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Working Paper Series

WORKING PAPER NO. 719, *REV.*

ECONOMIC IMPACTS OF URBAN FORESTRY
IN CALIFORNIA - 1992

by

WAITE MEMORIAL BOOK COLLECTION
DEPT. OF AG. AND APPLIED ECONOMICS
1994 BUFORD AVE. - 232 COB
UNIVERSITY OF MINNESOTA
ST. PAUL, MN 55108 U.S.A.

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**ECONOMIC IMPACTS OF URBAN FORESTRY
IN CALIFORNIA - 1992**

by

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and
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California Agricultural Experiment Station
Giannini Foundation of Agricultural Economics
August 1994

**Economic Impacts of Urban Forestry
in California - 1992**

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for

Urban Forestry Program
California Department of Forestry and Fire Protection
Richard A. Wilson, Director

August 1994

Douglas P. Wheeler, Secretary for Resources, The Resources Agency
Pete Wilson, Governor, State of California

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Executive Summary

The California Department of Forestry and Fire Protection (CDF) contracted with the Department of Agricultural and Resource Economics at the University of California, Berkeley to estimate the economic impacts of urban forestry in the state. CDF's objective for this research was to improve natural resource management in the state and highlight the economic importance of urban forestry for policy and budgetary decision-makers. 'Urban forestry' refers to the growing, planting, use, maintenance, removal, disposal, and study of trees usually in incorporated cities, towns, and other human settlements primarily for meeting needs and enabling activities of people. 'Urban forestry' also refers to activities that are undertaken as a direct consequence of these trees, such as repairs of infrastructure damaged by tree roots. 'Urban forestry' does not refer to tree-related range management or to the production, distribution, or use of timber, other industrial forest products, Christmas decorations, or commercial fruit and nut products.

Our best estimate of the sales of urban forestry-related products and services from California in 1992 is \$1.248 billion. This figure represents about 6.5% and 10% of the sales of agricultural commodities and commercial forest products from the state, respectively. Households in the state purchased an estimated \$559,135,720 of products and services for residential trees. Most of this expenditure represents expenses for tree maintenance and planting that individuals do themselves. Government institutions spent an estimated \$138,143,786 for tree maintenance, planting, research, education, and landscape planning. Electric utilities had estimated expenses of \$118,477,038 for line clearance and other tree-related services, more than any other business in the state. California's public and private schools spent an estimated \$10,946,707 for

contractual maintenance, planting, and tree-related landscape planning. Community tree groups, which play an important role in promoting tree planting and awareness about the importance of urban forests and their care in the state, spent \$2,542,110 from sources other than electric utilities or grants from state and federal sources.

Real estate companies, hotels and lodging places, amusement and recreation service companies, nursing and health care facilities, religious organizations, and many other businesses and organizations in California--other buyers in the state--had estimated expenditures of \$110,279,446 for contractual maintenance, planting, and tree-related landscape planning. City governments, households, and businesses spent an estimated \$139,813,644 for disposal of tree waste, unclogging storm inlets, certain repairs of tree-induced damages to infrastructure, and government legal fees and liability claims related to city trees. Finally, landscape, horticultural, and arboricultural companies in the state sold an estimated \$168,366,485 in tree-related services to buyers in other states. (See Table 1.)

The methods used to make these estimates are discussed in detail in the body of the report. In general, we have used four major sources of information: 1) the National Gardening Association's 1992-93 survey of households, 2) Bernhardt and Swiecki's 1992 survey of city and county governments, 3) the 1991 IMPLAN databases of regional consumption demand and of sales and purchases of 528 sectors of the California economy, and 4) our own surveys of utilities, community tree groups, two city governments, and the city arborist in San Jose. The Table of Contents indicates the page numbers where the discussion of each urban forestry buyer begins.

The \$1.248 billion in transactions create ripple effects on sales, employment, and personal income in the state. Participants in urban forestry markets generate an additional \$2.539 billion

in sales throughout the state's economy. Thus, we estimate that the total impact of urban forestry on sales in the state is \$3.787 billion. Sellers of goods and services from not only the urban forestry sector but also other sectors earn income as a result of the direct and ripple effects of urban forestry sales. Specifically, \$3.787 billion in total sales translates into \$2.091 billion dollars of income to individuals in the state. Finally, buyers and sellers of urban forestry products and services also generate employment not only within the state's urban forestry sector, as a result of these transactions, but also in all sectors of the state's economy, as a result of the ripple effects of those transactions. We estimate that 64,024 jobs are created in all sectors of the California economy as a result of the \$1.248 billion in sales of urban-forest related products and services and its ripple effects.

Table 1:
Summary of Expenditures on California Urban Forestry by Major Buyers, 1992

Buyer	Urban Forestry Activities	Expenditure
Households	equipment, supplies, and plant material for do-it-yourself maintenance and planting; contractual maintenance, planting, and tree-related landscape planning	\$559,135,720
Government	in-house and contractual maintenance, planting, research, education, and tree-related landscape planning	\$138,143,786
Electric Utilities	line clearance, restoration of power after tree-induced outages, trimming, planting, tree-related legal expenses, and research	\$118,477,038
Public and Private Schools	contractual maintenance, planting, and tree-related landscape planning	\$10,946,707
Community Tree Groups	planting and education	\$2,542,110
Other Buyers in California	contractual maintenance, planting, and tree-related landscape planning	\$110,279,446
Expenditures Not Elsewhere Counted	repair of sidewalks, sewers, and storm drains, disposal of tree waste, unclogging storm inlets, and tree-related legal fees and liability claims	\$139,813,644
Buyers in Other States	contractual maintenance, planting, and tree-related landscape planning	168,366,485
All Buyers	Grand Total	\$1,247,704,935

and David Bradley, all of whom work in Vegetation Management at Pacific Gas and Electric (PG&E) provided information on this utility's expenditures related to urban forests. Bob, in particular, took time to explain PG&E's line clearance program and also provided me with names and phone numbers of staff persons in the other major utilities. Phil Gresham encouraged us at an early stage of our research to create a written survey of our questions for utilities and provided information about urban forest-related expenditures of Southern California Edison (SCE). Jodean Giese provided us with information about various tree-related expenses of Los Angeles's Department of Water and Power and commented on a draft of this report. Richard Sequest promptly gave us information about Sacramento Municipal Utility District's (SMUD's) tree planting program. Doug Lopez and his administrative assistant explained their tree-related operations and provided us with information about SMUD's expenditure for line clearance.

We are grateful to staff people of fourteen different community tree groups for responding to our survey. Our survey of these groups was conducted in cooperation with Genni Cross, Director of California ReLeaf. In addition to making arrangements to have the survey included in a mailing of the members of California ReLeaf's network, Genni also helped us design the version of our survey for these groups, explained the process by which Proposition 111 grants are made and administered, provided information about the income and expenses of California ReLeaf, and commented on a draft of this report.

Two staff people in our department deserve special mention. Vijay Pradhan ran the IMPLAN software that generates various tables of information about the sales of landscape, lawn and garden, and ornamental shrub and tree care companies in the state and about the expenditures of households, businesses, and government institutions for the services of these companies. He

responded cheerfully and quickly to our frequent requests for this information and spent extra time creating paper copies of portions of these tables. Noreen Wong helped us to send written communications and parts of surveys over facsimile, to acquire a software package to read the databases from the survey of city and county governments, and to design the cover and title pages of this report.

