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CITY OF BAKERSFIELD

STATE WATER RESOURCES CONTROL BOARD

OF THE STATE OF CALIFORNIA

In the Matter of State Water Resources Control Board Hearing on Petitions to Revise the Declaration of Fully Appropriated Stream System of the Kern River in Kern and Tulare Counties	**DIRECT TESTIMONY OF KENNETH SCHWARZ PH.D IN SUPPORT OF PETITION OF CITY OF BAKERSFIELD**

Date: October 26, 2009
Time: 9:00 a.m.
Dept: 1001 I Street, Second Floor,
Sierra Hearing Room
CAL-EPA Building
Sacramento, CA

Hearing Officer: Arthur Baggett, Jr.

I, Kenneth Schwartz, Ph.D, declare and state as follows:

I. PERSONAL BACKGROUND, EDUCATION AND EXPERIENCE

1. I am a founding Principal at Horizon Water and Environment. My technical expertise is in the fields of geomorphology, hydrology, and watershed management. For over 16 years, I have directed complex projects throughout California involving erosion and sedimentation, flood and stormwater management, land use planning, habitat conservation, and ecosystem restoration. I have conducted hydrologic and geomorphic analyses and produces watershed and stream management plans, hydrologic reports, stream assessments, sediment and erosion control evaluations, restoration designs, conservation plans, and CEQA documents. I specialize in using my technical background to develop successful permit applications for the USACE, RWQCBs, CDFG, USFWS, and NMFS, as well as local county and municipal approvals. My watershed and stream projects typically balance the needs and requirements of local government planners, regulatory agencies, and watershed stakeholders, while maintaining focus to project costs and schedules.

2. Prior to founding Horizon, I was a Principal and Project Director at Jones & Stokes Associates where I managed large watershed, water resource, and environmental compliance projects. Previously, I was a Director at Philip Williams & Associates focusing on Southern California hydrology and restoration projects working under the guidance of Jeffrey Haltiner Ph.D., P.E. In 1999, I completed his Ph.D. at UCLA in geomorphology, under the supervision of Dr. Antony Orme. My Master's and Ph.D. research focused on watershed hydrology and sediment transport and delivery in watershed, stream, and estuarine systems. I have participated in several scientific and environmental management committees, including the Southern California Wetlands Recovery Program's Science Advisory Panel. I have led award-winning projects for the City of Chula Vista, Napa County, and Sonoma County. I have also taught courses in hydrology, geomorphology, watershed planning, riparian processes, physical geography, and ecosystem restoration for the University of San Francisco, UC Davis Extension, US Army Corps of Engineers, Lorman Educational Services, and UCLA. I have authored numerous articles and presented at several conferences. A more detailed description of my background, experience and education accompanies this testimony as Exhibit 3-2.

II. PURPOSE OF TESTIMONY

3. In support of the City of Bakersfield's petition, the purpose of this testimony is to briefly describe:

(a) The hydrologic context for river and streamflow conditions in the lower Kern River under the allocation conditions prior to the 2007 judgment;

(b) Conditions in the Kern Groundwater Basin and the relation between flows in the Kern River and groundwater at the time of the 2007 forfeiture judgment;

(c) The generalized or average flow conditions for the forfeited or surplus flows as described in the 2007 forfeiture judgment;

(d) Statewide directives or guidance on the importance of instream flows, based on the understanding that the forfeited, surplus water on the Kern River does not belong to any entity at this time, and would remain in the river pending the State Water Resources Control Board's ("SWRCB") determination of rights and claims to such water;

(e) Beneficial functions and values of enabling forfeited discharge to remain in the Kern River as streamflow; and

(f) The City of Bakersfield's approaches toward sound management of their water resources including conservation and reuse programs in connection with the forfeited water.

4. I provide this testimony to describe the environmental setting in and around the Kern River, and the hydrologic conditions in the river both before and after the forfeiture judgment, in order to describe the "changed conditions" on the Kern River that require revision of the fully appropriated status of the river.

5. Through this testimony I also describe the frequency, nature, extent and impact of the "new water" in the Kern River which results from the recent forfeiture judgment.

A. Hydrologic Context and Environmental Setting-Physical and Streamflow Conditions of the Lower Kern River.

6. **Physical Setting:** The upper Kern River Watershed is a large catchment basin that drains the southern Sierra Nevada. The upper watershed is 2,074 square miles in area measured to

Lake Isabella and 2,407 square miles in area measured to the First Point of Measurement location (Exhibit 3-3). The upper watershed drains the Sierra Nevada crest areas including Mt Whitney (el. 14,495) and collects runoff southward and westward through the main arm Kern River and the South Fork Kern River. These two main tributaries join at Lake Isabella where flows are managed for flood control and water supply purposes. Discharge from Lake Isabella flows southwestward descending the steep Kern River Canyon. At the canyon mouth, the Kern River emerges onto the alluvial fan east of Bakersfield. The river then flows through central Bakersfield, and continues west-southwesterly to its terminus at Buena Vista Lake.

7. **Hydrologic Setting:** Upper watershed precipitation (including snowmelt runoff) is the principal source for surface runoff and streamflow (discharge) for the lower Kern River. Annual precipitation amounts in the watershed vary, and generally increase, with elevation. The long term annual precipitation average at Bakersfield (el. 494 ft.) is 6.49 inches; at Lake Isabella (el. 2660 ft.) is 11.33 inches; and Glennville (el. 3140 ft.) is 18.42 inches (Kern River Annual Report, 2008). Similar to much of southern California, seasonal and annual precipitation patterns and amounts are highly variable in the Kern River Watershed. Exhibit 3-4 shows monthly and annual precipitation data for the Isabella Dam weather station between 1949 and 2008. Maximum annual precipitation (22.34 in.) occurred in 1982-83 (a strong El Nino season which generated above average precipitation throughout California). Minimum annual precipitation (3.80 in.) occurred in 1958-59.

