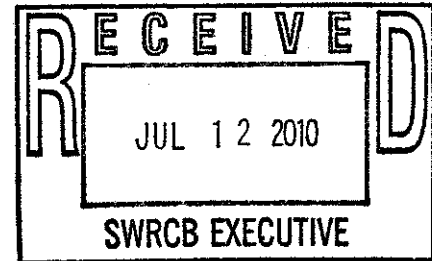


PEPPERDINE UNIVERSITY

GOVERNMENTAL AND REGULATORY AFFAIRS

Mr. Charles R. Hoppin, Chair
c/o Jeanine Townsend, Clerk of the Board
State Water Resources Control Board
P.O. Box 1000
Sacramento, CA 95812



Re: Comments on the Malibu Civic Center Septic Prohibition

Dear Mr. Hoppin:

This letter presents comments to the State Water Resources Control Board ("SWRCB") by Pepperdine University ("Pepperdine" or "University") regarding the Amendment to the Water Quality Control Plan for the Los Angeles Region (the "Basin Plan") to Prohibit On-site Wastewater Disposal Systems in the Malibu Civic Center Area, Resolution No. R4-2009-007, as adopted by the Los Angeles Regional Water Quality Control Board ("Regional Board") on November 5, 2009 (the "Resolution"). The Resolution, which would amend the applicable Basin Plan, is aimed at prohibiting, within a specific boundary (the "Boundary"), on-site wastewater disposal systems ("OWDS") that discharge wastewater directly into the subsurface.

Pepperdine's Malibu campus is outside of the Boundary and we support the reasoned decision to exclude the campus made by the Regional Board on November 5, 2009. In written comments submitted to the Regional Board on October 8, 2010 and oral comments given at the November 5, 2009 Regional Board meeting, the University expressed its concern that Regional Board staff included a portion of the University's Malibu campus within the boundary of the proposed septic prohibition area despite the fact that the Malibu campus has never utilized an on-site wastewater disposal system.¹ In its comments, Pepperdine explained to the Regional Board that it did not discharge wastewater, had no OWDS, sent all of its wastewater to wastewater treatment facilities for tertiary treatment, and retained the resulting recycled water on-site for reuse in irrigation. Pepperdine further stressed that the University's existing wastewater treatment capacity was more than sufficient to meet the University's current and planned future wastewater needs. In addition to written and oral comments, Pepperdine also provided, at the Regional Board staff's request, data from the University's hydrogeological monitoring program. Based on this substantial evidence, there was no reason to subject the University to the septic prohibition and Pepperdine respectfully requested that the Regional Board exclude the University from the proposed boundary. At the November 5, 2009 hearing, the Regional Board agreed and appropriately modified staff's proposal to exclude Pepperdine's Malibu campus from the prohibition area.

Should the SWRCB approve the Resolution adopted by the Regional Board on November 5, 2009, Pepperdine respectfully requests that the SWRCB's approval recognize the Regional Board's sound decision with respect to excluding the entirety of Pepperdine's Malibu campus

¹ Pepperdine University's comments to the Regional Water Quality Control Board, dated October 8, 2009, made in anticipation of the November 5, 2009 hearing are incorporated by discussion and reference (See Attachment).

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from the prohibition area. The exclusion of Pepperdine's campus reflects sound judgment, good governance, and is supported by substantial evidence demonstrating that Pepperdine does not discharge wastewater and has sufficient capacity to meet the University's current and planned future wastewater needs.

Comments on SWRCB Consideration of the Proposed Amendment

With nearly 40 years of experience with treatment and reuse of wastewater very similar to what is proposed here, Pepperdine has unique insight into the hydrogeological challenges associated with the reuse of significant quantities of treated effluent. As a long-standing member of the Malibu community that shares the Regional Board's vision of water quality, Pepperdine applauds the goals of the Resolution and supports the construction of a centralized wastewater treatment facility for the Malibu Civic Center (the "Civic Center"). Though Pepperdine's Malibu campus is not included within the Boundary, Pepperdine, along with other members of the Malibu community, has a vested interest in the water quality of the Civic Center and Santa Monica Bay. Furthermore, Pepperdine owns property that falls within both the Regional Board Boundary and the City's proposed Community-Based Treatment Solution boundary, and supports the transition from OWDS to a centralized wastewater treatment facility in the Civic Center. Like all parties invested in this process, Pepperdine would like to see the transition undertaken in the most efficient and effective means possible. Towards that end, Pepperdine recommends that the SWRCB take appropriate effluent dispersal and reuse areas as well as adequate support for the necessary assessment district into careful consideration while reviewing the Resolution.

Dispersal and Reuse of Treated Effluent

With the Resolution's current Boundary, Pepperdine anticipates that the City of Malibu (the "City") will face significant hurdles in the reuse and dispersal of the treated wastewater. Pepperdine understands that the City is currently exploring options to use the reclaimed water from a centralized wastewater treatment facility for irrigation to counter the area's limited receiving capacity. Recycled irrigation provides a significant benefit, particularly in light of the ever-increasing scarcity of water in Southern California. However, reuse of reclaimed water for irrigation requires a certain amount of land and the careful consideration of site specific conditions, which include soil and vegetation types, depth to groundwater, topography, and sun exposure. At Pepperdine, where reclaimed water accounts for 99.1% of irrigation by volume, all of these considerations are assessed through a sophisticated hydrogeological monitoring program, which utilizes groundwater monitoring wells, soil moisture access casings, a mathematical model, and an automated irrigation system based upon current climactic conditions, vegetation type, and evapotranspiration rates to monitor and prescribe irrigation that maintains healthy vegetation without over-irrigating. Even with sufficient land and carefully selected vegetation, the optimization and operation of Pepperdine's reclaimed irrigation system is complex and time intensive.

Recently, the City approached the University about the possibility of Pepperdine using the City's treated effluent for irrigation or potentially utilizing Pepperdine's existing infrastructure. However, Pepperdine's campus systems were not sized with the intent of meeting the Civic Center's significant wastewater treatment and reclaimed water needs. This limitation intensifies during winter months when seasonal rainfall limits Pepperdine's ability to utilize additional recycled water for irrigation. For these reasons, Pepperdine does not anticipate that it can be of

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significant assistance to the City in meeting their treatment and recycled irrigation needs once the septic ban goes into effect.

Uncertainties regarding the ability of the City to properly reuse all treated wastewater in the Boundary area undermine the potential success of a centralized wastewater treatment facility. The Prohibition Boundary, as we understand it, is likely to result in a wastewater system that produces more reclaimed water than can properly be disposed of within the prohibition area; particularly during the winter months when precipitation is high and irrigation demands are consequently low. One solution proposed by the City during the hearing was to reduce the size of the area subject to the OWDS ban under their Community-Based Treatment Solution. This aspect of the City's proposal was supported by Heal the Bay. Pepperdine agrees that a reduction in the size of the prohibition area along with a phased implementation may provide greater likelihood that the City can develop a successful wastewater treatment and reuse system that appropriately accounts for effluent dispersal and reuse in the Civic Center.

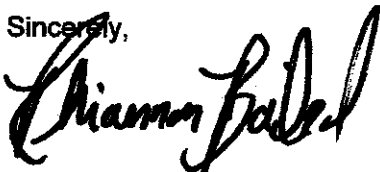
Support for a Centralized Wastewater Treatment Facility

As mentioned above, Pepperdine does own property that falls within the City's proposed Community-Based Treatment Solution boundary and supports the transition from OWDS to a centralized wastewater treatment facility in the Civic Center. Pepperdine, at the City's request, signed a letter agreeing to support an assessment district for the construction of a centralized facility. Pepperdine understands and appreciates the long term benefits of a centralized wastewater treatment system and is willing to contribute to its construction.

Conclusion

Pepperdine appreciates the opportunity to submit these comments for the SWRCB's consideration. Pepperdine respectfully requests that all of its public comments, including those herein and those previously filed with the Regional Board, be given appropriate consideration, be placed in the administrative record for this rulemaking, and be maintained in the agency's records.

Sincerely,



Rhiannon L. Bailard

Assistant Vice President, Governmental and Regulatory Affairs

Cc: Arnold Schwarzenegger, Governor, State of California
Linda Adams, Secretary, California Environmental Protection Agency
Jim Thorsen, City Manager, City of Malibu

Attachment

**Pepperdine University's Comments to
Regional Water Quality Control Board's
Proposed Resolution R4-2009-xx
October 8, 2009**

PEPPERDINE UNIVERSITY

GOVERNMENTAL AND REGULATORY AFFAIRS

Dr. Rebecca Chou
Chief Groundwater Permitting Unit
California Regional Water Quality Control Board, Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, CA 90013

RE: Water Quality Control Plan for the Coastal Watersheds of Ventura and Los Angeles Counties to Prohibit On-site Wastewater Disposal Systems in the Malibu Civic Center Area, Resolution No. R4-2009-xx

Dear Dr. Chou:

This letter presents comments by Pepperdine University ("Pepperdine" or "University") to the proposed Amendment to the Water Quality Control Plan for the Coastal Watersheds of Ventura and Los Angeles Counties to Prohibit On-site Wastewater Disposal Systems in the Malibu Civic Center Area, Resolution No. R4-2009-xx (the "Resolution"). The proposed Resolution, which would amend the applicable Basin Plan, is aimed at prohibiting, within a specific boundary, on-site wastewater disposal systems ("OWDSs") that discharge wastewater directly into the subsurface. The Resolution purports to prohibit discharges from "individual/group septic/disposal systems in the Civic Center area."

We are concerned that a portion of our property is included within the boundary of the proposed prohibition area even though Pepperdine is not a discharger of wastewater, has no OWDSs, sends all of its wastewater to wastewater treatment facilities for tertiary treatment, and retains the resulting recycled water onsite for use in irrigation. Existing wastewater treatment capacity at both the Malibu Mesa Wastewater Reclamation Facility ("Malibu Mesa") and Tapia Water Reclamation Facility ("Tapia") is sufficient to meet the University's current and planned future wastewater needs. Since there is no reason to include the University within the prohibition boundary, we ask that the boundary be moved to avoid University.

If Pepperdine is not excluded, we ask that it be made absolutely clear that the wastewater discharge prohibition does not apply to the University's use of recycled water for irrigation, which has been undertaken since the Malibu campus opened in 1972. Pepperdine University has a long history of sustainable environmental practices and the cornerstone is our use of recycled water to irrigate campus landscaping. Pepperdine is a user of this tertiary treated recycled water, which is fully permitted pursuant to California Regional Water Quality Control Board, Order No 00-167 and Order No 94-055 (W.R.R.). (See, Attachment A, RWQCB Order No. 00-167).

While we believe it is the intent of the Regional Board to prohibit wastewater discharges to the subsurface from underground OWDSs or septic systems, we are concerned that the Basin Plan amendment may be wrongly interpreted to apply to Pepperdine's irrigation system. We ask that either Pepperdine be excluded from the prohibition boundary or specific language be placed

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in the Resolution, which makes it crystal clear that the use of recycled water is not a discharge of wastewater and is outside the reach of the Basin Plan amendment. Absent such specific language, the record of these proceedings should reflect that the use of recycled water for irrigation is outside the reach of the Basin Plan amendment.

A. Pepperdine Should Not Be Included Within The Prohibition Boundary

There is no reason to include any portion of the Pepperdine campus within the prohibition boundary. The proposed boundary appears to bisect several campus facilities so the rationale for including some portions of the campus is unclear. There is no development proposed in area within the proposed boundary in Pepperdine's Long Range Development Plan nor does the University have any current plans to develop that area. There is sufficient wastewater treatment capacity at Malibu Mesa and Tapia for all existing and future planned University development so there is no need or intent to tie in to any future sewer system infrastructure proposed for the Malibu area. To the extent that the prohibition boundary is intended to help define the area requiring future wastewater treatment infrastructure, that rationale is not applicable to the Pepperdine property.

Moreover, we understand from conversations with City of Malibu environmental manager Craig George that the funding of a future regional wastewater system does not include plans to seek financial contribution from the University. Nonetheless, we are concerned that our inclusion within the boundary could leave us potentially exposed to assessment for funding a regional wastewater system which the University does not need or intend to use. This would be an unfair result as the University has already undertaken to ensure responsible wastewater treatment through the construction of Malibu Mesa, connections to Tapia, and all related infrastructure for both systems.

We understand from RWQCB staff that the prohibition is not intended to affect Pepperdine's ongoing operations. Section Chief Wendy Phillips stated publicly in a presentation at the Pepperdine campus on October, 1 2009 that "while the prohibition boundary includes a portion of the Pepperdine campus, it is not anticipated to impact campus operations." If that is the case, then is there really any reason to include Pepperdine within the boundary at all? We suggest not and ask that the University be removed from within the prohibition boundary.

B. The Recycled Water Used By Pepperdine For Irrigation Is Not A Discharge Of Wastewater And Therefore Not Subject To The Proposed Prohibition

Pepperdine's recycled water use is not a discharge of wastewater subject to the prohibition under any reasonable reading of the Resolution. First, as distinguished within the language of the W.R.R. recycled water is not wastewater. In addition, the prohibition is intended to ban wastewater discharges to the subsurface and there are no subsurface discharges of any type at the University. Moreover, use of recycled water for conservation is in the public's best interest and should not be jeopardized by a prohibition intended to improve water quality.

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The Resolution amends a section entitled "Septic Systems" found in Chapter 4 of the Basin Plan. By its terms, the ban prohibits "on-site wastewater disposal systems (OWDSs)." These systems discharge wastewater to the subsurface. Water Code § 13290 defines "onsite sewage treatments systems" as follows: "Onsite sewage treatment systems" includes individual disposal systems, community collection and disposal systems, and alternative collection and disposal systems **that use subsurface disposal** (emphasis added)." This Water Code definition includes the OWDSs that are the subject of the Resolution and is evidence of its intent to affect subsurface wastewater discharges. Pepperdine's irrigation system cannot be considered an OWDS. The irrigation system does not discharge wastewater nor does it discharge directly to the subsurface. All of Pepperdine's wastewater is sent off-site to Malibu Mesa or Tapia for treatment and returned as tertiary treated recycled water.

By its very nature, Pepperdine's recycled water irrigation system is not a discharge or disposal of wastewater and it is certainly not a discharge to the subsurface. This is made clear by the Regional Board order that authorizes the irrigation program. The recycled water used by Pepperdine is tertiary treated and used consistent with the stringent requirements of the W.R.R., which Pepperdine is in full compliance with. The recycled water program includes careful monitoring via the hydrological monitoring program (HMP) in place since 1987. The W.R.R. contains stringent effluent limitations on the recycled water and distinguishes between wastewater and recycled. According to Pepperdine's hydrogeological consultants, the recycled water does not pose the same threat to water quality as wastewater from OWDSs. (See Attachment B, Letter from Daniel B. Stephens & Associates)

In fact, the State Water Resources Control Board's ("SWRCB") Recycled Water Policy ("Policy") recognizes that the use of recycled water consistent with the Policy is presumed to have a beneficial impact. The requirements of the W.R.R. and the HMP which implements the recycled water program management protocols are consistent with the practices for landscape irrigation projects as set forth in the Policy. The beneficial use of recycled water consistent with the W.R.R. and the Policy are strong evidence that Pepperdine's use of recycled water for irrigation is not disposal or discharge of wastewater intended to be regulated by the proposed Resolution. So, there is no on-site disposal of wastewater taking place on University property.

The thrust of the Resolution is to prohibit direct on-site discharges of wastewater to the subsurface. The Resolution includes conclusions that the discharges of wastewater from OWDSs (by definition on-site subsurface discharges) in the Civic Center area fail to meet water quality objectives and contribute to impairments of existing and potential beneficial uses of water resources. In contrast, the University's irrigation system spreads water on landscaping on the surface and is designed to minimize percolation through the subsurface through the implementation of its HMP. (See Attachment B) The HMP includes management techniques for recycled water use, which ensure that irrigation avoids, to the maximum extent possible, any contribution of irrigation water to the groundwater system underlying and surrounding the University. Pepperdine's Irrigation Services Staff use HMP data to prescribe only the amount of irrigation necessary to maintain healthy vegetation accounting for evapotranspiration. Due to these and a number of other factors as outlined in the attached letter from Daniel B. Stephens &

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Associates, it is unlikely that the use of recycled water for irrigation at Pepperdine is adversely impacting water quality in the Civic Center area.

Finally, it is in the public's best interest to ensure that responsible use of recycled water under stringent requirements and as verified by an HMP is continued as a substitute for potable water. California is facing yet another year of drought. Governor Schwarzenegger has declared a state of emergency. Likewise, Senator Pavley has stated that recycled water use is one of the answers to this growing crisis. Senator Pavley recently proposed SB 565 to the SWRCB to ensure that 50% of wastewater discharged to the ocean is recycled and reused by 2030. Pepperdine has been recycling wastewater and reusing it onsite since 1972. We respectfully request that the RWQCB's efforts to improve water quality not jeopardize the equally necessary water conservation efforts of institutions like ours who have conserved for decades.

