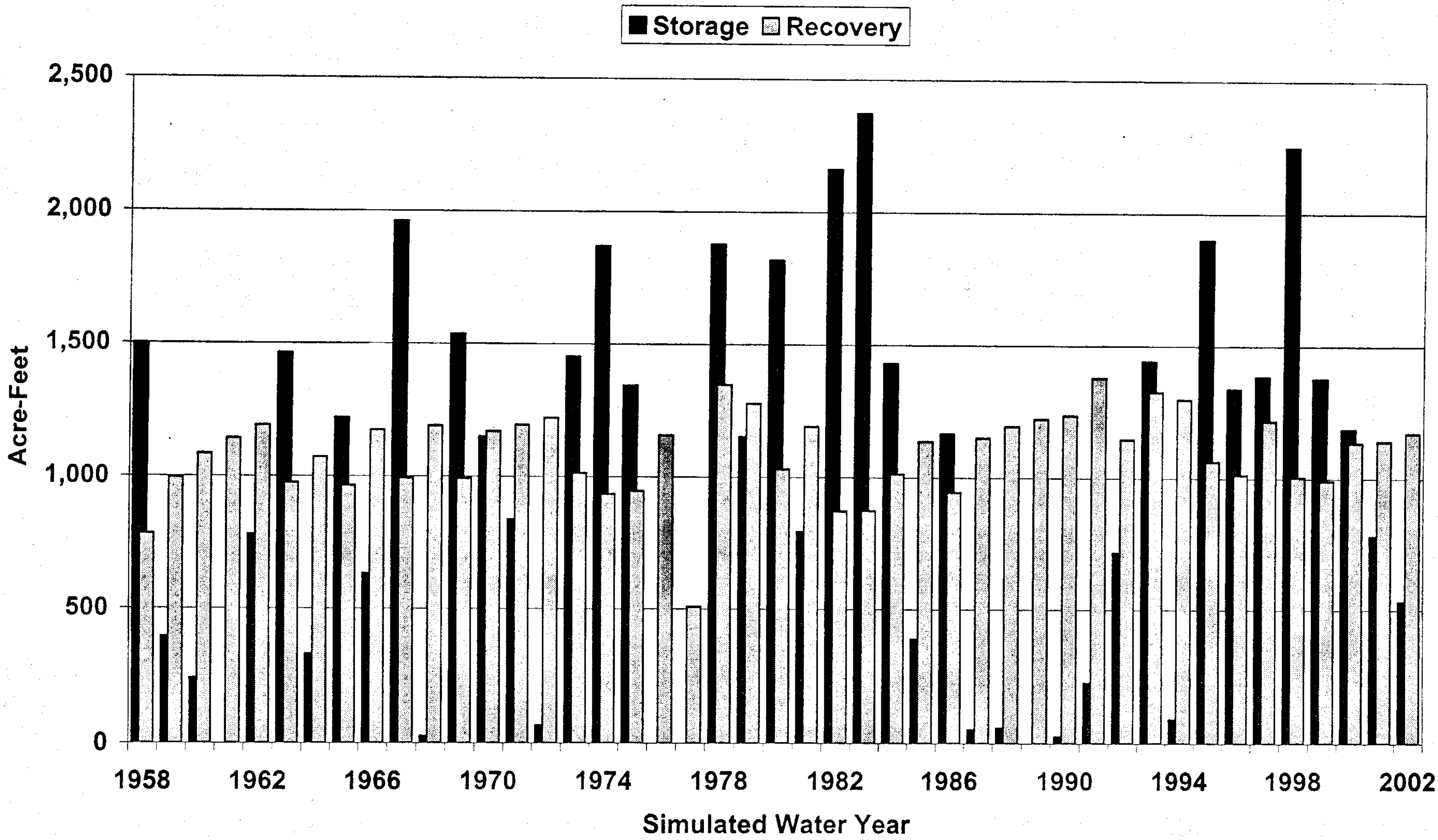


Figure 6. Average Simulated Monthly Cal-Am Diversions from the Coastal Area of the Seaside Groundwater Basin With and Without the Phase 1 ASR Project

