Sunshine Canyon Mitigation Oaks—A Success Story[1]

Ralph S. Osterling[2]

Abstract: *In 1987 Browning-Ferris Industries (BFI) proposed expanding the Sunshine Canyon Landfill located on the north side of the San Fernando Valley, CA. The extension plans called for the removal of approximately 3200 coast live oaks (*Quercus agrifolia*). Tree removal regulations in Los Angeles County clearly specified the replacement requirements for oak tree removal within the County. The ordinance was aimed at subdivision development and not a landfill. To meet the intent of the ordinance and to use a wildland approach to replacement plantings, negotiations were conducted with the Los Angeles County Forester. The negotiated agreement set the following specific goals: (1) within 1 year after the tree(s) are removed, two replacement trees shall be planted for each tree removed; (2) a 5-year maintenance period following planting, including annual monitoring reports, are required; and, (3) local seed sources shall be used. BFI established the on-site Plant Materials Center in 1989 to produce the trees and outplantings began in 1991. This project has clearly demonstrated that excellent survival and rapid growth of coast live oak is possible. Proper planting methods and prudent maintenance formed the foundation for the success of this project.*

Sunshine Canyon Landfill is a large sanitary waste facility located on the northerly rim of the Los Angeles Basin, California, adjacent to Interstate 5 and Granada Hills. The landfill was originally opened in 1958 to serve the local area. At the time of its closing in September 1991 it was operated as a major waste disposal facility by Browning-Ferris Industries of California (BFI). Reopening of landfill operation within the County of Los Angeles expansion area is scheduled for summer 1996. The expansion area grading caused the removal of some 3,200 native coast live oak (*Quercus agrifolia*) trees. A total of 215 acres were disturbed for project development. Eight mitigation sites on the surrounding ridge and canyon areas totaling 94.3 acres were approved for planting by the County. Based on 20-by 20-ft spacings, 10,269 mitigation trees could ultimately be planted.

In 1982, Los Angeles County Board of Supervisors adopted Ordinance 81-1068, commonly known as the Oak Tree Ordinance. This ordinance set the criteria for oak tree mitigation for trees removed as a result of construction in the County. These guidelines specified landscape size plant materials, including 15-gallon size "standard" as replacement trees. For this wildland project, it was clear to the Registered Professional Foresters involved that planting such large stock was disadvantageous and also was excessively costly. Extensive negotiations were held with the County Forester to adjust the regulations to allow for the planting of smaller stock with a higher replacement ratio, namely, 2 replacement trees for each oak tree removed instead of the 1 to 1 ratio specified in the Ordinance. In addition, the trees had to have a 1-inch caliper measured 1 foot above the ground within 1 year of the time the original trees were removed by construction. To ensure survival, the County also required a 5-year maintenance program which included annual monitoring and reporting to confirm survival and required growth. The County also required that onsite seed sources be used for all mitigation plantings.

It was clear early on that BFI could not be assured that saplings from the desired seed source in natural growth form were available from commercial nursery stock. Therefore, in 1989, BFI management decided to open an onsite facility to produce the seedlings required for the total project. The Sunshine

[1]An abbreviated version of this paper was presented at Symposium on Oak Woodlands: Ecology, Management, and Urban Interface Issues, March 19-22, 1996, Cal Poly, San Luis Obispo, Calif.

[2]Ralph Osterling, Consultant, Ralph Osterling Consultants, Inc.; 1650 Borel Place, Suite 204, San Mateo, CA 94402

Canyon Plant Materials Center was established in 1989 and the first crop of seedlings became available in February of 1991. Due to permit processing and legal delays, field planting did not begin until late summer 1991. Since 1991, tree planting has continued annually and the number of saplings planted exceed the Los Angeles County requirements.

Methods

Nursery Facilities

The Sunshine Canyon Plant Materials Center was established on a 1.5-acre site central within the property. The operating landfill was located to the south of the nursery and the proposed expansion and mitigation areas were located to the north. A pre-fabricated 16- by 20-ft greenhouse was assembled and a 20- by 40-ft shadehouse, including raised benches, was constructed. A small portable office building was moved in to provide for tool and equipment storage plus administrative activities. Water was available to the site; an automatic irrigation system was installed. Later expansion included doubling of the shadehouse to 40 by 60 ft plus approximately 2 acres of adjacent growing grounds. Irrigation was provided to each pot with drip emitters. The entire irrigation and fertilization system was automated.