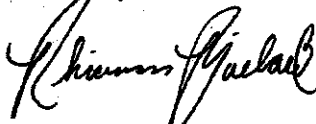
Consequently, it would not be reasonable to conclude that the use of recycled water for surface irrigation by Pepperdine is a subsurface disposal of wastewater intended to be prohibited by the Resolution.

C. Conclusion

Based on the above, Pepperdine respectfully requests that its property be excluded from the boundary affected by the Resolution. In the absence of a boundary change, Pepperdine asks that language be included in the Resolution which specifically excludes the use of recycled water for irrigation from its reach to ensure the availability of water resources for future generations. At a minimum, the record should clearly reflect that recycled water used for irrigation is not disposal of wastewater and not impacted by the Resolution.

Thank you for your attention and we look forward to working with you to resolve our concerns.

Sincerely,



Rhiannon L. Bailard
Assistant Vice President, Governmental & Regulatory Affairs

Attachment A

State of California
CALIFORNIA REGIONAL WATER QUALITY CONTROL
BOARD, LOS ANGELES REGION

ORDER NO. 00-167

State Of California
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

ORDER NO. 00-167

WASTE DISCHARGE REQUIREMENTS
AND
WATER RECYCLING REQUIREMENTS
FOR
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
AND
PEPPERDINE UNIVERSITY, MALIBU CAMPUS
(Malibu Mesa Wastewater Reclamation Facility)
(File No. 70-060)

The California Regional Water Quality Control Board, Los Angeles Region (Regional Board), finds:

1. The County of Los Angeles Department of Public Works (Recycler) operates and maintains the Malibu Mesa Wastewater Reclamation Facility (Reclamation Facility), located at 3863 Malibu Country Drive, Malibu, California (Figure 1). The Reclamation Facility has a design capacity of 0.2 million gallons per day (mgd) and has an approximate effluent flow of 0.177 mgd. The Recycler provides tertiary treatment producing effluent that complies with the water recycling requirements of Title 22 of the California Code of Regulations. The Recycler uses a portion of the recycled water for landscape irrigation of approximately 1.6 acres of the Reclamation Facility.
2. Pepperdine University (User) uses recycled water produced by the Recycler for landscape impoundment and landscape irrigation of approximately 126 acres of the approximately 300 developed acres of the Pepperdine University, Malibu Campus, located at 24255 Pacific Coast Highway, Malibu, California. The User operates and maintains the recycled water storage reservoirs and landscape irrigation facilities.

Regulation of Discharge

3. Section 13523 of the California Water Code provides that a Regional Board, after consulting with, and receiving the recommendations of the California Department of Health Services (CDHS), and after any necessary hearing, shall, if it determines such action to be necessary to protect the public health, safety, or welfare, prescribe Waste Discharge Requirements and Water Recycling Requirements for water which is used, or proposed to be used, as recycled water. Section 13523 further provides that such requirements shall include, or be in conformance with, the statewide recycling criteria.
4. The use of recycled water for landscape impoundment or for landscape irrigation at Pepperdine University, Malibu Campus could affect public health, safety and welfare, therefore, requirements for such use are needed in accordance with Section 13523 of the California Water Code.

October 30, 2000
Revised: November 9, 2000

5. Pursuant to Section 13523 of the California Water Code, the production and use of the recycled water are regulated under Water Recycling Requirements contained in Order No. 94-056, adopted by this Regional Board on June 13, 1994.
6. The amount of recycled water used for landscape irrigation at Pepperdine University varies with demand. During summer, approximately 0.3 mgd of recycled water is needed. At peak demand, approximately 70% of the recycled water used for irrigation is produced at the Reclamation Facility, and 30% is imported from the Las Virgenes Municipal Water District (Las Virgenes), Tapia Water Reclamation Facility (Tapia). The use of the recycled water from Tapia for irrigation is regulated under separate Water Recycling Requirements contained in Order No. 94-055, adopted by this Regional Board on June 13, 1994.
7. California Water Code Section 13263(e) provides that all waste discharge requirements shall be reviewed periodically, and, upon such review, may be revised by the Regional Board. Following a review of the requirements in Order No. 94-056, and inspections of the Reclamation Facility, storage reservoirs, and irrigation areas, this Order updates Order No. 94-056 and includes additional findings, effluent limitations, updated standard provisions, updated specifications for recycled water use, and an expanded monitoring and reporting program.
8. During the wet season (November 1 through April 15 of each year), when irrigated areas are saturated and the storage reservoirs are in imminent danger of overtopping, the recycled water is discharged (emergency discharge) either to Marie Canyon or an unnamed canyon adjacent to the Reclamation Facility. This emergency discharge is currently regulated under separate Waste Discharge Requirements and National Pollutant Discharge Elimination System (NPDES) permit contained in Order No. 94-027 (NPDES No. CA0059099), adopted by this Regional Board on April 4, 1994.

Reclamation Facility Description

9. The Reclamation Facility serves a population of approximately 3,360 persons at Pepperdine University and the Malibu Country Estates. All domestic wastewater generated by Pepperdine University is collected at the flow equalization station. The majority of the wastewater is then sent to the Reclamation Facility, and any portion of wastewater over 0.165 mgd is sent to Tapia. Domestic wastewater generated by Malibu Country Estates flows directly to the Reclamation Facility.

All laboratory waste generated by Pepperdine University is stored in 55-gallon drums and hauled offsite to a legal point of disposal.

10. The Reclamation Facility provides primary, secondary and tertiary treatment, with disinfection by an ultraviolet system (Figure 2).

11. Primary treatment consists of the headworks with a comminutor and a bypass channel with bar screen. An influent flow meter is located after the bypass channel. Secondary treatment consists of the Walker Process packaged activated sludge plant that includes an aeration basin with coarse bubble diffusers, two aeration blowers (one of which is a stand-by), an aerobic digester, and a secondary sedimentation basin. Return activated sludge and waste activated sludge are pumped by airlift pumps. Tertiary treatment is provided through coagulation, rapid mix, flocculation, and sand filtration. Filtration consists of three continuous backwash Dynasand® filters.
12. Disinfection is provided by four ultraviolet lamps in series. The Recycler began using ultraviolet disinfection on June 12, 1998. The CDHS approved the use of the ultraviolet disinfection system in a letter dated February 5, 1998.
13. The waste activated sludge is aerobically digested and pumped to a centrifuge for partial dewatering. The dewatered, digested sludge is stored in a 10,000-gallon underground storage tank prior to hauling to the Donald C. Tillman Water Reclamation Facility located at 6100 Woodley Avenue, Van Nuys, California.
14. In the event of upsets or other operational emergencies at the Reclamation Facility, wastewater from Pepperdine University can be pumped to Tapia for treatment under an agreement between Pepperdine University and Las Virgenes. The wastewater from Malibu Country Estates can be diverted to the sludge storage tank and hauled to the Donald C. Tillman Water Reclamation Facility for treatment. In the event of a power failure the Recycler has an emergency diesel-powered generator onsite to prevent the discharge of raw or inadequately-treated sewage.

Landscape Impoundments and Irrigation Facility

15. Prior to distribution for landscape irrigation, recycled water is stored in two landscape impoundments (also known as reservoirs). The reservoirs have double 20-mil polyvinyl chloride liners to prevent percolation. From the reservoirs, the recycled water is pumped into the irrigation distribution system. The distribution system is divided into two pressure zones, a lower zone and upper zone. The lower zone irrigates the lower portion of the campus through four pressure regulators. In the upper zone, the recycled water is pumped to a 10,000-gallon underground storage tank, then distributed to the irrigation system for the upper portion of the campus by gravity flow.
16. In a letter dated July 21, 2000, the User informed the Regional Board that under normal conditions the reservoirs are maintained at an equivalent of 5.2 million gallons of water. The User further stated that to maintain the pumps in the reservoirs in proper working condition, the water level can only be lowered to an equivalent of 3.5 million gallons. The reservoirs' combined storage capacity is approximately 8 million gallons. However, previous documentation made available to the Regional Board indicates the reservoirs can be filled to a level equivalent to 12 million gallons. Therefore, in the tentative

requirements for the renewal of the emergency discharge permit (NPDES No. CA0059099), the User is required to conduct a survey to determine the actual storage capacity of the reservoirs.

17. During a meeting on October 25, 2000, the User informed the Regional Board that the survey had been completed. The User stated (and confirmed in a letter transmitted via facsimile on October 26, 2000) that the total storage volume of both reservoirs is approximately 8.4 million gallons at an elevation of 245.56 feet. To maintain proper operation of the pumps, the water level can only be lowered to an elevation of 239.0 feet, which is approximately 0.6 million gallons total volume for both reservoirs. In addition, three inches of freeboard (0.25 feet) should be left in each reservoir to accommodate wind generated waves, which is approximately 0.4 million gallons total volume for both reservoirs. Therefore, the available wet weather storage capacity is approximately 7.4 million gallons at an elevation of 245.31 feet. This is equivalent to approximately 40 days of wet weather storage capacity at 0.177 mgd average effluent from the Reclamation Facility.
18. In 1985, the User initiated a hydrogeologic monitoring program to provide information on the soil moisture conditions and groundwater levels of the irrigated areas, to ensure that the infiltration due to irrigation does not affect geologic stability. The User manages the landscape irrigation system based on this hydrogeologic monitoring program.
19. The hydrogeologic monitoring program uses two direct and two indirect methods to determine how much infiltration occurs beneath the irrigated areas, either as a result of irrigation or precipitation. One of the direct methods consists of measuring soil moisture content monthly in nine access casings from 3 feet to 20 feet below ground surface using a portable neutron probe. The other direct method is measuring the depth to groundwater monthly in 17 onsite monitoring wells and five offsite monitoring wells located south of Pacific Coast Highway. The indirect methods consist of mathematical calculations for water and salt balance equations. Some of the parameters required for the water and salt balance equations include, but are not limited to: rainfall; evaporation; transpiration; runoff; subdrain outflow; deep percolation; recycled water usage; soil moisture; groundwater levels; and groundwater and runoff conductivity.
20. The Reclamation Facility and landscape irrigation areas are located within the Corral Canyon Hydrologic Subarea of the Point Dume Hydrologic Area of the Malibu Hydrologic Unit (404.31). The Reclamation Facility and landscape irrigation areas are generally located in Section 30, T01S, R17W, San Bernardino Base and Meridian at the approximate latitude and longitude of 34° 2' 31" and 118° 42' 33", respectively.

21. The Regional Board adopted a revised *Water Quality Control Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (Basin Plan) on June 13, 1994. The Basin Plan contains the designated beneficial uses and water quality objectives for the groundwater within the Point Dume area.

The beneficial uses of the groundwater in the Point Dume area are:

Existing: Municipal and domestic supply (MUN), and Agriculture.

Potential: Industrial service supply.

There is no current MUN use in the immediate area due to seawater intrusion and poor groundwater quality.

22. Based on data from the *Hydrogeologic Monitoring Program, Annual Report, Water Year 1997-98*, dated August 23, 1999, the recycled water does not infiltrate to groundwater. Therefore, groundwater quality monitoring is not required at this time. The User is required to continue implementing the hydrogeologic monitoring program. In the future, if the hydrogeologic monitoring demonstrates that the recycled water is infiltrating to the groundwater, then a groundwater quality monitoring program may be required.
23. This update of the Waste Discharge Requirements and Water Recycling Requirements for an existing facility is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 2100 et seq.) in accordance with California Code of Regulations, Title 14, Chapter 3, Section 15301.

The Regional Board has notified the Recycler and User and interested agencies and persons of its intent to revise Waste Discharge Requirements and Water Recycling Requirements for this discharge and has provided them with an opportunity to submit their written views and recommendations.

The Regional Board, in a public meeting, heard and considered all comments pertaining to the discharge and to the tentative requirements.

IT IS HEREBY ORDERED that the County of Los Angeles Department of Public Works and Pepperdine University shall comply with the following:

I. INFLUENT LIMITATIONS

- A. Waste discharged to the Reclamation Facility shall be limited to domestic wastewater only. No water softener regeneration brines, laboratory chemicals, or industrial wastes shall be discharged to the Reclamation Facility.

- B. The maximum daily flow of influent from the collection system to the headworks of the Reclamation Facility shall not exceed the design capacity of 0.2 mgd.

II. EFFLUENT LIMITATIONS

- A. Recycled water shall at no time contain any substances in concentrations toxic to human, animal, plant or aquatic life.
- B. Recycled water shall at no time contain any substances or agents that would produce offensive or unsightly conditions in the storage reservoirs or the irrigation areas.
- C. Recycled water shall not contain pollutants in excess of the following limits:

| <u>Pollutant</u> | <u>Units</u> | <u>Monthly Average</u> | <u>7-Day Average</u> | <u>Daily Maximum</u> |
|------------------------|----------------------|------------------------|----------------------|----------------------|
| BOD ₅ 20°C | mg/L | 20 | 30 | 45 |
| | lbs/day ¹ | 33 | 50 | 75 |
| Suspended solids | mg/L | 15 | 40 | 45 |
| | lbs/day ¹ | 25 | 67 | 75 |
| Oil and grease | mg/L | 10 | --- | 15 |
| | lbs/day ¹ | 17 | --- | 25 |
| Total dissolved solids | mg/L | --- | --- | 1,000 |
| | lbs/day ¹ | --- | --- | 1,668 |
| Chloride | mg/L | --- | --- | 250 |
| | lbs/day ¹ | --- | --- | 417 |
| Sulfate | mg/L | --- | --- | 250 |
| | lbs/day ¹ | --- | --- | 417 |
| Boron | mg/L | --- | --- | 1.0 |
| | lbs/day ¹ | --- | --- | 1.7 |
| Total organic carbon | mg/L | --- | --- | 20 |
| | lbs/day ¹ | --- | --- | 33 |

- D. Recycled water shall at all times be within the range of 6.5 to 8.5 pH units.
- E. Recycled water shall not contain organic chemicals, inorganic chemicals (i.e., heavy metals, arsenic, or cyanide), or general minerals in concentrations exceeding the limits contained in the current California Drinking Water Standards, Title 22, Division 4, Chapter 15, Sections 64431, 64444, and 64449, of the California Code of Regulations, or subsequent revisions.

¹ The mass-based discharge limit is based on the design flow of 0.2 mgd and remains the same during storm events.

- F. Radioactivity of the recycled water shall not exceed the limits specified in Title 22, Division 4, Chapter 15, Article 5, Sections 64441 and 64443, of the California Code of Regulations, or subsequent revisions.

III. RECYCLED WATER SPECIFICATIONS FOR LANDSCAPE IMPOUNDMENTS AND LANDSCAPE IRRIGATION

- A. Recycled water used for irrigation of food crops, parks, playgrounds, schoolyards, residential landscaping, and unrestricted access golf courses shall at all times be adequately oxidized, coagulated, clarified, filtered, and disinfected domestic wastewater.
1. An oxidized wastewater means wastewater in which the organic matter has been stabilized, is nonputrescible, and contains dissolved oxygen.
 2. A coagulated wastewater means an oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated, upstream from a filter, by the addition of suitable flocc-forming chemicals.
 3. A filtered wastewater means an oxidized, coagulated, clarified wastewater that has been passed through natural undisturbed soils or filter media, such as sand, activated carbon, or diatomaceous earth, so that the turbidity as determined by an approved laboratory method does not exceed any of the following:
 - (a) a daily average turbidity of 2 NTU;
 - (b) 5 NTU more than 5% of the time during any 24-hour period; and,
 - (c) 10 NTU at any time.
 4. The wastewater shall be considered adequately disinfected if the 7 day median number of coliform organisms in the effluent does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed, and the number of coliform organisms does not exceed 23 per 100 milliliters in more than one sample in any 30-day period. No sample shall exceed the number of coliform organisms of 240 per 100 milliliters.
- B. Recycled water produced at the Reclamation Facility shall not be used for purposes other than for landscape impoundment and landscape irrigation until requirements for such purposes have been established by this Regional Board in accordance with Section 13523 of the California Water Code, or unless the Regional Board finds that the above-cited standards are applicable to those purposes.

- C. There shall be no cross-connection between piping used for potable water supply and piping containing recycled water.
- D. Recycled water uses shall meet the requirements specified in the *California Health Laws Related to Recycled Water*, 1st Edition, dated January 1, 1998, issued by the CDHS.
- E. Recycled water used for irrigation shall be retained on the areas of use and shall not be allowed to escape as surface flow, except as provided for in a NPDES permit.