8. **Important Role of Snowpack:** At higher watershed elevations snowpack (and its equivalent water content) constitute the principle runoff source. Exhibit 3-5 provides long-term average April 1st snowpack depths (in terms of water content equivalents) for snow sensor stations in the upper Kern River Watershed. Melting snowpack historically augmented streamflow to the lower Kern River in the late spring and early summer months, typically generating the annual peak streamflows during that season.

9. **Flow Regime and Historic Channel System:** Based on the watershed physical setting, hydrologic setting, and high annual variability in climatic, precipitation, and snowpack conditions as described above – the resulting natural flow conditions in the lower Kern River were historically, also highly variable. Exhibit 3-6 shows a map of a portion of Kern County from 1877,

highlighting the historic channels of the lower Kern River system as it passed south and west of Bakersfield. Historically, the lower Kern River was an active alluvial fan with a complex network of distributary channels. Note - this active alluvial fan system existed prior to flood management efforts on the lower Kern River which realigned the channel and placed levees and other flood control works on the river, as well as, flood management through discharge control at Lake Isabella. Over time, these channels migrated across the fan surface, with some channels becoming more dominant while other channels carried smaller flows. Depending on flow conditions and the timing and amount of water in a given year (or recent years) flows variably reached the outer fan areas or terminated in the Buena Vista or Kern Lake systems. The Goose Lake Slough and Kern River Flood Channel (as shown on Exhibit 3-6) provided a conduit to Tulare Lake under certain conditions.

10. **Kern River is an Interior Draining System:** The Kern River is an interior and terminal draining system whereby flows do not join other downstream systems to reach the coast.

11. **Kern River is an Influent Stream:** The lower Kern River is an influent stream whereby flows have a high rate of infiltration into the alluvial sand and gravel dominated streambed. Influent streams such as the Kern River typically lose discharge as they travel downstream through infiltration into their alluvial streambeds. Most southern California rivers that drain across alluvial fans are influent streams.

12. **Historic Average Flow Conditions:** Exhibit 3-7 provides a summary of average monthly flow volumes (in acre-feet) for the Kern River at the First Point of Measurement from 1893 through 2008. Mean monthly flows (measured in cubic feet/sec per day) range from a low of 282 cubic feet/sec per day (or "second foot days") in October to a high of 2,548 cubic feet/sec per day in May.

13. Kern County agricultural and urban development from the later 19th century onward resulted in developing a complex system of water rights, withdrawal allocations, and a resulting canal system through the Bakersfield area. The detailed accounting of Kern River flows and diversions has been kept since the historic Miller-Haggin Agreement (1900).

14. Exhibit 3-8 shows the lower Kern River and main canals in the Bakersfield Area. Exhibit 3-9 provides flow volume information for the 2008 calendar year for the lower Kern River

for the principal locations shown in Exhibit 3-8. In 2008, the total annual discharge at the First Point of Measurement (upstream of any Bakersfield metro area canal diversions) was 455,874 acre feet (ac-ft). As shown in Exhibit 3-9, diversions to the various downstream canals results in the reduction of flows remaining in the mainstem lower Kern River channel. Diversions to the Beardsley Canal (141,696 ac-ft) and Kern Island Canal (147,668 ac-ft) represented 31.1% and 32.4% of the total flow volume, respectively, that passed through First Point in 2008.

15. **Longitudinal Profile and Flow (Historic Conditions):** Exhibit 3-10 provides a schematic longitudinal profile of the lower Kern River through Bakersfield from Manor St. (upstream) to Stockdale Highway (downstream). Exhibit 3-10 represents general flow conditions during the period 1890-1975. This period is prior to the purchase of the Kern County Land Company (KCLC)/Tenneco West water rights by the City of Bakersfield in 1976. This period is also prior to the delivery of State Water Project water to Bakersfield in 1976. Below the longitudinal profile of Exhibit 3-10, charts are provided that describe flow conditions at the different locations along the longitudinal profile for different hydrologic years. Boxes are shaded if the river conveyed flows during the given month and at the given location. Six charts are provided to describe a range of general flow conditions depending upon variable climate and runoff conditions. Charts are provided ranging from very dry and low runoff conditions (25% of normal runoff) to very wet and high runoff conditions (150% of normal runoff). During the historic 1890-1975 period (under average or "100% of normal" runoff conditions) the shaded boxes in the graph indicate that flows occurred at Manor St. from May to August, but did not occur at the other downstream stations. In contrast, during very wet years (when runoff was 150% of normal) during the historic period (1890-1975) flow at Manor St. occurred near year round, and then tapered off moving downstream, such that flow at Stockdale Highway only occurred in June and July. In general, during the historic period (1890-1975), flow diversions created a Kern River channel that was drier than under previous conditions.

16. **Longitudinal Profile and Flow (1976-1988):** Exhibit 3-11 provides a similar schematic to Exhibit 3-10, but characterizes flow conditions during the period (1976-1988) after the City of Bakersfield acquired the KCLC/Tenneco West water rights. During this more recent period,

flows increased in the river channel – in both frequency of flow and in terms of locations along the downstream river profile that experienced flow. For example, under "normal runoff" conditions (1976-1988) flows reach Chester Ave. during the 9 month period April-December, as compared to generally never reaching Chester Ave in the previous historic period, as shown in Exhibit 3-10. Following the City of Bakersfield acquiring the KCLC/Tenneco West water rights, and the delivery of State Water Project water to Bakersfield, the Kern River channel became wetter more often; with more frequent flow in the river, and with flows reaching further downstream along the river.

17. Exhibit 3-12 provides a series of photographs of the lower Kern River to depict general conditions along the river course. Below are brief descriptions for the individual photos shown in the sequence of Exhibit 3-12. All photos were taken on September 30, 2009.

