CHINA CREEK PARK
Valley Oak Tree
and
Natural Resources Analysis Study

Centerville, Fresno County

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EXECUTIVE SUMMARY

CHINA CREEK PARK
VALLEY OAK TREE AND NATURAL RESOURCES ANALYSIS STUDY

A comprehensive study was conducted at China Creek Park, an 120 acre undeveloped park owned by Fresno County, located south of Centerville. CalMat Co. operates a sand and gravel excavation and processing facility east of the park under Fresno Conditional Use Permits (CUP) 1466 and 1656. CalMat, in response to their concern over the health of the Valley Oaks and other natural resources present in the China Creek Park, commissioned this study to gather reliable scientific and technical information relating to the natural resources of concern. The study focused on the relationship of the following on the health and vigor of the valley oaks, riparian habitat and wetlands in the park:

- Surface water;
- Groundwater;
- Cattle grazing;
- Fungal or other disease pathogens;
- The direct or accidental use of herbicides or other chemicals; and
- The temporary pumping out of groundwater during mining in the adjacent sand and gravel (aggregate) operation.

The study was conducted under the direction of the author John C. Stebbins, Resource Botanist, Department of Biology, California State University, Fresno in association with Robert F. Winter, Wildlife Biologist, Fresno City College, and in consultation with Dr. Ted Swiecki and Dr. Elizabeth Berhardt of Phytosphere Research, Inc. of Vacaville, California, experts in California oak ecology, pathology, and restoration

Conclusions:

1. Virtually all of the tree mortality at the China Creek Park site and elsewhere in the Kings River floodplain, has resulted from the long term interaction of environmental stress and a complex of damaging biotic agents (Swiecki, 1997). Numerous changes in the soil water regime have occurred over time including the introduction of surface water irrigation practices and the construction of Pine Flat Dam in 1954 which created unseasonal shallow water during the summer over the long-term. These changes have debilitated the older trees and predisposed them to naturally occurring fungal disease. Furthermore, as the oaks stands thin due to the above described mortality, the remaining trees are exposed to greater amounts of fungal inoculum and more opportunistic pathogens, which increases their risk of damage due to these agents.

2. Regeneration of oaks is virtually nonexistent.

3. The remaining natural habitats at the park are highly degraded and are dominated by nonnative plant species which gradually cause further ecological declines each successive growing season.

4. Cattle grazing has severely constrained the regeneration of valley oaks, degraded the native habitats and created an environment favorable for nonnative species.

5. The loss of oaks in the southeastern corner of the park appears to have been due to a series of events;

   a. The oaks, as elsewhere in the park have a shallow root system. Groundwater in the southeast corner of the park was artificially kept at shallow levels by surface water from the Briscoe ditch and other tributaries for many decades. This surface water probably predisposed the trees to the naturally occurring pathogens.

   b. Briscoe ditch was abandoned in the early 1980's. The lack of local surface water resulted in lower groundwater levels, creating stress on adjacent oaks in the park, and initiating their decline.

   c. The temporary pumping out of groundwater during mining adjacent to the southeast corner of the park beginning in 1989 also lowered the groundwater levels and thus may have contributed to the continued decline of those oaks immediately adjacent to the mining area.

6. Long-term proactive land management is required to reverse the existing, declining conditions in the park and restore the natural habitats.

Recommendations:

1. Active land management is required to restore/enhance the oak habitat and other natural biotic and abiotic resources.

2. Direct planting and seeding of oaks and other native species is necessary to establish a healthy oak woodland with age class diversity.

3. Habitat restoration efforts should be directed towards the development and establishment of a more natural vegetative understory that is favorable to oak regeneration and survival (more native forb species and native bunchgrasses).

4. Future land alterations should carefully adhere to the mature oak avoidance recommendations of the California Oak Foundation , UC Cooperative Extension (Appendix B, Figure B-3).

5. Well-monitored livestock grazing of short, early season duration with rotational rest periods in the summer months and periodic controlled burns would help facilitate the removal of nonnative understory vegetation and buildup in the grasslands.

6. The full entitlement of surface water should be delivered to the park every year, the delivery system within the park maintained, and the timing and location of surface water deliveries should be revised to more closely mimic historic, seasonal surface water deliveries prior to Pine Flat Dam.

7. On-going, routine groundwater monitoring by CalMat should continue to determine any modifications that could be made to current groundwater management practices relating to mining.

8. A park conservation alliance could be formed to assist the County with the management of this habitat. Such an alliance could involve established conservation organizations, community and civic organizations, educational institutions, neighbors and corporate partners such as CalMat.

INTRODUCTION AND OBJECTIVES

Fresno County owns the 120 acre parcel of land known as China Creek Park. This land is located due south of Centerville and north of the Kings River in eastern Fresno County (Figures 1 and 2). The park is managed by the Fresno County Parks and Recreation Department as an undeveloped park.

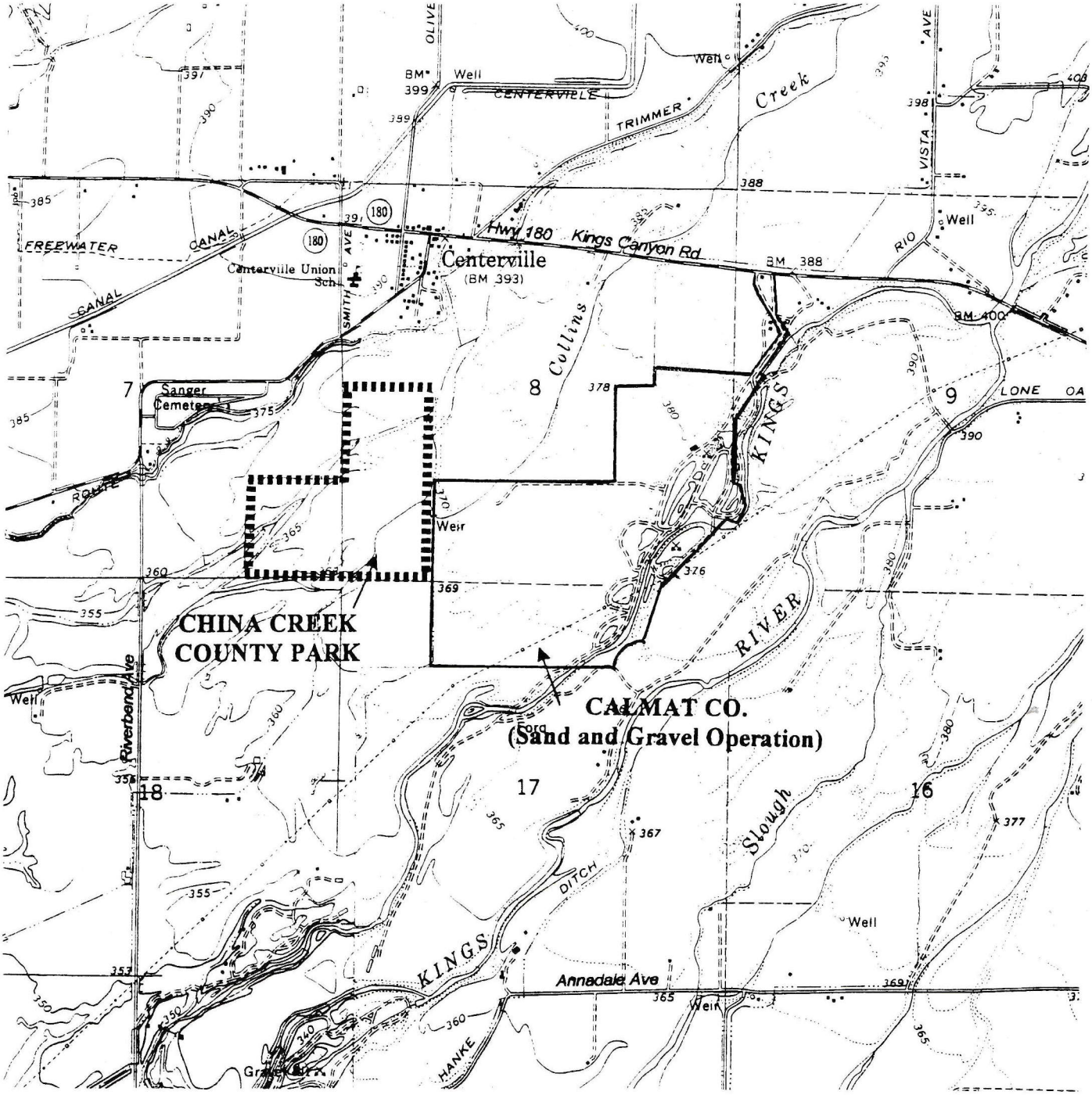
CalMat Co. operates a sand and gravel excavation and processing facility east of the park under Fresno Conditional Use Permits (CUP) 1466 and 1656. In response to their concern over the health of the Valley Oaks and other natural resources present in the China Creek Park, CalMat Co. commissioned this study to gather reliable scientific and technical information relating to the natural resources of concern. The study was conducted under the direction of the author John C. Stebbins, Resource Botanist, Department of Biology, California State University, Fresno in association with Robert F. Winter, Wildlife Biologist, Fresno City College, and in consultation with Dr. Ted Swieki and Dr. Elizabeth Berhardt of Phytosphere Research, Inc. of Vacaville, California, experts in California oak ecology, pathology, and restoration