For purposes of this requirement, however, minor amounts of irrigation return water from peripheral areas shall not be considered a violation of this Order.

- F. To prevent erosion and earth movement of the irrigated areas, recycled water shall be applied at such a rate and volume as to not exceed the vegetative demand and soil moisture conditions as determined by the User's hydrogeologic monitoring program. Special precautions must be taken to prevent clogging of spray nozzles, to prevent overwatering and the production of runoff. Pipelines shall be maintained so as to prevent leakage and pressure build-up.
- G. All areas where recycled water is used, and that are accessible to the public, shall be posted with conspicuous signs, in a size no less than 4 inches high by 8 inches wide, that include the following wording: "ATTENTION: NON-POTABLE RECYCLED WATER - DO NOT DRINK" or "RECYCLED WATER - DO NOT DRINK." Each sign shall display the international symbol for recycled water shown in Figure 3.
- H. Adequate freeboard shall be maintained in all storage reservoirs to ensure that direct rainfall does not cause overtopping.

IV. GENERAL REQUIREMENTS

- A. Standby or emergency power facilities or storage capacity or diversion capabilities shall be provided so that in the event of plant upset or outage due to power failure or other cause, discharge of raw or inadequately-treated sewage does not occur.
- B. Adequate facilities shall be provided so that the sewage treatment and recycling facilities shall be protected from inundation, washout, or other damage caused by storm or storm flows.
- C. Any increase in wastewater treatment beyond the current design capacity of 0.2 mgd will require revised waste discharge requirements.

V. PROHIBITIONS

- A. The discharge or recycling of raw or inadequately-treated sewage from the Reclamation Facility and from sewers comprising the wastewater collection system for the Reclamation Facility at any time is prohibited.
- B. Recycled water irrigation shall not be conducted during periods of extreme rainfall and/or runoff.
- C. Irrigation or discharge of recycled water to geologically unstable areas is prohibited. Irrigation or discharge of recycled water shall not result in earth movement.
- D. Recycled water shall not be used for irrigation or impoundment within 100 feet of any domestic water supply well.
- E. Recycled water use shall not result in problems due to breeding of mosquitoes, gnats, midges, or other pests.
- F. Recycled water use shall not impart tastes, odors, color, foaming, or other objectionable characteristics to receiving groundwater.
- G. Recycled water use that could affect receiving groundwater shall not contain any substance in concentrations toxic to human, animal, or plant life.
- H. Odors of sewage origin shall not be perceivable beyond the limits of the property owned or controlled by the Recycler.
- I. Raw sewage or partially dried waste sludge shall not be sprayed on the ground surface.
- J. The discharge of recycled water at any point(s) other than specifically described in this Order is prohibited, and constitutes a violation of this Order.
- K. The storage reservoirs for recycled water shall not contain floating materials, including solids, liquids, foams, or scum, in concentrations that cause nuisance, adversely affect beneficial uses, or serve as a substrate for undesirable bacterial and algae growth and insect vectors.

VI. PROVISIONS

- A. The Recycler and User shall each establish a responsible party or parties to comply with this Order and the monitoring and reporting program. This information shall be provided to the Board within 30 days of receiving this Order.

- B. This Order includes the *Standard Provisions Applicable to Waste Discharge Requirements* (Standard Provisions). If there is any conflict between provisions stated herein and the Standard Provisions, the provisions stated herein will prevail.
- C. The Recycler and User shall file with the Regional Board technical reports on self-monitoring work performed according to the detailed specifications contained in the Monitoring and Reporting Program, or as directed by the Executive Officer. The results of any monitoring done more frequently than required at the locations and/or times specified in the Monitoring and Reporting Program shall be reported to the Regional Board.
- D. A copy of this Order including the Standard Provisions and Monitoring and Reporting Program shall be maintained at the reclamation and reuse facilities so as to be available at all times to operating personnel.
- E. The Recycler shall submit to the Regional Board, within 60 days of the adoption of this Order, procedures that will be, or have been, taken to ensure that no discharge or recycling of any untreated or partially-treated sewage, will result from the Reclamation Facility, in the event of equipment failure.
- F. To provide maximum storage capacity during wet weather, the User shall monitor and properly maintain the level of water in the storage reservoir.
- G. The Recycler shall immediately notify the Regional Board, by telephone, of any confirmed coliform counts that could cause violations of coliform requirements in this Order, including the date(s) thereof. This information shall be confirmed in a written report within five working days of verbal notification. In addition, for any actual coliform limit violations that occurred, the report shall also include the reasons for the high coliform results, the steps being taken to correct the problem (including dates thereof), and steps being taken to prevent a recurrence.
- H. The Recycler and User shall take all reasonable steps to minimize or prevent any discharge that has a reasonable likelihood of adversely affecting human health or the environment.
- I. Bypass (the intentional diversion of waste streams from any portion of a treatment facility) is prohibited. The Regional Board may take enforcement action against the Recycler for bypass unless:
 - 1. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage. (Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources

that can reasonably be expected to occur in the absence of bypass. Severe property damage does not mean economic loss caused by delays in the operation of the Reclamation Facility.);

2. There were no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated waste, or maintenance during normal periods of equipment down time. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass that could occur during normal periods of equipment downtime or preventive maintenance; and,
3. The Recycler submitted a written notice to the Regional Board for a bypass at least ten days in advance of the need for a bypass.

The Recycler may allow a bypass to occur that does not cause recycled water limitations to be exceeded, but only if it is for essential maintenance to ensure efficient operations. In such a case, the above bypass conditions are not applicable.

- J. Any offsite disposal of sewage sludge shall be made only to a legal point of disposal, and in accordance with the provisions of Division 7.5 of the California Water Code. For the purpose of these requirements, a legal point of disposal is defined as one for which Waste Discharge Requirements have been established by a California Regional Water Quality Control Board, and which is in full compliance therewith. Any sewage or sludge handling shall be in such a manner so as to prevent its reaching surface waters or watercourses.
- K. A revised Engineering Report which addresses the elements outlined in the CDHS *Guidelines for the Preparation of an Engineering Report for the Production, Distribution and Use of Recycled Water*, dated September 1997, shall be submitted to the CDHS and the Regional Board within 120 days of adoption of this Order. The report shall include an operation and maintenance manual that specifies operational monitoring to verify compliance with applicable ultraviolet disinfection criteria.
- L. In accordance with Section 13522.5 of the California Water Code, and Title 22, Division 4, Chapter 3, Article 7, Section 60323, of the California Code of Regulations, the Recycler shall file an engineering report, prepared by a properly qualified engineer registered in California, of any material change or proposed change in character or volume of the recycled water produced, with the Regional Board and the CDHS. The CDHS *Guidelines for the Preparation of an Engineering Report for the Production, Distribution and Use of Recycled Water*, dated September 1997, or revised versions thereof, shall be followed. Revised Waste

Discharge Requirements and Water Recycling Requirements are required prior to implementation of such material change.

- M. In accordance with Section 13522.5 of the California Water Code, and Title 22, Division 4, Chapter 3, Article 7, Section 60323, of the California Code of Regulations, the User shall file an engineering report, prepared by a properly qualified engineer registered in California, of any material change or proposed change in the location or volume of the recycled water used, with the Regional Board and the CDHS. The CDHS *Guidelines for the Preparation of an Engineering Report for the Production, Distribution and Use of Recycled Water*, dated September 1997, or revised versions thereof, shall be followed. Revised Waste Discharge Requirements and Water Recycling Requirements are required prior to implementation of such material change.
- N. For any extension or expansion of the recycled water distribution system, the User shall submit a report detailing the extension or expansion for the approval of the Executive Officer and the CDHS Office of Drinking Water. Following construction, as-built drawings shall be submitted to the Executive Officer and the CDHS Drinking Water Field Operations Branch for approval prior to use of recycled water.
- O. The Recycler or User must notify the Regional Board, in writing, at least 30 days in advance of any proposed transfer of this Order's responsibility and coverage to a new recycler or user. The notice must include a written agreement between the existing and new recycler or user, containing a specific date, for the transfer of responsibility for compliance with this Order.
- P. The Recycle and/or User shall furnish, within a reasonable time, any information the Regional Board or the CDHS may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order. The Recycler and/or User shall also furnish to the Regional Board, upon request, copies of any records required to be kept by this Order.
- Q. After notice and opportunity for a hearing, this Order may be terminated or modified for cause, including, but not limited to:
1. Violation of any term or condition contained in this Order;
 2. Obtaining this Order by misrepresentation, or failure to disclose all relevant facts; and,
 3. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

- R. This Order does not alleviate the responsibility of the Recycler or User to obtain other necessary local, state, and federal permits to construct facilities necessary for compliance with this Order; nor does this Order prevent imposition of additional standards, requirements, or conditions by any other regulatory agency. Expansion of the facility from its current capacity shall be contingent upon issuance of all necessary permits, including a Conditional Use Permit.

VII. RESCISSION

Except for enforcement purposes, Order No. 94-056, adopted by this Board on June 13, 1994, is hereby rescinded.

VIII. APPEAL OF ORDER

Pursuant to California Water Code Section 13320, any aggrieved party may seek review of this Order by filing a petition with the State Board. A petition must be sent to the State Water Resources Control Board, P.O. Box 100, 901 P Street, Sacramento, California, 95812, within 30 days of adoption of this Order.

I, Dennis A. Dickerson, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Los Angeles Region, on November 9, 2000.



Dennis A. Dickerson
Executive Officer

FIGURE 1

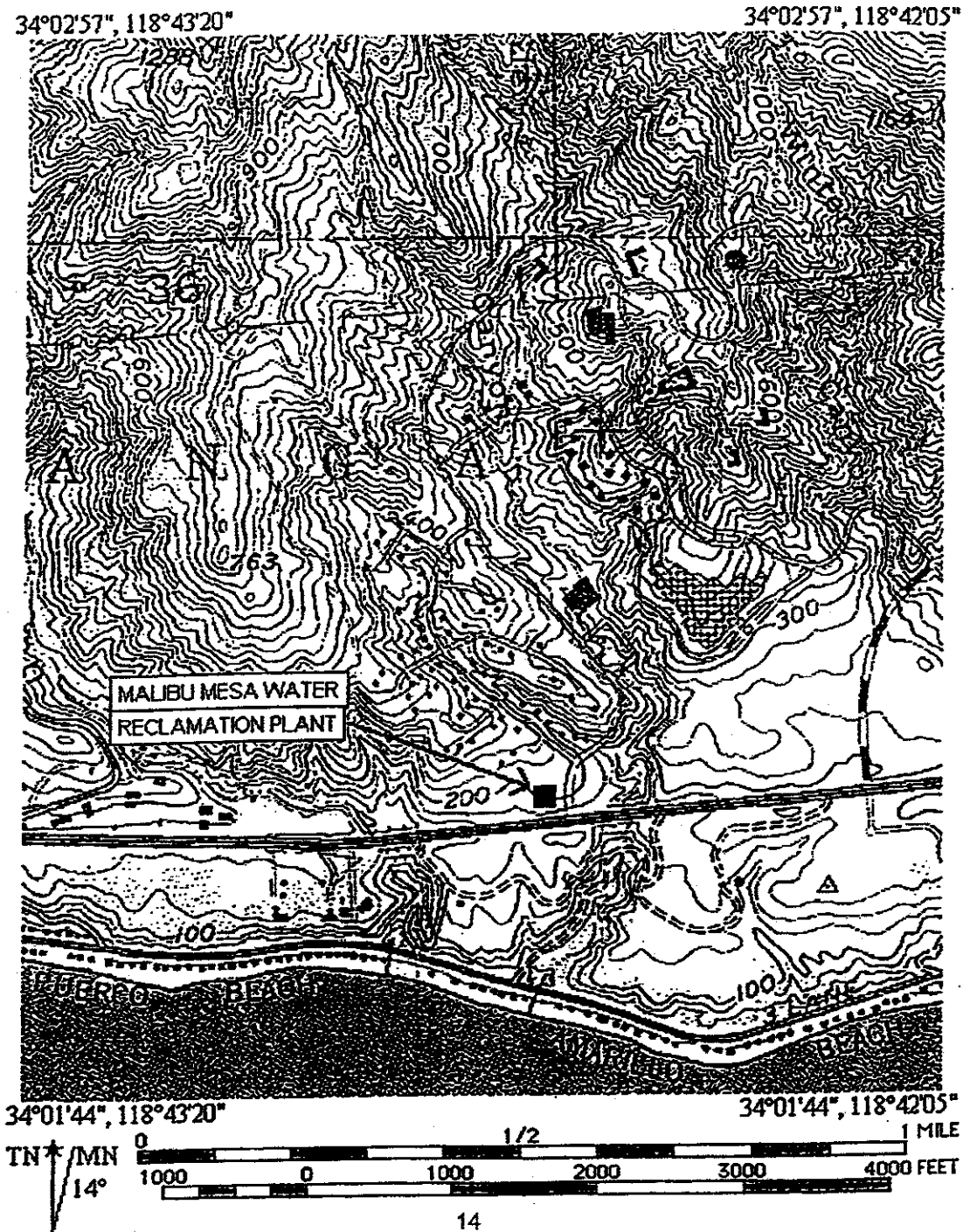
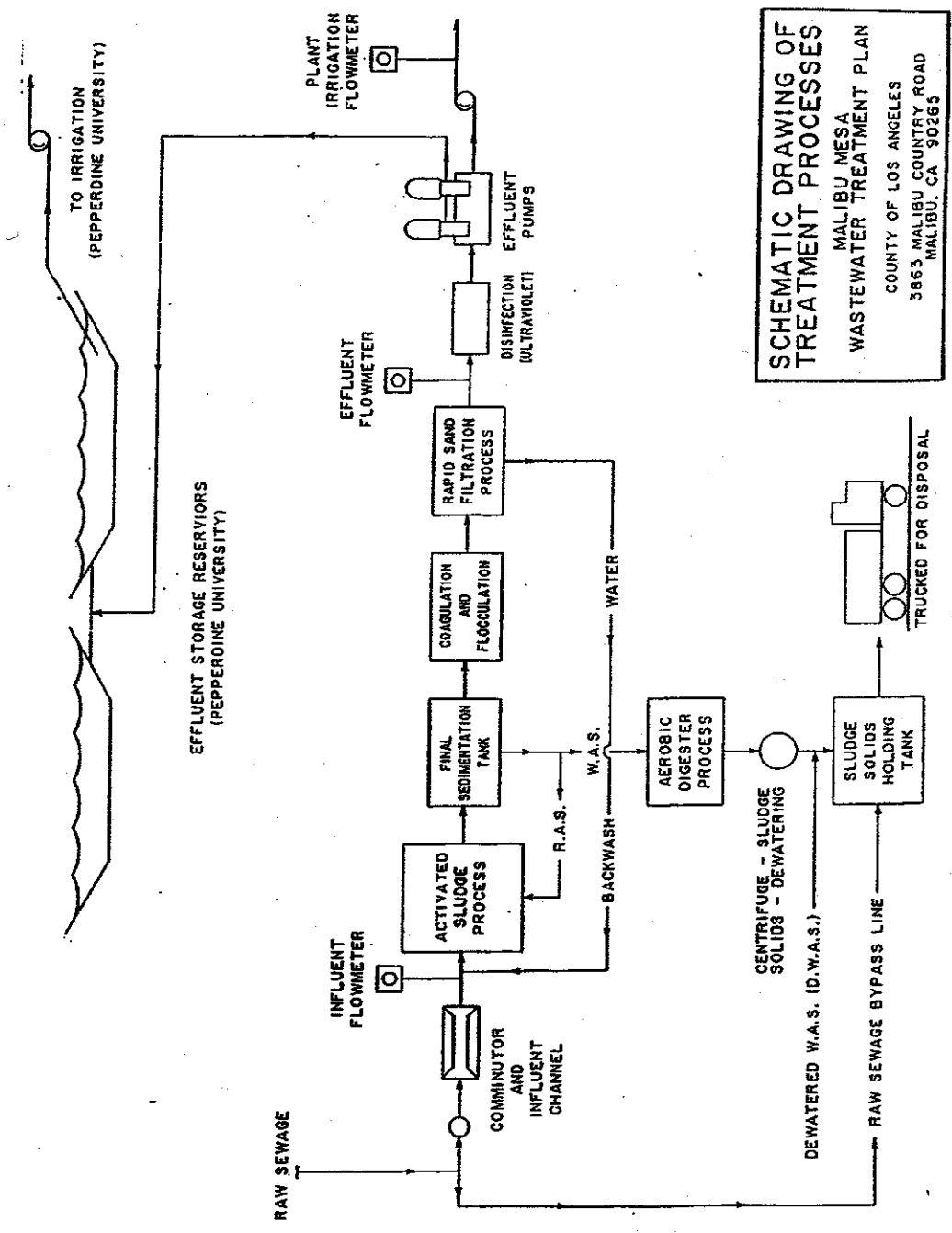