Using casual labor crews, seed was collected within the native stands of oaks growing in the undisturbed canyon areas on the property. Fortunately, acorn crops for the first 2 years were excellent. Following collection of the seed, pre-treatment included floating, stratification, and pre-germination. The acorns were placed in plastic bags and refrigerated for 6 weeks at 36-40 °F or until germination began. The germinated acorns were placed in 2-inch by 2-inch by 10-inch open-ended paper planting sleeves. The sleeves were placed in trays for initial growth in the greenhouse. Following leaf formation, the germinants were transferred to the shadehouse. It was the original intent of the foresters to plant these liner-size trees in the field in the interest of economy, and to establish naturally formed trees. However, because of the permitting delays, the 2-inch by 2-inch seedlings were transplanted into 3-gallon size containers. The 3-gallon size was chosen because it facilitated field handling and formation of a deeper root system when compared to a standard 5-gallon container. Three gallon pots measure 8 inches in diameter and 16 inches deep. Workers typically carried four or more 3-gallon size containers to the planting sites instead of only two 5-gallon size containers. Hole digging was also easier for the smaller pot diameters and rooting was facilitated with the greater hole depth. The soil mix in the container was highly organic. BFI requested we use their recycled green waste mulch produced at an adjacent Company facility. This recycled composted material was mixed with sand to produce a 70 percent organic, 30 percent sand planting mix.

The Los Angeles County permit required that all seedlings be natural in shape without pruning or shaping into a standard or "lollipop" form. Minor pruning was completed to reduce wild limb growth on the trees grown at the site. Due to the diameter requirements in the permit, an initial planting of 5-gallon and 15-gallon size stock was completed because the nursery stock grown on site were not of sufficient size. Since that initial planting, all seedlings have been planted from the 3-gallon size containers. Both 5-gallon and 15-gallon size trees were purchased from Franz Nursery in Hickman, CA. The seed source was unknown. The Registered Professional Foresters realized the characteristic oak attribute of sprouting following severe crown damage. To eliminate the standard look, all purchased trees were topped at between 3 and 4 ft to remove the entire "lollipop" crown. Within a few weeks, dormant buds developed and produced new branches on the bare stem. Pruning response was excellent and natural

formed crowns soon developed.

The nursery has proven to be extremely successful. To date, the Sunshine Canyon Plant Materials Center has produced over 34,000 coast live oaks, 2,000 canyon live oaks (*Quercus chrysolepis*), 200 valley oaks (*Quercus lobata*), 2,000 big cone Douglas-fir (*Pseudotsuga macrocarpa*), 300 sycamore (*Plantanus racemosa*), 250 big leaf maple (*Acer macrophyllum*) and 1,000 black walnut (*Juglans californica*). Although the permit requirement was for only coast live oak, BFI wanted to provide a greater diversity of overstory habitat, hence the other tree species were also grown and outplanted in selected areas. No growth records were maintained for the other species.

Irrigation

At the time of installation, all planting holes were thoroughly soaked. Following planting, the area was again soaked. Drip irrigation was then installed with the emitters placed in the wire cages.

Without onsite power and without a water source onsite, a gravity flow system was designed to provide water. Water was transported by water truck to the upper-most tanks for distribution into the lower tanks and to planting sites. Presently, over 30,000 gallon storage capacity is available between several banks of tanks. The tanks are connected with 10 miles of irrigation main lines, including a series of battery operated electric control valves. Distribution to each planting site is accomplished with over 35 miles of drip irrigation line. Two 1-gallon per hour drip emitters regulate the flow to each of the 5,500 trees.

The irrigation system included a Dositron® fertilizer pump which was used for fertigation both in the nursery and in the field planting areas. Plumbing was adapted to connect the pump at several locations. The pump operates hydraulically by the flow of the irrigation water, which made it ideal for remote operation in the field. Field fertigation used a soluble 20-20-20 fertilizer blend. Application was calculated to apply 0.25 pounds of fertilizer per plant for each fall and spring application. The soluble fertilizer was dissolved in a 55-gallon drum for proportional pumping into the drip irrigation system. Application was generally uniform using this system; however, an uneven application was acceptable since the resulting varied-size trees imitated nature.