Specifically, the relationship of the following on the health and vigor of the valley oaks, riparian habitat and wetlands in the park was investigated:

- Surface water;
- Groundwater;
- Cattle grazing;
- Fungal or other disease pathogens;
- The direct or accidental use of herbicides or other chemicals; and
- The temporary pumping out of groundwater during mining in the adjacent sand and gravel (aggregate) operation.

METHODS

This study utilized two primary research methods; a review and analysis of the existing database of pertinent information and on-site field surveys and observations in the park. The field surveys were initiated in March, 1997 and continued at approximately 15 day intervals throughout the year until mid December 1997. During this period data was accumulated by detailed record keeping and consultations with knowledgeable individuals and other technical personnel who had direct experience with the natural resources of the park. Much of the field data was derived from biological resource



Reference: USGS Sanger and Wahtoke Quadrangle 7.5'

N

Scale 1" = 2,000'

Fig 1
Location Map

CHINA CREEK PARK STUDY
Valley Oak Tree and Natural Resources Analysis Study

Date of Photo: 4/21/98

N

Scale 1" = 500'

Fig 2
Aerial Photo

CHINA CREEK PARK STUDY
Valley Oak Tree and Natural Resources Analysis

technical studies for the area undertaken for CalMat. The senior author of this report and biologist Russell Kokx assisted in the collection of field data for the above described studies. All the collected data was then evaluated by the authors and reviewed by CalMat's groundwater hydrologist consultant, Kenneth D. Schmidt (Kenneth D. Schmidt and Associates) in relationship to the groundwater monitoring data collected by CalMat from 1997 through 1998.

HISTORY AND DESCRIPTION OF THE SITE

China Creek Park

The 120 acre China Creek Park site was acquired by Fresno County in the mid-1970's (C. Janiel, pers. comm. 1997). Apparently, State of California park bond money was used for the purchase, but the specifics of the transaction was unavailable from County officials. The park is managed by the Fresno County Parks and Recreation Department as an undeveloped park with very limited management activities.

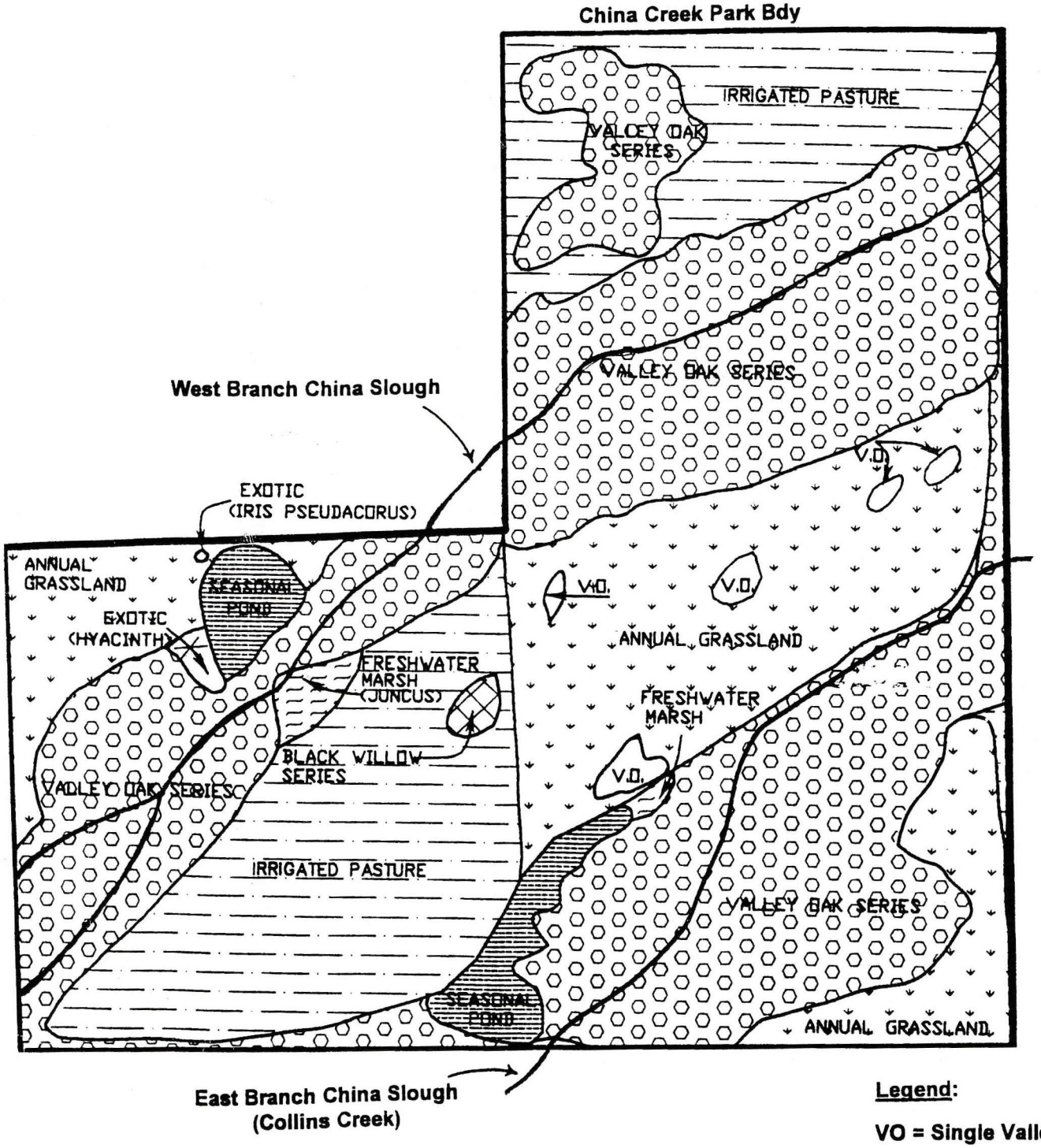
Sand and Gravel Operations

The adjacent sand and gravel facility immediately east of the China Creek Park has been operating at that location for over fifty years (Figure 1). The facility was previously operated by Wolf and then by Sanger Rock and Sand. CalMat Co. acquired it in 1990. It is currently operating under Fresno County Conditional Use Permit (CUP) 1466, granted in 1978, and CUP 1656, granted in 1980.