FIGURE 2



SCHEMATIC DRAWING OF TREATMENT PROCESSES
 MALIBU MESA
 WASTEWATER TREATMENT PLANT
 COUNTY OF LOS ANGELES
 3863 MALIBU COUNTRY ROAD
 MALIBU, CA 90265

FIGURE 3



State of California
CALIFORNIA REGIONAL WATER QUALITY CONTROL
BOARD, LOS ANGELES

ORDER NO. 94-055

State of California
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, LOS ANGELES

ORDER NO. 94-055

WASTE DISCHARGE REQUIREMENTS
WATER RECLAMATION REQUIREMENTS
FOR
LAS VIRGENES MUNICIPAL WATER DISTRICT
AND
PEPPERDINE UNIVERSITY, MALIBU CAMPUS
(Tapia Water Reclamation Facility)
(Files Nos. 64-104 & 70-060)

The California Regional Water Quality Control Board, Los Angeles Region, Finds:

1. The Las Virgenes Municipal Water District (Reclaimer) operates Tapia Water Reclamation Facility (Plant), located at 731 Malibu Road, Calabasas, California (Figure 1). The treatment plant has a design capacity of 16.1 million gallons per day (mgd). During 1993, the Reclaimer produced an average of 4.4 mgd of tertiary treated effluent for reclamation by spray landscape irrigation, agriculture, and industrial use under separate Waste Discharge Requirements contained in Orders Nos. 79-35, 79-107, 87-86 and 89-76 (File No. 64-104) adopted by this Regional Board on February 26, 1979, June 25, 1979, June 22, 1987, and February 25, 1989, respectively.
2. Pepperdine University (User) uses reclaimed water produced by the Reclaimer for landscape irrigation. The amount of reclaimed used supports approximately 60 of the 830 acres of the Pepperdine University - Malibu Campus, located at 24255 Pacific Coast Highway, Malibu, California, under Water Reclamation Requirements contained in Order No. 86-97, adopted by this Regional Board on November 24, 1986.
3. The User also receives reclaimed water produced at the Malibu Mesa Wastewater Treatment Facility operated by the County of Los Angeles - Department of Public Works, Engineering Services Division under separate Waste Discharge Requirements/Water Reclamation Requirements contained in Order No. 86-38, adopted by this Regional Board on June 23, 1986.
4. The California Water Code Section 13263(e) provides that all requirements shall be reviewed periodically, and, upon such review, may be revised by the Regional Board. A review of the current requirements, followed by a site inspection, was conducted by Regional Board staff and no violations were observed.

May 11, 1994

These Waste Discharge Requirements/Water Reclamation Requirements have been revised to include additional findings, effluent limitations, updated standard provisions, and an expanded monitoring and reporting program.

5. The Reclaimer operates a tertiary wastewater treatment plant in order to provide an effluent that complies with all Title 22 Water Reclamation Requirements.
6. The treatment plant is located in Section 19, T1S, R17W, San Bernardino Base & Meridian at latitude 34° 4' 37", longitude 118° 42' 15". The landscape irrigation areas are generally located in Section 30, T1S, R17W, at the approximate latitude 34° 2' 31" and longitude 118° 42' 33".
7. The wastewater treatment process consists of primary, secondary, and tertiary treatment. Primary treatment includes coarse screening, grit removal, and primary skimming and sedimentation using rectangular clarifiers. Secondary treatment employs activated sludge with single-stage nitrification followed by secondary clarification. Tertiary treatment includes the use of coagulation chemicals, flocculating, filtering, chlorination and de-chlorination. Sludge from the primary and secondary clarifiers is treated by anaerobic digestion, then dried in sludge drying beds at the Plant. The sludge is either transported to a landfill for disposal or composted and used for landscape soil amendment.
8. Prior to use for landscape irrigation, reclaimed water is stored in landscaped holding ponds with a combined storage capacity of approximately 12.4 million gallons. Reclaimed water is then pumped to a 10,000 gallon below-ground storage tank, that provides for gravity flow to the landscape irrigation systems.
9. The amount of reclaimed water used for landscape irrigation varies with demand, up to 300,000 gallons per day (gpd). Approximately 70% of the reclaimed water used is produced at the Malibu Mesa Wastewater Treatment Facility, and 30% is produced at the Las Virgenes Municipal Water District, Tapia Water Reclamation Facility. At times, 100% of the reclaimed water is supplied by Malibu Mesa Wastewater Treatment Facility.

These Waste Discharge Requirements/Water Reclamation Requirements have been revised to include additional findings, effluent limitations, updated standard provisions, and an expanded monitoring and reporting program.

5. The Reclaimer operates a tertiary wastewater treatment plant in order to provide an effluent that complies with all Title 22 Water Reclamation Requirements.
6. The treatment plant is located in Section 19, T1S, R17W, San Bernardino Base & Meridian at latitude 34° 4' 37", longitude 118° 42' 15". The landscape irrigation areas are generally located in Section 30, T1S, R17W, at the approximate latitude 34° 2' 31" and longitude 118° 42' 33".
7. The wastewater treatment process consists of primary, secondary, and tertiary treatment. Primary treatment includes coarse screening, grit removal, and primary skimming and sedimentation using rectangular clarifiers. Secondary treatment employs activated sludge with single-stage nitrification followed by secondary clarification. Tertiary treatment includes the use of coagulation chemicals, flocculating, filtering, chlorination and de-chlorination. Sludge from the primary and secondary clarifiers is treated by anaerobic digestion, then dried in sludge drying beds at the Plant. The sludge is either transported to a landfill for disposal or composted and used for landscape soil amendment.
8. Prior to use for landscape irrigation, reclaimed water is stored in landscaped holding ponds with a combined storage capacity of approximately 12.4 million gallons. Reclaimed water is then pumped to a 10,000 gallon below-ground storage tank, that provides for gravity flow to the landscape irrigation systems.
9. The amount of reclaimed water used for landscape irrigation varies with demand, up to 300,000 gallons per day (gpd). Approximately 70% of the reclaimed water used is produced at the Malibu Mesa Wastewater Treatment Facility, and 30% is produced at the Las Virgenes Municipal Water District, Tapia Water Reclamation Facility. At times, 100% (196,000 gpd) of the reclaimed water is supplied by Malibu Mesa Wastewater Treatment Facility.

10. Section 13523 of the California Water Code provides that a Regional Board, after consulting with, and receiving the recommendations of the State Department of Health Services, and after any necessary hearing, shall, if it determines such action to be necessary to protect the public health, safety, or welfare, prescribe Waste Discharge Requirements/Water Reclamation Requirements for water which is used, or proposed to be used, as reclaimed water.

Section 13523 further provides that such requirements shall include, or be in conformance with, the statewide reclamation criteria.
11. The Regional Board has consulted with the State Department of Health Services (DHS) regarding the current reclamation of tertiary-treated wastewater, and has incorporated the DHS findings and recommendations.
12. The use of reclaimed water for surface impoundments or for landscape irrigation could affect the public health, safety, or welfare; requirements for such use are therefore necessary in accordance with Section 13523 of the California Water Code.
13. The Plant is located within the Monte Nido Hydrologic Subarea of the Malibu Creek Hydrologic Area. The Users storage ponds and landscape irrigation areas are located within the Corral Canyon Hydrologic Subarea of the Point Dume Hydrologic Area, and overlies the Malibu Valley Groundwater Basin.
14. Groundwater in the Malibu Valley Groundwater Basin is beneficially used for agricultural supply.
15. The Board adopted revised Water Quality Control Plan for the Los Angeles River Basin on June 3, 1991. The Water Quality Control Plan contains beneficial uses and water quality objectives for groundwater within the Malibu Valley Groundwater Basin. The requirements contained in this Order, as they are met, will be in conformance with the goals and objectives of the Water Quality Control Plan.
16. This project involves an existing facility, and, as such, is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 2100 et seq.) in accordance with Title 14, California Code of Regulations, Chapter 3, Section 15301.

The Regional Board has notified the Reclaimer, User and interested agencies and persons of its intent to revise Waste Discharge Requirements/Water Reclamation Requirements for this discharge and has provided them with an opportunity to submit their written views and recommendations.

The Regional Board, in a public meeting, heard and considered all comments pertaining to the discharge and to the updated requirements.

IT IS HEREBY ORDERED that Las Virgenes Municipal Water District and Pepperdine University, Malibu Campus, shall comply with the following:

A. EFFLUENT LIMITATIONS

1. Reclaimed water shall be limited to treated domestic and commercial wastewater only, as proposed.
2. Waste discharge shall not contain constituents in excess of the following limits:

| <u>Constituent</u> | <u>Unit</u> | <u>Maximum Effluent Limitations</u> |
|--------------------------|-------------|---|
| Total dissolved solid | mg/L | 2,000 |
| Chloride | mg/L | 500 |
| Sulfate | mg/L | 500 |
| Boron | mg/L | 2 |
| BOD ₅ 20°C | mg/L | 30 |
| Oil & grease | mg/L | 15 |
| Suspended solids | mg/L | 30 |
| Total organic carbon | mg/L | 20 |

3. The pH of reclaimed water shall at all times be within the range of 6.5 to 8.5 pH units.

4. Reclaimed water shall not contain heavy metals, arsenic, or cyanide in concentrations exceeding the limits contained in the current California Drinking Water Standards.
5. Radioactivity shall not exceed the limits specified in Title 22, California Code of Regulations, Chapter 15, Article 5, Sections 64441 and 64443, or subsequent revisions.

B. SPECIFICATIONS FOR USE OF RECLAIMED WATER

1. Reclaimed water used for the irrigation of parks, playgrounds, schoolyards, and other areas where the public has similar access or exposure shall be at all times an adequately disinfected, oxidized, coagulated, clarified, filtered wastewater or wastewater treated by a sequence of unit processes that will ensure an equivalent degree of treatment and reliability.

The wastewater shall be considered adequately disinfected if the 7-day median number of coliform organisms in the effluent does not exceed 2 per 100 milliliters, as determined from the bacteriological results of the last 7-days for which analyses have been completed, and the number of coliform organisms does not exceed 23 per 100 milliliters in any sample.

An oxidized wastewater means wastewater in which the organic matter has been stabilized, is nonputrescible, and contains dissolved oxygen. For the purpose of these requirements, an oxidized wastewater shall be equivalent to secondary effluent with the following characteristics:

- (a) a biological oxygen demand, BOD₅, 20°C, value of less than 30 mg/L;
- (b) a suspended solids (SS) content of less than 30 mg/L; and
- (c) total organic carbon (TOC) value of less than 20 mg/L.

A coagulated wastewater means an oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated by the addition of suitable floc-forming chemicals or by an equally effective method.

A filtered wastewater means an oxidized, coagulated, clarified wastewater which has been passed through natural undisturbed soils or filter media, such as sand or diatomaceous earth, so that the turbidity as determined by an approved laboratory method does not exceed an average operating turbidity of 2 turbidity units and does not exceed 5 turbidity units more than 5 percent of the time during any 24-hours period.

2. Reclaimed water shall not be directly used for uses other than those enumerated above until requirements for these uses have been established by this Regional Board, in accordance with Section 13523 of the California Water Code, unless the Regional Board waives such requirements or finds that the above cited standards are applicable to these uses.
3. Reclaimed water uses shall meet the requirements specified in the "Guidelines for Use of Reclaimed Water" issued by the State Department of Health Services.
4. Reclaimed water used for irrigation shall be retained on the areas of use and shall not be allowed to escape as surface flow, except as provided for in a National Pollutant Discharge Elimination System (NPDES) Permit.

For the purpose of this requirement, however, minor amounts of irrigation return water from peripheral areas shall not be considered a violation of this Order.

5. Reclaimed water shall be applied at such a rate and volume as not to exceed vegetative demand and soil moisture conditions. Special precautions must be taken to prevent clogging of spray nozzles, to prevent over-watering and to exclude the production of runoff. Pipelines shall be maintained so as to prevent leakage.

6. Reclaimed water used for irrigation shall not be allowed to run off into recreational lakes unless it meets the criteria for such lakes.
7. Reclaimed water shall not be used for irrigation within 150 feet of any water well or mineral spring.
8. At locations within the facility, along the perimeter, at points of access to the area where reclaimed water is used, signs shall be posted with the following warning: "ATTENTION: RECLAIMED WASTEWATER-AVOID CONTACT - DO NOT DRINK".

C. GENERAL REQUIREMENTS

1. The discharge or use of raw or inadequately treated sewage at any time is prohibited.
2. Reclaimed water shall not be used for irrigation during periods of extreme rainfall and/or runoff.
3. Standby or emergency power facilities and/or sufficient capacity shall be provided for reclaimed water storage during rainfall or in the event of plant upsets or outages, and at times when spray irrigation cannot be practiced.
4. Reclaimed water use or disposal shall not result in earth movement in geologically unstable areas.
5. Adequate facilities shall be provided to protect the sewage treatment and reclamation facilities from damage by storm flows and runoff.
6. Adequate freeboard shall be maintained in the reclaimed water holding pond to ensure that direct rainfall will not cause overtopping.
7. Neither treatment of waste nor any reclaimed water use or disposal shall cause pollution or nuisance.
8. Water reclamation and reuse or disposal shall not result in problems due to breeding of mosquitoes, gnats, midges, or other pests.

9. Reclaimed water use or disposal shall not impart tastes, odors, color, foaming, or other objectionable characteristics to receiving groundwater.
10. Reclaimed water use or disposal, which could affect receiving groundwater, shall not contain any substance in concentrations toxic to human, animal, or plant life.
11. Odors of sewage origin shall not be perceivable beyond the limits of the property owned or controlled by the Reclaimer.
12. At a minimum, a certified Grade IV Wastewater Treatment Plant Operator shall inspect the treatment plant, on a weekly basis, to ensure that the treatment processes are working properly, and that the plant effluent wastewaters are in compliance with this Order.

D. PROVISIONS

1. A copy of these requirements shall be maintained at the reclamation and discharge facilities so as to be available at all times to operating personnel.
2. In accordance with Section 13522.5 of the California Water Code, and Section 60323 of the Wastewater Reclamation Criteria, the Reclaimer shall file an engineering report, prepared by a properly qualified engineer registered in California, of any material change or proposed change in character, location or volume of the reclaimed water or its uses to the Regional Board and to the State Department of Health Services.
3. The Reclaimer and User shall file with the Board technical reports on self-monitoring work performed according to the detailed specifications contained in the Monitoring and Reporting Program, as directed by the Executive Officer.

The results of any monitoring done more frequently than required at the locations and/or times specified in the Monitoring and Reporting Program shall be reported to the Regional Board.

4. The Reclaimer and User shall notify this Board, by telephone within 24 hours, of any violations of reclaimed water use conditions or any adverse conditions as a result of the use of reclaimed water from this facility; written confirmation shall follow within one week.
5. The Reclaimer and User shall notify Board staff, by telephone, immediately, of any confirmed coliform counts that could cause a violation of the Waste Discharge Requirements, including the date(s) thereof. This information shall be confirmed in the next monitoring report; in addition, for any actual coliform limit violations that occurred, the report shall also include the reasons for the high coliform results, the steps being taken to correct the problem (including dates thereof), and steps been taken to prevent a recurrence.
6. These requirements do not exempt the Reclaimer and/or User from compliance with any other laws, regulations, or ordinances which may be applicable; they do not legalize this reclamation and discharge facilities, and they leave unaffected any further constraint on the use of reclaimed water at this site which may be contained in other statutes or required by other agencies.
7. The Reclaimer shall be responsible to ensure that all users of reclaimed water comply with the specifications and requirements for such use.
8. This Order does not alleviate the responsibility of the Reclaimer or User to obtain other necessary local, state, and federal permits to construct facilities necessary for compliance with this Order; nor does this Order prevent imposition of additional standards, requirements, or conditions by any other regulatory agency. Expansion of this facility from its current capacity shall be contingent upon issuance of all necessary permits, including a Conditional Use Permit.
9. For any extension or expansion of the reclaimed water discharge system, the User shall submit a report detailing the extension or expansion for the approval of the Executive Officer. Following construction, as-built drawings shall be submitted to the Executive Officer for approval prior to use of reclaimed water.