18. Exhibit 3-12-a: Kern River, First Point of Measurement at controlled channel cross section and gaging station. Recorded flow rate of 508 cfs on 9/30/09.

19. Exhibit 3-12-b: Kern River 1.0 – 1.25 mi. downstream of First Point of Measurement. Channel supports riparian corridor along margin, includes a variety of instream geomorphic conditions (bars, swales, back channels, riffles, eddies) and associated habitats.

20. Exhibit 3-12-c: Kern River at entrance to Beardsley Canal. Gates pond river water to facilitate diversion to Beardsley Canal.

21. Exhibit 3-12-d: Kern River at Manor St. looking upstream. River water ponds behind downstream gates at Riverview Park (see photo 3-12-h) creating stagnant flow condition upstream of Manor St. Abundant sun and stagnant flow create good conditions for water primrose (*Ludwigia peploides montevidensis*) an invasive, exotic, aquatic weed which is problematic for its channel choking and sediment trapping qualities.

22. Exhibit 3-12-e: Kern River at Riverview Park looking upstream toward Chester Ave. crossing. River water is ponded behind gates shown in photo 3-12-h.

23. Exhibit 3-12-f: Gate at entrance to Calloway Canal.

24. Exhibit 3-12-g: Diverted flows from Kern River enter Calloway Canal and flow down the canal.

25. Exhibit 3-12-h: Looking south across ponded Kern River at Riverview Park toward main gate on mainstem Kern River (near ground) and gate for Carrier Canal (in distance.

26. Exhibit 3-12-i: Carrier Canal just downstream of Four Weirs diversion station and west of Manor St.

27. Exhibit 3-12-j: Kern River at Hwy 204 crossing. Downstream of Calloway and Carrier Canals, the Kern River is dry at surface.

28. Exhibit 3-12-k: Kern River looking upstream to Hwy 58 (Rosedale Hwy) crossing. Channel bed is dry and homogenous.

29. Exhibit 3-12-l: Kern River upstream of Hwy 99 crossing. Dry channel bed, sand and gravel deposited upstream of crossing.

30. Exhibit 3-12-m: Kern River looking downstream from Hwy 99 crossing. Sand and gravel bed channel is wide and dry, river channel sediment texture progressively fines moving downstream past crossings. Narrow vegetative margin bounds channel.

31. Exhibit 3-12-n: Kern River looking upstream along Truxtun Ave. Sand dominated dry river bed.

32. Exhibit 3-12-o: Kern River looking downstream near Coffee Rd.

33. Exhibit 3-12-p: Kern River looking upstream near Stockdale Hwy., channel bed becoming progressively sand dominated.

34. Exhibit 3-12-q: Kern River at McClung Weir within 2,800 acre recharge facility upstream of Second Point of Measurement.

B. Kern Basin Groundwater Recharge.

35. **Kern Basin Setting:** Groundwater in the Kern Basin is an important source of water for municipal and agricultural users. The Kern Basin is a ground water reservoir that is bound to the north by the relatively impervious Tulare Lake Bed deposits, bound to the east by the bedrock of the Sierra Nevada and its foothills; bound to the south by the San Emigdio and Tehachapi mountains; and bound to the west by the Coast Range. The groundwater basin is comprised of unconsolidated sedimentary deposits, whereby interbedded sand and gravel lenses provide relatively permeable aquifers with higher water holding capacity, and finer silt and clay units (mostly lacustrine

sediments) provide less permeable materials. Depending on local conditions and sedimentary textures, the less permeable silt/clay units may provide local confining, or semi-confining bases or ceilings for aquifers. In the area of the City of Bakersfield's 2,800 recharge facility (Exhibit 3-8) along the Kern River west of Bakersfield (and east of Second Point of Measurement) the general aquifer sequencing is that of an (a) unconfined upper aquifer that has a sand/clay impermeable unit at its base, creating a semi-confined base for the upper aquifer and a ceiling for the lower aquifer (b) found below with more permeable materials at depth.

36. **Sources of Groundwater Recharge:** Recharge of the Kern Groundwater Basin occurs primarily through percolation beneath streams, unlined canals, excess irrigation, and municipal and industrial waste water. The most significant source of recharge is from the Kern River itself, which carries runoff from the Sierra Nevada as described above (Stetson, 1983). Precipitation adds to groundwater recharge, particularly at the City of Bakersfield's 2800 recharge facility (Exhibit 3-8). Precipitation and stormwater in portions of Bakersfield are also captured and directed towards percolation to recharge groundwater through the City's Stormwater Percolation Program. It is estimated that 13,000 – 15,000 ac-ft are supplied to groundwater recharge annually through precipitation at the 2800 recharge facility and through the Stormwater Percolation Program (Bakersfield, 2006). The City collects stormwater runoff through its storm sewer collection system and concentrates it into drainage basins throughout the City that percolate the stormwater into the ground. Through the City & County Joint National Pollution Discharge Program, stormwater runoff is measured at three different sites throughout Metro Bakersfield that represent the amount of flow from commercial, industrial and residential areas. From this data the City is able to calculate an estimated amount of stormwater percolated back into the groundwater in these collection basins.

37. There is an extensive system of groundwater extraction wells and recharge areas along the lower Kern River as shown in Exhibit 3-13.

38. **General Decline in Groundwater Levels:** Over time, groundwater levels in the Kern Groundwater Basin have generally declined, reflecting that groundwater withdrawals have generally exceeded recharge. Exhibit 3-14 depicts groundwater profiles for select years between 1940 and 1982 in the area of the City of Bakersfield's 2,800 acre spreading grounds recharge facility

on the lower Kern River. Exhibit 3-14 plots groundwater over time along a transect from 8 mi. south of the Kern River to 36 mi. north of the spreading grounds at the Kern River. Exhibit 3-14 indicates how groundwater "mounds up" immediately beneath the Kern River where recharge occurs, and that a groundwater trough (depression) occurs about 30 mi. north of the Kern River.