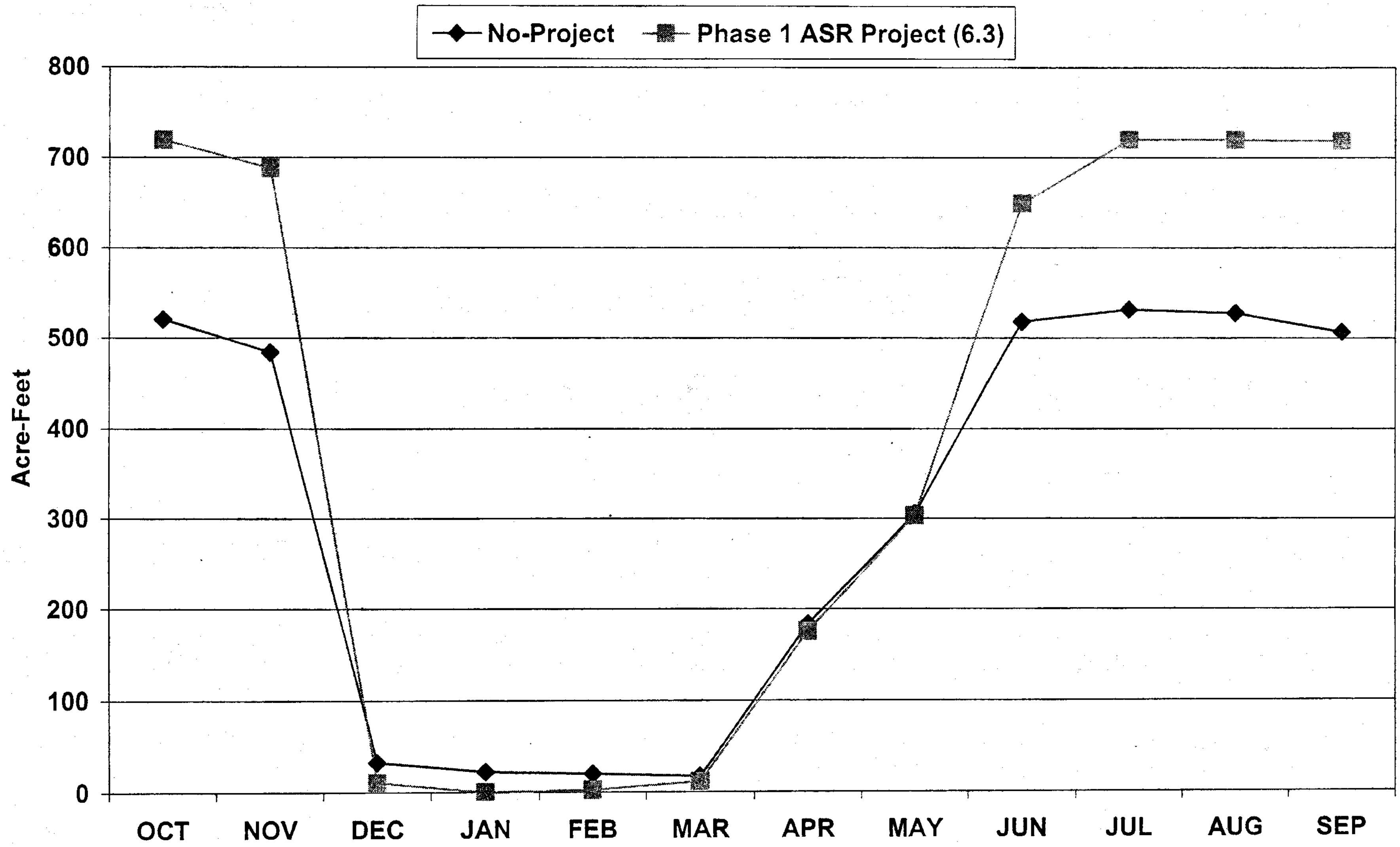


Figure 7. Average Simulated Monthly Cal-Am Diversions from Carmel Valley Alluvial Aquifer With and Without Phase 1 ASR Project

