Chapter 21

Urban Tree Removals

Donald F. Blair

1. Introduction

PEGSMOR is an acronym for the life of a tree: planting, establishment, growth, structure, maturity, overmaturity, removal. Since this text addresses PEGSMO, it is appropriate to include a chapter on the "R" factor. Tree removals are an essential arboricultural responsibility.

In 1993, The National Arborist Association and the US Forest Service conducted a survey to determine the number of trees administered to by arborists in the United States and what those treatments were. The survey concluded that 25,575,000 were pruned, fertilized, cabled, treated for insects and disease, removed, and/or planted. Of these, 1,663,235 trees were removed. Ninety percent of the work surveyed was done by commercial tree care firms, the balance by municipal agencies.

The two most expensive events in the life of an urban tree are its planting and its removal. In a talk given in 1992, the Director of Forestry for the City of Savannah, Dr Don Gardner, stated that his average tree maintenance costs worked out to:

1. First year: purchase, planting, and maintenance: $250.00
2. Annual average cost of pruning: $10.00
3. Removal: $350.00

Obviously, the more years of productive health a tree can enjoy between numbers 1 and 3 (or P and R), the more cost-effective that tree is going to be to the landscape.

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1.1. Reasons for Removal

Urban trees will have to be removed for a variety of reasons. Among them are the following:

1. Overmaturity. This could mean that the trees are either in decline as a result of their age or are too large for their planting area. Many communities have planted thousands of flowering trees such as plum, cherry, or pear, only to have them decline within three decades.
2. Hazardous structure. Trees with codominant stems, including bark or other structural defects may have to be removed as part of a risk management program.
3. Infrastructure. Tree removal made necessary as a result of road widening or development. Perfectly healthy trees may have to be removed because they have outgrown their planting space, causing upheaval of sidewalks or interference with vehicular traffic or utility space. Tree-caused obstruction of traffic signals and stop signs and tripping hazards caused by uplifted sidewalks are a major source of litigation against municipalities. Trees have been removed because they interfered with air traffic control or radar tracking of shipping in a bay, harbor, or waterway.
4. Storm damage. Hurricanes, thunderstorms, ice storms, snow storms, and flooding all take their toll on the urban forest in the Northeast.

2. Understanding Tree Failure

Since tree failure is going to be the cause of many tree removals, it is useful to understand that there are two distinct categories of tree failure: biological and mechanical.

2.1. Biological Failure

Biological failure results in a standing dead tree. As a result of advanced age or disease or insect attack, the tree has died. Environmental changes, such as soil compaction or changes in grade, can lead to biological failure. Weather events, such as drought or flooding, can kill trees.

In 1972 and again in the late 1980s, hard freezes in the San Francisco Bay Area caused severe dieback in eucalyptus, carob, mimosa, and grevillia by the thousands. Although many trees were not totally killed, the amount of fuel wood created by dead limbs caused great concern over the potential fire hazard. In 1991, fueled by eucalyptus, Monterey pine, and the homes themselves, a firestorm in the East Bay Hills above Oakland, California, destroyed hundreds of homes and thousands of trees. In the aftermath of the fire, helicopter logging techniques had to be employed to clear steep slopes and hillsides of hazardous trees.

2.2. Mechanical Failure

The collapse or uprooting of a tree is a mechanical failure. Uprooting may occur as a result of poor root stock, disease, or improper root pruning. Limb and leader fail-

ure may be the result of poor genetic structure such as weak attachments or codominant stems.

A common cause of mechanical failure is improper pruning. Topping and flush cuts are often the reason why large columns of decay or cavities develop in trees, weakening them to the point of collapse or complete failure.

Mechanical failure will occur when loading overcomes resistance. Limb breakage and total tree loss as a result of snow storms, ice storms, hurricanes, and thunderstorms are an expensive and serious problem in the Northeast.

3. Removal Options

There are almost as many ways to remove a tree as there are reasons to take one down. In an effort to bring some semblance of order to the methods of removal, the options have been divided into two main headings: mechanical and manual.

3.1. Mechanical Options

3.1.1. Bulldozer

Just shove the tree over and get on with life. Although this method works well in right-of-way work and lot clearing, it is certainly not an option downtown or in a residential neighborhood. However, if your site makes it feasible to use heavy equipment, the time saved can be spectacular when compared to more conventional methods.

Years ago, at Stanford University, Palo Alto, California, I watched in awe as experienced equipment operators using four-in-one loaders put in a "face cut" excavation and pushed huge 150-foot eucalyptus over. Two loaders and a chainsaw bucker, working as a team, pulled the leaders apart, bucked them to length, and loaded them into tractor trailers. We had bid against them, planning on conventional felling, brush chipping, and stump-grinding techniques. They were tens of thousands of dollars lower than my bid, and I am sure they made more money with less effort than I would have. I learned that the low bid does not always mean the lowest profit; in this case, my competitor's experience, equipment, and perspective were completely different from mine, and in this case more suited to the job at hand.

3.1.2. Crane

Compared to manual methods and technical rigging with rope, all things being equal, a crane may be your most economical option. My personal business philosophy about crane rigging was that I could rent much larger than I could ever afford to own. Over the years I have developed the following guidelines for working with large cranes. Many public agencies as well as tree companies make good use of truck-mounted cranes that are not large enough to qualify for these recommendations.