39. **Recent Decline in Groundwater Levels:** Exhibit 3-15 depicts how in much of the Bakersfield area, groundwater depth dropped 10 feet or more from 2007 levels. Similar observations were made in 2007 (Exhibit 3-16) where groundwater levels dropped over 10 ft. from the previous 2006 levels. These recent observations suggest how the relatively dry winter runoff conditions of the winter and spring of 2007 and 2008 resulted in relatively less recharge and further reductions in groundwater levels.

40. **Physical Impacts Associated with Declining Groundwater Levels:** In the Kern Basin, historic reductions in groundwater levels have resulted in land subsidence and the reduction of ground-water storage capacity due to the compaction of the aquifers (Stetson, 1983). Because the Kern River is an influent stream, whereby a portion of flows percolate directly below the river bed toward the groundwater aquifer, the reduction in groundwater elevations over time has reduced the "mounding" effect of groundwater beneath the Kern River (Exhibit 3-17). This has in turn altered the groundwater gradient which previously was more strongly directed out from the Kern River area (at the mound) toward areas north and south of the river where water levels were lower. The Kern County Water Agency Report on Water Conditions 2008 - Plate 6 - *Elevation of Water in Wells* (Plate 6 page 72) suggests that the groundwater gradient that previously trended away from the river is flattening and in areas may be trending now toward the river. This trend could be compounded with 2009 continued groundwater pumping and the unprecedented declining groundwater elevations.

41. This change in the strength and direction of the groundwater gradient has negative effects for water quality, whereby pollutants are increasingly migrating in groundwater now toward the Kern River, where wells are more concentrated.

42. **General Water Quality Degradation Due to Declining Water Levels:** Declining groundwater levels has also been associated with declining water quality within groundwater wells. Agricultural and urban development in the Bakersfield region has influenced the concentration of

total dissolved solids in groundwater over the years. Historically, concentrations of total dissolved solids were observed as high as 1,000 mg/l in the 1950s and 1960s, but since that time concentrations have declined due to better land and groundwater management efforts (Leeds, Hill, and Jewett, 1973, Stetson, 1983; City of Bakersfield, Caltrans, Federal Highway Authority, 2006).

43. **Recent Arsenic Data from Groundwater Wells:** Arsenic is a naturally occurring mineral found within soils present in the Bakersfield area and is toxic when consumed in drinking water. The City closely monitors the quality of groundwater from all its wells. From 1997 to 2007, data from at least four wells located in the southeast area of the City, at the outer edges of the river's subsurface influence, show a steady increase in arsenic concentrations, with a few exceeding the federal drinking water standard. It is hypothesized that alterations to the groundwater table, as illustrated in Exhibit 3-17, are drawing minerals and contaminants from the soil down into the groundwater aquifer and towards the Kern River. The arsenic data recorded by the City may validate this theory and additional investigations are underway. Note that groundwater extracted from wells which do not comply with federal or state drinking water standards is not distributed for public consumption.

C. Potential Extent of Forfeited Flows

44. Exhibit 3-18 provides a summary description of forfeited water conditions. This summary is based on the application of the preserved entitlement amounts (as determined by the past litigation and 2007 judgment) toward observed flows during the period of record 1954-2008).

45. For the four canals shown in Exhibit 3-18 (Kern Island, Buena Vista, Stine, and Farmers canals) – the average monthly volume of forfeited water (ac-ft) is shown for the various months in which forfeiture occurred. For example, for the Kern Island Canal, the average January monthly volume of forfeited water was 8,678 ac-ft. This volume is based on applying the preserved entitlement amounts for the historically observed January monthly flows between 1954 and 2008. Subtracting the preserved entitlement (cap) from the gross entitlement results in the amount of back calculated forfeited flow. The monthly data in Exhibit 3-18 provides a summary of the long term average monthly forfeitures.

46. The right side of Exhibit 3-18 provides two additional summary statistics. The average monthly forfeiture amounts taken from the four different canals are summed to provide a total monthly forfeiture volume. For example, for January the total average monthly forfeiture for the four canals is 11,011 ac-ft. To the right of this volume, a mean monthly flow rate is provided. For example, for January the 11,011 ac-ft flow volume translates to a mean monthly flow rate of 179 cfs. In September, the mean monthly flow rate of forfeited water is 23 cfs.

47. These mean monthly flow rate estimates are useful in assessing the magnitude of the forfeited flows in terms of an instream channel flow rate. Exhibit 3-12-a shows flow conditions at the First Point of Measurement on September 30, 2009. On that day, the mean daily flow rate was 508 cfs. In comparison, the mean monthly flow rate of forfeited flow for September is 23 cfs.

48. The bottom row of Exhibit 3-18 provides annual summary information for the average forfeited water estimates that were back calculated from the observed flow record between 1954-2008. Based on the 54-yr record, the average annual volume of calculated forfeiture is 50,646 ac-ft. This volume translates to a mean annual flow rate of approximately 70 cfs (as applied over the course of a year).

D. Statewide Recognition of Importance of Instream Flows.

49. I was asked to assume that the new, additional flows of Kern River water resulting from the forfeiture judgment would remain in the Kern River for an undefined time period because presently no entity holds rights to such water. I was additionally asked to study and describe the potential impact and effect of such increased flows, and to describe the change in circumstances in the Kern River that would result from the presence of such new, additional flows of water in the river. To describe the viability and effect of increased flows in the Kern River resulting from the changed conditions, this section presents examples of how the State of California has recognized the importance of maintaining streamflow, typically through supporting programs and projects which seek to restore and protect beneficial uses of the State's waters. Minimum instream flow requirements for water control projects have been, and are currently being, established by the State Water Resources Control Board (SWRCB) through state mandates and court rulings.