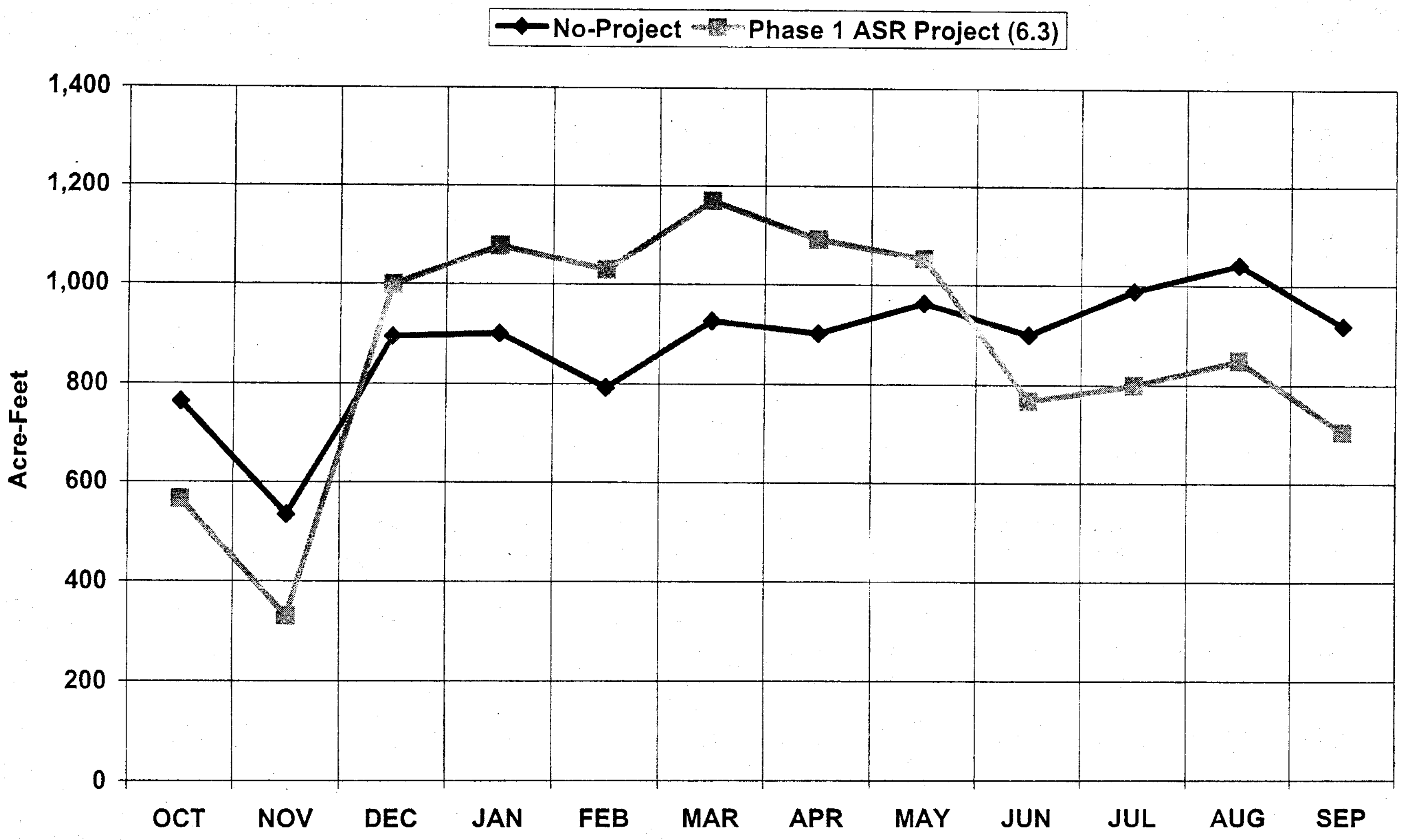


Figure 8. Simulated End-of-Year Usable Storage in Coastal Area of Seaside Groundwater Basin

