BEFORE THE STATE WATER RESOURCES CONTROL BOARD

In the Matter of the State Water Resources Control Board (State Water Board) Hearing to Determine whether to Adopt a Draft Cease & Desist Order against California American Water Regarding its Diversion of Water from the Carmel River in Monterey County under Order WR 95-10	Hearing Date: July 23 - 25, 2008 Carmel River in Monterey County

EXHIBIT MPWMD-LH1

TESTIMONY OF LARRY M. HAMPSON

WATER RESOURCES ENGINEER

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

TESTIMONY OF LARRY M. HAMPSON

I, Larry M. Hampson, provide the following testimony under penalty of perjury, under the laws of the State of California, in relation to the State Water Resources Control Board (State Water Board or SWRCB) hearing to determine whether to adopt a draft Cease and Desist Order (CDO) against California American Water (CAW or Cal-Am) regarding its diversion of water from the Carmel River in Monterey County under SWRCB Order WR 95-10.

Q1: PLEASE STATE YOUR NAME AND QUALIFICATIONS.

1. My name is Larry M. Hampson. My resume' is attached as Exhibit MPWMD-LH2.

2. In my capacity as Water Resources Engineer, I am knowledgeable regarding Monterey Peninsula water resource management issues in general and issues related to hydrology, erosion protection, and riparian habitat mitigation and restoration in the Carmel River watershed in particular. I have participated in the development of integrated water resource planning documents for the Carmel River watershed, Monterey Peninsula, and Seaside Groundwater Basin. I have reviewed and commented on water supply projects and other proposals affecting the environment of the Carmel River. I have designed, managed, inspected, and monitored many stream restoration projects along the Carmel River within the Water Management District boundaries. I have conducted, and/or supervised, studies concerning the condition of and changes to the channel and banks of the Carmel River between the ocean and the upstream limit of the Los Padres Reservoir at approximately River Mile (RM, measured from the ocean) 27. A list of stream restoration projects I have been involved in is attached as Exhibit MPWMD-LH3.

Q2: PLEASE DESCRIBE DISTRICT MITIGATION ACTIVITIES ASSOCIATED WITH SWRCB ORDER WR 95-10.

3. I am responsible for implementing portions of MPWMD's Carmel River Management Plan and Mitigation Program activities associated with management of the riparian corridor from the Carmel River lagoon at RM 0 to Camp Steffani at RM 15.5 (a copy of the "Carmel River mileage survey" is attached as Exhibit MPWMD-LH4). Duties include monitoring of the lagoon and the Carmel River channel using topographic survey equipment, documenting river conditions using photographs, designing, implementing, and monitoring river restoration projects, enforcing riparian corridor rules and regulations, and providing technical assistance to riverfront property owners with streambank erosion problems.

Q3: PLEASE DESCRIBE HOW CAW DIVERSIONS ALLOWED UNDER SWRCB ORDER WR 95-10 AFFECT CARMEL VALLEY FLOOD ELEVATIONS.

4. Flooding of low-lying properties and some structures along the lower 15.5 miles of the Carmel River from the Pacific Ocean to Carmel Valley village can begin when flow in the river exceeds about 7,000 cubic feet per second (cfs) at Carmel Valley village. A flow of about 9,500 cfs near the mouth of the river is considered to be about a 10-year return event. The most recent estimate for the peak of the 100-year event is about 22,700 cfs at the "Near Carmel" U.S. Geologic Survey (USGS) gaging station (RM 3.2) . In 2003, Monterey County determined that there were 94 repetitive loss structures (two or more flood insurance claims of $1,000 or more within a 10-year period) in the Carmel River floodplain. Most of these losses were the result of floods in January 1995, which was estimated to be about a 10-year event, and March 1995, which was estimated to have peaked at a magnitude of 16,000 cfs or about a 35-year event at the Near Carmel gage. Nearly 500 homes and businesses suffered damages as a result of the March 1995 flood. A flood in February 1998 was similar in magnitude to the March 1995 flood; however, due to improvements made after 1995 there were fewer structures damaged, although there was significant streambank erosion damage between RM 1 and RM 6.7 in 1998.

5. CAW diversions during the high flow season can occur between the Cañada well at approximately RM 3 and the Russell Wells at RM 16. The maximum instantaneous capacity of CAW wells in this reach is about 33 cfs, which represents about 0.15% of the estimated peak flow in a 100-year flood. However, it is unlikely that the system can be operated at maximum capacity due to storage and equipment limitations. It should be noted that during flood flows, CAW likely diverts some of the streamflow, so historic peak flow data may already reflect these diversions. Most of these peak flow data were collected since diversions from Carmel Valley increased, beginning in the mid-1960's. Based on these considerations, it is unlikely that existing CAW diversions during winter floods have a significant effect on the magnitude of peak flood flows.

