B.C. HYDRO AND POWER AUTHORITY

CENTRAL INTERIOR DIVISION
VEGETATION MANAGEMENT
WORKLOAD ANALYSIS

DISTRIBUTION

Tree Trimming

Tree Removal

Brush Control

M.R. Gardner

September 1975.

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R. Gardner
Vancouver 1975

TABLE OF CONTENTS

PART FIVE

PART SIX

CENTRAL INTERIOR DIVISION

VEGETATION MANAGEMENT WORKLOAD ANALYSIS

ABSTRACT

This Report has been prepared as the first of four models suggested in the Vegetation Management Task and Implementation Analysis. That Report laid the initial groundwork for a comprehensive plan for vegetation management throughout the Operating Divisions of British Columbia Hydro & Power Authority. This Report examines under three headings - Tree Trimming, Tree Removal, and Brush Control - the conflict between arborateous vegetation and the electrical distribution system in the Central Interior Division of B. C. Hydro. Two chapters introduce and discuss the problems arising from this conflict and discuss the concept of workload analysis; one chapter discusses aspects of safety, reliability, and regional policy in the context of cost benefit; one comprehensive chapter reviews problem management techniques and alternatives; two chapters then review the survey techniques used in workload analysis, and the results of the analysis which are categorized by the three main tasks of trimming, removal, and brush control in tabular form. Two final chapters draw conclusions from the analysis and make specific recommendations for distribution vegetation management in each of the Central Interior Districts. Appended to the Report are comprehensive tables compiled from the field workload assessment, and plates to illustrate distribution vegetation control.

municipal shade and ornamental trees and shrubs of high aesthetic value are replaced predominantly by forest trees of greater height and size at maturity in an arvicaline or forest environment with corporate or Crown ownership.

1.2 Workload

The essence of effective vegetation management must evolve from comprehensive examination and assessment of apparent conflicts. It must then predict consequent cost in time and effort required to overcome the examined problems with incremental degrees of effectiveness.

This assessment procedure is commonly known as workload analysis. Such analysis must address the suggested need for tasks, establish a rationale for undertaking such tasks, then move to quantitatively and qualitiatively examine the work in a temporal dimension. The analysis must then provide a review of solutions as task methods, controls, and records, with a further assessment of their relative capital costs and cost effectiveness. It must also calculate the effort in terms of manhours which must be expended over time. Without such basic information it is neither possible to objectively assess present conditions, nor to comprehensively plan for the future. Work and manpower scheduling and programme budgeting also become readily visible with workload analysis. Further, it provides base line information allowing a programme manager to eventually compare current task productivity against planned targets of time and quantity.

1.3 Scope

Workload analysis has no inherent ability to ensure qualitative results. Method effectiveness, if fundamentally sound is contingent on four premises:

I. Detailed specifications are compiled and are rigorously implemented.

II. Innovative employee training and motivation is undertaken.

III. Efficient, safe and properly maintained equipment is provided.

IV. Enlightened supervision of both staff and contractors is encouraged.

This work accepts de facto the need for overhead distribution and assumes that significant capital will not be committed in the foreseeable future to undergrounding large portions of the existing system. Some new subdivisions in the Region are presently being provided with underground service, but it is not expected that significant reduction of vegetation management workload will accrue for the system as a whole, although the problem of private shade or ornamental tree pruning may diminish in ensuing years.

Although beyond the scope of this report, it should be recognized that aggressive root encroachment of woody plants may, in the future, present problems with conduit services, as may the restoration of planted gardens and boulevards after excavation for underground cabling.

PART II

RATIONALE AND DISCUSSION

The rationale for vegetation control along distribution lines has two principal components; firstly, it substantially assists in ensuring a continuous uninterrupted supply of electricity to the consumer. Secondly, the safety of the general public and utility staff is contingent on the maintenance of adequate clearances between vegetation and energized conductors.

2.1 Problem Statement

Arborateous vegetation poses a threat to distribution systems in three ways:

- It may grow directly beneath the conductor as underbrush, small shade trees, and detruncated forest species; or
- It may grow beside the conductor, normally on the side furthest from the road access; and
- It may grow above the conductor as overhang from the spreading canopy of tall forest trees.

Such vegetation may either be adeciduate or deciduous in nature. The latter will normally constitute the greater hazard, since most species exhibit greater annual growth.

2.2 Peripheral Problems

In addition to the specific hazards noted previously, vegetation may also affect the reliability of communications circuitry, the access to physical plant, the safety of triplex services, and the security of anchor guys and tiebacks.

2.3 Detailed Hazards

I. Where growth of a tree is such that it contacts the conductor, power is diverted through the tree to ground, resulting in power loss. This also presents a hazard to anyone touching a tree, especially on wet days or touching a species of high conductivity.

II. Trees allowed to grow directly under the line with inadequate clearances, or trees which are allowed to grow with the conductor tunnelled through the canopy, can constitute a considerable hazard if the energized conductor can be then reached by children. Thus, in established clearances the possibility of children climbing trees and contacting the live conductor must always be borne in mind. Particular caution should be exercised regarding trees in or near school yards and recreational areas.

III. Small, dead or broken branches may fall and lodge between individual conductors, causing the line to short and trip out of service.