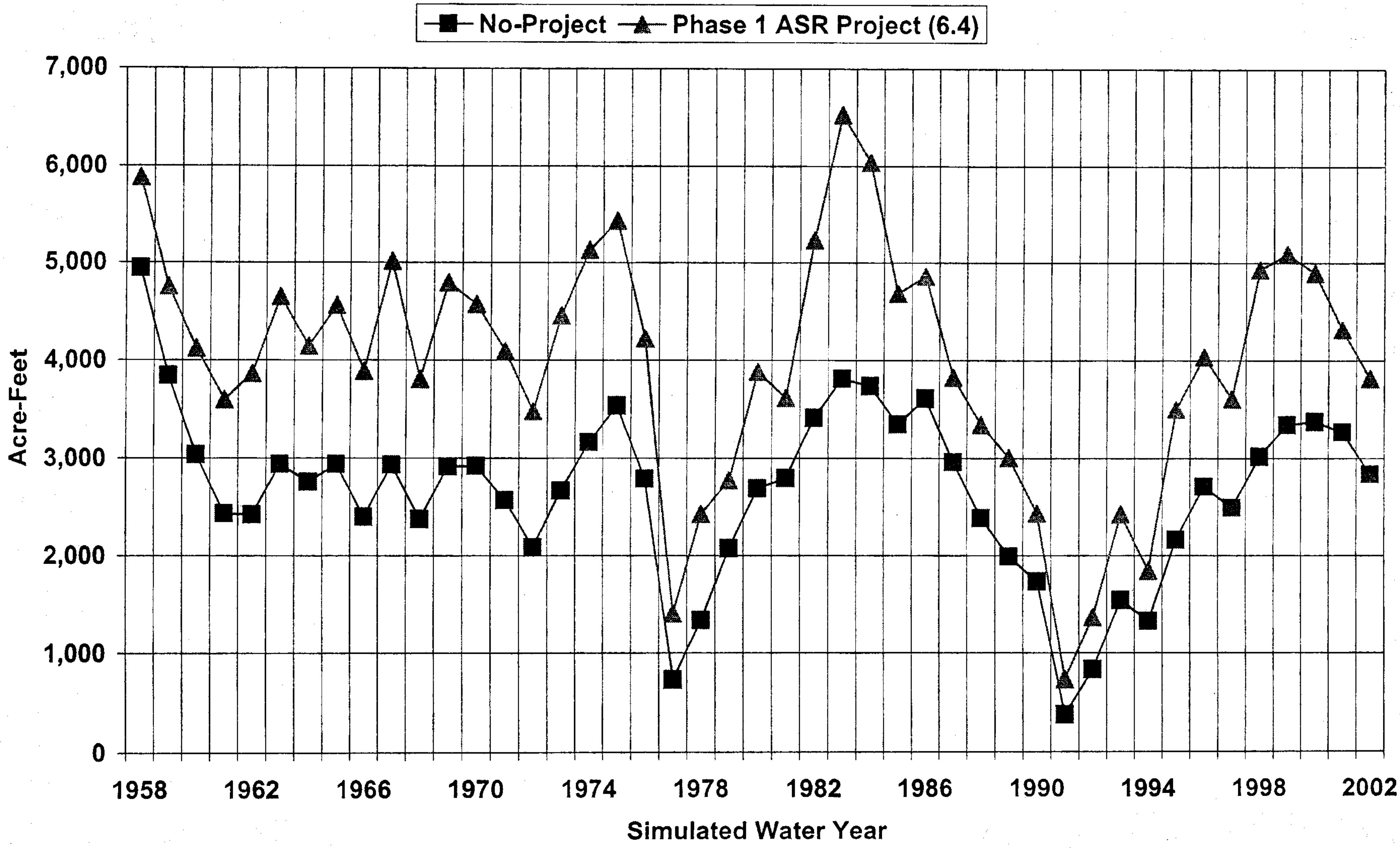


Figure 9. Simulated Annual Amounts of Water Stored and Recovered in the Seaside Basin With the Phase 1 ASR Project Based on Version 6.4 of CVSIM3: Water Years 1958-2002