Q4: SHOULD MEASURES BE CARRIED OUT TO REDUCE IMPACTS ON FLOODING FROM CAW DIVERSIONS IN THE CARMEL VALLEY AQUIFER?

6. No.

Q5: HOW DID PRE-1995 CAW DIVERSIONS AFFECT CARMEL RIVER RIPARIAN VEGETATION AND STREAMBANK STABILITY?

7. The effects of CAW diversions on riparian vegetation were documented as early as 1966 and extensive testimony about these effects was presented during hearings for SWRCB Order No. WR 95-10. CAW diversions in Carmel Valley Aquifer between RM 5 and RM 15 (in sub-units 1, 2, and 3 or AQ1, AQ2, and AQ3 as shown on Exhibit MPWMD-LH5) resulted in extensive dewatering of the Carmel Valley Aquifer and caused stress and mortality to riparian vegetation that depends directly on access to adequate levels of surface and groundwater to become established and to maintain its health and vigor. Loss of healthy streamside vegetation culminated in 1976 and 1977 in this reach just prior to a severe episode of erosion and degradation of riparian resources between 1978 and 1983 along about eight miles of the river corridor.

8. The lower 15 miles of the Carmel River is a potentially unstable system where the presence of a continuous corridor of healthy riparian vegetation can make the difference between a narrow, stable channel, and a wide, shifting channel. CAW diversions led to a loss of this type of vegetation and exposed streambanks to erosive forces during winter flows. Approximately 641,000 cubic yards of sediment was dumped into the active channel (the lowest portion of the stream) as river flows worked against unprotected streambanks between 1978 and 1983. Sediment deposited in the active channel caused a feedback loop of erosion as gravel bars formed that deflected flows into banks and eroded additional material. During this period, portions of the river were transformed from a narrow, single-thread channel fringed by a dense riparian forest to a wide, shifting channel nearly devoid of riparian vegetation (for an example, see Exhibit MPWMD-LH8). It should be noted that during this episode, peak stream flows did not exceed 10,000 cfs, or about a 10-year return event, and moderate to severe bank erosion occurred during lower magnitude, more frequent events.

9. In contrast to the degradation and property loss that occurred upstream of RM 5 during this episode of erosion, the reach from the Carmel River lagoon to Quail Lodge (at RM 5) was virtually unscathed during the same period. The absence of CAW diversions in this reach prior to the episode of erosion was a key factor in this reach remaining stable.

Q5: WHAT PRE-1995 ACTIONS MITIGATE EFFECTS OF CAW DIVERSIONS? HAVE THESE ACTIONS RESTORED RIPARIAN VEGETATION OR STREAMBANK STABILITY?

10. After the 1978-1983 episode of erosion along the river, MPWMD implemented three important measures to mitigate for the adverse effects of diversions on streambank stability and riparian vegetation. These consisted of: 1.) a program initiated in 1984 to restore channel stability, riparian vegetation, and steelhead habitat and manage areas downstream of RM 15.5 that had been degraded by diversions; 2.) in 1985, MPWMD adopted an ordinance to require that CAW shift a portion of their diversions during the dry season to wells downstream of the

Narrows (near RM 10) in order to maintain surface flow above the Narrows; and 3.) in 1990, MPWMD combined into one program (the Mitigation Program) the following activities: water conservation within the MPWMD boundary, coordinated surface and groundwater management of the Carmel Valley Aquifer and the Seaside Groundwater Basin; fisheries management, channel restoration, irrigation, and management of other activities within the riparian corridor of the Carmel River.

11. The first action taken by MPWMD to mitigate effects of diversions was to implement a comprehensive channel restoration program in 1984 that focused primarily on reaches downstream of the Narrows (see location maps 1 and 2, Exhibit MPWMD-LH6), with some work carried out upstream of the Narrows (see location map 3, Exhibit MPWMD-LH5). Intensive channel restoration was recommended along eight miles of the river between RM 5 and RM 13 in order to reduce instability and restore streamside resources. Intensive restoration work included realignment and rebuilding of the active channel, installation of structural protection in areas that had been eroded, installation of steelhead habitat features, installation of native riparian plants, and installation and operation of an irrigation system to augment natural soil moisture. By 1995, nearly four miles of restoration had been completed.

12. The second action taken by MPWMD to restore riparian vegetation and channel stability upstream of the Narrows was to require CAW (in 1985) to release flow at San Clemente Dam to the lower river and transfer water production to wells downstream of the Narrows. This change resulted in perennial flow above the Narrows after 1985, except at the deDampierre reach (between about RM 13 and RM 14), where flow often travels below the riverbed for an extended period during the dry season.