50. This section includes the following topics to demonstrate the State's recognition of the importance of instream flows:

- Key sections of the California Water Code and Public Resources Code which pertain to SWRCB and Department of Fish and Game (DFG) mandates to protect resources supported by instream flows.
- Relevant key court cases including Natural Resources Defense Council, *et al.* v. Rodgers, *et al.* and the Putah Creek Water Cases)
- A water appropriation request on the Santa Ana River, and
- A summary of instream flow requirements established through the federal permit process for operation hydroelectric generation facilities.

California Water Code and Public Resources Code

51. In the 1980s, the state Legislature recognized the value of instream flows, particularly in streams that have been modified for flood control and water supply. As a result, the following sections of the California Water Code and Public Resources Code were revised to provide more specific guidance related to instream flows. Prior to acting on future applications for water appropriations, the SWRCB and the DFG are required to identify and assess instream flow requirements necessary to support habitat and wildlife in the state's streams.

52. California Water Code Section 1257 includes:

> "In acting upon application to appropriate water, the board shall consider the relative benefit to be derived from (1) all beneficial uses of the water concerned including, but not limited to, use for domestic, irrigation, municipal, industrial, preservation and enhancement of fish and wildlife, recreational, mining and power purposes, and any uses specified to be protected in any relevant water quality control plan…"

53. California Water Code Section 1257.5 includes:

> "The board, in acting on applications to appropriate water, shall consider streamflow requirements proposed for fish and wildlife purposes pursuant to Sections 10001 and 10002 of the Public Resources Code. The board may

establish such streamflow requirements as it deems necessary to protect fish and wildlife as conditions in permits and licenses in accordance with this division."

54. Public Resources Code Sections 10001 through 10002 includes:

> 10001. The Director of Fish and Game shall identify and list those streams and watercourses throughout the state for which minimum flow levels need to be established in order to assure the continued viability of stream-related fish and wildlife resources...
>
> 10002. The Director of Fish and Game shall prepare proposed streamflow requirements, which shall be specified in terms of cubic feet of water per second, for each stream or watercourse identified pursuant to Section 10001...

Department of Fish and Game Priority List for Instream Flow Assessment

55. Pursuant to Public Resources Code Sections 10000-10005, the DFG compiles a list of priority streams to study and establish minimum instream flow requirements to ensure protection of fish and wildlife within those streams. The list and instream flow recommendations are submitted to the SWRCB for consideration in taking action on water appropriation applications.

56. The DFG establishes this list to prioritize their efforts in formulating specific flow recommendations to protect stream-related fish and wildlife habitat for each stream on the list. For example, DFG submitted their minimum instream flow recommendations to protect salmonid habitat within Butte Creek, a northern California stream whose flows are controlled by an extensive network of dams and reservoirs which generate hydroelectric power. Based on current hydrologic and biologic data from the watershed, the DFG recommended monthly minimum flows for normal and dry water years which range from 40 to 100 cfs depending on the month and year type (Department of Fish and Game 2009). The SWRCB will utilize these recommendations in review of FERC re-licensing and water appropriation applications to ensure protection of beneficial uses.

57. The most recent list of priority streams was submitted to the SWRCB in August of 2008. The current list of priority streams can be viewed online at: http://www.dfg.ca.gov/water/instream_flow_docs.html.

58. The Kern River shares attributes with several of the streams on the priority list. For example, the Mojave River is listed as the #18 priority stream for the 2008-2009 fiscal year. Like the Kern River, the Mojave River is an interior draining, influent stream in an arid region whose runoff source area is found in highland mountains in its upper watershed. Like the Kern River, the Mojave River supports a unique assemblage of plant and wildlife species. That instream flow requirements will be established for the Mojave River may suggest that similar attention to the Kern River may be appropriate.

SWRCB North Coast Instream Flows Policy

59. Assembly Bill 2121 from 2004 added Sections 1259.2 and 1259.4 to the California Water Code. These sections require that the SWRCB Division of Water Rights prepare a SWRCB Policy for Maintaining Instream Flows in Northern California Coastal Streams. The policy specifically affects water diversions in coastal streams in portions of Marin, Napa, Sonoma, Mendocino, and Humboldt Counties. The "North Coast Instream Flows Policy" is currently under development, but will establish instream flow requirements for the protection of biological resources and water rights. This regional policy is another example of the state's support and recognition of the value of instream flows.

Natural Resources Defense Council, et al. v. Rodgers, et al. – San Joaquin River Restoration Program

60. On September 13, 2006, a settlement and Memorandum of Understanding (MOU) was signed by the National Resources Defense Council (NRDC) *et al.* and the State of California, including CalEPA (governing agency of the SWRCB) concluding an 18-year lawsuit regarding the quality of riverine and fish habitat in the San Joaquin River below Friant Dam. Restoring stream flows in the San Joaquin River was the key result of the lawsuit settlement. The original lawsuit was filed in 1998 and involved the renewal of service contracts associated with the Friant Dam. One of the claims alleged that the operation of Friant Dam violated California Fish & Game Code Section 5937, which requires dams to release sufficient water to keep fish in "good condition" below the dam.

61. The San Joaquin settlement requires that specific releases of water from Friant Dam will occur to meet the various life stage needs for spring and fall run Chinook salmon. A number of studies were conducted to determine the specific volume and timing of releases of water necessary to restore salmon habitat in this reach of the river. In compliance with the settlement agreement and as a result of these studies, interim flow releases from the Friant Dam were initiated in October 2009. While fish are a focus of the overall program, the instream flow regime will be managed to enhance the entire river ecosystem including restoring physical processes such as floodplain functioning and sediment supply and transport dynamics, aquatic food webs, and the riparian corridor.