Vegetation Habitat Types

Essentially four different vegetation habitat types, Valley Oak Series, Black Willow Series, Annual Grassland, and Irrigated Pasture, are present in the 120 acre park (Figure 3). The classification system used to describe these habitats is based upon the California Native Plant Society methodology (Sawyer and Keeler-Wolf, 1995).

The **Valley Oak Series (60 acres)** occurs in several locations within the park. Although once undoubtedly much more extensive, this remnant habitat is now restricted mostly to the historic China Creek and Collins Creek floodplains. The dominant overstory plant species present in this habitat are the often large and in most cases old valley oaks (*Quercus lobata*). This tree is commonly associated with other smaller trees and shrubs (willow, sycamore, ash, elderberry) in the wetter areas along the sloughs and ditches. Valley oaks are also found in somewhat isolated sites in the drier clearings where they are the only trees present. It is significant to note that very little regeneration or young trees were observed. The exception is along the sloughs and ditches where increased summer moisture is available, but these young trees are subject to the periodic routine clearing of the waterways by water district personnel.



Legend:

VO = Single Valley Oak

N

Scale 1" = 400'

Fig 3
Vegetation Habitat Map

CHINA CREEK PARK STUDY
Valley Oak Tree and Natural Resources Analysis Study

The **Black Willow Series** (1 acre) occurs in one dense stand in a low wet location in the center of the park. The dominant species present is black willow (*Salix goodingii*). This species also occurs in the scattered sites within the wettest areas of some of the other habitats in the park.

The **Annual Grassland** (30 acres) is found in the driest parts of the park. The dominant plant species are nonnative grasses and herbs. Ripgut brome (*Bromus diandrus*), soft chess (*B. hordeaceus*), fiddleneck (*Amsinckia intermedia*), bermuda grass (*Cynodon dactylon*), wild mustard (*Hirschfeldia incana*), and filaree (*Erodium sp.*).

The **Irrigated Pasture** (24 acres) is located in the northeast and southwest portions of the park. This habitat type intergrades into the annual grassland, but is the dominant type in the lower areas that remain seasonally wet for much of the spring months and thus support obligate and facultative wetland plant species. The dominant plants present include sour dock (*Rumex crispus*), blue-eyed grass (*Sisyrinchium bellum*), California brome (*Bromus carinatus*), blue grass (*Poa pratensis*), lizard *tail (Anemopsis californica*), foxtail (*Alopecurus carolinianus*), barnyard grass (*Echinochloa crus-galli*), and foxtail barley (*Hordeum jubatum*).

Two **artificial ponds** (about 2.5 acres each) are also present in the park. These ponds were built in the mid 1970's by the US Soil Conservation Service in an attempt to provide for waterfowl habitat. The pooling within these ponds is a result of the construction of berms and not natural topography. The ponds have historically been kept full of water during most summer months by utilizing a portion of the irrigation allocation from the China Slough system. However, the water flow to these ponds is often sporadic (A. Phillips, pers. comm. 1997). Several common emergent and wetland plant species such as spike rush (*Eleocharis macrostachya*), sedge (*Carex senta*), speedwell (*Veronica sp.*), umbrella sedge (*Cyperus involucratus*), baltic rush (*Juncus balticus*) and dallis grass (*Paspalum dilatatum*) are well established on the banks of these ponds.

Noxious and Weedy Plants

In addition to the above described habitat types it is important from an ecological standpoint to understand that the park is inhabited by several exotic or nonnative and noxious or weedy plant species.

Portions of both ponds and several sections of the west and east branches of China Slough as well as the existing historic China Creek slough support vigorous stands of water hyacinth (*Eichornia crassipes*). This exotic south American species is perhaps the world's most troublesome aquatic weed (Hickman, 1993). The plant spreads rapidly by vegetative methods and can completely "choke out " native aquatic species.

Himalayan blackberry (*Rubus discolor*) is abundant in the wetter areas and in the oak understory of the park. This prickly exotic vine can completely dominate the

understory and exclude all native species.

White mulberry (*Morus alba*) is widely established in several areas in the valley oak habitat especially in the woodland north of the historic existing China Creek slough . This water loving and rapidly growing tree from China can easily grow 15 or more feet per year and crowd out native oaks and riparian trees such as willow and ash.

Japanese honeysuckle (*Lonicera japonica*) is an aggressive vine that is widely distributed throughout the oak woodland and riparian habitat in the park and along the nearby Kings River. In some cases this plant completely covers willow, oak, alder, ash, and sycamore trees. It is viewed as a serious pest in the region because it reproduces both sexually and vegetatively and because of its ability to rapidly outcompete native species.

Yellow Iris (*Iris pseodacorus*) is well established in the wet areas near the northern pond and along the existing China Slough below the pond. This showy exotic emergent plant from Europe can quickly become a pest of low elevation waterways and valley riparian habitats. It has become widespread in a relatively short period along the Merced and San Joaquin Rivers to the north.

Yellow star-thistle (*Centaurea solistitalis*) is an invasive bristly annual species from southern Europe that flowers during the late spring and summer months (Appendix A, Photo 6). This plant is well established in the more heavily disturbed areas of the grassland and oak woodland habitats. It is a noxious species that is known to be cumulatively toxic to some livestock, particularly horses.

Milk thistle (*Silybum marianum*) is a purple flowered spiny annual that readily colonizes disturbed sites in the central valley (Appendix A, Photo 6). It is often used by range conservationists and ranchers as an "indicator species" of chronic long term overgrazing. The presence of excessive colonies of milk thistle in oak woodlands often indicates excessive stocking rates or unseasonal grazing regimes. Many of the understory sites beneath the canopies of the mature oaks in the park are dominated by milk thistle .