Scott Lindall, a staff person at Minnesota IMPLAN Group, Inc., spent time to investigate and clarify household purchases of landscape, horticultural, and arboricultural services in the IMPLAN database.

As should be evidently clear, our research has been a social process in which many people have contributed time and information. We thank all those who helped us produce this report.

ECONOMIC IMPACTS OF URBAN FORESTRY IN CALIFORNIA

Introduction

The California Department of Forestry and Fire Protection (CDF) contracted with the Department of Agricultural and Resource Economics at the University of California, Berkeley to estimate the economic contribution of urban forestry in the state. Thus, the purpose of this research project is to estimate the value of transactions between buyers and sellers of urban forestry-related products and services in the state and the multiplier effects of these transactions on sales, employment, and personal income in the state's economy in a given year. For the purpose of this research, 'urban forestry' refers to the growing, planting, managing, or care of trees, usually in towns and incorporated cities, primarily for human needs and activities. Urban forestry also includes activities that are undertaken as a direct consequence of these trees, such as repairs of infrastructure damaged by tree roots. 'Urban forestry' does not refer to tree-related range management or to the production, distribution, or consumption of timber, other industrial forest products, Christmas decorations, or commercial fruit and nut products.

Each monetary transaction involves a buyer and a seller. Major sellers of products and services related to urban forests include tree nurseries and landscape, horticultural, and arboricultural service companies. Although not typically considered sellers, government institutions, electric utilities, and community tree groups 'sell' urban tree-related services when they perform these services and receive money--tax revenues, sales revenues, grants, and donations--for this work rather than hire private contractors. Many city, county, and state government institutions care for street, highway, or landscape trees, repair sidewalks and sewers

that are damaged by tree roots, unclog storm inlet drains that are blocked with tree leaves, remove and replace old trees, plant new trees, and take part in other activities related to urban forests. Electric utilities have relatively small groups of employees that coordinate line clearance and shade tree programs. Some electric utilities perform their own line clearance and trim trees around company property. Community tree groups receive money from various sources to organize tree planting efforts in their community and to educate people about urban forestry.

Government entities, utilities, and community tree groups are also buyers to the extent that they hire contractors to perform tree-related services. The largest group of buyers of products and services related to urban forests is households. They purchase seedlings, fertilizer, spades, water, and pruning equipment to plant and care for trees around their houses. Households also hire private contractors to plant and care for trees, repair sidewalks that are damaged by trees, collect and dispose of tree waste, unclog water and sewer lines that run from homes to main lines, and litigate tree related matters. Electric utilities usually pay contractors to trim trees to clear power lines, incur expenses and revenue losses related to tree-induced power outages, and sponsor tree planting programs in selected cities. Schools, businesses, and organizations also usually pay landscape contractors to plant trees and arborists to care for them.

We focus on the 'buying side' and estimate the expenditure by major buyers of urban trees and tree-related products and services in 1992. However, with the possible exception of household purchases of tree plants or tree-care equipment from businesses located outside the state, the major buyers purchase urban-forestry-related products and services from sellers located within the state. Thus, our focus on the buying side enables us, ironically perhaps, to estimate the sales of major sellers who are located within the state.

Expenditures on Urban Forestry by Major Buyers

Households

Households purchase trees to plant and buy fertilizer, pesticides, spades, water, and pruning equipment to care for trees around their houses. In the Pacific region of the U.S. households that made purchases spent \$117.50 on do-it-yourself tree care and \$27.70 for do-it-yourself planting and care of fruit trees per household in 1992 (NGA, 1993, pgs. 185 and 195).¹ In the same region and year households that made purchases also spent \$187.40 for do-it-yourself landscaping and \$36.50 on do-it-yourself insect control per household (NGA, 1993, pgs. 175 and 190). A majority of households made no such purchases, however. As a result, the mean 1992 expenditure per household in the Pacific region for landscaping, insect control, tree care, and fruit trees was \$49.49, \$13.44, \$24.40, and \$5.17, respectively.

Landscaping expenditures include purchases of trees. Insect controls are used for not only trees but also shrubs, lawns, and all other plants in the household's landscape. The research director of the National Gardening Association suggests that 35% of the expenditures for do-it-yourself landscaping and 10% of those for do-it-yourself insect control are attributable to trees (Butterfield, 1994). Thus, the average household expenditure for the tree-related portion of landscaping and insect control for trees in 1992 was \$17.32 and \$1.34, respectively.

These average tree-related expenditures of Pacific region households are the best available estimates of average expenditures of California households. There were 10,381,206 households in California in 1990 (California Statistical Abstract 1992, pg. 125).² Based on this census

¹ The Pacific region consists of California, Oregon, and Washington (Butterfield, 1994).

² A household is a group of persons who occupy a housing unit.

number, there were a projected 10,667,451 households in 1992 in the state (California Statistical Abstract 1992, pg. 127). Thus, the estimated expenditure by households in California on tree planting, insect controls for trees, tree care, and planting and care of fruit trees in 1992 was \$514,466,796. (See Table 2.)

This expenditure does not include, however, homeowner expenditures for certain professional, tree-related services of companies that are engaged primarily in the sale of landscape, horticultural, and arboricultural services. These companies are classified into Standard Industrial Classification (SIC) Industry Group No. 078.³ SIC 078 is composed of three industries: SIC 0781, 0782, and 0783. SIC 0781 refers to business establishments that are primarily engaged in landscape planning and in performing landscape architectural and counseling services. SIC 0782 consists of companies that are primarily engaged in performing a variety of lawn and garden services. SIC 0783 denotes businesses that are primarily engaged in performing a variety of ornamental shrub and tree services. California homeowners paid \$352,229,700 in 1991 to companies that belonged to SIC 078 and that submitted employment and payroll reports to appropriate government agencies (IMPLAN, 1991).⁴ Part of this \$352,229,700 represents contractual payments for these tree-related services: planning and designing landscapes with trees, tree planting, trimming, pruning, spraying, removal, surgery, and other arborist services.

³ The Standard Industrial Classification is the Office of Management and Budget's standard that underlies all establishment-based Federal economic statistics classified by industry (SIC Manual, 1987, pg. 3). SIC 078 is sector 27 in the IMPLAN database.

⁴ This figure is found in the interindustry transaction table of the IMPLAN database for 1991 as purchases by 'owner-occupied dwellings' (sector 461) of services from sector 27 (i.e. SIC 078). Household purchases from sector 27 should be \$0, not \$99 million, in IMPLAN's 1991 regional consumption demand table (Scott Lindall, 1994).

To estimate these contractual payments for tree-related services the following procedures were followed. First, multiply \$352,229,700 by 70%, which is an estimate of the percentage decrease in sales from 1991 to 1992 due to economic recession and the sixth year of drought in the state.⁵ The result is an estimate of purchases by homeowners in 1992 from landscape, horticultural, and arboricultural companies. Second, allocate this estimate into separate estimates of homeowner purchases from landscape (SIC 0781), horticultural (0782), and arboricultural (0783) companies. To do so, multiply the estimate of homeowner purchases in 1992 from companies that belong to SIC 078 by each sub-industry's share of total 078 payroll expenses.⁶ Third, multiply the estimates of homeowner purchases in 1992 from landscape (SIC 0781), horticultural (0782), and arboricultural (0783) companies by estimates of the fractions of purchases that are attributable to trees.⁷ We estimate that California homeowners spent

⁵ The expenditure of households in the Pacific region for do-it-yourself lawn care, landscaping, insect control, shrub care, tree care, and fruit tree planting and maintenance decreased from \$2.87903 billion in 1991 to \$2.01905 billion in 1992 (Butterfield, 1994). The ratio \$2.01905 billion/\$2.87903 billion equals 70%.

