

Memorandum

Date : July 22, 1994

To : Kathlin R. Johnson, Chief
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From : Department of Water Resources

Subject: Los Banos Grandes Facilities Sycamore Pilot Program
Report Number III

This is the third in a planned series of memorandum reports summarizing the progress and status of the Los Banos Grandes Facilities Sycamore Pilot Program.

In 1990, the Department published the Los Banos Grandes Facilities Feasibility Report, recommending the construction of a 1.73 million acre-foot reservoir and associated facilities in western Merced County. Under this configuration, the proposed LBG Reservoir would inundate 426 acres of sycamore alluvial woodland located along Los Banos Creek. Although the sycamores are not listed as a threatened or endangered species, they have significant value because of the habitat they provide for wildlife in the area. This loss would be mitigated by creating and restoring other SAW habitat in nearby areas. The LBG Sycamore Pilot Program was initiated in 1989 to develop effective methods for growing and propagating sycamores and to demonstrate the viability of the proposed mitigation plan for SAW.

The first memorandum report, published in August 1991, describes the implementation of the overall LBG Sycamore Pilot Program and its components. A second report was published in December 1992 that updates the progress of this project to that date. The enclosed report reviews and summarizes the current progress and findings of the program, and substantiates the importance of water and periodic browsing to the survival and procreative ability of the sycamore.

Enclosure

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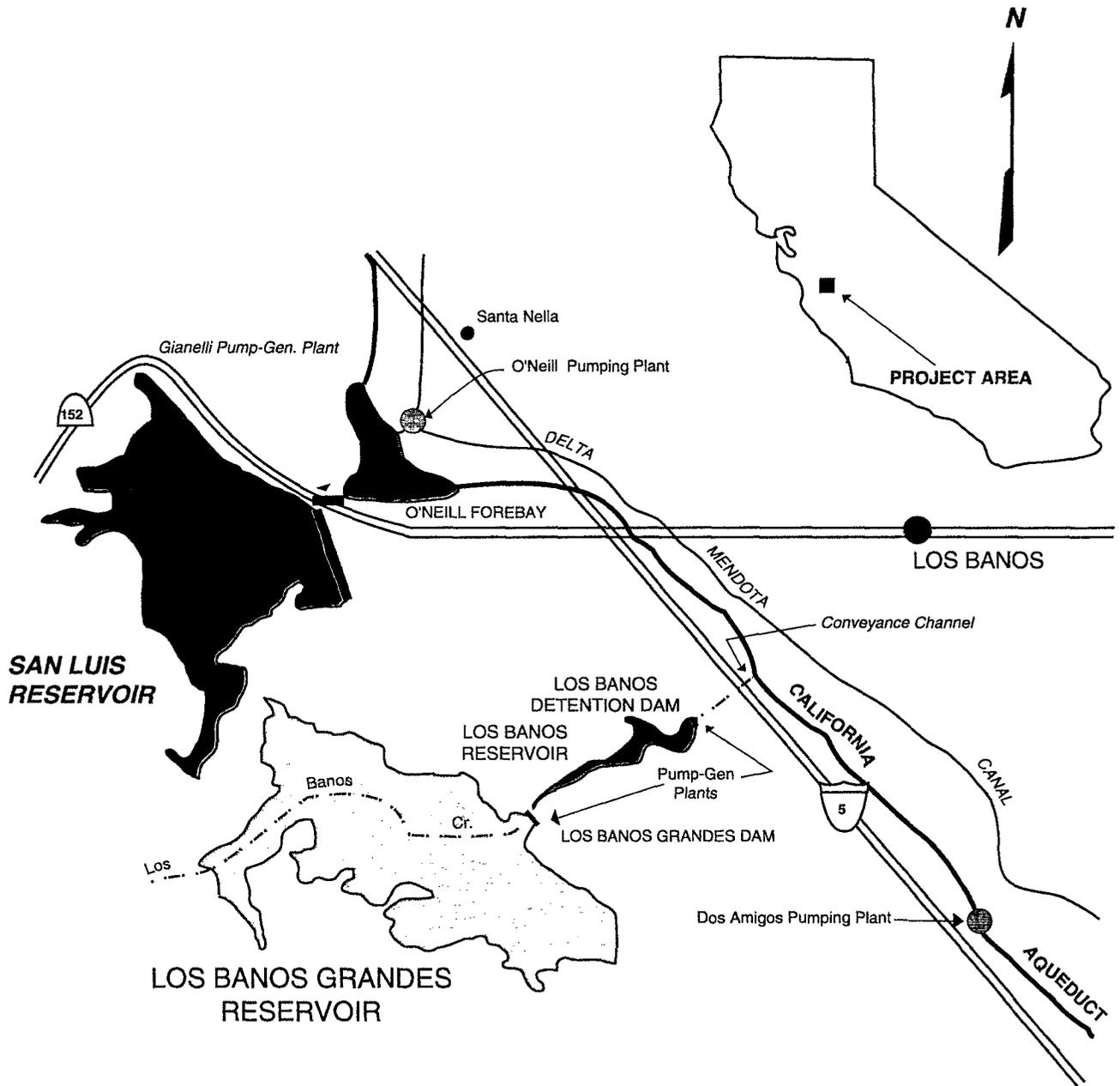
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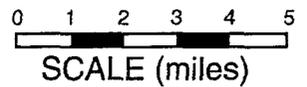
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Map A. Los Banos Grandes Facilities Location



LEGEND

-  EXISTING
-  PROPOSED



Sycamore Pilot Program

1994 Report

Introduction

The California Department of Water Resources is studying the feasibility of constructing the Los Banos Grandes Facilities—a south-of-the-Delta offstream storage reservoir project for the State Water Project. The reservoir, located south of the Sacramento-San Joaquin Delta in Merced County (Map A), would store water diverted from the Delta during periods of high flow and low impact to fisheries. During drier periods or when direct diversions from the Delta would cause significant impacts to fisheries, stored water would be released to agencies contracting for water from the State Water Project.

If constructed, the LBG reservoir would inundate a significant habitat composed largely of California sycamores (*Platanus racemosa*). The California Environmental Quality Act (CEQA) Statutes and Guidelines Section 15126 (C) requires inclusion of mitigation measures in the Environmental Impact Report process. CEQA Guidelines Section 15370 (C) further states that mitigation includes rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.

To provide mitigation for the loss of this resource, DWR proposes to preserve and restore existing sycamore riparian habitat and create new habitat within the western San Joaquin Valley. Two potential areas were identified along Orestimba and Garzas Creeks, in western Stanislaus County. The Orestimba site contains sycamore alluvial woodlands that were degraded due to local gravel mining and/or grazing activities. Creation and restoration of sycamore habitat at both locations are anticipated to provide a significant portion of the required mitigation.