13. After diversions were shifted to wells downstream of the Narrows, natural recruitment of riparian species occurred upstream of the Narrows along approximately five miles of the channel from the Narrows to Camp Steffani (RM 15). Recovery of streamside vegetation in the reaches upstream of the Narrows was swift and growth was so considerable that in 1990

MPWMD began an annual program to remove vegetation in selected portions of the channel bottom to reduce the potential for erosion. In a 1991 measurement of vegetation encroachment at the confluence of Garzas Creek with the main stem (at RM 12.5), I found only three feet of open channel at this location.

14. By 1995, recovery of riparian vegetation upstream of the Narrows was astonishing. Complex, narrow channels with cut banks overhung with alders and willows had replaced open, braided sections of the river. Perennial flow had encouraged the development of mature vegetation that stabilized streambanks with roots larger than the human leg. Deep pools developed as winter flows scoured maturing vegetation.

15. Increased streamflow and a generally higher groundwater table upstream of the Begonia wells at RM 8.5 also aided channel restoration projects funded by CAW and carried out by MPWMD at the Berwick and Scarlett Projects – (see Exhibit MPWMD-LH6).

16. The third major action taken by MPWMD (in 1990) to mitigate for CAW diversions was to integrate resource management into a single Mitigation Program and expand fisheries management, riparian corridor management and water conservation. This program continues today.

17. However, after diversions began to shift to downstream wells in the mid 1980's, the USGS Near Carmel gage at RM 3.2 shows that this site was dry more than 60% of the months between 1984 and 1994. During this period, groundwater levels downstream of the Narrows were drawn down annually for extended periods and sometimes were well below the root zone of streamside vegetation. In 1988, during the second year of a severe drought, MPWMD installed and operated an enormous drip irrigation system along most of the lower nine miles of the riparian corridor in an effort to preserve riparian vegetation. This system relied on drip irrigation and was focused primarily on preserving larger trees. However, the system was prone to leaks from natural causes (such as rats and exposure to strong sunlight and heat) and pressure drops due to leaks and poor water quality (drip emitters plugged in as little as a few

months). Maintenance in some areas was difficult due to dense stands of poison oak and other under story vegetation. In addition to District-operated systems, MPWMD worked with private golf courses to modify their systems to irrigate the riparian corridor along the riverfront property owned by the golf courses. Despite these efforts to preserve streamside vegetation, a severe drought between 1987 and 1991 coupled with increased groundwater withdrawals resulted in significant degradation of streamside vegetation downstream of about RM 8. This effect was particularly acute in dewatered areas where irrigation systems were ineffective or not present.

18. Between 1991 and 1994, MPWMD documented an increase in streambank instability in reaches that were annually dewatered, such as in the deDampierre reach (RM 13 to RM 14) and downstream of RM 8 at the Red Rock area (RM 7-8), the Valley Hills area (RM 5-6) and the Hacienda Carmel area (RM 3-4). Moderate (locally variable; many reaches unaffected, some reaches with up to 100 feet lateral migration) to severe (occurring throughout a reach or lateral migration of more than 100 feet in some areas) streambank erosion occurred in WY 1991-1993 at peak flows of less than the five-year return event. In 1994, MPWMD took action to stabilize a critical portion of the levee protecting Hacienda Carmel, which is a 300-unit retirement community situated in the middle of the 100-year floodplain just upstream of the USGS Near Carmel gage (RM 3.2). Action was required as a result of a collapse of a small portion of the levee in the winter of 1992-93 after a peak flow of less than 5,000 cfs.

19. The erosion along Hacienda Carmel between RM 3 and RM 4 was particularly troubling, as prior to the mid 1990's, the lowest five miles of the river (downstream of Valley Greens Drive) had remained stable throughout the 1978-83 episode of erosion. Even the flood of 1958, which has been estimated by MPWMD to be 12,500 cfs at Esquiline Road caused only local erosion.

20. With the exception of problems associated with operating what was essentially a nine-mile long irrigation system, the actions taken by MPWMD to mitigate for CAW diversions were effective in the areas they were implemented.

Q6: WHAT EFFECTS HAVE CAW DIVERSIONS HAD ON RIPARIAN VEGETATION AND STREAMBANK STABILITY SINCE 1995?

21. In the area downstream of the Narrows and in the deDampierre reach there was a virtual repeat of the 1978-83 episode of streambank erosion that occurred between RM 5 and RM 13. In the reach between RM 2 and RM 5, the shift to pumping farther downstream essentially transferred the effects of CAW diversions on riparian vegetation and channel stability downstream and concentrated them in a shorter reach of the river. In 1991, at the beginning of the erosion episode, portions of the river between RM 5 and RM 8 were still in a degraded state from the 1978-83 erosion episode and 1987-1991 drought. Some erosion in these areas between 1991 and 1998 could have been expected as a result of continued diversions and, in general, these areas suffered degradation during the 1991-98 period where restoration projects had not been completed.