⁶ We assume that the ratio of sales to payroll expenses is the same for these three industries in 078. Under this assumption, each industry's share of payroll expenses equals each industry's share of sales. The payroll expenses of landscape planners and architects account for about 13% of all payroll expenses of business establishments that sell landscape and horticultural services. The payroll expenses of companies that sell lawn and garden services account for about 77% of payroll expenses in industry group 078. The remaining 10% are payroll expenses of ornamental shrub and tree service companies.

⁷ Based on discussions with managers of a few landscape and tree service companies, we assume that 10% of the sales of landscape planners, architects, and counselors and 10% of the sales of companies that primarily provide lawn and garden services are attributable to trees in customer landscapes. Based on these same discussions, we also assume that 90% of sales to households by companies that are primarily engaged in selling ornamental shrub and tree services is attributable to tree care. That is, we assume that 90% of a household's contractual costs for care of shrubs and trees is for trees.

\$3,138,937, \$19,066,861 and \$22,463,126 for tree-related contractual work of landscape planners and architects, of lawn and garden service companies, and of ornamental shrub and tree service companies, respectively, in 1992. Finally, add the three estimates together to get an estimate of total tree-related purchases by homeowners in 1992 from landscape, lawn- and garden-service, and shrub- and tree-care businesses. (See Table 3.)

In short, California households spent an estimated \$514,466,796 for do-it-yourself activities related to trees and \$44,668,923 for contractual work attributable to trees in residential landscapes in 1992. Thus, the total household expenditure in the state in 1992 for tree planting and tree care was \$559,135,720. (See Table 2 and Table 3.)

City and County Government

Cities and counties were recently surveyed about their urban forestry programs (Swiecki and Bernhardt, 1993, pgs. 20-21). Respondents from 220 agencies or departments of 215 city governments reported tree budgets for either calendar year 1992 or fiscal year 1991-1992 that totaled \$77,184,945. Respondents from 18 county government reported tree budgets for the same time periods that totaled \$2,892,327. Thus, the total amount for urban forestry budgets of survey respondents for the period was \$80,077,272.

This figure understates expenditures on tree programs by local government for two reasons. First, 121 out of a total of 468 incorporated cities and 12 out of a total of 57 counties in the state did not respond at all to the survey.⁸ Second, agencies or departments of 74 cities and 9 counties did not report their tree budgets even though evidence from their answers to other

⁸Two other cities did not respond to the Swiecki-Bernhardt survey but did provide us the information.

survey questions or from secondary sources indicated that they engaged in urban forestry activities.⁹ Local governments in this group had tree programs, employed people for these programs, were responsible for some positive number of trees, or had at least one certified arborist with the government's mailing address.

The following assumptions were used to estimate the expenditures of local government agencies or departments that did not provide information on their tree budgets or did not respond at all. First, budgets are assumed to equal expenditures. Second, city and county expenditures are assumed to be proportional to expenditures per capita or to expenditures per tree. Third, city expenditures per capita and the probability that a city spent money on urban forestry are assumed to vary across these seven population groups: 1) greater than 250,000, 2) 100,001 to 250,000, 3) 50,001 to 100,000, 4) 25,001 to 50,000, 5) 10,001 to 25,000, 6) 5,001 to 10,000, and 7) 5,000 or less. County expenditures per capita and the probability that a county spent money on urban forestry are assumed to vary across these two population groups: 1) greater than 250,000 and 2) 250,000 or less. Fourth, the probability of positive expenditure is, by assumption, one for cities or counties for which evidence indicates their involvement in urban forestry activities even though they did not provide budgetary information in their survey response. Fifth, the probability that a non-responding city or county in a particular population group made expenditures equals, by assumption, the number of cities or counties in the population group that reported positive expenditures or for which evidence indicates positive expenditure divided by the sum of all cities or counties in the population group that definitely did and did not spend money.

⁹ There are 58, not 57, counties in the state. However, San Francisco operates as both a city and county. As a result, its county expenditures are not comparable to those of other counties. In these calculations San Francisco is treated only as a city.

In general, the estimated expenditure of the government of a city or county for urban forestry equals the probability of expenditure for the city's or county's population group times the expenditure per capita in that group times the population of that city or county. This estimation procedure was not appropriate, however, for one county and four cities that had one or more departments that reported tree budgets but had one department or agency that responded but did not report tree budgets. In these cases, the estimated expenditure of a responding but not reporting department or agency equals the probability of expenditure for the city's or county's population group times the average expenditure per tree for the same population group times the number of trees under the management of the agency or department that did not provide the information. As a result of both procedures, the estimated expenditures for those cities and counties that did not provide budget information are \$31,745,377 and \$4,215,776, respectively.

In the Swiecki and Bernhardt data set, one county reported a tree budget of \$172,195, which was 31 times larger than the average budget per capita and 17 times larger than the budget per capita in counties of similar population size. Because of this figure's unreliability, we reduce \$2,892,327 by \$172,195, estimate this particular county's expenditure as the product of the county's population times the expenditure per capita for that population group, and include the estimate with those for other counties. In the same data set, two respondents did not provide the name of their cities even though they reported \$197,000 of tree budgets. Since this figure corresponds to two unknown cities, we subtract it from \$77,184,945. However, we add \$1,328,766 to the result because two other cities, which did not respond to the Swiecki-Bernhardt survey, reported to us expenditures of this amount on urban forest-related activities. As a result of these adjustments for data reliability, the reported expenditures of cities and counties are

\$78,316,712 and \$2,720,132, respectively. If these reported budgetary amounts are added to estimated expenditures, cities and counties in the state spent, in total, \$110,062,088 and \$6,935,908, respectively, for tree care and planting in 1992. (See Table 2 for city government expenditure.)

County governments also spend money for research and educational programs conducted by U.C. Cooperative Extension. A small part of the work of U.C. Cooperative Extension is related to urban forestry. In FY93, Cooperative Extension had one-half of a full time equivalent employee (FTE) who worked on urban forestry. In FY93, Cooperative Extension's budgetary cost per FTE was \$164,629. County governments contribute about 20% of Cooperative Extension's overall budget. Thus, county governments spent about \$16,463, 20% of \$82,315, to 'purchase' urban tree-related research and educational services that Cooperative Extension provided to the community. If this small expenditure for education is added to the large figure for tree maintenance and planting, county governments spent a total of \$6,952,371 on urban forestry activities. (See Table 2.)

State Government

The state government spends money on urban forestry because various departments, commissions, and institutions either manage state-owned landscapes or provide grants for urban forestry tree planting, research, and education. The California Dept. of Transportation, known as CALTRANS, managed about 21,000 acres of landscape in 1987 (Pittenger, Gibeault, and Cockerham, 1991, pg. 16). CALTRANS's landscape management includes a number of tree-related activities: pruning, trimming, removing, replacing, fertilizing, and mulching existing trees, controlling tree pests, cleaning up fallen trees and tree vegetation, planting new trees, and

creating landscape designs that include trees. The Division of Maintenance and the Office of Landscape Architecture reported expenditures on landscape maintenance, landscape engineering design, and tree planting. Tree planting expenditures in 92-93 accounted for 14% of total expenditure for highway planting projects. We assume that expenditures on landscape design that are attributable to trees are also 14% of the total expenditure on landscape design. A staff person in the Division of Maintenance provided estimates of fractions of expenditures on landscape maintenance that were attributable to tree maintenance. In total, CALTRANS spent an estimated \$9,405,024 for tree-related activities in 92-93.