10. The Reclaimer shall submit to the Regional Board, within 60 days of the adoption of this Order, procedures that will be (or have been) taken to ensure that discharge of untreated sewage from the treatment facility, in the event of equipment failure, will not occur.
11. Raw sewage or partially dried waste sludge shall not be sprayed on ground surface.
12. Any offsite disposal of sewage sludge shall be made only to a legal point of disposal, and in accordance with provisions of Division 7.5 of the California Water Code. For the purpose of these requirements, a legal point of disposal is defined as one for which Waste Discharge Requirements have been established by a California Regional Water Quality Control Board, and is in full compliance therewith.
13. Any discharge of reclaimed water at any point(s) other than specifically described in this Order is prohibited, and constitutes a violation of the Order.
14. After notice and opportunity for a hearing, this Order may be terminated or modified for cause, including, but not limited to:
 - (a) Violation of any term or condition contained in this Order;
 - (b) Obtaining this Order by misrepresentation, or failure to disclose all relevant facts;
 - (c) A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.
15. The Reclaimer and User shall furnish, within a reasonable time, any information the Regional Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order. The Reclaimer and User shall also furnish to the Regional Board, upon request, copies of records required to be kept by this Order.

16. The Reclaimer and User shall take all reasonable steps to minimize or prevent any discharge that has a reasonable likelihood of adversely affecting human health or the environment.
17. Bypass (the intentional diversion of waste streams from any portion of a treatment facility) is prohibited. The Regional Board may take enforcement action against the Reclaimer for bypass unless:
 - (a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage. (Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.);
 - (b) There were no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated waste, or maintenance during normal periods of equipment down time. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that could occur during normal periods of equipment downtime or preventive maintenance; and
 - (c) The Reclaimer submitted a notice at least ten days in advance of the need for a bypass to the Regional Board.

The Reclaimer may allow a bypass to occur that does not cause reclaimed water limitations to be exceeded, but only if it is for essential maintenance to ensure efficient operation. In such a case, the above bypass conditions are not applicable.

Las Virgenes Municipal Water
District and Pepperdine University
Order No. 94-055

Files Nos. 64-104 & 70-060

18. The Reclaimer and User shall establish a responsible party to comply with this Order and the monitoring and reporting program. This information shall be provided to the Board at least 30 days of receiving this Order.

Thereafter, the responsible party must notify the Board, in writing, at least 30 days in advance of any proposed transfer of this Order's responsibility and coverage to a new Reclaimer and/or User. The notice must include a written agreement between the existing and new Reclaimer containing a specific date for the transfer of responsibility under this Order and compliance between the current and new Reclaimer and/or User.

19. This Order includes "Standard Provisions Applicable to Waste Discharge Requirements". If there is any conflict between provisions stated herein and the "Standard Provisions Applicable to Waste Discharge Requirements", these provisions stated herein will prevail.

E. RESCISSION

Order No. 86-97, adopted by this Board on November 24, 1986, is hereby rescinded.

I, Robert P. Ghirelli, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a revised Order adopted by the California Regional Water Quality Control Board, Los Angeles Region, on June 13, 1994.

Robert P. Ghirelli

ROBERT P. GHIRELLI, D.Env.
Executive Officer

/MB

Attachment B



October 8, 2009

Rhiannon Bailard
Assistant Vice President, Governmental & Regulatory Affairs
Director, Center for Sustainability
Pepperdine University
24255 Pacific Coast Highway
Malibu, California 90263

Re: Response to RWQCB Resolution R4-2009-XX;
Proposed Amendment to the Water Quality Control Plan for the Coastal Watersheds of
Ventura and Los Angeles Counties to Prohibit On-Site Wastewater Disposal Systems in the
Malibu Civic Center Area

Dear Ms. Bailard:

Daniel B. Stephens & Associates, Inc. (DBS&A) has reviewed the Regional Water Quality Control Board (RWQCB) proposed amendment to the *Water Quality Control Plan for the Coastal Watersheds of Ventura and Los Angeles Counties* to prohibit on-site wastewater disposal systems in the Malibu Civic Center area. We have also reviewed the supporting technical memoranda, and the *Risk Assessment of Decentralized Wastewater Treatment Systems in High Priority Areas in the City of Malibu, California* by Stone Environmental, Inc (SEI) (2004), which serves as the technical basis for much of the proposed amendment.

Personal and Company Background

I am a Principal Hydrogeologist and Senior Vice President with DBS&A in Goleta, California (see attached résumé for in-depth professional and technical background). DBS&A has conducted technical aspects of the University's Hydrogeologic Monitoring Program (HMP) since the year 2000. The HMP was initiated in late 1987 with the objective of guiding and ensuring responsible and efficient water use that has no adverse effect on Pepperdine University's Malibu campus or the surrounding environment. With the goal of monitoring and documenting water use on campus, the HMP prescribes monitoring of precipitation, irrigation, runoff, evapotranspiration, soil moisture content, and shallow and deep groundwater elevations. Data on individual parameters that effect campus irrigation are regularly collected on hourly to monthly intervals (depending on the parameter). The data are synthesized and reported on a semiannual basis to the Los Angeles RWQCB.

Comments to RWQCB Resolution R4-2009-XX

Based on the findings of SEI (2004) and the results of Pepperdine's HMP, we find it unlikely that the University is contributing to the water quality degradation found in the Civic Center area. The basis for this opinion is provided below.

Daniel B. Stephens & Associates, Inc.

5951 Encina Rd., Suite 208 805 683-2409

Goleta, CA 93117 FAX 805 683-2419

Reason 1

The University irrigates with tertiary-treated effluent ("recycled water" under Title 22, California Code of Regulations) that is received from either Malibu Mesa or Tapia Treatment Plants. Recycled water does not pose the water quality threat of septic systems or other raw-sewage disposal systems. For example, recycled water discharged from Malibu Mesa to Pepperdine is required by RWQCB Order No. RS-2007-0002 to contain less than 10 milligrams per liter (mg/L) of nitrogen (nitrate + nitrite).

Reason 2

Recycled water is applied to vegetated portions of campus only. Travel through the root zone is known to decrease levels of nutrients by plant uptake.

Reason 3

Recycled water is applied to areas that lie between approximately 28 and 100 feet above the closest water table. Percolation through a thick vadose zone is known to decrease levels of pathogens.

Reason 4

Groundwater beneath the Pepperdine Campus flows either south through Winter Mesa toward the Pacific Ocean, or southeast, through Alluvium in Winter Canyon. SEI found that travel times from Pepperdine to the Pacific Ocean through Winter Canyon Alluvium are on the order of 10 to 30 years. Groundwater travel times across Winter Mesa are unknown, but they are likely to be similar because the distance, hydraulic gradient, and geologic materials are all similar to those found in the Winter Canyon flow path. It is very unlikely that pathogens and nutrients found at the low levels that exist in recycled water would remain after 10 to 30 years.

Reason 5

The Pepperdine HMP performs campus-wide monitoring of recycled water use through a combination of water metering, climate monitoring, soil moisture measurements, groundwater level measurements, and water balance modeling. The intention of the HMP is to ensure that irrigation is conducted in a manner that avoids, to the maximum extent possible, any contribution of irrigation water to the groundwater system underlying the University. Pepperdine Irrigation Services Staff use HMP data to guide irrigation practices and to help ensure that no more water is added to the vegetation than is required for their health and to meet water consumptive use requirements driven by vegetation evapotranspiration.

Reason 6

Historical groundwater elevation data from the HMP indicate that groundwater elevations are inversely related to irrigation and directly related to precipitation; water levels generally decrease during the high irrigation summer months and increase during the low irrigation (and high precipitation) winter months.

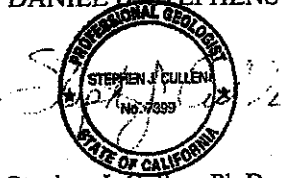
In summary, due to the relatively high quality of water used for irrigation, plant nutrient uptake, thick vadose zone, long groundwater travel times, and lack of groundwater level response to

Ms. Rhiannon Bailard
October 8, 2009
Page 3

irrigation, we find it unlikely that Pepperdine is adversely impacting water quality in the Civic Center area.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.



Stephen J. Cullen, Ph.D., PG (CA)
Senior Vice President

SJC/rpf
Attachment



Daniel B. Stephens & Associates, Inc.

Stephen J. Cullen, PhD, PG (CA), REA II, CPSS, CEM (NV)

Specialization

Dr. Cullen is a Principal Hydrogeologist with the firm with over 30 years experience. Areas of expertise include hydrocarbon and halocarbon site investigations, contaminant source identification, hazardous and solid waste landfill investigations and monitoring systems, metals and radionuclide investigations, land disposal of biosolids and sewage effluent, vadose zone and groundwater flow and transport modeling, land treatment facilities, intrinsic bioremediation as well as active approaches to soil and groundwater remediation. Expert opinions and testimony: resolution of a wide range of groundwater and vadose zone characterization, monitoring, and remediation problems.

Academic Degrees

Ph.D., Geography, University of California at Santa Barbara, 1996

Dissertation title: Field and Laboratory Investigations of Contaminant Natural Attenuation and Intrinsic Remediation in Soils and the Vadose Zone

M.Sc., Soil Physics, Montana State University, 1981

B.Sc., Soil Science and Hydrology, University of California at Davis, 1977

Professional Registration

California Professional Geologist, No. 7399

California Registered Environmental Assessor – Level II, REA II- No. 20107

Certified Environmental Manager, State of Nevada, No. 1839

Certified Professional Soil Scientist, Reg. No. 03169, ARCPACS

Registered Nuclear Soil Water and Density Gauges, CPN No.19336

Representative Professional Assignments

- ◆ *Expert Panel Member, Single-Shell Tank Integrity Program (SSTIP), U.S. Department of Energy Facility at Hanford, Washington.* Sits on panel of experts tasked with providing leak integrity and structural integrity recommendations to guide implementation of an enhanced SSTIP for the River Protection Project. The SSTs at Hanford have been used to store up to 56 million gallons of high-level radioactive waste until future site closure is implemented. Dr. Cullen provides expertise on soils and the vadose zone.
- ◆ *Principal Hydrogeologist, Investigation of Historic Sources of Arsenic, Basic Remediation, Inc., Henderson, Nevada:* Reviewed and assessed the site data, along with historical and current site conditions, to determine if the presence of arsenic is anthropogenic or naturally occurring. Evaluated site geology (including pedogenic, hydrogeologic and geochemical site conditions), summarized and evaluated site use history (including potential anthropogenic sources and potential arsenic mobilization and/or accumulation mechanisms), and conducted supplemental sampling and lab analyses.
- ◆ *Principal Hydrogeologist, Investigation of Sulfometuron methyl pesticide (SM) movement in rangeland soils, farm plaintiff group, Southeastern Idaho.* Evaluated the subsurface environmental fate of SM after aerial application to rangeland. Conducted vadose zone flow and transport modeling using Hydrus-1D to simulate the movement of water and contaminant in the subsurface. Evaluated effect of farm tillage and irrigation on SM leaching. Wrote expert rebuttal reports, gave expert deposition testimony, and provided expert testimony in federal court.



Daniel B. Stephens & Associates, Inc.

Stephen J. Cullen, PhD, PG (CA), REA II, CPSS, CEM (NV)

Representative Professional Assignments Continued

- ◆ **Principal Hydrogeologist, Investigation of Historic Sources of Solvent Releases, Crown City Plating Company, El Monte, California.** Provided historical review and evaluation of soil, soil vapor, and groundwater data to determine the location and timing of solvent releases relative to insurance coverage in place during the period of operational activity. Provided consultation and expert trial testimony.
- ◆ **Principal Hydrogeologist, Wastewater Holding Pond Evaluation, Confidential Wastewater Agency, CA.** Evaluated the integrity of wastewater pond liners; evaluate potential impacts of pond effluent on vicinity water production wells; development of monitoring program to evaluate groundwater quality over time; reporting and consultation with staff and Board of Directors.
- ◆ **Principal Hydrogeologist, CERCLA-compliant Hydrogeologic Characterization, Magnesium Processing and Chemical Production and Distribution Effluent Disposal Facility, Basic Management, Inc., Henderson, Nevada:** Lead hydrogeologist for program to characterize impacted soil and groundwater on a 2,332-acre redevelopment site including: Interpretation of geologic, soil, groundwater, hydrologic, chemical, and geotechnical data to support the description of the conceptual site model; design and oversight of intrusive field investigation utilizing multiple drilling techniques; characterization of multiple aquifers; development of site-specific soil background concentrations for metals (including arsenic) and radiochemicals; design and oversight of an aquifer testing and soil hydraulic testing program; manage development and QA of analytic and numerical groundwater flow and contaminant fate and transport models; participation in public accountability meetings with technical, legal, and public representatives of State, County, and City governments, other potentially responsible parties, and the local citizen Remediation Advisory Board; database and GIS development and support. Site Closure Plan approved by NDEP.
- ◆ **Principal Hydrogeologist, CERCLA-compliant Hydrogeologic Characterization, Corrective Action Management Unit (CAMU), Basic Management, Inc., Henderson, Nevada:** Lead hydrogeologist for program to characterize impacted soil and groundwater in support of permitting of a 114-acre CAMU proposed to receive waste soils resulting from remediation of a nearby redevelopment site. Work included: Interpretation of geologic, soil, groundwater, hydrologic, chemical, and geotechnical data to support the description and reporting of the hydrogeologic conceptual site model; design and oversight of intrusive field investigation utilizing multiple drilling techniques; characterization of multiple aquifers; development of site-specific soil background concentrations for metals (including arsenic) and radiochemicals; fate and transport analysis of Site and Off-Site impacts; review and analysis of Groundwater Treatment system performance; participation in public accountability meetings with technical, legal, and public representatives of State, County, and City governments, other potentially responsible parties, and the local citizen Remediation Advisory Board; database and GIS development and support.
- ◆ **Principal Hydrogeologist, remediation of lead-impacted soils, Havlik Group, Santa Barbara, CA:** Site investigation, regulatory negotiations, risk assessment, statistical analysis, groundwater monitoring, fate and transport analysis, remedial action plan developed to conduct hot spot excavation beneath existing structure.
- ◆ **Principal Hydrogeologist, remedial alternatives evaluation of VOC-impacted soils, Confidential Client, Richmond, CA.** Evaluation of the technical and financial feasibility of conducting 1) In-Situ Thermal Desorption (ISTD) and 2) Excavation with Off-Site Disposal to remediate chlorinated hydrocarbons at a site adjacent to the San Francisco Bay ("bay muds") and slated for redevelopment. Tasks included: current and historical geologic/hydrogeologic data evaluation; calculation of seepage velocity; evaluation of the presence of DNAPL; evaluate compliance with CERCLA and the National Contingency Plan (NCP); remedial cost estimation and evaluation; estimation of remedial volumes and removed



Stephen J. Cullen, PhD, PG (CA), REA II, CPSS, CEM (NV)

Representative Professional Assignments Continued

- groundwater; evaluate remedial performance monitoring alternatives; evaluate compliance with Regional Water Quality Control Board orders. Settlement achieved, and the Site is undergoing redevelopment.
- ◆ **Principal Hydrogeologist, RI/FS Remedial Alternatives, Operable Unit No. 2, Confidential Client, Brown & Bryant Superfund Site, Arvin, California.** Evaluation and comment as to the technical and financial feasibility of conducting Pump and Treat in a shallow aquifer, Monitored Natural Attenuation (MNA) in a deeper aquifer, and removal of a deep municipal supply well as a mean of remediation and prevention of exposure to chloroform, 1,2-DCBP, 1,2-DCP, 1,3-DCP, Dinoseb, EDB, and 1,2,3-TCP. Task included: remedial cost evaluation; historic geologic/hydrogeologic data evaluation; municipal well abandonment protocols evaluation and recommendation; surface cap effectiveness evaluation; surface runoff evaluation; fate and transport analysis. Comments submitted to EPA on behalf of client.
 - ◆ **Chlorinated Hydrocarbon Site Characterization, Remediation, and cost evaluation, Confidential Client Aerospace Manufacturer, Santa Ana, California.** Evaluated historical environmental sampling data and interpreted fate and transport of site constituents at a former electronics and aerospace manufacturing facility operational since 1959; researched historical regulatory & commercial documents to interpret use of chemicals at site; evaluated site characterization data to adequacy as the basis for remedial cost estimation; prepared remedial action plan that proposed enhanced bioremediation of PCE, TCE, Freon-113 and related breakdown products; provided an federal court expert opinion report and deposition testimony; directed groundwater flow (MODFLOW96) and PCE transport (MT3DMS) modeling (GWVISTAS pre/post processor) to quantify PCE travel time to the supply well perforations under various assumed hydraulic conditions; client achieve favorable settlement.
 - ◆ **Principal Hydrogeologist, basin-scale perchlorate groundwater investigation, Confidential Client:** Basin-scale groundwater investigation, vadose zone source identification, forensic data analysis, flow and transport analysis, source identification, remediation alternatives study, regulatory negotiation, client consultation.
 - ◆ **Principal Hydrogeologist, former illegal methamphetamine lab, Solvang, CA:** Forensic data analysis, regulatory negotiation, assisted client with closeout of regulatory case file. Residential redevelopment proceeded.
 - ◆ **Technical Specialist, CERCLA remedial investigation, Pantex Plant, Carson County, Texas, Department of Energy:** Feasibility study and implementation, conceptual site model development, design, test and implement soil vapor extraction system for chlorinated hydrocarbon soil impacts. Remediation O&M ongoing.
 - ◆ **Technical Specialist, design and implementation of innovative in-situ TCE remediation, Garden Plaza, Santa Barbara, California:** In-situ remediation of tetrachloroethene via electron donor injection in a guaranteed-price remediation program in support of Site redevelopment. Site closure granted by Regional Water Quality Control Board and site is redeveloped as retail shopping center.
 - ◆ **Technical Specialist, innovative reduction of ammonia IDLH health and safety hazard, Equilon Lube Plant, Carson, California:** Designed in-situ vadose zone remediation via hydrolysis used to induce transformation of the ammonia gas to the nongaseous ammonium at an industrial redevelopment site. Ammonium was oxidized to nitrate that subsequently served as electron acceptor for biodegradation of benzene in underlying groundwater. IDLH conditions removed such that Level D excavation and redevelopment activities proceeded.
 - ◆ **Principal Hydrogeologist, Texaco Exploration and Production, Inc., Santa Maria California:** Site Characterization, Feasibility Study, Remedial Action Plan, Statistical Sampling Design and Analysis,