22. The 1990's episode of erosion downstream of RM 8 followed the same pattern as the 1978-83 episode: increased groundwater pumping; followed by drought; followed by high flows and then severe erosion. Except in previously restored reaches of the channel (see Schulte Restoration Project Exhibit MPWMD LH8), moderate to severe erosion occurred throughout the river from RM 2 to the Begonia wells at RM 8 between 1995 and 1998. During the 1995 flood, with an estimated peak of 16,000 cfs, moderate erosion occurred along both sides of the river at Rancho Cañada (RM 2-3), Hacienda Carmel (RM 3-3.7), Quail Lodge (RM 5-5.5), in the vicinity of the Pearce well at RM 5.7 and in the reach between the Manor well at RM 7.2 and the Begonia well at RM 7.8. At Hacienda Carmel, scour at the toe of the north levee, which is on the left streambank looking downstream, caused about 300 feet of the levee to collapse and threatened the loss of several buildings.

23. In 1998, far greater erosion damage occurred downstream of RM 6.7 than had occurred in 1995 in the same reach. For example, at Rancho Cañada, severe erosion resulted in

approximately 70,000 cubic yards of the right overbank washing away in just a few days (see Exhibit MPWMD-LH9). At Hacienda Carmel on the morning of the February 3, 1998 flood (estimated at 14,600 cfs), the north levee eroded and fell into the active channel at a rate of one foot per hour and required emergency dumping of riprap to stabilize the streambank and prevent loss of buildings. A portion of the reach opposite from the site of repairs to the Hacienda Carmel levee remains unstable and required emergency work in 2005 and 2007. Streambank failures also occurred between RM 5.5 and 5.7 and opposite the Schulte well at RM 6.5. However, the moderate to severe erosion that occurred between RM 2 and RM 5 was unexpected, since the reach had suffered little or no erosion during the 1978-83 episode and had remained stable since the early 1970's.

24. Most, but not all, of the streambanks downstream of RM 8 that failed between 1991 and 1998 had little or no structural protection (e.g., rip-rap or gabions, or other non-native material) and contained areas with relatively sparse vegetation where erosion was initiated. But, at least one reach that failed in 1995 (between RM 5 and 5.5) did have previously installed riprap along the south bank (placed after the 1969 flood). Although peak flows along the river were significantly higher during the 1991-98 period than during the 1978-83 period, the erosion between RM 2 and RM 5 cannot be attributed to higher flows alone. If this were true, there should have been erosion along streambank areas with a similar channel configuration immediately upstream of this reach and between the Narrows and RM 15.5.

25. In addition, while it is now recognized that application of large quantities of water through an overhead sprinkler system can be effective in establishing and maintaining a fairly dense corridor of vegetation along the lowest portion of the bank, this method was not attempted until after the 1995 floods (it is worth noting that these systems are difficult to deploy in overbank areas, due to fairly extensive and often dense underbrush as well as the volume of water required for large areas). Thus, there was little or no opportunity for natural recruitment

and establishment of dense vegetation along the toe of streambanks, except in reaches where MPWMD installed and irrigated vegetation along the toe.

26. A consistent factor leading to the failure of streambanks between 1991 and 1998 was the presence of discontinuities or sparse vegetation along the lowest portion of the streambank. A common method of failure during this period was from small scour points developing along the toe of an exposed streambank that led to complete collapse of the streambank as streamflows methodically worked upstream and downstream of the initial point of erosion.

27. **Streambank Stability Upstream of the Narrows.** In contrast, vigorous and nearly continuous riparian vegetation developed upstream of the Narrows after CAW diversions were curtailed in that reach. Where streambank vegetation had become quite dense between 1984 and 1991, little or no erosion occurred in the mid 1990's. Severe erosion was limited to the deDampierre reach, which is frequently dewatered in the dry season and did not have established vegetation along the streambanks. Moderate erosion in the reach upstream of the Narrows was limited to areas within about 2,000 feet upstream and downstream of Esquiline Road Bridge at RM 14.5

28. The stability of the streambanks upstream of RM 8 during the 1991-98 period can be attributed to a combination of healthy streamside vegetation and channel restoration projects that were implemented and maintained in the wake of the 1978-83 episode. It should be noted that where structural protection alone was installed and little or no streamside vegetation was present, streambanks tended to be unstable.

29. Peak flood flows in 1995 (16,000 cfs at Near Carmel) and 1998 (14,600 cfs at Near Carmel) were substantially higher than any previously recorded flows. However, most of the reach between RM 8 and RM 15.5, except the deDampierre portion, suffered only localized erosion and property damage. This same reach had previously suffered extensive erosion and lateral migration at much lower flows during the 1970's and 1980's. The stability of this reach

in the mid 1990's can be attributed to a combination of direct restoration and the change to producing groundwater farther downstream – a change that increased surface and groundwater flows in the reach.