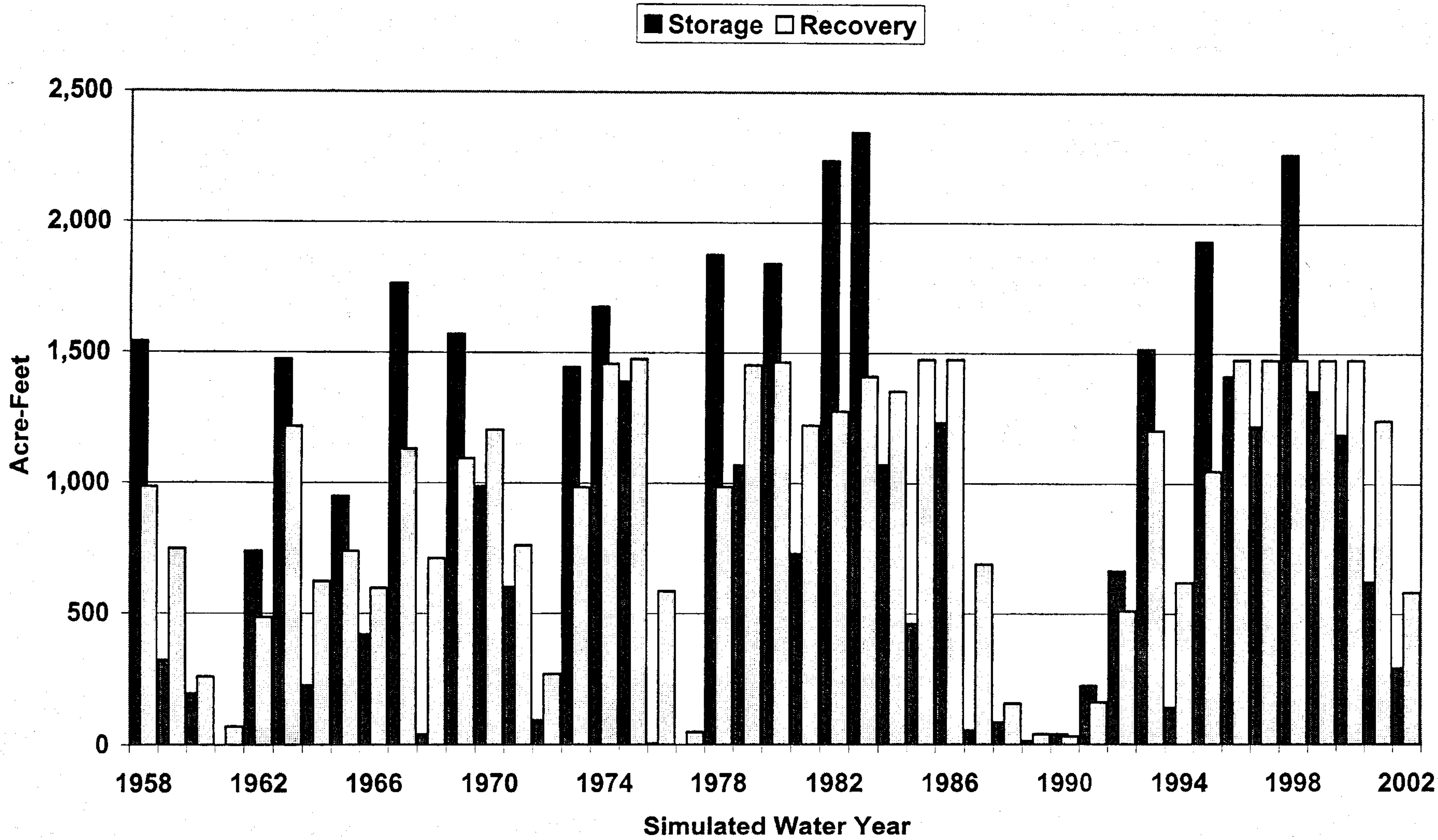


Figure 10. Average Simulated Monthly Cal-Am Diversions from the Coastal Area of the Seaside Groundwater Basin With and Without the Phase 1 ASR Project

