# TREE MANAGEMENT AIDED BY COMPUTER

**by Franklin J. Chan and Gwen Cartwright**

Street tree management is complex in highly-populated urban areas. In order to effectively analyze and monitor a tree population, test operation effectiveness, and evaluate costs, much data and record-keeping are essential. A computer is effective in organizing and summarizing pertinent information. Information can be compiled and retrieved at any time. The benefits of a computer include:

a) develop integrated pest management;
b) determine tree population composition, density, and distribution;
c) evaluate species adaptation and performance (useful for environmental planning);
d) determine scope and magnitude of specific tree maintenance problems;
e) determine priorities of maintenance;
f) provide accurate and valid data to prepare budgets and to make critical decisions on operations; and
g) determine the monetary value of City-maintained trees.

To manage street trees in a large metropolitan area requires reliable, current, and readily available information. Available tree maintenance resources can be used to best advantage by coordinating data in order to solve tree problems. Rather than arbitrary action based on poor estimates, the computer allows for a more accurate and reliable basis for sound decisions.

The computer provides a perspective of the status of the tree population. It is a means of assessing the condition of the trees and monitoring changes in the population. With readily available information, management can set priorities and determine the feasibility of various practices and control measures. By programming for a history of individual trees, an evaluation of treatments and results is possible. This provides for both a useful management and research tool.

In the computer-aided approach to tree management, there is no substitute for the human role in collecting reliable pertinent data, analyzing the data, and making recommendations. After the data are received some corrective action is implemented. However, in some cases, to do nothing may be the best solution, depending on the individual problem.

The inventory and maintenance update systems used for computer programming are important links to tree maintenance operations. An inventory allows for an accurate assessment of the problems and the need for maintenance work. It also indicates the need for new plantings and replanting. It is especially useful in studying the composition of the tree population and to plant tree species in locations which would better balance the population. The maintenance update system is used to check the effectiveness and efficiency of the operations. Accumulated data over a period of time will produce accurate cost estimates. By evaluating operations and cost, the manager can determine whether changes or adjustments are needed. The maintenance update system is also a means of making the inventory current.

The Electronic Data Processing (EDP) street coding system used by the City of Sacramento is amenable to identify individual trees, develop inventory and maintenance update systems. This coding system is used by the Police, Fire, Engineering, and other Departments to determine any physical location in the streets of Sacramento and to record data in relation to these locations. Essentially, each street segment (length of a block) is defined by adjacent intersections with a coded location number. The aggregate of all the location numbers produces a grid system, which is broken down by EDP districts and sub-districts. Tree locations are recorded in relation to their position in a street segment when entered into the computer file. For field personnel, trees are identified by a street address or in reference to a street address. Each tree has its unique tree identification number for individual attention if needed. The EDP system is well suited for computer mapping. An example of the possibilities is correlating the species of trees with soil types. Available soil

surveys can be overlaid onto the tree survey. This would provide information as to which soil is suited or not suited to a particular species. Other possibilities include studying growth in relation to street lighting or smog concentrations.

**Inventory.** Reducing pertinent data to a minimal amount is advisable. This is particularly true when dealing with a large diverse tree population. Avoid details but don't lose the essential managerial information. For example, it is enough to know a tree is large (46 to 60 foot range) compared to a medium-sized tree (21 to 45 foot range), rather than to precisely measure a tree to determine whether it is 52 feet or 53 feet tall. Rarely is it necessary in maintenance work to have exact measurements. However, sufficient information should be collected to avoid re-surveying. Occasionally a special survey may have to be conducted, but this would not have to be extensive because the basic survey is established. Even by simplifying pertinent data, one will usually end up with a broad data base because of the large number of trees and the possible combinations of data.

The data collected in Sacramento's tree inventory include:

1. an individualized tree location for special retrieval if desired,
2. identification of the tree species (open-end listing for additional species),
3. tree height by five categories (range of height),
4. tree diameter at breast height by nine categories (ranging in 6-inch increments up to 48 inches),
5. general health conditions by four categories,
6. mistletoe infestations by three categories,
7. if roots are damaging sidewalk,
8. if tree needs pruning,
9. space is open for soil-related problems,
10. if irrigation is required.