IV. Small, dead or broken branches catching on a live conductor and contacting the pole or line hardware, will partially or wholly ground the conductor, especially in times of high humidity, rain or snowfall.

V. Dominant leaders of a tree canopy allowed to short in the conductor constitute a fire hazard, especially in summer.

VI. Aggressive tree growth may partially obscure or hide street lights and diminsh the visibility of line hardware during inspection.

VII. Structurally unsound, diseased, or insect weakened trees and limbs may fall through the conductor resulting in substantial outages, broken poles, damaged hardware and hazards to public or staff.

VIII. Tall, poorly rooted brush or spindly trees may blow, or bend under weight of snow, into the conductor or crossarms causing intermittent or permanent line faults.

IX. Fast growing species under conductors may force the neutral wire into the phase wire, causing blow fuses and subsequent outages.

2.4 Organizational Statement

It is apparent from the above that a number of principal functions and attendant tasks face the vegetation manager. He must ensure that the specific tasks of vegetation control are carried out by qualified, trained staff or by properly supervised contractors. This must be implemented on a cyclical basis which reflects the rate of regrowth per tree, or per acre, of the undesirable plant species, and the consequent diminishing electrical clearances. He must further initiate some simple and reliable method of recording both productivity and subsequent system interruptions in order to satisfy the issue of cost versus benefit and to arrive at at judgement of alternative task methods. This may be shown in the simple value formula:

Number of faults x trouble call costs + loss of revenue x quality of service = expenditure on tree trimming + factor for safety + factor for aesthetics.

The aim must be to adopt work practices which reduce the cost per unit per annum before required treatment, by gradually extending the period of effective control.

These methods must not compromise the aesthetic appearance of vegetation to the extent of mutilation, but must recognize the manhour savings accruing from a relatively small reduction in manhours spent per unit over a substantial number of units. Obviously then, an equitable balance must be struck between appearance and clearance.

Techniques used now must also be sufficiently versatile to accept change. This may occur in funding, policy, procedure, responsibility, staff availability and training, or in the increased productivity which may result from the use of new equipment.

PART III

COSTS ASSOCIATED WITH VEGETATION HAZARDS

Costs associated with vegetation hazards cannot be readily discerned without accurate and detailed records. At present these records do not exist. Costs are primarily associated however, with the general categories suggested previously of safety, and reliability. Acceptance of potential or actual costs are apparently at present determined by varying subjective judgements as to the acceptable implicit hazards.

3.1 Safety

Vegetation burned in the conductor has been seen in a number of districts and is shown in the report illustrations. To date, no personal injury or fatality to a member of the public has been recorded as a consequence. The potential danger is, however, always present. Clear and explicit policy at the Regional level with regard to minimum clearance for vegetation that Power Districts must maintain, would largely overcome this hazard, as will identification of areas with troublesome fast growing tree species and a recommended trend towards cyclical problem management. Suggested minimum tree clearances for various line voltages are given in the Appendix, Table 1.

3.2 Reliability

The amount of protection required for the distribution system substantially predicates the cost. Task intensity, that is, the degree to which various jobs are undertaken, will determine the amount of time spent per line mile, as it is contingent on previous line clearing practices and present tree density, and thus the amount of time to be spent in each individual tree. Initial cost of complete protection may be high. However, with the passage of two or three retreatment cycles, costs should substantially decrease while reliability increases. Specific cost detail is reviewed in the district and regional summaries.

Records maintained by the Region have allowed a retrospective picture of actual outages to be drawn for both primary and secondary lines in each district as shown in Figure 1.

TREE OUTAGE SUMMARY
1974

Power District	TREE ON OR THROUGH PRIMARY	TREE ON OR THROUGH SECONDARY	TOTAL
WILLIAMS LAKE	8	2	10
VANDERHOOF	1	Ø	1
QUESNEL	15	8	23
PRINCE GEORGE	36	17	53
BURNS LAKE	17	Ø	17
MCBRIDE	1	Ø	1
FT. ST. JOHN	3	2	5
100 MILE	27	7	34
VALEMONT	3	Ø	3
DAWSON CREEK	4	Ø	4
(FORT ST. JAMES)	10	Ø	10
CHETWYND	7	3	10
FORT NELSON	1	Ø	1
TOTAL	133	39	172

FIGURE 1

From Figure 2 it may be seen that "trees through the line" comprise the largest number of all outages. In addition, categories (2) and (4) "fuse blown, reason doubtful" and "unknown" can be substantially attributed to thin, spindly vegetation, having caused intermittent contact with the conductor.

TROUBLE CALL SUMMARY

TEN MOST COMMON CAUSES: 1973 & 1974

1.	Tree on or through Primary	- 315
2.	Fuse blown, reason doubtful	- 163
3.	Other known	- 152
4.	Other unknown	- 134
5.	Transformer burnt out on overload standard	- 92
6.	Burnt or loose connection on Secondary or Serv.	- 90
7.	Birds, squirrels, etc. causing flashover	- 89
8.	Caused by outside party	- 88
9.	Transformer burnt out on overload e.p.	- 85
10.	Tree on or through Secondary	- 75

FIGURE 2

From data supplied by a C.I. Power District for maximum and minimum direct cost of outages it is possible to compile a range of basic costs for actual outages caused by trees in the year 1974, Figure 3. These costs which range from a low of $13,700 to a possible high of $34,400 do not reflect overhead or material expenditures and are based on a possible minimum of $80 comprised of two-man crew and vehicle, and a maximum of $200 for a three-man crew and vehicle required to affect a conductor splice outside normal working hours. If we assume that many of these outages occur during storm conditions and necessitate emergency work, it can be assumed that the higher figure is probably more reliable.