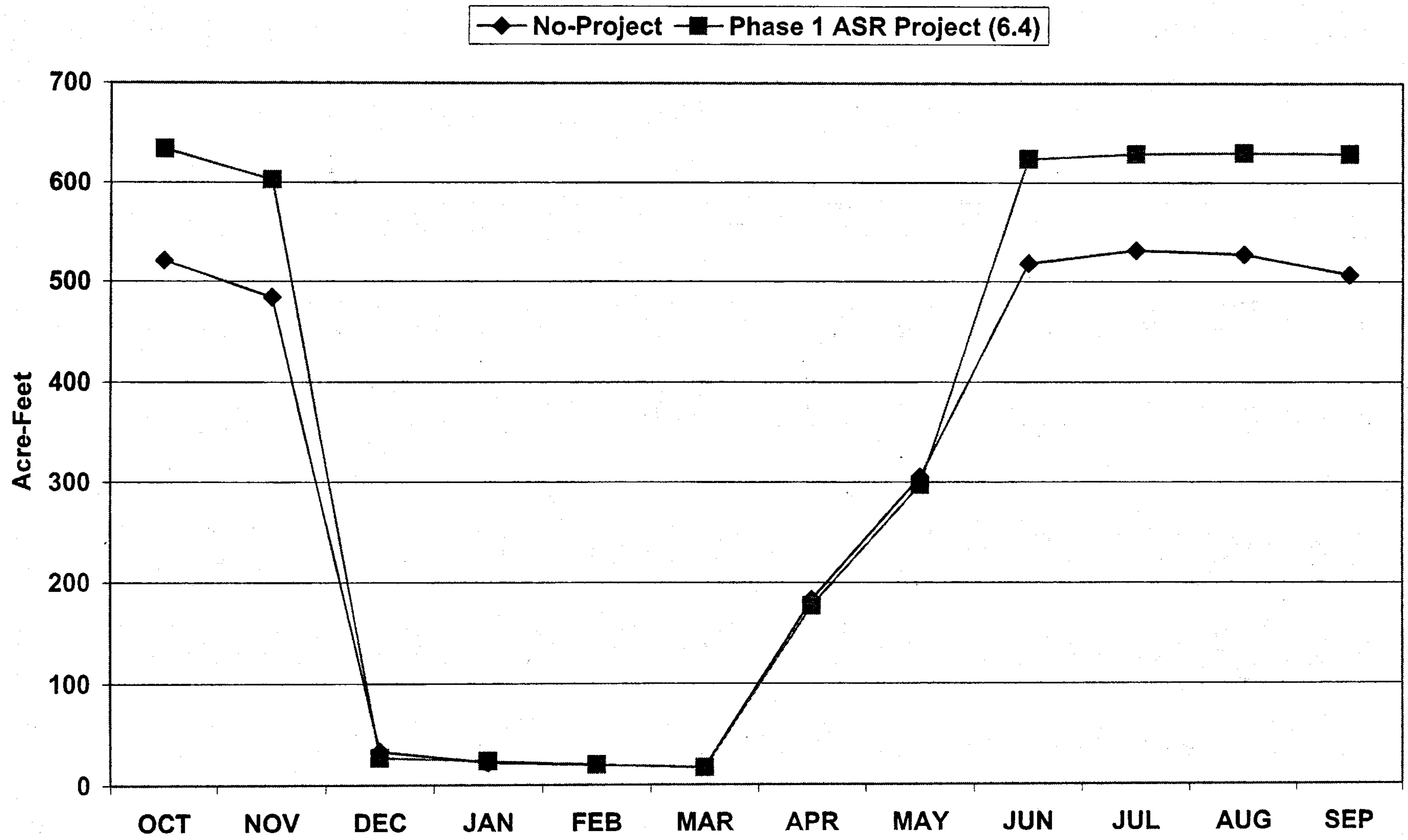


Figure 11. Average Simulated Monthly Cal-Am Diversions from Carmel Valley Alluvial Aquifer
With and Without Phase 1 ASR Project