**Personnel for Survey.** Inventory data are good only if reliable. Because of this, it is important that qualified persons conduct the surveys. Careful training is essential. Technical instructions as well as field experience should be emphasized, particularly in tree identification, tree location designations, and tree health evaluations. Other categories are relatively easy to define.

The experience of conducting a tree inventory of a large tree population is educational, particularly if a person has already had some background

**TABLE 1. INVENTORY ITEM CODES**

**HEIGHT CODES**
Current Tree Size

| | | |
|---|---|---|
| 1′ to 10′ | Young | (Y) |
| 11′ to 20′ | Small | (S) |
| 21′to 45′ | Medium | (M) |
| 46′ to 60′ | Large | (L) |
| Over 60′ | Very Large | (V) |

**DIAMETER SIZE CODES**
At 5 Feet

| | |
|---|---|
| 1″ to 6″ | (1) |
| 7″ to 12″ | (2) |
| 13″ to 18″ | (3) |
| 19″ to 24″ | (4) |
| 25″ to 30″ | (5) |
| 31″ to 36″ | (6) |
| 37″ to 42″ | (7) |
| 43″ to 48″ | (8) |
| Over 48″ | (9) |

**HEALTH CODES**

| | | |
|---|---|---|
| Good | Little or no insect or disease problems. | (G) |
| Fair | Tree conditions can be improved at a reasonable maintenance cost. | (F) |
| Poor | Tree not likely to improve. Costly to maintain. | (P) |
| Remove | Tree beyond correction. Damaging to property or dangerous. | (R) |

**MISTLETOE INFESTATION CODES**

| | | |
|---|---|---|
| Low | 1% to 25% of crown infested. | (L) |
| Moderate | 26% to 50% of crown infested. | (M) |
| High | Over 50% of crown infested or majority of major scaffolds infected at base. | (H) |

**SIDEWALK DAMGE CODES**

| | |
|---|---|
| Less than ½″. | (L) |
| More than ½″. | (M) |

**TRIMMING CODES**

| | |
|---|---|
| Trim required. | (T) |
| No Trim. | ( ) Blank |

**IRRIGATION CODES**

| | |
|---|---|
| Needed. | (N) |
| Not needed. | ( ) Blank |

about trees. He or she is continually exposed to the inter-relationships of the host trees with the natural environment, man-made conditions, and pests and diseases. Promising employees within the Tree Department or college students studying environmental horticulture or pest management are good possibilities for doing surveys and handling maintenance update records.

**Completion of Inventory.** The tree inventory should be completed as quickly as feasible. The obvious advantage is to analyze and get a better perspective of the overall problems and to record work on the maintenance update file. Doing the inventory over a longer period of time is possible and in some cases, desirable in terms of available manpower to survey. If an inventory file is developed over a period of time without omitting records for maintenance update, work sheet records must be kept for future submittal to the computer after the inventory is completed.

**Maintenance Update.** The objective of maintenance update is to monitor operations and keep them efficient. It is used to identify problems, to check if reasonable progress is being made, or if jobs are being completed. No attempt should be made to threaten workers on their performance through this system. The system is intended to improve operations. It is important for employees to understand the value of record-keeping and not to allow mistrust between the employee and the supervisor.

It is reasonable to require an employee to keep records of his daily work. Records are kept daily and turned in weekly. At any time during the week, the foreman or supervisor may request to review a worker's time sheet. The time sheet should be designed to facilitate the employee completing the record in the minimum time and the least amount of writing. Below is an example of a work sheet form. Only pertinent data are entered into the computer. Other information is used by the supervisor or foreman for operation adjustments. The worker needs to fill out his name, crew, tree location(s), date worked, and hours on the job. The operation he performed and the major reason for the work is simply entered as codes. These are listed on the back of the work sheet. In our example, 26 basic operations have been identified, although most employees are involved in only a few of them. Pests and diseases and their controls are filled in by the foreman.