Indirect costs attributed to customer complaints and subsequent work, or cleanup of storm damage are not readily identifiable. Further, since present records do not record outage duration or number of customers effected, it is not possible to draw inference as to the effect on quality of service due to system failures occasioned by vegetation problems.

CALCULATED OUTAGE COSTS
- PRIMARY AND SECONDARY
LINES. 1974

Assumption: Minimum Cost = $ 80.00
Maximum Cost = $ 200.00

Power District	PRIMARY			SECONDARY			TOTAL	
	#	Min. Cost	Max. Cost	#	Min. Cost	Max. Cost	Min. Cost	Max. Cost
WILLIAMS LAKE	8	$ 640	$ 1,600	2	$ 160	$ 400	$ 800	$ 2,000
VANDERHOOF	1	80	200	∅	∅	∅	80	200
QUESNEL	15	1,200	3,000	8	640	1,600	1,840	4,600
PRINCE GEORGE	36	2,880	7,200	17	1,360	3,400	4,240	10,600
BURNS LAKE	17	1,360	3,400	∅	∅	∅	1,360	3,400
MCBRIDE	1	80	200	∅	∅	∅	80	200
FT. ST. JOHN	3	240	600	2	160	400	400	1,000
100 MILE	27	2,160	5,400	7	560	1,400	2,720	6,800
VALEMONT	3	240	600	∅	∅	∅	240	600
DAWSON CREEK	4	320	800	∅	∅	∅	320	800
(FT. ST. JAMES)	10	800	2,000	∅	∅	∅	800	2,000
CHETWYND	7	560	1,400	3	240	600	800	2,000
FT. NELSON	1	80	200	∅	∅	∅	80	200
	133	$10,640	$26,600	39	$3,120	$7,800	$13,760	$34,400

FIGURE 3

3.3 Policy

A clear policy as regards line protection must be a regional matter.

Three principal alternatives exist:

(1) A complete protection policy is introduced.

(2) A policy which differentiates protection by customer and/or line priority is adopted; or

(3) The discretion of foreman and to some extent external contractors, determine the areas which require more intensive work as the need arises.

Obviously, the third possibility must be discounted if it is agreed that planned cyclical treatment is preferable to random problem management.

At the present time, with severe budget restraints, a complete protection policy may not be attainable. Since this workload analysis used sample techniques to establish base line workload, it cannot identify specific areas of troublesome species on lines requiring greater protection.

As an initial pass, it does, however, provide a framework within which the individual districts may identify the broad relationship between tree growth, condition, the density per line mile, and past outage frequencies.

From this furnished information each district may assess past performance for effort expended, and predict desirable, yet attainable, future levels of protection, for each dollar spent.

CENTRAL INTERIOR POWER DISTRICTS

*History of Vegetation-Caused Outages

Year	Total Outages	Outages By Known Causes	Outages By Vegetation	Percent Of Total Outages	Percent Of Known Outages
1974	736	602	172	23%	28%
1973	450	260	73	16%	28%
1972	392	217	91	23%	42%
1971	427	258	65	15%	25%
1970	346	275	69	20%	25%
1969	407	338	75	18%	22%
1968	217	180	44	20%	24%
			Average Percentages	19.2%	27.7%

* As noted previously, outages of unknown cause may be largely attributable to intermittent interruptions caused by vegetation.

FIGURE 4

PART IV

MANAGEMENT TECHNIQUES AND IMPLICATIONS

4.1 General Techniques

The alternate methods chosen to control vegetation differ within the three general tasks of removal, pruning or trimming, and underbrushing. To some extent the methods are also governed by location, access and aesthetics.

4.1.1 Tree Removal

Municipal and residential tree removal normally presents difficulties of access and safety. Large and medium trees cannot normally be felled but must be removed in sections. Where ready access is available aerial ladders or trim lifts may be used to remove the tree in short sections from the crown downwards. Where this access is not available trees must be climbed, roped, cut, and lowered in sections. This work is skilled and hazardous. Dead or dying trees are particularly unsafe.

In rural areas it may be possible to fell and buck timber more easily. Energized conductors, farm fences, and travelled routes, may dictate skill in directional felling. Damaged, dead or leaning trees may require roping and strain winching.

4.1.2 Tree Pruning and Trimming

The techniques for cutting limbs and trimming branches follow the constraints of access and location. A further consideration of crown size may govern the equipment chosen. Large limb removal assumes larger tree size and normally necessitates mechanical access for aerial ladders or trim lift. Small short-bar power saws are required. Where manual tree climbing is necessary electric start saws are less hazardous for the tradesmen.