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Representative Professional Assignments Continued

- Modeling, Expert Testimony, Oilfield Restoration. Site closure and redevelopment achieved. Jury verdict rendered. Trial defense named one of the Top 20 Defense Cases in 2002 by the National Law Journal.
- ◆ **Principal Project Hydrogeologist, Chlorinated Hydrocarbons, Aerospace and Electronics manufacturing, Litton Industries, Santa Clara, California:** Forensic Data Evaluation, Fate and Transport Analysis, expert testimony. Settlement achieved.
 - ◆ **Principal Hydrogeologist, Chlorinated Hydrocarbons, Norvell Bass Dry Cleaner, Santa Barbara, California:** Site Characterization, Remedial Design Development, Cost Allocation, Expert Testimony. Settlement achieved. Site is currently undergoing redevelopment.
 - ◆ **Principal Hydrogeologist, Chlorinated Hydrocarbons, Aerospace Manufacturing Facility, Rockwell Collins, Santa Ana, California:** Site Characterization, Forensic Data Evaluation, Remedial Design Development, Remedial Action Plan, Remedial Cost Estimation, Expert Testimony at redeveloped industrial site. Settlement achieved.
 - ◆ **Principal Project Hydrogeologist, Hydrogeologic Site Characterization, Confidential Client, Santa Barbara, California:** Evaluation of conditions conducive to Mold Invasion in a coastal multi-unit dwelling, hydrogeologic assessment, aerial photo evaluation, calculation of water vapor flux through concrete, Expert Testimony. Judgment verdict rendered.
 - ◆ **Principal Project Hydrogeologist, Chlorinated Hydrocarbons, Law Office of DeLoreto and DeLoreto, Dutch Maid Dry Cleaners, Santa Barbara, California:** RCRA remedial investigation, DNAPL sampling, limited access indoor soil matrix and soil vapor sampling, development of site conceptual model, aquifer testing, groundwater monitoring well network design, geologic fault investigation, feasibility study, remedial design, treatability study, soil vapor pilot testing, soil excavation, indoor air sampling, forensic data evaluation, fate and transport analysis, expert testimony, regulatory negotiation. Settlement achieved.
 - ◆ **Principal Project Hydrogeologist, Gasoline Service Stations, Petroleum Hydrocarbons, UNOCAL, Stockton, California:** RCRA remedial investigation, remedial alternatives evaluation for petroleum hydrocarbons, Corrective Action Plan development, Intrinsic Bioremediation Study, regional hydrogeologic characterization, evaluation of saltwater intrusion, client consultation, expert testimony to California State Water Resources Control Board. Site granted MNA status.
 - ◆ **Principal Project Hydrogeologist, chlorinated hydrocarbons, aerospace manufacturing site, Hawker Pacific, Inc., Sun Valley, California:** RCRA remedial investigation, remedial alternatives study, regional hydrogeologic and contaminant plume investigation, 3-D vadose zone modeling, litigation support, presentation to Special Master. Site closure achieved; settlement achieved.
 - ◆ **Principal Project Hydrogeologist, petroleum hydrocarbon, Kern County School District, Bakersfield, California:** RCRA remedial investigation, feasibility study, soil vapor/air sparging extraction pilot test, in-situ bioremediation.
 - ◆ **Principal Project Scientist, Irvine Bus Base Closure, Orange County Transit Authority, Irvine, California:** Groundwater monitoring, geochemical analyses and evaluation for bioattenuation activity, free product removal evaluation, MTBE evaluation, dissolved phase diesel plume remediation, regulatory negotiations. Site closure achieved.
 - ◆ **Principal Hydrogeologist, former aerospace manufacturing facility, AlliedSignal, Los Angeles, California:** RCRA remedial investigation, feasibility study, fate and transport analysis (including assessment of the effects of the West Coast Basin saltwater intrusion barrier wells), and conceptual remedial action plan of soils and multiple aquifers impacted by chlorinated hydrocarbons, petroleum hydrocarbons, 1,4-dioxane adjacent to LAX. Evaluation of historic aquifer testing data. Evaluation of



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Representative Professional Assignments Continued

- offsite impacts; evaluation of potential downgradient liabilities. Pilot and treatability testing included soil vapor extraction, dual phase extraction, groundwater circulation wells, and enhanced in-situ bioremediation followed by polishing with monitored natural attenuation. Remedial action objectives successfully negotiated with LA Regional Water Quality Control Board.
- ◆ **Principal Hydrogeologist, former aerospace facility, AlliedSignal Aerospace Equipment Systems, Rancho Dominguez, California:** RCRA remedial investigation to delineate the extent of chlorinated VOC impacts to groundwater and the feasibility of remediation by monitored natural attenuation (MNA). Site closure achieved.
 - ◆ **Principal Hydrogeologist, perchlorate treatability study, Edwards Air Force Base, California:** Environmental tracer study of long-term recharge rates in the Mojave Desert using chloride balance method, bomb tritium, CFC profile analysis, unsaturated flux calculation. Results submitted to Army Corp of Engineers; presentation to California Groundwater Association.
 - ◆ **Project Hydrogeologist, DBCP Impacts to Groundwater; FMC Corp., multiple locations, USA:** Forensic data analysis, vadose zone fate and transport modeling, insurance cost recovery evaluation.
 - ◆ **Principal Hydrogeologist, Sulfofeturon methyl (SM) pesticide migration and crop damage, multiple farm corporations, Southern Idaho.** Designed and conducted vadose zone numerical modeling study of a rangeland applied post-fire pesticide application using Hydrus-2D. Evaluated V2DT modeling work, wrote two expert opinion reports, deposition testimony. Site reconnaissance and court testimony are scheduled.
 - ◆ **Principal Project Hydrogeologist and Team Leader, multiple locations in Arizona, California, Nevada, New Mexico; New York Orion Power Holdings, LLP.** Power generation asset acquisition due diligence, manage air emissions control evaluation, hydrogeologic environmental site assessment, remedial cost estimation, assess NPDES requirements, evaluate seller EIRs, participate in asset auction bid preparation, manufactured gas plant, steam and combustion turbines, ..
 - ◆ **Principal Project Hydrogeologist, chlorinated hydrocarbons, historic manufacturing activities, Confidential Regional Medical Center, Los Angeles Metro Area:** Real estate development due diligence and acquisition consultation, property historical research, environmental compliance assessment, streamlined feasibility study and remedial cost estimation; developed 3-scenario remedial economic/risk analysis. Property purchased.
 - ◆ **Principal Hydrogeologist, Intrinsic Remediation Sites, Texaco, Victorville, California; Roadway, Fresno, California:** Demonstrated viability of intrinsic natural attenuation mechanisms at two operating service stations (Texaco) and an operating trucking terminal (Roadway) to remediate petroleum hydrocarbons. Utilized innovative monitoring networks including soil vapor monitoring, barometric and thermal monitoring, neutron monitoring, and numerical fate and transport modeling that coupled vadose zone and groundwater transport. Site closures achieved.
 - ◆ **Technical Specialist, Refinery Remediation, Bakersfield Refinery, Bakersfield, California.** Designed a pilot soil vapor extraction test along with vapor recovery by condensation and return to refinery operations; developed final design of a remediation recovery system for petroleum reformate impacting the vadose zone and groundwater (annual fluctuations up to 100 feet). Final extraction system design addressed impacted soils 90 feet deep over an area 25 acres in size. Enhanced by air sparging, the system has recovered over 1.5 million gallons of petroleum reformate from the well field.
 - ◆ **Principal Hydrogeologist, waste soil pile remedial investigation, Bakersfield, California.** Directed CERCLA-based remedial investigation at a former waste recycling/treatment facility for soils impacted by



Stephen J. Cullen, PhD, PG (CA), REA II, CPSS, CEM (NV)

Representative Professional Assignments Continued

metals, VOCs chlorinated hydrocarbons, petroleum hydrocarbons, fuel oxygenates, semivolatile organic compounds (SVOC), polynuclear aromatic hydrocarbons (PAH), PCBs, pesticides, and herbicides. Developed an innovative field-sampling plan using a custom-made hybrid between a direct push rig and an extending fork lift to extract samples. Conducted a statistical analysis of the sampling data used to identify the appropriate method of waste disposition. Remediation by excavation and off-site treatment. Communicated with PRP group and interacted with DTSC.

- ◆ **Technical Specialist, EG&G, Rocky Flats Nuclear Manufacturing Facility, Colorado.** Principal reviewer of performance evaluation modeling of vadose zone and groundwater modeling to assess viability of remediation by entombment of radionuclides and mixed wastes under alternative cap at low-level radioactive waste disposal site, Rocky Flats plant, Colorado.
- ◆ **Principal Investigator, metals soil column study, Springfield Township Committee, Springfield, Michigan.** Managed controlled laboratory study to design, implement, and report on comparison of soil column leaching to the Synthetic Precipitation Leachate Procedure batch testing methodology (EPA Method 1312). Demonstrated attenuation of metals and PCB's within soil media through soil sorption.
- ◆ **Technical Specialist, petroleum hydrocarbon fate and transport analysis, Farmland Industries, Coffeyville, Kansas.** Modeled the potential impacts to groundwater of residual vadose zone concentrations of petroleum hydrocarbons at an 85-year old refinery operated by Farmland Industries in Coffeyville, Kansas.
- ◆ **Technical Specialist and Reviewer, DTSC California school siting, William S. Hart Union School District, Santa Clarita, California.** Preliminary Endangerment Assessment (PEA). Project challenges included: rugged inaccessible terrain; oil drilling and production, and explosives manufacture and testing on adjacent properties; active community participation in the siting process; and an aggressive overall construction schedule. Ambient air monitoring systems were deployed at strategic site locations. Over 100 soil and 150 soil-gas samples collected from over 50 borings within and around the 50-acre school site. Based on the project findings, the school district funded the final construction of the school.
- ◆ **Technical Specialist, low-level radioactive waste disposal, EG&G, Rocky Flats Nuclear Manufacturing Plant, Golden, Colorado.** Designed a vadose zone characterization and monitoring program. Identified contaminant release sources, developed conceptual model of the subsurface geology, mechanisms and pathways for contaminant migration, candidate remedial approaches, and viable monitoring approaches during closure and post closure. Contaminants of concern included nitrates and a variety of actinides.
- ◆ **Principal Hydrogeologist, biosolids land application, City of Santa Barbara, Santa Ynez, California.** Evaluated suitability of the land application of dewatered anaerobically digested sewage sludge. Developed model to calculate, assess, and forecast nitrogen balance for the site. Made recommendations for site-specific agronomic loading rate, Determined maximum annual and cumulative biosolids application rates. Designed and implemented a surface-water, groundwater, soils, and soil pore liquids monitoring system.
- ◆ **Principal Project Hydrogeologist, TCE Joplin, Missouri:** Ball bearing manufacturing site, fate and transport analysis in area of karst hydrogeology, litigation support.
- ◆ **Principal Project Hydrogeologist, pesticide formulation and distribution site, Great Lakes Chemical, Irvine, California:** Fate and transport analysis, forensic data evaluation. Allocation of liability.
- ◆ **Collaborating Principal Investigator and Co-Author, Lawrence Livermore Reports, State of California:** State Water Resources Control Board, University of California and Lawrence Livermore National Laboratory Study, State-wide Investigation of Leaking Underground Fuel Tanks Impact on Groundwater.



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Stephen J. Cullen, PhD, PG (CA), REA II, CPSS, CEM (NV)

Representative Professional Assignments Continued

Conducted study that determined that passive bioremediation of petroleum hydrocarbons leaked from underground fuel tanks is an effective alternative to active engineered remediation approaches. As a result of the study, the State Water Resources Control Board recommended to its nine regional water boards that passive remediation should be considered the primary remediation tool in most cases once the fuel leak source has been removed.

- ◆ **Collaborating Principal Investigator for Multi-Agency Petroleum Hydrocarbon Remediation Demonstration Project, Department of Defense (DOD) sites throughout the state of California:** Conducted site inspections and met with base civilian and military personnel. Participated in expert panel demonstration of innovative and alternative risk-based cleanup strategies and recommended alternative innovative remediation approaches to cleanup petroleum hydrocarbons that contaminated soils and groundwater at the respective base sites.
- ◆ **Technical Specialist, petroleum hydrocarbon fate and transport, Western States Petroleum Association, California.** Initiated study to determine fate and transport of heavy crude oil products and byproducts and coordinated exchange of data with the American Petroleum Institute in Washington, DC.
- ◆ **Technical Specialist, vadose zone monitoring, US EPA, Alton, Missouri.** Demonstrated and installed a vadose zone monitoring system at a Superfund hazardous waste land treatment site for polychlorinated biphenyls (PCB).
- ◆ **Technical Consultant, national lab site characterization, Lawrence Livermore National Laboratory, Livermore, California.** Served as reviewer and consultant to LLNL, designed infiltration experiment to determine the influence of precipitation on the migration of chemicals, including radionuclides, through the vadose zone. Developed laboratory protocols for hydrologic testing of soil core samples
- ◆ **Principal Investigator, tritiated water vapor diffusion, University of California, Santa Barbara.** Designed an experiment to measure diffusion coefficients of tritiated water vapor in undisturbed soil cores.
- ◆ **Principal Hydrogeologist, heap leach mining, confidential client, Kingman, Arizona.** Managed installation, testing, and reporting of vadose zone monitoring systems including suction lysimeters and gypsum block arrays for a heap leach mining facility in Kingman, Arizona.
- ◆ **Principal Investigator, vadose zone monitoring, Santa Barbara County, Santa Ynez, California.** Provided neutron moderation logs to document background soil moisture conditions in the vadose zone below a leaking underground storage tank contaminating groundwater at Santa Ynez Airport.
- ◆ **Technical Specialist, tritium migration modeling, Brookhaven National Laboratory, Upton, New York.** Modeled and provided opinion of the significant factors affecting tritium migration beneath the High Flux Beam Reactor at Brookhaven National Laboratories.
- ◆ **Principal Investigator, USEPA, Santa Barbara, California.** Supervised a comparison of three functional forms for representing soil moisture characteristic curves.
- ◆ **Technical Specialist, vadose zone transport modeling, Spokane Regional Solid Waste Disposal Project, Spokane, Washington.** Developed and wrote a predictive scenario model to approximate the time-dependent travel distance of a wetting front below a breach in an earthen liner at three potential solid waste landfill disposal sites.
- ◆ **Principal Investigator, Geographic Information System, Multiple Agencies, Santa Barbara County, California:** Developed an interagency cooperative agreement between UCSB, USEPA, the US Bureau of Reclamation, and the US Air Force Space Command to develop GIS suitable for use in decision-making in ground water and vadose zone characterization and remedial investigations.