The Resources Agency and the California Transportation Commission (CTC) provide grants from Proposition 111 bonds to various state agencies, local governments, and non-governmental organizations to mitigate environmental damage caused by transportation projects. CTC approves three kinds of grants: highway landscape and urban forestry, roadside recreation, and resource lands. Based on discussions with a Resource Agency staff person familiar with the grant program and the specific projects that were funded in 91-92, we assume that tree related activities, primarily planting and maintenance, account for 90-100% of the amount of each highway landscape and urban forestry grant, 20-25% of the amount of each roadside recreation grant, and 15% of the amount of each resource lands grant that were not for land acquisitions. Given these assumptions and the amounts of all grants in 91-92, the state government spent an estimated \$4,159,022 of Proposition 111 funds for urban forests in California.¹⁰

¹⁰ There were 36 recipients of these grants in 91-92. Of this total, 14 recipients were city governments, 5 were county governments, and the remainder were CALTRANS, Parks and Recreation Departments, Dept. of Fish and Game, and non-governmental organizations.

We assume that the city and county government recipients did not include their Proposition 111 grants in reporting their tree budgets. Three of the fourteen cities and three of

The California Dept. of Forestry and Fire Protection (CDF) also spends money for tree planting, education, research, and other urban forestry programs. Proposition 70 is the largest source of money that CDF spends. General revenues account for the remainder. In FY 92-93 CDF spent \$826,608 on urban forestry. Of this total, \$683,000 was spent on contracts, most of which went to city governments to enhance their management of city forests.¹¹

The state government, through the University of California, also spends money for research and education related to urban forestry. For example, the University of California paid about \$49,389 for urban forestry-related research and educational services that Cooperative

the counties received resource lands or roadside recreation grants. Since these three grants were not highway landscape and urban forestry (HLUF), the respective city and county governments would not likely count them as part of the tree budgets, even though some of the grants were spent on tree planting or tree maintenance. Moreover, although 11 of the 14 cities and 2 of the 5 counties received highway landscape and urban forestry (HLUF) grants, available information indicates that these cities and counties did not treat the grants as part of their tree budgets. To wit, eight of the 11 cities that received HLUF grants also reported their tree budgets and indicated the sources thereof. Five of these eight grant recipients indicated that none of the tree funds came from grants. Two of the remaining three city recipients indicated that grants accounted for 1% of their tree budgets. But their Proposition 111 grants represented 7% and 19% of their respective tree budgets. If the grants had been counted as part of the tree budget, grants would have accounted for shares larger than those reported. The eighth recipient reported that grants accounted for 10% of its tree budget and the Proposition 111 grant represented 4% of the same budget. But, in this case, the name of this recipient's project, 'Reforestation Arroyo Seco', suggests that the project is extraordinary and, thus, not likely to be part of the tree budget.

¹¹ In response to the Swiecki-Bernhardt survey, city and county governments reported the sources of their tree budgets. Grants serve as minor sources of funds. Grants provide only about 15%, on average, of the funds for cities and counties that use them (Swiecki and Bernhardt, 1993, pg. 23). Few cities or counties use grants. For example, only twenty-two cities and one county received Proposition 70 grants in 92-93 (Mayer, 1994). Moreover, the survey question did not ask cities and counties to distinguish between Proposition 70 and other grants. Finally, we believe that most of the cities that received Proposition 70 grants did not consider them as part of their tree budgets. Union City, for example, received \$40,000 in Proposition 70 money in 91-92 but did not report the amount as part of its budget of \$212,000 in that fiscal year. For these reasons, we assumed that cities that received Proposition 70 grants did not report them as part of their tree budgets in response to the Swiecki-Bernhardt survey.

Extension provided in FY93. This was about 60% of \$82,315, the total budgetary income of Cooperative Extension for urban forestry. The University of California also pays U.C. Experiment Stations to conduct research on urban forests and primarily bio-physical aspects thereof. U.C. Experiment Stations had about \$255,000 to conduct this research in FY93. We assume that the state government, through the University of California, contributed 50% of this total amount.¹²

All together, these departments and agencies of the state government spent a total of \$14,567,543 on tree maintenance tree planting, education, and research. (See Table 2.) However, these expenditures do not include those made by state government enterprises.

State and Local Government Enterprises

Local government passenger transit (sector 510) and other state and local government enterprises (512) are two of the three sectors in the IMPLAN database that refer to state and local government enterprises.¹³ As a rule, state and local government enterprises produce a good or service that has a private sector counter-part. In practice, 'other state and local government enterprises' includes airports, liquor stores, housing and community development agencies, and utilities that provide sanitation, sewage treatment, water, and gas. These state and local

¹² The Forest Service of the United States Department of Agriculture (USDA) is the other major contributor to the expendable income of the Experiment Stations.

¹³ To avoid double counting, we ignore the third state and local government enterprise, state and local electric utilities (sector 511), because we already have independent, and more reliable, data on electric utilities. For the same purpose, we also ignore the expenditures by non-educational departments, agencies, commissions, and districts of state and local government for services of landscape, horticultural, and arboricultural companies (SIC 078) because most of the tree-related expenditures of government entities that take care of parks, recreation facilities, highways, streets, and natural resources are, in principle, tree expenditures for which we have independent, and more reliable information.

government enterprises spent \$43,061,200 on contractual services of landscape, horticultural, and arboricultural companies (SIC 078) in 1991 (IMPLAN, 1991).¹⁴ We estimate the expenditures of state and local government enterprises in 1992 for tree-related contractual services with the same procedures that we use to estimate tree-related purchases by homeowners.¹⁵ Based on those procedures our estimate is \$4,240,387. (See Tables 2 and 3.)

Federal Government

The United States Department of Agriculture (USDA) is the other major contributor to the expendable income of U.C.'s Experiment Stations. We assume that the USDA pays for the other half of U.C. Experiment Station's total urban forestry-related income of \$255,000. The USDA also paid about 20%, or \$16,463, of Cooperative Extension's income in 92-93 that was attributable to urban forestry. But the largest expenditure that the USDA makes on urban forestry in California is for the National Urban Forestry (NUF) program. The Forest Service of the U.S. Department of Agriculture (USDA) provided \$253,400 in grants administered by California ReLeaf to various community tree groups primarily to promote volunteer participation in these groups. The Forest Service also provided \$391,908 in NUF funds to the California Department of Forestry (CDF). In turn, CDF used \$304,000 of these funds to contract with California ReLeaf for a state-wide program and with other urban forestry organizations for research projects.

¹⁴ These purchases are found in IMPLAN's interindustry transaction table.

¹⁵ As in the case of homeowners, we assume that 10% of purchases by state and local government enterprises from landscape planners, architects, and counselors and 10% of their purchases from companies that primarily provide lawn and garden services are attributable to trees in landscapes. However, we assume that only 50% of purchases by state and local government enterprises from companies that are primarily engaged in selling ornamental shrub and tree services is attributable to tree care.

