EXHIBIT WDCWA-200

Testimony of Dr. Charles H. Hanson
Before the State Water Resources Control Board
Water Right Applications 30358A and 30358B

1. My name is Charles H. Hanson. I am a principal in the firm of Hanson Environmental, Inc., located at 132 Cottage Lane, Walnut Creek, California. My academic training includes Bachelor of Science and Master of Science degrees in fisheries from the University of Washington, College of Fisheries, graduate studies in environmental engineering at the Johns Hopkins University and a Ph.D. in fisheries and ecology from the University of California, Davis.

2. I have been involved in issues related to the status of fish species in the Sacramento-San Joaquin Delta since 1976. These issues have included state and federal endangered species act studies regarding fisheries populations, including the biological monitoring of listed fish species, preparation of biological assessments, preparation of habitat conservation plans and service as a member of the United States Fish and Wildlife Service's (USFWS) Sacramento-San Joaquin Delta Native Fisheries Recovery Planning Team and the National Marine Fisheries (NMFS) Service's Central Valley Salmonid Technical Recovery Team. I served as a member of the National Scientific Peer Review Panel for Stanislaus River Water Temperature Criteria for Salmonid Restoration.

3. I also served as an expert witness on fishery issues on the American River in the case of *Environmental Defense Fund v. East Bay Municipal Utility District,* Alameda County Superior Court No. 425955 and in numerous water right hearings before the State Water Resources Control Board (SWRCB). I also served as an expert witness on fishery issues in the delta smelt federal court proceeding (*NRDC et al. v. Kempthorne*) regarding the SWP and CVP OCAP biological opinion and interim remedies. I currently serve on the consultant team assisting in developing conservation strategies for water project operations and fishery habitat protection and enhancement within the Sacramento-San Joaquin Delta as part of the Bay Delta Conservation Plan (BDCP). I also served on the independent scientific peer review panel for the USBR 2008 OCAP biological assessment. A statement of my qualifications is Exhibit WDCWA-201.

4. The proposed Davis-Woodland Water Supply Project (DWWSP) will involve the construction and operation of a new diversion facility on the Sacramento River that will be shared by the DWWSP and Reclamation District 2035. The average monthly diversion rate for the DWWSP will not exceed 80.3 cfs, and diversions under the permits issued on Applications 30358A and 30358B will be operated in accordance with the SWRCB's Standard Permit Term 91. Term 91 prohibits surface water diversions when water is being released from CVP and SWP storage reservoirs to meet downstream, in-basin or Delta water right or water quality requirements. During times when Term 91 prohibits diversions under the DWWSP's water-right permits, the DWWSP may divert water pursuant to water transfers from senior upstream water right holders.

5. The DWWSP diversion structure, which will be either a flat plate screen or cylindrical screen, will be equipped with a state-of-the-art positive barrier fish screen. The fish screen will be designed to achieve a maximum approach velocity of 0.33 ft/sec in accordance with the intake design criteria established by the National Marine Fisheries Service (NMFS), California Department of Fish and Game (CDFG), and U.S. Fish and Wildlife Service (USFWS) for an intake located in an area where salmonid fry may be present but which is outside the geographic distribution of delta smelt. The intake will be located at RM 70.5 on the mainstem Sacramento River just upstream of the I-5 overcrossing in Yolo County (see Exhibit WDCWA-202). This reach of the Sacramento River serves as a migration and juvenile rearing habitat for Chinook salmon, steelhead, sturgeon, and other resident and migratory fish. The proposed intake location is upstream of the northern boundary of delta smelt distribution, which is typically identified as the I Street Bridge in downtown Sacramento, although delta smelt have occasionally been reported in low abundances at sampling stations located upstream of the I Street Bridge.

6. RD 2035 currently operates an unscreened diversion, located on the Sacramento River immediately adjacent to the proposed project. The close proximity of the two projects offers the potential opportunity to consolidate the diversions and remove an unscreened diversion from the river which would be replaced with a consolidated diversion equipped with state-of-the-art positive barrier fish screens. Juvenile winter-run, spring-run, fall-run, and late fall-run Chinook salmon, Central Valley steelhead, green sturgeon, and a variety of other fish that inhabit the Sacramento River and its tributaries are potentially vulnerable to entrainment into the existing unscreened diversion. Consolidating the existing unscreened diversion into the proposed project is dependant, in part, on the availability of funding for the proposed consolidated diversion structure. If funding is available, the consolidation of the existing unscreened diversion in combination with the proposed project offers the opportunity to reduce the risk of fish entrainment and reduce the mortality of fish inhabiting and migrating within the Sacramento River.