Where light trimming is required, insulated hydraulic pruners and circular saws are available for trim lifts. Pruners are more desirable, though slower, since hydraulic saws are difficult to use for lateral pruning. Small limbs may be cut with hand pruning saws. These should be a standard part of journeymen equipment and provided with a leather scabbard attached to the safety belt. Where tree trimming only is necessary on smaller trees, this is normally accomplished with insulated long handled pruners and similar pole saws.

4.1.3 Underbrushing

Hand or mechanical control of brush followed by chemical treatment of deciduous stumps to preclude delitescent sprout growth is the common practice. Hand control methods will vary depending on brush density and stem diameter.

Clearing axes, machetes, and slash hooks are slow, cumbersome, and leave hazardous mucronate stubble. Rotary brush saws are produced as adaptations to power saws by a number of manufacturers. They are both noisy and tiring to use over long periods. Rocky terrain increases the necessity for blade resharpening.

Mechanical brush cutting has been in the ascendancy since 1969 - 1970 with the controversy over chemical brush treatment and greater emphasis on aesthetic appearance. It is costly and restricted to undulating or level terrain. It is totally unselective and distruptive of ecological development. Tracked types are less desirable than rubber tired vehicles as they increase the risk of erosion and tend to scarify the humus, opening new seed beds. Attempts to deracinate deciduous brush, disc, and re-seed, have not been practiced on a wide scale. Although perhaps initially advantageous, questions regarding cost, length of control, aesthetics, and wild life habitat remain unresolved.

4.1.4 Clean Up

Burning or chipping are the two principal methods of residue disposal. Piling, trucking, and dumping is both costly and inefficient. Burning is restricted by season, fire hazard, and concerns for unnecessary air pollution. Chipping equipment is now available which will handle substantial limbs. It may be integral with an aerial bucket device or towed as ancillary equipment. Most chippers will either chip to the roadside or into a truck body for later dumping. A market for chips as soil improvers, mulch, playground cover, or farm use, may develop.

4.2 Protection

The degree of protection instituted at the Regional level may vary; the principal influences being those of acceptable risk, line priority, customer reaction to outages, emphasis on sound arboricultural practices, and budget constraints. It is obvoiusly desirable to strive for a condition of no outages attributable to vegetation. Past history is summarized in Figure 4.

4.2.1 Implication

This policy of complete line protection would mean providing protection from trees and all other forms of woody growth during the pre-determined cycles for distrubtion lines and communication circuits. This includes their guys, poles, transformers and other apparatus which can be considered a part of the installation. Such protection would encompass the following.

I. Removal of all deadwood which under normal wind conditions could strike the conductors or any part of the electrical apparatus in falling.

II. The reduction of crown height or breadth by the pruning or removal of sufficient branches to ensure that electrical clearance is maintained during the nominated cycle.

III. Institution of corrective pruning and good tree maintenance by the removal of stubby limbs and stubs, the correction of faulty flush cuts, and painting of tree wounds.

IV. Removal of such limbs as may be necessary for the maintenance of tree symmetry when, as in heavy pruning on one side, a condition of visual imbalance results.

V. Removal or stiffening of all limbs or main stems of trees, using acceptable arboricultural practices, if these parts of the tree would create a hazardous condition to the line during the clearing cycle.

VI. Cabling trees where necessary.

VII. Removal of such trees as is necessary in the interests of line protection.

VIII. Treatment, with an approved herbicidal formulation, of all stumps where adventitious growth could occur from either the root collar or roots.

IX. Provision of emergency line protection where necessary. This means providing emergency or short-term line protection by pruning or removing limbs or trees which are in contact with conductors or likely to be in contact within one year. As this is an inefficient work method, it should only be used in emergency situations.

4.3 Cycles

The natural evolution of plant communities in the Northern hemisphere is toward tall growing woody plants, predominantly coniferous. Removal by any means of this final climax vegetation or any intermittent stage, can only be transient with successional regeneration, returning anew toward arborateous species.

Individual species, both indigenous and exotic, progress through a life span characterized by substantial early vigor, slower main crown development, maturity, and final decadence. Removal of large limbs or branches during the first two stages normally stimulates growth in response to the additional sunlight available. Vegetation control practices on distribution systems are therefore of a recurring nature; control over time being referred to as the "cycle" and normally expressed as the number of elapsed years between treatments.

4.3.1 Criteria

A number of social, economic, and natural constraints restrict the term of cycles. The length of clearing cycles should be as long as possible, consilient with the following considerations:

I. As some species grow faster than others they must be controlled more often in certain locations to maintain designated clearances, indicating the necessity for short cycles.

II. Public safety alluded to in preceding sections will dictate the length of cycles where clearances diminish rapidly.

III. Optimum clearing cycles will depend on the established reliability requirements for specific lines.

IV. Remote accessibility of locations with reduced visibility to the general public may allow extended clearing cycles and substantial tree removal.

V. Public and private attitudes as to the appearance of treated vegetation will influence the permissible duration of cycles.

VI. Heavy tree density, high district line mileages, availability of contractural services or Authority trained staff and appropriate supervision, may necessitate lengthened pruning cycles.