In total, we estimate that the Forest Service and other parts of the USDA spent \$789,271 on urban forestry in California in 92-93.

Similar to households, federal government institutions in California also purchase tree-related services from landscape (SIC 0781), horticultural (0782), and arboricultural (0783) companies primarily for the purpose of caring for trees on federal government landscapes. To estimate tree-related expenditures of the federal government, we consider four different federal sectors in the IMPLAN database: 1) U.S. Postal Service, Sector 513, 2) other federal government enterprises, Sector 515, 3) Department of Defense, and 4) all non-military institutions of the federal government in the state.¹⁶ These sectors purchased products and services worth \$15,588,800 from 078 companies.¹⁷ The federal government's purchases of tree-related contractual services were estimated with the same procedures as those used for homeowners and for state and local government enterprises.¹⁸ Our estimate of those purchases in 1992 is \$1,532,127. (See Table 3.)

In short, the total expenditures that the federal government made for California urban forests and related activities in 1992 is \$2,321,397. (See Table 2.)

¹⁶ Other federal government enterprises include national airports, military PXs, Federal Home Loan Bank, Pension Guarantee Fund, and the Overseas Investment Company.

¹⁷ The purchases of the Postal Service and other federal government enterprises are found in IMPLAN's interindustry transaction table. The purchases of non-enterprise departments, agencies, and institutions of the federal government are found in IMPLAN's final demand table.

¹⁸ Recall that we assumed 90% of purchases by households from companies that are primarily engaged in selling ornamental shrub and tree services is attributable to tree care. We changed our assumption to 50% for the state and local government enterprises and the federal government for two reasons. First, residential landscapes tend to have more trees per unit area than the landscapes of government institutions. Second, government institutions are more likely to provide their own tree maintenance whereas households are more likely to hire an arborist.

All Government

Various agencies, departments, commissions, and other institutions of government at the local, state, and federal level make expenditures on urban forestry in California. The spending decreases as the government's authority becomes more removed or the jurisdiction more encompassing. That is, local government spends more on urban forestry than state government, which spends more than the federal government. Total government spending on urban forests and related activities in California in 1992 was an estimated \$138,143,786. (See Table 2.)

Electric Utilities

Privately-owned and consumer-owned electric utilities spend more money on tree-related activities than any other business spends. Their most important urban-forestry expenditure, in terms of amount, is for clearance of utility lines. Line clearance is a special kind of tree trimming and tree removal. Electric utilities also spend money to restore power after outages caused by fallen or damaged trees and lose revenue by not selling electricity during the outage. Some electric utilities pay for tree planting, which is usually part of a shade tree program but also may be part of tree replacement or beautification of company property. Tree trimming around company property is another beautification activity for which utilities incur costs. Legal fees and liability claims related to tree fires account for a small share of all tree-related expenditures of electric utilities. But tree-related research is the smallest expenditure category.

The five largest electric utilities in the state are Pacific Gas and Electric (PG&E), Southern California Edison (SCE), Los Angeles Department of Water and Power (LADWP), San Diego Gas and Electric (SDG&E), and Sacramento Municipal Utility District (SMUD). We surveyed these utilities about their expenditures on trees and tree-related services in 1992. They

reported expenditures of \$96,470,385 in 1992: \$77,090,385 for line clearance and \$19,380,000 for restoration of power and lost revenue due to tree-related outages, tree trimming, tree planting, tree-related legal expenses, and urban forestry research.¹⁹

Although all five utilities spent money on line clearance, not every one of these five spent money on each of the non-line-clearance activities. Moreover, not every utility was able to provide information for some of these activities. Only one utility was able to provide information about the costs of tree-induced power outages and tree-related legal expenses. The estimated expenses of three of the other four utilities for these two items equals, by assumption, the miles of transmission lines or the number of electric customers of each utility multiplied, respectively, by the costs per transmission line mile or per customer of the one utility that provided the information.²⁰ Based on this method, our estimate of tree-related legal expenses and costs of tree-induced power outages for three of the other four utilities in 1992 is \$12,858,010. Considering both reported and estimated costs, the five largest utilities had expenses of \$109,328,395 for line clearance and other tree-related activities.

In addition to LADWP and SMUD, there are twenty nine other consumer-owned, or

¹⁹ The costs of tree-induced outages equal the costs of restoring power and the revenue losses during the outages. Revenue losses are about 3% of the total costs of tree-induced outages. Unlike other costs of urban forests, revenue losses are a cost that are not associated with utility expenditure. That is, a utility only spends money to restore power; the revenue loss does not represent spending by the utility. As such one can argue that these revenue losses should not count as expenditures. However, one can also argue that utility customers increase their spending on other items by precisely the amount that they did not spend on electricity during outages. We count the revenue losses as expenditure in the sense of this latter argument.

²⁰ SDG&E reported an estimate of their line clearance expenditures but did not return their answers to our survey. Since we have no information on the number of SDG&E's electric customers or the miles of SDG&E transmission lines, we were not able to even estimate their tree-related legal expenses or their costs of tree-related power outages.

municipal, electric utilities and four rural electric companies (California Almanac, 1991, pg. 369). These other utilities had about 899,756 customers throughout the state (California Almanac, 1991, pg. 369). The average reported and estimated tree-related expenses per customer of PG&E, SCE, LADWP, and SMUD in 1992 was \$10.17. The tree-related expenses of the other municipal and rural electric utilities is estimated by multiplying the expenses per customer of the big four by the number of customers of the other thirty three utilities. The result is \$9,148,643.²¹ In total, utilities incurred costs of \$118,477,038 in 1992 for tree-related activities. (See Table 2.)

Public and Private Schools

Educational institutions of local and state governments and private schools spend money on tree care, tree planting, and other tree-related services. While some schools hire themselves to perform these services, we believe that many schools hire others, particularly landscape, horticultural, or arboricultural companies. Our belief notwithstanding, the only available source of relevant information is contained in the IMPLAN database. In 1991, public and private schools purchased \$30,156,700 and \$64,058,300, respectively, from private landscape, lawn- and garden-service, and shrub- and tree-care companies (IMPLAN, 1991).²² To estimate how much of these expenditures are attributable to urban forests we use the same procedures as we use for

²¹ The California Municipal Utility Association reports that San Francisco and Inglewood also have municipal utilities that sell electricity, in addition to the thirty one listed in the California Almanac. We were not able to survey these additional two utilities or get information about the number of their electric customers. Thus our estimate does not include estimates for their tree-related expenses.

²² Public school purchases are found in the final demand table under 'State and Local Government Purchases, Education. Private schools are IMPLAN sectors 495, 496, and 497 and their purchases from sector 27 (SIC 078) are found in the interindustry transactions table.

homeowners, state and local government enterprises, and the federal government.²³ Based on these procedures, our estimate of the tree-related expenditures of schools in 1992 is \$10,946,707. (See Tables 2 and 3.)

Community Tree Groups

Community tree groups exist throughout California and spend primarily for planting trees and conducting educational programs on the importance of trees and their care. Non-profit and local volunteer tree groups are both sellers and buyers of tree-related services. They are sellers in the sense that individuals, utilities, Geo-Chevrolet and other corporations, government entities, non-profit foundations, and local businesses and organizations donate money or pay them, i.e. enter into implicit or explicit contracts with them, for their tree-related services. Community tree groups are buyers in the sense that they spend their income to plant trees, conduct educational programs, and perform other services for urban forests in the state.