7. The new intake structure will be oriented parallel to the river flow along the channel margin (see Exhibit WDCWA-203). This intake configuration (referred to as “on-bank”) offers the advantage of minimizing the intake footprint and the area of aquatic habitat lost as a result of construction and long-term operation of the intake. The on-bank configuration also will reduce the effects of the intake structure on water current patterns and turbulence in the river and improves the performance of the intake screen by increasing the sweeping velocity across the screen surface. By having the intake structure parallel to the channel shoreline, the occurrence of physical structures in the river that attract predatory fish and increase the vulnerability of juvenile fish to increased predation mortality will be reduced.

8. The Sacramento River in the vicinity of the proposed intake structure serves as habitat for a variety of fish and other aquatic species. The primary fish species in the typical fish assemblage in the area are listed in Exhibit WDCWA-204. Photographs of juvenile Chinook salmon steelhead, splittail, and striped bass, some of the typical fish species that occur in the project area, are in Exhibit WDCWA-205.

9. The proposed point of diversion is located upstream of the estuarine habitats (area where freshwater and saltwater mix) within the Delta (see Exhibit WDCWA-206). The Delta is a complex network of interconnected channels and sloughs where hydrodynamic and water quality conditions are strongly influenced by tidal action for the coastal marine waters. The Delta is an important aquatic habitat that supports of 50 fish species, phytoplankton and aquatic marsh/wetland communities, zooplankton and macroinvertebrates, a wide variety of resident and migratory fish, birds, and other wildlife. Many of the species that currently inhabit the Delta were accidently or intentionally introduced (exotic or non-native species) from other areas of the world. Delta smelt and longfin smelt are two of the native pelagic species that inhabit the Delta.

10. In recent years there has been a general overall decline in the abundance of fish and other organisms within the Delta that has been referred to as the Pelagic Organism Decline (POD). A number of potential factors affecting aquatic species in the Delta have been identified. These factors include changes in hydrologic conditions and flow patterns, reductions in seasonal and annual flows through the Delta, exposure to toxics including the contributions of municipal wastewater discharges and agricultural return flows, changes in land use including levee construction, channel dredging, reclamation of tidal wetlands, predation, and non-native species. Of these factors, the DWWSP has the potential to affect river and inflows to the Delta and thereby habitat conditions for aquatic species in areas downstream of the proposed point of diversion.

11. The proposed project may, depending on hydrologic conditions in the Sacramento River, divert water during any month of the year. The average monthly diversion volumes (recognizing there is substantial variation among months and water years) that are estimated to occur under the DWWSP water-right permits under both current and future conditions, as reflected in 82 years of CALSIM hydrodynamic simulation modeling, are listed in Exhibit WDCWA-207.

12. My assessment of effects of the DWWSP on fishery resources is based on information regarding the habitat characterizations for aquatic species, the species of fish and their lifestages expected to occur in the area, the timing within the year of when various species and lifestages of fish are potentially present (see Exhibit WDCWA-208), the characteristics of the DWWSP intake (e.g., approach velocity, screen mesh size), and the seasonal distribution of DWWSP water diversions.

13. Based on these considerations, I identified and analyzed three potential mechanisms for impacts to fishery resources as part of my evaluation of the potential effects of the DWWSP. These three areas of potential fishery impacts are: (a) construction impacts related to site preparation and construction of the intake structure and the positive barrier fish screen, (b) operations of the diversion and the potential to entrain or impinge fish on the fish screen, and (c) effects of DWWSP diversions of water from the Sacramento River on habitat conditions downstream in the Sacramento River and Delta. Each of these areas is briefly discussed below.

14. Construction of the DWWSP on-bank intake structure and fish screen on the Sacramento River is expected to require the installation of a temporary sheetpile cofferdam around the work area that can then be dewatered to facilitate intake construction. In addition, local excavation and dredging may be required as part of site preparation for the intake foundation. Site disturbance may lead to increased erosion or sediment discharge into the river, and there is some risk of accidental spills of various chemicals that will be used on-site as part of the intake construction. Each of these potential impacts was evaluated in the environmental impact report (EIR) for the DWWSP. Copies of the cover page and pages 3.6-15 through 3.6-27 and 3.6-46 through 3.6-54 are included in Exhibit WDCWA-209.