Initiated in December 1989, the LBG Sycamore Pilot Program evaluates potential methods of restoration and propagation of the California sycamore. This report updates the progress of three components of the Sycamore Pilot Program: the San Luis Field Division Sycamore Pilot Program, the Medeiros Restoration Program (Map B), and the Orestimba Exclusion Plot (Map C).

San Luis Field Division Sycamore Pilot Program

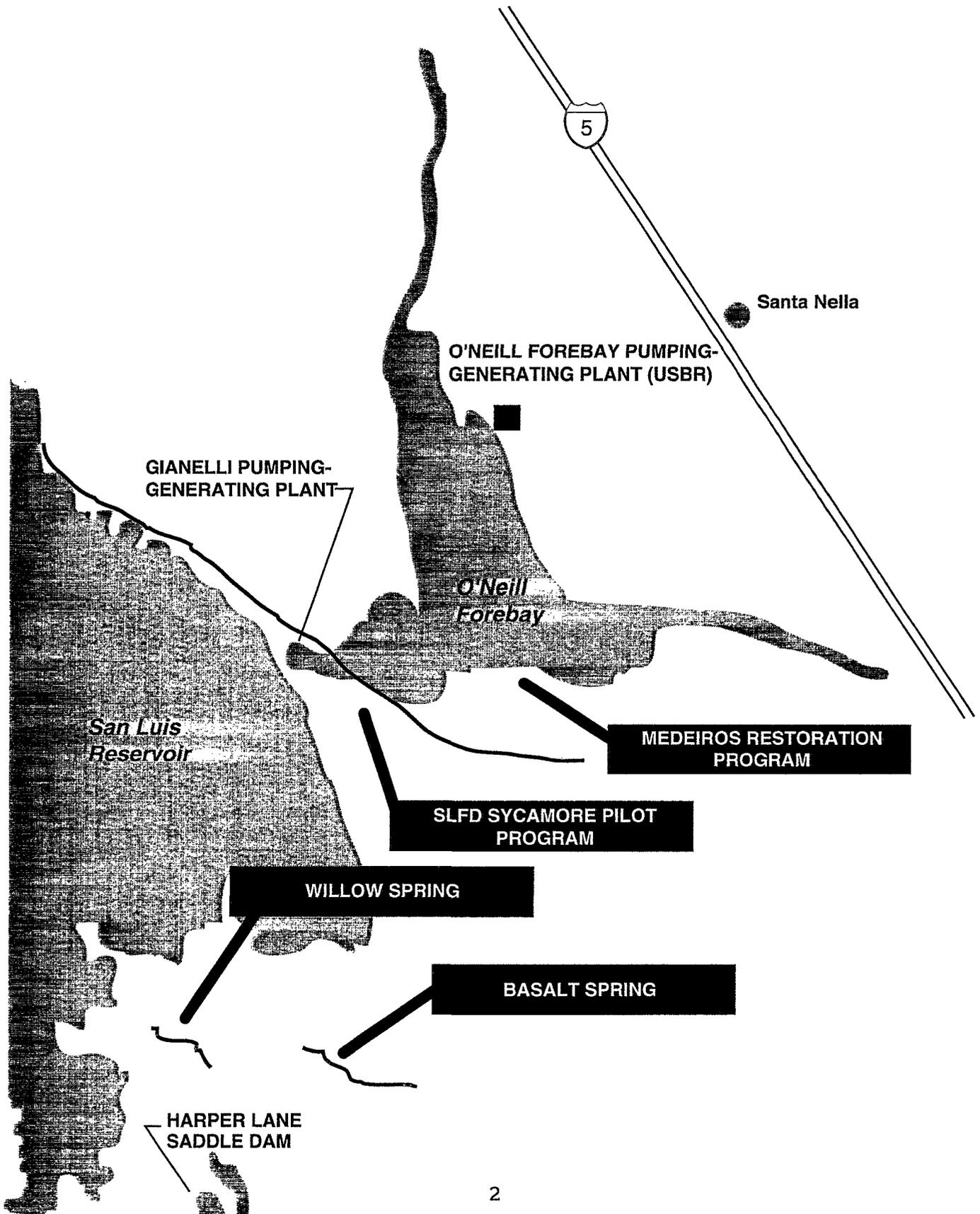
The San Luis Field Division component of the Sycamore Pilot Program is designed to test methods of establishing and achieving the long-term survival of the California Sycamore. The criteria tested in this project include: plant competition, water requirements, and browse by non-domestic mammals. Other factors at this site are wind, insect damage, and soil compaction.

Previous reports published in 1991 and 1992 provided basic information about growth rate, survivability, plant competition, and grazing pressures. This report continues the discussion of these factors and also includes additional information about procreation and water requirements.

