EXHIBIT E

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

WILD EQUITY INSTITUTE, a non-profit corporation, *et al.* Plaintiffs, v. CITY AND COUNTY OF SAN FRANCISCO, *et al.*, Defendants.	Case No.: 3:11-CV-00958 SI **DECLARATION OF VANCE VREDENBURG, PH.D.**

I, Dr. Vance Vredenburg, declare as follows:

1. I am submitting this declaration in support of plaintiff's motion for preliminary injunction. For the past decade I have worked as a post-doctoral researcher and professor studying the ecology of amphibians, with a particular emphasis on the causes of amphibian declines. I received my B.A. in Biological Sciences from the University of California Santa Barbara in 1992, and my Ph.D. in Integrative Biology from the University of California Berkeley in 2002. I am currently an Assistant Professor at San Francisco State University, and a Research Associate at the California Academy of Sciences and the Museum of Vertebrate Zoology at UC Berkeley. More detailed information about my background can be found in my *curriculum vitae*, which is attached as Exhibit A.

2. My research focuses on the causes of amphibian declines. For example, I conducted several whole-lake studies in the Sierra Nevada Mountains that conclusively demonstrated amphibian population declines when non-native fish were stocked in mountain lakes. This groundbreaking study was published in 2004 in the *Proceedings of the National Academy of Sciences*, arguably the world's most prestigious academic journal. I have since published over 30 peer-reviewed articles including five more articles in the *Proceedings of the National*

Academy of Sciences and several other prestigious scientific journals, and eight book chapters on amphibian ecology.

3. Currently I am collaborating with colleagues from UC Berkeley, UC Santa Barbara, and the University of Idaho on a National Science Foundation-funded study that seeks to understand how some populations of frogs survive disease epidemics. A newly discovered fungal pathogen (the chytrid fungus, *Batrachochytrium dendrobatidis*) has caused hundreds of recent amphibian extinctions and represents the worse case of a single pathogen driving vertebrates to extinction in recorded history. Because this is so unusual in evolutionary history, my research on this issue has garnered substantial media attention, including feature articles on my field research in the Sierra Nevada in the *New York Times*, *National Geographic Magazine*, and documentary videos on Animal Planet (with Jeff Corwin), the National Science Foundation's *Science Nation* show and coverage of my studies on the California red-legged frog at Sharp Park on KQED's Quest, a weekly television show on the Bay Area's science and environment.

4. Living amphibians (Class Amphibia, Subclass Lissamphibia) include frogs (Order Anura), salamanders (Order Caudata), and caecilians (Order Gymnophiona). Of the three groups, frogs and toads exhibit the most varied reproductive modes and habitat associations and comprise the majority of recognized species (>6000 species). Salamanders and caecilians, also diverse, have fewer species and are more restricted but still have a widespread distribution (614 species and 188 species, respectively). Most of the world's amphibian diversity occurs in the tropics, especially in Central and South America, but other amphibian biodiversity hotspots include sub-Saharan Africa, Madagascar, Sri Lanka, Southeast Asia and Australia.

5. Amphibians are represented in diverse aquatic and terrestrial ecosystems and frequently are important components of communities and food webs. In some parts of the world they are the dominant predator, both in terms of numbers and total mass. They are diverse in behavior. Most salamanders have the structure of a generalized tetrapod with four legs, a relatively short

trunk, and a tail, but some are extremely elongated with very small limbs or only forelimbs, and some reach very large size -- in excess of 1.5 meters. Caecilians, restricted mainly to the tropics, are limbless and their eyes are covered by skin. They have larger numbers of trunk vertebrae and are very elongated, but they either lack or have an exceedingly short tail. Frogs have a characteristic form consisting of a large head, a very short trunk, and four legs, the hind limbs containing four major segments, being elongated associated with jumping and /or swimming, and being suspended from elongated and specialized pelvic girdles. However, despite the constraints of body form frogs are diverse in morphology, coloration and behavior.

6. Adult amphibians are effective predators and both salamanders and frogs have tongues specialized for rapid, long distance prey capture. Caecilians generally feed on subterranean prey such as earthworms. The amphibians are long-term survivors (existing on earth for more than 350 million years) that endured four previous mass extinctions (e.g., 95 percent of all living species were lost in the Permian-Triassic extinction). Through these extinctions, all three orders of amphibians escaped extinction, and even most families and genera survived. This was not the case for most other groups of organisms (e.g. dinosaurs, etc). Yet today the amphibians, presently including more than 6,800 species, are the most threatened group of vertebrates on Earth with over 40 percent of species in decline and over 30 percent threatened with extinction.

The geographic extent of the declines is worldwide. The areas most affected are located in Central and South America, the Caribbean, the wet tropics of eastern Australia (Figure 2), and western North America (Stuart et al. 2004). Less is known about the status of species in Africa and Asia due to a lack of long term studies. The first reports of massive collapse of amphibian faunas came from montane areas in Central America and Australia. The loss of more than 50% of the species in a large tropical montane fauna (Monteverde Cloud Forest Reserve) in Costa Rica in the course of a single year (1987) was a profound shock, and included the first prominent extinction (the Golden Toad, *Bufo periglenes*). Collapse of amphibian fauna in montane and lower montane Central America and South America is on-going. Several species of frogs declined dramatically, some to apparent extinction, in eastern Queensland, Australia, starting at about the same time (1980's).

7. Concern has been expressed over declines of frogs in California for many years, and in the 1980's and early 1990's the phenomenon accelerated. Now there have been reports of mainly geographically limited declines from many parts of the world. California, along with Central America and Australia, has been a focal area for the study of amphibian population declines, because of the severe declines of many of its species. The region is recognized as one of the world's biodiversity hotspots (the "California Floristic Province") and contains a heterogeneous landscape that sustains a wide variety of ecosystems, such as Sonoran deserts, marshes and wetlands, oak woodlands, high-elevation alpine systems, temperate rain forests, and many others. The amphibian fauna is diverse and includes 67 recognized native species, including 41 species of salamanders from five families and nine genera, and 26 species of frogs and toads from five families and six genera (plus two introduced species). Amphibians in California can be found in nearly all habitat types ranging from near Mount Whitney (at 3,657 m, the highest peak in the contiguous United States) to Death Valley (85 m below sea level). Despite the fact that California contains some of the largest contiguous protected habitats in the continental United States, nearly one-quarter of amphibians in California are threatened. Many potential causes for the widespread declines of amphibians have been proposed. In general these can be grouped into two major categories: 1) factors general to the overall biodiversity crisis, including habitat destruction, alteration and fragmentation, introduced species and over-exploitation, and 2) factors associated with amphibians that might account for declines in relatively undisturbed habitats. The first category includes relatively well understood and reversible direct ecological phenomena, whereas the second includes complex and elusive mechanisms, such as climate change, increased ultraviolet (UV-B) radiation, chemical

contaminants, infectious diseases, and the causes of deformities (or malformations). Habitat alteration and outright destruction are the single most important cause of declines in California and worldwide. The underlying mechanisms behind all of the factors stated above are sometimes complex and may be working synergistically with more evident factors, such as habitat destruction and introduced species, to exacerbate declines.

In California, amphibian declines are associated with many of the various hypotheses. Habitat destruction, alteration, and fragmentation have affected a large number of species including the California red-legged frog (CRLF), the Foothill Yellow-legged Frog, the Arroyo Toad, and the California Tiger Salamander, to name a few. Some amphibians began suffering declines long ago. In the 19th century, the California Gold Rush brought waves of new settlers who quickly over-exploited some frog species for food, including the CRFL. They also altered the environment in ways that have had much more substantial effects on amphibians. Cities were built, rivers dammed and diverted, forests were cleared, and the waterways of Great Central Valley were completely altered for agriculture and to provide water for cities and industrial growth. The effect on California's ecosystems has been profound. As elsewhere, habitat conservation has become a central theme in efforts to preserve the region's biodiversity.

8. Throughout my career I have retained a particular interest in the California red-legged frog, *Rana draytonii.* This frog ranges in size from 1.5 to 5 inches in length, making it the largest native frog in the Western United States. Adult females are significantly larger than males, with an average length of 138 mm versus 116 mm for adult males. The hind legs and lower abdomen of adult frogs are often characterized by a reddish or salmon pink color, and the back is brown, gray, olive, or reddish brown, marked with small black flecks and larger irregular dark blotches. Dorsal spots often have light centers, and in some individuals form a network of black lines. Dorsolateral folds, raised fleshy stripes that run parallel to the length of the frog, are prominent in this species of frog. Tadpoles range in length from 14 to 80 mm, and are a dark brown or

olive, marked with darker spots. *R. draytonii* breeds when the rains begin in earnest, usually in November and , an breeding may continue through April, depending on local conditions. Egg masses consist of between 300 and 5,000 eggs. Egg masses are nearly always attached to submerged vegetation that has some standing plant matter above water. Eggs hatch after 6 to 14 days depending on water temperature. Larvae typically metamorphose in 3.5 to 7 months, usually between July and September, but some overwinter and transform after more than 12 months in the larval stage. Males may attain sexual maturity at 2 years, females at 3 years, and adult frogs may live 8 to 10 years. Like tadpoles of many frog species, larvae are thought to be algal grazers, and the adult diet consists mostly of invertebrates. Pacific Tree Fogs (*Pseudacris regilla*) and California mice (*Peromyscus californicus*) are occasionally consumed by adult frogs but the importance of them in the diet is unknown. Juvenile frogs may be active both nocturnally and diurnally, whereas adult frogs are primarily active nocturnally. The primary predators on *R. draytonii* include garter snakes (*Thamnophis spp.*), raccoons (*Procyon lotor*), and great blue herons (*Ardea herodias*). Less frequently, red-legged frogs are eaten by American bitterns (*Botaurus lentiginosus*), black-crowned night herons (*Nycticorax nycticorax*), and rarely by red-shouldered hawks (*Buteo lineatus*). Introduced species such as the bullfrog (*Rana catesbeiana*) and non-native fish also prey on the frog.

9. The California red-legged frog is often referred to as "Twain's frog" because the Mark Twain included them in his colorful stories of California's Gold Rush days. The species faces several threats, and there is a high probability that the species will one day go extinct if these threats are not addressed. The species is already gone from 70% of its historic range, and has suffered a 90% population decline. Destruction and adverse modification of terrestrial and aquatic habitat is the primary reason for these declines, along with disease, pollutions in the form of pesticides and fertilizers, exploitation of the species for food, and predation from nonnative, invasive species.

10. I have often shared my interest in the California red-legged frog with my graduate students and research assistants. Recently one of my master's graduate students completed her degree in a study on the California red-legged frog, including the California red-legged frog populations at Sharp Park, to determine precisely what comprises the frog's diet. We analyzed stable isotopes of carbon and nitrogen to trace energy flow through food webs. The basis of this technique is simply that carbon's isotopic signatures in aquatic and terrestrial plants are consistently different from each other (aquatic plants contain consistently more heavy isotopes than terrestrial plants). Because the isotopic signature of carbon does not vary once it is in the food chain (as you move up the food chain from plants to higher consumers), you can use it to trace where energy in food webs was first captured by plants. You can trace energy flow through food chains by comparing isotopic signatures in an organisms' tissues. We used this technique with California red-legged frogs and showed that the carbon in frog tissues could be traced back to terrestrial, and not aquatic sources. This ground-breaking study discovered that over 99% of the frog's diet is composed of terrestrial insects—*indicating that the frog's upland and terrestrial habitats are much more important to the species' long-term survival than previously imagined.*

11. My PhD training at UC Berkeley in the Museum of Vertebrate Zoology has provided me a deep understanding of amphibian morphology, phylogenetics, evolution and taxonomy. In 2007, I published a detailed peer-reviewed paper in the *Journal of Zoology* on California's mountain yellow-legged frogs showing that there are two distinct species, while previously only one was recognized. I used morphology, frog vocalizations and molecular data to distinguish the two species. This work built on previous molecular and phylogenetic work I conducted on the relationship between western North American frog lineages, including the California red-legged frog, and published in the journal *Molecular Phylogenetics and Evolution.* I have studied thousands of laboratory specimens including hundreds of the California red-legged frog at the

permanent collections at the California Academy of Sciences, the Museum of Vertebrate Zoology, and other biological science collections. These specimens have given me insight on the basic ecology, evolution and conservation of the species. As many others before me, I have been especially struck by how the species' population has been impacted over time. For example, museum records and specimens, perhaps more than any other line of evidence, illustrate the loss of populations because many specimens were collected in areas where the frog no longer exists today.

12. Because of my study of frogs in the field and in the laboratory, I am an expert in identifying frog species. I can identify all life phases of the California red-legged frog in particular.

13. I am also familiar with Sharp Park and its aquatic features that provide habitat for California red-legged frogs. As mentioned above, I have mentored a graduate student who has conducted field research at this site; I have visited the site to test the frogs for disease; and I regularly take my undergraduate and graduate students there on field trips to gain experience observing and identifying amphibians in the wild. I have also reviewed several reports about Sharp Park prepared by biological contractors for the City and County of San Francisco, and publications prepared by the U.S. Fish and Wildlife Service.

14. It is my professional opinion that Sharp Park is an extremely important area for the California red-legged frog. Sharp Park must have successful recovery actions implemented, or it will one day lose its CRLF population, and potentially jeopardize populations at nearby properties as well. Because Sharp Park is relatively free from American bullfrogs (*Rana catesbeiana*, also called *Lithobates catesbeiana* in the scientific literature)—a non-native predator and competitor of the California red-legged frog—and relatively free from disease, it is one of the last best restoration opportunities to help recover the species along the Coast. Moreover, Sharp Park is adjacent to several protected lands with California red-legged frog

populations of their own, and therefore it serves as a central location for populations of the species on adjacent PUC watershed lands and neighboring Mori Point National Park.

15. California red-legged frogs have been documented at Sharp Park for decades. Wade Fox, one of the first biologists to survey the area, noted that California red-legged frogs were found in the bellies of snake specimens he had collected from Sharp Park in the 1940s. The frog has persisted on the land since: although survey's in the 1980s did not find any California red-legged frogs on the property, surveys in the 1990's found significant evidence of the species, and several recent publications and reports produced by the City and County of San Francisco have confirmed the presence of the species on the property. I have personally observed the species at Sharp Park on numerous occasions. Sharp Park and the adjoining Mori Point are excellent teaching examples for the students in my courses at San Francisco State University, located not more than a 10 minute drive away. I use the contrast between land management in Sharp Park vs. Mori Point as an example how the effects of human development and ongoing activities on threatened amphibians can be reversed. At Mori Point, the National Park Service has restored several breeding ponds and the California red-legged frog population has responded very positively whereas at Sharp Park, human activities have obvious negative effects on the threatened frog. It is not hard to see the difference when you are standing right there at the border between the two properties. It is remarkable that you can park your car on Fairway Drive, walk 15 paces and view California red-legged frogs in the creek below. In the rainy months of the year the frogs lay hundreds of egg masses that are easily visible from shore. Even during the day adults can be seen at these sites and this is not always the case for California red-legged frogs. In many other areas where they still occur, you usually have to visit sites at night to see adult frogs. I believe they are visible at Sharp Park and especially Mori Point because there are few introduced bullfrogs and the habitat, especially the restored areas, is prime habitat for the species that can support robust populations. This has been the case dating back to the 1940s. At Sharp

Park and Mori Point all stages of California red-legged frog are visible, eggs, tadpoles, juveniles and adults. This is not only great for educational purposes, but also signals that the habitats can support robust populations. If it can be fully restored, this habitat is some of the best I've seen for the species. Unfortunately, it is well documented that Sharp Park Golf Course has been killing California red-legged frogs through operations and management of a pump house for many years. San Francisco's Conceptual Restoration Alternatives Report explains that the take of the CRLF, documented as early as 1992, is ongoing at Sharp Park.

16. After 2008, the City released a Final Draft Endangered Species Compliance Plan for Sharp Park. I have reviewed this plan, and I am also familiar with the City's effort to move egg masses in the Park. Even with these efforts, it is my professional opinion that there is a high degree of scientific certainty that take of California red-legged frog egg masses through desiccation will continue to occur in Sharp Park. Moreover, based on records of golf course management and operations I have reviewed, my own observations of Sharp Park, and my professional expertise, I believe that the City is not, and cannot, actually implement the Compliance Plan – which contemplates managing water levels to avoid desiccation of CRLF egg masses – making it virtually certain that California red-legged frogs will be taken unless the relief requested by plaintiffs here is granted.

17. The California red-legged frog requires aquatic habitats to breed successfully. If the aquatic features are not of sufficient depth and duration, the eggs may not survive.

18. At Sharp Park, the opportunity for frogs to complete this cycle is being undermined by the management of the golf course, whereby two pumps drain Sharp Park wetlands (upon which the golf course was built) during flooding that occurs as a natural function of winter rains. This unnatural draining of what would otherwise be a naturally functioning wetlands complex is causing the take of many California red-legged frog egg masses.

19. The Compliance Plan does not prevent egg mass strandings. This past winter, for example, the golf course operated the pumps with the Compliance Plan in place. Yet beginning in January, 2011, Recreation and Park Department staff had to move over one hundred egg masses that they concluded would not survive in the location where they were laid. It is my professional opinion that these egg masses would not have been stranded if the pumps were not draining Sharp Park's wetlands.

20. These frogs have evolved over millions of years towards a strategy of egg-laying that balances water depth, water temperature, predator avoidance, and pond desiccation. The most successful frogs maximize the contrasting pressures of pond desiccation and water temperature. For example female frogs that choose to lay their eggs in deeper water are minimizing risk to desiccation but also exposing eggs to cooler water temperatures, which translate into slower growth and development. Deeper, more permanent water also harbors a more diverse food web which is more likely to contain aquatic egg and tadpole predators. Females that lay eggs in the shallowest water on the margin of ponds are maximizing growth potential (warmer temperatures) and minimizing exposure to aquatic predators, but are also exposing egg masses to higher probability of desiccation. If the rains continue and the pond does not dry too quickly the strategy pays off and eggs in shallow waster hatch faster, tadpoles grow faster and outcompete other eggs and tadpoles from other frogs laid in deeper water.

21. Ponds fill and dry seasonally and although it can seem rather dramatic from wet to dry years, the change over the course of days is not rapid because water levels decrease mostly due to evaporation from heat and use by terrestrial and emergent plants during photosynthesis. The pumping of water to dry up fairways at Sharp Park, however, is well outside the natural rate of pond drying and the frogs are not adapted to this type of rapid change in pond depth. Therefore, because these frogs have evolved a breeding strategy over millions of years that is cued in on natural rates of desiccation, the pumping of the ponds by the golf course will inevitable lead to a

much higher mortality rate for the eggs that the females lay at the margins of the pond, in the shallowest water. This elevated mortality is completely man made and can be reduced if pumping is not allowed. Although RPD has for years been moving egg masses it determines are at some risk, egg mass movement is not part of the Compliance Plan.

22. Moving egg masses does not ensure their survival. Frog egg masses are encased in a protective jelly coating. California red-legged frogs females attach the egg masses to emergent vegetation usually suspended near the surface of the water to balance impacts from solar radiation from above while avoiding predators from below. Movement of egg masses can damage the embryos in a number of ways. For example, jarring movements can damage eggs directly and even when the embryos are at later stages and are less sensitive to movement, egg survival can plummet if egg masses are moved. Amphibian eggs are sensitive to changes in gas exchange rates across the jelly boundary and the egg membrane. If eggs masses are taken out of the water for more than a few minutes and exposed to air, then oxygen and carbon dioxide exchange rates can decrease rapidly because the jelly does not function well as a gas exchange membrane when exposed to air. The jelly can quickly begin to dry along the outer edge, this edge, like a thicker skin, impedes natural gas exchange rates. Additionally, once egg masses are placed in a new location, it is very difficult, to suspend them in the water column off the bottom yet also near the surface. If eggs become dislodged they can float away and end up in less than perfect microhabitats, for example they can be washed ashore by wind or even small wave action. Therefore, it is my professional opinion that at least some eggs and even entire egg masses that are relocated by the City in 2011 did not survive the relocation effort.

23. I am also concerned by the artificially high concentration of egg masses placed in Horse Stable Pond. Horse Stable Pond is the aquatic feature closest to Sharp Park's pump house, and therefore it is the area most impacted by the suction of the pumps. When a very large portion of Sharp Park's California red-legged frogs are placed in Horse Stable Pond, nearly the

entire population is at greater risk of entrainment, impingement, or desiccation. If the eggs did in fact survive, then the pond may be at risk of exceeding its ecological carrying capacity. Many species, and in particular amphibians, have been shown to display density dependent growth. The idea is a simple one: while each species or population has the potential to grow exponentially this does not happen because of interspecific and intraspecific factors. At some point a population's size is either limited by resources (food, space, breeding sites, etc) or other individuals (competitors, predators, parasites, etc.). If thousands of eggs are being artificially added to a pond that wouldn't naturally have that high a number, then this could have very negative effects on the population. It could make food acquisition more difficult, it could make the population a target to predators that may be attracted to the large number or prey items, or abiotic conditions in the environment (oxygen concentration in the water may be lowered, or excreted compounds could overwhelm natural decomposers leading to toxic levels of nitrogenous waste). Of course, not all egg masses can be moved. On February 21, 2011 a partially submerged egg mass was found on the edge of Horse Stable Pond. The water level of Horse Stable Pond, as measured by the gauge at the pump house, at 2.9 meters (relative scale), but massive amounts of water were being pumped through the system. On February 23, 2011, I visited this egg mass, and discovered that the water levels were at 2.6 meters (relative scale): and the egg mass was completely exposed to the air due to the ongoing pumping. I identified the egg mass as a California red-legged frog egg mass, and concluded that it was not likely to survive. A photograph of the egg mass I viewed on that date is attached as Exhibit B. On March 1, 2011 a follow-up visit to the egg mass found that it was completely desiccated and partially frozen. All of these egg mass strandings occurred despite the Compliance Plan, which cannot reduce egg mass strandings to zero or anything close to it. Because, even with the pumps on full throttle, it can take days for the water to draw down after significant rainfall, large numbers of California red-legged frog egg masses are often laid in areas that become exposed to the air due to the pumping operations, even though the Compliance Plan is functioning as designed. Finally, because the Compliance Plan provides for so much pumping the water that remains to secure egg and tadpole development is reduced. If a large rain event is followed by an extended drought, the buffer of rainwater provided by the initial storm event will have been eliminated, and the frog eggs and tadpoles also are at serious risk of desiccation and stranding. All of this is occurring despite implementation of the Compliance Plan.