Putah Creek Water Cases

62. Diversions from the Putah Creek Diversion Dam during a very dry period in the early 1990's resulted in a loss of native fish habitat in Putah Creek below the dam. The Putah Creek Council filed suit against a number of parties in Superior Court (referred to as the Putah Creek Water Cases) to restore flows to the Creek, pursuant to Section 5937 of the California Fish & Game Code and the Public Trust Doctrine. Appropriate flow regimes to improve and restore the condition of the Creek's fish were identified during court hearings. This case also clarified the Fish & Game Code's mandate to maintain fish in "good condition" below a dam. In 1996, the Superior Court ordered enhanced flows to be released from the diversion dam into Putah Creek. Today, as a result of the enhanced flows ordered by the Superior Court, a sustainable and thriving native fish population has returned to Putah Creek for almost twenty miles below the Putah Creek Diversion Dam (Moyle 2005).

Santa Ana River Appropriations – Orange County Water District

63. On December 2, 2008, the SWRCB approved diversions of 362,000 acre-feet of non appropriated water per year from the lower Santa Ana River for the purposes of municipal, irrigation, recreational, and industrial uses. Water was approved to be released from an upstream dam that would wet a portion of the downstream riverbed to support natural riparian habitat. The reach to be receiving additionally released flows was previously generally dry due to flood control channel modifications.

64. The testimony received at SWRCB hearings (2007) stated that the additional flows in the previously dry reach of the river would benefit riparian habitat as well as habitat for the Santa Ana sucker, a federally listed threatened species found along the lower Santa Ana River. As a result of the SWRCB approval, water diversions would continue to occur downstream of the reach which supports this listed species. No adverse impacts were identified as a result of the water diversions downstream of the identified Santa Ana sucker habitat. However, recognizing the potential for restoration opportunities, the SWRCB's water appropriation approval included conditions that require the water district to implement a habitat restoration and monitoring plan for the Santa Ana sucker. (SWRCB 2008 Decision 1647 partially approving Application 31174).

Flow Release Requirements Established during FERC Relicensing Processes

65. Hydroelectric projects are regulated by the federal government under the Federal Energy Regulatory Commission (FERC). Each project must complete a federal review process to obtain an operating license. The licenses for many hydroelectric projects in California have recently expired and the project operators subsequently applied for renewal of their operating license from the FERC. As part of the re-licensing process, the FERC is required to review the existing and potential effects of the proposed operating plans for the project, many of which proposed to alter the characteristics of flows to be released from dams. Typical flow alterations might include releasing less water or altering the timing or season of releases.

66. In reviewing the existing conditions and potential effects of the proposed dam operations, FERC has mandated that additional flows are to be released from the dams specifically to support or restore habitat downstream from hydroelectric projects. FERC re-licensing of hydroelectric operations at the New Don Pedro Dam on the Tuolumne River, 6 dams owned by PacifiCorp on the Klamath River, and PG&E-owned dams on the Feather River and Hat Creek all included minimum streamflow release requirements to protect and support wildlife habitat downstream from the dams. Of note, FERC required that 4 of the 6 dams on the Klamath River be removed entirely to restore stream flows and promote restoration of anadromous fish habitat.

E. Beneficial Use and Functions of Instream Flow.

67. The purpose of this section is to describe the beneficial uses and functions of increased streamflow resulting from the forfeiture judgment and the changed conditions on the river, and to explain how maintaining or enhancing instream flow resulting from the forfeiture protects, supports, or improves beneficial uses and functions. While this discussion is somewhat generic to river channels in general, the description of beneficial uses is targeted to the conditions of the Kern River. Topics addressed in this section include an overview of Kern River beneficial uses, geomorphology, groundwater recharge and groundwater quality, riverine ecology, surface water quality, recreation, and aesthetics.

Lower Kern River Beneficial Uses

68. The Central Valley Regional Water Quality Control Board (Regional Board) regulates the Kern River according to the Water Quality Control Plan for the Tulare Lake Basin (Basin Plan, CVRWQCB 2004). The beneficial uses of the lower Kern River, below the Southern California Edison Kern River Powerhouse No. 1 (KR-1) include: Municipal and Domestic Supply (MUN); Agricultural Supply (AGR); Industrial Service Supply (IND); Industrial Process Supply (PRO); Hydropower Generation (POW); Ground Water Recharge (GWR); Warm Freshwater Habitat (WARM); Wildlife Habitat (WILD); Rare, Threatened, or Endangered Species (RARE); Water Contact Recreation (REC-1); and Non-Contact Water Recreation (REC-2).

69. A river's flow regime (the timing and magnitude of its discharge) is largely governed by structural and climatic conditions in the watershed. For the lower Kern River, the key hydrologic factors that determine streamflow are described above in Section 1 (Hydrologic Context). Flow conditions are also controlled by flood management and water supply operations (also described above for the lower Kern River) that affect the natural hydrology provided by the source watershed. Existing flow diversions from the lower Kern River support the following beneficial uses: MUN, AGR, IND, PRO, POW. However, maintaining and enhancing instream flows by allowing past forfeited flows to remain in the lower Kern River as streamflow would further improve the following beneficial uses: MUN, AGR, GWR, WARM, WILD, RARE, REC-1.

Geomorphology – River Form and Process

70. Riverine systems are complex and involve interdependent physical and biological processes. A stream channel's form (shape) represents the dynamic balance between discharge (the historic flows that the river has passed), channel geometry (the channel's slope, depth, and width), and sediment load (the source and volume of material the river carries) (Leopold *et al.*, 1964; Richards, 2004). This dynamic balance of processes is depicted in Exhibit 3-19.

71. Streamflow is the key driver of these processes as it largely influences the hydraulic geometry of the channel and the sediment load carried by the river. More specifically the timing and magnitude of streamflow directly influence stream channel pattern (meandering, straight, or braided), channel shape (depth, width, slope); instream geomorphic features (bars, riffles, pools, eddies, benches); and floodplain conditions (inundation frequency of floodplain, terrace development) (Schumm, 1977). Enhancing or restoring these natural riverine functions begins with restoring streamflow (discharge) in the channel which in turn drives the physical river channel and floodplain processes.