The following recommendations are just good, basic, sound advice; apply them as applicable to your particular situation:

1. Work to develop a relationship with a crane company so that you know what their equipment is capable of and which operator has the best feel for working with a climber.
2. Before bidding a job, contact the crane company and show the job to their estimator. That person can check the site for access and recommend the best crane for the job.
3. Keep in mind that the distance the boom has to extend to reach the load has a tremendous bearing on the actual weight the crane will be able to handle. This is why you might need to use a 150-ton crane to do the job that a 25-ton unit could do if it was right next to the tree.
4. Big cranes are heavy. In parks and along secondary roads, you might have to factor in repair of pavement or curbing as part of the cost of the job.
5. Big cranes are large. Make sure that there is more than enough clearance from energized conductors and other installations.
6. Crane rigging is a highly specialized skill. The climber and the crane operator have to work in perfect harmony or risk injury, death, or property damage.
7. Tree removal by crane must be done in compliance with ANSI Z133.1 (American National Standards Institute, 1994) (current standard at time of publication; see Appendix B).

A potential downside of a successful crane job can be the amount of wood that piles up in an amazingly short period of time. You either have to plan a staging area or have enough trucks available to keep the flow of the job going. An excellent strategy for those who have a smaller crane in-house is to use the big crane to get the tree(s) on the ground and to use your crane to load the wood at your pace. In this way, you might be able to reduce your large crane rental from a full day to a half day with a net increase in efficiency and economy. Or, if you are working on a large project, you can send the large crane to the next job, following behind with the cleanup phase.

Rental agreements should include a clause that suspends charges in the event of mechanical problems with the crane. If the crane is down, make sure the clock stops on the rental until it is serviced, repaired, or working again.

3.1.3. Auxiliary Equipment

Most removals are going to make use of a truck and chipper. Many removals in the Northeast utilize an aerial lift for worker safety and convenience. As noted, cranes in a variety of sizes are often employed. Beyond that, any piece of equipment that helps with handling the wood and brush is welcome. Skid loaders with log forks on the bucket can be very useful in some situations, while knuckle-boom loaders can be very helpful in others. When it comes to auxiliary equipment, the specific situation, the job budget, your experience, and the availability of a piece of equipment are your best guides to selection.

3.2. Manual Methods

Manual removal refers to any method that requires extensive chainsaw work and/or roping to accomplish the task. Manual methods can range from ground felling

to advanced technical rigging. Since an aerial lift is nothing more than a platform to access the work from, I have not included them in either list. An aerial lift can find gainful employment in crane work as well as manual methods. Manual methods include but are not limited to the methods subsequently described.

3.2.1. Felling from the Ground

Wedges, fiber rope tag lines, winches, hydraulic jacks, and block and tackle may all be used to guide the tree down. In some cases, it is necessary to top the tree or limb a portion of it to get it to fit into the drop zone. As access becomes more and more restricted, the amount of rigging necessary to bring the tree down safely increases.

3.2.2. Dismantling

Piecing down, chunking down, whatever you want to call it, someone has to get in the tree, brush it out, and get the limb wood and base wood to the ground. This work can be done by a rope and saddle climber or an aerial lift operator or a combination of the two.

3.2.3. Rigging

The primary function of rigging is worker safety, when the tree cannot be felled or dismantled without causing collateral damage to adjacent structures, utilities, or sensitive landscaping. When a tree is out of reach of a crane, rigging may become necessary. Rigging may range from simple to technical:

1. Simple rigging makes use of lowering lines and guide ropes called *tag lines*, but relies on natural crotches and trunk wraps for rope placement and control.
2. Technical arboricultural rigging involves the use of ropes, pulley blocks, lowering devices, slings, and false crotches to create a system that provides the greatest degree of precision, accuracy, and control.
3. More important than the equipment are the knowledge and skills necessary to make it all work safely and efficiently.

It is not within the scope of this chapter to go into technical "how to" instruction on techniques and methods for removal. Information of that nature is best reserved for a very large volume devoted entirely to the subject.

3.3. Safety in Tree Removal

The leading causes of death and serious injury to arborists are falls, being hit by falling objects, and electrocution. In addition to these causes, chainsaw cuts and back strains account for a significant number of painful and debilitating injuries. Tree removal, by its very nature, carries with it a high potential for injury.

- All tree maintenance and removal operations shall be performed in full compliance with all applicable American National Standards Institute (ANSI) and Occupational Safety and Health Administration (OSHA) regulations (see Appendix 1).

- Always observe the general condition of the tree to be removed.
- Locate all conductors and utility equipment.

Be aware of:

- Ivy obscuring the root collar, trunk, and/or limb structure from view
- Major deadwood
- Broken, hanging limbs
- Cables and bracing rods
- Split crotches
- Bird or other nests
- Cavities
- Bee, wasp, or hornet activity
- Decay fruiting bodies
- Poison oak, ivy, or other allergy-inducing plants
- Ground-level obstructions such as irrigation heads, holes, and stakes. Such tripping hazards may be particularly dangerous if obscured by low-growing ground cover (Blair, 1995)

3.3.1. Site Security

The following removal site hazards must be managed.

3.3.1.1. Traffic. Many urban removal sites are going to be along roadways, park paths, or utility corridors. Provisions must be made to secure the work site. Road cones, flagging, and lane closings may all be necessary to protect the work crew and the public. From experience, I can tell you that the public-at-large, whether they are motoring, bicycling, or on foot, are not a particularly observant lot. Extraordinary measures must be taken sometimes to protect them from themselves and your workers. Scopes, signs, and cones must comply with local standards and regulations. Residential streets have different requirements from major throughways.