Field Planting

The field planting sites are a series of ridge tops surrounding Sunshine Canyon on the rim of the Los Angeles Basin. An additional planting area was identified in East Canyon located adjacent to Sunshine Canyon. The droughty sites are very harsh with little available water and relatively shallow soils. Soils were classified into the Millsholm loam, 30-50 percent slopes, derived from sandstone (USDA, 1980). Annual precipitation is about 18 inches, often coming in intense storm events. Drying Santa Ana winds in excess of 100 miles per hour were measured on the adjacent landfill (Ultrasystems, 1989). Surface runoff was rapid and erosion hazard was high. Although the records were not clear, these open ridge top planting areas were probably cleared by the Los Angeles County Fire Department as part of their early fire break management program. Similar clearing patterns were observed on nearby ridges. Soil conditions were similar on each side of the ridge planting areas. No site conditions were observed that would preclude historic natural oak stands in these areas.

Wise use of water and irrigation monitoring were very important. To ensure an appropriate irrigation regime, a pressure chamber was used to determine the internal moisture stress of the planted saplings and that of the surrounding mature native trees. A simple sampling scheme was designed to sample native oak trees growing nearby and the planted stock. Trees were measured when

daily moisture stresses were at minimum levels (Cleary, 1984). The morning period of 4:30 a.m. to 6:00 a.m. was selected. Native trees on the ridge top growing adjacent to the planted area, native oaks in the adjacent canyon bottom, the planted saplings and individuals in the nursery were systematically sampled, prepared, and analyzed. For contrast, the same procedure was completed at mid-day (2:00 to 4:30 p.m.) to determine maximum stress. *Table 1* depicts the average range of values for the monitoring period.

Table 1—Plant moisture stress values

Trees sampled	Average pre-dawn[1] values measured in bars[3]	Average mid-day[2] values measured in bars
Irrigated saplings	1.8	25.5
Native ridge top	2.6	30.0
Native canyon bottom	3.1	23.0
Nursery containers	1.4	20.3

[1]4:00 a.m. - 6:30 a.m.
[2]2:00 p.m.–4:30 p.m.
[3]A bar is equal to the average air pressure at sea level or 14.7 pounds per square inch.

The field sampling schedule was repeated on a 4-day interval through the month of July 1993. The preliminary unpublished data showed the 4-day irrigation cycle could be extended to every 16 days during moderate weather. However, temperature and winds were often unpredictable on the ridgetop sites. To error on the conservative side, the cycle was increased from 4 days to 8 days. Utilizing the data derived from the pressure chamber, the initial irrigation schedule was halved, resulting in a 50 percent savings in the trucked water. The irrigation continued for three growing seasons. It appeared that within 2 years the coast live oak on this site were utilizing deeper existing soil moisture, thus reducing dependency upon irrigation water.

Planting

The planting process included both machine augered and hand-dug planting holes. Machine access was limited due to steep and uneven terrain in much of the planting areas.

At the time of planting, a root protection cage of 1-inch galvanized poultry wire folded closed at the bottom was placed around each of the root balls. Concern was expressed by the County and others that the poultry netting would restrict root growth or possibly cause root girdling. Our experience indicated that poultry netting lasts about three years before it rusts and is no longer effective for rodent control, and therefore should not damage roots.

The 1993 Northridge earthquake caused a landslide through part of the planting area. Several saplings were lost due to earth movement and the roots were exposed on more. The roots of these disturbed trees were closely inspected. Some partial imbedment by the wire was noted, however, root restriction or girdling was not observed. The trees rooted freely through and outside the wire cages.

Initial fertilizer was provided by four 0.95 ounces Agriform (20-10-5) tablets with one placed beneath and three around the plant root wad about 12 inches below the ground surface. Spring and fall fertigation (see Irrigation) is now provided to accelerate growth and development.

Following planting and installation of the irrigation, each planting site was mulched with green waste from tree trimmings. The mulch was applied approximately 6 to 10 inches deep with a radius of 2–3 ft around each plant. This mulch effectively controlled the weeds and reduced soil temperatures during the hot summer days. No doubt it also helped conserve soil moisture by reducing surface evaporation.