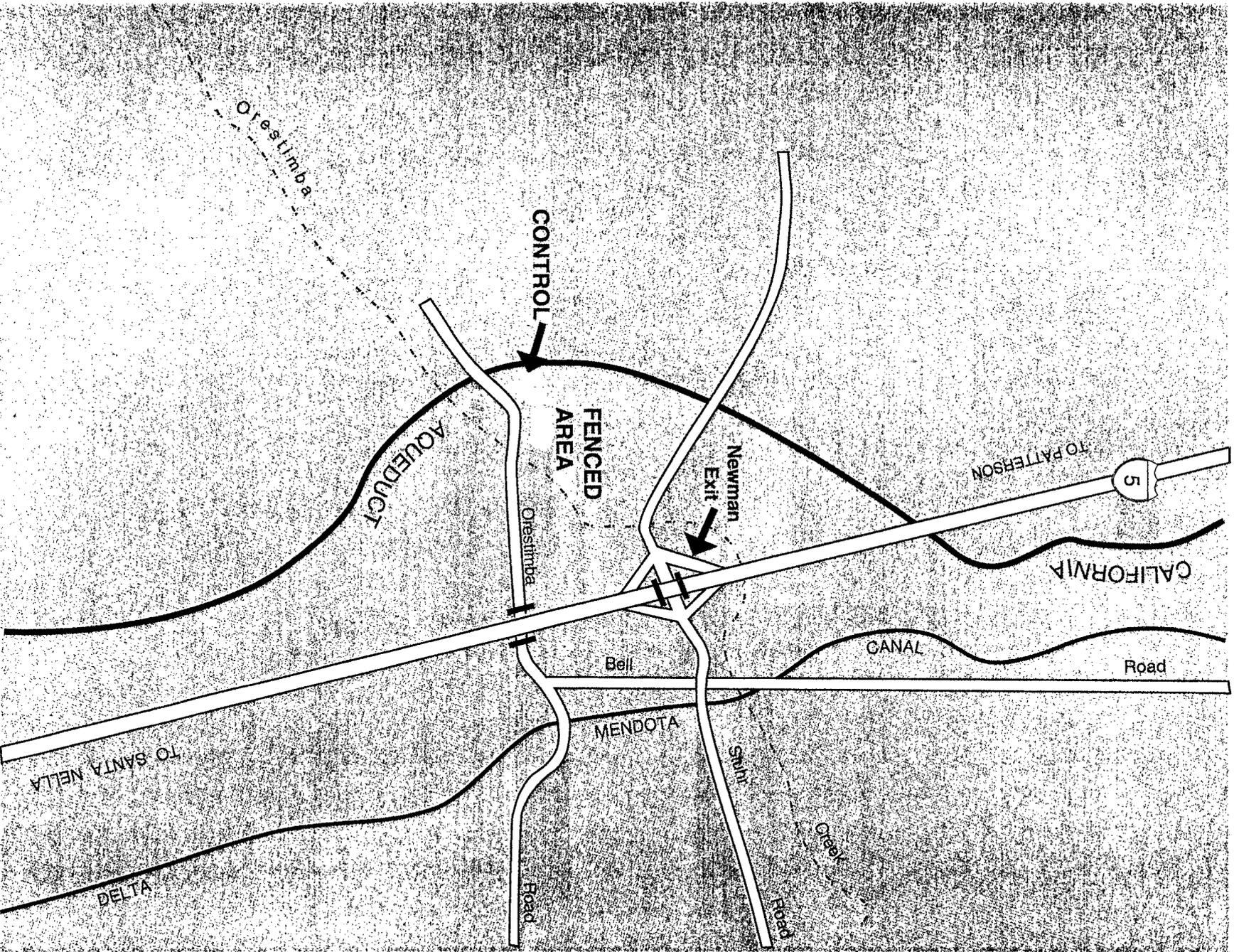
Planting

In December 1989, 672 sycamores were planted at the San Luis Field Division site, comprised of 96 5-gallon, 432 1-gallon, and 144 sleeve liners. Cuttings and seeds taken from Los Banos Canyon were also planted in two areas within the plot. Thirty-eight percent of the trees (36 5-gallon, 162 1-gallon, and 57 sleeves) were not irrigated and died within 6 months.

**Map B. Los Banos Grandes Sycamore Pilot Program
Selected Site Locations**



Map C. Location of Orestimba Exclusion Plot



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In spring 1990, an additional 228 trees (15 5-gallon, 134 1-gallon, and 79 sleeves) died when the drip irrigation system was incorrectly reset after a power outage, depriving the trees of sufficient water. By July 1990, the irrigation system was repaired and in December 1990 these trees were replaced with 15 5-gallon and 142 1-gallon trees. This includes 8 1-gallon trees that were planted in the sleeve plot, for a total of 346 trees (60 5-gallon, 278 1-gallon, and 8 sleeves). No sleeves were replaced.

In February 1994, 61 trees were moved from the site (as described later). There are currently 172 living trees at the plot: 46 5-gallon, 122 1-gallon, and 4 sleeves (Table 1 and Figure 1). Of these, 106 produced seed balls as recorded in March 1994 (Table 2 and Figure 2).

Tree Size	April 8, 1992		November 9, 1992		March 29, 1994	
	Alive/Total	%	Alive/Total	%	Alive/Total ¹	%
Fenced 5-gallon	10/12	83	10/12	83	6/12	50
Unfenced 5-gallon	48/48	100	47/48	98	44/48	92
Total 5-gallon	58/60	97	57/60	95	50/60	83
Fenced 1-gallon	29/54	54	22/54	41	16/54	30
Unfenced 1-gallon ²	205/224	91	169/224	75	159/224	71
Total 1-gallon	234/278	84	191/278	69	175/278	63
Sleeves	8/8 ¹	100	8/8 ¹	100	8/8	100
Grand Total	300/346	87	256/346	74	233/346	67

¹ Includes 61 relocated trees
² Eight replanted into sleeve plot

**Figure 1. Survival Rate of Irrigated Sycamores Since December 1992
San Luis Field Division Site**

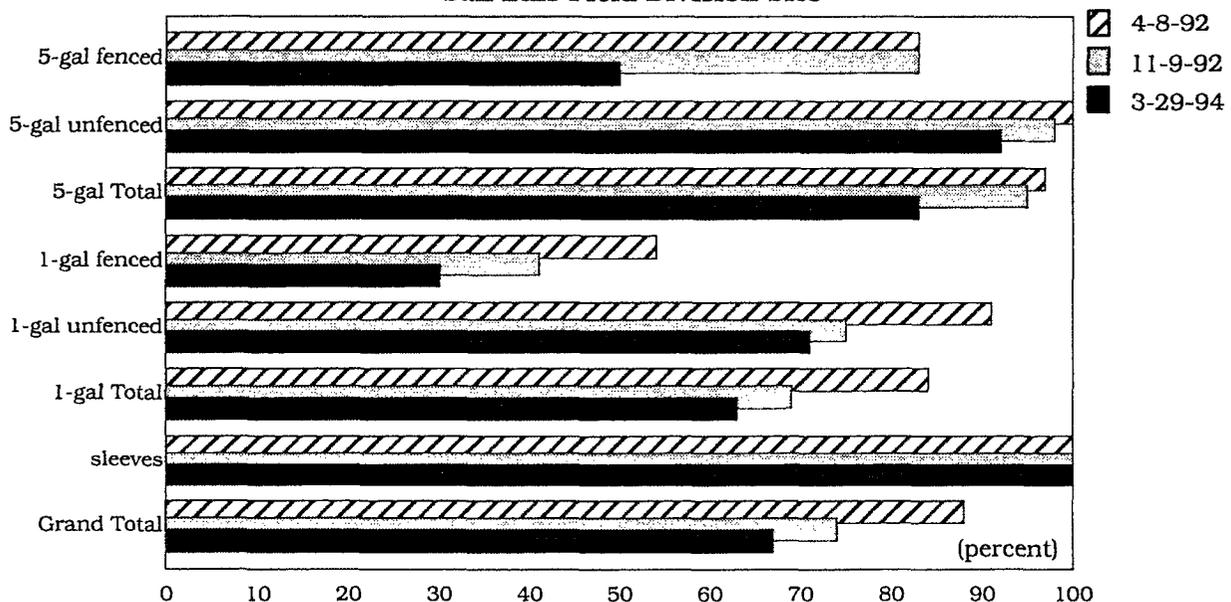
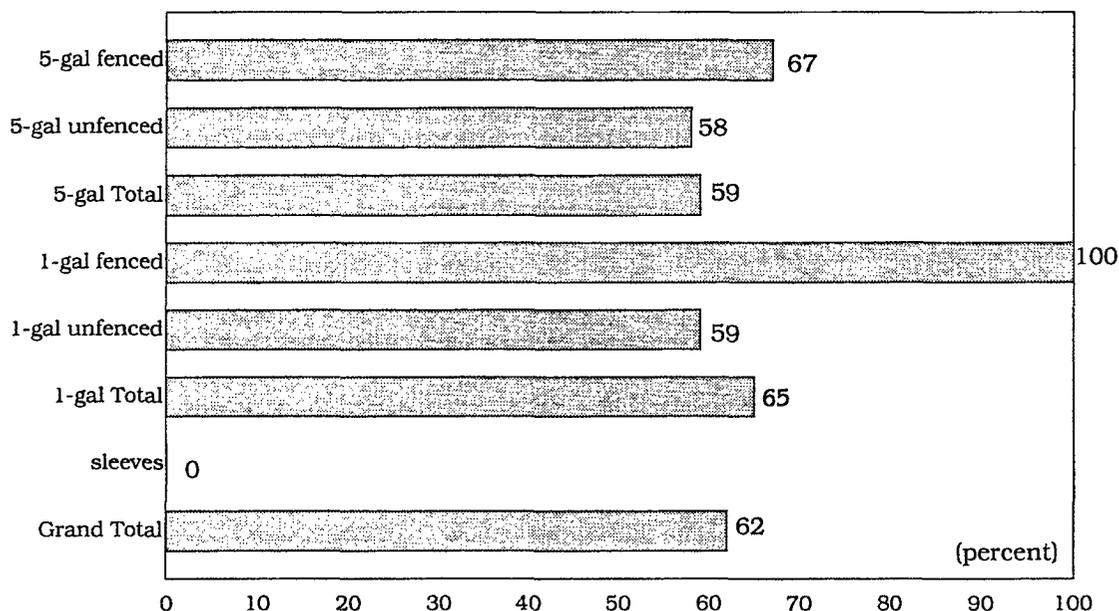