3.3.1.2. Pedestrian. Many pedestrians stroll through life so totally absorbed in themselves that they are deaf to chainsaws, blind to road cones, and oblivious to tree work in progress. I have been witness to unbelievable acts of ignorance by pedestrians. Do not trust them any more than you would a crazed motorist. Do not trust them to notice your work or to heed normal traffic signs. Sometimes you have to literally fence an area off or post a full-time guard to control the movements of passersby.

3.3.1.3. Site. You are on the job to remove a tree, not to destroy the surrounding area. Some sites are an arborist's dream: open, flat, no competing obstructions. Other sites are what we call a "challenge." In developing the work plan, find out what is expendable and what has to be protected. Plan accordingly. Simple measures like scaffolding and plywood can protect understory vegetation from branch drop. We have been known to drape buildings with plastic sheeting to protect the walls from being stained by sawdust and chain oil. Plywood is less expensive than plate glass. Consider protecting expensive windows with plywood *before* they get broken. Advanced rigging techniques have evolved to enable arborists to cope with site security while accomplishing an efficient removal.

4. Planning a Removal Operation

Tree removal calls for far more consideration than the choice between a hinge cut and a jump cut or which brand of chainsaw is most desirable. Some municipalities have in-house crews, some contract all of their work, and many use a combination of both. When drafting specifications for competitive bids, be sure to cover as many factors of the removal as necessary to ensure that the work is done safely, efficiently, and with adequate safety measures for protection of property and passersby.

Safe and efficient removal begins with a work plan. In the planning stages, it is far more important to know what your access is than whether you will be using a bowline or a clove hitch to tie off limbs. The following work plan assessment forms have been developed to enable a person to develop a clear picture of how to cope with any removal ranging from a single tree to a major project (Figs. 1 and 2). By working through the questions on the assessment form, the project planner will create a clear picture of what it is going to be encountered and what will be required to accomplish the task.

The sample assessment forms in Figs. 1 and 2 have sample answers in italics to show the reader how a completed form might work. There are blank forms in Appendix C that may be copied for actual field use.

5. Thoughts on Tree Removal

There are commercial arborists who specialize in large-scale tree removal. There are others who have built up successful practices that do very little, if any, tree removal. With an obligation to public safety, municipalities do not enjoy the luxury of deciding whether they want to do removals. If it is a public tree and it is a hazard, it has to be removed.

5.1. Changing Cultural Practices May Reduce the Need for Future Removal

Sooner or later, every tree is going to die and require removal. The unfortunate fact with too many municipal trees is that they succumb "sooner" rather than "later." Premature removals could be greatly reduced if the following commonsense practices were followed more often and with greater diligence.

5.1.1. Species to Site Match

Too often the wrong tree gets planted in the wrong place. If a selected tree is unsuitable to the site it may die prematurely or outgrow the site. Example: Over the vehement objection of the arborist, a city once planted tulip poplar as the shade tree in its downtown area. Each tree went into a square hole in the sidewalk. The trees grew quickly and large. The leaf drop increased the street sweeping burden. The annual infestation of aphids and sooty mold made the sidewalks and vehicles parked near them black and sticky. The vigorous root systems buckled the sidewalks. Within

A. Tree Removal Work Plan Assessment Form

1. **Site Location of Tree(s) to be removed** *509 Bailey Avenue, Mountain View*
2. **Inventory Number/GPS location** *CL9672210*
3. **Number of Tree(s) to be removed** *One*
4. **Species of Tree(s) to be removed** *Quercus macrocarpa. Bur Oak*
5. **Reason for removal** *Clogged drain system created wet conditions favoring water mold fungi. Tree is dying and needs to be removed while it is still safe to work in*.
6. **Heritage Tree removal permit required? Yes *XXX* No _____ Permit on file *XXX***
7. **Diameter of Tree to be removed (answer only if single tree)** *38-inches @ 4.5ft above ground*
8. **Height of Tree to be removed (answer only if single tree)** *76-feet*
9. **Range of diameter of trees to be removed** *NA*
10. **Range of height of trees to be removed** *NA*
11. **Access**
    A. _____ **Excellent. Accessible to any motorized equipment**
    B. _____ **Limited. Describe** _____
    C. ***XXX*** **Restricted. Describe** *Inner courtyard of Children's Museum*
12. **Debris Disposal Method** *Chip and haul to mulch pile*
    A. **Estimated Quantity of brush and/or chips** *30 cu. Yds. Of chips*
    B. **Estimated quantity of logs/wood** *8 cords of firewood*
13. **Stump removal** Yes ***XXX*** No _____
    A. **Number of stumps to grind** *Just the one*
    B. **Estimated total inches/feet of stump to grind** *78-inches (large butt swell at ground)*
    C. **Stump grinder needed** *Small, self-propelled unit*