Surface Waters

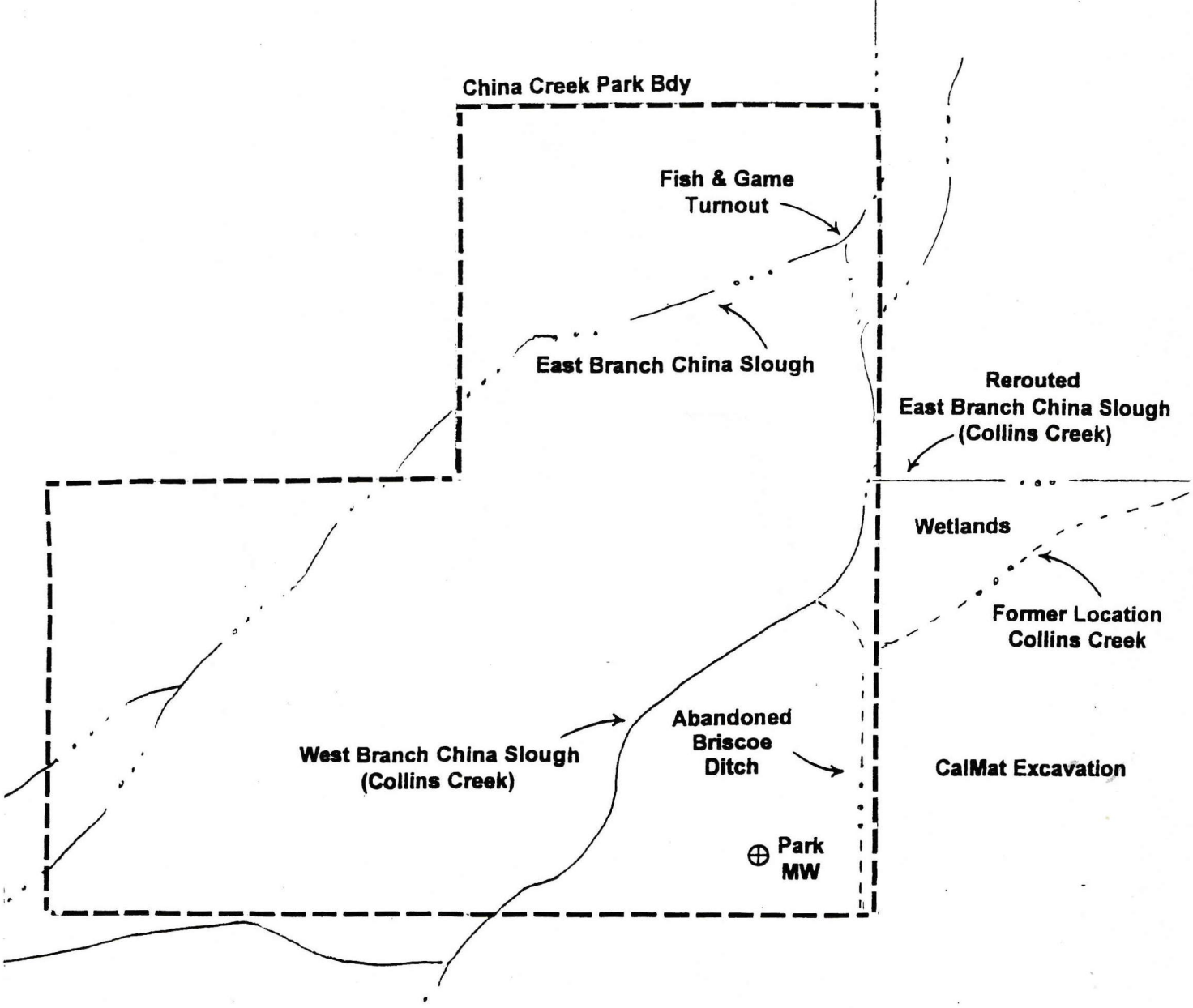
The park is located in the historic floodplain of the Kings River. It is important to recognize that the present day remnants of the historic riparian and associated habitats in the park are part of an ecosystem that developed over a long period of time prior to the land development and water storage and diversions that have occurred in the past century. The overall history of the alteration of surface waters within the park have had an impact on the wetlands, riparian, and oak woodland habitats that are present (Figure 3). The County Park contains several habitats that have evolved with, and are ecologically dependent on, surface water flows throughout the growing season. All of the numerous observations made during the field studies, and statements made by the Water District employees (past and present) indicate that the water flows into and within the park have been highly altered over the past 100 plus years. The historic diversions on the Kings River before Pine Flat Dam was completed in 1954 were dependent on the "run of the

river" operations that existed at the time. Since 1954, the periodic spring flood flows in the lower Kings River have been significantly reduced and the flows have been more regular and spread out later in the year because of the storage and release operations from the dam. During this last century, numerous artificial water conveyance and storage facilities (ditches, sloughs, old creek channels, ponds, flooded pastures etc.) have been constructed or utilized in the park site (Figures 3 and 4).

The present day surface water system is a part of the Kings River Water District, a member unit of the Kings River Water Association. The association is made up of twenty-eight separate units, public and private, which hold the water rights to the Kings River. The watermaster for the Kings River Water Association is in charge of administering the river water entitlements, storage, releases, and diversions. The Kings River Water District has senior water rights which are based on the earliest Kings River diversions in the 1860's. Therefore, the diversions to the district do not vary significantly from year to year even during drought periods (Kings River Water District, 1997).

The park receives surface water from China Slough (Figure 4). The slough diversions vary from about 2 cubic feet per second (cfs) up to a maximum of about 23 cfs. All of the surface water which flows into the park comes by way of the two branches of China Slough. The west branch of China Slough essentially follows the historic China Creek channel and brings water from north of Highway 180 to the northeast portion the park. At the above described location, a piped diversion structure allows for the removal of some water from the slough and delivers it to the historic slough channel. This structure is not regularly maintained. However, the structure has been periodically checked and cleaned out by some of the immediate neighbors who are interested in the park. The water flows in a westerly direction from this point and helps to maintain the level of the northern pond. However, the water flow to the pond is often sporadic (A. Phillips, pers. comm. 1997). This water eventually flows out of the western boundary of the park and crosses Riverbend Avenue.

The east branch of China Slough joins the west branch along the eastern boundary of the park. This east branch of the slough is more commonly referred to as Collins Creek (A. Phillips, pers. comm. 1997). This portion of Collins Creek was rerouted just east of the park in the early 1980's to enter the park midway along the east park boundary. The combined slough flows in a southwesterly direction and helps to maintain the southern pond and exits along the south park boundary. A cut diversion exists in the slough just below the junction of the two branches. This diversion was made by local neighbors to help provide water to the oak woodland habitat that is located east of the southern pond (H. Uhrbach, pers. comm. 1997). Another ditch, known as the Briscoe Ditch, previously transported water from near the junction of the two above described branches along the southeastern boundary of the park. This ditch used to supply water to the agricultural fields that were located south and east of the park. This waterway was abandoned in the early 1980's at or about the same time Collins Creek was rerouted to the north. (A. Phillips, pers. comm 1997) Other evidence of former ditch construction and later abandonment activities were found at several locations in the park but it was impossible



Legend:

⊕ = Monitoring Well (MW)

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Scale 1" = 500'

Fig 4
Surface Water Delivery System
Groundwater Monitoring Well

CHINA CREEK PARK STUDY
Valley Oak Tree and Natural Resources Analysis

to determine exactly when these facilities were in use. Mr. Phillips confirmed that several former ditches were used at various times in the past before the County acquired the property.

The China Creek Park is entitled to the water rights of 1/2 share of the 9 shares of water that are available in the above system (A. Phillips, pers. comm. 1997). The two diversions described above utilize some of the entitlement, but it is unlikely that the park consistently receives its full entitlement because the facilities are not reliably maintained. Mr. Phillips, ditchtender for the Kings River Water District, stated that they often become plugged with debris and the water flow is often sporadic. He further stated that the District has a "verbal good faith agreement" with the Department of Fish and Game to supply water to the wetlands in the park, but that no formal written exists. This above described informal agreement was confirmed by Dale Mitchell, Environmental Services Supervisor with the Department of Fish and Game (pers. comm, 1998).

Groundwater

The depth to groundwater in native riparian, wetland and oak woodland habitats can be an important factor in maintaining the natural ecosystems that are water dependent. CUP 1656, granted in 1980, for the existing aggregate facility east of the park allows the management of groundwater in the active excavation by temporarily pumping out the groundwater during mining. Three observation wells were required to be constructed to allow for the monitoring of ground water in and around the project (Madrone Associates, 1980. Two of the observation wells on the sand and gravel site were removed during excavation of the phase southeast of the park in the late 1980's by the previous operator (Sanger Rock and Sand). One monitoring well is still located in the southeast portion of the park (Fig. 4). Sanger Rock and Sand began mining east of the southeast corner of the Park in 1989.

The monitoring data from the park well site indicates that the water table has varied both seasonally and over a period of many years. Water table depth varied between 5.5 and 8 feet between February 1979 and May 1980 (Table 1). It is uncertain whether the measuring point for those measurements was from the top of the casing or from ground level. Mining was occurring at that time southeast of the park.