In keeping with our focus on the buying side, we examined the annual expenditures that community tree groups made in 1992 or 1993. In cooperation with California ReLeaf, we sent a survey to over forty community tree groups. Fourteen responded and reported income and expenditures. Lack of time and money prevented us from following up with the non-respondents. However, the fourteen respondents include the five largest community tree groups in the state-- Tree People in Los Angeles, the Sacramento Tree Foundation, Friends of the Urban Forest in San

²³ We assume that 10% of purchases by public schools from landscape planners, architects, and counselors and 10% of the purchases by public schools from companies that primarily provide lawn and garden services are attributable to trees in surrounding landscapes. We also assume that 75% of purchases by public schools from companies that are primarily engaged in selling ornamental shrub and tree services is attributable to tree care.

Francisco, Tree Fresno, and California Oak Foundation in Oakland--and most of the groups with any substantial budgets. Three of the fourteen reported income and expenditures for periods of time other than a year: six months, twenty one months, or two years. We calculated the income and expenditure per month of these three and multiplied by twelve to get annual figures. The total annual expenditure of these fourteen groups in 1992, 1993, or 92-93 was \$4,401,831. However, \$1,859,721 of the money spent came from National Urban Forestry (NUF) grants, California Department of Forestry grants, Proposition 70 and 111 grants, and electric utilities. Hence, only \$2,542,110 of the total expenditure of these community tree groups has not been counted elsewhere. (See Table 2.)

Other Buyers in California

Real estate companies, hotels and lodging places, amusement and recreation service companies, nursing and health care facilities, religious organizations, and many other businesses and organizations in California spend money on tree care and other tree-related services.²⁴ We believe that these businesses and organizations in California contract out most of their tree-related work to private companies. Given this belief and lacking any better alternative, we estimate the expenditures of these other buyers in the following manner. From the total sales of IMPLAN sector 27 (i.e. SIC 078) to the economy's 528 sectors we subtract the purchases of owner-occupied dwellings (IMPLAN sector 461), state and local government enterprises (IMPLAN sectors 510 and 512), federal government enterprises (IMPLAN sectors 513 and 515), electric utilities (IMPLAN sectors 443, 511, and 514), and private schools (IMPLAN sectors 495, 496, 497). The result for 1991 is \$1,010,740,400, the expenditures of all other buyers for services of

²⁴ The order of buyers herein is close to the order of expenditures from largest to smallest.

landscape, horticultural, arboricultural companies. Then we use the same procedures that we use to estimate the tree-related expenditures of homeowners, state and local government enterprises, federal government institutions, and schools.²⁵ In this manner we estimate that other California buyers spent \$110,279,446 on tree-related services from landscape, horticultural, and arboricultural companies in 1992. (See Tables 2 and 3.)

Expenditures Not Counted in Breakdowns by Major Buyers in California

A number of important expenditures by households, businesses, and government entities for services related to urban forests in California have not been yet been considered or counted. The uncounted expenditures for which we have limited data are the following: 1) payments for repairs of sidewalks that are damaged due to trees, 2) payments for disposal of tree waste, 3) expenditure for repair of sewers and storm drains that are damaged by trees, 4) expenditure for clearing storm inlet drains that are clogged with tree leaves, 5) city government payments for legal services and liability claims for tree-induced injuries.

Our information about these expenditures comes from only one source: the city arborist in San Jose. Because they are not paid from cities's tree budgets, these repair and disposal costs, legal fees, and liability claims are not included in the Bernhardt-Swiecki data. For lack of time and money we also did not survey households and local governments about these expenditures. Nevertheless, the information from San Jose indicates the importance of these expenditures.

²⁵ As in all other cases, we assume that 10% of purchases by other California buyers from landscape planners, architects, and counselors and from companies that primarily provide lawn and garden services is attributable to trees in surrounding landscapes. However, we assume that 65% of other buyers's purchases from companies that are primarily engaged in selling ornamental shrub and tree services is attributable to tree care.

Citizens of San Jose and their government spent an estimated \$7,091,820 for these tree-related repairs, disposal costs, legal fees, and liability claims.²⁶

We use this information to estimate these expenditures by households, businesses, and local government throughout the state in the following manner. First, we calculate the expenditure per capita in San Jose. The population of this city in 1992 was about 806,200 (California Statistical Abstract 1993, pg. 17). Thus, the expenditure per capita was \$8.80 for that period. Second, we divide this expenditure per capita by two because San Jose has a well-developed urban forest and related management program. We use the result as a conservative estimate of the expenditure per capita in other cities and unincorporated areas of the state. Third, we multiply our estimate of expenditure per capita by 30,175,800, the 1992 population in the state except for San Jose (California Statistical Abstract 1993, pg. 14). The result is \$132,721,824, our estimate of the expenditure of non-San Jose residents, businesses, and local governments. Thus, our estimate of total expenditure in 92-93 for certain tree-related repairs, disposal costs, legal fees, and liability claims is \$139,813,644. (See Table 2.)

U.S. Buyers Outside California

Private companies that sell landscape-related, horticultural, and arboricultural services in California also sell them outside the state. Sales to buyers in states outside of California

²⁶ Citizens and the City of San Jose spent an estimated \$1,224,000 and \$225,000, respectively, on sidewalks repairs in 92-93 and 68% of this expenditure was for repairs of damages that were attributable to trees. Homeowners and the City of San Jose spent \$59,000,000 for collection and disposal of garbage in the same period; 7.35% of garbage is tree waste. The same parties spent \$1,400,000 on repair of sewers and storm drains in 92-93 and 55% of this expense was attributable to trees. Approximately \$700,000 was spent by these parties in the same period to clear storm inlet drains that were clogged with tree leaves. The City of San Jose also spent approximately \$300,000 in tree-related legal fees and liability claims.

contribute to the state's economy. In economic jargon, these sales are called domestic exports. According to the IMPLAN database, the domestic exports of companies that belong to SIC 078 and that filed appropriate reports with the government were \$1,498,162,000. Some of these sales were for tree-related services.

Purchases by U.S. buyers outside California of tree-related services of landscape, horticultural, and arboricultural companies in the state are estimated with the same procedures as those used for homeowners, state and local government enterprises, the federal government, schools, and other buyers in the state. However, since out-of-state domestic buyers can be households, government institutions, and businesses, we take a weighted-average of the tree-related fractions of purchases by in-state households, government, and businesses from companies that are primarily engaged in selling ornamental shrub and tree services (SIC 0783). The weights are the purchases by in-state households, government, and businesses of services of 0783 companies. Our estimate of the tree-related fraction of sales of 0783 companies is 70%. Following this methodology, we estimate that those purchases in 1992 were \$168,366,485. (See Table 2 and Table 3.)

Economic Impacts of Urban Forestry Expenditures

In total, we estimate about \$1.248 billion of expenditures in 1992 for California-related urban forestry products and services. With the possible exception of some household purchases from out-of-state sellers, this amount also represents urban forestry sales of sellers located within the state. This figure less the \$168,366,485 of expenditures by buyers in other states equals \$1,079,338,450 and represents expenditures on urban forests in the state. To put \$1.248 billion

into perspective, the state's commercial forest products industry and agricultural sector had sales of \$12.557 billion and \$18.8578 billion, respectively, in 1992 [(McWilliams and Goldman, 1994, pg. 28), (California Agricultural Statistics Service, 1994)]. Thus, the commercial forest products and agricultural industries were about 10 and 15 times larger than the urban forestry sector.