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Stephen J. Cullen, PhD, PG (CA), REA II, CPSS, CEM (NV)

Representative Professional Assignments Continued

- ◆ **Principal Investigator, Geographic Information System (GIS), Vandenberg Air Force Base.** Conducted a one-day GIS workshop at VAFB on developing groundwater and vadose zone remedial action plans. Subsequently managed development of GIS suitable for use in decision-making in ground water and vadose zone characterization and remedial investigations. Designed a GIS to facilitate remediation of approximately 1,000 underground storage tanks (USTs) at VAFB. Reviewed USBR field investigation strategies and protocols and served in a training capacity with respect to vadose zone hydrogeology.
- ◆ **Principal Investigator, Vadose Zone Research Laboratory, University of California, Santa Barbara.** Conducted research under USEPA cooperative agreement funding and lectured in Engineering Geology, Hydrogeology, Geography, and Environmental Engineering courses on the subject of vadose zone hydrologic processes. Conducted course instruction for upper division course on soil processes.
- ◆ **Principal Author, EPA Guidance Document, USEPA, Washington, D.C.** Wrote guidance document under RCRA Subtitle C entitled "Vadose Zone Monitoring at Hazardous Waste Sites". The work was a compilation of research efforts conducted at the Vadose Zone Monitoring Lab at the University of California at Santa Barbara.
- ◆ **Principal Author, Vadose Zone Monitoring Case Studies, USEPA.** Provided vadose zone monitoring case histories for the purpose of developing an agency position and rationale upon which national vadose zone monitoring regulatory requirements have been developed and promulgated under the RCRA.
- ◆ **Principal Author, Environmental Standards Development, ASTM.** Developed national standards for vadose zone monitoring through ASTM (formerly the American Society of Testing and Materials) and served as task force leader for D-18.04 Hydrologic Properties of Soil - Laboratory Techniques. Authored or co-authored four national standards:
 - ◆ Standard Test Method for the Determination of a Soil Water Retention Curve by Pressure Plate Extraction, ASTM D2325
 - ◆ Standard Test Method for the Determination of Soil Water Retention Curve by Pressure Membrane Extraction, ASTM D3152
 - ◆ Standard Guide to Soil Pore-Liquid Sampling in the Vadose Zone
 - ◆ Standard Guide to Soil Core Sampling in the Vadose Zone, and reviewed numerous others
- ◆ **Principal Investigator, lysimeter evaluation, USEPA.** Evaluated use of pressure-vacuum lysimeters for obtaining representative vadose zone water samples containing volatile organic compounds.
- ◆ **Principal Investigator, reclaimed water irrigation, Facilities Management, University of California, Santa Barbara.** Studied feasibility of using reclaimed wastewater for landscape irrigation.
- ◆ **Project Scientist, solid waste assessment tests, Kern County, Bakersfield, California.** Participated in Solid SWAT Investigations, monitoring programs, and closure plans for landfills. Assisted with the preparation of a Report of Waste Discharge, Report of Disposal Site Information, CEQA Documents (Negative Declaration), Auto-Shredder Feasibility Study, and Infectious Waste Feasibility Study. Assisted in preparing detailed site expansion plans for both vertical and horizontal expansion of the landfill. Participated in the completion of a Final Closure Plan, Post-Closure Maintenance Plan, Vadose Zone Monitoring Program Report, Gas Monitoring Program Report, Buffer Zone Evaluation Report, Special Impact Studies, and Supplemental Groundwater Monitoring Report.
- ◆ **Principal Investigator, solid waste landfill monitoring, Calaveras County, Angels Camp, California.** Supervised installation of an innovative, automated vadose zone monitoring system at a Calaveras County solid waste landfill used remote-deployed neutron probe.



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Representative Professional Assignments Continued

- ◆ **Principal Investigator, landfill monitoring system design, Johnson Canyon Road Landfill, Monterey County.** Designed, constructed and installed a unique vadose zone monitoring system that combined direct pore-liquid, indirect pore-liquid, and soil-gas monitoring techniques with retrofit installations of these monitoring devices completed to depths of over 300 feet below grade.
- ◆ **Technical Specialist, landfill monitoring system design, Woodward Clyde, Flagstaff, Arizona.** Technical Advisor and Lead Designer for the design and installation of a vadose zone monitoring system at a landfill in Arizona. The design was notable in that it was implemented as a preventative plan and used in lieu of a groundwater monitoring system.
- ◆ **Technical Advisor, vadose zone landfill monitoring system design, Santa Barbara County, Santa Barbara County, California.** Advised Santa Barbara County Solid Waste Disposal Unit regarding application of vadose zone monitoring techniques to the groundwater monitoring strategy being developed for use at Foxen Canyon Landfill.
- ◆ **Technical Specialist, instrumentation development, Soilmoisture Equipment Corp., Santa Barbara, California.** Managed research and monitoring instrumentation product and market development for applications including hydrogeology, environmental engineering, research, well drilling, oil exploration, and natural resource management in over 50 countries.
- ◆ **Technical Specialist, landfarm monitoring system design, wood treatment facility, Alton, Missouri.** Developed instructional videotape for the USEPA Region VII Laboratory that demonstrated vadose zone monitoring techniques and methodologies.
- ◆ **Principal Laboratory Investigator, laboratory soil hydrologic studies, Oklahoma, Michigan.** Developed the conductivity-pressure head relationship for mine spoils in Oklahoma and a compacted clay liner in Michigan.
- ◆ **Principal Investigator, instrumentation design and development, USEPA.** Conceived an innovative air permeameter in which the soil-water matric potential can be precisely controlled, permitting quantification of soil air permeability under changing pore liquid content conditions. Patent pending.
- ◆ **Principal Hydrogeologist, Water Master Plan Update 2007-2008, Big Bear Community Services District, Big Bear City, CA.** Principal in charge of team that conducted work that evaluated: water system service area review; population projections and future water use, source of water supply; storage requirement reviews; water distribution systems review, analyses, and projection; update of drought contingency plan; new water systems facilities and construction costs; systems operations evaluation; improvement review; fee review; and, financing alternative review. Dr. Cullen also headed up the evaluation of long term recharge for the Big Bear Valley using the Distributed Parameters Watershed Model, a water balance approach that uses fine level of spatial discretization.
- ◆ **Principal Hydrogeologist, strategic long-term groundwater management plan, Owens Valley, Los Angeles Department of Water and Power (LADWP), Los Angeles, California.** Conducted a study of a technical groundwater management guidance protocol for the management of Owens Valley groundwater resources. Performed detailed analysis of hydrologic instrumentation used in Owens Valley, conducted mathematical analysis of the algorithms used to make groundwater pumping decisions, and evaluated the scenarios that would result from following the management protocols. Evaluated the state-of-the-art methodologies for measuring and estimating evapotranspiration. Proposed approach to the strategic management of groundwater in the Owens Valley subsequently recommended for adaptation.
- ◆ **Principal Hydrogeologist, Quantification of Nitrogen Removal, Eastern Municipal Water District (EMWD), Perris, CA.** Performed subsurface evaluation associated with recycled water storage ponds.



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Representative Professional Assignments Continued

Project involved data collection and review, conceptual modeling, pressure/vacuum lysimeter and monitoring well installation, sampling, analysis and reporting. Data evaluation demonstrated total inorganic nitrogen removal from recycled water during recharge on the order of three times the default reduction values used in Regional Water Quality Control Board (RWQCB) models. Tasks included: project design; drilling and lysimeter installation oversight; weekly and monthly monitoring and sample collection; data evaluation using comparison of boron to chloride ratios and stiff water quality diagrams comparisons to native water; control duplicate sampling; presentations of project findings to stakeholders from the RWQCB, Technical Oversight Committee, and EMWD Board and Staff personnel.

- ◆ **Principal Hydrogeologist, Watershed Management and Hydrologic Monitoring, Confidential Client, Southern California.** Oversee hydrologic monitoring program and water balance modeling effort to document and ensure that irrigation of reclaimed wastewater does not result in downslope geotechnical instability. Task included: development of a water balance model; monitoring of irrigation, ET, surface runoff, soil storage, and deep percolation; monitoring of perched and regional groundwater elevations; water quality sampling and reporting; support NPDES permit requirements; semiannual and annual reporting to regulatory agencies and community groups; general hydrologic advice regarding recycled water demand, water conservation, water quality enhancement, and operational efficiency measures aimed at saving money.
- ◆ **Principal Hydrogeologist, Installation and Testing of the Vadose Zone Monitoring System, Los Angeles County Sanitation District, Water Reclamation Facility (WRF), Effluent Management Site, Palmdale, California.** Installed and tested vadose zone monitoring instrumentation in soils receiving treated water from the Palmdale PWRP. Tasks included: project management, monitoring system design and instrumentation selection review; monitoring instrumentation testing, calibration, and installation; soil sampling and analysis; field data collection; reporting. Instrumentation included: percolation samplers; pressure/vacuum lysimeters; ECHO soil moisture sensing probes; data loggers.
- ◆ **Principal, natural resource inventory, Santa Cruz, Inc., Cazadero, California.** Performed investigation of the geologic, hydrologic, soils, and biological resources on a 3,000 acre ranch in northern California and wrote a plan to develop the water resources and a profitable agricultural enterprise.
- ◆ **Lead Scientist, agricultural and irrigation management, Various Private and Corporate Farms, Montana and South Dakota.** Supervised an interdisciplinary team that studied and consulted in the areas of dryland soil water management, irrigation management, and the use and management of pesticides.
- ◆ **Assistant Research Scientist, Hydrologic, soil and geotechnical research, U.S. Forest Service, Libby, Montana; Darby, Montana; Bozeman, Montana.** Designed, conducted, and wrote research on the effect of heavy machine traffic on the hydrologic, chemical, physical, and engineering properties of compacted soils. Lectured to introductory soil science classes and soil physics laboratory sessions.
- ◆ **Project Scientist, geologic, hydrologic, and soil resource inventory, Tongass National Forest, U.S. Forest Service, Sitka, Alaska.** Surveyed watershed resources and conducted project level planning. Wrote technical manuals on slope stability, floodplain logging, and soil and hydrologic survey work. Co-authored the first detailed soils maps of northeast Chichagof and Admiralty Islands, southeast Alaska.
- ◆ **Assistant Project Scientist, hydrologic and soil resource inventory, U.S. Bureau of Land Management, Salem, Oregon.** Conducted watershed surveys and wrote a soils handbook and map of the Mollala area and watershed in the Western Cascades with associated management guidelines. Developed a detailed map of road engineering feature the resulted in stream sediment loading.



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Additional Professional Training

OSHA 40-hour Health and Safety Training

OSHA Hazardous Waste Supervisor Training

National Groundwater Association Webinar, A Practitioner's Guide to Isotope Hydrology; NGWA Webinar No. 825, Instructor Ian Clark, PhD.

Professional Affiliations

American Society of Agronomy (ARCPACS)

American Society of Testing and Materials, 1985 - 2000

Soil and Rock Committee (full voting member)

Hydrologic Properties of Soils Subcommittee

Chairman of Task Group on Hydrologic Properties of Unsaturated Soils

Vadose Zone Monitoring Subcommittee

Waste Disposal Committee (full voting member)

Environmental Assessment of Commercial Real Estate Transactions Committee (full voting member)

Association of Groundwater Scientists and Engineers (National Groundwater Association), No. 121697

Coast Geologic Society

Groundwater Resources Association of California

Soil Science Society of America

Southern California Water Utilities Association

Professional Experience

Daniel B. Stephens & Associates, Inc., Santa Barbara Co., California, September 2004 to present
Hydrogeologist, Senior Vice President, California Operations

MWH Americas, Inc., Santa Barbara Co., California
Principal Hydrogeologist, Vice President, Domestic Energy & Infrastructure, June 2002 - September 2004
Director, National Experts Group, June 2002 to September 2004

IT/Shaw Group, Santa Barbara, California, May 2000 to August 2002
Principal Hydrogeologist, Vice President, Environment and Infrastructure

Arcadis Geraghty & Miller, Inc., Santa Barbara, California
Principal Hydrogeologist, Associate Vice President, February 1998 to May 2000
Principal Hydrogeologist, Area Operations Manager, June 1997 to February 1998
Principal Scientist, Office Manager, November 1992 to February 1998

University of California, Santa Barbara, Vadose Zone Monitoring and Research Laboratory, Institute for
Crustal Studies, Faculty, Assistant and Associate Research Hydrologist, August 1989 to 1996

Metcalf & Eddy, Santa Barbara, California, November 1990 to November 1992
Senior Environmental Scientist

Kaman Sciences Corporation, Santa Barbara, California, August 1989 to November 1990
Senior Environmental Scientist

Soilmoisture Equipment Corp., Santa Barbara, California, June 1985 to August 1989
Director of Technical Marketing and Product Development

Private Environmental Consultant, Santa Rosa, California, June 1984 to August 1985



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Professional Publications and Presentations Continued

- Steffen Robertson Kirsten, Lake County, California, March to June 1984
Geotechnical Laboratory Support, Heap Leach Mining
- Control, Inc., Webster, South Dakota, September 1981 to February 1984
Lead Soil Scientist, Consultant, and Operations Manager
- Montana State Cooperative Extension, Fairfield, Montana, May to August 1981
Extension Specialist, Irrigation Management and Nitrate Groundwater Pollution
- Montana State University, Bozeman, Montana, September 1979 to April 1981
Faculty, Assistant Research Soil Scientist
- United States Forest Service, Tongass National Forest, Sitka, Alaska, January 1978 to September 1979
Forest Soil Scientist
- United States Bureau of Land Management, Salem, Oregon, July to September, 1977
Soil Scientist
- United States Forest Service, Klamath National Forest, Seiad Valley, California, June to August, 1976
Soil, Geologic, Hydrologic, and Timber Survey Intern

Professional Publications and Presentation

- Schnaar, Gregory, and S. Cullen, 2009. *The Hydrology of Geologic Sequestration*. Southwest Hydrology, Vol. 8, No. 5, September/October 2009.
- Stephens, D.B., S. Moore, and S. Cullen, 2009. *Artificial Recharge Using Water Harvesting and Dug Wells*. Presentation to Ground Water for the Americas Conference, National Groundwater Association, Panama City, Panama, June 8 to 10, 2009.
- Kear, J., F. Manghi, S.J. Cullen, P.M. Kaiser, 2009. *Quantification of Nitrogen Removal under Recycled Water Recharge Ponds*. Invited presentation to California 09 Section Conference of the Water Reuse Association, March 22-24, 2009, Intercontinental Mark Hopkins Hotel, San Francisco, California.
- Cullen, S. J., Todd G. Umstot, and Daniel B. Stephens, 2009. *Parameter Estimation or Measurement for Vapor Transport Modeling?* Invited presentation to The 19th Annual AEHS Meeting and West Coast Conference on Soils, Sediments, and Water, March 9-12, 2009 Mission Valley Marriott, San Diego, California.
- Cullen, S.J., J. Kelsey, N. Blandford, D. Reaber, 2007. Principal Workshop Developer and Instructor, *Vadose Zone Hydrology: Principles and Practices*, two day workshop co-sponsored by Wyoming Department of Environmental Quality, Sheridan, Wyoming, October 25-26, 2007.
- Sahu, R., Cullen, S.J., M. Jones, D. Reaber, 2007. Development of a Conceptual Site Model of Chemical Migration in Groundwater Adjacent to the Las Vegas Wash, *Bringing Water To The Desert, Spring Conference, American Water Works Association*, April 19, 2007, Las Vegas, Nevada.
- Cullen, S.J., R. Sahu, M. Jones, D. Reaber, 2006. Invited speaker, Investigating Paleochannel Occurrence Near The Las Vegas Wash, *High Resolution Site Characterization & Monitoring*, California Groundwater Resources Association, November 14, 2006, Long Beach, CA



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Professional Publications and Presentations Continued