In the early 1980's Collins Creek was rerouted to the north and the former Briscoe Ditch along the southeast corner of the park was abandoned. The rerouting caused the creek to by-pass wetlands east of the park and south of the new creek alignment and cutoff of any surface water supply to the southeastern corner of the park.

Mining began next to the park in 1989. There are no water level measurements available from the park monitoring well from 1980 until 1990, just prior to the acquisition of the mining operation by CalMat. In 1997 CalMat began monitoring the park well and between 1997-98, installed several additional monitoring wells adjacent to the Park in conjunction with this study. Water level measurements are now made monthly by CalMat from the Park well and the new CalMat monitoring wells. The data from the

routine monitoring indicates that water levels have declined since 1990, but currently are relatively stable with little variability throughout the year.

Table 1
Water Levels in Monitoring Well in China Creek Park

Date	In Feet [1]	Measured By
2/79-5/80	5.5-8.0	Sanger Rock
06/29/90	12.0	Sanger Rock
04/25/97	16.5	Schmidt & Assoc.
05/29/97	14.6	Schmidt & Assoc.
10/19/97	15.0	Stebbins
01/08/98	15.4	Schmidt & Assoc.
02/17/98	15.9	Schmidt & Assoc.
03/30/98	15.2	CalMat
04/27/98	15.4	CalMat
05/19/98	15.8	Schmidt & Assoc.
05/26/98	15.7	CalMat
06/29/98	14.3	CalMat
07/27/98	15.0	CalMat
08/17/98	15.6	Schmidt & Assoc.
08/31/98	15.5	CalMat
09/28/98	14.0	CalMat
10/29/98	15.7	Schmidt & Assoc.
11/30/98	14.1	CalMat
12/21/98	14.1	CalMat

1. The measuring point of measurements taken since 1997 has been from the top of casiong. The measuring point for measurements before 1997 is uncertain if it was from the top of the casing or from ground level.

In addition to the depth of ground water, the soils underlying the park area play an important role in determining the availability of water to the surface habitats. The soils underlying most of the oak woodlands are in the Grangeville and Tujunga series (USDA, 1971). These soils are underlain by layers of coarse sand, gravel or cobbles at depths as shallow as 15 inches. The variability in soils and subsoil layering is partly responsible for the historic patterns of habitat development in the Kings River floodplain. The sandier surface soils have a much lower water holding capacity than heavy loam or clay soils.

Groundwater is shallow in the Centerville bottom due to an abundance of Kings River water for irrigation and the relatively small amount of groundwater pumpage that is necessary. Where these soils remain saturated throughout the growing season, rooting depth will typically be limited to the top portion of the saturated zone, because oak roots will not survive in permanently saturated soil (Pavlik et al., 1991). Based upon our observations of exposed and fallen oaks in and near to the Park it is obvious that most of the roots of the mature oaks are quite shallow (less than 3 feet). This condition is explained further in the results section of this report. It is reasonable to conclude that the

previously described surface water system alterations have lowered the shallow water tables in portions of the Park.

Grazing

Because most of the current remaining oak woodlands in the State are used as rangeland, grazing is a land management factor that must be scrutinized when evaluating the condition of the valley oak habitat at China Creek Park. Long term cattle grazing has more potential to adversely affect oak regeneration than any other factor (Swiecki and Bernhardt, 1998). The alarming negative relationships between continuous cattle grazing and the regeneration of valley oaks in the Central Valley was conclusively documented by Griffin (1973).

The widespread lack of oak regeneration in California is a complex problem with origins that can be traced back to the arrival of the Spanish and European immigrants. Although Indians altered and managed the natural landscape for thousands of years, it was the Europeans that brought the most profound ecological changes to the oak woodlands of California. With the permanent settlements came livestock, predator control, fire suppresssion, and exotic species (weeds) that would impact the habitat forever.

Since the arrival of the Spanish in the late 1700'S native grasses and wildflowers have largely been replaced by weedy plants that came from the Mediterranean old world. These weeds, especially exotic grasses, arrived along with the imported livestock and became established. Livestock preferred to graze on the more palatable and nutritious native grasses and herbs. The nonnative species thus avoided, quickly spread throughout the State in the areas with Mediterrean climates such as the Central Valley. These exotic plants now form a dense understory in many of the remaining oak woodlands that contain trees that were growing before their widespread establishment. This dense annual grassland now dominates most of the oak woodland understory in much of the State.

This complete change in the flora of the understory grasslands has brought other broad ecologic changes that effect oak regeneration (Pavlik et al, 1991). Research has shown that oak regeneration is suppressed by the introduced species that compete with oak seedlings for water, light, and nutrients (Appendix A, Photo 3). In addition to facilitating the spread of highly competitive, nonnative plants, livestock grazing directly impacts oak regeneration. Cattle eat oak leaves, acorns, seedlings and saplings. The extent to which cattle are detrimental to oak regeneration is the subject of much heated debate. Several studies have shown that the complete removal of cattle from oak habitats show the same low rates of regeneration. Plant ecologists respond that these studies must recognize that the role of nonnative plants on oak regeneration can continue for many decades after the removal of livestock from a study site. Other factors such as explosive populations of gophers, mice, squirrels and other rodents which result from the loss of natural predator control can also significantly impact oak regeneration because acorns are widely eaten by these rodents.

Cattle grazing has officially occurred at China Creek Park for most of the past 20 years that the County has owned the property (J. McNulty, pers. comm. 1997). During this period the County would issue a grazing lease with no specific management criteria such as stocking rate, season of use, water sources, etc. No cattle grazing leases have been issued for the past two years (C. Janial, pers. comm. 1997). Recently the property has reportedly been used by the Fresno County Sheriff's office to house cattle that were picked up during rustling investigations. No records exist on the stocking rates or specific utilization period for these activities. This practice was discontinued in the summer of 1997. In December 1997 the County Board of Supervisors discontinued cattle grazing because of the costs associated with CEQA compliance. Cattle were observed in the park during field surveys throughout the 1997 summer and fall seasons (Appendix A, Photo 9). It was determined that these cattle were "trespass" livestock that routinely enter the park from many of the surrounding properties. This conclusion was confirmed by some of the neighbors and by the Kings River Water District personnel who periodically inspect the systems within the park. One area near the existing China Creek Slough which receives water from the Fish and Game turnout (Fig 4) and a Caltrans riparian "mitigation site" near the southern pond have been fenced in the past to exclude cattle, but these two systems are not maintained. It is important to note that the fencing system around and within the park is inadequate to effectively control or exclude cattle or other livestock.

Domestic and Feral Animals

Free-roaming dogs were observed during field surveys. Many native wildlife are negatively impacted by dogs and domestic and feral cats which disrupt nesting and eat and harass young. The presence of domestic and feral animals thus can have significant negative impacts on the health, reproduction and variety of wildlife in the park.

RESULTS, ANALYSIS

Surface Water Relationship to Valley Oak Health and Vigor

As previously stated, the surface waters of China Creek Park have been highly altered from the historic natural system that existed prior to the construction of the many irrigation delivery systems, artificial ponds, Pine Flat Dam, flooded pastures and other diversions. This present day system has created a very complicated and degraded ecosystem that is dominated in most sites by exotic nonnative plant species. These exotics (primarily Japanese honeysuckle, white mulberry, and himalayan blackberry) aggressively colonize the sites where surface water systems are manipulated. The valley oaks that manage to initially pioneer these sites where surface soil moisture is sufficient can usually not successfully compete with the exotics.