4.3.2 Sequence of Cycles

Initial quantity of work may outweigh the need and opportunity to establish short cycles, however, once the bulk of undesirable vegetation has been controlled, manhours per line mile should diminish allowing a period of reduced cycles. Continuous cyclical maintenance and on-going corrective pruning should allow for a period of gradually increased cycles. In addition, chemical treatment of adventitious species should eventually encourage a cespitous plant community which naturally discourages woody regeneration.

4.4 Clearances

Factors of bioclimatic zone which influence and limit the growth rate and distribution of woody species, the type of line construction, particularly pole height, insulator or cross arm type, span length, topography, and the desired cycle between terms, prescribe the amount of clearance to be attained at each treatment. These factors may be incorporated in the general formulae.

I. The number of years in the cycle x increment of top growth + allowance for conductor sag = the amount of top clearance.

II. The number of years in the cycle x increment of side growth + allowance for conductor sag = the amount of side clearance.

4.4.1 Plant Morphosis

There are some 118 species either introduced or indigenous to the Central Interior Region, Appendix Table 2. Their distribution is largely contingent on prevailing climatic conditions. Inherent characteristics of, and between, species yield different growth rates. Variance within species can be ascribed to factors of site, influenced by elevation, aspect, exposure, rainfall, and soil type. Tree crown expansion continues until maturity and is both upwards (apical) and lateral. The more rapid this growth the greater the proportion of the canopy which must be removed during each tree trimming cycle.

For the purpose of clearance for electrical conductors it is sufficient to class species into general groups based on their relative growth rates under normal conditions.

I. Extra fast growing trees.
II. Fast growing trees.
III. Trees having medium growth rate.
IV. Slow growing trees.

4.4.2 Line Construction

Offset crossarms and stand-off insulators are two construction types which reduce the conflict between conductors and vegetation. These features are not in common use in the Central Interior. Determinant factor of construction in establishing clearances is that of span length. Construction technique dictates that conductors are strung with a designed sag. Temperature, icing and amperage will all increase sag under certain conditions. When sag increases, conductor sway increases, as ambient wind condition intensifies. This characteristic movement of the conductor must be allowed for in determining tree clearances. Appendix Table 1 indicates suggested clearances for different voltage conductors in the distribution system. As voltage or cycle increases, the amount of overhanging permissible decreases rapidly to zero.

4.5 Shade Tree Values

It is perhaps not recognized that shade and ornamental tree values have risen steadily in the last few years, as have the replacement costs for trees damaged or destroyed. It is therefore incumbent on supervisors, tradesmen and contractors to recognize the value of individual trees and to establish methods to control their undesirable growth which increases rather than decreases that value.

4.5.1 Value Calculations

The International Society of Arborists had adopted a

$10.00 per square inch of trunk cross-section as the conservative value of a perfect specimen shade tree.

Since not all species and varieties of trees are of equal value, a formula which determines the monetary value of individual specimens using three basic factors has been adopted. These are size, species, and condition of the tree. The area of the cross-section of the trunk at a point 4.5 feet above the ground (BH) is used to express size.

The same species of tree may have different values in different geographical locations, depending on its bio-climatic range. Therefore, a list of trees growing in the Central Interior has been compiled and the trees are segregated into classes based on relative value. Trees in Class 1 are valued at 100%, in Class 2 at 80%, in Class 3 at 60%, in Class 4 at 40%, and those in Class 5 at 20%.

To illustrate the method for determining the value of a shade tree, consider a European Birch with a trunk diameter of 8 inches at BH. By referring to Appendix Table 3, the trunk cross-section area of this tree is found to be 50.27

square inches. This birch has a basic value of $10.00 x 50.27 or $502.70. This would be the value of the tree if it were in Class 1 or 100% condition group. By referring to Appendix Table 2 it can be seen that European Birch in the Central Interior is in Class No. 2 - 80%, so its value is 80% of $502.70, or $402.16.

4.5.2 Replacement Costs

The replacement of damaged trees is an expensive and time consuming task. Moreover, subsequent maintenance for large trees is necessary for about one year to ensure establishment. Cost obviously increases with tree size. Trees up to 25 feet in height are presently costing between $1,500.00 and $2,500.00 for digging, transportation, planting, guying, and subsequent maintenance. Trees in the 12" caliper range, 45 feet tall, may cost as much as $5,000.00 per tree for establishment and maintenance. Any legal action which arose from tree deaths attributable to poor arboricultural practices would recognize claims and awards of this nature made in B. C. Courts.

4.6 Arboricultural Techniques

It is beyond the scope of this report to write detailed instructions on vegetation control practices. Revised work methods and specifications are being developed by the Vegetation Management Section, Structures Department, Operations Engineering. It is, however, possible to highlight salient points of importance.

4.6.1 Pruning

I. Drop Crotch Pruning:

The essence of drop crotch method of pruning is to retain the natural shape of a tree while making fewer but larger cuts. This leaves less pruning work and reduces the manhours required in crown pruning. It may also be used to lower tall weak wooded trees growing immediately adjacent to conductors. Where limb structure permits, leaders or upright growing branches are severed to a crotch well below the estimated height of the finished upper crown. Secondary branches may be removed entirely or cut back where they form a strong junction with a larger limb.

II. Crown Pruning:

Crown pruning refers to work performed in the upper crown or branch spread of a tree. It is probably the most difficult type of work to perform. Tradesman is often located in a position where it is difficult to assess the final result.