Although \$1.248 billion in sales is, by itself, a contribution to the California's economy, these transactions also create additional impacts on sales, income of individuals, and employment in the state.²⁷ Urban forestry sales create additional impacts because sellers of products and services related to urban forestry buy inputs from other industries and because households, the primary income recipients in the economy, spend some of their additional income on more goods and services.

Economic impacts are frequently analyzed with multipliers that are calculated from input-output models.²⁸ However, urban forestry is not a sector in the IMPLAN input-output model. Thus, there are no urban forestry multipliers in the IMPLAN model. But there are multipliers for a sector that bears close resemblance to urban forestry, namely the sector that sells landscaping, horticultural, and arboricultural services. Sector 27's sales, employment, and income multipliers, which are calculated from IMPLAN's 1991 database and input-output model, are

²⁷ Strictly speaking, an increase or decrease of \$1.244 billion in urban forestry expenditures creates additional impacts. However, the convention is to discuss impacts of the current level of expenditure. A potential decrease of the level of expenditure to zero is implicit in this convention. We follow this convention here.

²⁸ The key assumptions of the IMPLAN and many other input-output models are that inputs are used in fixed proportions to create products and services and that increases in demand do not induce price increases. For a more detailed and thorough discussion of the assumptions about the production and price formation processes in each sector of input-output models see any number of economic textbooks (e.g. Miller and Blair, 1985).

used to analyze the state-wide economic impacts of these urban forestry expenditures.

Sales

The total sales multiplier for landscape, horticultural, and arboricultural companies is 3.0351.²⁹ This multiplier indicates that a dollar of urban forestry-related sales leads to an additional \$2.04 worth of sales throughout the California economy. In other words, \$1.248 billion of urban forestry-related sales leads, through numerous linkages among industries and between consumers and industries, to \$2,539,204,313 in additional sales. Thus, the total sales impact of urban forestry in the state is \$3,786,909,248.

Income and Employment

The total income multiplier for landscape, horticultural, and arboricultural companies is 1.6759. This multiplier indicates that a dollar increase in urban forestry sales leads to an increase in income of individuals of \$1.68. In other words, buyers and sellers of products and services related to urban forests in California generate an estimated \$2,091,028,701 in income to individuals throughout the state.

The biggest source of income for most people is employment. We lack sufficient data to count the number of jobs that are directly connected with urban forestry. However, the direct and total employment multipliers suggest the orders of magnitude of jobs. According to the IMPLAN database, a million dollars of sales in the landscape, horticultural, and arboricultural sector supports a total of 51 jobs throughout the economy and about 23 of those jobs within the sector itself. Applied to urban forestry, the total and direct employment multipliers suggest that

²⁹ In technical jargon, the total sales multiplier is the sum of the direct, indirect, and induced multipliers.

the \$1.248 billion in sales in 1992 supported a total of 64,024 jobs in California and about 28,339 of them are directly associated with urban forestry.

Conclusion

Limitations of Study

Our estimate of \$1.248 billion of sales of products and services related to urban forestry in California is conservative. We have chosen procedures and estimates that are likely to error on the low side. The IMPLAN data also tend to understate sales. For example, the IMPLAN database indicates that electric utilities purchased \$2,832,900 from landscape, horticultural, and arboricultural companies in 1991. However, our own survey of the five largest utilities indicates that they paid \$62,250,949 for line clearance in 1992 to tree-service companies, companies that belong to sector 27. Finally, some important urban forestry expenditures have not been counted for lack of data. For these reasons, the estimates of \$1.248 billion and the related impacts on total sales, income, and employment should be considered conservative lower bounds.

Future Research Possibilities

For more comprehensive and undoubtedly larger estimates of the economic impacts of urban forestry, researchers in the future should also estimate expenditures on as many as possible of the following important urban forest activities. First, homeowners and other property owners spend money on equipment or contractors to clear or repair lateral sewer lines that have been clogged with leaves or damaged by tree roots.³⁰ Second, property owners also pay plumbers or local water utilities to repair water lines that are damaged by tree roots. Third, government

³⁰ Lateral sewer lines run from houses or buildings to the main sewer lines.

institutions, particularly those at the local level, spend money to repair curbs and gutters that have been damaged by tree roots.

Fourth, individuals and businesses pay legal fees and liability claims for injuries, disabilities, or deaths that are attributable to trees. Fifth, individuals pay medical bills for allergies, in addition to injuries, that are tree related.³¹ Sixth, households and businesses spend money on tree relocation and preservation.³² Seventh, landscape contractors are paid to plant trees and install landscapes with trees.³³ Eighth, government enterprises, schools, 'other buyers in California', and buyers in other states purchase trees from nurseries and growers when they plant trees or install landscapes with trees themselves.³⁴

³¹ The city arborist in San Jose believes that 15 to 20% of all people in the state have tree-related allergies.

³² These services are typically not provided by companies that are primarily engaged in selling arborist (SIC 0783), lawn and garden (SIC 0782), or landscape counseling, planning, and architectural services (SIC 0781). Most tree relocation and preservation is performed either by specialists called tree spaders or tree boxers or by large nurseries. Thus, most sales of tree relocation and preservation are not included in sector 27's sales.

³³ Landscape contractors might be classified into a four-digit industry in Major Group 17, 'Special Trade Contractors'. The Standard Industrial Classification Manual, 1987 does not clearly indicate which of the four-digit industries in Major Group 17 includes landscape contractors. Landscape contractors might also belong to SIC 1629, 'Heavy Construction, Not Elsewhere Classified', or to SIC Major Group 15, 'General Building Contractors and Operative Builders'. As a result of this ambiguity, sales data are not readily available. However, our estimates of the expenditures of government institutions (other than government enterprises), utilities, and community tree groups include purchases, if any, of tree planting and tree-related landscape installation by landscape contractors. Our other estimates do not.

³⁴ Wholesale nurseries and retail nurseries are classified, respectively, into SIC Industry No. 5193 and 5261. SIC 5193 refers to establishments primarily engaged in the wholesale distribution of flowers, nursery stock, and florists' supplies (SIC Manual 1987, pg. 311). We assume that 'nursery stock' includes trees. SIC 5261, 'Lawn and Garden Supply Stores and Retail Nurseries', refers to establishments primarily engaged in selling trees, shrubs, other plants, seeds, bulbs, mulches, soil conditioners, fertilizers, pesticides, garden tools, and other garden supplies to the general public (SIC Manual 1987, pg. 316). Establishments primarily engaged

Finally, certain professional associations spend money on training, certification, research, and lobbying to promote the interests of their members, some or all of whom reside in California and grow nursery trees, design and install landscapes with trees, or provide various arborist services.³⁵ Examples of these associations include the California Association of Nurserymen, the California Landscape Contractors Association, the California and American Association of Landscape Architects, the American Society of Consulting Arborists, the Council of Tree and Landscape Appraisers, and the Western Chapter of the International Society of Arboriculture.