At the other extreme, the many sites in the park that have been changed over the years to drier conditions represent serious problems for mature oaks and completely eliminate regeneration due to seedling mortality and sapling stress. A good example of

this above described situation is in the southeast corner of the park where the rerouting of the Briscoe Ditch along the County/CalMat boundary has caused a collapse in the wetland and oak habitat immediately to south of the ditch (Appendix A, Photo 7, 8). The remnant wetland plants (elderberries, rush, etc.) that are still identifiable along the former ditch and the descriptions of the local neighbors as to the habitat conditions that were present confirm this fact. The mature oaks in this area have succumbed to one or more specific fungal pathogens (discussed later in this report), but the stress of a much drier surface and shallow subsurface moisture regime following the construction of upstream dams and the cessation of historic spring flood flows was probably a significant contributing factor.

Young valley oaks will usually adapt to changes in the available moisture regime if the changes do not occur to rapidly. Older mature trees do not tolerate major changes to the surface or subsurface soil moisture regimes as young trees can, due to a variety of reasons. Changes to either wetter or drier conditions are not usually immediately lethal to mature valley oaks, but such changes subject the trees to considerable stress over a period of time (Appendix B, Fig B-1). Stressed trees are much more susceptible to the many naturally occurring fungal pathogens and insect pests, and the gradual damage caused by these agents further weakens trees. Chronic stress and damaging biotic agents interact to deteriorate tree vigor over time, which generally causes eventual tree death. The rate at which this decline progresses is affected by many factors, including the genetic makeup and physiological condition of the trees, the severity and sequence of the applied stresses, and the type and population density of the pathogens and other biotic pests present in the area. Changes in surface and soil water regimes including unseasonal flooding and or drought, depending on the specific location, over many years has predisposed the valley oak trees in the park to naturally occurring diseases. (See section on Fungi and Other Pathogens.)

Groundwater Relationship to Valley Oak Health and Vigor

Of major concern to many individuals is the possible impact of ground water level alterations relating to the observed decline of valley oaks in China Creek Park.

It is a fact that Valley Oaks require access to permanent moisture throughout the growing season. The correlation between ground water depth and valley oaks is relative to the long term conditions present at the site of a specific oak population. The valley oaks that occur well away from the floodplains of the major rivers in the State have been documented to have essentially two root systems with deep "sinker roots" that tap the soils immediately above the ground water table and shallower feeder roots.(Appendix B, Fig. B-2). These oak stands occur where heavier clay or loam soils provide support and allow the roots to utilize the soil moisture from the deeper strata near the permanent water table. Some fine examples of such oak stands include the many historic populations in San Luis Obispo County near Paso Robles, the Micke Grove and Oak Grove Parks near Stockton, and the Visalia oak groves in Tulare County.

The oak populations present at China Creek Park and elsewhere in the Kings River floodplain have root systems that are much shallower and reflect the historically shallow subsurface soil moisture conditions. An examination of the fallen trees in the park demonstrated that the major root systems are confined to the upper two to four feet of the soil profile (Appendix A, Photos 1 and 2). As previously discussed, this phenomenom is probably due to the historic shallow water tables associated with the historically abundant surface water conditions. Similar patterns of shallow root system development were noted on the neighboring lands adjacent to the park and elsewhere in the region such as the Giffen Ranch, Pine Flat Park, and Avocado Lake Park.

In addition, we have seen this same described situation on failed oaks near the Merced River floodplain at Snelling and Hilmar, the San Joaquin River, the Mokelumne River near Lodi, the Consumnes River near Galt, and in Bidwell Park near Chico Creek in Butte County where the historically shallow subsurface soil moisture conditions have been changed with the construction of upstream dams and the cessation of historic spring flood flows. The important fact to remember is that the root systems of mature valley oaks (100 plus years) reflect the historic local moisture conditions which may be further influenced by soil strata (sand lenses, etc.). These described situations from as far north as Chico and as far south as China Creek Park should not be viewed as isolated aberrant conditions, but rather as examples of a continuum of ecological responses to similar historic environmental conditions.

Cattle Grazing: Relationship to Valley Oaks, Riparian Habitat, and Wetlands

As previously discussed, the park has been grazed by cattle without any active management or restrictions for a very long time. As mentioned, cattle grazing can severely constrain the regeneration of valley oaks, but the impact of grazing isn't limited to regeneration. The ecological changes that occur in the understory, such as the impacts on native species diversity are equally important. Recent evidence demonstrates a possible link between the spread and innoculation of the various pathogenic fungi and cattle grazing (Swiecki, pers. comm. 1997).

Well timed short duration seasonal grazing can be an effective management tool when used properly (controlled stocking rates, etc.), to encourage the gradual reduction of the aggressive nonnative plants and the reestablishment of native bunchgrasses and wildflowers in the oak understory. The grazing in the park for a long time has been essentially a year round operation with the major negative impacts occurring during the summer and fall months. During this period the cattle concentrate in the wetland, riparian and oak woodland habitats where more green palatable forage will remain longer. In addition, soil compaction from cattle hooves has been shown to be detrimental. This practice over many years further degrades these habitats and creates an environment favorable for nonnative species.

Even if the recently enacted County resolution not to continue cattle grazing were enforced through fencing improvements and active on-site management, the immediate ecological effects would likely be negative. The well established yellow star thistle, milk

thistle, ripgut brome and other aggressive "Weedy" and noxious plant species would dominate the grasslands and oak understory. Other problems such as fire danger related to increased dry season fuel loads, and the rapid utilization of surface moisture by these annuals would occur.

The long term answer to the issue of grazing in the park lies in a program to eradicate the extremely unnatural vegetation composition that is now present in the park and initiate a program to reestablish a sustainable, more natural habitat that is both stable and competitive. Active management using short term grazing and an integrated rotation system would probably be an effective tool in the transition period between the present situation and a more natural habitat in the future. The use of controlled fires to encourage native grasses and herbs would also probably very effective. A fundamental part of such a policy would also be the development of a comprehensive program to encourage oak regeneration. The eventual exclusion of cattle would allow some natural regeneration to occur such as that which has taken place in some of the areas that are adequately fenced. Direct seeding and the planting of healthy trees would also likely be needed to establish oak groves in the areas that are distant from acorn-bearing trees. A "healthy" oak population consists of trees of many different age classes. Once established, a healthy oak tree canopy would also suppress many of the aggressive nonnative annuals. Sod forming perennial native grasses (eg. *Leymus, Poa, Nassella, Muhlenbergia*), are ecologically stable and do not cause the build up of a lot of combustible thatch.

Fungi and Other Pathogens: Relationship to the Valley Oak Decline

The field surveys resulted in a early hypothesis that the presence of some widely recognized oak pathogens were related to the observed decline and death of the trees of concern. Officials of the California Native Plant Society and the U.C. Berkeley, Department of Forestry and Hardwood Management were consulted. Dr. Pamela Muick, a widely published California oak authority and co-author of Oaks of California (Pavlik et al, 1991) was also contacted. The consensus among these experts was a recommendation that Dr. Ted Swiecki, a plant pathologist and a widely regarded specialist in oak diseases and tree physiology. Dr. Swiecki and Dr. Elizabeth Bernhardt jointly operate Phytosphere Research, Inc. in Vacaville, California be consulted. They have been extensively involved in many technical studies and research on California oak ecology, pathology, and restoration since 1988.

Phytosphere Research was contracted to investigate the causes of valley oak mortality and overall decline at China Creek Park. Dr. Swiecki and Dr. Bernhardt investigated the biotic and abiotic conditions relating to the oak mortality during joint field surveys made on October 21 and October 26, 1997. The senior author of this report accompanied them on both dates and assisted in the collection of field data and provided a description of the relevant site and historical events that have occurred in the park.