24. It is my professional opinion that in order to reduce take of California red-legged frogs in the future, the relief requested by Plaintiffs in this motion must be granted. Specifically, San Francisco must be ordered to cease all pumping at Sharp Park. The best way to safeguard the frog is to reduce unnatural variation in pond levels which is known to increase egg mortality. These frogs evolved with naturally fluctuating water levels in ponds, the best thing we can do to insure their survival and recovery is to let the water levels at Sharp Park vary naturally.

25. Based on the stable isotope food web research done by my lab, as well as my understanding of CRLF biology and habitat requirements, it is also my professional opinion that mowing Sharp Park lands, particularly lands along the edge of aquatic features, is taking California red-legged frogs by significantly modifying the frog's habitats to the point where individual animals are killed or injured by impeding significant behavior functions, particularly feeding. As noted, our recent research demonstrated that for postmetamorphic individuals, the CRLF's diet consists mostly of terrestrial insects, which are produced and in many cases also obtained in terrestrial habitat. Mowing in these areas, therefore, is interfering with these essential life functions. Moreover, it is also my professional opinion that mowing in these areas is reasonably certain to take SFGS in Sharp Park, since the CRLF is a significant prey species for the SFGS. The City's Compliance Plan, which provides an inadequate monitoring protocol prior to certain mowing, would not avoid the significant risks of take even were it being implemented,

particularly given the massive scale of mowing in the vicinity of water features and the large scale habitat modification mowing causes.

26. This is why the plaintiffs requested relief is essential to protect the California red-legged frog and San Francisco gartersnake. The plaintiffs request to cease all mowing within roughly 200 meters of the delineated wetland boundary area will provide a large swath of buffer and edge habitat that will be free from mowing and wheels that could compress and take endangered frogs and snakes. Although I certainly believe a much larger buffer area would provide even further protection for the species, this will significantly diminish the risks as compared to current golf course operations.

27. If this relief is provided, it is my professional opinion that the probability of ongoing take as a result of golf course operations, while not eliminated, will be substantially reduced.

Pursuant to 28 U.S.C. § 1746, I hereby declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Executed on this _____ day of September, 2011. ____________________________

Vance Vredenburg

I, Brent Plater, hereby attest that Vance Vredenburg's concurrence in the e-filing of this document has been obtained.

Executed on: September 23, 2011 Brent Plater

Brent Plater

EXHIBIT A

Vance Thomas Vredenburg

Assistant Professor
Department of Biology
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Research Area:

Amphibian ecology, evolution and conservation, disease ecology, food webs

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Education

- PhD, University of California, Berkeley (Integrative Biology), Dec 2002 "The effects of introduced trout and ultraviolet radiation on anurans in the Sierra Nevada" Co-advisors: Dr Mary E Power and Dr David B Wake
- BA, University of California, Santa Barbara (Biology), 1992

Professional background

- 2007- to present *Assistant Professor* Department of Biology, San Francisco State University
- 2007- to present *Research Associate* Museum of Vertebrate Zoology, University of California Berkeley
- 2008- to present *Research Associate* California Academy of Sciences, San Francisco, California, USA
- 2003-2007 *Postdoctoral Scholar* Department of Integrative Biology and Museum of Vertebrate Zoology, University of California Berkeley
- 1998-to present *Co-Founder and Associate Director* of AmphibiaWeb.org an online bioinformatics project promoting science and conservation of the world's amphibians

Research Grants (currently funded)

2011-2013 National Science Foundation, (DEB) *The effects of climate change and fungal disease on Andean montane frogs*, V Vredenburg (PI)

2011-2012 The Rufford Small Grants Foundation, Grants for Nature Conservation, *Conservation of montane forest anurans in Southeastern Peru*, V Vredenburg (co-PI)

2007-2012 National Science Foundation, (DEB) *After the crash: factors allowing host persistence following outbreaks of a highly virulent disease, C* Briggs (PI), C Moritz (co-PI), R Knapp (co-PI), V Vredenburg (co-PI)

2008-2010 CalFed-Bay Delta Program *Climate change impacts to San Francisco Bay-Delta wetlands: Links to pelagic food webs and predictive responses based on landscape modeling* T Parker (PI), J Callaway (co-PI), M Kelli (co-PI), V Vredenburg (co-PI)

Publications (*SFSU Master's student; #SFSU Undergraduate student)

<u>*In Review*</u>

1. Catenazzi, A, E Lehr, and VT Vredenburg *Thermal physiology fails to link climate warming to enigmatic amphibian declines in neotropical mountains* (PNAS)
2. Reeder*, NMM, AP Pessier, and VT Vredenburg *Pathogen resistance identifies reservoir species and its role in infectious disease outbreaks in amphibians* (PNAS)
3. Woodhams, DC, Rollins-Smith, LA, Reinert, LK, Lam, BA, Harris, RN, Briggs, CJ, Vredenburg, VT; Caprioli, RM Chaurand, P *Microbial biotherapy causes immunomodulation of brevinin-1Ma, a novel antifungal peptide from the skin of mountain yellow-legged frogs, Rana muscosa* (Peptides)
4. Woodhams, DC, Geiger, CC, Reinert, LK, Rollins-Smith, LA, Lam, BA, Harris, RN, Briggs, CJ, Vredenburg, VT; Voyles, J *Treatment of amphibians with chytrid fungus: learning from failed trials with itraconizole, antimicrobial peptides, bacteria, and heat therapy* (Diseases of Aquatic Organisms)
5. Bishop*, MR, RC Drewes, and VT Vredenburg *Stable isotope approach illustrates the importance of terrestrial prey to the California red-legged frog* (Ecology)

<u>*In Press*</u>

1. Vásquez Almazán, CR, and VT Vredenburg (*2011*) Discovery of the lethal amphibian fungal pathogen, *Batrachochytrium dendrobatidis*, in a direct-developing salamander in Guatemala *Herpetological Review*

<u>*Published*</u>

1. Swei, A, JJL Rowley, D Rödder, MLL Diesmos, AC Diesmos, CJ Briggs, R Brown, TT Cao, TL Cheng*, B Han, J Hero, DH Hoang, MD Kusrini, TTD Le, M Meegaskumbura, T Neang, SPhimmack, D Rao, NMM Reeder*, SD Schoville, N Sivongxay, N Srei, M Stöck, B Stuart, L Torres#, TAD Tran, TS Tunstall, D Vieites, and VT Vredenburg (2011) Is Chytridiomycosis an Emerging Infectious Disease in Asia? *PLoS ONE* 6(8): e23179 doi:101371/journalpone0023179
2. Cheng*, TL, S Rovito, DB Wake and VT Vredenburg Coincident mass extinction of neotropical amphibians with the emergence of the fungal pathogen *Batrachochytrium dendrobatidis* 2011 *Proceedings of the National Academy of Sciences*108(23):9502-9507
   a) <u>Review of Cheng et al 2011</u>: Lips KR 2011 Museum collections: Mining the past to manage the future *Proceedings of the National Academy of Sciences USA* 108(23):9323-9324
   b) Cheng, et al. 2011 won the *Best Student Paper Award* at the Ecological Society of America general meeting 2011
3. Schoville, SD, TS Tustall, VT Vredenburg, AR Backlin, DA Wood, RN Fisher 2011 Conservation of evolutionary lineages of the endangered mountain yellow-

legged frog, *Rana muscosa* (Amphibia: Ranidae), in southern California *Biological Conservation* 144:2031-2040

4. Reeder[*], NMM, TL Cheng[*], VT Vredenburg, and DC Blackburn 2011 Survey of the chytrid fungus *Batrachochytrium dendrobatidis* from montane and lowland frogs in eastern Nigeria *Herpetology Notes* 4:83-86
5. Catenazzi A, E Lehr, LO Rodriguez, and VT Vredenburg 2011 *Batrachochytrium dendrobatidis* and the collapse of anuran species richness and abundance in the upper Manu National Park, southeastern Peru *Conservation Biology* 25: 382-391
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10. Vredenburg, VT, RA Knapp, T Tunstall, and CJ Briggs 2010 Dynamics of an emerging disease drive large-scale amphibian population extinctions *Proceedings of the National Academy of Sciences* 107:9689-9694

    Reviews and other significant citations of Vredenburg et al 2010:

    a) Blaustein, AR and PTJ Johnson 2010 When an infection turns lethal *Nature* 465:881-882
    b) Jeremy, A 2010 Epidemiology: It's not easy being green *Nature Reviews Microbiology 8:467*
    c) Kinney, V C, J L Heemeyer, A P Pessier, and M J Lannoo 2011 Seasonal pattern of B*atrachochytrium dendrobatidis* infection and mortality in *lithobates areolatus*: Affirmation of Vredenburg's "10,000 zoospore rule" *PLoS ONE* 6(3):e16708
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12. Harris, RN, RM Brucker, JB Walke, MH Becker, CR Schwantes, DC Flaherty, BA Lam, DC Woodhams, CJ Briggs, VT Vredenburg, KPC Minbiole 2009 Skin microbes on frogs prevent morbidity and mortality caused by a lethal skin fungus *The ISME Journal* 3:818-824
13. Wake, DB, and VT Vredenburg 2008 Are we in the midst of the sixth mass extinction? A view from the world's amphibians *Proceedings of the National Academy of Sciences 105:11466-11473*
14. FrÍas-Álvarez P, V T Vredenburg, M Familiar-Lopez, JE Longcore , E Gonzalez-Bernal, G Santos-Berrera, L Zambrano, and G Parra-Olea 2008 Chytridiomycosis survey in wild and captive Mexican amphibians *EcoHealth* 5: 18-26

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17. Finlay, JC and VT Vredenburg 2007 Introduced trout sever trophic connections in watersheds: consequences for a declining amphibian *Ecology* 88(9): 2187-2198
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22. Briggs, C, VT Vredenburg, RA Knapp, and LJ Rachowicz 2005 Investigating the population-level effects of chytridiomycosis, a fungal disease of amphibians *Ecology* 86(12):3149-3159
23. Rachowicz, LJ, JM Hero, JAT Morgan, VT Vredenburg, J Taylor, CJ Briggs 2005 The novel and endemic pathogen hypothesis: explanations for the origin of an emerging infectious disease of wildlife *Conservation Biology* 19(5):1441-1448
24. Vredenburg, VT 2004 Reversing introduced species effects: Experimental removal of introduced fish leads to rapid recovery of declining frog *Proceedings of the National Academy of Sciences* 101(20):7646-7650
25. Rachowicz, LJ and VT Vredenburg 2004 Transmission of *Batrachochytrium dendrobatidis* within and between amphibian life stages *Diseases of Aquatic Organisms* 61:75-83
26. Macey, JR J Stasburg, J Brisson, VT Vredenburg, M Jennings, and A Larson 2001 Molecular phylogenetics of western North American frogs of the *Rana boylii* species group *Molecular Phylogenetics and Evolution* 19(1):131-143
27. Vredenburg, VT, T Tunstall, H Nguyen, J Romansic and S Schoville 2001 *Hydromantes platycephalus* (Mt Lyell salamander) *Herpetological Review* 32:178
28. Vredenburg, VT, and AP Summers 2001 Field Identification of chytridiomycosis in *Rana muscosa Herpetological Review* 32:151-152

29. Vredenburg, VT 2000 Natural History Notes: *Rana muscosa* (mountain yellow-legged frog), conspecific egg predation *Herpetological Review* 31:170-171
30. Vredenburg, V T, Y Wang, and G Fellers 2000 Scientific meeting raises awareness of amphibian decline in Asia *FrogLog* 42: 2-3
31. Knapp, R A, V T Vredenburg, and K M Matthews 1998 Effects of stream channel morphology on golden trout spawning habitat and recruitment *Ecological Applications* 8(4):1104-1117
32. Knapp, RA, and VT Vredenburg 1996 A field comparison of the substrate composition of golden trout redds using two sampling techniques *North American Journal of Fisheries Management* 16:674-681
33. Knapp, RA, and VT Vredenburg 1996 Spawning by California golden trout: characteristics of spawning fish, seasonal and daily timing, redd characteristics, and microhabitat preferences *Transactions of the North American Fisheries Society* 125(4):519-531
34. Knapp, RA, PC Sikkel, and VT Vredenburg 1995 Age of clutches in nests and the with-in nest spawning-site preferences of three damselfish species (Pomacentridae) *Copeia*(1995):78-88

Book Chapters and other publications In Press 2011

1. Catenazzi, A, E Lehr, LO Rodriguez, and VT Vredenburg Amphibian Disease in the Peruvian Andes 2011 *Smithsonian Institution Scholarly Press*
2. Vredenburg, VT, M Koo, K Whittaker, and DB Wake 2011 Global Declines of Amphibians *In Encyclopedia of Biodiversity* Elsevier Press
3. Cheng*, TL, S Rovito, DB Wake and VT Vredenburg (*In Press*) Museum specimens reveal spread of pathogen and collapse of amphibians in Central America *Froglog*
4. A Swei, JJL Rowley, D Rödder, MLL Diesmos, AC Diesmos, CJ Briggs, R Brown, TT Cao, TL Cheng*, B Han, J Hero, DH Hoang, MD Kusrini, TTD Le, M Meegaskumbura, T Neang, SPhimmack, D Rao, NMM Reeder*, SD Schoville, N Sivongxay, N Srei, M Stöck, B Stuart, L Torres#, TAD Tran, TS Tunstall, D Vieites, and VT Vredenburg (*In Press*) Prevalence and distribution of chytridiomycosis throughout Asia *FroLog* 98

Book Chapters and other publications

1. Vredenburg, V. T., C. J. Briggs, and R. N. Harris. 2011. Host-pathogen dynamics of amphibian chytridiomycosis: The role the skin microbiome in health and disease In *Fungal diseases: An emerging threat to human, animal and plant health*, edited by L. Olsen, E. R. Choffnes, D. A. Relman and L. Pray. Washington, D.C.: The National Academies Press IOM (Institute of Medicine). Pp. 342-355.
2. Vredenburg, VT, MS Koo, and DB Wake 2008 Declines of amphibians in California *In* Hoffman, M (Ed), *Threatened Amphibians of the World* Lynx Ediciones, Barcelona, Spain, pp 126
3. Vredenburg, VT, G Fellers, and C Davidson 2005 The mountain yellow-legged frog (*Rana muscosa*) *In* Lannoo, MJ (Ed), Status and Conservation of US Amphibians University of California Press, Berkeley, California, USA, pp 563-566
4. Vredenburg*, VT, M McDonald, & T Sayre (2010) *Amphibians and Climate Change* Natural Selections 6(1):10-12

Teaching Experience at SFSU

Ecology (BIOL 482) 40-60 undergraduates
Ecology and Evolution Seminar (BIOL 862) 12-18 graduate students
Vertebrate Evolution and Natural History (BIOL 470) 20 undergraduates

Student Mentoring

Master's Students-Chair

Completed

1. Natalie Reeder; *Potential role of the pacific chorus frog in the spread of chytridiomycosis disease* (6-25-2010) [This thesis was San Francisco State University's nomination for the 2010 Western Association of Graduate Studies Distinguished Master's Thesis Award 2010]
2. Tina Cheng; Title: *The effects of chytridiomycosis disease on Central American salamanders* (please see publication #2, published in PNAS; winner Ecological Society of America *BEST STUDENT PAPER 2011*)
3. Meghan Bishop*; Title: *Habitat use and conservation of red-legged frogs in coastal California* (*Official Chair was Dr R Drewes at the California Academy of Sciences)

In progress

1. Sam McNally; *Tracking the spread of Batrachochytrium dendrobatidis through amphibians in California's Sierra Nevada*
2. Stephanie Hyland; *Development of a rapid PCR Assay for* Janthinobacterium lividum*, a bacterium that occurs symbiotically on amphibian skin*
3. Raul Figeroa; *Was the fungal pathogen,* Batrachochytrium dendrobatidis*, spread throughout Asia by the amphibian food and pet trade*?
4. Celeste Dodge; *Effects of a fungal pathogen on the Yosemite Toad (*Bufo canorus*)?*
5. Danquing Shao; *Investigating the role of introduced American Bullfrogs in the spread chytridiomycosis disease in Chinese amphibians?*
6. Gabriela Rios-Sotelo; *Did the fungal pathogen* Batrachochytrium dendrobatidis *originate from Japan?*
7. *Angel Jacobo Pereira; The amphibian chytrid pathogen* Batrachochytrium dendrobatidis *in Guatemala*

Master's Students-Committee Member

Completed

1. Kim Vincent (Chair E Routman), *The effects of pesticides on tadpoles*
2. Anthony Chazar (Chair Dr R Sehgal), *Effects of deforestation on the prevalence and diversity of blood parasites in two African rainforest birds*
3. Maria Tonione (Chair E Routman), *Microsatellite variation in the hellbender,* Cryptobranchus alleganiensis
4. Jenny Carlson (Chair R Seghal), *Evolution of blood pathogens*
5. Hazel Thwin (Chair J Dumbaucher), *Ornithology of Myanmar*
6. Molly Dodge (Chair R Sehgal), Transmission of haemosporidian pathogens in resident and migrating birds
7. Holly Archer (Chair R Seghal), *Emerging infectious disease and blood parasite prevalence in countryside birds*

8. Stephen Micheletti (Chair E Routman), *Population structure of Side-blotched Lizards (*Uda stansburiana*): Displaying adaptive dorsal coloration*

In progress

1. Alexandra Vasquez Ochoa; El ensambleaje de anfibios en 13 localidades de la region Andina central oriental, Orinoquia y Amazonia de Colombia; Pontificia Universidad la Javeriana, Bogota, Colombia

PhD Students-Committee Member

In progress

1. Brooke Talley (Chair K Lips, Southern Illinois University), *Distribution of* Batrachochytrium dendrobatidis *in amphibians of Illinois*

Service

University Level

1. San Francisco State University Academic Senator (elected Fall 2011)
2. Curriculum Review and Approval Committee

Departmental Level

1. Undergraduate General Biology Major advisor

Graduate Student advising

1. Weekly lab meetings in Vredenburg Lab, students participate in reading and evaluating recent scientific publications, present updates on student and lab projects and report on animal status in the SFSU animal care facility
2. Weekly individual meetings with graduate students

New Course Development

1. Biol 470 Evolution and Natural History of Vertebrates - course includes lectures, weekly laboratories and field trips (This course uses preserved museum specimens maintained at SFSU by Vredenburg)

Committee work

1. CRAC -Curriculum Review and Approval Committee
2. Biology Undergraduate and Graduate Scholarship Committee (2009-2010)
3. CSU System-wide Student Research Competition (2009-2010)
4. Undergraduate Curriculum Committee (2008-2010)
5. Judge for the College of Science and Engineering Project Showcase (2009-2010)
6. Biology Chair Evaluation Committee (2011)

Synergistic Activities

1. Co-Founder and Associate Director: wwwAmphibiaWeb.org an online research and conservation resource for the world's amphibians This site has an average of 20,000+ successful queries per day by students, conservation scientists, and the general public
2. Faculty Sponsor at SFSU for 7 graduate students (see below) and 9 undergraduate students (4 undergraduates are underrepresented minority students receiving funding from NSF and NIH)
3. Provided training in the form of lectures, field trips and lab methodology *in Spanish* to students and faculty in Latin America (Training Course on Quantitative PCR Detection of Chytridiomycosis, Mexico City, Mexico, at

UNAM, for the Red de Análisis para los Anfibios Neotropicales Amenazados; and in Guatemala City, Guatemala for the Museo de Historia Natural, Univ de San Carlos de Guatemala; and to professors and students at Pontificia Universidad la Javeriana, Bogota, Colombia)

Public Outreach/Education/News coverage of the Vredenburg Lab

Television

1. Animal Planet: *The Vanishing Frog* with Jeff Corwin; 11-20-09
2. ABC-News; CNN; CBS Evening News (various appearances)

Radio

1. NPR-Science Friday-*Modern Extinctions* (KQED; 5-14-10)
2. WALO 1240 AM Radio Puerto Rico (6-22-10)- in Spanish

Movie Documentaries

1. NSF Science Nation (*Disappearing Frogs: Trying to save the world's amphibians*, by Miles O'Brien and Marsha Walton; 11-2-09)
2. NPR KQED QUEST (*Disappearing Frogs*; 5-15-08)

Print/News media

1. National Geographic Magazine (4-1-09); *The Vanishing* by Jenny Holland
2. New York Times (05-10-10); *Toiling against a deadly disease to save a threatened frog* by Erica Rex
3. Popular Science (in press); *Can skin microbes save our frogs?* By Susannah Locke
4. GEO Magazine (Germany; 07/01/10); *Amphibians in Crisis* by Markus Wolff
5. National Parks Magazine (2011)
6. Audubon Magazine (*in press*)
7. Deep-Sea News (volume5: 9-12-2011)

Biology Textbook featuring Vredenburg research

1. Campbell, NA, & Reece, J B (*In Press*) *Biology*, Benjamin Cummings, 8th edition pp650-651 *(This is the most commonly used Biology textbook in Introductory Biology Courses in the USA)*

Collaborators & Other Affiliations

1. Collaborators and Co-Editors J Taylor, C Moritz (UC Berkeley); R Knapp, C Briggs (UC Santa Barbara), E Rosenblum (U Idaho)
2. Graduate and Postdoctoral Advisors PhD co-advisors Mary Power and David Wake (UC Berkeley); postdoc advisor Cheryl Briggs (UC Santa Barbara)
3. Thesis Advisor and Postgraduate-Scholar Sponsor Master's students: *completed* (3) Natalie Reeder (6-25-10); Tina Cheng (6-25-11), Meghan Bishop (5-22-11) *current* (7) Celeste Dodge, Raul Figeroa*, Stephanie Hyland*, Danquing Shao, Gabriela-Rios-Sotelo*, Sam McNally, and Angel J. Pereira* (*underrepresented minority)

Reviewer

1. National Science Foundation (two Panels)
2. National Geographic (research grants)
3. Scientific Journals
   a) *Proceedings of the National Academy of Sciences*
   b) *Nature*

c) *Public Library of Science Biology*
d) *Public Library of Science Pathogens*
e) *Journal of Animal Ecology*
f) *Conservation Biology*
g) *Herpetologica*
h) *Journal of Herpetology*
i) *Diseases of Aquatic Organisms*
j) *The Herpetological Journal*