Maintenance

Maintenance is a vital and ongoing process. Weed control, irrigation maintenance and rodent control were primary concerns. Because of the magnitude of the rodent populations, the Los Angeles County Agricultural Office provided contract services for rodent control. Their services proved very effective. Weed control was completed with manual removal from within the root protection cages and by mulching to a greater depth. Larger areas of weeds were mowed to facilitate irrigation inspection and reduce the fire hazard. The chipped mulch appears to last about 2 or 3 years depending on the amount of solid wood within the mulch. Reapplication is required every 3 years. Routine irrigation maintenance is accomplished by walking the pressurized irrigation lines to ensure that the trees were receiving water and that no breaks in the system existed. If problems were noted, repair was completed immediately.

Results and Discussion

Growth and survival exceeded expectations and far exceeded permit requirements set forth in the Los Angeles County Oak Tree Ordinance. As of the 1994 monitoring, 5,176 trees were planted and 4,943 survived with 3,990 of the surviving trees being 1 inch or greater in diameter at 1 foot above the ground. The 1995 monitoring recorded 4,883 trees surviving with 4,374 over 1 inch in diameter. Overall survival since 1995 is approximately 90 percent. The maximum tree height was 15 ft at the end of the 1994 growing season and the maximum 1995 annual elongation was 72 inches. The applications of fertilizer were made to better achieve the size requirements as set by the permit. *Tables 2, 3* and *4* depict average height, diameter and diameter increment, respectively, of surviving seedlings, averaged over all planting years.

The growth and survival to date have been encouraging. Problems resulting from rodent populations were controlled. Vandalism and cattle rubbing and trampling damage continue to occur since the area is open range, but the damage is acceptable. After 3 years of burial in the ground, the poultry netting had weakened sufficiently to allow for gopher intrusion into the rooting area. It appears that gophers were attracted to the irrigation moisture and the light textured potting mix since many of the roots outside the wire cage were left alone. In areas where the irrigation was turned off, the rodent problem was reduced. It was estimated that over 90 percent of the mortality was due to gophers.

Table 2—Coast live oak height comparison by location and year

	Monitoring years		
Average height (ft)	1993	1994	1995
Area 1	4.66	5.37	6.89
Area 2	4.06	4.49	5.85
Area 7	3.67	4.16	5.47
Area 8	5.03	5.74	7.58

Table 3—Coast live oak diameter comparison by location and year

Average diameter (inches)	Monitoring year		
	1993	1994	1995
Area 1	0.92	1.22	1.68
Area 2	0.62	0.98	1.31
Area 7	0.58	0.78	1.24
Area 8	1.11	1.53	2.20

Table 4—Coast live oak annual diameter increment by location and year

Average diameter increment (inches)	Growing season	
	1993-94	1994-95
Area 1	0.30	0.46
Area 2	0.36	0.33
Area 7	0.20	0.46
Area 8	0.42	0.67

Conclusion

Successful oak planting and mitigation in a wildland setting were demonstrated to be both feasible and achievable. Proper and professional site evaluation, quality planting stock and proper planting methods were critical to the success of this project. Consistent maintenance by trained and dedicated personnel was vital to ensure the survival and growth of the saplings. Budgets had to include quality maintenance for a minimum of 5 years. In this climatic regime, irrigation was essential to assure survival and to meet the permit requirements.

Acknowledgments

This project has been a cooperative effort between BFI, Los Angeles County Forester and Fire Warden, Oregon State University, Angeles National Forest and Ralph Osterling Consultants, Inc. A team effort was important. The combined experiences and expertise of the professionals played important roles in the success of this project. Using similar methodologies the author completed additional planting projects in the Los Angeles Basin.

References

Cleary, B.; Zaerr, J. 1984. **Guidelines for measuring moisture stress with a pressure chamber**. PMS Instrument, Co. Corvallis, Oregon.

Ultrasystems, 1989. **Informational Summary of Draft Environmental Impact Report Sunshine Canyon Landfill Extension.** Irvine, CA: Ultrasystems; 1.

United States Department of Agriculture. 1980. **Soil survey of Los Angeles, California, West San Fernando Valley Area, January 1980**; 25, 32.