A major emphasis of these investigations was the compilation of the necessary technical data relating to the apparent rapid death of the large valley oak located in the center of the eastern field during the spring of 1997, and the widespread mortality and

decline of the oaks present in the southeast portion of the park (Appendix A, Photos 1, 7 and 8). Published soils data, sequential on site photographs, aerial photos, current and historical surface and groundwater data, and CIMIS weather data from the nearby stations in Parlier and Fresno were provided. Numerous tissue samples were collected from the trees of concern for later analysis in the laboratory. A technical report was prepared documenting the complete analysis and the conclusions of their research (Swiecki, 1997). The salient points of this research are hereby summarized.

The large (6.1 ft diameter at breast height) open field valley oak had fully leafed out when it was seen in mid-April of 1997 (Appendix A, Photo 4). By mid-May the foliage had turned brown and necrotic (Appendix A, Photo 5). When casually observed from a distance, especially from the west, it appeared that the tree was in fair to good condition prior to its sudden death. However, upon closer examination, evidence of chronic stress and long term decline were evident Appendix A, Photo 6. The tree showed a loss of fine branch structure (thinning) and some branches had significant epicormic sprouting. The tree had also lost a 33.5 inch diameter branch several years ago. The failure of this huge branch was associated with a brown rot of the heartwood, but other portions of the branch showed substantial white rot of the outer sapwood. The trunk was examined to a height of about 6 feet and two butress roots on opposite sides of the tree were also examined. In all places that were probed the outer sapwood was decayed with a white stringy rot to a depth of 1 inch. Beneath the decayed outer sapwood a core 1 inch long had 7 growth rings, which led to the estimate of an age of about 250 years for this large tree. Because the decay of the sapwood essentially inhibited translocation of water from the roots to the shoots, the foliage suddenly dried up under the high evapotranspiration demand of late April and early May. It was concluded that the final stress in this described collapse was most likely the extended period of soil saturation during the early 1997 spring months. The combination of warm temperatures and soil saturation would have led to anaerobic conditions in the root zone. These conditions are favorable for the growth of fungal pathogens. In addition, it has been determined that the field that the oak grew in had been subjected to summer "flood irrigation" during past seasons (A. Phillips, pers. comm. 1997). All of these factors undoubtedly played a cumulative role in predisposing the tree to the opportunistic pathogens.

Several other dead and dying oaks within the vicinity of this tree were also examined. A large dying oak at the north end of the field, about 300 feet from the above tree had fresh fruiting bodies of *Laetiporus sulfureus*, which causes a brown cubical rot of roots, trunk, and limbs, and *Ionotus dryophyllus*, which causes a white heart rot of oaks.

The dead and declining oaks in the southeast field were examined using similar methods (Appendix A, Photo 8). It has been noted previously in this report that many of these trees have failed at their shallow roots, including some that have recently failed but were still alive One declining tree in this area was inspected closely and it was determined that much of the trunk had been decayed by a species of *Hypoxylon* fungi similar to *H. mediterraneum*, but that exact identification was not possible due to the absence of mature spores. A cluster of dead and declining trees within the fenced area

near the southern pond along China Slough (Collins Creek) was also examined (Appendix A, Photo 3). Several fruiting bodies of a *Hypoxylon* sp. associated with a white rot of the sapwood was also observed.

It was determined that virtually all of the tree mortality at the China Creek Park site, including the rapid death of the large open field oak, has resulted from the long term interaction of environmental stress and a complex of damaging biotic agents (Swiecki, 1997). Numerous changes in soil water regimes, including unseasonal flooding, redirection and ponding of summer surface water, and / or localized drought have debilitated the trees and predisposed them to naturally occurring fungal disease. Furthermore, it was noted that "as the oaks stands thin due to the above described mortality, the remaining trees are exposed to greater amounts of fungal inoculum and more opportunistic pathogens, which increases their risk of damage due to these agents". This is especially true because the remaining mature trees in the park undoubtedly also have very shallow root systems and the soils present have relatively low mechanical strength.

It was estimated that perhaps as high as 90% of the mature valley oaks present in the park show obvious symptoms related to the previously described agents and conditions. This fact, when considered with the demonstrated low regeneration rate and lack of any systematic active land management program, points to a continued decline in the remaining trees. Many of the other valley oak groves adjacent to the park and in the Centerville region show similar trends, undoubtedly due to many of the same causative factors discussed in this report.

As previously mentioned, the best chance for maintaining the valley oak woodland in this area is to encourage an active regeneration program. This type of program would need to integrate an intensive transitional grazing regime with the gradual eradication of exotic species to restore an oak woodland with age class diversity, understory grassland, and riparian/ wetland habitats.

Chemicals: The Possible Relationship with Valley Oak Decline

Because of the speed at which the large valley oak in the central area died during Spring, 1997, it was initially speculated that perhaps the accidental use of chemical herbicides might be a factor. To determine if any chemicals were involved a comprehensive analysis of the leaf tissue was performed. The author met with Mr. Dale Duckering, a scientist with Dellavalle Laboratory, Inc., and assisted him with the collection of tissue samples on July 11, 1997. A complete analytical screen of all regularly used Dithiocarbamates, Phenoxy Herbicides, and Substituted Urea herbicides was performed according to industry and CDFA standards. No detectable concentrations of any of these chemical compounds were found in the leaf tissue from the oak tree (Duckering, 1997). These findings are consistent with the previously discussed diagnosis that this specific tree died from pathogenic biotic agents related to environmental stress. The speed at which mortality occurred was related to a collapse of the vascular transport system and the depletion of the carbohydrate reserves.

Adjacent Sand and Gravel Operations: Relationship to Valley Oak Decline

The loss of oaks in the southeastern corner of the park appears to have been due a series of events. The oaks, as elsewhere in the park have a shallow root system. Groundwater in the southeast corner of the park was artificially kept at its shallow pre-dam levels by surface water from the Briscoe ditch and other tributary ditches along the southeastern border of the park. This surface water probably predisposed the trees to the naturally occurring pathogens. The ditch was abandoned in the early 1980's, thereby lowering the groundwater, creating stress on adjacent oaks in the park, and initiating their decline. The temporary pumping out of groundwater during mining adjacent to the southeast corner of the park beginning in 1989 further lowered the groundwater levels and thus may have contributed to the continued decline of those oaks.

CONCLUSIONS

1. Virtually all of the tree mortality at the China Creek Park site and elsewhere in the Kings River floodplain, has resulted from the long term interaction of environmental stress and a complex of damaging biotic agents (Swiecki, 1997). Numerous changes in the soil water regime have occurred over time including the introduction of surface water irrigation practices and the construction of Pine Flat Dam in 1954 which created unseasonal shallow water during the summer over the long-term. These changes have debilitated the older trees and predisposed them to naturally occurring fungal disease. Furthermore, as the oaks stands thin due to the above described mortality, the remaining trees are exposed to greater amounts of fungal inoculum and more opportunistic pathogens, which increases their risk of damage due to these agents.

2. Regeneration of oaks is virtually nonexistent.

3. The remaining natural habitats at the park are highly degraded and are dominated by nonnative plant species which gradually cause further ecological declines each successive growing season.

4. Cattle grazing has severely constrained the regeneration of valley oaks, degraded the native habitats and created an environment favorable for nonnative species.

5. The loss of oaks in the southeastern corner of the park appears to have been due to a series of events;

    a. The oaks, as elsewhere in the park have a shallow root system. Groundwater in the southeast corner of the park was artificially kept at shallow levels by surface water from the Briscoe ditch and other tributaries for many decades. This surface water probably predisposed the trees to the naturally occurring pathogens.

b. Briscoe ditch was abandoned in the early 1980's. The lack of local surface water resulted in lower groundwater levels, creating stress on adjacent oaks in the park, and initiating their decline.

c. The temporary pumping out of groundwater during mining adjacent to the southeast corner of the park beginning in 1989 also lowered the groundwater levels and thus may have contributed to the continued decline of those oaks immediately adjacent to the mining area.