III. Side Pruning:

Side pruning normally involves trees growing immediately adjacent to the conductor. Side pruning is done to remove or shorten limbs or branches growing towards the conductor. It may also be used to remove limbs at circuit height which may blow into the conductor.

IV. Under Pruning:

This work, normally pertinent to large trees, involves raising the crown base to give clearance where the tree normally overhangs the conductor. Where branches are removed at the front for clearance an effort should be made to remove branches at the rear to produce a symmetrical form.

V. Corrective Pruning:

This work normally pertains to improving shade tree health by removing the weaker of rubbing limbs, flush cutting stubs from previous faulty pruning, wound tracing and painting tree wounds.

VI. Guy Wire Pruning:

Guy wires should be cleared in line clearing operations in order to prevent limbs chafing on the cable or growing against it, creating a strain on the pole or anchors.

VII. High Spot Pruning:

This method should only be used to provide temporary clearance for individual fast growing specimens which can outgrow a normal pruning cycle. Where apical growth only has been removed, clearance should be considered effective for no greater than one growing season.

4.6.2 Cutting

I. Drop Cutting:

This is used when a clean cut is desired on a limb that is leaning rather than perpendicular. In some cases the limb may be roped first to prevent it falling. If the cut is made properly the direction of fall can be controlled. The limb is first sawn on the underside until the saw binds, a saw cut is then made on top further out along the limb and sawn until the limb breaks through. This method is often used to stub back limbs before final flush cuts.

II. Hinge Cut:

One complete cut is made from the side opposite the direction required for the limb to fall or swing. Cuts of this type are continued until the weight of the limb allows it to hinge slowly in the direction required. As the limb is never entirely cut through, the holding or uncut wood acts as a hinge. Once the limb is hinged into the desired position, by hand for small limbs, or by rope for large limbs, the cut may be completed and the limb thrown or lowered to the ground.

III. Notch Cut:

This is used when removing a vertical or nearly vertical limb in much the same procedure as tree felling. Its principal application is in the topping of large trees. In hazardous locations, it may be necessary to rope the section to be cut allowing it to be held in the top of the tree before being safely lowered to the ground.

IV. Pruner Cuts:

Hydraulic and pole pruners are used extensively in line clearing operations. Branches may be shortened by making pruner cuts to reduce them. Limbs may be shortened prior to safe removal of sections with a hand saw. The basic tree form after drop crotch pruning is normally attained with pruner work. Cuts should always be cleanly made to a lateral branch directing the tree growth away from the conductor. Branches cut with the pruner should be sufficiently short as to allow them to pass between the conductors.

V. Flush Cuts:

These cuts on the main bole or in large branches of a tree are made in the crotch at the juncture of growth. Where the limb is removed no stub should exist. The cut should follow the natural curvature of the remaining branches. In this way no obtrusion restricts callus information during occlusion of the wound. Decay and sucker growth are substantially less when branch removal follows the flush cut method.

4.6.3 Miscellaneous

I. Bark Protection:

Tearing of bark through improper limb removal, the use of tree spurs in shade trees, and damage resulting from aerial devices, should be controlled. Resulting wounds can become a source of sucker growth or decay, weakening the health and vigor of individual trees.

II. Overhang Removal:

Ideally overhang should be completely eliminated, however, sound trees will be encountered where removal permission has been refused. In these cases overhang limbs should be cut back and lightened in a way so that they cannot break and strike the line during windstorms or heavy snow.

III. Deadwood Removal:

Deadwood where directly over or in the near vicinity of power lines is hazardous. Large dead limbs may fall or be blown into the conductor. Smaller limbs may span the phases causing an interruption. All deadwood should be removed, and extreme caution should be exercised in so doing. Where possible small limbs should first be broken off and then flush cut.

IV. Wound Treatment:

Fortified tree wound dressing which contain a chemical inhibitor to suppress the regrowth of dormant and adventitious buds after pruning, has been developed. Present formulations on the market vary in effectiveness. Asphalt dressings in aerosol cans are effective but expensive, heavier tree wound dressings with an asbestos base give some limited protection against insects but may mechanically interfere with wound healing. All cuts greater than 3 centimeters in diameter should be treated with tree wound dressing.

V. Cabling:

Although not common practice, use of cables and anchors to support weak limbs in trees of historic or aesthetic value may be necessary. Care and skill is necessary in installing and tensioning cables.

4.7 Training

Distribution vegetation management tasks may either be undertaken by B. C. Hydro, contractural staff, or a combination of both. In order that work is carried out safely, efficiently, and in accord with specifications, three levels of training appear necessary:

- Programme supervisors must have an adequate knowledge of the implications implicit in the specifications;

- B. C. Hydro staff carrying out vegetation control work must be sufficiently knowledgeable as to ensure their own safety and acceptable levels of productivity;

- Where contract work predominates emphasis must be placed on degree of supervision. The staff responsible for such supervision must be knowledgeable of basic arboricultural techniques embodied in the work specifications.