Table 2. Sycamore Trees with Seed Balls in March 1994 San Luis Field Division Site		
Tree Size	1994	
	Live trees with Seed Balls	%
Fenced 5-gallon	4/6	67
Unfenced 5-gallon	23/40	58
Total 5-gallon	27/46	59
Fenced 1-gallon	16/16	100
Unfenced 1-gallon	63/106	59
Total 1-gallon	79/122	65
Sleeves	0/14	0
Grand Total	106/172	62

**Figure 2. Sycamore Trees with Seed Balls in March 1994
San Luis Field Division Site**



Water availability is clearly the most basic requirement of the sycamore. Trees that were deprived of water died quickly. This is not surprising, considering the California sycamore is classified as a facultative wetland (FACW) species, meaning it usually occurs in a wetland.

Root Systems

Currently, the trees in the main plot are growing rapidly, but have under-developed root systems due to their dependence on surface irrigation. Beginning in February 1994, the irrigation schedule was altered to a longer duration, less frequent cycle of 12 hours a day, once every 3 weeks. This change was made to fully saturate the ground, promote deeper infiltration of applied water, and encourage deeper penetration of the root systems. Trees will be randomly selected to monitor differences in root growth patterns on an annual basis.

Competing Vegetation

Plant competition for water and space provided the opportunity to test various treatments. Plants growing directly adjacent to the trees were periodically hand pulled and hoed. This treatment proved to be labor intensive, but effective, when applied on an annual basis. In the unfenced area, the rows were also mowed on a regular basis. Although the mowing was timed before the unwanted plants had set seed, the disturbance to the soil from the machinery caused increased weed growth. At the beginning of the study, tarweed (*Hemizonia purgens*) was a major competitor with the 1- and 5-gallon trees. Beginning in 1993, *Salsola kali* and *Baccharis pilularis* were the most prolific plants. Currently, *Amsinkia intermedia* has replaced the *Salsola kali* in the mowed section of the plot. *Salsola kali* continues to dominate in the unmowed section of the plot. In the seed plot, the original co-dominant, *Gnaphalium luteo-album* disappeared and volunteer species *Cyperus eragrostis*, *Salix spp.*, and *Populus fremontii* are thriving. These species will not be removed in order to monitor their long-term impact on the sycamores. So far they have not caused a significant decline in the number or the growth rate of the seedlings.

Browse

The impact of mammalian browse on the trees is a primary concern. Throughout the study, efforts were made to protect the trees from destruction and concurrently measure the impacts caused by different levels of browse. At the initiation of the study, a chain-link fence was installed in the center of the plot protecting 70 irrigated trees (12 5-gallon, 54 1-gallon, and 4 sleeves). The fence completely protects the trees from browse. Within 2 months of the planting, baskets were installed over one-third of the non-fenced trees. These trees had already been exposed to browsing. After five months, the baskets were removed due to the rapid growth of the trees and Deer-Away™ (putrefied egg whites) was applied once on 15 trees. The Deer-Away™ discouraged browse on the targeted trees for approximately 3 (summer) months.

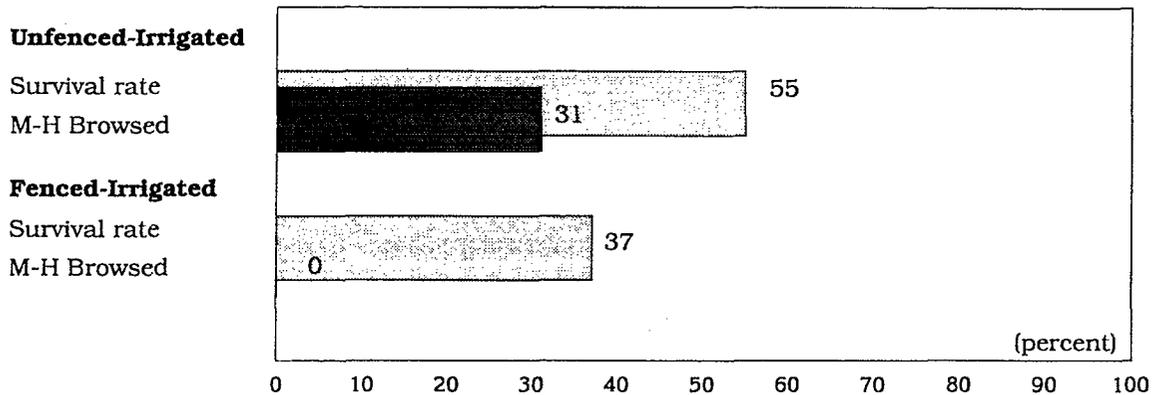
Within one month of planting, damage to trees due to browsing was detected and reported as: low (L), medium (M), or high (H). Forty-three percent of the unfenced trees were M-H browsed, 52 percent were L browsed, and 5 percent were unbrowsed.