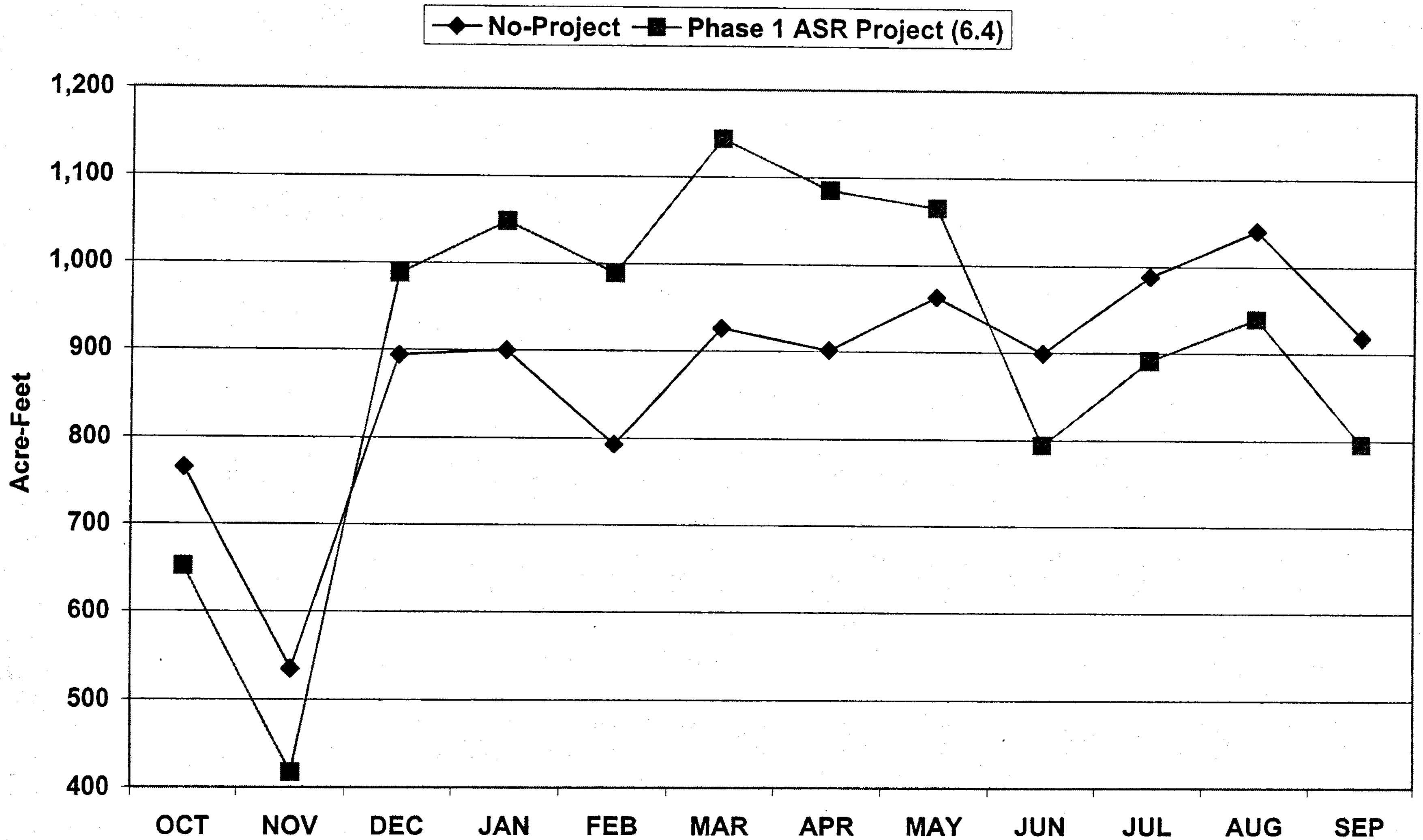


Table 1. Summary of Impacts and Mitigation Measures for the Proposed Project

Issue Area	Potential Impact	Significance Determination without Mitigation	Mitigation	Significance Determination with Mitigation
Aquatic Resources	AR-1: Change in Flows for Adult Steelhead Upstream Migration	Beneficial	None required	Beneficial
	AR-2: Change in Juvenile Steelhead Rearing Habitat	Beneficial	Mitigation Measure AR 5-2: Cooperate to help develop a Project to Maintain, Recover, or Increase Storage in Los Padres Reservoir and If Needed, Continue Funding Program to Rescue and Rear Isolated Juveniles	Beneficial
	AR-3: Improved Flows for Fall/Winter Downstream Migration	Beneficial	None required	Beneficial
	AR-4: Maintenance of Flows for Spring Emigration	Beneficial	None required	Beneficial
	AR-5: Changes in California Red-legged Frog Habitat Due to Changes in River Flows	Beneficial	None required	Beneficial
	AR-6: Changes in Habitat for Other Aquatic Species Due to Changes in River Flows	Beneficial	None required	Beneficial
Surface and Groundwater Hydrology and Water Quality	GWH-1: Changes in Seaside Basin Groundwater Storage	Beneficial	None required	Beneficial
	GWH-2: Short-Term Changes in Seaside Basin Groundwater Quantity	Less than significant	None required	Less than significant
	GWH-3: Long-Term Changes in Seaside Basin Groundwater Levels	Beneficial	None required	Beneficial
	GWH-4: Changes in Seaside Basin Groundwater Levels in Overlying Units	Less than significant	None required	Less than significant
	GWH-5: Potential for Seaside Basin Hydrofracturing	Less than significant	None required	Less than significant
	GWH-6: Short-Term Change in Seaside Basin Groundwater Quality	Less than signficant	Mitigation Measure GWH-1: Comply with Performance Standards in NPDES Permits	Less than significant