Although there is evidence to suggest that the MPWMD program to mitigate for the effects of diversions by restoring portions of the river is effective in preventing additional streambank erosion and loss of riparian vegetation, irrigation of mature riparian vegetation in the overbank areas (i.e., in the riparian forest) during dry periods continues to be a logistical challenge. Also, it appears that additional irrigation of streambanks in dewatered areas may be warranted to enhance natural recruitment of riparian species.

30. In summary, it is clear that CAW diversions – especially downstream of RM 5 – continue to adversely affect riparian vegetation and channel stability. Streambanks in the vicinity of diversions remain at risk of being destabilized when those diversions affect the health and density of streamside vegetation. On the other hand, it is also clear that mitigation for these diversions has been successful to a point. Where comprehensive restoration efforts are undertaken and maintained, the riparian forest has been given an opportunity to become re-established and a stable channel is the result.

Q7: WHAT ARE THE COMBINED EFFECTS OF CAW DIVERSIONS, MAIN STEM RESERVOIRS, AND MITIGATION ACTIVITIES ON RIPARIAN VEGETATION AND STREAMBANK STABILITY SINCE 1995?

31. **Channel Degradation.** In previous testimony before the SWRCB, the combined effects of main stem dam building, diversions, and mitigations for diversions were not considered. In the 1980's, it was presumed that the channel had stabilized after dam building and that channel incision and narrowing were complete. In addition, research in the 1980's showed that instability along the Carmel River was due in part to the active movement of large quantities of sediment passing through the system. Until recently, the main problem to solve concerning instability in the river was how to flush excess sediment through the system while maintaining streambank stability. In order to accomplish this, streambanks were armored and

vegetation re-established. In 2001, MPWMD estimated that 6.86 miles, or about 44%, of the right bank and 5.57 miles, or about 36%, of the left bank had been armored or otherwise stabilized (see Exhibit MPWMD-LH10). The difference in length between streambanks is probably associated with bedrock outcrops and meander development.

32. Recently, MPWMD has documented degradation in the active channel in the lower five miles of the river. This is a fundamental change due primarily to the presence of main stem dams that prevent sediment from moving downstream. In addition, the MPWMD program to restore channel stability has resulted in a reduced supply of sediment from lateral migration of the channel into floodplain deposits. With no bedload from the upper watershed and no deformable banks to supply sediment, the river digs into the channel bottom.

33. Repeated surveys of the thalweg, or the lowest point of the channel, by MPWMD (see Exhibit MPWMD-LH11 and LH12) in the alluvial reach since 1984 show degradation of two to four feet in the thalweg in the lower five miles, despite episodes of streambank erosion that are estimated to have added between about 785,000 cubic yards (CY) to more than one million CY of sediment into the active channel downstream of RM 16 since 1978. This reach of the river has an extremely high sediment transport capacity and tends to quickly transport the large volume of sand that was added to the channel.

34. The effects of channel degradation can be seen in the lower seven miles at bridges and along streambank areas where structural and other types of protection were installed in the mid 1990's to resist erosion (see Exhibit MPMD-LH13 to Exhibit LH16). Significant scour has occurred at mid-channel supports for bridges in at least five locations (Rancho Cañada 2 and 3, Via Mallorca, Rancho San Carlos Road, and Schulte Road). The property owners of Rancho Cañada and Rancho San Carlos Road bridges took action in 2007 to protect the bridges. Monterey County Public Works plans to replace the Schulte Road bridge in 2009. In some areas, such as through Rancho Cañada and Hacienda Carmel, some streambank slumping has occurred after scour removed toe support.

35. In addition to scouring of infrastructure, degradation leads to loss of aquifer storage and decoupling of the floodplain from the channel bottom. This has important effects on the type and density of vegetation that grows in overbank areas. In a dynamically stable system, some fluctuation in the thalweg from year to year is expected and likely is evidence of a healthy system that has had a "flushing" that creates pools, gravel bars and channel complexity in the active channel. Riparian vegetation is adapted to this environment and, in an environment with adequate moisture, quickly reestablishes itself through natural recruitment of seedlings along the channel margins and on gravel bars in the active channel. Establishing vegetation along the margins of the river often results in trapping fine sediment and a channel-building process (aggradation) is started. Reestablishment of vegetation along the toe of the streambank is also key to maintaining streambank stability.

36. However, where groundwater withdrawals are concentrated, pumping interrupts this process and contributes to accelerated erosion during high flows by exposing the lowest portion of the streambank to powerful erosive forces. In the lowest five miles of the river, where diversions by CAW are now concentrated, the natural recruitment process is interrupted. This is most in evidence in the area between the downstream end of Rancho Cañada (RM 2) and the San Carlos well (RM 3.7) where portions of the streambanks and floodplain remain unstable 10 years after the 1998 flood. The instability currently being exhibited in the lower river is likely to persist in the face of the combination of reduced sediment supply to the lower river and continued groundwater extraction.