Although browsing was apparent throughout the plot, damage was much more severe in the non-irrigated section. Sixty-six percent of the trees in the non-irrigated section were M-H browsed, compared to only 31 percent M-H browsed in the irrigated section. The remainder of the irrigated trees were L browsed (Table 3). It is possible that the lack of destructive browse on the irrigated trees is due to the alkaloid produced by sycamores, which may be less potent in the dying trees than the healthy irrigated trees.

Treatment	M-H Browsed (2-9-90)	%	Survival Rate (6-29-90)	%
Unfenced-Irrigated	63/204	31	112/204	55
Unfenced-Unirrigated	71/108	66	0/108*	0
Fenced (Unbrowsed)-Irrigated	0	0	19/51	37
Fenced (Unbrowsed)-Unirrigated	0	0	0*	0
*Due to nonirrigation				

Of the irrigated 1-gallon trees, those that were fully protected by the chain link fence had the highest rate of mortality. Only 37 percent of the trees within the fence survived compared to 55 percent of the unfenced trees (Figure 3).

**Figure 3. Level of Browse and Survival Rate of 1-Gallon Sycamore Trees
San Luis Field Division Site**



Further mortality was caused when the drip irrigation system was incorrectly reset after a power outage in May 1990, as described earlier. After this incident, 149 trees died. In December 1990, these trees were replaced.

Within one year of the replanting, 71 of the 149 (48 percent) 1-gallon trees died. During this period, only 4 of the 190 (2 percent) original 1-gallon trees died. This supports the presumption that trees are most vulnerable soon after planting.

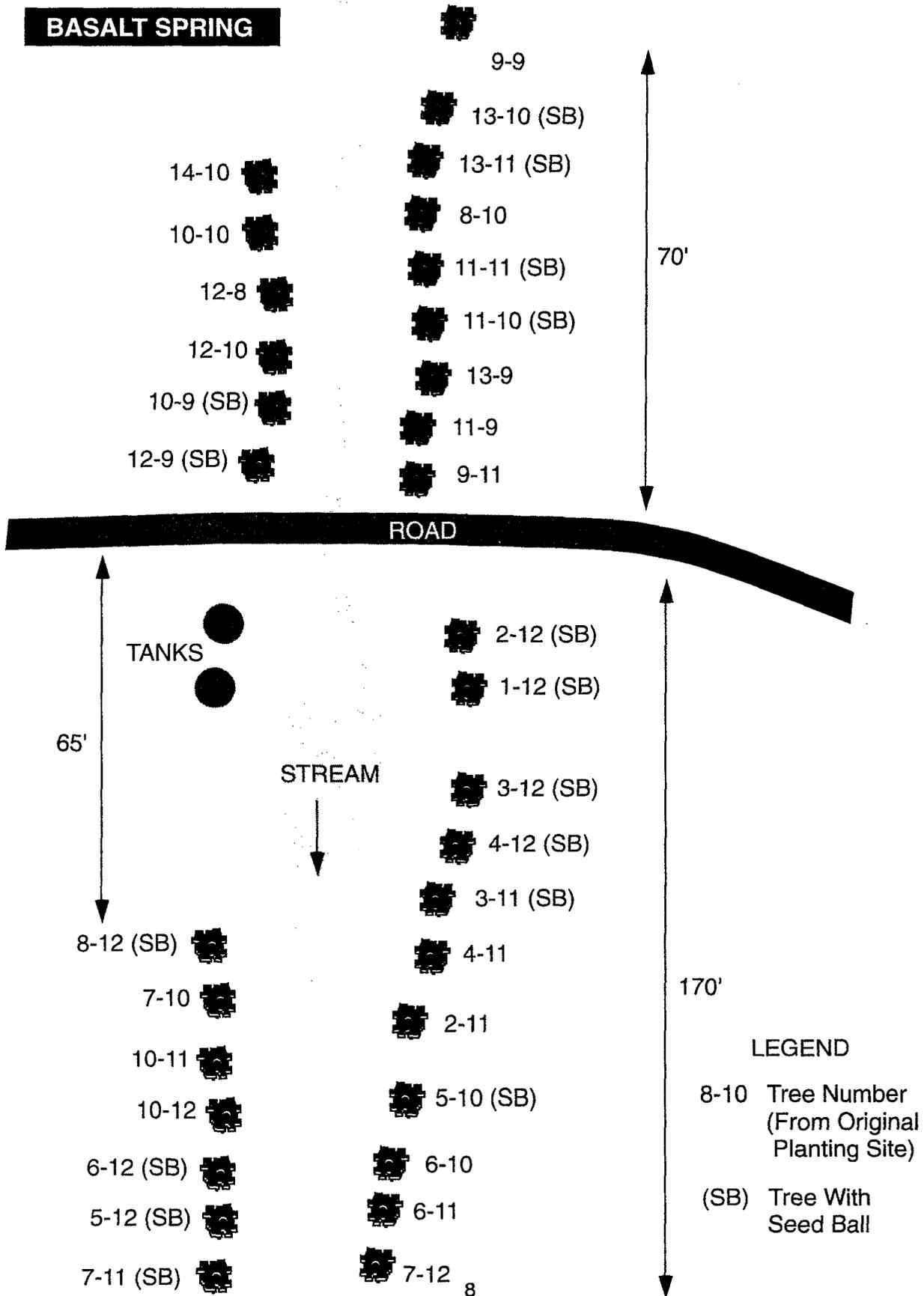
Although the new trees in the plot had been browsed, 5 months after planting they were described as spindly. Reducing the shoot-to-root ratio may allow the sycamore to recover from transplanting and better adapt to new conditions. Evidence gathered from this study supports the conclusion that sycamores subjected to periodic browsing have a better survival rate than those that are not.