Invited presentations/lectures

1. Special Forums
   a) National Academy of Sciences/Institute of Medicine, Dec 2010 F*orum on Microbial threats: Fungal Diseases; Washington, DC*
2. *Departmental Seminars*
   a) 2011 Universidad de los Andes, Bogota, Colombia
   b) 2011 La Javeriana University, Bogota, Colombia
   c) 2011 California Academy of Sciences
   d) 2010 University of Nevada Reno, Dept of Biology
   e) 2009 University of San Francisco, Dept of Biology
   f) 2008 Department of Zoology; Southern Illinois University
   g) 2008 Department of Biology; Museo de Historia Natural, Guatemala City, Guatemala
   h) 2007 Department of Biology; University of Puerto Rico, PR USA
   i) 2005 Department of Ecology and Evolution; University of California Santa Cruz
   j) 2002 Department of Ecology and Evolutionary Biology; University of Connecticut
1. *Scientific Meetings*
   a) *2012 World Congress of Herpetology - symposium presentation*
   b) *2011 Ecological Society of America- symposium presentation*
   c) *2009, 2011, 2012 Integrative Research Challenges in Environmental Biology*; Amphibian declines and chytridiomycosis; Arizona State University, Tempe, Arizona
   d) *2007* Partners in Amphibian and Reptile Conservation; Amphibian declines and chytridiomycosis; Tempe, Arizona

Symposium Organizer

1. 2012 World Congress of Herpetology: Reversing the effects of introduced species on amphibians
2. 2007 Ecological Society of America: Disease emergence and amphibian decline: using ecology to understand patterns and promote restoration; San Jose, California
3. 2005 Declining Amphibian Population Task Force; Berkeley, California
4. 2000 Amphibian Conservation; 4th Asian Herpetological Conference; Chengdu, China

Provided qPCR Prep and Analysis Training

1. NSF Collaborative Network

   a) The Research and Analysis Network for Neotropical Amphibians (Red de Análisis para los Anfibios Neotropicales Amenazados); Training Course on Quantitative PCR (Q-PCR) Detection of Chytridiomycosis; invited by Dr Gabriela Parra (Univ Nacional Autonoma de Mexico) Course co-funded by NSF and the IUCN Amphibian Specialist Group
2. Faculty - Pontificia Universidad la Javeriana, Bogota, Colombia
3. Postdocs - UC Berkeley; Gonzaga University; Smithsonian Institution
4. Graduate students - Universidad Nacional Autonoma de Mexico (UNAM), Mexico City, Mexico; Southern Illinois University; Museo de Historia Natural, Guatemala City, Guatemala; Pontificia Universidad la Javeriana, Bogota, Colombia

EXHIBIT B

EXHIBIT B, p. 1
Declaration of Vance Vredenburg
February 23, 2011, 11:01am
Southeastern Shore of Horse Stable Pond, Sharp Park Golf Course

EXHIBIT B, p. 2
Declaration of Vance Vredenburg
February 23, 2011, 11:01am
Southeastern Shore of Horse Stable Pond, Sharp Park Golf Course

EXHIBIT F

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August 3, 2012

Ryan Olah, Chief
Coastal Division Branch
U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, CA 95825

Jane Hicks, Chief
Regulatory Division
U.S. Army Corps of Engineers
San Francisco District
1455 Market Street, 16th Floor
San Francisco, CA 94103

Subject: Technical Review Comments to Biological Assessment
Sharp Park Safety, Infrastructure Improvement and Habitat Enhancement Project

Dear Mr. Olah and Ms. Hicks:

I have reviewed the subject Biological Assessment (BA) prepared by Recreation and Park Department, City and County of San Francisco, dated March 14, 2012. In addition, my firm and I have completed numerical storm modeling in an effort to evaluate the benefits and/or impacts associated with proposed project actions. The reason for this letter is two-fold. First, because my firm's work and study conclusions are cited within the BA, as well as having a unique knowledge of the site, I would like to clarify and elaborate on selected sections within the BA. Secondly, based on our analyses, it is my opinion that some of the key proposed actions in the BA intended to reduce flooding and improve California red-legged frog and San Francisco gartersnake habitat would fail at providing the desired benefits and may adversely affect these species. Specifically, my analyses indicate the following.

- Removing vegetation from the connector channel will increase the flow rate from Horse Stable Pond to Laguna Salada during the early parts of storm events, causing the water level in Laguna Salada to reach a maximum level sooner under BA conditions than currently exists.

- The maximum simulated water level attained in Laguna Salada under BA project conditions is about 0.2-feet higher than the existing condition simulated water level for a one inch storm event. This means that the extent of flooded area within Laguna Salada and near the golf course associated with a one inch rainfall storm event will be larger under proposed BA project conditions than existing conditions.

- The maximum simulated 2- and 5- year storm water levels attained in Laguna Salada during the proposed BA project conditions reach the same elevation that water levels reach under existing conditions, just sooner. This means that the extent of flooded area associated with these storm events remains virtually the same between existing and BA project conditions.

- Simulation results indicate that removal of vegetation from the connector channel does not lead to faster drainage of water or reduced duration of inundation in Laguna Salada and the golf course area between existing and proposed BA project conditions. Therefore, the associated conversion of cover habitat to open water habitat for CRLF would not provide any reduction in the extent or duration of flooding in LS and the surrounding golf course.

My comments associated with specific sections of the BA and rationale for my conclusions are provided below after a paragraph summarizing my credentials.

I am a hydrologist with over twenty five years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology. I have been providing professional hydrology services in California since 1991 and routinely manage projects in the areas of aquatic ecosystem restoration planning and design, surface- and groundwater hydrology, water supply, water quality assessments, water resources management, and geomorphology. Most of my work is located in the Coast Range watersheds of California, including the Northern and Southern San Francisco Bay Counties. My areas of expertise include: characterizing and modeling watershed-scale hydrologic and geomorphic processes; evaluating surface- and ground-water resources/quality and their interaction; assessing hydrologic, geomorphic, and water quality responses to land-use changes in watersheds and causes of stream channel instability; and designing and implementing field investigations characterizing surface and subsurface hydrologic and water quality conditions. I co-own and operate the hydrology and engineering consulting firm Kamman Hydrology & Engineering, Inc. in San Rafael, California (established in 1997). I earned a Master of Science in Geology, specializing in Sedimentology and Hydrogeology as well as an A.B. in Geology from Miami University, Oxford, Ohio. I am a Certified Hydrogeologist (CHg) and a registered Professional Geologist (PG).
I am also very familiar with Sharp Park. In 2009 my firm was retained by Tetra Tech of Portland, Oregon on behalf of the San Francisco Recreation and Parks Department to prepare a hydrological report for Sharp Park. Our work focused on characterizing conditions on the site and preparing a suite of analytical models that were used to a) evaluate hydrologic and drainage conditions, and b) design marsh, pond, and stream restoration alternatives that would benefit the California red-legged frog (CRLF) and the San Francisco gartersnake on the property. Our study is documented in a report[1]

[1] Kamman Hydrology & Engineering, Inc., 2009, Report for the Hydrologic Assessment and Ecological Enhancement Feasibility Study, Laguna Salada Wetland System, Pacifica, CA. Prepared for Tetra Tech, Inc., San Francisco, CA, 30p.

summarizing our hydrologic assessment, salinity assessment, and storm response modeling for Sharp Park. In writing this report, I studied historic rainfall records, local surface runoff, pumping operations, and water storage capacity of Laguna Salada, Horse Stable Pond, Sanchez Creek, and Sharp Park as a whole.

The following sections provide comments to selected sections of the BA that warrant clarification and elaboration with respect to the feasibility of proposed project actions.

1. Section 2.2 Project Description – Elaboration on Historic and Future Conditions

On page 4, the BA states, "A seawall on the western boundary of Sharp Park eliminated the historic hydrologic connection between the Pacific Ocean and the wetlands complex." Prior to construction of the seawall, there was likely a higher degree of exchange of water between Pacific Ocean and the Laguna. The current seawall likely inhibits floodwater drainage to the Ocean and is the primary cause for the winter flooding of the Laguna and golf course. With the seawall in place, the current and future outflow from Sharp Park is primarily controlled by the Horse Stable Pond pumps and to a lesser degree on internal drainage features. I elaborate on how the proposed BA project actions will affect future drainage and flooding conditions below.

Based on my experiences in restoring wetlands (e.g., Giacomini Wetlands at Point Reyes National Seashore) and California red-legged frog habitat along the Central California coast (e.g., Mori Point ponds), I think it is important to point out that removing the Sharp Park seawall would not preclude frog habitat. Although there would be the introduction of salt water and initial loss of freshwater marsh and pond, coastal estuaries display an ocean-to-land continuum in salinity structure between marine, brackish and freshwater conditions. These habitats are transient, shifting oceanward in response to seasonal rains and freshwater input from inland drainages. In turn, there is a corresponding transition in suitable frog habitat, with frog habitat likely precluded in the high salinity ocean side water but suitable breeding and rearing habitat located a short distance inland. In my experiences at the Giacomini Project in Marin County, CRLF and designated CRLF habitat is found in very close proximity to high salinity waters. Work by Fellers and Kleeman [2] at the Park documented how frogs move seasonally over considerable distances between temporary bodies of water for breeding and nonbreeding habitat. Thus, I think it is important to acknowledge the frog's natural ability to breed on the fringe of tidal wetland areas.

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[2] Fellers, G.M., and Kleeman, P.M., 2007, California red-legged frog (*Rana draytonii*) movement and habitat use: implications for conservation. Journal of Herpetology, Vol. 41, No.2, pp. 271-281.

2. Section 2.2 Project Description – Clarification between Wet and Dry Season Controls Over Wetland Ponding

Page 4 of the BA states, "The wetlands are believed to be maintained by ground water but are also fed by surface water inflow due to precipitation in the winter. A flood control pump system in HSP affects water levels in that body, and it may affect water levels in LS when the channel connecting the two water bodies creates a surface water connection between them." These sentences should be clarified with respect to both the wet and dry seasons. The first sentence refers to wetland water supply during the summer, when groundwater contributions dominate because there is little to no surface water runoff. With regard to the second sentence, the exchange of water between Horse Stable Pond (HSP) and Laguna Salada (LS) is dramatically different during the wet and dry seasons. For example, through the dry season and after the Horse Stable pumps stop pumping, water levels decline in both ponds due to cessation of surface water inflow, declining groundwater inflow and increased evaporation. The highest measured elevation in the bed of the connector channel between HSP and LS is approximately 6.2-feet NAVD88. When water levels in either pond fall below this elevation, HSP and LS are segregated from each other and behave as two independent water bodies. The lowest observed stage in Laguna Salada that I am aware of is about 6.0-feet NAVD88 (Figure 6 in KHE 2009 report).

The BA project proposes, "Removal of sediment and emergent vegetation that impedes water flow and reduces habitat suitability for CRLF in selected locations with the connecting channel and culverts that link HSP and LS. This removal work would not exceed 480 cubic yards of removed sediment and vegetation within an area of approximately 6,500 square feet or 0.15 acres." (second bullet on page 7 of BA). If the BA action lowers the elevation of the bed of the channel that connects HSP and LS, it is possible that these water bodies will remain in hydraulic connection longer during the dry times of the year or at water levels below 6.2-feet in elevation. However, it is important to point out that during our 2008-2009 hydrologic investigation we measured the invert (lowest point) elevation of the culvert used to accommodate a golf cart path over the connector channel culvert at an elevation of 6.0-feet NAVD88. Thus, without lowering the culvert elevation, the hydraulic connection between the ponds can't be lowered below 6.0-feet NAVD88.

During winter high flows, the existing hydraulic connection between HSP and LS is much more dynamic. As part of our 2008-2009 hydrologic and hydraulic investigation of Sharp Park, we developed a calibrated numerical model that simulates water movement into and through the HSP-LS-Sharp Park complex. Our model was developed and calibrated using data collected during the storm of November 1, 2008, when we estimate a little over one inch of rainfall occurred. Using this model, we evaluated the effects of removing the vegetation and associated channel roughness that inhibits flow through the connector channel pursuant to the proposed BA project. This analysis included simulation of the November 1, 2008 storm and 24-hour storms having recurrence intervals of 2- and 5-years. Under existing conditions, we calibrated the numerical model using a connector channel roughness value of 0.15 (see pages 26-27 of KHE, 2009). In order to simulate the effects of vegetation removal from the connector channel, we modified the numerical model by lowering the roughness coefficient to 0.035).[3]

The results of the three modeled storm simulations for existing and proposed BA project conditions are provided in Figures 1 through 3 and discussed below. The simulation results of each storm are presented on each Figure with two graphs of information per Figure. The upper graph on each Figure presents the existing and proposed BA project water levels in HSP, LS and connector channel over the storm period. The lower graph on each page presents the associated water flow rates out of HSP, flow at a point within the middle of the connector channel, flow rate into LS, and the cumulative pumping rate out of HSP to the Pacific Ocean. A negative flow rate in the lower graphic indicates that the flow direction through the connector channel is from HSP towards LS (i.e., water level in HSP is higher than LS). A positive flow rate on the lower graph indicates that low is from LS to HSP (i.e., water levels in LS are higher than HSP).

Based on watershed mapping, field reconnaissance and runoff monitoring, we estimate that the amount of runoff to HSP during any given storm is approximately twice the magnitude as the runoff total to LS. In addition, the storage volume of HSP for any increment in water level rise is significantly less than that of LS. Thus, during the initiation and rising limb of a storm hydrograph, the water level in HSP rises much more quickly than the water level in LS. Because the water level in HSP is higher that LS, water then starts to drain out of HSP through the connector channel into LS. This phenomenon is observed even during the 1-inch storm event before water levels trigger the pump in HSP to start discharging water to the Pacific Ocean. Simulation results for the 2- and 5-year storm events indicate that inflow rates to HSP far exceed the discharge pump capacity, leading to higher incremental rises in water level and longer durations of flow from HSP into LS[4]. The main findings of the proposed BA project model simulations are as follows:

- Removing vegetation from the connector channel will increase the flow rate from HSP to LS during the early parts of storm events, causing the water level in LS to reach a maximum level sooner under BA conditions than currently exists.

- The maximum simulated water level attained in LS under BA project conditions reaches a water level elevation about 0.2-feet higher than during the existing condition simulation for a one inch storm event. This means that the extent of flooded area within LS and near the golf course associated with a one inch rainfall

[3] It's important to note that we did not alter (deepen or widen) the channel geometry in an attempt to emulate changes associated with sediment removal because the BA does not provide sufficient detail regarding this type of work. However, based on our modeling and understanding of the water level responses to changes in channel conveyance capacity, I don't believe there would be any significant change in the rate of water level change if the channel were widened and/or deepened. Deepening the channel would allow Laguna Salada to be drained to a lower and comparable depth via pumping from Horse Stable Pond.

[4] Simulations of pumping from HSP follow the pump operation "rules" implemented in 2008/09. Review of modeling results suggest that doubling the pump rate from HSP would roughly equal the inflow to HSP during the 2-year storm, but inflow during a 5-year storm would still overwhelm the system.

storm event will be larger under proposed BA project conditions than existing conditions.

- The maximum simulated 2- and 5- year storm water levels attained in LS during the proposed BA project conditions reach the same elevation that water levels reach under existing conditions, just sooner. This means that the extent of flooded area associated with these storm events remains virtually the same between existing and BA project conditions.

- Simulation results indicate that removal of vegetation from the connector channel does not lead to faster drainage of water or reduced duration of inundation in LS and the golf course area between existing and proposed BA project conditions. Therefore, the associated conversion of cover habitat to breeding habitat for CRLF would not provide any reduction in the extent or duration of flooding in LS and the surrounding golf course.

3. 2.2.1 Construction Action – Loss of Hydraulic Connection

On page 7 of the BA it states, "Because there is no surface water connection between these areas and LS, they cannot sustain CRLF through metamorphosis." This sentence is a bit unclear. Are the authors suggesting that it's the golf cart path that is limiting habitat or is it the available hydrology? In addressing the later, it is simply untrue that there is no surface water connection between the golf cart path area and Laguna Salada. The loss of hydrologic connectivity is a direct result of pumping from HSP. In the absence of pumping from HSP there would be a significant increase in the duration of flooding that would maintain connectivity in these areas over significant breeding periods. Based on Vandivere's Sharp Park Golf Course Inundation Area Map[5], the golf cart path area becomes inundated when water levels reach between 7 and 8-feet NAVD88 or higher. Vandivere's map also indicates that when water levels reach this level, LS, the connector channel and HSP are all hydraulically connected. Our modeling simulation results support this interconnected condition at water levels of 7- to 8-feet and also indicate that this has the chance of occurring once every two years under the 2008/09 pumping regime, but likely more often. It is only through pumping from HSP that waters recede quickly and ponded cart path areas become isolated from the connector channel, LS and HSP. If no pumping were occurring at all from HSP, the areas within the elevation range in question would surely be inundated annually and for durations likely exceeding the metamorphosis period.

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[5] Vandivere, W. 2011. Declaration of William Vandivere, P.E. in Support of Defendants' Opposition to Plaintiffs' Motion for Preliminary Injunction. *Wild Equity Institute, et al., v. City and County of San Francisco, et al.*, Case No. C 11-CV-00958-SI. 30 pp.

4. 2.2.1 Construction Action and Impact to Habitat Quality

On page 11 of the BA it states, "Repairs to the cart paths will involve moving the paths away from the wetland and into the golf course, installing interlocking pavers to support the downslope embankment and backfilling the area with drain rock to raise elevations." This description of work is very vague and unclear. Regardless, any fill placed in the area that raises the ground surface elevation will effectively reduce the frequency and duration of flooding at that raised area. Although it might only be a small change, it still would be a change reducing CDFG habitat. Areas covered in drain rock, even if they remain at the current elevation, may alter the substrate in a way that precludes emergent vegetation used to secure egg masses. As an aside, this area may be designated wetland by the Coastal Commission and the path relocation could constitute filling of wetland.

5. 3.2 Watershed Boundaries and Drainage Patterns

On page 31, the BA states, "The connecting channel between LS and HSP allows for water exchange at surface elevations greater than 6.2 feet (NAVD 88). Water exchange between the two water bodies is reduced by the hydraulic friction created by dense cattail growth (Kamman 2009). In some areas surrounding the wetlands and on the golf course, ponds or swales may form, which do not appear to have surface water connection to LS, HSP and the connecting channel. These ponds form immediately after rainfall events and may last for several days to several months." Again, like my response in item 2. above, the impact of vegetation on flow conveyance through the connector channel is really dependant on the water depth within the connector channel. Water depth in the connector channel depends on the season (wet or dry) and pumping from HSP. During periods when the water depth is well contained and shallow within the connector channel, the effects of vegetation on reducing flow conveyance are greatest. However, during these periods, there is no flooding of the golf course and no need to move water between LS and HSP any faster than already occurs. It is during the winter floods when water levels are approaching flood level of the golf course that are of concern. As demonstrated from our hydrologic modeling of storm events (see Figures 1 through 3) when water levels rise to an elevation of around 8-feet NAVD88, the saturated flow area and conveyance capacity within the connector channel increases to a level that far exceeds the rate of pumping from the HSP discharge pump, even with vegetation choked channels. In short, increasing the potential flow rate between LS and HSP when the golf course is at flood level makes no difference when the discharge pump from HSP can't keep up with the flows that are already delivered to the pump intake. Again, our modeling results indicate that even with a vegetation free channel, the depth and duration of flooding in Sharp Park will not change in response to the proposed BA project. Vegetation free channels will not change the frequency or area of pond/swale formation when the discharge capacity of the system can not keep up with the volume of inflow, even with improved water exchange between LS and HSP.

Our analyses indicate that the objective of restricting the formation of ponded areas and swales can't be accomplished through implementation of the proposed BA project.

Therefore, frogs and egg-masses will continue to populate the ponds and swales equally under existing and proposed BA project conditions. The best available approach towards protecting and enhancing existing frog habitat, given existing infrastructure, is a reduced pumping regime from HSP that stops dewatering the ponded areas and swales given they will continue to form at an uninterrupted frequency. In essence, this approach works to preserve frog habitat by maintaining the ponds/swales instead of dewatering them.

6. 3.4.4 Wetland Dredging and Flood Hazard Reduction

Page 33 of the BA states, "Over the last several decades, the extent of this vegetation has increased, replacing the open water." Dredging tules from LS will convert certain areas from frog cover habitat to open water habitat. However, based on my analyses and understanding of the project site, it is my opinion that this action would not result in any meaningful or significant relief from flooding. Specifically, I don’t believe that dredging tules from LS will lead to a significant reduction in flooded golf coarse area or flood duration.

If you have any questions or wish to discuss these opinions and conclusions further, please feel free to contact me.

Sincerely,

Gregory R. Kamman, PG, CHg
Principal Hydrologist

cc:

U.S. Army Corps of Engineers: Cameron Johnson, Ian Liffmann

U.S. Fish and Wildlife Service: Susan Moore, Jan Knight, Eric Tattersall, Cay Goude, Chris Nagano, and Josh Hull

California Coastal Commission: Renee Ananda and Karen Geisler

Figure 1: Flood model simulation results for project area for November 1, 2008 storm. Graphs plot results for densely and lightly vegetated connector channel simulations.