B. Job Site Safety

1. **Visible Tree Defects/Hazards Present No _____ Yes *XXX***
   Describe *Die-back in crown. Extensive signs of Armillaria mellea at root crown. Large pruning wound cavity in NE leader. 3-span cabling system*.
   Plan: *Anchoring root system still sound enough to support climbing and rigging. Do not tie-in to NE leader. Do not cut cables until the leaders have been lightened*.
2. **Utility Installations Above ground** *None* **Below ground** *Conduit for courtyard lighting located. Not in conflict with job*.
   Recommended Course of Action *None needed at this site*
3. **Traffic**
   A. **Vehicular** *Busy street, library traffic*
   B. **Pedestrian/bicyclist** *On street, and at entrance, okay in courtyard*
   C. **Other (equestrian, air, aquatic, etc.)** *NA*
   D. **Traffic Security Plan** *Cordon off staging area in parking lot. Close courtyard to public. Do work in stages 6:00 a.m. to 10:00 a.m. to avoid disruption*
4. **Job Site Concerns**
   A. **Structures** *Glass walls of library, slate roof*
      Plan: *Build a plywood barricade in front of east wall to protect glass. Hang black plastic sheeting on other walls to prevent chain oil and sawdust staining of adjacent walls. Put plywood on roof where necessary to stand. Use blower on roof to remove sawdust and fine debris in clean-up phase*.
   B. **Landscape** *Fish pond, fern garden, flintstone paving*
      Plan: *Cover pond. Put a scaffold over the ferns. Do not service saws on stone paving. Do not drop sections of wood onto paving. Lay plywood down over most heavily worked areas*.
   C. **Noise (hospital zone, noise ordinances, etc.)** *Library, shhhhhh!*
      Plan: *Schedule work in phases from 6:00 a.m. to 10:00 a.m. to avoid disruption*.
   D. **Other** _____
      Primary Challenge: *Crane is not an option. Out of reach. Can't afford to tip a crane over on the structure*

FIGURE 1. Sample work plan for single tree. This sample shows how a work plan can be developed from the data provided to plan for the removal of a single tree.

Removal Plan

Personnel Required *Standard team.*
Phase One*—Speedline brush over roof to staging area. Use traveling block and "crossline" set-up with 4:1 yachting blocks to manage tension and control descent.*
Phase Two*—Using Hobbs Lowering Device™ and Rope Brake™, tip-tie and butt hitch scaffold limbs, lower them into courtyard and bring wood out through library with hand truck and four-wheel rubber-tired dolly.*
4. Phase Three*—Grind-out stump, clean-up, remove tarps, scaffolding and plywood.*
Removal Equipment Needed:
Full range of chain saws, Hobbs Lowering Device™, Rope Brake™, single and double braided lowering lines, "Crossline" SPEEDLINE gear, rigging bag with slings, shackles, carabiners, rescue pulleys, plywood, scaffolding, tarps, hand truck, ARBOR CART™, wedges, can't hook

FIGURE 1. (*continued*)

10 years, they were all removed and replaced with locust. An appallingly poor species to site match resulted in controversy, unnecessary maintenance, and premature removal.

Planting a tall tree beneath a power line ensures that the tree will have to be severely headed back periodically to keep the utility space clear of obstruction. Periodic severe heading of such species as maple or yellow poplar practically guarantees that cavities and decay will develop, dramatically reducing the effective life of the tree.

5.1.2. Improper Pruning

There is a long list of problems related directly to incorrect pruning. Among them, heading cuts (topping), flush cuts, and overthinning can be the cause of serious wounds, cavities, and defects that can lead directly to premature mechanical failure.

Proper pruning in the first 5 years of a tree's life is essential to helping the tree develop the proper structure. In the formative years, a hand pruner can remove many potential problems that, if left unattended, can grow into structural defects that cannot be resolved without removal.

5.1.3. Good Plant Material

Even if you select a suitable species for the site and have made provisions for establishment pruning and after planting care, the tree has to have a good root system and a decent structure to begin with to ensure any measure of long-term success. Take an interest in what gets purchased, how it is transported and planted. Remember that the birth of a baby is when the care begins. The planting of a tree is when the real commitment begins. People feel good about planting trees, but I think many forget that they need to be irrigated, trained, and pruned for years to come. Make sure that you have detailed planting specifications appropriate to the site and species drawn up for reference and review.

A. Tree Removal Work Plan Assessment Form

1. **Site Location of Tree(s) to be removed** El Camino Real
2. **Inventory number/GPS location** *All trees between Matthew Dr. and Mackenzie Terrace.*
3. **Number of Tree(s) to be removed** *350*
4. **Species of Tree(s) to be removed** *Ulmus americana*
5. **Reason(s) for removal** *road improvement, trees are also overmature and hazardous*
6. **Heritage Tree removal permit required? Yes *XXX* No _____ Permit on file *XXX***
7. **Diameter of Tree to be removed (answer only if single tree)** *NA*
8. **Height of Tree to be removed (answer only if single tree)** *NA*
9. **Range of diameter of trees to be removed (in inches)** *18 to 84*
10. **Range of height of trees to be removed** *40 to 125*
11. **Access**
    A. ***XXX*** **Excellent. Accessible to any motorized equipment**
    B. _____ **Limited. Describe** _____
    C. _____ **Restricted. Describe** _____
12. **Debris Disposal Method** *Load as large as possible, haul to disposal site and process*
    A. **Estimated Quantity of brush and/or chips** *4200 cu. Yds of chips*
    B. **Estimated quantity of logs/wood 150,000 cu. ft.** (1171 cords)
13. **Stump removal**
    A. **Yes *XXX***
    B. **No** _____
    C. **Number of stumps to grind** *350*
    D. **Estimated total inches/feet of stump to grind** *1,000 feet*
    E. **Stump grinder needed** *Track-Mounted, self propelled, largest unit available, sub-contract work to specialist*.