72. As these geomorphic functions determine the basic physical conditions of the riverine system they also directly influence biological resources and habitat quality, quantity, structure, and connectivity along the river ecosystem (further described below). Plant and wildlife species abundance, distribution, composition, and trophic structure are all influenced by the physical river processes.

73. Maintaining or enhancing instream flows in the lower Kern River through allowing past forfeited flows to remain in the channel directly supports all the geomorphic and habitat functions described above.

Groundwater Recharge and Groundwater Quality

74. As discussed in Section B, the groundwater table in the Bakersfield area has steadily declined over the long term due to groundwater withdrawals having exceeded recharge. The lowering of groundwater levels has severed the available water supply to many native plant species, which in turn has negatively affected wildlife habitat and water quality functioning (discussed further below).

75. The Kern River channel substrate is highly productive for percolation and groundwater recharge, and as described above, provides the premier source for recharge for the Kern Groundwater Basin. Maintaining and enhancing instream flows in the Kern River channel will over time help support groundwater levels and/or help prevent further decline in water levels. Eventually, by sustaining instream flows and percolation, groundwater levels could rise within reach of plant roots and foster reestablishment of riparian habitat. Stabilizing or increasing groundwater levels would also help stabilize or reduce long-term trends in land subsidence and improve groundwater pumping conditions (reducing the need to drill deeper wells). Maintaining and enhancing instream flows along the lower Kern River strongly supports the groundwater recharge beneficial use (GWR).

76. The City's 2,800 Acre Recharge Facility (Exhibit 3-8) has successfully raised the groundwater table locally, improved groundwater quality, and increased the City's water supply by providing water storage (City of Bakersfield, 2000). The addition of instream flows in the channel upstream from the 2,800 Acre Recharge Facility would extend these beneficial effects to a larger area within the basin.

77. Groundwater quality generally improves with increased influxes of surface water recharge. The high concentrations of contaminants, such as arsenic, nitrates, and organics, currently recovered in groundwater wells on the southeastern edge of the City (California Water Service Company, unpublished data) could potentially decline over time as the groundwater "mounding" beneath the Kern River strengthens with increased recharge (Exhibit 3-17). As described above, with heightened groundwater beneath the Kern River (increased groundwater "mounding" condition) the groundwater gradient is strengthened that directs flow away from the river, and this supports improved groundwater quality by reducing the influx of potential contaminants from larger areas surrounding the Kern River.

78. In sum, increased flows made available for streamflow in the lower Kern River will directly support groundwater recharge. The delivery of additional flows to the Kern River will beneficially support maintaining groundwater elevations, strengthen the groundwater gradient beneath and away from the river, and result in a water quality benefit. The additional percolation and groundwater recharge from streamflow sources also supports municipal wells.

Riverine Ecology (Pre-Forfeiture Environmental Setting)

79. Habitats currently supported along the lower Kern River include Great Valley cottonwood riparian forest, valley saltbush scrub, valley sink scrub, and grassland. Historically, freshwater marsh habitat occupied the river banks and the Great Valley cottonwood riparian forest was more robust and provided channel shading. It is likely that the valley saltbush scrub, valley sink scrub, and grassland habitats were also more abundant historically but have declined due to the lowered groundwater table.

80. The Great Valley cottonwood riparian forest, valley saltbush scrub, and valley sink scrub habitats support many federal- and state-listed endangered and threatened species. These species include the San Joaquin kit fox, Tipton kangaroo rat, California condor, Least Bell's vireo, loggerhead shrike, Swainson's hawk, western burrowing owl, and Buena Vista Lake shrew; as well as plant species such as the California jewelflower, Kern mallow, and Bakersfield cactus.

81. In terms of the quality of these habitats, the following statement from an environmental impact analysis conducted for a roadway project through the City of Bakersfield accurately summarizes current habitat conditions within the Kern River and the importance of instream flows to support those habitats (City of Bakersfield, Caltrans, and the Federal Highway Administration 2006):

> *"...the Kern River possesses a moderate capacity for wildlife production and export, a moderate diversity and abundance of terrestrial and aquatic species, and moderate value for its uniqueness and heritage. The moderate value of this site for uniqueness and heritage is enhanced by the Kern River channel's function as habitat for special-status species but reduced by habitat fragmentation and channel maintenance disturbance."*

82. Healthy riparian ecosystems, supported by natural hydrologic and fluvial geomorphic processes, provide the interface between terrestrial and aquatic habitats and are the centers of biodiversity and corridors of dispersal for plants and animals. The past reduction of instream flows has reduced the health of the riparian ecosystem. If instream flows are allowed to extend down the Kern River channel, marsh vegetation could reestablish along its banks and the quality of riparian

and scrub habitats would improve from moderate to good conditions. Beneficial uses identified for the Kern River (WILD and RARE) would be enhanced by the additional river flows and improvements in habitat quality.

83. Together, a healthy functioning physical river system along with its habitat and species represent the full spectrum of physical and biological "beneficial uses" of a river ecosystem. River ecosystems also support the human environment, thus provisions for water supply and recreational uses are considered "beneficial uses" as well.

Surface Water Quality

84. Riparian forests and freshwater marshes filter nutrients and agricultural chemicals from runoff; stabilize channel banks; and provide leaf litter for aquatic food webs, large woody debris, and overhead shading. Riparian and marsh vegetation assists in moderating water temperature, dissolved oxygen levels within the water column, nutrient cycling, contaminant sequestration in fine sediments, and salinity control. These water quality characteristics and functions are further supported by in-channel features as discussed above, such as pools and sorted bed substrate materials.