15. A suite of mitigation measures has been developed for the DWWSP based on experience in constructing similar on-bank intake structures and fish screens on the Sacramento River and in Delta (e.g., RD 108 Wilkins Slough intake, RD 108 Poundstone intake, Sutter-Mutual Tisdale intake, CCWD Alternative Intake Project (AIP), and others). These mitigation measures, in the form of Best Management Practices (BMPs) are specified in the draft and final EIR for the DWWSP and in protest-dismissal agreement that the applicants signed with the CDFG (Exh. WDCWA-210), and have been incorporated into the proposed project to reduce and avoid potential adverse construction-related impacts to fish, water quality, and aquatic habitat. As a result of implementing these BMPs into the proposed project design, the potential for adverse impacts from site preparation and construction was determined to be less than significant (see Exh. WDCWA-209, pp. 3.6-46 to 3.6-52).

16. Operation of the proposed water intake has the potential to cause entrainment or impingement of fish. Entrainment occurs where small fish are drawn into an intake and pass through the fish screen. Impingement occurs when larger fish are drawn into an intake but are physically excluded from passing through the fish screen and are held against the fish screen by the hydraulic pressure created by the diversion. CDFG, NMFS, and USFWS have developed intake screen design criteria that specifically reduce and avoid these adverse effects. The DWWSP fish screen and intake will be designed and operated in accordance with these criteria (e.g., maximum allowable approach velocity, screen mesh size, screen cleaning, etc.). An intake structure and fish screen that meet these criteria are expected to be very effective (95% or greater) in avoiding adverse effects of entrainment and impingement of larger fish (greater than approximately 15 mm in length).

17. Based on the analysis of the potential environmental effects of the DWWSP, it was concluded that the fish screen will be effective in avoiding adverse effects to the juvenile and adult lifestages of fish such as Chinook salmon, steelhead, sturgeon, and all other fish inhabiting the Sacramento River. The planktonic (free floating) eggs and larvae (less than approximately 15 mm in length) will be vulnerable to being entrained through the fish screen mesh. These fish eggs and larvae could include, but are not limited to, species such as striped bass and American shad during the seasonal period in which spawning occurs by these species upstream in the river. (See Exh. WDCWA-209, pp. 3.6-15 to 3.6-27.)

18. None of the fish species that have been listed for protection under the Federal or California Endangered Species Acts will be vulnerable to entrainment at the diversions, either because of their size when they occur in the area (e.g., salmon fry and smolts, juvenile sturgeon, etc) or because of their geographic distribution further downstream in the Delta (e.g., delta and longfin smelt). The relatively low rate of diversions by the DWWSP, when compared to flow rates in the Sacramento River, especially during the spring when most fish spawn and early larval stages are present, will reduce the risk of adverse fishery impacts as a result of diversions. (See Exh. WDCWA-209, pp. 3.6-52 to 3.6-54.)

19. In addition, the on-bank intake structure will be designed to avoid and reduce potential holding areas for predatory fish and turbulence and other conditions that would increase the vulnerability of juvenile fish to increased predation risk. The on-bank intake configuration (see Exhibit WDCWA-203) also will reduce and avoid structures in the river that would serve to block or impede the upstream and downstream migration of adult and juvenile fish. Based on these factors, it was concluded that, although there is a risk of entrainment of fish eggs, larvae and smaller invertebrates, the impacts of the proposed DWWSP diversion operations on fishery resources and habitat in the Sacramento River will be less than significant. (See Exh. WDCWA-209, pp. 3.6-52 to 3.6-54.)

20. The positive barrier fish screen will undergo a performance evaluation and monitoring to document and verify that the fish screen is operating in accordance with the 0.33 ft/sec approach velocity criteria and that the velocity distribution across the screen surface is relatively uniform (see Exh. WDCWA-210, pp. 27-31, App. C). Results of this performance monitoring program will be used to fine-turn the intake screen (e.g., adjust internal baffles) to achieve suitable hydraulic screen performance. In addition, long-term procedures and protocols will be established to ensure proper inspection, repairs, and maintenance of the intake and fish screen to ensure that the facility is operating in accordance with the standard design and performance criteria.

21. The diversion of water from the Sacramento River for the DWWSP will contribute to changes in river flows and Delta inflows. The magnitude of changes in Sacramento River flows, for example at Freeport, can be used as an indicator of the potential effects of the DWWSP on fishery resources and their habitats in the lower Sacramento River and Delta. Results of CALSIM hydrologic simulation modeling over an 82 year period of hydrologic conditions were used to assess the potential effects of the proposed project operations of fishery habitat. The modeling that was conducted for the DWWSP EIR was based on the latest version of the CALSIM II model that was available at that time. For this hearing, MBK Engineers has updated that modeling work using the latest version of the CALSIM II model that currently is available. Both of these sets of modeling work compared, for each month of the 82 year period, the estimated Sacramento River flows at Freeport under existing conditions (including consideration of D-1641 and the current USFWS and NMFS biological opinions) with and without the proposed project operations as well as similar comparative analyses for anticipated future conditions. The

conclusions in the following paragraphs are based on MBK Engineers' recent modeling work.