B. Job Site Safety

1. **Visible Tree Defects/Hazards Present No** _____ **Yes *XXX***
   Describe *Too many to note herein*.
   Plan: *Mark trees with hazards or defect and brief crew before commencing work*.
2. **Utility Installations**
   A. **Above ground** *Yes, high voltage to 12kv*
   B. **Below ground** *Yes, natural gas*
   C. **Recommended Course of Action** *Have utility company top trees below the power lines, work with gas company to locate and work around gas lines during stump removal*.
3. **Traffic**
   A. **Vehicular** *Main thoroughfare, 33,000 vehicle daily count*.
   B. **Pedestrian/bicyclist** *On street, and sidewalk*
   C. **Other (equestrian, air, aquatic, etc.)** *NA*
   D. **Traffic Security Plan** *close inside lane and sidewalk traffic on work side of road*.
4. **Job Site Concerns**
   A. **Structures** *Trees overhang private yards and some residential structures*
      Plan: *rig as necessary to protect property, use crane on largest trees and most hazardous*.
   B. **Landscape** *privately owned lawns, shrubs and shade trees in front yards*
      Plan: *rig and rope as necessary to protect property. Use crane on largest trees*.
   C. **Noise (hospital zone, noise ordinances, etc.)** *residential neighborhood*.
      Plan: *Schedule work from 7:30 a.m. to 5:00 p.m. to avoid disruption*.
   D. **Other** _____
      Primary Challenge: *A whole lot of big trees. Lots of brush, wood and traffic*.
      Personnel Required *Standard team plus flagging crew*.

FIGURE 2. Sample work plan for large project. This sample shows how a work plan can be developed from the data provided to plan for the removal of a large quantity of trees.

C. Removal Plan

1. Have contract line clearance contractor come in and top all trees below the power lines.
2. send ground falling crew down the line, felling those that can be dropped in one piece.
3. send aerial lift and climbing crew down the line, removing and rigging what they can get.
4. send crane crew down the line. Recommend leaving large trunks upright and "on the stump", where practicable for crane to "pick and load" in one piece. Action will reduce damage to sidewalks that aren't being removed in the widening and reduce chance of damage to private lawns.
5. Grind stumps and final clean-up.
Notes: *With the volume of brush, logs and wood coming off this job, I recommend using a grapple to load as much material as possible for transport to a biomass recycling center for high-volume processing*.
Removal Equipment Needed: *28-inch road cones, lane barricades and 48-inch traffic warning signs in sufficient quantity to comply with D.O.T. regulations. Aerial lift, self-loading log trucks, grapple-mounted skid loader, debris box trucks, Hobbs Lowering Device™, Rope Brake™, single and double braided lowering lines, "rigging bag". Plywood and tarps for site protection as needed*.

FIGURE 2. (*continued*)

Most removals in the urban forest may be classified as either being: maintenance or emergency:

1. Maintenance removals would be the more or less scheduled removal of those trees that have died or need to be taken down for some other reason.
2. Emergency removals are those necessitated by storm emergencies.

Each type of removal requires planning and preparation.

Maintenance removals require the sort of planning that accompanies the process of filling out the work plan assessment form. With maintenance removals, you have the luxury of being able to plan for the removal of a tree or trees under more-or-less controlled conditions.

Emergency removals require planning in advance to be able to cope with the chaos that comes with a hurricane, ice storm, or other natural disaster. Every municipality should have a storm emergency contingency plan worked out in advance that addresses tree removal. The first thing that happens after a natural disaster like Hurricane Hugo, the great ice storm of January 1998, or countless other storm emergencies is a period of chaos, confusion, and isolation immediately following the aftermath. Untold miles of roads are going to be clogged with trees, power lines, and poles. Everybody will demand they be taken care of first. Have you made plans to cope with the situation?

During hurricane or the winter season, watch the weather reports carefully. Keep the trucks in good repair, the tanks filled with fuel, and the chip boxes empty. Have plenty of spare saw chains, spark plugs, saw mix and oil, and essential parts.

What roads are you going to clear first? Do you have contracts in place with commercial tree care firms to provide back-up emergency help? Are all your equipment eggs parked in one basket, or do you have them placed in strategic locations throughout the city?

If you have not been through a natural disaster of even a small scale, you cannot imagine the impact that small, usually insignificant details can have if overlooked.

Not usually accustomed to pruning trees at 2:00 a.m., will your crews be able to see in the dark? Caver's headlights on the hardhats are an invaluable aid to the tree workers. Portable lighting can be essential for safe storm emergency work. Have you made provisions to give them a place to rest between shifts if they cannot go home? The danger of accidents during storm emergency work cannot be overemphasized.

In California, our celebrated Pacific Storms can pack inches of rain for days, driven by 80 mph winds, and knocking down trees by the thousands. But the weather was always tolerable. My heart goes out to anyone who has to cope with the immediate aftermath of an ice storm while the weather is still brutal.

Fatigue coupled with heavy work under slippery conditions is a recipe for disaster. Make sure that your crews are properly clothed and equipped for the conditions. A worker in the best of shape can only push just so far and just so hard before he/she will break down. Make sure that your people get enough to eat and are required to take a reasonable break for sleep. You will get even less done if your people collapse or end up in the ER as a result of fatigue-induced injury.

Without trying to provide instruction in removal, the following outline details a few of the tricks, procedures, and lessons that I have learned over years of maintenance and emergency removal:

1. Chainsaws. Learn all you can about maintenance, safe use, and sharpening. An executive from Husqvarna once told me that they spend millions of dollars trying to shave a few ounces of weight off a saw or wring out a few more rpms, when the operator can gain an immediate increase in power of 20% by merely seeing that the chain is correctly sharpened.