37. **Brief Background of Carmel River Streambank Instability.** The riverbed and streambanks of the Carmel River are generally composed of non-cohesive silts, sands, and gravels. In the lower 15 miles of the river, this sediment ranges in thickness from up to 150 feet near the mouth of the river to about 60 feet near RM 15. The alluvium thins progressively in the upstream direction and is thought to be less than 10 feet upstream of San Clemente Reservoir. The lower 18 miles of the river is considered the alluvial reach of the river. Previous to

development of the floodplain, the river worked and re-worked sediments to form natural channels and low-lying floodplains that are referred to as the active channel. In many rivers, flow in the range of the two-year to five-year return event, or about 2,000 cfs to 5,000 cfs, which are also called "frequent flows" or "channel forming flows," is thought to create the basic form of the active channel. In the absence of major floods, this basic form may not change, or change only slowly, for very long periods.

38. Frequent flow events carry sediment from the watershed through the river and also scour sediment from the riverbed and streambanks in the alluvial reach. In a balanced system, frequent flows shape the basic channel form and result in a complex ecosystem that provides opportunities for diversification of aquatic and plant species, while maintaining a balance between the flow of water and sediment. This condition is sometimes referred to as "dynamic stability" or "dynamic equilibrium," which describes a system with continuous input and outflow of materials that maintains a consistent form or character. However, sudden changes in the magnitude of sediment supply, water supply, or environmental conditions along a stream can disrupt this balance.

39. The alluvial reach of the Carmel River no longer emulates the "dynamic equilibrium" model due to several major influences including main stem dam building, floodplain development, gravel extraction, and diversion practices.

40. After installation of San Clemente Dam in 1921, the main stem of the Carmel River downstream of the dam became a supply-limited stream and appeared to adjust somewhat to a lower sediment load within a few decades by cutting into the bed of the stream (degradation). Limited photos from early in the 20th century and the first complete set of aerial photographs in 1939 indicate the river transformed from a relatively wide channel with frequent braids into a meandering single-thread channel through most of the alluvial section. By the middle 1960's, the river appeared to be stable with a dense fringe of riparian vegetation along both streambanks. The transition to a single-thread channel was probably accelerated by gravel

mining, agricultural development, residential development, and routine removal of vegetation and gravel bars from the active channel. This transition was also made possible by a lack of large floods after 1911.

41. However, the alluvial portion can transition abruptly between a meandering single-thread channel, which is frequently associated with stability, and a braided channel, which is frequently associated with instability. This power was clearly demonstrated in portions of the alluvial reach that were relatively wide and unconstrained by bank hardening during episodes of erosion between 1978 and 1983 and more recently between 1995 and 1998.

42. Testimony at the SWRCB hearings in preparation of SWRCB ORDER WR 95-10 chronicled the impacts to streambank stability from increased diversions beginning in the 1960's. At that time, the focus was on the detrimental effects of diversions on the health of vegetation, which in turn stabilized streambanks during winter high flows.

43. In this unbalanced system, the presence of vigorous streamside vegetation was shown to be a critical factor influencing whether reaches of the river remain relatively stable during winter flows or become unstable. Where streamside vegetation is present and in healthy condition, this vegetation limits erosion and eroded streambanks tend to recover naturally as vegetation re-sprouts or new vegetation takes hold along the streambank. Where vegetation is non-existent or in poor condition as a result of human impacts, sustained flows cause episodes of erosion (i.e., extensive and continuous bank erosion) that have resulted in temporarily changing the river into a highly unstable, braided system of channels with poor quality conditions for aquatic and land-based species.

44. Streamside vegetation depends directly on access to adequate levels of surface and groundwater to become established and to maintain its health and vigor. Diversions along the river during the low flow season reduce the amount of water available to sustain healthy streamside vegetation and can result in reduced vigor and/or mortality and loss of diversity of streamside vegetation.

Q8: PLEASE DESCRIBE THE POTENTIAL FOR DIVERSIONS FROM THE CARMEL VALLEY AQUIFER TO AFFECT THE VOLUME OF WATER IN THE CARMEL RIVER LAGOON

45. The Carmel River State Beach lies at the mouth of the Carmel River and forms a barrier beach that creates a shallow lagoon before the river enters the ocean. The Carmel River Lagoon provides important habitat for feeding, rearing, and acclimatization of steelhead migrating to and from the ocean. California red-legged frogs have also been found in fringe areas of the lagoon. The lagoon and State Beach is currently managed on a cooperative basis by the Lagoon Technical Advisory Committee (TAC), which is comprised of State Parks and Recreation staff responsible for managing the lagoon and State Beach, plus water resource engineers, environmental scientists and other technical staff from those local, state and federal agencies with functional responsibilities related to the Beach and Lagoon. In 2007, the TAC concluded that an insufficient body of technical knowledge exists regarding the complex physical interaction of the Beach and Lagoon, and its effect both on Beach stability and the threatened fish and other species that use the Lagoon as habitat. The TAC developed an outline for studies to complete a Long Term Adaptive Management Plan (Carmel River Technical Advisory Committee, 2007). The studies include addressing environmental degradation due to mechanical breaching, upstream diversions, and sediment starvation. However, funds to complete the plan and implement solutions have not been identified. MPWMD is currently facilitating meetings of this group.