22. Results of the comparisons show that, on average, the proposed project will change Sacramento River flows at Freeport under existing conditions by amount varying from an increase of 19 cfs (September) to a reduction of 80 cfs (October), with the majority of the changes being reductions in the range of approximately 25 to 60 cfs. Results of the analysis for anticipated future conditions were similar, with average overall flow reductions at Freeport ranging from 1 cfs (July) to 68 cfs (May), and with typical reductions in flows within the range from approximately 25 to 70 cfs. The monthly variations were substantially greater under both current and future conditions for individual months and water year types (see Exh. WDCWA-211).

23. Expressing the simulated changes in Sacramento River flows at Freeport with the proposed project as percentages of river flows without the proposed project shows the relative magnitude of average changes in instream flows that are expected. Results of these analyses are summarized in Exhibit WDCWA-212 for both current and future conditions. Results of these analyses show that the magnitude of changes in the Sacramento River flows is consistently less than 1%, with the majority of changes being within the range from -0.1% to -0.2 % under both current and future conditions.

24. Results of MBK hydrologic modeling of the estimated effects of the proposed project diversions on Delta outflow under existing conditions (see Exh. WDCWA 213) and cumulative future conditions (see Exh. WDCWA 214) show, that on average, there are small reductions (35 cfs of less) in flow within the Delta. Analysis of the estimated Delta outflows, each month, were developed using the hydrologic simulation modeling for existing and cumulative future conditions over the 82 year period of hydrologic simulation. Results of the analysis, summarized for all water years, showed that reduction in Delta outflow were 0.3% or less in all months (see Exh. WDCWA 215). The biological significance of reductions in Delta outflow within the range identified in the hydrologic simulation analyses are not expected to be detectable in terms of changes in either estuarine habitat conditions or relationships between fish species abundance indices and Delta outflow.

25. The biological responses, such as changes in habitat quality and availability, migration rates, juvenile survival, larval transport, etc., to these very small changes in river flows will be so small that they will not be detectable. Further, the relative magnitude and potential effects on fishery resources as a result of upstream diversions by the DWWSP proposed project will be diminished as flows pass further downstream and enter the Delta, where additional tributary inflows and tidal hydrodynamics will affect habitat conditions for estuarine fish and other aquatic resources. Based on results of these analyses, it was concluded that the DWWSP will result in only small incremental reductions in Sacramento River flows, and that the biological impacts on fishery resources in the Sacramento River and Delta from these changes were found to be less than significant.

26. In summary, my fishery analysis for the DWWSP project reached the following conclusions:

- Construction of the on-bank intake structure and fish screen will result in localized temporary disturbances, some risk of fish stranding during cofferdam dewatering, and some risk of exposure to increased sediments and potential accidental spills of hazardous materials. Implementation of site-specific BMPs for the DWWSP and as part of permit requirements will reduce and avoid the potential for adverse impacts to fishery resources and their habitat to less than significant levels.

- The DWWSP intake structure will be equipped with a state-of-the-art positive barrier fish screen designed and operated in accordance with CDFG, NMFS, and USFWS criteria. The fish screen is expected to be extremely effective (95% or greater effectiveness) in avoiding entrainment and impingement of fish present in the Sacramento River in the vicinity of the diversion facility. Fish eggs and larvae less than approximately 15 mm in length will be vulnerable to entrainment into the diversion. No ESA listed fish species are expected to be vulnerable to entrainment losses because of their sizes when they are in the area and their geographic distributions relative to the intake location. The fish screen will be designed to reduce and avoid structures that would attract predatory fish and the screen and intake structure will not impede or block the upstream of downstream migration of fish within the Sacramento River.

- Operation of the DWWSP diversions will slightly reduce Sacramento River flows downstream of the diversion. The flow reductions, as estimated at Freeport, will be small (average reductions of 0.1% to 0.2 % in most months) and are not expected to result in any adverse biological impacts like reduced juvenile Chinook salmon migration rates or survival that would be large enough to be detectable. Operation of the DWWSP diversions will also slightly reduce Delta outflows. The Delta outflow reductions will be small (average reductions of 0.1% to 0.3 % in most months) and are not expected to result in any adverse biological impacts like reduced juvenile Chinook salmon migration rates or survival that would be large enough to be detectable. The relative influence of the DWWSP diversions on flows further downstream in the Delta will be progressively less. The magnitude of the expected changes in river flows and Delta outflows and associated fishery habitat quality and availability will be less than significant.