85. Within the Bakersfield area, untreated stormwater runoff from urbanized areas is conveyed to the Kern River through stormwater drainage systems. Stormwater runoff contains urban pollutants such as oil and grease, bacteria, pesticides, and other chemicals that are toxic to wildlife. Similarly, agricultural return flows and runoff from fields convey salts, pesticides, and nutrients from fertilizers to the Kern River and into underlying groundwater supplies (as discussed above).

86. The majority of development in the Kern River watershed is located at the downstream and lower elevations of the watershed. Because the Kern River system is closed with no outlet, salts and contaminants naturally have a tendency to accumulate in the soils and groundwater in the Kern Basin, the same vicinity where development is currently occurring. If surface flows in the Kern River were not diverted east of the City of Bakersfield, riverine vegetation and channel features would encourage natural filtration of urban contaminants from the water as it flowed downstream and percolated into underlying groundwater (Osborne and Kovacic, 1993).

However, because the majority of surface river flows downstream of Riverview Park are diverted from the Kern River channel, the channel through much of the City lacks robust riparian forest vegetation and freshwater marsh that could provide these additional water quality filtering functions.

87. Currently, stormwater runoff and agricultural return flows are weakly treated within the channel because these habitat types and associated water quality functions are poor or lacking. If surface flows, and resulting physical and biological functions are restored to the channel, water quality functioning would improve and so would the ability to better treat runoff from urban and agricultural development in the watershed. In turn, the quality of water percolating to groundwater supplies would also improve.

Recreation and Aesthetics

88. An extensive trail and park network exists along the lower Kern River throughout most of Bakersfield. The City has made several improvements to parklands along the river including developing the Kern River Parkway (Jones & Stokes Associates, 1988). Enhanced marsh and riparian vegetation resulting from increased instream flows would improve the aesthetics of the riverside trails and parks. Additionally, riparian trees would provide shading over the trails and thus improve the recreational experience. Currently, non-contact recreation (REC-2) occurs along the channel, but with additional instream flows opportunities for water contact recreation (REC-2) could be supported.

IV. CONCLUSION AND INTEGRATED WATER MANAGEMENT

89. **Summary:** The testimony presented above is intended to briefly describe the lower Kern River hydrologic system (Section A), groundwater considerations for the lower Kern River (Section B), the magnitude of forfeited flows (Section C), state guidance on the importance of instream flows (Section D), and the benefits of additional instream flows to the Kern River based on the "changed conditions" resulting from the forfeiture judgment (Section E). In light of the beneficial uses described above and the overall goal of protecting a sustainable Kern River system - this testimony strongly supports protecting and preserving the current changed conditions on the lower Kern River which have produced the additional flows that were forfeited in the past.

90. **Streamflow Supports Municipal Uses:** Augmenting streamflow in the lower Kern River as a result of forfeiture increases groundwater recharge and thereby supports the network of municipal, irrigation, and other wells in the region that draw from groundwater. As described above, augmenting streamflow in the lower Kern River also protects groundwater quality and the resulting quality of water drawn from wells in the area.

91. **Wise Municipal Water Use:** Because this testimony supports augmenting streamflow in the lower Kern River as a result of the forfeiture judgment, which also supports municipal water uses by the City of Bakersfield, it is important to ensure that municipal water, under the management and distribution of the City of Bakersfield is used wisely.

92. The City of Bakersfield has undertaken several water management initiatives to ensure that their water is used and managed well, these include the following:

- Water Conservation – In partnership with water supply agencies in the area, the City promotes water conservation within residential, commercial, and agricultural communities. Examples of City-led conservation efforts include a high efficiency washing machine rebate program, the City's progressive conversion to a 100% metered domestic water system, and the City's extensive school and public education programs that promote water conservation.

- Water Reuse and Recycling – The City currently produces recycled water (tertiary treated wastewater) from their wastewater treatment facilities. Recycled water is applied at sports fields and park facilities throughout the city and for groundwater recharge. The expansion and upgrade of the City's Wastewater Treatment Plant No. 3 will eventually allow for the option to percolate 16 million gallons per day (MGD) of effluent, or 18,000 acre-feet per year. The expanded tertiary treatment system will be initiated in January 2010. This treated water will be used to irrigate City parks/sports facilities onsite Plant wash make-up water and groundwater recharge. The plant may not be fully operational until 2012, and is not estimated to reach full capacity until 2025. The plant upgrades will meet the State of California Department of Health Services requirement of advance treatment of recycled water prior to percolation into the groundwater aquifers. The upgrade will include a modular tertiary treatment facility to handle up to 2 MGD for reuse on nearby land applications and onsite Plant wash and make-up water. The tertiary effluent (TE) will be treated to meet the State of California Title 22 Recycled Water requirements for restricted recreational use. The Title 22 TE will meet stringent public health turbidity and disinfection standards. This reclaimed water may be used for irrigation of public and private land, industrial water supply needs, or any restricted recreational use.

- Agricultural Water Use Offsetting – The City is in the process of expanding its reclaimed water irrigation program to reduce reliance on groundwater for agricultural water uses. Reclaimed water is used to grow non-consumable crops.

93. **Integrated Water Management:** Through the City of Bakersfield efforts at water conservation, water reuse, and recycling, as well as protection of groundwater quality and enhancement of the Kern River ecosystem; the City seeks to provide a comprehensive and integrated approach toward their water management. The SWRCB and DWR promote integrated regional water management (IRWM) as a key strategy to support the long-range planning goals of the California Water Plan. The City's approach at the local scale reflects the goals and objectives of IRWM as guided by the State. For example, the City is converting to using more treated surface water for various municipal applications (as described above under water reuse and recycling). Increased utilization of water reuse has allowed the City to use groundwater wells for other peak demand purposes. Increasing water reuse and recycling has created additional redundancy and reliability in the water delivery system and has reduced the amount of groundwater pumping.

Executed under the penalty of perjury under the laws of the State of California at Oakland, California on October 18, 2009.

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