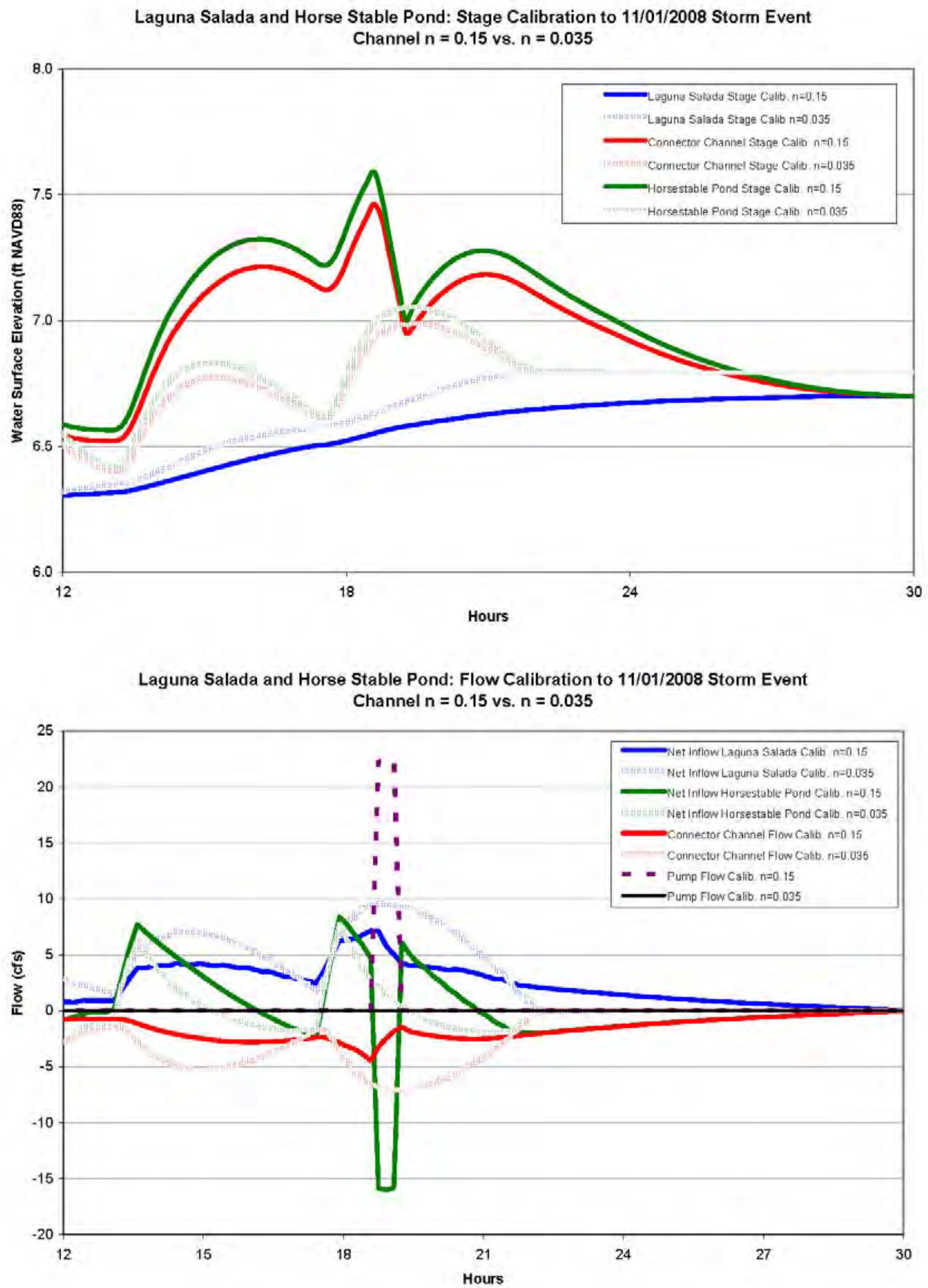
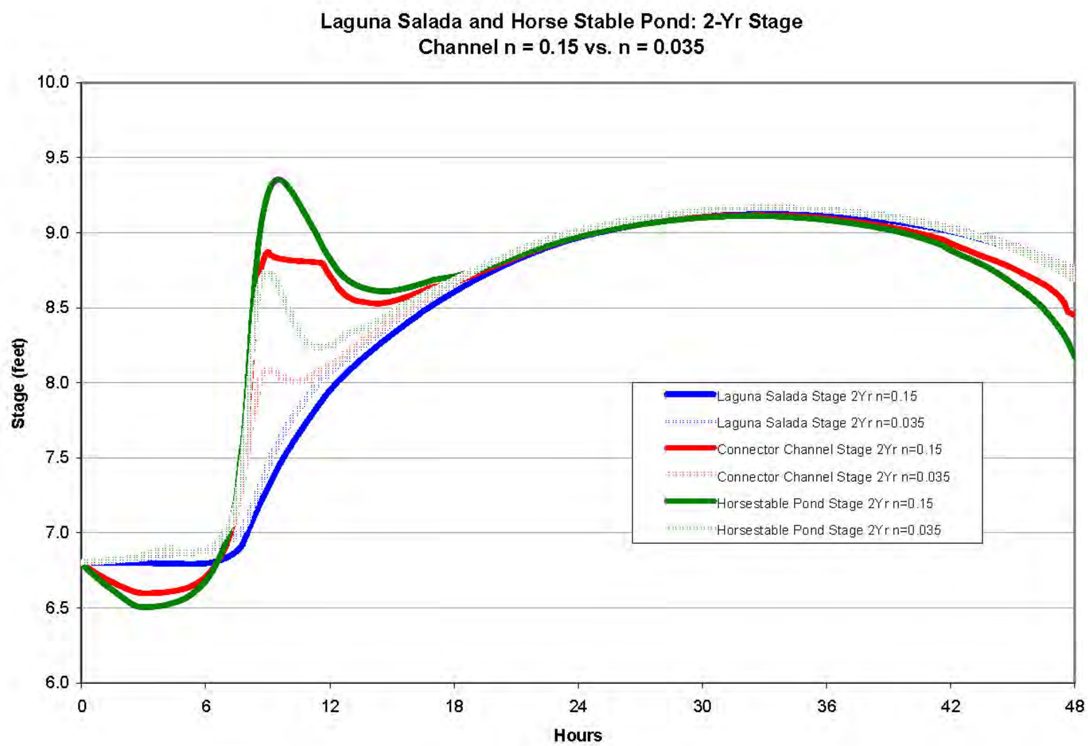


Figure 2: Flood model simulation results for project area for 2-Year storm. Graphs plot results for densely and lightly vegetated connector channel simulations.



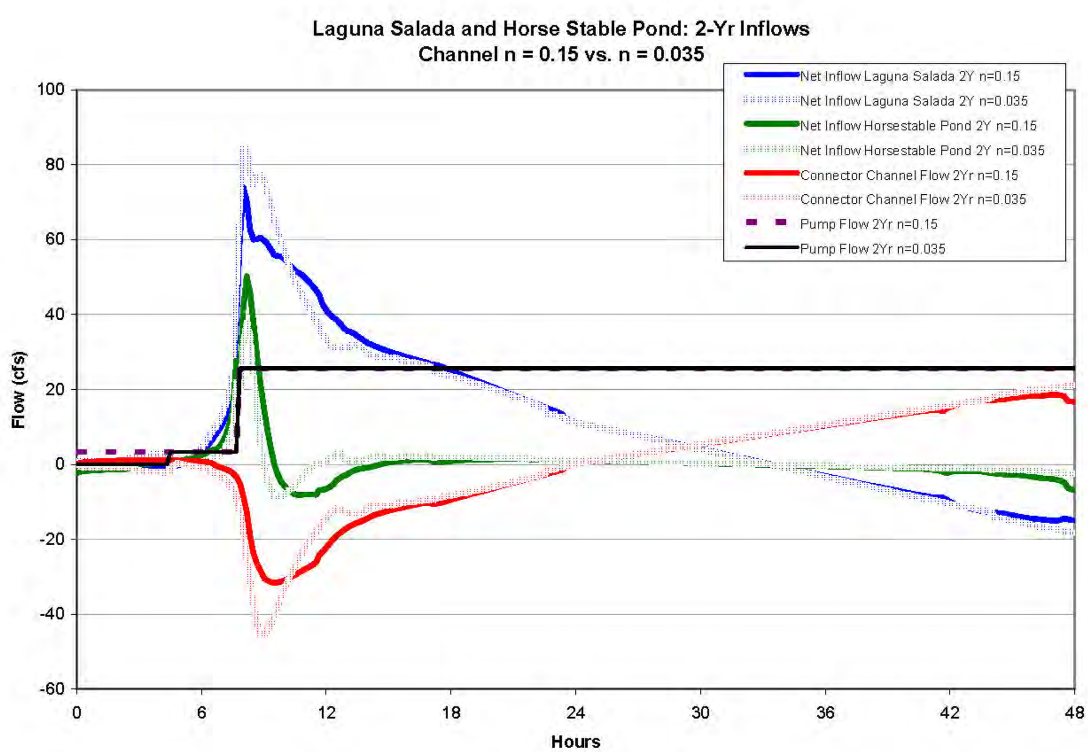
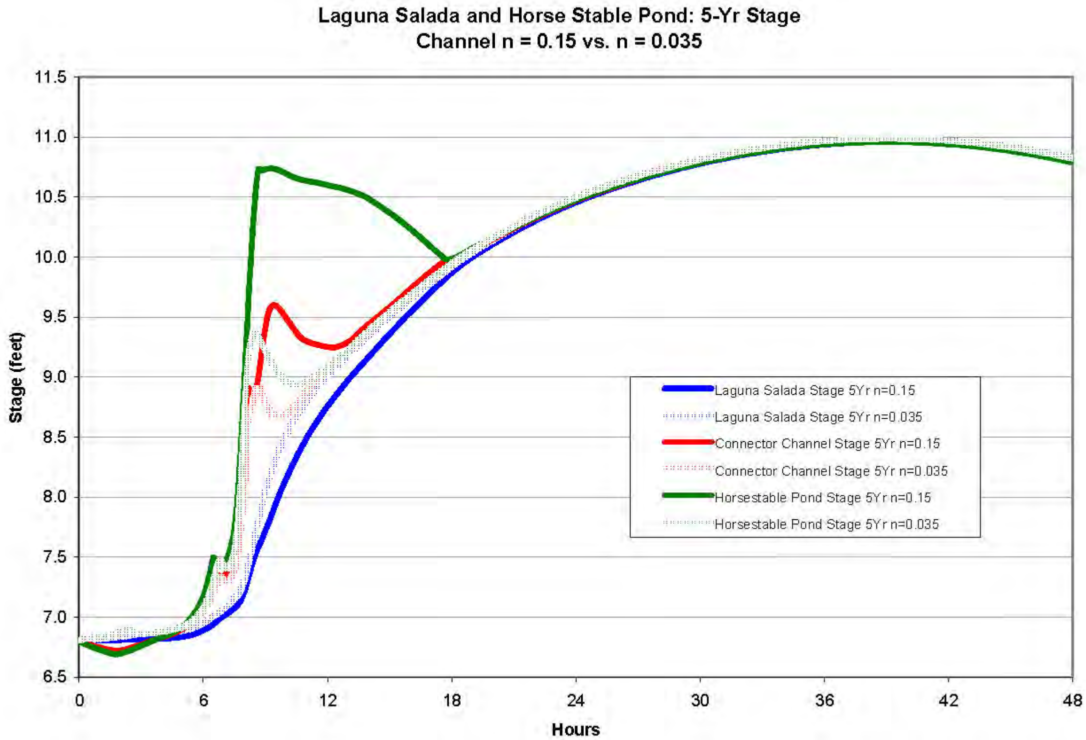
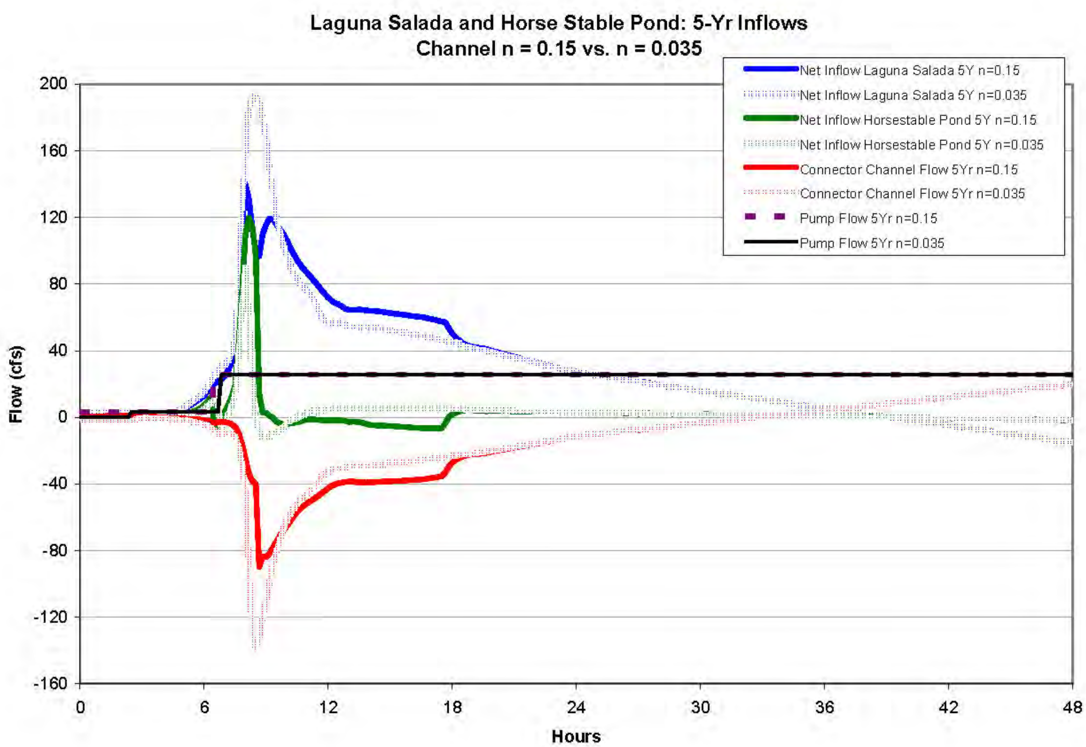


Figure 3: Flood model simulation results for project area for 5-Year storm. Graphs plot results for densely and lightly vegetated connector channel simulations.





UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA
NORTHERN DIVISION

WILD EQUITY INSTITUTE, a non-profit corporation, *et al.* Plaintiffs, **v.** **CITY AND COUNTY OF SAN FRANCISCO,** *et al.*, Defendants.	Case No.: **3:11-CV-00958 SI** **GREG KAMMAN EXPERT REPORT**

1. I am submitting this expert report on behalf of plaintiffs in this case.

BACKGROUND AND QUALIFICATIONS

2. I am a hydrologist with over twenty five years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology. I have been providing professional hydrology services in California since 1991 and routinely manage projects in the areas of surface- and ground-water hydrology, water supply, water quality assessments, water resources management, and geomorphology. Most of my work is located in the Coast Range watersheds of California, including the Northern and Southern San Francisco Bay Counties. My areas of expertise include characterizing and modeling watershed-scale hydrologic and geomorphic processes; evaluating surface- and ground-water resources/quality and their interaction; assessing hydrologic, geomorphic, and water quality responses to land-use changes in watersheds and causes of stream channel instability; and designing and implementing field investigations characterizing surface and subsurface hydrologic and water quality conditions. I co-own and operate the hydrology and engineering consulting firm Kamman Hydrology & Engineering, Inc. in San Rafael, California (established in 1997). I earned a Master of Science in Geology, specializing in Sedimentology and Hydrogeology, as well as an A.B. in Geology from Miami University, Oxford, Ohio. I am a Certified Hydrogeologist (CHg) and a registered Professional Geologist (PG). My CV summarizing my qualifications, along with a list of publications from the past 10 years, are attached as Ex. A. I am charging plaintiffs $100 per

hour for the time I spend reviewing materials and providing deposition and trial testimony in this matter. I have not been deposed or served as an expert witness in the past four years.

3. I am very familiar with Sharp Park. In 2009, my firm was retained by Tetra Tech of Portland, Oregon on behalf of the San Francisco Recreation and Parks Department to prepare a hydrological report for Sharp Park, attached as Ex. B. While producing this report, I reviewed a previous study of Sharp Park and Laguna Salada, entitled "Laguna Salada Resource Enhancement Plan," prepared by Philip Williams Associates in 1992. Our report expanded upon Philip Williams Associates' earlier study by reflecting current conditions on the site and by preparing a suite of analytical models that could be used to a) evaluate current hydrologic and drainage conditions, and b) design marsh, pond, and stream restoration alternatives that would benefit the California red-legged frog and the San Francisco gartersnake on the property. Our report included a hydrologic assessment, a salinity assessment, and a storm response model for Sharp Park. In writing this report, I studied historic rainfall records, local surface runoff, pumping operations, and the water storage capacity of Laguna Salada, Horse Stable Pond, Sanchez Creek, and Sharp Park as a whole. Our report considers, in part, the anticipated water levels that can be expected in Sharp Park during various winter rain scenarios under current pumping operations from Horse Stable Pond.

4. My expert testimony in this report is based on the resources described above, along with water level monitoring data for Horse Stable Pond and Laguna Salada collected by my firm, the Horse Stable Pond pump house log provided by the City and County of San Francisco in this litigation, egg mass survey data collected by the City and County of San Francisco from 2005-07, egg mass monitoring reports prepared by the GGNRA covering the years 2003-2005, and 2006-2009, water quality data for Sharp Park, the declaration provided by Dr. Marc Jennings in opposition to plaintiffs' motion for preliminary injunction, Docket No. 68, and the associated exhibits, and the declaration of William Vandivere in opposition to plaintiffs' motion for preliminary injunction, Docket No. 66-2, and the associated exhibits. A list of all materials I have relied upon in preparing this report is attached as Ex. C.

REQUESTED TESTIMONY

5. Plaintiffs have requested that I provide my expert opinion and testimony regarding six questions. First, plaintiffs have asked me to describe the geologic and hydrologic forces that cause Sharp Park Golf Course to flood on a regular basis. Second, plaintiffs have asked me to explain why Sharp Park Golf Course's pumping operations have not been able to prevent flooding. Third, plaintiffs asked me to determine if Sharp Park's pumping operations cause water levels to recede below elevations that California red-legged frog egg masses have been laid in the past. Fourth, plaintiffs asked me to determine the water levels that must be retained at Sharp Park to ensure that known California red-legged frog breeding areas remain hydrologically connected to the Laguna Salada wetland complex for six weeks, presuming no further water inputs occur during the six-week period. Fifth, plaintiffs asked me to compare typical flooding events at Sharp Park to the water levels at which I determine are necessary to keep known frog breeding areas hydrologically connected to Laguna Salada for six weeks. Finally, plaintiffs asked me to determine if ceasing pumping at Sharp Park when California red-legged frog eggs and tadpoles are present will cause flooding in surrounding communities.

SHARP PARK GOLF COURSE IS UNIQUELY PRONE TO FLOODING

6. Sharp Park Golf Course floods in the winter on a regular basis. It is especially prone to flooding because of the Golf Course's location within it's watershed, the sea wall which blocks natural freshwater outflow from Sanchez Creek, and other factors that ensure that large portions of the golf course remain under water for several days in all but the driest years. This is true even when Sharp Park's pumps are in full operation.

7. Flooding is a chronic and persistent issue at Sharp Park. Historically, Sharp Park has experienced severe flooding due to intense storm runoff and sea wall overtopping in April 1958, January 1978 and January 1983 (Geomatrix, 1987; FEMA, 1987).

8. Flooding continues to be persistent in modern times. For example, flooding of the golf course is reported in the Horse Stable Pond pump house log on February 20, 2011. Many of the log's gauge recordings indicate that even when the Horse Stable Pond pumps are in full operation, water levels reach between 9- and 10-feet in elevation (NAVD88) every year (2007

through 2011). Based on review of the available site topographic map (Lee, Inc., 2008) and the inundation map presented in the Vandivere declaration, water levels above 9-feet NAVD88 extend well into the western margins of the golf course. Water levels may reach up to 10-12 NAVD 88 in response to large storm events (see Ex. B, Figure 12).

PUMPING HAS NOT PREVENTED FLOODING AT SHARP PARK

9. The golf course attempts to drain Sharp Park using two pumps stationed at Horse Stable Pond, one referred to as the large pump and the second referred to as the small pump. The maximum discharge rates for these pumps are designed for approximately 10,000 gallons per minute (gpm) and 1,500 gpm. I have reviewed the Pump house log book and the deposition transcript of pump house stationary engineer John Ascariz, and although the pumps expel massive amounts of water from Sharp Park, the golf course continues to flood.

10. In order to translate the staff gauge readings from the Pump house log into water level elevations consistent with the Lee, Inc. 2008 topographic maps (NAVD88 datum), the Horse Stable Pond staff gauge recordings in the Pump house log were converted to the NAVD88 datum elevations by adding 5.9-feet to staff gauge measurements. This conversion was derived by comparing Pump house log staff gauge recordings to our continuous Pond water level measurements collected in 2008 and 2009. Our continuous water level record was tied to the NAVD88 vertical datum through an elevation survey of an associated pond staff plate installed and monitored at our recording instrument. Ex. D presents a plot of the converted Pump house log water level recordings versus our 2008/09 continuous Pond water level recordings, and these data are in close agreement. The continuous water level record for the December 13, 2008 through February 3, 2009 period is missing due to instrument error over this period.

11. In order to compare Horse Stable Pond pumping rates and water levels, I converted the remainder of the Pump house log gauge records to the NAVD88 datum and plotted concurrent water levels and cumulative pumped volumes from Horse Stable Pond during the past four winters (2007/08, 2008/09, 2009/10 and 2010/11). This graph is provided as Ex. E. The diamonds plotted on Ex. E represent Pump house log water elevations in feet NAVD88. The cumulative large, small and combined (large +small) pump water volumes for each individual

winter period are also plotted as the multi-colored lines on Exhibit E. Rising water levels and cumulative pump volumes indicate periods of increased surface runoff to the Laguna and Pond in response to winter rain storms. The cumulative total pumped water over any given winter reflects the total amount of runoff entering the project area. For example, the lesser cumulative pump volume during the winter of 2008/09 as compared to the volume pumped during the winter of 2010/2011 indicates 2008/09 was a noticeably drier year than 2010/11. As indicted above, flooding of the golf course occurs between 8- and 9-feet in elevation, and water levels during each winter monitored between 2007 and 2011 exceed this level. This lead to extensive flooding onto Sharp Park Golf Course.

12. Only when winter rains slow or cease can floodwaters at Sharp Park be pumped faster than the rains fall. Indeed, based on my own records and the Sharp Park Pump house log, it is apparent that the pumps often must operate for hours or even days after rain events to drain water from Sharp Park.

PUMPING OPERATIONS CAUSE EGG MASS STRANDINGS AT SHARP PARK

13. While pumping has limited utility in preventing Sharp Park Golf Course from flooding, it has caused California red-legged frog egg masses to strand and desiccate.

14. I have reviewed the Recreation and Park Department's maps of California red-legged frog egg-mass locations at Sharp Park for the past several winters. Based on these maps it is apparent that the vast majority of California red-legged frog egg masses have been laid in the same general areas at Sharp Park. Frogs have breed in these areas under a variety of winter rain conditions, during dry winters (2008/09) to wet years (2010/11).

15. I have also reviewed elevation data for Sharp Park's lagoon, pond and golf course. At 8-feet in elevation, Figure 1 of Exhibit 2 of the Vandivere declaration depicts all of Laguna Salada—including the areas that are considered "isolated" when water levels fall below 7-feet in elevation—as one large, contiguous, hydrologically connected water body. By comparing the egg mass locations to the elevation data, the elevation of these breeding areas can be ascertained and compared to water levels at Sharp Park. Based on my review of available maps indicating egg mass observation in 2003 through 2011, the vast majority of egg masses were located at

elevations between 7.0- and 8.0-feet NAVD88. (Ex. F). Historically, pumping operations have caused these egg masses to strand, as pumping lowers the water level below this elevation range (Ex. E).