6 Long-term proactive land management is required to reverse the existing, declining conditions in the park and restore the natural habitats.

RECOMMENDATIONS

1. Active land management is required to restore/enhance the oak habitat and other natural biotic and abiotic resources.

2. Direct planting and seeding of oaks and other native species is necessary to establish a healthy oak woodland with age class diversity.

3. Habitat restoration efforts should be directed towards the development and establishment of a more natural vegetative understory that is favorable to oak regeneration and survival (more native forb species and native bunchgrasses).

4. Future land alterations should carefully adhere to the mature oak avoidance recommendations of the California Oak Foundation, UC Cooperative Extension (Appendix B, Figure B-3).

5. Well-monitored livestock grazing of short, early season duration with rotational rest periods in the summer months and periodic controlled burns would help facilitate the removal of nonnative understory vegetation and buildup in the grasslands.

6. The full entitlement of surface water should be delivered to the park every year, the delivery system within the park maintained, and the timing and location of surface water deliveries should be revised to more closely mimic historic, seasonal surface water deliveries prior to Pine Flat Dam.

7. On-going, routine groundwater monitoring by CalMat should continue to determine any modifications that could be made to current groundwater management practices relating to mining.

8. A park conservation alliance could be formed to assist the County with the management of park habitat. Such an alliance could involve established conservation organizations, community and civic organizations, educational institutions, neighbors and corporate partners such as CalMat.

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APPENDIX A

SITE PHOTOGRAPHS

Photo 1
Dr. Ted Swiecki pointing the shallow root system lacking a tap root in a failed valley oak in the southeastern section of the park.

Photo 2
A recently failed oak in the southern part of the park exhibiting a similar shallow root system.

Photo 3
Several mature. but declining, valley oaks In the south central part of the park. Note dense understory dominated by nonnative Himilayan blackberry and lack of young oaks.

Photo 4
Valley oak in eastern field – April 1997

Photo 5
Valley oak in eastern field – May 1997
(Note dead foliage)

Photo 6
Dr. Ted Swiecki collecting data on fungal pathogens from dead oak. Note abundance of milk thistle *(Silybum marianum)* and Yellow star thistle *(Centaurea solistitalis)* in canopy zone. noxious weeds that are widely established in the park grasslands.

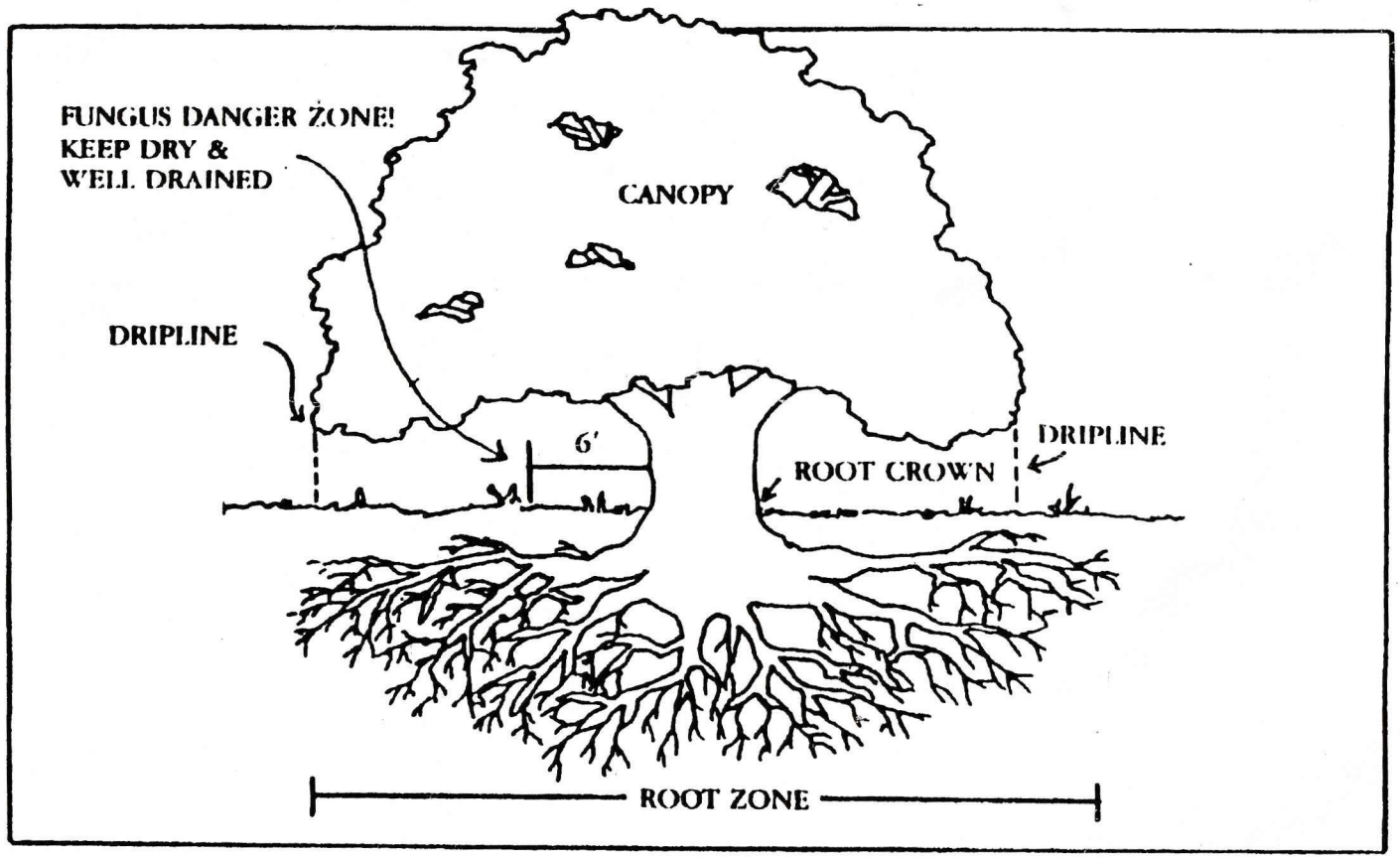
Photo 7
The Briscoe Ditch along the southeastern boundary abandoned in early 1980's. This ditch was formerly colonized by young oaks and other riparian vegetation that are now severely stressed

Photo 8
Dead and declining oaks in southeastern part of park. The abandoned Briscoe Ditch is in the far right background. Other dead and declining species in the area indicate that this site was formerly much wetter.

Photo 9
Cattle in western wetland area. (April 1997)

APPENDIX B

VALLEY OAK ROOT SYSTEMS



University of California Cooperative Extension at Berkeley, Natural Resources Program

"Young, native oaks are tolerant of environmental changes and will usually adapt.. But as oaks mature, their environmental tolerances become set and changes can weaken or kill them. A mature oak, for example, is well adapted to California's naturally dry summer weather. If the environment of an adult tree is changed by the introduction of summer watering.... fungi will proliferate on its roots and begin to kill it. Unfortunately, there may be few visible signs of a fungus attack before it is too late. ..... Changes in the drainage around an oak can put water into the root zone during the season when temperatures are high and oaks need to be dry. Saturated soils inhibit the exchange of oxygen in the root zone and encourage the proliferation of soil-borne diseases."

Living Among the Oaks, University of California Cooperative Extension at Berkeley, Natural Resources Program

Figure B-1