Relocations

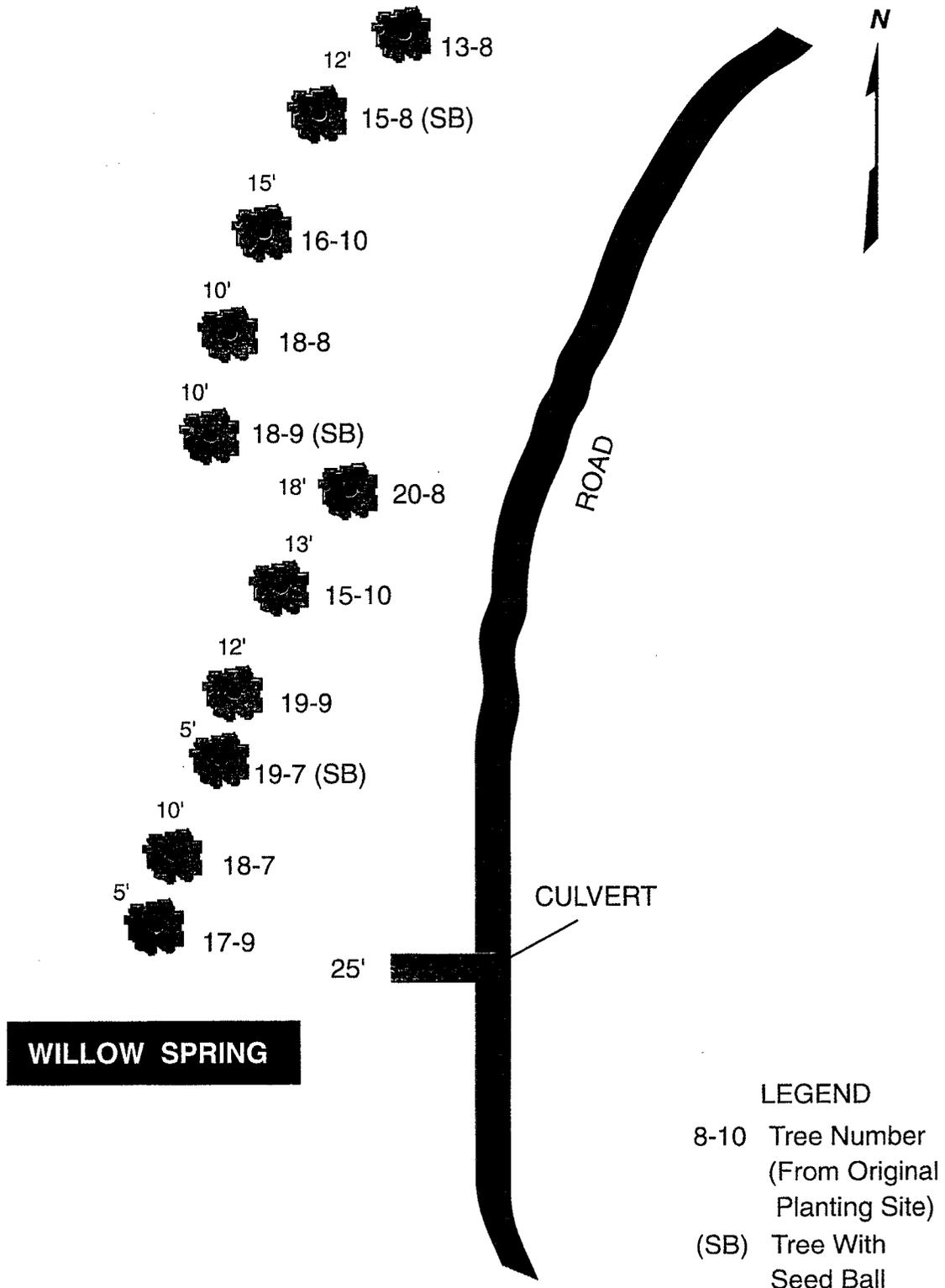
In February 1994, 61 trees (4 5-gallon, 53 1-gallon, and 4 sleeves) were relocated to remove them from the surveying line-of-sight for San Luis Dam. This provided an opportunity to test their survival in other circumstances. Forty-three trees were planted at two perennial springs above San Luis Reservoir. These natural springs have been disturbed due to non-native plantings, water diversion, road cuts, and mining activities for dam construction. Thirty-two trees were planted at Basalt Spring (Map D) and 11 were planted at Willow Spring (Map E). These trees will be monitored for survival, seed production, and procreation. The soil contains heavy clay, which may be a major detriment to the trees' survivability, as sycamores are usually found within alluvial soil.

Eighteen trees were relocated to an area near the San Luis Field Division offices. Irrigation is applied through a buried 2-foot-long corrugated pipe, filled with sandy material to prevent soil displacement. This subsurface irrigation technique should encourage root growth and discourage weed competition.

Map D. Layout of Relocated Sycamore Trees at Basalt Spring



Map E. Layout of Relocated Sycamore Trees at Willow Spring



Orestimba Exclusion Plot

The Orestimba exclusion plot project was implemented to study the ability of sycamores to reproduce with and without domestic cattle grazing. The site contains two mature sycamore trees that grow approximately 300 feet from the Orestimba Creek stream bed. One tree is exposed to normal cattle grazing. The other tree is fenced year round.

Previous reports documented suckers growing within the fenced portion of the plot. These suckers have wilted and died each year. In the previous years of this study, no seed balls have grown on either tree. In 1994, the protected sycamore at the Orestimba exclusion plot began producing many seed balls and healthy juvenile shoots. This may be due to the high rainfall last year. The current plant composition is an indicator of the moist conditions. This year the understory is dominated by wetland plants (obligate-OBL, FACW or facultative-FAC) such as saltgrass (*Distichlis spicata*), nettle (*Urtica dioica*), and Mediterranean barley (*Hordeum hystrix*). In previous surveys, the vegetation was dominated by upland species, while wetland plants comprised no more than 5 percent of the total herbaceous vegetation.

The understory of the unprotected sycamore has consistently been dominated by upland vegetation, except for an area in a drainage ditch outside the barbed wire fence and unexposed to grazing. The unprotected sycamore has no shoots except the three previously documented in the August 1991 report in the area outside the barbed wire fence. These shoots average 15 feet in height. Numerous shoots inside the fence have been masticated. The unprotected sycamore has not produced seed balls during this study.