16. It is also my professional opinion that pumping operations at Horse Stable Pond have caused egg masses to become stranded and desiccated at Sharp Park over the past four years in response to storm water pumping. This occurs when pond water levels rise rapidly in response to storm events and increased runoff that out-paces the ability of the pumps to maintain a constant pond water level. As the storm passes and runoff recedes, pond water levels drop rapidly as pumps draw the pond back down to a pre-set level. In order to minimize rapid cycling of the pumps on/off, a common practice is to set the pump to turn on at a predetermined water level and then to turn off at a lower predetermined level. For example, the Pump house log for January 31, 2008 indicates that a pump "on" level is set at a gauge height of 3.9 and pump "off" at 3.3. During these water level fluctuations, frogs will lay eggs during the high stand in water level and eggs become stranded above the water when levels are drawn down by pumping. Based on a comparison of egg mass monitoring notes and Pump house log entries, an example of this type of egg stranding occurred during a storm on or around February 20, 2011. For the week prior to the storm on the 20th, pond water levels were maintained around an elevation of 8.4-feet. In response to the increased storm runoff outpacing the pumps, water levels rose almost a foot to 9.3-feet. Within two or three days after the storm, water levels were pumped back down to 8.4-feet where they remained for several weeks. This stranding event was opportunistically observed by plaintiffs' members. See Docket No. 60-2, Ex. 4; 60-7, Ex. 26. An egg mass was discovered at risk on February 21, Docket No. 60-2, Ex. 4, and then stranded on February 22 through February 24, *id*.; Docket No. 60-7, Ex. 26, which could only have occurred if the frogs laid their eggs during the short highstand associated with storm flooding and subsequent dewatering.

17. Over the past four winters, notes in the Pump house log have indicated an increased effort to reduce impacts to frog egg masses. As a result, there has been an increased frequency in visits (as determined by increased frequency in Pump house log entries) to monitor and adjust

pumping levels, which has progressively reduced the variability in the range of pond water levels between 2007 and 2011 (see Ex. E). However, there continue to be periods of higher water levels followed by rapid drawdown by pumping, which lead to egg stranding events such as the one described for the February 20, 2011 storm event above.

18. It is not likely that strandings are caused by shallow depressions in Sharp Park's landscape independent of the golf course pumping operations. Based on Defendants' shaded relief map presented as Figure 1 of Exhibit 2 of the Vandivere declaration, Docket No. 66-2, isolated pond areas only occur when water levels drop below approximately 8-feet in elevation. Historically, pumping operations targeted maintaining water levels below 8-feet in elevation (see Ex. E). However, over the winter of 2010/11, water levels reached and were maintained above 8-feet in elevation for long periods. This was made possible due to the constant and extended period of rainfall and runoff that supplied the pond through the winter and spring months. The result of this extended surface water runoff supply, combined with the pumping of the pond down to only an elevation around 8.4-feet, allowed the known frog egg mass breeding areas between 7- 8-feet to remain hydrologically connected to the Laguna Salada wetland complex for long periods of time, significantly reducing, if not eliminating, the opportunity for stranding and desiccation of eggs laid at or below 8-feet in elevation. Although water levels at Sharp Park remained high enough to keep the Laguna Salada complex hydrologically connected during the 2010/11 winter, the City's rapid drawdown of the complex immediately after the February 20, 2001 storm caused an egg mass to strand.

19. Historically, runoff to the pond did not last as late into the season as it did the winter of 2010/11. In addition, historic pumping durations were shorter and the decline in pond water levels was more rapid and occurred much earlier in the year (Exhibit E), leading to water levels falling below 8-feet in elevation. Moreover, wet years like 2010/11 are unique and not a normal or predictable occurrence. This winter, for example, has been fairly dry until recently. The low rainfall should caution the City to be judicious in its pumping operations to ensure that egg masses are not stranded between 7- and 8-feet, as they have been in many previous years.

20. However, I have reviewed photographs of the Sharp Park Pump gauge taken on January 18, 2012 that indicate the City recently drained Horse Stable Pond to 7.1 feet NAVD in anticipation of upcoming storms. If egg masses are laid during the storm's highstand and water levels subsequently fall back to 7.1 feet NAVD, there is a high probability that stranding events will occur.

21. It is my opinion that a reasonable and conservative approach towards protecting frog eggs from stranding and desiccation is to initiate a pumping and pond management strategy that maintains egg inundation for a sufficient length of time at locations and elevations where frogs have repeatedly laid eggs. As indicated above, the majority of historic egg masses observed stranded or relocated were found at elevations between 7.0- and 8.0-feet NAVD88. Sustaining viable egg masses at an elevation of 8-feet requires a sufficient supply of water to keep them inundated for a reasonable duration of time. Since surface water runoff is an unpredictable supply, which is further complicated by dewatering by pumps, it seems prudent to provide a sufficient level of ponded water above the 8-foot elevation so that even with no further surface runoff into the Laguna/Pond system, egg masses at or below 8-feet in elevation would remain inundated. Such a scenario and water level would not be lowered by pumping and would need to account for losses and declines associated with evaporation, seepage and subsurface outflow.

WATER LEVELS MUST REMAIN AT 10.2-FEET NAVD88 OR HIGHER IN ORDER TO PREVENT STRANDING OF EGG MASSES AT SHARP PARK

22. It is my understanding that a conservative estimate of the duration needed for California red-legged frog egg-masses to hatch and tadpoles to become strong enough to swim to deeper waters in cool climates like Pacifica is approximately 6 weeks. (ESA/PWA 2011, Appendix C, Table 1).

23. To determine the water level needed to ensure hydrologic connection and six weeks of saturation in the portions of Sharp Park where California red-legged frogs have traditionally laid eggs (generally areas with elevations between 7- and 8-feet NAVD88), I've completed a simple pond recession analysis (spreadsheet model) similar to the groundwater seepage computation

presented in Vandivere's declaration. However, my analysis was improved in several ways, providing more accurate information.

24. First, after reviewing the Vandivere declaration, I realized that his calculation contained a conversion error. Lines 9-10 on page 6 indicates the upper elevation of the seepage face at the edge of the Pacific Ocean is 6-ft *NAVD88*. But Figure 4 of Exhibit 5 of Vandivere's declaration indicates this elevation at 6-ft *NGVD29* – a different measurement unit that has a 2.1-foot conversion factor. This inconsistency leads to an incorrect hydraulic gradient (i) calculation. This error is corrected in my seepage computations, yielding a steeper initial gradient (0.0126 ft/ft when the Laguna water level is 12-ft NAVD88) along the seepage front and higher groundwater outflow rates.

25. Second, Vandivere uses a hydraulic conductivity (K) value of 10,000 gallons per day per ft^2 (gpd/ ft^2) for the assumed homogeneous and clean beach sands that groundwater seeps through under the western levee. This value is biased towards the highest K-values published for sand. Ex. G presents published ranges for K as reported from a number of different publications related to groundwater flow hydraulics. For purposes of my pond recession analysis, the 10,000 gpd/ft^2 rate was used but it should be recognized that a more conservative or median value would yield much slower seepage rates causing a longer recession in ponded water levels after flooding.

26. Third, Vandivere's analysis only considers groundwater outflow, yet there is a significant component of groundwater inflow to Laguna Salada wetland as documented in our report, Ex. B, p. 7, and the PWA 1992 report. In order to account for this groundwater inflow, we assume the following: a constant hydraulic gradient (i) of 0.0058 ft/ft (calculated from seasonal groundwater elevations presented on Figure 24 of the PWA 1992 report; a constant saturated area of 12,000 ft2 (saturated aquifer thickness of 6-feet and seepage front of 2000 linear feet); and initial hydraulic conductivity of 100 gpd/ft2 for the upgradient "medium grained sand" aquifer as reported on Figure 22 of PWA's 1992 report (see Ex. H).

27. By incorporating known groundwater inflows into the model and fixing the conversion error, it is my professional judgment that my pond recession analysis is more accurate than

those presented by Defendants in this matter. Furthermore, because I use the same (K) rate as Defendants' experts—which as explained above is biased towards the highest rates published in the relevant literature—it is likely that the model creates conservative estimates.

28. The analysis assumes an initial Laguna Salada water level of 10.2-feet. The results of the pond recession analysis are presented in Ex. I and include: daily Laguna volumes and ponded surface areas; ending daily Laguna water levels; and ponded volume and area after accounting for seepage losses/gains. The hydraulic gradient and saturated thickness of the seepage front are recalculated each day based on the adjusted water volumes and associated water surface elevation. Seepage calculations were performed for a 365-day period. Ex. J presents the water level-volume-surface area relationships used to translate between Laguna water level, volume and surface area. These values were calculated from the project topographic map completed by Lee, Inc. for Tetra Tech, Inc. as part of the Sharp Park Conceptual Restoration Alternatives Report (Tetra Tech, 2009). The groundwater seepage model is validated to some extent by the equilibration of the late season Laguna water levels at an elevation between 6.0- and 6.5-feet, the approximate static pond level observed during PWA's monitoring in 1990-91 and KHE's monitoring in 2008.

29. Ex. K presents the recession analysis results as a plot of changing water surface elevation and ponded area versus days since the water level reached 10.2-feet NAVD 88 at Sharp Park. This analysis targets providing 6-weeks of inundation to eggs at or below 8-feet in elevation and assumes no further inflows or pumping after the peak rain event. Highlights of these results include:

- Day 1 flooding to an elevation of 10.2-feet yields 40-acres of ponded area;
- Ponding recedes to 9-feet and 32-acres after 18 days;
- Ponding recedes to 8.0-feet and 26-acres after 42 days (6 weeks);
- Ponding recedes to 7.0-feet and 19-acres after 103 days;
- Ponding recedes to 6.5-feet and 15-acres after 217 days.

30. These results indicate that ceasing pumping after attaining a water level elevation of 10.2-feet NAVD 88 would allow eggs and tadpoles at 8-feet in elevation to remain submerged

in waters hydrologically connected to the deeper areas of Laguna Salada for more than six weeks, even if no further rain or other water inputs are provided.

THE NECESSARY WATER LEVELS ARE SIMILAR TO WATER LEVELS THAT OCCUR AT SHARP PARK ON A REGULAR BASIS

31. An inundation level of 10.2-feet is not out of the ordinary at Sharp Park. Based on the historic pumping volumes recorded in the Pump house log, there is sufficient surface water supply to reach this level during all but critically dry years as long as pumping is reduced or temporarily curtailed. The Pump house log indicates water levels have reached between 9- and 10-feet in elevation over the past four winters even with operational pumping. Hydraulic modeling of a pond with a starting water level of 6.8-feet under maximum pumping conditions would be flooded to the 10.2-foot elevation during a storm having a recurrence interval between 2- and 5-years (Figure 10 of Ex. B). Much smaller winter storms lead to more frequent flooding to 10.2-feet when the pond level starts at an elevation of 8-feet NAVD88. The main difference in providing ponding relief to frog eggs would be the duration of ponding between 8- and 10.2-feet; currently water is pumped down from this level whereas ponding would be sustained above 8-feet for a minimum of 6-weeks under the frog egg relief scenario.

MAINTAINING WATER LEVELS THAT DO NOT STRAND RED-LEGGED FROG EGG MASSES WILL CREATE NO FURTHER APPRECIABLE FLOOD RISK ON THE SURROUNDING COMMUNITY

32. It is my professional opinion that a water level at or below 10.2-feet NAVD 88 can be maintained in Sharp Park without pumping water from Horse Stable Pond.

33. In the event water levels exceed 10.2-feet, mobile pumps can be used along Clarendon Road and Lakeside Avenue (near the Northeast Corner of Sharp Park's western unit) to pump water from Sharp Park. Mobile centrifugal pumps that can provide relief from flooding are readily available for purchase or rent in the Bay Area. It is my understanding that mobile pumps are already used in this area during heavy winter rains, see Ex. L, when waters already extend beyond the Sharp Park boundaries.

34. Consequently, it is my professional opinion that there is relatively low incremental increase in existing flood hazards beyond the boundaries of Sharp Park this winter associated

with cessation of pumping of water from Horse Stable Pond and implementation of adequate mobile pumping along Clarendon Road and Lakeside Avenue (near the Northeast Corner of Sharp Park's western unit).

CONCLUSION

35. Even with pumps operating at full capacity, Sharp Park golf course floods on an annual basis. Rapid changes in pond water levels are a byproduct of current pump operations, even under diligent monitoring and maintenance. In turn, rapid changes in pond levels, especially those that accompany winter storms, lead to egg stranding and desiccation. Holding pond levels at or above 8.0-feet in elevation would maintain saturated conditions in segregated depressions and shallow channels for a period of six weeks along the margins of Laguna Salada, common areas where frog like to lay eggs. An inundation level of 10.2-feet after eggs are laid would provide a minimum six weeks of incubation and hatching for eggs laid at an elevation of 8-feet or less even if no further rain inputs occur after eggs are laid. Maintaining ponding above 8-feet is also important to maintain connectivity for tadpoles between shallow channels and depressions and the main Laguna water body. Any increased flood hazards associated with reducing the floodwater storage capacity of the project area (by maintaining a 10.2-foot elevation) can be mitigated through the use of mobile pumps.

01/20/12
Date

Gregory R. Kamman
Greg Kamman

EXHIBIT A

Greg Kamman, PG, CHG
Principal Hydrologist

EDUCATION	1989	M.S. Geology - Sedimentology and Hydrogeology Miami University, Oxford, OH
	1985	A.B. Geology Miami University, Oxford, OH
REGISTRATION	No. 360 No. 5737	Certified Hydrogeologist (CHG.), CA Professional Geologist (PG), CA
PROFESSIONAL HISTORY	1997 - Present	Principal Hydrologist/Vice President Kamman Hydrology & Engineering, Inc. San Rafael, CA
	1994 - 1997	Senior Hydrologist/Vice President Balance Hydrologics, Inc., Berkeley, CA
	1991 - 1994	Project Geologist/Hydrogeologist Geomatrix Consultants, Inc., San Francisco, CA
	1989 - 1991	Senior Staff Geologist/Hydrogeologist Environ International Corporation, Princeton, NJ
	1986 - 1989	Instructor and Research/Teaching Assistant Miami University, Oxford, OH

SKILLS AND EXPERIENCE

As a hydrologist with over twenty years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology, Mr. Kamman routinely manages projects in the areas of surface- and ground-water hydrology, stream and wetland habitat restoration, water supply, water quality assessments, water resources management, and geomorphology. Areas of expertise include: stream and wetland habitat restoration; characterizing and modeling basin-scale hydrologic and geologic processes; assessing hydraulic and geomorphic responses to land-use changes in watersheds and causes of stream channel instability; evaluating surface- and ground-water resources and their interaction; and designing and implementing field investigations characterizing surface and subsurface conditions. In addition, Mr. Kamman commonly works on projects that revolve around sensitive fishery, wetland, animal and/or riparian habitat issues and problems. Thus, Mr. Kamman is accustomed to working within a multi-disciplined team and maintains close collaborative relationships with biologists, engineers, planners, architects, lawyers, and various agency staff.

PROFESSIONAL SOCIETIES & AFFILIATIONS	American Geological Institute Society for Ecological Restoration International California Native Plant Society

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Kamman, G.R. and Lapine, S., 2010. Alluvial Fan Fill Site, Restoration at Muir Beach, Golden Gate National Recreation Area (100% Construction drawings). Prepared for Golden Gate National Parks Conservancy, May 12, 2 sheets.

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Kamman G.K. and Kamman, R.Z., 2008, Giacomini Wetland Restoration Project, Phase 2 (2008) Construction Drawings. Prepared for Golden Gate National Recreation Area and Point Reyes National Seashore, May, 33 sheets.

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Kamman G.K. and Kamman, R.Z., 2008, Technical Specifications for Giacomini Wetland Restoration Project, Phase 2 (2008) Construction. Prepared for Golden Gate National Recreation Area and Point Reyes National Seashore, May, 243p.

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Kamman, R.Z., Kamman G.K., and Beahan, C., 2007, 100% Design Drawings, Lower Redwood Creek Restoration, The Banducci Site, Golden Gate National Recreation Area, Marin County, CA. Prepared for Golden Gate Parks Conservancy and National Park Service, February 28, 7 sheets.

EXHIBIT C

GREG KAMMAN EXPERT REPORT
EXHIBIT C
MATERIALS RELIED ON IN FORMING EXPERT REPORT OPINIONS

REFERENCES

Federal Emergency Management Agency (FEMA), 1987, Flood Insurance Study, Pacifica, California, San Mateo County, community number 060323, February 19, 30p.

Geomatrix, 1987, Feasibility Study, Restoration of Coastal Embankment, Sharp Park Golf Course, Pacifica, CA. Prepared for: City and County of San Francisco, Department of Public Works, Bureau of Engineering, November, 91p.

Kamman, G.R. and Higgins, S., 2009, Report for the Hydrologic Assessment and Ecological Enhancement Feasibility Study, Laguna Salada Wetland System, Pacifica, California. Prepared for: Tetra Tech Inc., San Francisco, March 30, 45p.

Lee, Inc., 2008, Topographic survey of Laguna Salada wetlands complex. Prepared for Tetra Tech, Inc., datums NAD83 and NAVD88 (feet).

Phillip Williams & Associates, Ltd. (PWA), Wetlands Research Associates, Inc., and Associated Consultants: Todd Steiner and John Hafernik, 1992. Draft Laguna Salada Resource Enhancement Plan. Prepared for: The City of San Francisco and the State of California Coastal Conservancy.

PWA Conceptual Ecosystem Restoration Plan and Feasibility Assessment: Laguna Salada, Pacifica, California (ESA PWA Feb. 2011) and Appendices.

Tetra Tech, Inc., 2009, Sharp Park Conceptual Restoration Alternatives Report: Recovery Action Planning for the San Francisco Garter Snake. Prepared for: **San Francisco Recreation and Parks Department, September, 71p.**

LIST OF DATA OBTAINED AND REVIEWED

Water Level Monitoring Data (available from Kamman)

Higgins, Shawn. *LS Monitoring Summary*, Word document, May 9, 2008.

***LagunaSalada HSP water levels*, Excel spreadsheet, April 4, 2008 – May 4, 2009.**

Monitoring\LagunaSalada HSP water levels.xls

Memorandum to David Munro from S. Higgins and G. Kamman, *Preliminary Summary of Monitoring Data from the Laguna Salada*, December 12, 2008.

Stage-Storage Relationships

Terrain analysis of topographic and hydrographic survey data collected by Lee Incorporated, 2008. Area and volume measurements completed in GIS.

Rainfall

National Weather Service station at Pacifica (NWS Coop ID: 46599)

(see page 11 of KHE, Inc., *Report for the Hydrologic Assessment and Ecological Enhancement Feasibility Study: Laguna Salada Wetland System, Pacifica, California,* March 30, 2009). This reference used to describe climate and to obtain mean annual precipitation estimate for surface water inflow calculations (see below).

November 1, 2008 rainfall event, first storm of monitoring period, 1.3 inches of rainfall. (see page 16 of KHE, Inc., *Report for the Hydrologic Assessment and Ecological Enhancement Feasibility Study: Laguna Salada Wetland System, Pacifica, California,* March 30, 2009). Data also from observed historical rainfall events measured at weather stations published for Pacifica, California on Weather Underground website

Design storm hydrographs used depth-duration-frequency data for San Francisco Bay region to develop 24-hour storm rainfall totals for recurrence intervals between 2- and 100-years (with base flow added as a percentage of peak flow rate).
(Rantz, S.E., 1971. Precipitation Depth-Duration-Frequency Relations for the San Francisco Bay

Surface Water Flows

Mean annual runoff estimated from a percentage of mean annual precipitation (from NWS rainfall data) and based on a regional rainfall-runoff relation developed for SF Bay area (Rantz, S.E., 1974. Mean Annual Runoff in the San Francisco Bay Region, California, 1931-70., U.S. Geological Survey Miscellaneous Field Studies Map 613.)

Seasonal distribution of surface inflow is derived from mean monthly stream flow data at USGS gaging station on Pescadero Creek (St ID: 11162500) and modified to reflect lack of sustained baseflow to project site during months of low rainfall. (

see pages 11-12 of KHE, Inc., *Report for the Hydrologic Assessment and Ecological Enhancement Feasibility Study: Laguna Salada Wetland System, Pacifica, California,* March 30, 2009).

Hydraulic Conductivity Sources

American Society of Civil Engineers (ASCE), 1996, Hydrology handbook, second edition. ASCE Manuals and Reports on Engineering Practice No. 28, ASCE, New York, NY, 784p.

Domenico, P.A. and Schwartz, F.W., 1990, Physical and chemical hydrogeology. John Wiley & Sons, New York, NY, 824p.

Driscoll, F.G., 1986, Groundwater and wells. Johnson Screens, St. Paul, MN, 1089p.

Fetter, C.W., Jr., 1980, Applied hydrogeology. Charles E. Merrill Publishing Co., Columbus, OH, 488p.

Freeze, A.R. and Cherry, J.A., 1979, Groundwater. Prentice Hall, Inc., Upper Saddle River, NJ, 604p.

Heath, R.C., 1987, Basic ground-water hydrology. U.S. Geological Survey Water-Supply Paper 2220, 84p.

Surface Water Outflows

Excess water is drained by the pump station in Horse Stable Pond, and controlled by adjustment of probes which activate the pumps at a given water level. Water budget modeling (prior to obtaining pump log) assumed that the pumping station maintained water levels at 6.9 feet NAVD88 at the beginning of winter; water level is adjusted in February to maintain water levels at 7.3 feet.

(see page 12 of KHE, Inc., *Report for the Hydrologic Assessment and Ecological Enhancement Feasibility Study: Laguna Salada Wetland System, Pacifica, California,* March 30, 2009)

Pump probe settings provided by Sean Sweeney in email communication on 11/4/2008. (Table 4, page 27 of KHE, Inc., *Report for the Hydrologic Assessment and Ecological Enhancement Feasibility Study: Laguna Salada Wetland System, Pacifica, California*, March 30, 2009).

Annotated Pump house log

Evapotranspiration and Groundwater

Both discussed in (page 13 of KHE, Inc., *Report for the Hydrologic Assessment and Ecological Enhancement Feasibility Study: Laguna Salada Wetland System, Pacifica, California*, March 30, 2009).