46. Normally, the volume of the lagoon fluctuates significantly throughout the year and when the river flows freely to the ocean, water levels in the lagoon frequently fluctuate diurnally in response to tidal action. Lagoon volume ranges from a little more than 10 acre-feet (AF) at an elevation of about three (NGVD 1929) to nearly 400 AF at elevation 10 (see Exhibit LH-13). Aquatic habitat area ranges from as little as five acres at the lowest stage to more than 100 acres at elevation 10. Changes in water level are a function of surface and groundwater

inflows, ocean swell and tidal influence, and the configuration of the beach. In general, inflows of up to about 10 cubic feet per second (cfs) are associated with a closed lagoon. Between about 10 cfs and 200 cfs – flows that are normally associated with winter and spring – the lagoon is open intermittently to the ocean. At flows above 200 cfs, the lagoon remains open to the ocean 100% of the time. Based on openings and closings between 1993 and 2005, the average number of days between opening and final closure is 172 – a majority of which were in the winter and spring. During 10 of the last 17 water years, there was flow to the ocean throughout most of the winter and much of the spring (see WY 93, 95, 96, 98, 99, 00, 02, 04, 05, and 06).

47. It is estimated by MPWMD that a maximum of about eight (8) cfs can pass through the barrier beach. Thus, when the lagoon is closed and inflow is less than 8 cfs, the lagoon level generally drops. Inflow to the lagoon, except in the wettest years, typically drops below 8 cfs by the beginning of July. The volume of the lagoon at the time of final closure can range from about 75 acre-feet (AF) up to about 250 AF. Initially, up to about 16 acre-feet per day (AF/day) flow out through the beach after final closure and the lagoon slowly drops as water flows out through the sand berm at a higher rate than surface and groundwater flows into the lagoon. The lagoon typically reaches a low point of between elevation 2.5 and three within six to 12 weeks after closure. The time to reach the lowest level depends both on the water level at final closure and the nature of the spring/summer recession of the river. Based on a preliminary analysis of lagoon elevations after river flow drops to zero at Highway 1, it appears that from two to four AF/day flow out of the lagoon at elevation 5, although as much as six AF/day appeared to flow out in some years in the 1990's. The lagoon appears to stabilize at no lower than about elevation 2.5 in the dry season. However, the reasons for stabilizing at this elevation are not well understood, but may be related to tidal influence (note that the lagoon elevation drops to 1.5 feet in the winter).

48. In 2006, 2007, and 2008, the California State Department of Parks took action to close the lagoon to outflow prior to cessation of river inflow. This resulted in starting the dry

season at a relatively high lagoon water level, which resulted in improved water quality conditions at the end of the dry season in 2006 and 2007. As lagoon stage drops through the summer, water temperatures tend to increase and can exceed what is considered an optimum range for steelhead (50-60°F).

49. In early fall, ocean activity typically increases and waves can overtop the beach, bringing with them large volumes of organic material and salt water into the lagoon. If there is no freshwater inflow, wave overtopping can have significant effects on water quality (e.g., increased salinity). Often, there is no freshwater surface flow to the lagoon for many months until well after the beginning of the rainy season, normally in October, and after the Carmel Valley Aquifer is fully recharged by runoff. Exhibit LH-15 shows data from 1991 to 2008 concerning lagoon openings, aquifer depletion, and antecedent rainfall at the time of opening. These data confirm what is intuitive – that the lagoon opens much later when the aquifer is significantly depleted (e.g., in 1991 and 1992) and much sooner when the aquifer is nearly full on October 1 (e.g., 1999). However, there is a wide variation in the time to opening when the aquifer is partially depleted, despite years with similar amounts of antecedent rainfall. This can be explained in part by rainfall patterns and runoff in the fall and early winter. If antecedent rainfall is spread out over several small storms, which is typical in the fall, runoff to the river can be quite minimal. Whereas, a significant volume of runoff is generated if antecedent rainfall comes in one or two large events.

50. The lack of a clear connection between aquifer depletion and time to opening may also indicate a considerable carryover of base flow in wet years and that dry years can significantly affect outflow from the watershed in subsequent years, even after the Carmel Valley Aquifer fills. For example, in 1996 the lagoon opened 73 days after October 1 with only 3.26 inches of antecedent rainfall. The preceding water year (WY 1995) was extremely wet and the aquifer remained nearly full. Whereas, in 1992 the lagoon opened 133 days after October 1, despite an antecedent rainfall amount of 12.28 inches. This was preceded by a drought between

1987 and 1991 during which the aquifer was drawn down heavily. Therefore, there may be cumulative effects on lagoon openings from CAW diversions.