Appropriate levels of expertise should be developed in the following areas, consonant with job responsibilities:

I. Plant taxonomy
II. Basic plant anatomy and morphology
III. Basic plant physiology
IV. Plant ecology
V. Basic plant habits and factors influencing growth

VI. Reasons for underbrushing, trimming and pruning

VII. Methods of underbrushing, trimming and pruning

VIII. Equipment for underbrushing, trimming and pruning.

IX. Safety practices

X. Diagnosis of structural defects and disease.

XI. Tree surgery

XII. Public Relations.

4.8 Safety

Consideration of personnel safety must be paramount in the choice of work methods and the execution of all tasks. Hazards arise from three areas:

(a) Work may be carried out above, below, or beside energized conductors. This work can be carried out safely without service interruptions if staff are properly trained, competent, and equipped with tested insulated tools;

(b) Many of the tools used in vegetation management are cutting tools which give rise to a higher direct accident frequency and attendant injuries resulting from flying debris or dust.

(c) The incidence of falling and crushing injuries is greater with forestry tradesmen, who must contend with tree climbing, felling, and disposal. Safety saddle and safety rope use is fundamental to safe work practices. Use of protective boots, leggings, gloves, hard hats, as well as ear and eye protection must be stressed.

4.8.1 Responsibility

The responsibility for safe practices is four-fold. The Safety Department of B. C. Hydro, and the Workers' Compensation Board of B. C. are organizationally responsible. District Supervision carries the burden of responsibility in determining appropriate safe methods, and finally, the individual tradesmen must promote his own, and crew, safety.

4.8.2 B. C. Hydro

In suggesting an environmental maintenance trades category, it was felt that skilled staff should be developed to reduce the present dependency on contract workers. Distribution vegetation management was seen as only one part of a broader scope of responsibilities. The continued use of linemen for this work while recognizing current practices (S.P.R. 423) and Union jurisdiction, was felt to be inappropriate and inefficient use of labour. Other utilities allow live line caution tags to be held by forestry tradesmen. Establishing these practices after appropriate training and negotiating with Local 258, would allow patrolmen and linemen to be used in their optimum role. Substantial advances would be required in establishing a comprehensive S.P.R. code specifically for vegetation management tasks.

There has been a tendency to assume that contract work requires less effort than in-house operation. Some advantages and disadvantages are discussed elsewhere. However, contract work must receive adequate supervision. B. C. Hydro staff engaged in such supervision must be fully cognizant of safe and unsafe practices and must have a responsibility level which allows for direct control of contract employees.

4.8.3 Contract Work

Rigorous supervision of contract staff is apparently necessary to ensure their own safety. Certain "bravado" appears to be associated with utility tree work by some younger employees. This attitude can and has been fatal.

Use of improperly maintained, damaged, incomplete or untested aerial bucket devices can and has resulted in fatalities. Hand tools improperly stored or maintained are hazardous. On record are the use of aluminum pole saws and long handled Marvin pruners with wire ropes. The lethality of this ignorance or insoucience cannot be over stated.

At present it appears that some tree trimmers work completely on their own with only occasional visits from patrolmen. Less scrupulous employees trim trees actually burning from contact with the conductor rather than refer it to B. C. Hydro, as this upsets their work sequence. This contravention of safety regulations should cease.

4.8.4 Hazardous Trees

Hazardous working conditions are heightened with some particular situations. Every care must be exercised with the following:

I. Dead trees.

II. Trees or brush growing directly under the conductor with branches within the limits of approach.

III. Trees with their trunk extending between the conductors.

IV. Trees that have "U" shaped notches or tunnels cut through the canopy for conductor clearance.

V. Trees growing on the far side of the conductor with side limbs within the limits of approach.

VI. Trees with overhanging limbs, where removal may drop such limbs on the conductor.

4.8.5 Public Safety

It is natural for children to climb trees, particularly in the vicinity of play areas. Clearances should be obtained to preclude children touching the energized conductor. Removal of lower tree limbs may suffice.

Overhead work on public roads and highways should be adquately signed and patrolled by groundmen. At no time should severed limbs or branches be left in trees overnight. In addition, brush should be piled so that it presents no hazard to vehicles or pedestrians.

4.9 Public Relations

Vegetation control work can best be achieved by treating the public in a courteous, considerate manner. In addition, staff should be well presented, properly equipped, and knowledgeable as to the reasons for, and methods of, effecting the degree of control which is necessary to maintain adequate clearances.

4.9.1 Permissions

It has become corporate policy to be as responsive as possible to the feelings of the general public. The pruning or removal of privately owned trees is an area which places staff in a contentious position with the customer.

In order to alleviate possible tension between the Authority and the consumer, permission of the owner of a tree or trees should be secured before any work is commenced. This permission should be obtained by the persons performing the work, except in the case of municipalities where a written application should be filed. This should, however, be followed with verbal communication to indicate that work is starting in a particular location.

If private permission is refused the matter should be referred to the person authorizing the work. It is recognized that obtaining permission from absentee owners can be very time consuming and will contribute to inefficient work practices.

It is recognized also that those responsible for Vegetation Management Operations have a local understanding of the attitudes and concerns of property owners which enables them to carry out some aspects of the operation without contacting owners, provided a reasonable and sincere attempt has first been made. In these circumstances great care should be taken to effect control which in no way depletes the present aesthetic value of a tree.