Inclusion of these expenditures with those counted and estimated herein would still not finish the task of estimating and analyzing economic impacts of urban forestry in the state, however. Individuals also spend unpaid time planting, caring for, and dealing with the

in growing trees (except Christmas trees), shrubs, and other plants, seeds, and bulbs are classified in Agriculture, Major Group 01 (SIC Manual 1987, pg. 316). The four-digit industry number that most likely includes tree growers is SIC Industry No. 0181, 'Ornamental Floriculture and Nursery Products'. SIC 0181 refers to establishments primarily engaged in the production of ornamental plants and other nursery products, such as bulbs, florists' greens, flowers, shrubbery, flower and vegetable seeds and plants, and sod.

Information on final and interindustry sales of SIC 0181, 5193, and 5261 is not readily available, however. SIC 0181, 5193, and 5261 are not separate IMPLAN sectors. Payroll data are the only readily available pieces of information. Moreover, only some of the sales of SIC 0181, 5193, and 5261 are sales of growers and nurseries to government enterprises, schools, 'other buyers in California', and buyers in other states for tree plants and tree-related equipment and supplies. Thus, our estimates of the urban forestry expenditures of government enterprises, schools, 'other buyers in California', and buyers in other states do not include their purchases of trees and other tree planting inputs from nurseries or growers. Our estimates of the expenditures of households, government institutions other than government enterprises, utilities, and community tree groups do, however, include their purchases of trees and other tree planting inputs from nurseries and growers.

³⁵ One can also view these organizations as sellers of tree-related services. That is, members pay dues and donate money to purchase educational, certification, lobbying and other services from their respective associations to promote their professional interests. Income from not only member dues or donations but also outside contributions or payments from non-members constitute the sales of these organizations.

consequences of trees in residential landscapes and throughout their communities. For example, the fourteen community tree groups that responded to our survey reported that people volunteered 127,972 hours of their time in 1992-1993 for urban forestry activities. Assuming a full-time employee works 1920 hours per year, these volunteer hours represent the equivalent of 65 full-time jobs.³⁶ If the opportunity cost of time for volunteers is \$5.00 per hour on average, then 127,972 is equivalent to \$639,862.

The \$1,079,338,450 of expenditures by California buyers on urban forests in the state in 1992 exemplify annual costs that residents of the state incur to have and use these natural resources.³⁷ Knowledge of the costs of a natural resource is important for efficient and equitable resource management. However, sound economic management of urban forests also requires knowledge of the benefits of these resources. Urban forests provide a number of benefits some of which are these: 1) aesthetic, 2) recreational, 3) energy conservation through shade, 4) reduction in local particulate and gaseous pollution, 5) carbon sequestration, 6) noise abatement, 7) better control of water runoff and improved water quality, 8) larger wildlife habitat, and 9) tree products, such as firewood, mulch, and compost. Benefit estimation that is independent of cost estimation of community forests is an active area of applied ecological-economic research. Once development and refinement of methodologies to estimate these benefits are complete and the methodologies applied, then policy makers and taxpayers will be in a better position to make collective decisions about the management of urban forests.

³⁶ Our assumption is that a full-time employee works 40 hours per week, 49 weeks per year.

³⁷ If one believes that individuals, businesses, and government institutions only undertake activities with benefits that are at least as great as costs, then one can also interpret the \$1.079 billion as a lower bound estimate of the discounted benefits of urban forests.

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Table 2:
Expenditures on Urban Forestry in California by Major Buyers, 1992

Buyer	Urban Forestry Activities	Expenditure
Households	equipment, supplies, and plant material for do-it-yourself maintenance and planting	514,466,796
Households	contractual maintenance, planting, and tree-related landscape planning	44,668,923
Households	Subtotal	559,135,720
City Government	in-house and contractual maintenance and planting	110,062,088
County Government	in-house and contractual maintenance, planting, research, and education	6,952,371
State Government	in-house and contractual maintenance, planting, research, and education	14,567,543
State and Local Government Enterprises	contractual maintenance, planting, and tree-related landscape planning	4,240,387
Federal Government and its Enterprises	contractual maintenance, planting, research, education, and tree-related landscape planning	2,321,397
All Government	Subtotal	138,143,786
PG&E, SCE, LADWP, SMUD, and SDG&E	line clearance, restoration of power after tree-induced outages, trimming, planting, tree-related legal expenses, and research	109,328,395
Other Electric Utilities	same activities as five largest utilities	9,148,643
All Electric Utilities	Subtotal	118,477,038
Public and Private Schools	contractual maintenance, planting, and tree-related landscape planning	10,946,707
Community Tree Groups	planting and education	2,542,110
Other California Buyers	contractual maintenance, planting, and tree-related landscape planning	110,279,446
Expenditures in California Not Broken Down by Buyer	repair of sidewalks, sewers, and storm drains, disposal of tree waste, unclogging storm inlets, and tree-related legal fees and liability claims	139,813,644
Buyers in Other States	contractual maintenance, planting, and tree-related landscape planning	168,366,485
All Buyers	Grand Total	\$1,247,704,935

Table 3:
IMPLAN Sectoral Purchases¹ of Tree-Related and Other Services from Landscape, Horticultural, and Arboricultural Companies

Purchaser	Purchases in 1991 from SIC 078 (IMPLAN Sector 27)	Estimated Purchases in 1992 from SIC 078	Estimated Purchases in 1992 from SIC 0781 and 0782	Estimated Purchases in 1992 from SIC 0783	Fraction of 0781 and 0782's Sales Related to Trees	Fraction of 0783's Sales Related to Trees	Tree-Related Purchases in 1992 from SIC 0781 and 0782	Tree-Related Purchases in 1992 from SIC 0783	Estimated Tree-Related Purchases in 1992 from SIC 078
Households ²	352229700	247017008	222057979	24959028	0.1	0.90	22205798	22463126	44,668,923
Federal Government ³	10127700	7102508	6384858	717650	0.1	0.50	638486	358825	997,311
Federal Government Enterprises ⁴	5431100	3808776	3423931	384845	0.1	0.50	342393	192423	534,816
State and Local Government Enterprises ⁵	43061200	30198593	27147275	3051318	0.1	0.50	2714727	1525659	4,240,387
Public Schools ⁶	30156700	21148750	19011843	2136906	0.1	0.75	1901184	1602680	3,503,864
Private Schools ⁷	64058300	44923780	40384603	4539177	0.1	0.75	4038460	3404383	7,442,843
Buyers in Other States ⁸	1498162000	1050653861	944493966	106159895	0.1	0.70	94449397	73917088	168,366,485
Other California Buyers ⁹	1010786900	708859994	637235547	71624448	0.1	0.65	63723555	46555891	110,279,446

¹ Nominal dollars; ² Sector 461, Owner-Occupied Dwellings; ³ Final Demand sub-components 'Federal Military' and 'Federal Non-Military'; ⁴ Sector 513, U.S. Postal Service, and Sector 515, Other Federal Government Enterprises; ⁵ Sector 510, Local Passenger Transit, and Sector 512, Other State and Local Government Enterprises; ⁶ Final Demand sub-component 'State and Local Government Purchases, Educational'; ⁷ Sector 495, Elementary and Secondary Schools, Sector 496, Colleges and Universities, and Sector 497, Other Educational Services; ⁸ Final Demand sub-component 'Domestic Exports'; ⁹ Intermediate Demand less Purchases of Sector 443, Private Electric Utilities, and Sectors 461, 495-497, and 510-515.