51. When the lagoon elevation fills above about an elevation of 10.7, local residences can experience flooding. Monterey County typically responds to this by breaching the barrier beach to allow outflow before residential flooding occurs. This action is normally taken when river flows fill the lagoon and threaten to flood nearby residential property. However, on two occasions (2001 and 2008), ocean activity was so intense that no action could be taken to prevent flooding. The difference between creating a breach to prevent a flood from the river and using the same technique to prevent a flood from the ocean is that sustained river inflow can maintain a breach through the barrier beach for outflow. Whereas, if the lagoon is filled from the ocean and there is no inflow from the river, wave activity is likely to quickly fill in a mechanical breach created by bulldozers.

52. The most significant effects on lagoon volume from diversions in Carmel Valley likely occur during the low flow season after ocean waves push sand across the mouth of the river and block outflow. Diversions upstream of the Lagoon that reduce surface and groundwater inflow may affect water quantity and quality after the lagoon closes. However, when the lagoon closes in spring, changes in diversions may not correlate directly with changes to lagoon inflow. During the spring, inflows can be significantly affected by temperature, flow from bank storage, and small amounts of rainfall that cause relatively significant increases in runoff.

53. Diversions may affect lagoon volume and water quality more during the summer and early fall and may affect the timing of lagoon opening in late fall/early winter. It has been shown that closing the barrier beach in the spring and creating a large volume of fresh water before the dry season can temporarily mitigate effects on water quality. However, because the lagoon stage normally drops to a very low level prior to re-opening, the Lagoon TAC has set a

long-term management goal of finding additional sources of freshwater to maintain lagoon volume throughout the summer and fall.

Q9: WHAT STEPS HAS MPWMD TAKEN TO INTEGRATE MANAGEMENT OF WATER RESOURCES IN THE REGION COMPRISED OF THE CARMEL RIVER WATERSHED, SEASIDE GROUNDWATER BASIN, AND MONTEREY PENINSULA CITIES?

54. In 2005, MPWMD defined a geographic planning area, or Region, and began developing an Integrated Regional Water Management Plan (IRWMP) that encompasses the groundwater basins and watersheds of the Monterey Peninsula, Carmel Bay and South Monterey Bay. The Region includes the six Monterey Peninsula Cities, portions of the unincorporated area of Monterey County in the Carmel Highlands, Pebble Beach, and the inland areas of Carmel Valley and the Laguna Seca area. Nearly 40 stakeholders were identified and invited to participate in the development of an IRWMP. The IRWMP provides a framework for agencies, non-profit groups, for-profit corporations and other stakeholders with missions and responsibilities to work together on common water management strategies, objectives, goals and projects. As such, the IRWMP takes into consideration the many plans and policies currently being implemented for water resource management, analyzes how these are interrelated and shows how projects and programs can have multiple benefits when grouped together. However, the IRWMP does not bind any agency or group to carry out particular actions, policies, or projects. As currently drafted, the plan includes these five Regional priorities:

- meet current replacement supply and future demand targets for water supply and support the Seaside Groundwater Basin Watermaster to implement the physical solution in the Basin
- reduce the potential for flooding in Carmel Valley and at the Carmel River Lagoon
- mitigate effects of storm water runoff throughout the planning Region
- address storm water discharges into Areas of Special Biological Significance

- promote the steelhead run

The plan proposes 11 projects to meet these priorities and, if implemented as proposed, could help in addressing several of the Region's priorities. MPWMD adopted the plan in November 2007 and is working with other agencies with similar plans in the Central Coast hydrologic unit to identify means to fund projects through the State IRWM grant program.

Q9: WHAT ACTIVITIES CAN MITIGATE THE EFFECTS OF CAW DIVERSIONS ON RIPARIAN VEGETATION, CHANNEL STABILITY, AND AT THE CARMEL RIVER LAGOON?

55. Please see Exhibit MPWMD-LH20.

I, Larry M. Hampson, declare under penalty of perjury that I have read the foregoing "Testimony of Larry M. Hampson" and know its contents. The matters stated in it are true of my knowledge except as to those matters which are stated on information and belief, and as to those matters I believe them to be true.

Executed on July 3, 2008, at Monterey, California.

MONTEREY PENINSULA WATER
MANAGEMENT DISTRICT

Larry Hampson

By: Larry Hampson
Water Resources Engineer

5 Harris Court, Building G
Monterey, CA 93940
Telephone: (831) 659-2543
Facsimile: (831) 659-2598
Email: larry@mpwmd.dst.ca.us

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