Buy a dealer and not necessarily a brand. Make sure that the saws you buy can be serviced and supplied with parts in a timely manner. A saw waiting for parts is a saw wasting time.

Make sure you have plenty of saws on the job. If one breaks down, you should be able to grab another and keep on working. Saw maintenance should be done in the shop, at the workbench, not on the stump.

That said, I also recommend making up a field kit that has a spare plug, replacement nuts and bolts that are prone to loss, some loops of sharp chain sized to the saws issued, and the tools needed to tighten or assemble.

2. Rope. Use ropes recommended by the manufacturer as suitable for arborist use. Know what their tensile strengths are and how to calculate a safe working load. Adopt an inspection protocol that incorporates the following three elements:

   a. Initial. Make sure the rope is what you ordered and in good condition when you first receive it.
   b. Frequent. Train field personnel in daily inspection for cuts, abrasion, heat fusion,
   c. Periodic. On a scheduled basis, a person in authority inspects the rope as well as other safety and production gear and passes it or fails it for use until the next inspection cycle.

The most commonly offered cut lengths by vendors are 120- and 150-foot lengths. Buy your rope in the lengths that serve your needs best. Always remember that the working height is half the length of the rope. A 150-foot rope is going to be

too short to work in a 60-foot tree if you consider wraps and the need to provide the line handler with enough rope to keep him or her away from the drop zone.

Take good care of your ropes. Keep them clean and coil and hang them or bag them when not in use. Let wet ropes dry out whenever possible.

3. Backsavers. Tree removal is tough enough without making it impossible. One tool that I do not see often enough on the job is a cant hook. Few hand tools are more useful for rolling logs than a cant hook. Every crew geared up for removal should have at least one cant hook as standard equipment. Plastic falling wedges and a logger's falling axe are also essential tools in my removal kit.

6. Bid Specifications

You are the city arborist. Your small tree maintenance crew is hopelessly backlogged with routine pruning and planting work. The finance department finally approves your budget request for funds to hire outside contractors. Now the trick is to get the most work from the best contractor with the least amount of hassle. The key to success is in your bid specifications.

As a commercial contractor who has spent years reading good and bad bid specifications, when applicable, I like to have the following questions answered in the specifications before I have to spend time trying to track down the answers on my own:

1. Be specific about the location, species, and size of the tree(s) to be removed.
2. Mark the trees or tag them so that there can be no doubt about which trees are to be removed.
   ANECDOTE: We once took a job removing most but not all street trees in a downtown area. Upset that his tree obscured his storefront, a merchant took me to task when I felled trees on either side of his store, leaving his tree healthy and full of leaf. I told him that without its fluorescent orange death sentence, I could not remove it. About an hour later, the merchant told me I had made a mistake, that I had failed to notice the orange paint on the tree trunk. He had failed to notice the orange paint on his hands! The tree stayed.
3. Let us know if there are any time restrictions or noise ordinances that we will have to operate in compliance with.
4. Let us know if there is a completion date. Let us know if there are liquidated damages, what they are, and if there are allowances made for bad weather.
5. Be specific about debris disposal. Some municipalities will issue dump tickets to handle the disposal of debris, but many do not. Some cities have a wood yard, but many do not. Some cities will allow firewood to be left on site, but many do not.
6. On large projects, it can be helpful to all parties to provide the contractor with secure parking for equipment at the corporation yard.
7. Always require that all work be done in compliance with current and applicable ANSI (1994) Z133.1 standards as well as other appropriate municipal, state, and federal standards.

8. Be specific about stump removal. If you want the stumps removed, say so; do not try to convince the contractor that "you meant the stumps" after you put the job to bid. If you want them ground, specify the width and depth of grind out that you want and whether the chips can be left on site or cleaned up and hauled away.
9. On large projects, it is always wise to plan a bid tour and orientation. I have asked so many questions on some bid tours that the exasperated tour guide had to grant an extension to the submission date in order to answer our concerns. From my perspective as a contractor, I am not willing to assume the risk of an open-ended project that leaves issues unresolved or open to interpretation that could cost me profit or my professional reputation.
10. Be clear about who assumes the responsibility for traffic control and lane closure, if necessary.
11. Establish a rate for add-ons either through unit pricing or an established labor and equipment rate.
12. When appropriate to the job site or situation, make provisions to shield the contractor from the public by making it clear that any questions are to be answered by the appropriate agency and not by the contractor.
13. For everyone's protection, make sure that the preexisting condition of curbs, side-walks, structures, and so on is established and documented before the contractor begins work.
14. Many municipalities require removal permits or environmental impact reports. Make the job easier and less expensive for the contractor by taking care of the red tape in the course of preparing the bid specifications.
15. In jobs requiring backfill, specify what is acceptable. Show samples at the bid tour.
16. Be wary of having tree work buried deep in a large project such as a downtown redevelopment.

Case History: In 1979, we ended up as a sub-to-a-sub-to-a-general contractor! The general contractor had bid the total job, subbing out the tree removal to the excavating contractor who had the job of tearing up the street. We in turn, subbed the stump grinding to our stump grinding specialist. We had bid $80.00 per tree, removed and ground out. Later the "stump guy" asked for another $5.00 per tree because it did not turn out that we could do all six blocks at once.