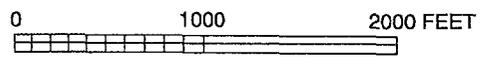
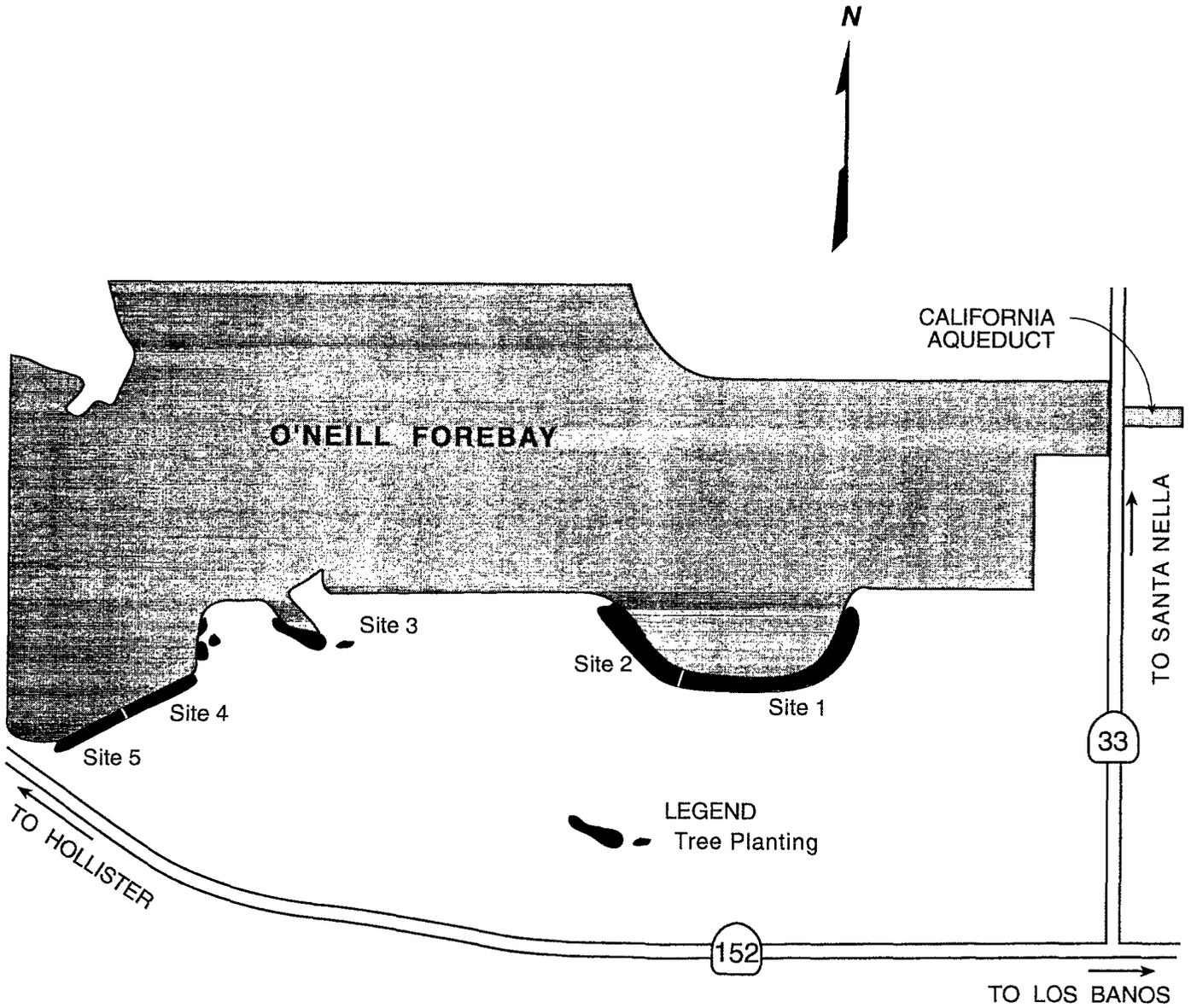
It is apparent that unmanaged domestic grazing eradicates all sycamore sprouts and seedlings thereby halting successful procreation.

Medeiros Restoration Program

Sycamores were planted in December 1989 at specific locations around O'Neill Forebay to test passive irrigation techniques (Map F). In addition, cottonwoods (*Populus fremontii*), willows (*Salix lasiolepis* and *S. exigua*), valley oaks (*Quercus lobata*), and one coyote brush (*Baccharis pilularis*) were planted to provide a more diverse habitat. Most of the trees are doing well despite variable dry conditions and inundation caused by yearly, seasonal, and daily fluctuation of the forebay elevation.

The mortality rate since the December 1992 report is low. Overall, 82 percent of the sycamores (Table 4 and Figure 4), 79 percent of the cottonwoods, and 83 percent of the willows survived (Table 5). Nine percent of the sycamores produced seed balls (Figure 5). The willows are spreading rapidly due to clonal sprouting and many have formed reproductive structures. A distinct increase in native bird species was also noted at the planting sites.