Water Quality Data

Salinity (specific conductivity and temperature) collected via legelogger from 4/7/2008 – 8/26/2008. Additional discrete samples collected via multi-probe system. Measurements taken from Laguna Salada, Horse Stable Pond, monitoring wells on

GGNRA property near Mori Point and from ponded water in the drainage channel near Sanchez Creek.

Exhibits and Dockets

Horse Stable Pond pump house log provided by the City and County of San Francisco

Egg mass survey data collected by the City and County of San Francisco from 2005-07,

Egg mass monitoring reports prepared by the GGNRA covering the years 2003-2005, and 2006-2009,

Declaration provided by Dr. Marc Jennings in opposition to plaintiffs' motion for preliminary injunction, Docket No. 68, and the associated exhibits

Declaration of William Vandivere in opposition to plaintiffs' motion for preliminary injunction, Docket No. 66-2, and the associated exhibits

Deposition transcript of pump house stationary engineer John Ascariz

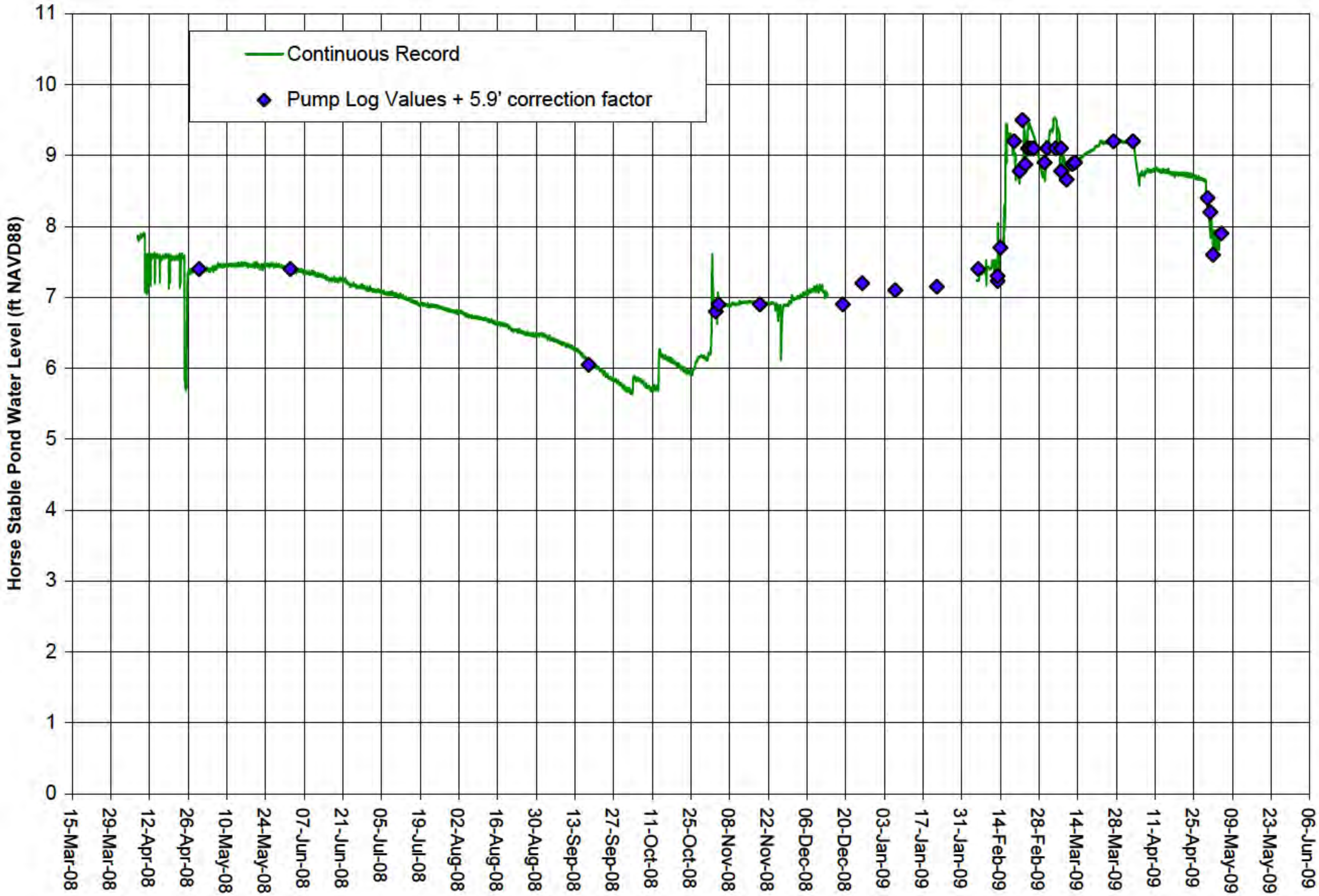
1. Source of hydraulic conductivity values used in water budget – see exhibit

Declaration of Jewel Snavely in Support of Plaintiffs Motion for a Preliminary Injunction, Docket No. 60-2, Ex. 4, and all associated exhibits.

Declaration of John Bowie in Support of Plaintiffs' Motion for a Preliminary Injunction, Docket No. 60-7, Ex. 26, and all associated exhibits.

Photos of Horse Stable Pond Pump house 1/18/12.

EXHIBIT D



Continuous Record
Pump Log Values + 5.9' correction factor
Horse Stable Pond Water Level (ft NAVD88)
0
1
2
3
4
5
6
7
8
9
10
11
15-Mar-08
29-Mar-08
12-Apr-08
26-Apr-08
10-May-08
24-May-08
07-Jun-08
21-Jun-08
05-Jul-08
19-Jul-08
02-Aug-08
16-Aug-08
30-Aug-08
13-Sep-08
27-Sep-08
11-Oct-08
25-Oct-08
08-Nov-08
22-Nov-08
06-Dec-08
20-Dec-08
03-Jan-09
17-Jan-09
31-Jan-09
14-Feb-09
28-Feb-09
14-Mar-09
28-Mar-09
11-Apr-09
25-Apr-09
09-May-09
23-May-09
06-Jun-09

EXHIBIT E

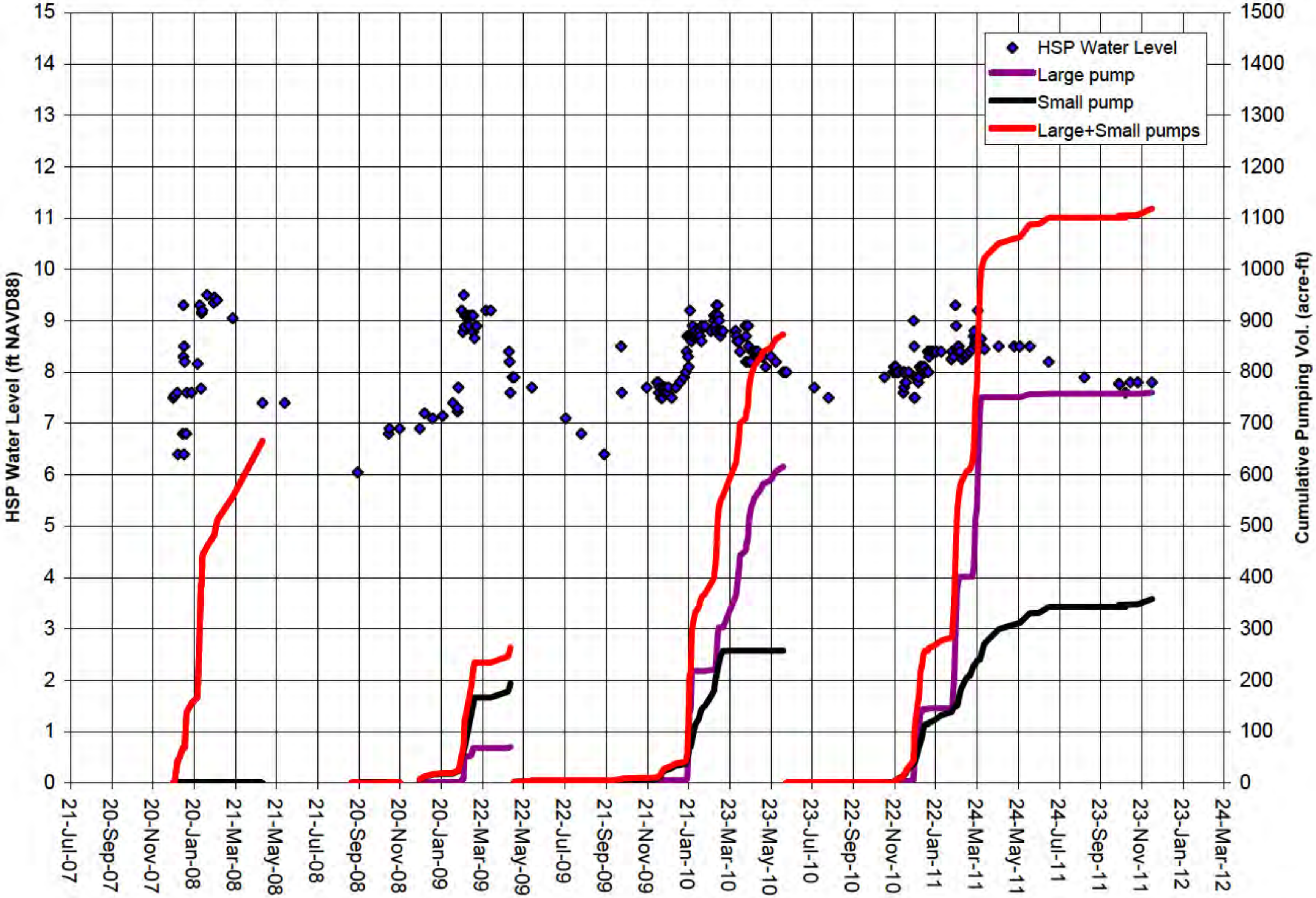

HSP Water Level
Large pump
Small pump
Large+Small pumps
HSP Water Level (ft NAVD88)
Cumulative Pumping Vol. (acre-ft)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
21-Jul-07
20-Sep-07
20-Nov-07
20-Jan-08
21-Mar-08
21-May-08
21-Jul-08
20-Sep-08
20-Nov-08
20-Jan-09
22-Mar-09
22-May-09
22-Jul-09
21-Sep-09
21-Nov-09
21-Jan-10
23-Mar-10
23-May-10
23-Jul-10
22-Sep-10
22-Nov-10
22-Jan-11
24-Mar-11
24-May-11
24-Jul-11
23-Sep-11
23-Nov-11
23-Jan-12
24-Mar-12

EXHIBIT G

		gpd/ft^2 lower	gpd/ft^2 upper
1	Freeze & Cherry, 1979: clean sand	10.00	60,000
2	USGS, 1987: clean sand	10.00	8,000
3	Driscoll, 1986; fine to coarse sand	0.80	30,000
4	ASCE, 1996; fine to coarse	0.25	24,537
5	Domenico & Scwartz, 1990; coarse sand	1.91	12,720
6	Domenico & Scwartz, 1990; medium sand	1.91	1,060
7	Domenico & Scwartz, 1990; fine sand	0.42	424

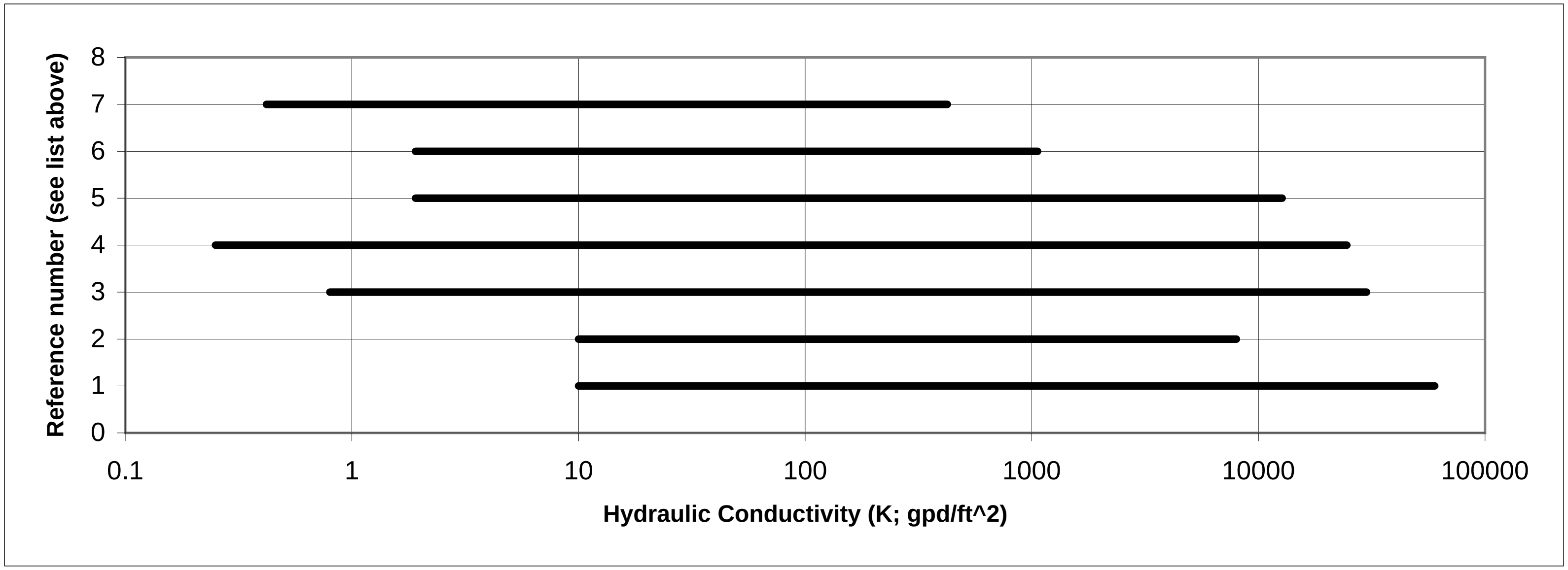
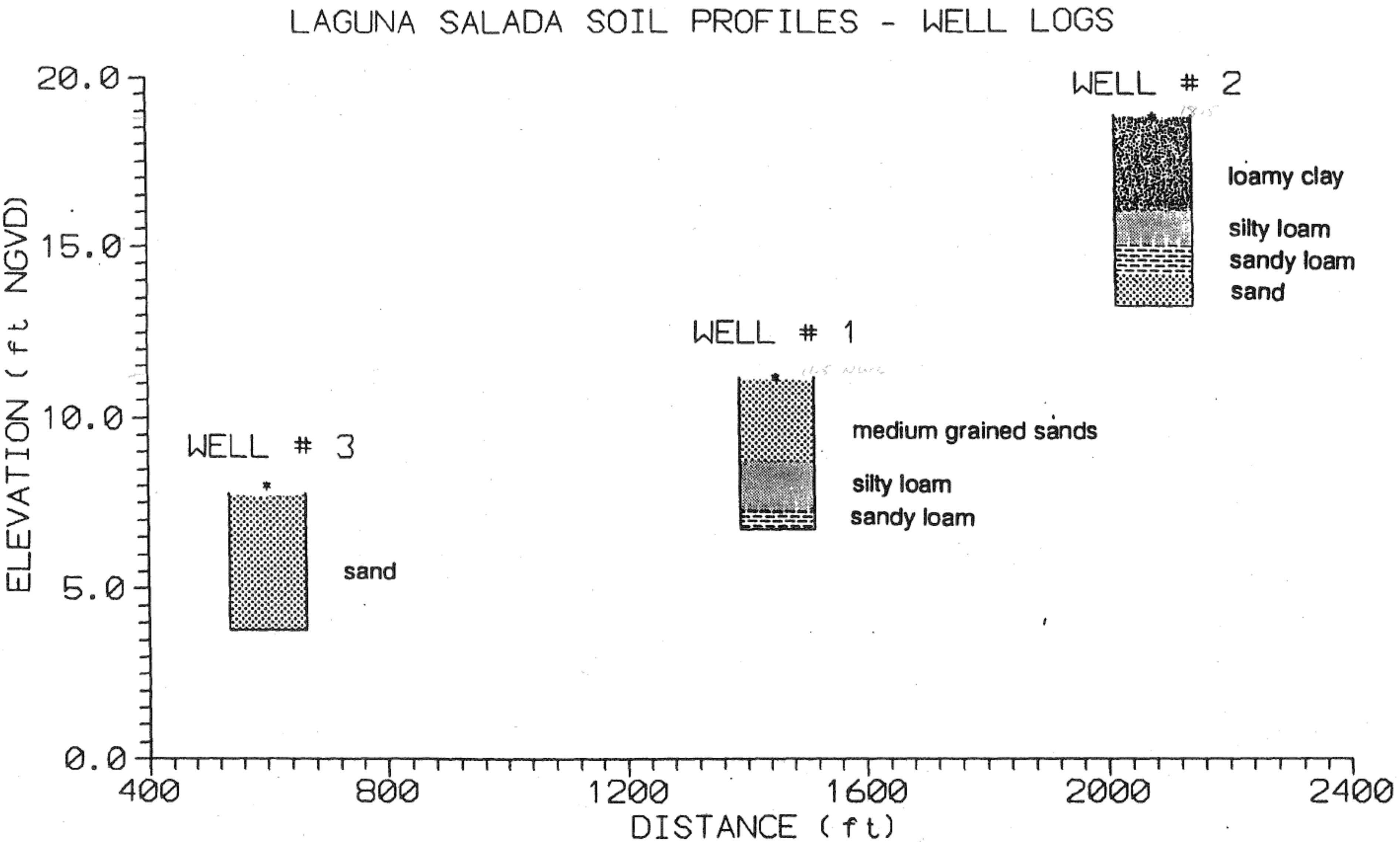


EXHIBIT H



Philip Williams & Associates, Ltd.
Pier 35, The Embarcadero
San Francisco, CA 94133

Figure 22

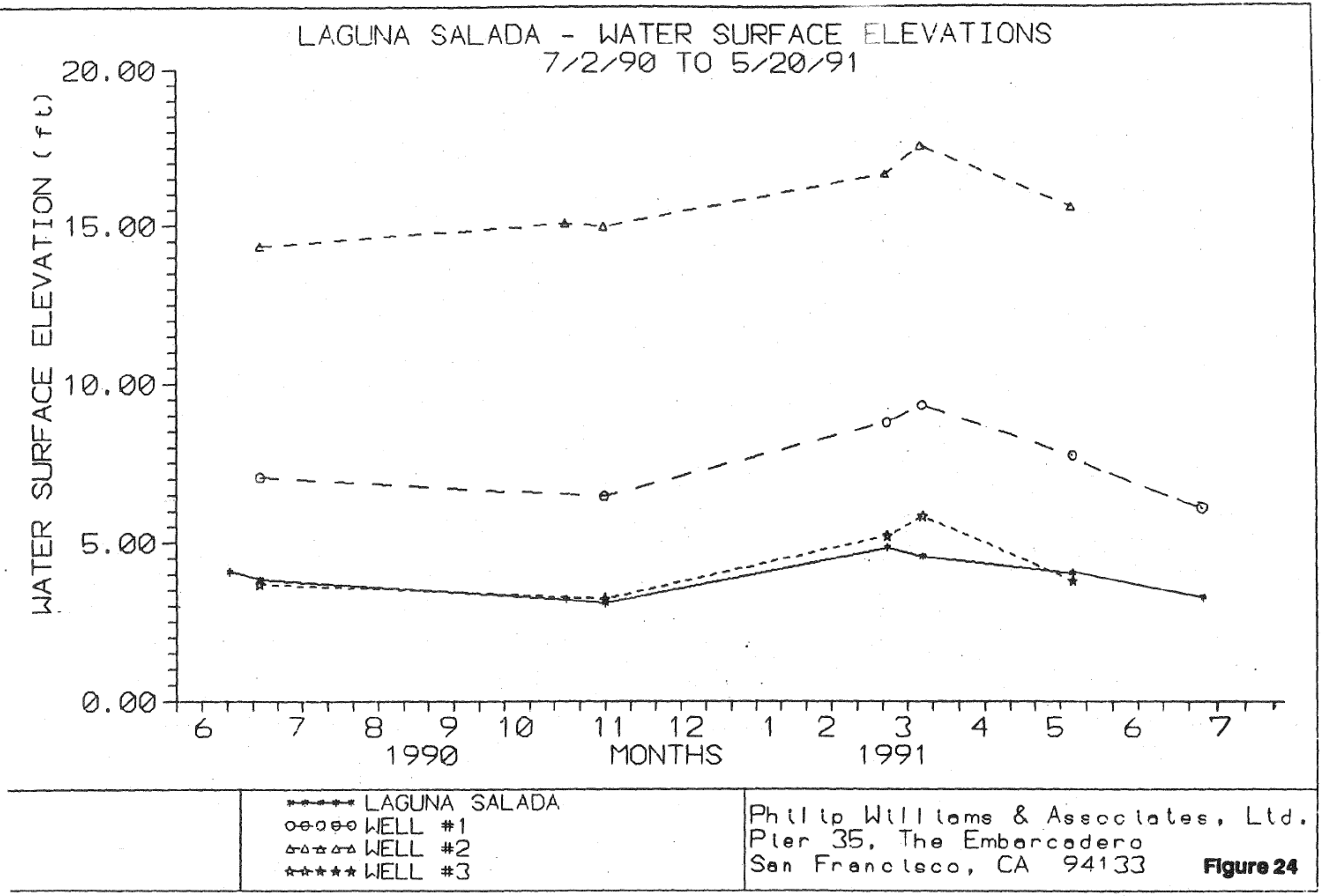

LAGUNA SALADA - WATER SURFACE ELEVATIONS
7/2/90 TO 5/20/91
WATER SURFACE ELEVATION (ft)
20.00
15.00
10.00
5.00
0.00
6
7
8
9
10
11
12
1
2
3
4
5
6
7
1990
MONTHS
1991
LAGUNA SALADA
WELL #1
WELL #2
WELL #3
Phillip Williams & Associates, Ltd.
Pier 35, The Embarcadero
San Francisco, CA 94133