What is expected of an employee in performing any operation should be clear to the employee. This is accomplished by having training sessions and developing "workers manuals." A basic operation is quite constant but within a basic operation, procedures and techniques may readily change. These need to be conveyed to the employee to keep accepted practices current.

Normally five to ten minutes are spent by workers to fill out daily work records. At the end of the week, these records are transcribed to the maintenance update computer sheets. The computer sheets are turned in once a month to Data Processing for a monthly report.

**Application of the Inventory and Maintenance Systems.** An example of the application of the inventory and maintenance update systems is found in managing a mistletoe epidemic. Upon investigating the mistletoe problem in Sacramento, the scope and severity of the problem was determined. The economic and visual impact was quite serious, in some ways being comparable to the Dutch elm disease in other communities. Below is a diagram outlining steps in solving the mistletoe problem and where the computer data were utilized to help provide information for analysis and decision-making.

Other examples of tree problems amenable to computer analysis include tree roots lifting and damaging sidewalks, prevention and control of Dutch elm disease, controlling "honeydew" secretion, and detecting and assessing smog damage to trees.

**Integrated Pest Management (IPM).** The inventory and maintenance update systems are amenable to integrated pest management. A technical coordinator, such as an arborist, horticulturist, forester, or other pest management specialists is capable of utilizing data to best con-

trol pests and diseases. Their role would include:

a. analyze data to identify problems and their severity,
b. recognize or identify specialized pest and disease problems in the field by monitoring the population and by strategic sampling,
c. verify by laboratory testing in cooperation with State and University agencies the identity of special pests and disease, coordinate a control program,
d. determine species adaptation and tolerances,
e. balance population by phasing out problem species and re-planting with more desirable ones,
f. determine allowable percentage categories based on desirability and determine which species in each category,
g. make tree selections and introductions,
h. coordinate findings and make recommendations to the administrative staff,
i. coordinate recommendations with field operations,
j. conduct research on specialized pest and disease problems.

## Summary

A computer is effective and efficient in processing data useful for street tree management. It provides information on adaptation of trees planted in the past, identifies and reveals the scope of present tree problems, and provides information that will minimize problems in the future. It is a nonbiased means of determining priority tree services needed in the community and gives the public a truer picture of problems that confront manage-

CITY OF SACRAMENTO
DEPARTMENT OF RECREATION AND PARKS
TREE SERVICES

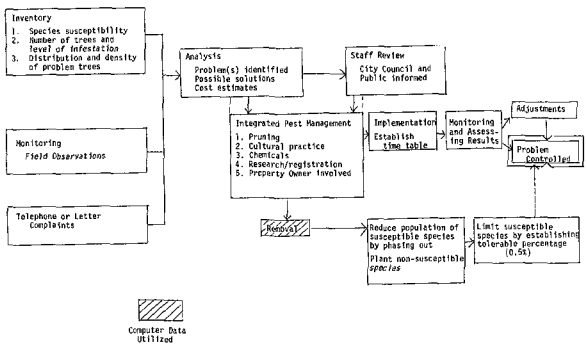
Name John Brown Month May
Area Old Downtown Week 5/1 to 5/5
Crew Members B. Wilson, T. Hall Cost Center 8223
Down Equipment No.

Down Time Code - Hours (see opposite)

| Mon. | Tue. | Wed. | Thur. | Fri. |
|---|---|---|---|---|
| -- | 4.0 | 8.0 | -- | -- |