Our boss (the sub-to-the general) had no problem with an extra charge for a change in the original agreement. About halfway through the project, the city arborist called me up and asked what my bid was. I told him about the $80.00 plus $5.00 bid. The arborist thought our price fair enough, but on principle, he did not like getting charged $280.00 per tree by the general contractor! I did not much appreciate the thought that someone I had never met was making 2.5 times the amount we were without getting wet, dirty, and covered in sawdust. The contract had been let for one side of the street at a time, so the arborist eliminated tree removal from phase two of the project and did the work with his own crew.

Through no fault of our own, we lost out on phase two of a nice job. The city lost out because it probably cost them more per tree than our bid to do the work

in-house (but a lot less than the general contractor's bid). While occupied with Main Street, other tree work was not getting done. From that job forward, I have always been careful about getting buried too deep in a bid.

7. Conclusion

Tree removal is an unavoidable aspect of urban forestry in the Northeast and anywhere else for that matter. Tree removal may become necessary for reasons as varied as biological failure, storm damage, or urban renewal. Tree loss through hurricanes and ice storms is more or less unavoidable, but premature failure as a result of poor selection, inadequate establishment practices, or improper pruning is very avoidable. A much better use of taxpayer revenue and arborist skills is in quality tree maintenance as opposed to removals that could have been prevented or postponed for decades in the life of a tree.

Large-scale tree removal is a highly specialized, potentially dangerous arborist skill. Personnel must be properly trained, equipped, and supervised in such diverse skills as chain-saw use, rope and saddle climbing, felling, limbing, bucking, knots ropes, and rigging (see Appendix D). Work that is put out to bid should be as clear and concise in intent and objective as possible.

For all its blood, sweat, tears, and aggravation, few assignments in arboriculture are more challenging or rewarding than a large-scale removal well-planned and skillfully executed. I will tell you something that is, however, tree preservation. For me, nothing is more nourishing to my soul than the practice of the preservation arts, for example, pruning, cabling, soil manipulation, and diagnosis. The hope and promise that my grandchildren may someday be able to enjoy the shade of a favorite tree that their grandpa labored to preserve when he was a young man is the essence of this profession.

Appendix A

Cordage Manufacturers

Some of the arborist suppliers and most of the cordage manufacturers are beginning to publish reference material along with product information.

The American Group/Samson Division
2090 Thornton Street
Ferndale, WA 98248
(360) 384–4669

New England Ropes, Inc.
848 Airport Road
Fall River, MA 02720
(800) 333–6679

Yale Cordage, Inc.
PO Box 3820
Portland, ME 04101
(207) 282–3396

Chainsaw Manufacturers

The major chainsaw manufacturers such as Husqvarna, Stihl, and Shindaiwa publish good, basic safety, and operational information regarding chainsaw use and safety.

Husqvarna Forest and Garden Company
9006-J Perimeter Woods Drive
Charlotte, NC 28216
(800) 438–7297

Shindaiwa, Inc.
11975 SW Herman Road
Tualatin, OR 97062
(800) 521–7733

Stihl, Inc.
PO Box 2015
536 Viking Drive
Virginia Beach, VA 23450–2015
(757) 486–9100

Associations

American National Standards Institute
11 W 42nd Street
New York, NY 10036

The MF Blair Institute of Arboriculture
PO Box 292
Big Pool, MD 21711
(301) 842–2544
Donald F. Blair, Director
Arborist skills training, consultation.

The International Society of Arboriculture
PO Box 3129
Champaign, IL 61826
(217) 355–9411

The ISA has over 10,000 members, worldwide, organized into state and/or regional chapters. The ISA has an arborist certification program, as well as publications and videos on a wide selection of safety and performance-related topics. Membership is open to anyone with an interest in the advancement of arboriculture.

The National Arborist Association
PO Box 1094
Amherst, NH 03031-1094
(603) 673–8952

Membership is limited to the owners and principals of contracting firms. Training seminars offered at various times and locations throughout the country. Publications and videos on a wide selection of safety and performance-related topics are available. The National Arborist Association is working with this author, Ken Johnson and Robert Phillips to develop a training program on rigging for removal that will include a videotape, manual, and continuing education credits.

Arborist Supplies

Karl Kuemmerling, Inc.
129 Edgewater Avenue NW
Massillon, OH 44646
(216) 477–3457

Sherrill Arborist Equipment and Supply
3101 Cedar Park Rd.
Greensboro, NC 27405-9657
(800) 525–8873

The Sierra Moreno Mercantile Company
PO Box 292
Big Pool, MD 21711
(800) 262–0800
(301) 842–2544
Donald F. Blair, founder

Tools for the tree health professional—work-proven solutions worldwide since 1975. Sierra Moreno Mercantile Company is the innovative firm responsible for introduction

of the Hobbs lowering devices, Hobbs rigging blocks, rope brakes, custom climbing gear, and a comprehensive stock of arborist tools, supplies, and equipment. Available direct and through authorized dealers worldwide.