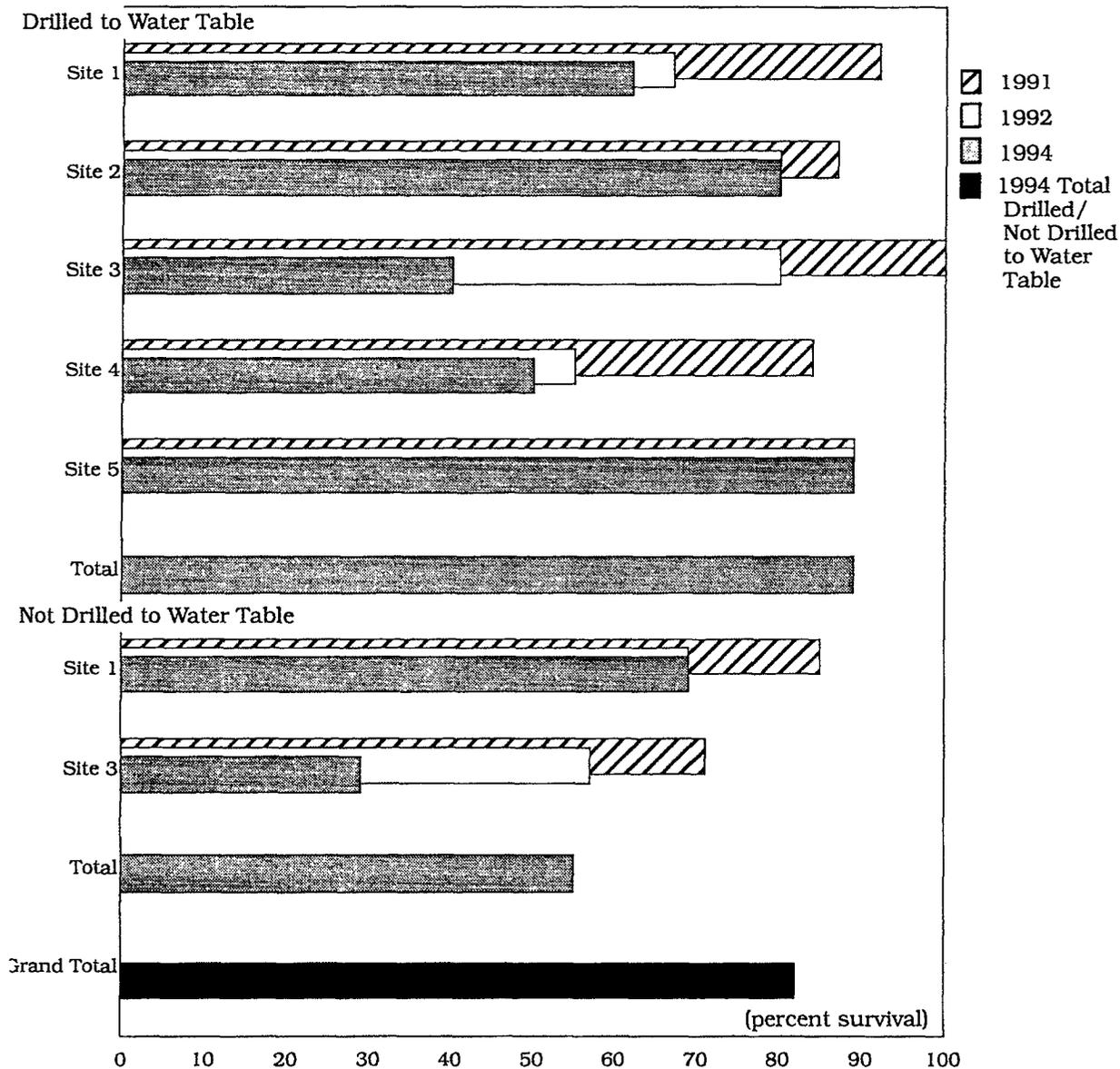
Map F. Medeiros Restoration Program



SCALE

Table 4. Survival Rate of Sycamores as of March 1994 Medeiros Restoration Program				
Site Location	Year	Alive/Total Ratio	%	General Planting Condition
Drilled to Water Table				
Site 1	1991	36/39	92	Mixture*
Site 1	1992	26/39	67	
Site 1	1994	24/39	62	
Site 2	1991	26/30	87	Mixture*
Site 2	1992	24/30	80	
Site 2	1994	24/30	80	
Site 3	1991	5/5	100	Unvegetated, Draw-down Zone
Site 3	1992	4/5	80	
Site 3	1994	2/5	40	
Site 4	1991	32/38	84	Above Draw-down Zone
Site 4	1992	21/38	55	
Site 4	1994	19/38	50	
Site 5	1991	8/9	89	Vegetated, Draw-down Zone
Site 5	1992	8/9	89	
Site 5	1994	8/9	89	
Total	1994	77 out of 87	89	
Not Drilled to Water Table				
Site 1	1991	11/13	85	Mixture*
Site 1	1992	9/13	69	
Site 1	1994	9/13	69	
Site 3	1991	5/7	71	Above Draw-down Zone
Site 3	1992	4/7	57	
Site 3	1994	2/7	29	
Total	1994	11 out of 20	55	
Total Drilled and Not Drilled to Water Table				
Total	1994	88 out of 107	82	
*Combination of vegetated and unvegetated draw-down zone and area above draw-down zone				

**Figure 4. Survival Rate of Sycamore Trees
Medeiros Restoration Program**

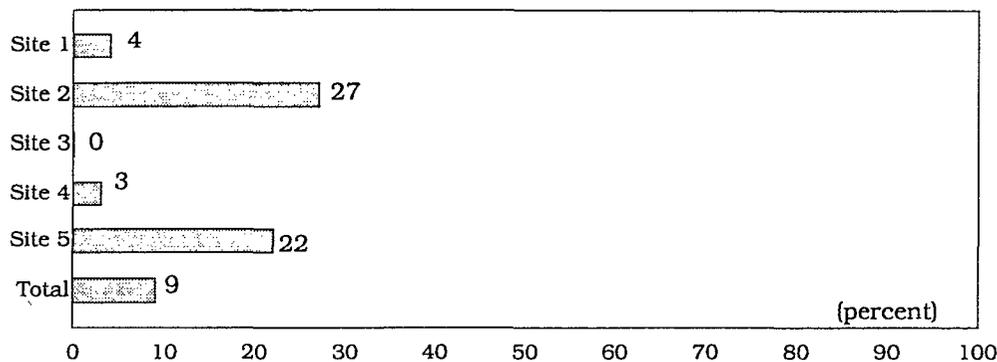


Survival of the trees is primarily associated with the planting location. Trees planted in the vegetated (stable) draw-down zone of the forebay have the best chance of survival. Those planted within the unvegetated area of the draw-down zone are the most unstable and exposed. Trees above the draw-down zone, whether drilled to the water table or not, have a low survival rate.

The availability of ground and surface water at this site may provide an opportunity to study sexual and asexual reproduction of the sycamore. This aspect of their progress will be carefully monitored.

Table 5. Survival Rate of Other Tree Species as of March 1994 Medeiros Restoration Program			
Site Location	Tree Species	No. Living Out of No. Originally Planted	% Survival
Site 1	Arroyo Willow	17/20	85
Site 1	Sandbar Willow	15/20	75
Site 1	Cottonwood	4/4	100
Site 1	Valley Oak	3/4	75
Site 1	Coyote Brush	1/1	100
Site 1 Total		40/49	82
Site 2	Arroyo Willow	4/4	100
Site 2	Cottonwood	4/5	80
Site 2 Total		8/9	89
Site 4	Arroyo Willow	3/3	100
Site 4	Sandbar Willow	6/6	100
Site 4	Cottonwood	2/4	50
Site 4	Valley Oak	4/11	36
Site 4	Scrub Oak	0/1	0
Site 4 Total		15/25	60
Site 5	Arroyo Willow	4/7	57
Site 5	Sandbar Willow	3/3	100
Site 5	Cottonwood	5/6	83
Site 5 Total		12/16	75
Grand Total		All	75/99
Site 1	Coyote Brush	1/1	100
Sites 1, 2, 4, 5	Cottonwood	15/19	79
Site 4	Scrub Oak	0/1	0
Sites 1, 4	Valley Oak	7/15	47
Sites 1, 2, 4, 5	Arroyo Willow	28/34	82
Sites 1, 4, 5	Sandbar Willow	24/29	83

**Figure 5. Sycamore Trees with Seed Balls in March 1994
Medeiros Restoration Program**



Conclusions

Conclusions from the 1991 and 1992 reports include the following:

- Highest growth rate occurred in seedlings, followed by sleeve-size, 1-gallon, and 5-gallon trees.
- Survivability was highest in seedlings, followed by 5-gallon trees, 1-gallon trees, cuttings, and sleeve-size trees.
- Mammalian browse is more severe on 1-gallon trees, sleeves, and cuttings than 5-gallon trees.
- Five-gallon trees are better able to withstand other plant competition.
- Baskets provide some protection from mammalian browse; however, the trees quickly outgrow them.
- In one trial, Deer-Away™ repelled deer for approximately 3 months.
- Sycamore trees were successfully germinated from seed.
- Young sycamores can withstand and benefit by periodic grazing but regeneration cannot occur with intense grazing.

Conclusions from this report are as follows:

- Level of irrigation is an important consideration at sycamore mitigation sites. A system that reproduces a high ground water table is preferable since it encourages root growth.
- Over-browsing and low ground water table inhibit clonal reproduction.
- A low level of browsing on newly planted sycamore seedlings may reduce the shoot-to-root ratios to levels that promote long-term survival.

Future Plans

All sites continue to be monitored for growth, reproduction, and impacts of external factors. Update reports will be published annually.

Additional studies will be initiated at the Orestimba Creek mitigation area. Projects may include testing irrigation techniques, controlled domestic grazing scenarios, controlled burns, seasonal browsing by non-domestic mammals, the relationship between precipitation amount and sycamore germination, and studies to determine relationships between native grasses and forbs and sycamore germination. A report outlining these plans will be published later this year.

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