| Address: Number and Street | No. of Trees | Type | Date Started & Completed | Hours on Job | Emergency Check if Yes | Service Code (see opposite side) | Reason Code (see opposite side) | Pest/Control Code (see manual sheets) | Disease/Control Code (see manual sheets) |
|---|---|---|---|---|---|---|---|---|---|
| 2001-A P St. | 1 | Modesto Ash | 5/1 | 7:15 10:20 | | 01 | HL | | |
| 2001-B P St. | 1 | " | 5/1 | 0:30 1:00 | | 01 | MS | | |
| 1600 Capitol Ave. | 1 | Elm | 5/1 | 1:15 2:45 | X | 03 | HZ | | |
| 2005 P St. | 1 | Modesto Ash | 5/2 | 7:30 10:15 | | 01 | MS | | |
| 2012 P St. | 1 | Boxelder | 5/2 | 0:30 2:00 | | 02 | UD | | |
| 2031-A P St. | 1 | M. Ash | 5/2 | 2:15 3:00 | | 01 | HL | | |
| 2031-A P St. | 1 | M. Ash | 5/3 | 7:30 9:30 | | 01 | MS | | |
| 2031-B P St. | 1 | M. Ash | 5/3 | 9:45 2:15 | | 01 | MS | | |
| 900 L St. | 1 | Zelkova | 5/3 | 2:30 3:00 | X | 06 | SL | | |
| 2111 P St. | 1 | Silver Maple | 5/4 | 7:30 3:00 | | 01 | HL | | |
| 2115 P St. | 1 | M. Ash | 5/5 | 7:20 1:30 | | 02 | MS | | |
| 2360 I St. | 1 | Crape Myrtle | 5/5 | 1:42 3:00 | | 01 | TR | | |

EXAMPLE OF A TREE MANAGEMENT PROBLEM -- MISTLETOE



ment. By using this tool wisely, the City can be assured of making the best use of funds for tree maintenance.

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## ABSTRACTS

Weidensaul, T.C., C. Liben, and C.W. Ellett. 1977. **Decay losses in woodlots.** Ohio State Univ. Coop. Ext. Ser. Bul. 629. 14 p.

The purpose of this bulltin is to provide information primarily for the layman about ways disease organisms damage trees and how losses can be minimized. This can be done most easily by incorporating good management practices in routine care of forest and woodlot trees. Following are some general observations about decay diseases: 1) since decay fungi enter trees primarily through wounds, control practices are aimed primarily at minimizing the frequency and sizes of wounds, 2) wounds near the soil line are particularly hazardous, 3) heartwood is usually more susceptible to invasion by decay fungi than sapwood; thus, deep wounds into the heartwood constitute a greater disease risk than shallow wounds confined to the sapwood, and 4) decay disease risks usually increase as trees age. This is because a) the proportion of susceptible heartwood increases as trees age, b) total numbers of wounds increase as trees age, and c) as trees age, wounds heal over more slowly.

Whitcomb, C.E. 1978. **Propagating woody plants from cuttings.** Oklahoma State Univ. Agric. Exp. Sta. Bul. 733. 20 p.

Propagation from cuttings is the major means of propagating most landscape shrubs at the present time. More landscape plants will be propagated from cuttings in the future as more cultivars with unique features are released. However, the propagation techniques employed by nurseries vary almost as widely as the number of nurseries in existence. This bulletin describes the techniques used in mist propagation. The following procedures are most suitable for rooting of most cuttings: 1) small propagation structure for humidity control, 2) bottom heat and temperature control, 3) light intensity appropriate for the species, 4) a mist cycle suitable for seasonal conditions, 5) water pressure of 45-60 psi, 6) level mist lines and clean mist nozzles, 7) metal or plastic benches for ease of sanitation, 8) a well aerated rooting medium that supported the cutting well and holds a moderate amount of water, 9) small containers for each cutting in flats or trays for ease of handling and adequate space per cutting, 10) thorough incorporation of 8 to 12 lbs of 18-6-12 Osmocote per cu. yd. in to the rooting medium, 11) good quality water, 12) vigorous healthy parent plants and stout well developed shoots for cuttings, 13) dip cutting in talc preparation of rooting hormone, 14) sanitation in all aspects from cleansing of clippers to occasionally washing down the entire propagation house with chlorox, 15) prompt removal of cuttings from mist following rooting, and 16) prompt removal of cuttings from containers and planting following rooting.