Appendix B

Applicable American National Standards

- Z133.1, Tree care operations: safety
- A300, Standard practices for trees, shrubs and other woody plants: pruning, cabling, etc.
- A10.14, Requirements for safety belts, harnesses, lanyards, lifelines, etc. for industrial use
- A14.1, Ladders; portable wood; safety requirements
- A14.2, Ladders; portable metal; safety requirements
- A92.2, Vehicle-mounted elevating and rotating aerial devices
- B175.1, Gasoline powered chain saws; safety requirements
- Z87.1, Practice for occupational and educational eye and face protection
- Z89.1, Personnel protection; protective headgear for industrial workers; requirements

Applicable Federal Regulations

US Department of Labor, Occupational Safety and Health Administration:

- CFR 29 1910.000, General industry
- CFR 29 1910.67, Vehicle-mounted elevating and rotating work platforms
- CFR 29 1910.95, Occupational noise exposure
- CFR 29 1910.151, Medical services and first aid
- CFR 29 1910.268, Telecommunication
- CFR 29 1910.269, Electric power generation, transmission, and distribution
- CFR 29 1910.331.335, Safety; electric-related work practices
- CFR 29 1910.1200, Hazard communication
- 49 CFR (transportation regulations)

Appendix C

Tree Removal Work Plan Assessment Form

1. Site location of tree(s) to be removed _____
2. Inventory number/GPS location _____
3. Number of tree(s) to be removed _____
4. Species of tree(s) to be removed _____
5. Reason for removal _____

6. Heritage tree removal permit required? Yes _____ No _____ Permit on file _____
7. Diameter of tree to be removed (answer only if single tree) _____
8. Height of tree to be removed (answer only if single tree) _____
9. Range of diameter of trees to be removed _____
10. Range of height of trees to be removed _____
11. Access _____
    A. _____ Excellent. Accessible to any motorized equipment
    B. _____ Limited. Describe
    C. _____ Restricted. Describe
12. Debris disposal method _____
    A. Estimated quantity of brush and/or chips _____
    B. Estimated quantity of logs/wood _____
13. Stump removal
    A. Yes _____
    B. No _____
    C. Number of stumps to grind
    D. Estimated total inches/feet of stump to grind
    E. Stump grinder needed

Notes: _____

_____

Job Site Safety

1. Visible tree defects/hazards present No _____ Yes _____
   Describe _____
   Recommended course of action _____
2. Utility installations
   A. Aboveground _____
   B. Belowground _____
   C. Recommended course of action _____
3. Traffic
   A. Vehicular _____
   B. Pedestrian/bicyclist _____
   C. Other (equestrian, air, aquatic, etc.) _____
   D. Traffic security plan _____
4. Job site concerns
   A. Structures _____
   Plan: _____
   B. Landscape _____
   Plan: _____
   C. Noise (hospital zone, noise ordinances, etc.) _____
   Plan: _____
   D. Other _____

Personnel required _____

Removal Plan

Phase one _____

_____

Phase two _____

_____

Phase three _____

_____

Removal equipment needed:

_____

_____

_____

Notes:

_____

_____

_____

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Appendix D

Recommended Guidelines for Safety Training and Standard Performance for Qualified Personnel

For a person to be considered qualified to do tree removal as well as general tree maintenance, they should first receive training and instruction from competent persons in the following areas.

General

- Job description appropriate to job assignment
- Introduction to immediate supervision and crew members
- Instruction in selection, care, use, and maintenance of personal protective equipment
- Familiarization with equipment
- Introduction to company policies and procedures
- Safe work practices as related to job assignments

Tree Knowledge Appropriate to Job Assignments

- Education and training in accordance with prevailing national standards for tree removal and/or general tree maintenance.
- Education and training in accordance with local, state, or regional standards for removal and/or general tree maintenance as well as those specified by contract.

Tree Knowledge for Removal and/or General Tree Maintenance Appropriate to Job Assignments

- Provide education and training relative to predominant tree species within geographic area, such as identification, growth habits, structure, and wood strength.

General Safety

- OSHA standards
- ANSI standards
- Public safety and traffic control
- Electrical hazards
- Emergency conditions
- Job site briefings
- Lifting
- Load handling
- Direct supervision
- Noise level compliance

Equipment Safety

- Mobile equipment and aerial lifts
- Aerial equipment and electrical hazards
- Chain saw, power tool, and hand tool use and safety
- Climbing equipment

Operational Safety

- Climbing techniques
- Rigging and tree removal
- Hazard communications

Personal Safety

- Personal protective equipment
- Emergency response procedures
- Back and other accidental injury prevention
- Poison plant/animal identification and avoidance

Note: A training program that does not document the employees' progress and participation is an inadequate program. Make sure you keep records of your safety meetings, seminars, and field exercises and have all attending sign in. Keep your records for at least 5 years.

References

I have been lecturing, demonstrating, and writing about arborist skills since 1972. I have welcomed this opportunity to assemble many of these thoughts and experiences for the first time in published format. In addition to common sense, experience, and my personal notes, I have referred to the following published data in researching this chapter:

American National Standards Institute (ANSI), ANSI Standard Z133.1, *Safety Requirements for Pruning, Trimming, Repairing, Maintaining and Removing Trees for Cutting Brush*, American National Standards Institute, New York.

Blair, D. F., 1995, *Arborist Equipment*, International Society of Arboriculture, Champaign, IL.

Blair, D. F., 1986, *Catalog of Arborist Supplies*, Sierra Moreno Mercantile Company, Big Pool, MD.

At present, there is no comprehensive manual or guide for tree removal. In addition to books used in the bibliography, the following are excellent references in their fields of specialization:

Beranek, 1996, *The Fundamentals of General Tree Work*, Beranek Publications, PO Box 251, Fort Bragg, CA 95437

Jepson, J. L., 1997, *The Tree Climber's Companion*, Jeff L. Jepson, Longview, MN.