- Cullen, S.J., R. Sahu, M. Jones, D. Reaber, 2006. Invited speaker, An Investigation of Perchlorate Impacts to Groundwater in the Las Vegas Vicinity, *2006 Water Quality / Regulatory Conference*, East Valley Water District, October 26, 2006, Ontario, California.
- Cullen, S.J. 2005. Invited speaker, The Driving Force to Perchlorate Leaching: Application of Methods To Date Historic Meteoric Recharge Travel Time to Groundwater, "*Environmental Forensics: Focus on Perchlorate*", Workshop sponsored by the International Society of Environmental Forensics, La Fonda on the Plaza, Santa Fe, New Mexico, September 21- 22, 2005
- Sahu, R., S. Cullen, and M. Jones. 2005. An Update on Remedial Investigations of the BMI Site Common Areas Properties, Henderson, Nevada, presented to the BMI and Vicinity - All Companies Meeting, May 24, 2005, Henderson, Nevada.
- Cullen, S.J. 2005. Invited speaker, Theory and Application of Vadose Zone Instrumentation, *The Santa Barbara Groundwater and Vadose Zone Instrumentation Workshop*, Soilmoisture Equipment Corp., May 17, 2005, Goleta, California.
- Cullen, S.J. 2005. Invited speaker, Commercial Applications of Laboratory and Field Groundwater and Vadose Zone Instrumentation, *The Santa Barbara Groundwater and Vadose Zone Instrumentation Workshop*, Soilmoisture Equipment Corp., May 17, 2005, Goleta, California.
- Cullen, S.J. 2005. Invited speaker, Theory and Application of the Guelph Permeameter, *The Santa Barbara Groundwater and Vadose Zone Instrumentation Workshop*, Soilmoisture Equipment Corp., May 17, 2005, Goleta, California.
- Cullen, S.J. 2005. Invited speaker, The Importance of Environmental Protection of Soil and Groundwater Worldwide, *The Santa Barbara Groundwater and Vadose Zone Instrumentation Workshop*, Soilmoisture Equipment Corp., May 16, 2005, Goleta, California.
- Cullen, S.J., W. Allmon, and T. Battey. 2005. An Evaluation of Baseline Recharge Conditions at a Perchlorate-Impacted Site in an Arid Environment, a technical poster presentation to the California Groundwater Resources Association meeting, "Artificial Recharge: Nexus of Quantity and Quality in California", March 16-17, 2005, Sacramento, California.
- Cullen, S.J. 2004. Fate and Transport of Perchlorate in the Subsurface. Invited presentation to the American Chemical Society, Annual Meeting, March 31, 2004, Anaheim, California.
- Cullen, S.J. 2002. Dry Cleaners: Characterizing and Remediating Multiple Sources of PCE in a Complex Hydrogeologic and Legal Environment. Invited presentation to Entech West 2002, November 12, 2002, Long Beach, California.
- Cullen, S.J. and M. Lupo, 2001. Soil Bioventilation and Modeling of Air Flow. In American Microbiological Society (eds.), *Manual of Environmental Microbiology*, 2nd Edition, American Microbiological Society Press, Washington, D.C.
- McNab, W.W., Jr., B.P. Dooher, D.W. Rice, S.J. Cullen, L.G. Everett, M.C. Kavanaugh, W.E. Kastenber, M.C. Small, and P.C. Johnson. 1998. Risk-Based Assessment of Appropriate Fuel Hydrocarbon Cleanup Strategies for the Base Exchange Service Station at Vandenberg Air Force Base, California. Report submitted to the Air Force Center for Environmental Excellence, Environmental Restoration Directorate, Technology Transfer Division, Brooks Air Force Base, Texas. Lawrence Livermore National Laboratory, Livermore, CA.
- Everett, L.G., S.J. Cullen, D.W. Rice, W.W. McNab, Jr., B.P. Dooher, M.C. Kavanaugh, P.C. Johnson, W.E. Kastenber, and M.C. Small. 1998. Risk-Based Assessment of Appropriate Fuel Hydrocarbon Cleanup



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Publications and Presentations Continued

- Strategies for the Naval Exchange Gasoline Station, Naval Construction Battalion Center, Port Hueneme, California. Submitted to the Naval Facilities Engineering Services Center, Port Hueneme, CA. Lawrence Livermore National Laboratory, Livermore, CA.
- Kavanaugh, M.C., D.W. Rice, W.W. McNab, Jr., M.C. Small, S.J. Cullen, P.C. Johnson, L.G. Everett, and W.E. Kastenburg. 1998. Risk Based Assessment of Appropriate Fuel Hydrocarbon Cleanup Strategies for Site 390, Marine Corps Air Station (MCAS), El Toro, California. Report submitted to the U.S. Navy, Southwest Division, Naval Facilities Engineering Command, San Diego, CA. Lawrence Livermore National Laboratory, Livermore, CA.
- Small, M.C., W.W. McNab, Jr., D.W. Rice, S.J. Cullen, L.G. Everett, M.C. Kavanaugh, W.E. Kastenburg, and P.C. Johnson. 1998. Risk-Based Assessment of Appropriate Fuel Hydrocarbon Cleanup Strategies for Presidio at San Francisco, Building 637 Area. Report submitted to the U.S. Army Corps of Engineers, Sacramento District, Sacramento, California. Lawrence Livermore National Laboratory, Livermore, CA.
- Kavanaugh, M.C., W.W. McNab, Jr., D.W. Rice, P.C. Johnson, M.C. Small, W.E. Kastenburg, L.G. Everett, and S.J. Cullen. 1998. Risk-Based of Appropriate Fuel Hydrocarbon Cleanup Strategies for China Lake Naval Air Weapons Station Navy Exchange Gas Station Site. Report submitted to the U.S. Navy, Southwest Division Naval Facilities Engineering Command, San Diego, California. Lawrence Livermore National Laboratory, Livermore, CA.
- Springer, D.S., H. Loaiciga, S.J. Cullen, and L. Everett, 1998. Air Permeability of Porous Materials Under Controlled Laboratory Conditions, *Groundwater*, vol. 36, No. 4, pp 545-704.
- McNab, W.W., Jr., B.P. Dooher, D.W. Rice, M.C. Kavanaugh, P.C. Johnson, S.J. Cullen, L.G. Everett, W.E. Kastenburg, and M.C. Small. 1997. Assessment of Appropriate Fuel Hydrocarbon Risk-Management Strategies for George Air Force Base, Victorville, California, Using a Risk-Based Approach. Report submitted to the Air Force Center for Environmental Excellence, Environmental Restoration Directorate, Technology Transfer Division, Brooks Air Force Base, Texas. Lawrence Livermore National Laboratory, Livermore, CA.
- McNab, W.W., Jr., D.W. Rice, S.J. Cullen, L.G. Everett, P.C. Johnson, W.E. Kastenburg, M.C. Kavanaugh, M.C. Small, and T.M. Carlsen. 1998. Risk-Based Assessment of Appropriate Fuel Hydrocarbon Cleanup Strategies for Area 43 MWR Gas Station, Marine Corp Base, Camp Pendleton, California. Report submitted to the U.S. Navy, Southwest Division, Navy Facilities Engineering Command, San Diego, CA. Lawrence Livermore National Laboratory, Livermore, CA.
- McNab, W.W., B.P. Dooher, D.W. Rice, M.C. Kavanaugh, S.J. Cullen, L.G. Everett, W.E. Kastenburg, M.C. Small, and P.C. Johnson. 1997. Draft Final Assessment of Appropriate Fuel Hydrocarbon Cleanup Strategies for Travis Air Force Base, Fairfield, California, Using a Risk-Based Approach. Report submitted to the Air Force Center for Environmental Excellence, Environmental Restoration Directorate, Technology Transfer Division, Brooks Air Force Base, Texas. Lawrence Livermore National Laboratory, Livermore, CA.
- Cullen, S.J., L.G. Everett, W.W. McNab, Jr., D.W. Rice, B.P. Dooher, M.C. Kavanaugh, W.E. Kastenburg, M.C. Small, and P.C. Johnson, 1997. Expert Committee Evaluation of Site Characterization Adequacy for the Base Exchange Service Station Site at Vandenberg Air Force Base.
- Cullen, S.J., and J.C. Michaelsen, 1997. Factors affecting the Occurrence and Distribution of Selected Petroleum Hydrocarbon Compounds in California's Alluvial Aquifers (in review).
- Rice, D.W., B.P. Dooher, S.J. Cullen, L.G. Everett, W.E. Kastenburg, and R.C. Ragaini, 1997. Response To U.S. EPA Comments on the LLNL/UC LUFT Cleanup Recommendations and California Historical Case



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Publications and Presentations Continued

- Analysis. Submitted to the California State Water Resources Control Board and the United States Environmental Protection Agency Underground Storage Tank Program.
- McNab, W.W., Jr., D.W. Rice, B.P. Dooher, M.C. Kavanaugh, P.C. Johnson, S.J. Cullen, L.G. Everett, W.E. Kastenburg, and M.C. Small, 1997. Assessment of Appropriate Fuel Hydrocarbon Cleanup Strategies for George Air Force Base, Victorville, California Using a Risk-Based Approach. Submitted to the Air Force Center for Environmental Excellence, Environmental Restoration Directorate, Technology Transfer Division, Brooks Air Force Base, Texas.
- Keller, B.R. S.J. Cullen, and D.S. Springer. Multiple Source Groundwater Plume in Fault-Controlled Hydrogeologic Regime, Santa Barbara, California. American Geophysical Union 1996 fall meeting. December 1996. San Francisco, CA.
- Kramer, J.H., and S.J. Cullen, 1996. Soil Bioventilation and Modeling Of Air Flow. In American Microbiological Society (eds.), Manual of Environmental Microbiology. American Microbiological Society Press, Washington, D.C.
- Cullen, S.J., J.C. Michaelsen, D.W. Rice, B.P. Dooher, L.G. Everett, W.E. Kastenber, R.D. Grose, and M.A. Marino, 1996. Overview of California's Leaking Underground Fuel Tank (LUFT) Cleanup Process. In Proceedings of the 1st International Conference on The Impact of Industry on Groundwater, Water Resources and the Environment, Priority of the Third Millennium, May 22-24, 1996, Cernobbio, Italy.
- Rice, D.W., B.P. Dooher, S.J. Cullen, L.G. Everett, W.E. Kastenber, R.D. Grose, and M.A. Marino, 1995. Recommendations To Improve The Cleanup Process for California's Leaking Underground Fuel Tanks (LUFTs). Report submitted to the California State Water Resources Control Board and the Senate Bill 1764 Leaking Underground Fuel Tank Advisory Committee, 20 pp. with references.
- Rice, D.W., R.D. Grose, J.C. Michaelsen, B.P. Dooher, D.H. MacQueen, S.J. Cullen, W.E. Kastenber, L.G. Everett, and M.A. Marino, 1995. California Leaking Underground Fuel Tank (LUFT) Historical Case Analyses. Report submitted to the California State Water Resources Control Board and the Senate Bill 1764 Leaking Underground Fuel Tank Advisory Committee, 20 pp. with references.
- Cullen, S.J., J.H. Kramer, and J.R. Luellen, 1995. A Systematic Approach to Designing a Multiphase Unsaturated Zone Monitoring Network. Groundwater Monitoring and Remediation, vol. 15, no. 3, pp. 124-135.
- Cullen, S.J. 1995. Vadose Zone Monitoring: Experiences and Trends in the United States. Groundwater Monitoring and Remediation, vol. 15, no. 3, pp. 136-143.
- Wilson, L.G., L.G. Everett, and S.J. Cullen (eds.). Handbook of Vadose Zone Characterization and Monitoring, 1995. Lewis Publishers, Chelsea, MI, 730 pp.
- Cullen, S.J., J.H. Kramer, L.G. Everett, and L.A. Eccles. 1995. "Is Our Groundwater Monitoring Strategy Illogical?" In L.G. Wilson et al. (eds.) Handbook of Vadose Zone Characterization and Monitoring, Lewis Publishers, Chelsea, MI. pp. 1-8.
- Cullen, S.J. and L.G. Everett. 1995. "Estimating the Storage Capacity of the Vadose Zone". In L.G. Wilson et al. (eds.) Handbook of Vadose Zone Characterization and Monitoring, Lewis Publishers, Chelsea, MI, pp. 159-176.
- Springer, D.S., S.J. Cullen, and L.G. Everett. 1995. "Laboratory Studies on Air Permeability". In L.G. Wilson et al. (eds.) Handbook of Vadose Zone Characterization and Monitoring, Lewis Publishers, Chelsea, MI, pp. 217-248.



Stephen J. Cullen, Ph.D., P.G., REA II, CPSS, CEM

Publications and Presentations Continued

- Kramer, J.H. and S.J. Cullen. 1995. "Review of Vadose Zone Flow and Transport Models". In L.G. Wilson et al. (eds.) Handbook of Vadose Zone Characterization and Monitoring, Lewis Publishers, Chelsea, MI, pp. 267-290.
- Kramer, J.H., S.J. Cullen, and L.G. Everett. 1995. "Vadose Zone Monitoring with the Neutron Moisture Probe". In L.G. Wilson et al. (eds.) Handbook of Vadose Zone Characterization and Monitoring, Lewis Publishers, Chelsea, MI, pp. 291-310.
- Dorrance, D.W., L.G. Wilson, L.G. Everett, and S.J. Cullen. 1995. "A Compendium of Soil Samplers for the Vadose Zone". In L.G. Wilson et al. (eds.) Handbook of Vadose Zone Characterization and Monitoring, Lewis Publishers, Chelsea, MI, pp. 401-428.
- Wilson, L.G., D.W. Dorrance, L.G. Everett, and S.J. Cullen. 1995. "In Situ Pore Liquid Sampling in the Vadose Zone". In L.G. Wilson et al. (eds.) Handbook of Vadose Zone Characterization and Monitoring, Lewis Publishers, Chelsea, MI, pp. 477-522.
- Cullen, S.J., G. Deane, and W. Lick. 1994. "The Diffusion of Tritiated Water Vapor in Unsaturated Soils." Report to Lawrence Livermore National Laboratory, Environmental Restoration Division.
- Ogg, R.T., L.G. Everett, and S.J. Cullen. 1994. "Rocky Flats Solar Evaporation Ponds: RCRA Hybrid-Closure Case Study". In Hazardous Materials Control Resources Institute (eds.), Proceedings of the Third Federal Environmental Restoration Conference, April 27-29 New Orleans, Louisiana.
- Cullen, S.J., J.H. Kramer, and R.T. Ogg. 1994. "Vadose Zone Monitoring: Preventing and Mitigating Aquifer Contamination". In G. Gambolati (ed.), Proceedings of the International Symposium on Advanced Methods for Groundwater Pollution Control, May, 1994, Udine, Italy. Published by the International Center for Mechanical Sciences, Udine, Italy (in press).
- Cullen, S.J., J.H. Kramer, and Jon R. Luellen. 1994. "Risk-based approach to the design of a vadose zone monitoring system for a solid waste landfill". In Proceedings of the 1994 Air and Waste Management Association Annual Session on Integrated Media Corrective Action at Solid Waste and Hazardous Waste Landfills, July, 1994.
- Kramer, J.H., P.E. Gagnard, and S.J. Cullen. 1993. "Wick layer-enhanced vadose zone monitoring (Abstract and Poster Presentation). Supplement to EOS Transactions AGU Fall Meeting, December 6-10, 1993, American Geophysical Union, Washington DC, :288.
- Cullen, S.J., D.P. Imperato, and J.H. Kramer. 1993. Agricultural Utilization of Biosolids at the Gardner Ranch, Santa Ynez Valley, California. Report submitted to the Department of Public Works, City of Santa Barbara, California (9/1/93).
- Cullen, S.J. 1993. "Vadose Zone Monitoring: Part I. Experiences and Future Trends in the United States." In (invited paper) Proceedings of the United Nations Scientific Committee on Protecting the Environment, Regional Course and Workshop on Groundwater Contamination, July 26-30, 1993, San Jose, Costa Rica.
- Cullen, S.J., J.H. Kramer, and J.R. Luellen. 1993. "Vadose Zone Monitoring: Part II. A Systematic Approach to Designing a Multiphase Unsaturated Zone Monitoring Network." In (invited paper) Proceedings of the United Nations Scientific Committee on Protecting the Environment, Regional Course and Workshop on Groundwater Contamination, July 26-30, 1993, San Jose, Costa Rica.
- Cullen, S.J., and L.G. Everett. 1993. "Permit Writer's Guidance Document for Monitoring Unsaturated Regions of the Vadose Zone at RCRA, Subtitle C, Facilities." Guidance document submitted as a report to the United States Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV, April, 1993.



Daniel B. Stephens & Associates, Inc.

Stephen J. Cullen, Ph.D., P.G., REA II, CPSS, CEM

Publications and Presentations Continued

- Cullen, S.J., B.R. Newton, and W.W. Bewley. 1993. Irrigation and Salinity Management of Turf: Report of Findings and Recommendations. Report submitted to the Facilities Management Department, University of California, Santa Barbara.
- Cullen, S.J. 1992. "Subsurface Migration and Remediation of Hazardous Waste", seminar presented to the Dept. of Mechanical and Environmental Engineering, UCSB, Nov., 1992.
- Cullen, S.J. 1992. "Ground Water Pollution: An International Perspective", Igor Zektser, L.G. Everett, and Stephen J. Cullen. *Journal of European Water Pollution Control*. (Vol. 2, No. 6, Nov. 1992).
- Everett, L.G., S.J. Cullen, and J.H. Kramer. 1992. "Direct and Indirect Pore-Liquid Monitoring in the Vadose Zone." In Proceedings of the Conference on Field Screening for Environmental Pollutants: Defining User Instrumentation Needs, October 26-27, 1992. Cambridge, MA.
- Cullen, S.J. 1992. "Vadose Zone Monitoring: Techniques and Instrumentation". Invited speaker, 2-day workshop, National Outdoor Action Conference, National Ground Water Association, Las Vegas, NV, May, 1992.
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