Figure 24

EXHIBIT I

day	Start Pond Level (feet)	Start Volume (AF)	Start Wetted Area (Ac)	GW Outflow - Beach Seepage area (ft^2)	gradient	seepage (AF)	GW inflow (AF)	End Volume (AF)	End Pond Level (feet)	End Wetted Area (Ac)
1	10.20	135.4	40.2	12,390	0.0088	3.36	0.02	132.1	10.12	39.5
2	10.12	132.1	39.5	12,150	0.0087	3.23	0.02	128.8	10.04	38.9
3	10.04	128.8	38.9	11,919	0.0085	3.11	0.02	125.8	9.96	38.3
4	9.96	125.8	38.3	11,677	0.0083	2.99	0.02	122.8	9.87	37.7
5	9.87	122.8	37.7	11,422	0.0082	2.86	0.02	120.0	9.79	37.1
6	9.79	120.0	37.1	11,177	0.0080	2.74	0.02	117.2	9.71	36.6
7	9.71	117.2	36.6	10,944	0.0078	2.62	0.02	114.6	9.63	36.0
8	9.63	114.6	36.0	10,719	0.0076	2.52	0.02	112.1	9.56	35.5
9	9.56	112.1	35.5	10,505	0.0075	2.42	0.02	109.7	9.49	35.0
10	9.49	109.7	35.0	10,298	0.0073	2.32	0.02	107.4	9.42	34.6
11	9.42	107.4	34.6	10,100	0.0072	2.23	0.02	105.2	9.36	34.1
12	9.36	105.2	34.1	9,909	0.0071	2.15	0.02	103.1	9.30	33.7
13	9.30	103.1	33.7	9,726	0.0069	2.07	0.02	101.1	9.24	33.2
14	9.24	101.1	33.2	9,549	0.0068	2.00	0.02	99.1	9.18	32.8
15	9.18	99.1	32.8	9,379	0.0067	1.93	0.02	97.2	9.12	32.5
16	9.12	97.2	32.5	9,215	0.0066	1.86	0.02	95.3	9.07	32.1
17	9.07	95.3	32.1	9,057	0.0065	1.80	0.02	93.6	9.02	31.7
18	9.02	93.6	31.7	8,904	0.0064	1.74	0.02	91.8	8.96	31.4
19	8.96	91.8	31.4	8,736	0.0062	1.67	0.02	90.2	8.90	31.0
20	8.90	90.2	31.0	8,563	0.0061	1.61	0.02	88.6	8.85	30.7
21	8.85	88.6	30.7	8,398	0.0060	1.54	0.02	87.1	8.79	30.4
22	8.79	87.1	30.4	8,238	0.0059	1.49	0.02	85.6	8.74	30.1
23	8.74	85.6	30.1	8,085	0.0058	1.43	0.02	84.2	8.69	29.9
24	8.69	84.2	29.9	7,937	0.0057	1.38	0.02	82.8	8.64	29.6
25	8.64	82.8	29.6	7,795	0.0056	1.33	0.02	81.5	8.60	29.3
26	8.60	81.5	29.3	7,658	0.0055	1.28	0.02	80.3	8.55	29.1
27	8.55	80.3	29.1	7,526	0.0054	1.24	0.02	79.1	8.51	28.8
28	8.51	79.1	28.8	7,398	0.0053	1.20	0.02	77.9	8.47	28.6
29	8.47	77.9	28.6	7,275	0.0052	1.16	0.02	76.7	8.43	28.4
30	8.43	76.7	28.4	7,156	0.0051	1.12	0.02	75.6	8.39	28.2
31	8.39	75.6	28.2	7,041	0.0050	1.09	0.02	74.6	8.35	28.0
32	8.35	74.6	28.0	6,930	0.0049	1.05	0.02	73.5	8.31	27.8
33	8.31	73.5	27.8	6,822	0.0049	1.02	0.02	72.5	8.28	27.6
34	8.28	72.5	27.6	6,717	0.0048	0.99	0.02	71.6	8.24	27.4
35	8.24	71.6	27.4	6,616	0.0047	0.96	0.02	70.6	8.21	27.2
36	8.21	70.6	27.2	6,518	0.0047	0.93	0.02	69.7	8.18	27.0
37	8.18	69.7	27.0	6,423	0.0046	0.90	0.02	68.9	8.15	26.8
38	8.15	68.9	26.8	6,331	0.0045	0.88	0.02	68.0	8.12	26.7
39	8.12	68.0	26.7	6,241	0.0045	0.85	0.02	67.2	8.09	26.5
40	8.09	67.2	26.5	6,154	0.0044	0.83	0.02	66.4	8.06	26.3
41	8.06	66.4	26.3	6,069	0.0043	0.81	0.02	65.6	8.03	26.2
42	8.03	65.6	26.2	5,987	0.0043	0.79	0.02	64.8	8.00	26.0
43	8.00	64.8	26.0	5,907	0.0042	0.76	0.02	64.1	7.97	25.8
44	7.97	64.1	25.8	5,809	0.0041	0.74	0.02	63.3	7.94	25.5
45	7.94	63.3	25.5	5,712	0.0041	0.71	0.02	62.7	7.90	25.3
46	7.90	62.7	25.3	5,618	0.0040	0.69	0.02	62.0	7.87	25.1
47	7.87	62.0	25.1	5,528	0.0039	0.67	0.02	61.3	7.84	24.9
48	7.84	61.3	24.9	5,440	0.0039	0.65	0.02	60.7	7.82	24.7
49	7.82	60.7	24.7	5,355	0.0038	0.63	0.02	60.1	7.79	24.5
50	7.79	60.1	24.5	5,273	0.0038	0.61	0.02	59.5	7.76	24.3
51	7.76	59.5	24.3	5,194	0.0037	0.59	0.02	58.9	7.73	24.1
52	7.73	58.9	24.1	5,117	0.0037	0.57	0.02	58.4	7.71	23.9
53	7.71	58.4	23.9	5,042	0.0036	0.56	0.02	57.9	7.68	23.7
54	7.68	57.9	23.7	4,970	0.0035	0.54	0.02	57.3	7.66	23.5
55	7.66	57.3	23.5	4,899	0.0035	0.53	0.02	56.8	7.64	23.4
56	7.64	56.8	23.4	4,831	0.0034	0.51	0.02	56.3	7.62	23.2
57	7.62	56.3	23.2	4,765	0.0034	0.50	0.02	55.9	7.59	23.0
58	7.59	55.9	23.0	4,700	0.0034	0.48	0.02	55.4	7.57	22.9
59	7.57	55.4	22.9	4,638	0.0033	0.47	0.02	55.0	7.55	22.7
60	7.55	55.0	22.7	4,577	0.0033	0.46	0.02	54.5	7.53	22.6
61	7.53	54.5	22.6	4,518	0.0032	0.45	0.02	54.1	7.51	22.4
62	7.51	54.1	22.4	4,460	0.0032	0.44	0.02	53.7	7.49	22.3
63	7.49	53.7	22.3	4,404	0.0031	0.42	0.02	53.3	7.47	22.2
64	7.47	53.3	22.2	4,350	0.0031	0.41	0.02	52.9	7.46	22.0
65	7.46	52.9	22.0	4,296	0.0031	0.40	0.02	52.5	7.44	21.9
66	7.44	52.5	21.9	4,245	0.0030	0.39	0.02	52.1	7.42	21.8

day	Start Pond Level (feet)	Start Volume (AF)	Start Wetted Area (Ac)	GW Outflow - Beach Seepage area (ft^2)	gradient	seepage (AF)	GW inflow (AF)	End Volume (AF)	End Pond Level (feet)	End Wetted Area (Ac)
67	7.42	52.1	21.8	4,194	0.0030	0.39	0.02	51.8	7.41	21.7
68	7.41	51.8	21.7	4,145	0.0030	0.38	0.02	51.4	7.39	21.5
69	7.39	51.4	21.5	4,097	0.0029	0.37	0.02	51.1	7.37	21.4
70	7.37	51.1	21.4	4,050	0.0029	0.36	0.02	50.7	7.36	21.3
71	7.36	50.7	21.3	4,004	0.0029	0.35	0.02	50.4	7.34	21.2
72	7.34	50.4	21.2	3,960	0.0028	0.34	0.02	50.1	7.33	21.1
73	7.33	50.1	21.1	3,916	0.0028	0.34	0.02	49.8	7.31	21.0
74	7.31	49.8	21.0	3,874	0.0028	0.33	0.02	49.5	7.30	20.9
75	7.30	49.5	20.9	3,832	0.0027	0.32	0.02	49.2	7.29	20.8
76	7.29	49.2	20.8	3,792	0.0027	0.31	0.02	48.9	7.27	20.7
77	7.27	48.9	20.7	3,752	0.0027	0.31	0.02	48.6	7.26	20.6
78	7.26	48.6	20.6	3,713	0.0026	0.30	0.02	48.3	7.25	20.5
79	7.25	48.3	20.5	3,675	0.0026	0.30	0.02	48.0	7.23	20.4
80	7.23	48.0	20.4	3,638	0.0026	0.29	0.02	47.7	7.22	20.3
81	7.22	47.7	20.3	3,602	0.0026	0.28	0.02	47.5	7.21	20.2
82	7.21	47.5	20.2	3,566	0.0025	0.28	0.02	47.2	7.20	20.1
83	7.20	47.2	20.1	3,531	0.0025	0.27	0.02	47.0	7.19	20.1
84	7.19	47.0	20.1	3,497	0.0025	0.27	0.02	46.7	7.17	20.0
85	7.17	46.7	20.0	3,464	0.0025	0.26	0.02	46.5	7.16	19.9
86	7.16	46.5	19.9	3,431	0.0024	0.26	0.02	46.3	7.15	19.8
87	7.15	46.3	19.8	3,399	0.0024	0.25	0.02	46.0	7.14	19.7
88	7.14	46.0	19.7	3,368	0.0024	0.25	0.02	45.8	7.13	19.7
89	7.13	45.8	19.7	3,337	0.0024	0.24	0.02	45.6	7.12	19.6
90	7.12	45.6	19.6	3,307	0.0024	0.24	0.02	45.4	7.11	19.5
91	7.11	45.4	19.5	3,278	0.0023	0.24	0.02	45.1	7.10	19.4
92	7.10	45.1	19.4	3,249	0.0023	0.23	0.02	44.9	7.09	19.4
93	7.09	44.9	19.4	3,220	0.0023	0.23	0.02	44.7	7.08	19.3
94	7.08	44.7	19.3	3,192	0.0023	0.22	0.02	44.5	7.07	19.2
95	7.07	44.5	19.2	3,165	0.0023	0.22	0.02	44.3	7.06	19.2
96	7.06	44.3	19.2	3,138	0.0022	0.22	0.02	44.1	7.05	19.1
97	7.05	44.1	19.1	3,112	0.0022	0.21	0.02	43.9	7.05	19.0
98	7.05	43.9	19.0	3,086	0.0022	0.21	0.02	43.7	7.04	19.0
99	7.04	43.7	19.0	3,061	0.0022	0.21	0.02	43.6	7.03	18.9
100	7.03	43.6	18.9	3,036	0.0022	0.20	0.02	43.4	7.02	18.9
101	7.02	43.4	18.9	3,012	0.0021	0.20	0.02	43.2	7.01	18.8
102	7.01	43.2	18.8	2,988	0.0021	0.20	0.02	43.0	7.00	18.7
103	7.00	43.0	18.7	2,964	0.0021	0.19	0.02	42.9	7.00	18.7
104	7.00	42.9	18.7	2,938	0.0021	0.19	0.02	42.7	6.99	18.6
105	6.99	42.7	18.6	2,907	0.0021	0.19	0.02	42.5	6.98	18.5
106	6.98	42.5	18.5	2,878	0.0021	0.18	0.02	42.4	6.97	18.4
107	6.97	42.4	18.4	2,848	0.0020	0.18	0.02	42.2	6.96	18.3
108	6.96	42.2	18.3	2,820	0.0020	0.17	0.02	42.1	6.95	18.3
109	6.95	42.1	18.3	2,792	0.0020	0.17	0.02	41.9	6.94	18.2
110	6.94	41.9	18.2	2,765	0.0020	0.17	0.02	41.8	6.93	18.1
111	6.93	41.8	18.1	2,738	0.0020	0.16	0.02	41.6	6.92	18.0
112	6.92	41.6	18.0	2,712	0.0019	0.16	0.02	41.5	6.91	18.0
113	6.91	41.5	18.0	2,687	0.0019	0.16	0.02	41.3	6.90	17.9
114	6.90	41.3	17.9	2,662	0.0019	0.16	0.02	41.2	6.89	17.8
115	6.89	41.2	17.8	2,638	0.0019	0.15	0.02	41.1	6.89	17.7
116	6.89	41.1	17.7	2,614	0.0019	0.15	0.02	41.0	6.88	17.7
117	6.88	41.0	17.7	2,590	0.0018	0.15	0.02	40.8	6.87	17.6
118	6.87	40.8	17.6	2,568	0.0018	0.14	0.02	40.7	6.86	17.6
119	6.86	40.7	17.6	2,545	0.0018	0.14	0.02	40.6	6.86	17.5
120	6.86	40.6	17.5	2,523	0.0018	0.14	0.02	40.5	6.85	17.4
121	6.85	40.5	17.4	2,502	0.0018	0.14	0.02	40.4	6.84	17.4
122	6.84	40.4	17.4	2,481	0.0018	0.13	0.02	40.2	6.83	17.3
123	6.83	40.2	17.3	2,460	0.0018	0.13	0.02	40.1	6.83	17.3
124	6.83	40.1	17.3	2,440	0.0017	0.13	0.02	40.0	6.82	17.2
125	6.82	40.0	17.2	2,420	0.0017	0.13	0.02	39.9	6.81	17.1
126	6.81	39.9	17.1	2,401	0.0017	0.13	0.02	39.8	6.81	17.1
127	6.81	39.8	17.1	2,381	0.0017	0.12	0.02	39.7	6.80	17.0
128	6.80	39.7	17.0	2,363	0.0017	0.12	0.02	39.6	6.79	17.0
129	6.79	39.6	17.0	2,344	0.0017	0.12	0.02	39.5	6.79	16.9
130	6.79	39.5	16.9	2,326	0.0017	0.12	0.02	39.4	6.78	16.9
131	6.78	39.4	16.9	2,309	0.0016	0.12	0.02	39.3	6.78	16.8
132	6.78	39.3	16.8	2,291	0.0016	0.11	0.02	39.2	6.77	16.8

day	Start Pond Level (feet)	Start Volume (AF)	Start Wetted Area (Ac)	GW Outflow - Beach Seepage area (ft^2)	gradient	seepage (AF)	GW inflow (AF)	End Volume (AF)	End Pond Level (feet)	End Wetted Area (Ac)
133	6.77	39.2	16.8	2,274	0.0016	0.11	0.02	39.1	6.77	16.7
134	6.77	39.1	16.7	2,258	0.0016	0.11	0.02	39.0	6.76	16.7
135	6.76	39.0	16.7	2,241	0.0016	0.11	0.02	38.9	6.75	16.6
136	6.75	38.9	16.6	2,225	0.0016	0.11	0.02	38.9	6.75	16.6
137	6.75	38.9	16.6	2,209	0.0016	0.11	0.02	38.8	6.74	16.6
138	6.74	38.8	16.6	2,194	0.0016	0.11	0.02	38.7	6.74	16.5
139	6.74	38.7	16.5	2,178	0.0016	0.10	0.02	38.6	6.73	16.5
140	6.73	38.6	16.5	2,163	0.0015	0.10	0.02	38.5	6.73	16.4
141	6.73	38.5	16.4	2,148	0.0015	0.10	0.02	38.4	6.72	16.4
142	6.72	38.4	16.4	2,134	0.0015	0.10	0.02	38.4	6.72	16.3
143	6.72	38.4	16.3	2,120	0.0015	0.10	0.02	38.3	6.71	16.3
144	6.71	38.3	16.3	2,106	0.0015	0.10	0.02	38.2	6.71	16.3
145	6.71	38.2	16.3	2,092	0.0015	0.10	0.02	38.1	6.70	16.2
146	6.70	38.1	16.2	2,078	0.0015	0.09	0.02	38.1	6.70	16.2
147	6.70	38.1	16.2	2,065	0.0015	0.09	0.02	38.0	6.70	16.2
148	6.70	38.0	16.2	2,052	0.0015	0.09	0.02	37.9	6.69	16.1
149	6.69	37.9	16.1	2,039	0.0015	0.09	0.02	37.9	6.69	16.1
150	6.69	37.9	16.1	2,026	0.0014	0.09	0.02	37.8	6.68	16.0
151	6.68	37.8	16.0	2,014	0.0014	0.09	0.02	37.7	6.68	16.0
152	6.68	37.7	16.0	2,002	0.0014	0.09	0.02	37.7	6.67	16.0
153	6.67	37.7	16.0	1,989	0.0014	0.09	0.02	37.6	6.67	15.9
154	6.67	37.6	15.9	1,978	0.0014	0.09	0.02	37.5	6.67	15.9
155	6.67	37.5	15.9	1,966	0.0014	0.08	0.02	37.5	6.66	15.9
156	6.66	37.5	15.9	1,954	0.0014	0.08	0.02	37.4	6.66	15.8
157	6.66	37.4	15.8	1,943	0.0014	0.08	0.02	37.3	6.65	15.8
158	6.65	37.3	15.8	1,932	0.0014	0.08	0.02	37.3	6.65	15.8
159	6.65	37.3	15.8	1,921	0.0014	0.08	0.02	37.2	6.65	15.8
160	6.65	37.2	15.8	1,910	0.0014	0.08	0.02	37.2	6.64	15.7
161	6.64	37.2	15.7	1,899	0.0014	0.08	0.02	37.1	6.64	15.7
162	6.64	37.1	15.7	1,889	0.0013	0.08	0.02	37.0	6.64	15.7
163	6.64	37.0	15.7	1,879	0.0013	0.08	0.02	37.0	6.63	15.6
164	6.63	37.0	15.6	1,868	0.0013	0.08	0.02	36.9	6.63	15.6
165	6.63	36.9	15.6	1,858	0.0013	0.08	0.02	36.9	6.63	15.6
166	6.63	36.9	15.6	1,848	0.0013	0.07	0.02	36.8	6.62	15.5
167	6.62	36.8	15.5	1,839	0.0013	0.07	0.02	36.8	6.62	15.5
168	6.62	36.8	15.5	1,829	0.0013	0.07	0.02	36.7	6.62	15.5
169	6.62	36.7	15.5	1,820	0.0013	0.07	0.02	36.7	6.61	15.5
170	6.61	36.7	15.5	1,810	0.0013	0.07	0.02	36.6	6.61	15.4
171	6.61	36.6	15.4	1,801	0.0013	0.07	0.02	36.6	6.61	15.4
172	6.61	36.6	15.4	1,792	0.0013	0.07	0.02	36.5	6.60	15.4
173	6.60	36.5	15.4	1,783	0.0013	0.07	0.02	36.5	6.60	15.4
174	6.60	36.5	15.4	1,774	0.0013	0.07	0.02	36.4	6.60	15.3
175	6.60	36.4	15.3	1,766	0.0013	0.07	0.02	36.4	6.60	15.3
176	6.60	36.4	15.3	1,757	0.0013	0.07	0.02	36.3	6.59	15.3
177	6.59	36.3	15.3	1,749	0.0012	0.07	0.02	36.3	6.59	15.3
178	6.59	36.3	15.3	1,741	0.0012	0.07	0.02	36.2	6.59	15.2
179	6.59	36.2	15.2	1,732	0.0012	0.07	0.02	36.2	6.58	15.2
180	6.58	36.2	15.2	1,724	0.0012	0.07	0.02	36.2	6.58	15.2
181	6.58	36.2	15.2	1,716	0.0012	0.06	0.02	36.1	6.58	15.2
182	6.58	36.1	15.2	1,708	0.0012	0.06	0.02	36.1	6.58	15.2
183	6.58	36.1	15.2	1,701	0.0012	0.06	0.02	36.0	6.57	15.1
184	6.57	36.0	15.1	1,693	0.0012	0.06	0.02	36.0	6.57	15.1
185	6.57	36.0	15.1	1,686	0.0012	0.06	0.02	35.9	6.57	15.1
186	6.57	35.9	15.1	1,678	0.0012	0.06	0.02	35.9	6.57	15.1
187	6.57	35.9	15.1	1,671	0.0012	0.06	0.02	35.9	6.56	15.1
188	6.56	35.9	15.1	1,664	0.0012	0.06	0.02	35.8	6.56	15.0
189	6.56	35.8	15.0	1,656	0.0012	0.06	0.02	35.8	6.56	15.0
190	6.56	35.8	15.0	1,649	0.0012	0.06	0.02	35.7	6.56	15.0
191	6.56	35.7	15.0	1,642	0.0012	0.06	0.02	35.7	6.55	15.0
192	6.55	35.7	15.0	1,635	0.0012	0.06	0.02	35.7	6.55	15.0
193	6.55	35.7	15.0	1,629	0.0012	0.06	0.02	35.6	6.55	14.9
194	6.55	35.6	14.9	1,622	0.0012	0.06	0.02	35.6	6.55	14.9
195	6.55	35.6	14.9	1,615	0.0012	0.06	0.02	35.6	6.55	14.9
196	6.55	35.6	14.9	1,609	0.0011	0.06	0.02	35.5	6.54	14.9
197	6.54	35.5	14.9	1,602	0.0011	0.06	0.02	35.5	6.54	14.9
198	6.54	35.5	14.9	1,596	0.0011	0.06	0.02	35.5	6.54	14.8