Table 1. Summary of Impacts and Mitigation Measures for the Proposed Project

Issue Area	Potential Impact	Significance Determination without Mitigation	Mitigation	Significance Determination with Mitigation
	GWH-7: Long-Term Change in Seaside Basin Groundwater Quality From Mixing Groundwater with Injected Water	Less than significant	Mitigation Measure GWH-2: Operate Project in Compliance with SWRCB and DHS Policies	Less than significant
			Mitigation Measure GWH-3: Modify Project Operations as Required by Results of Monitoring	
	GWH-8: Changes in Seaside Basin Groundwater Quality Caused by ASR Well Operation Discharges	Less than signficant	None required	Less than significant
	GWH-9: Changes in Seaside Basin Recovered Water Quality	Less than significant	None required	Less than significant
	GWH-10: Effects on Other Seaside Basin Groundwater Users	Beneficial	None required	Beneficial
	GWH-11: Changes in Carmel River Streamflow During High Flow Periods	Less than significant	Mitigation Measure GWH-4: Operate Project in Compliance with NOAA Fisheries Recommendations, and Reduce Unlawful Diversions	Less than significant
	GWH-12: Changes in Carmel Valley Alluvial Aquifer Storage During High Flow Periods	Beneficial	None required	Beneficial
	GWH-13: Changes in Carmel River Streamflow During Low Flow Periods	Less than significant	Mitigation Measure GWH-4: Operate Project in Compliance with NOAA Fisheries Recommendations, and Reduce Unlawful Diversions	Less than significant
	GWH-14: Changes in Carmel Valley Alluvial Aquifer Storage During Low Flow Periods	Beneficial	None required	Beneficial

Source: Monterey Peninsula Water Management District EIR/EA, August 2006.