day	Start Pond Level (feet)	Start Volume (AF)	Start Wetted Area (Ac)	GW Outflow - Beach Seepage area (ft^2)	gradient	seepage (AF)	GW inflow (AF)	End Volume (AF)	End Pond Level (feet)	End Wetted Area (Ac)
199	6.54	35.5	14.8	1,590	0.0011	0.06	0.02	35.4	6.54	14.8
200	6.54	35.4	14.8	1,584	0.0011	0.05	0.02	35.4	6.53	14.8
201	6.53	35.4	14.8	1,578	0.0011	0.05	0.02	35.4	6.53	14.8
202	6.53	35.4	14.8	1,572	0.0011	0.05	0.02	35.3	6.53	14.8
203	6.53	35.3	14.8	1,566	0.0011	0.05	0.02	35.3	6.53	14.8
204	6.53	35.3	14.8	1,560	0.0011	0.05	0.02	35.3	6.53	14.7
205	6.53	35.3	14.7	1,554	0.0011	0.05	0.02	35.2	6.52	14.7
206	6.52	35.2	14.7	1,548	0.0011	0.05	0.02	35.2	6.52	14.7
207	6.52	35.2	14.7	1,542	0.0011	0.05	0.02	35.2	6.52	14.7
208	6.52	35.2	14.7	1,537	0.0011	0.05	0.02	35.1	6.52	14.7
209	6.52	35.1	14.7	1,531	0.0011	0.05	0.02	35.1	6.52	14.7
210	6.52	35.1	14.7	1,526	0.0011	0.05	0.02	35.1	6.52	14.6
211	6.52	35.1	14.6	1,521	0.0011	0.05	0.02	35.0	6.51	14.6
212	6.51	35.0	14.6	1,515	0.0011	0.05	0.02	35.0	6.51	14.6
213	6.51	35.0	14.6	1,510	0.0011	0.05	0.02	35.0	6.51	14.6
214	6.51	35.0	14.6	1,505	0.0011	0.05	0.02	35.0	6.51	14.6
215	6.51	35.0	14.6	1,500	0.0011	0.05	0.02	34.9	6.51	14.6
216	6.51	34.9	14.6	1,494	0.0011	0.05	0.02	34.9	6.50	14.6
217	6.50	34.9	14.6	1,489	0.0011	0.05	0.02	34.9	6.50	14.5
218	6.50	34.9	14.5	1,485	0.0011	0.05	0.02	34.9	6.50	14.5
219	6.50	34.9	14.5	1,480	0.0011	0.05	0.02	34.8	6.50	14.5
220	6.50	34.8	14.5	1,475	0.0011	0.05	0.02	34.8	6.50	14.5
221	6.50	34.8	14.5	1,468	0.0010	0.05	0.02	34.8	6.50	14.5
222	6.50	34.8	14.5	1,461	0.0010	0.05	0.02	34.7	6.49	14.5
223	6.49	34.7	14.5	1,454	0.0010	0.05	0.02	34.7	6.49	14.4
224	6.49	34.7	14.4	1,448	0.0010	0.05	0.02	34.7	6.49	14.4
225	6.49	34.7	14.4	1,442	0.0010	0.05	0.02	34.7	6.49	14.4
226	6.49	34.7	14.4	1,435	0.0010	0.05	0.02	34.6	6.48	14.4
227	6.48	34.6	14.4	1,429	0.0010	0.04	0.02	34.6	6.48	14.4
228	6.48	34.6	14.4	1,423	0.0010	0.04	0.02	34.6	6.48	14.4
229	6.48	34.6	14.4	1,417	0.0010	0.04	0.02	34.6	6.48	14.3
230	6.48	34.6	14.3	1,411	0.0010	0.04	0.02	34.6	6.48	14.3
231	6.48	34.6	14.3	1,405	0.0010	0.04	0.02	34.5	6.47	14.3
232	6.47	34.5	14.3	1,399	0.0010	0.04	0.02	34.5	6.47	14.3
233	6.47	34.5	14.3	1,394	0.0010	0.04	0.02	34.5	6.47	14.3
234	6.47	34.5	14.3	1,388	0.0010	0.04	0.02	34.5	6.47	14.3
235	6.47	34.5	14.3	1,383	0.0010	0.04	0.02	34.5	6.47	14.2
236	6.47	34.5	14.2	1,378	0.0010	0.04	0.02	34.4	6.47	14.2
237	6.47	34.4	14.2	1,372	0.0010	0.04	0.02	34.4	6.46	14.2
238	6.46	34.4	14.2	1,367	0.0010	0.04	0.02	34.4	6.46	14.2
239	6.46	34.4	14.2	1,362	0.0010	0.04	0.02	34.4	6.46	14.2
240	6.46	34.4	14.2	1,357	0.0010	0.04	0.02	34.4	6.46	14.2
241	6.46	34.4	14.2	1,352	0.0010	0.04	0.02	34.3	6.46	14.2
242	6.46	34.3	14.2	1,347	0.0010	0.04	0.02	34.3	6.46	14.1
243	6.46	34.3	14.1	1,342	0.0010	0.04	0.02	34.3	6.45	14.1
244	6.45	34.3	14.1	1,338	0.0010	0.04	0.02	34.3	6.45	14.1
245	6.45	34.3	14.1	1,333	0.0010	0.04	0.02	34.3	6.45	14.1
246	6.45	34.3	14.1	1,328	0.0009	0.04	0.02	34.2	6.45	14.1
247	6.45	34.2	14.1	1,324	0.0009	0.04	0.02	34.2	6.45	14.1
248	6.45	34.2	14.1	1,319	0.0009	0.04	0.02	34.2	6.45	14.1
249	6.45	34.2	14.1	1,315	0.0009	0.04	0.02	34.2	6.44	14.0
250	6.44	34.2	14.0	1,311	0.0009	0.04	0.02	34.2	6.44	14.0
251	6.44	34.2	14.0	1,306	0.0009	0.04	0.02	34.2	6.44	14.0
252	6.44	34.2	14.0	1,302	0.0009	0.04	0.02	34.1	6.44	14.0
253	6.44	34.1	14.0	1,298	0.0009	0.04	0.02	34.1	6.44	14.0
254	6.44	34.1	14.0	1,294	0.0009	0.04	0.02	34.1	6.44	14.0
255	6.44	34.1	14.0	1,290	0.0009	0.04	0.02	34.1	6.44	14.0
256	6.44	34.1	14.0	1,286	0.0009	0.04	0.02	34.1	6.43	14.0
257	6.43	34.1	14.0	1,282	0.0009	0.04	0.02	34.1	6.43	14.0
258	6.43	34.1	14.0	1,278	0.0009	0.04	0.02	34.1	6.43	13.9
259	6.43	34.1	13.9	1,275	0.0009	0.04	0.02	34.0	6.43	13.9
260	6.43	34.0	13.9	1,271	0.0009	0.04	0.02	34.0	6.43	13.9
261	6.43	34.0	13.9	1,267	0.0009	0.04	0.02	34.0	6.43	13.9
262	6.43	34.0	13.9	1,264	0.0009	0.03	0.02	34.0	6.43	13.9
263	6.43	34.0	13.9	1,260	0.0009	0.03	0.02	34.0	6.43	13.9
264	6.43	34.0	13.9	1,257	0.0009	0.03	0.02	34.0	6.42	13.9

day	Start Pond Level (feet)	Start Volume (AF)	Start Wetted Area (Ac)	GW Outflow - Beach Seepage area (ft^2)	gradient	seepage (AF)	GW inflow (AF)	End Volume (AF)	End Pond Level (feet)	End Wetted Area (Ac)
265	6.42	34.0	13.9	1,253	0.0009	0.03	0.02	34.0	6.42	13.9
266	6.42	34.0	13.9	1,250	0.0009	0.03	0.02	34.0	6.42	13.9
267	6.42	34.0	13.9	1,246	0.0009	0.03	0.02	33.9	6.42	13.9
268	6.42	33.9	13.9	1,243	0.0009	0.03	0.02	33.9	6.42	13.8
269	6.42	33.9	13.8	1,240	0.0009	0.03	0.02	33.9	6.42	13.8
270	6.42	33.9	13.8	1,237	0.0009	0.03	0.02	33.9	6.42	13.8
271	6.42	33.9	13.8	1,233	0.0009	0.03	0.02	33.9	6.42	13.8
272	6.42	33.9	13.8	1,230	0.0009	0.03	0.02	33.9	6.42	13.8
273	6.42	33.9	13.8	1,227	0.0009	0.03	0.02	33.9	6.41	13.8
274	6.41	33.9	13.8	1,224	0.0009	0.03	0.02	33.9	6.41	13.8
275	6.41	33.9	13.8	1,221	0.0009	0.03	0.02	33.8	6.41	13.8
276	6.41	33.8	13.8	1,218	0.0009	0.03	0.02	33.8	6.41	13.8
277	6.41	33.8	13.8	1,215	0.0009	0.03	0.02	33.8	6.41	13.8
278	6.41	33.8	13.8	1,212	0.0009	0.03	0.02	33.8	6.41	13.8
279	6.41	33.8	13.8	1,210	0.0009	0.03	0.02	33.8	6.41	13.8
280	6.41	33.8	13.8	1,207	0.0009	0.03	0.02	33.8	6.41	13.7
281	6.41	33.8	13.7	1,204	0.0009	0.03	0.02	33.8	6.41	13.7
282	6.41	33.8	13.7	1,201	0.0009	0.03	0.02	33.8	6.41	13.7
283	6.41	33.8	13.7	1,199	0.0009	0.03	0.02	33.8	6.41	13.7
284	6.41	33.8	13.7	1,196	0.0009	0.03	0.02	33.7	6.40	13.7
285	6.40	33.7	13.7	1,193	0.0009	0.03	0.02	33.7	6.40	13.7
286	6.40	33.7	13.7	1,191	0.0008	0.03	0.02	33.7	6.40	13.7
287	6.40	33.7	13.7	1,188	0.0008	0.03	0.02	33.7	6.40	13.7
288	6.40	33.7	13.7	1,186	0.0008	0.03	0.02	33.7	6.40	13.7
289	6.40	33.7	13.7	1,183	0.0008	0.03	0.02	33.7	6.40	13.7
290	6.40	33.7	13.7	1,181	0.0008	0.03	0.02	33.7	6.40	13.7
291	6.40	33.7	13.7	1,179	0.0008	0.03	0.02	33.7	6.40	13.7
292	6.40	33.7	13.7	1,176	0.0008	0.03	0.02	33.7	6.40	13.7
293	6.40	33.7	13.7	1,174	0.0008	0.03	0.02	33.7	6.40	13.7
294	6.40	33.7	13.7	1,172	0.0008	0.03	0.02	33.7	6.40	13.6
295	6.40	33.7	13.6	1,169	0.0008	0.03	0.02	33.6	6.40	13.6
296	6.40	33.6	13.6	1,167	0.0008	0.03	0.02	33.6	6.39	13.6
297	6.39	33.6	13.6	1,165	0.0008	0.03	0.02	33.6	6.39	13.6
298	6.39	33.6	13.6	1,163	0.0008	0.03	0.02	33.6	6.39	13.6
299	6.39	33.6	13.6	1,160	0.0008	0.03	0.02	33.6	6.39	13.6
300	6.39	33.6	13.6	1,158	0.0008	0.03	0.02	33.6	6.39	13.6
301	6.39	33.6	13.6	1,156	0.0008	0.03	0.02	33.6	6.39	13.6
302	6.39	33.6	13.6	1,154	0.0008	0.03	0.02	33.6	6.39	13.6
303	6.39	33.6	13.6	1,152	0.0008	0.03	0.02	33.6	6.39	13.6
304	6.39	33.6	13.6	1,150	0.0008	0.03	0.02	33.6	6.39	13.6
305	6.39	33.6	13.6	1,148	0.0008	0.03	0.02	33.6	6.39	13.6
306	6.39	33.6	13.6	1,146	0.0008	0.03	0.02	33.6	6.39	13.6
307	6.39	33.6	13.6	1,144	0.0008	0.03	0.02	33.6	6.39	13.6
308	6.39	33.6	13.6	1,142	0.0008	0.03	0.02	33.5	6.39	13.6
309	6.39	33.5	13.6	1,140	0.0008	0.03	0.02	33.5	6.39	13.6
310	6.39	33.5	13.6	1,139	0.0008	0.03	0.02	33.5	6.39	13.6
311	6.39	33.5	13.6	1,137	0.0008	0.03	0.02	33.5	6.38	13.5
312	6.38	33.5	13.5	1,135	0.0008	0.03	0.02	33.5	6.38	13.5
313	6.38	33.5	13.5	1,133	0.0008	0.03	0.02	33.5	6.38	13.5
314	6.38	33.5	13.5	1,131	0.0008	0.03	0.02	33.5	6.38	13.5
315	6.38	33.5	13.5	1,130	0.0008	0.03	0.02	33.5	6.38	13.5
316	6.38	33.5	13.5	1,128	0.0008	0.03	0.02	33.5	6.38	13.5
317	6.38	33.5	13.5	1,126	0.0008	0.03	0.02	33.5	6.38	13.5
318	6.38	33.5	13.5	1,125	0.0008	0.03	0.02	33.5	6.38	13.5
319	6.38	33.5	13.5	1,123	0.0008	0.03	0.02	33.5	6.38	13.5
320	6.38	33.5	13.5	1,121	0.0008	0.03	0.02	33.5	6.38	13.5
321	6.38	33.5	13.5	1,120	0.0008	0.03	0.02	33.5	6.38	13.5
322	6.38	33.5	13.5	1,118	0.0008	0.03	0.02	33.5	6.38	13.5
323	6.38	33.5	13.5	1,116	0.0008	0.03	0.02	33.4	6.38	13.5
324	6.38	33.4	13.5	1,115	0.0008	0.03	0.02	33.4	6.38	13.5
325	6.38	33.4	13.5	1,113	0.0008	0.03	0.02	33.4	6.38	13.5
326	6.38	33.4	13.5	1,112	0.0008	0.03	0.02	33.4	6.38	13.5
327	6.38	33.4	13.5	1,110	0.0008	0.03	0.02	33.4	6.38	13.5
328	6.38	33.4	13.5	1,109	0.0008	0.03	0.02	33.4	6.38	13.5
329	6.38	33.4	13.5	1,107	0.0008	0.03	0.02	33.4	6.37	13.5
330	6.37	33.4	13.5	1,106	0.0008	0.03	0.02	33.4	6.37	13.5

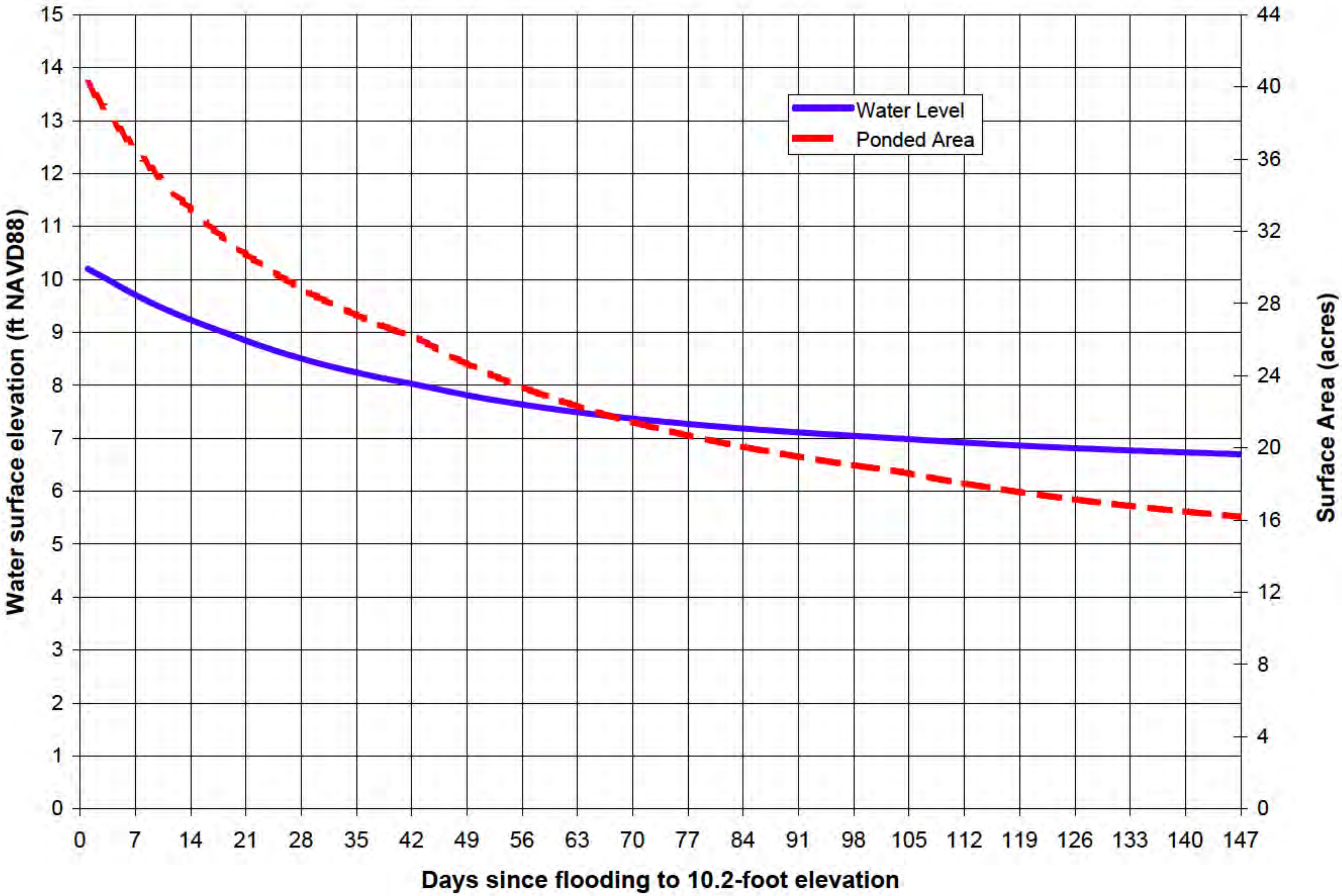
day	Start Pond Level (feet)	Start Volume (AF)	Start Wetted Area (Ac)	GW Outflow - Beach Seepage area (ft^2)	gradient	seepage (AF)	GW inflow (AF)	End Volume (AF)	End Pond Level (feet)	End Wetted Area (Ac)
331	6.37	33.4	13.5	1,105	0.0008	0.03	0.02	33.4	6.37	13.5
332	6.37	33.4	13.5	1,103	0.0008	0.03	0.02	33.4	6.37	13.5
333	6.37	33.4	13.5	1,102	0.0008	0.03	0.02	33.4	6.37	13.5
334	6.37	33.4	13.5	1,100	0.0008	0.03	0.02	33.4	6.37	13.4
335	6.37	33.4	13.4	1,099	0.0008	0.03	0.02	33.4	6.37	13.4
336	6.37	33.4	13.4	1,098	0.0008	0.03	0.02	33.4	6.37	13.4
337	6.37	33.4	13.4	1,096	0.0008	0.03	0.02	33.4	6.37	13.4
338	6.37	33.4	13.4	1,095	0.0008	0.03	0.02	33.4	6.37	13.4
339	6.37	33.4	13.4	1,094	0.0008	0.03	0.02	33.4	6.37	13.4
340	6.37	33.4	13.4	1,093	0.0008	0.03	0.02	33.4	6.37	13.4
341	6.37	33.4	13.4	1,091	0.0008	0.03	0.02	33.4	6.37	13.4
342	6.37	33.4	13.4	1,090	0.0008	0.03	0.02	33.3	6.37	13.4
343	6.37	33.3	13.4	1,089	0.0008	0.03	0.02	33.3	6.37	13.4
344	6.37	33.3	13.4	1,088	0.0008	0.03	0.02	33.3	6.37	13.4
345	6.37	33.3	13.4	1,087	0.0008	0.03	0.02	33.3	6.37	13.4
346	6.37	33.3	13.4	1,085	0.0008	0.03	0.02	33.3	6.37	13.4
347	6.37	33.3	13.4	1,084	0.0008	0.03	0.02	33.3	6.37	13.4
348	6.37	33.3	13.4	1,083	0.0008	0.03	0.02	33.3	6.37	13.4
349	6.37	33.3	13.4	1,082	0.0008	0.03	0.02	33.3	6.37	13.4
350	6.37	33.3	13.4	1,081	0.0008	0.03	0.02	33.3	6.37	13.4
351	6.37	33.3	13.4	1,080	0.0008	0.03	0.02	33.3	6.37	13.4
352	6.37	33.3	13.4	1,079	0.0008	0.03	0.02	33.3	6.37	13.4
353	6.37	33.3	13.4	1,078	0.0008	0.03	0.02	33.3	6.36	13.4
354	6.36	33.3	13.4	1,076	0.0008	0.03	0.02	33.3	6.36	13.4
355	6.36	33.3	13.4	1,075	0.0008	0.03	0.02	33.3	6.36	13.4
356	6.36	33.3	13.4	1,074	0.0008	0.03	0.02	33.3	6.36	13.4
357	6.36	33.3	13.4	1,073	0.0008	0.03	0.02	33.3	6.36	13.4
358	6.36	33.3	13.4	1,072	0.0008	0.03	0.02	33.3	6.36	13.4
359	6.36	33.3	13.4	1,071	0.0008	0.03	0.02	33.3	6.36	13.4
360	6.36	33.3	13.4	1,070	0.0008	0.03	0.02	33.3	6.36	13.4
361	6.36	33.3	13.4	1,069	0.0008	0.03	0.02	33.3	6.36	13.4
362	6.36	33.3	13.4	1,068	0.0008	0.03	0.02	33.3	6.36	13.4
363	6.36	33.3	13.4	1,067	0.0008	0.02	0.02	33.3	6.36	13.4
364	6.36	33.3	13.4	1,067	0.0008	0.02	0.02	33.3	6.36	13.4
365	6.36	33.3	13.4	1,066	0.0008	0.02	0.02	33.3	6.36	13.3

EXHIBIT J

stage (ft)	volume ft^3	area ft^2	volume AF	area acres
0	0	0	0.0	0.0
1	6,000	42,100	0.1	1.0
2	97,000	157,200	2.2	3.6
3	293,000	227,700	6.7	5.2
4	551,000	289,600	12.6	6.6
5	874,000	358,200	20.1	8.2
6	1,271,000	449,400	29.2	10.3
6.5	1,517,000	632,400	34.8	14.5
7	1,870,000	814,700	42.9	18.7
8	2,820,000	1,133,000	64.7	26.0
9	4,048,000	1,376,100	92.9	31.6
10	5,540,000	1,680,500	127.2	38.6
11	7,329,000	2,035,100	168.3	46.7
12	9,510,000	2,459,300	218.3	56.5
13	12,100,000	2,854,800	277.8	65.5
14	15,090,000	3,214,400	346.4	73.8
15	18,440,000	3,553,700	423.3	81.6
16	22,100,000	3,778,500	507.3	86.7
17	25,960,000	3,953,600	596.0	90.8

EXHIBIT D
Reply Declaration of Greg Kamman
Stage-Volume-Surface Area Relationships for
Laguna Salada Project Area

EXHIBIT K



Water Level
Ponded Area
Water surface elevation (ft NAVD88)
Surface Area (acres)
Days since flooding to 10.2-foot elevation
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
0
4
8
12
16
20
24
28
32
36
40
44
0 7 14 21 28 35 42 49 56 63 70 77 84 91 98 105 112 119 126 133 140 147

EXHIBIT L

EXHIBIT
Greg Kamman Declaration
Mobile Pumping at Sharp Park Near Lakeside Avenue and Clarendon Road
Sharp Park Golf Course