Where permission to trim trees has been received, either verbally or in writing, the amount of clearance should be no greater than that consented to.

4.9.2 Heritage Trees

The intrinsic value of some trees to the community as a result of historic or landmark value, must be recognized in vegetation management practices. Great care should be taken to maintain these trees congruent with the principles of sound arboricultural practice. Tree removal should be exercised only as a last resort.

4.9.3 Damage and Clean Up

Every effort should be made to avoid damage to private property. If damage occurs it should be reported to the programme authorizing authority as soon as possible. In addition, standards of clean-up and disposal should leave no reason for public complaint.

4.10 Compatible Trees and Tree Replacement Programmes

Two fundamental approaches to reducing the conflict between trees and overhead distribution lines are evidenced in large programmes initiated and encouraged by other utilities to reduce the problem at source. Private property owners and municipal Parks Departments are encouraged in new planting to establish only small trees beside electrical lines, and where large gerontic species presently exist, to initiate a systematic replacement programme.

4.10.1 Compatible Trees

Federal statistics of shipped nursery stock by Province show that B. C. is amongst the major provinces where a large number of trees, especially fast growing species, are sold to the retail market. Private home owners are the principal recipients of this stock and some will plant it without due regard to position or eventual size at maturity. Some of these trees will become a hazard to the integrity of the electrical system. Responsibility therefore rests with the Authority to provide public education on the choice of compatible plant material and suitable locations for planting. Different species differ significantly in top height at maturity. In addition, the more compact the crown the less likely that trimming or removal will be necessary. Some species of tree with globe, fastigate or columnar crowns can be planted in reasonably close proximity to conductors. Tall forest species, with spreading crowns should be discouraged.

A number of North American utilities have produced well illustrated and informative coloured leaflets for distribution to the general public indicating the problems associated with overhead distribution and trees or frutescent species compatible with overhead lines.

4.10.2 Tree Replacement Programmes

Tree replacement programmes are normally undertaken on a cost sharing basis with municipalities. An annual payment is made to a joint fund which will allow for the removal, disposal, purchase, and replanting of trees on boulevards in residential areas. In commercial, industrial, and georgic areas, arrangements are normally made with the individual landowners. In the case of municipalities the work is ordinarily undertaken by Parks staff, whereas in the latter cases, either utility or contractural services are normally used.

4.11 Joint Use

Where communication lines are carried on the same poles as distribution lines, only side and under pruning are directly involved. Communication circuits are always carried on the lowest crossarm when the occur on low voltage or distribution structure, or are cabled below the neutral wire. Clearances should be provided to last the length of cycle for which the electrical circuits are scheduled. Communication lines which occupy a right-of-way jointly with other lines should receive the same clearances as for the distribution system, including underbrush control. Trees should be pruned or removed so as to give at least five feet clearances on either side of open circuits and large limbs should not be allowed to chafe on cable circuits.

4.11.1 Cost Sharing

A Cost Sharing Joint Use Agreement negotiated at the beginning of January 1971 exists between B. C. Hydro and British Columbia Telephone. Section 14, and in particular 14.02, defines right-of-way maintenance. B. C. Hydro is responsible for arranging and programming joint use vegetation management. Accredited costs for right-of-way maintenance on the joint use system are accumulated by B. C. Hydro in their 440 account. The cost sharing ratio of 60% to Hydro and 40% to B. C. Telephone is calculated annually on the total expenses. The present number of joint use poles in the Central Interior according to the latest computer record totalled 48,485; Hydro-only poles totalled 42,500. This gives a total of 90,985.

In 1974 the Central Interior distribution right-of-way maintenance account totalled $106,307.00. The total for all maintenance including ground line treatment, stubbing, etc. amounted to $190,283.00. An adjusted total including IBEW award and redistribution for an organizational change of Smithers district to the North Coast, amounts to $227,778.00. Accounts payable charge to B. C. Telephone is calculated by dividing the total maintenance cost by the total number of poles in the Region, arriving at a unit cost per pole, multiplying this by the number of joint use poles and calculating 40%. In 1974 this amounted to some $54,378.00.

4.11.2 Future Benefits

The cost sharing agreement should be recognized in assessing predicted maintenance costs in the Central Interior. However, B. C. Telephone have indicated an interest in renegotiating the agreement in the area of shared maintenance. Some dubiety exists as to whether B. C. Telephone received value for their shared costs. If cost sharing continues, the present system of account credits should examine the possibility of crediting account 440, rather than the present practice of using the General Maintenance Account 490. In this way District Managers will have a clear picture as to their actual and shared cost for vegetation management.

4.12 Contract Work

At the present time and in light of current economic constraints for some time in the future, the Region will be dependent on contract work. B. C. Hydro is presently bound by law to tender contracts exceeding $10,000.00. The nature of vegetation management control, especially in the area of tree pruning, and trimming, does not readily lend itself to block tendering. Recommendation No. 10 of the Task and Implementation Analysis suggested that in-house expertise be developed rather than extending present reliance on contract services.

Two basic methods of payment to contractors are presently in force:

- Lump sum payment for block tenders.
- Hourly payment on the master tree trimming contract.

B. C. Hydro has been poorly served in the past by using the tendering process for tree trimming work, which has allowed the lowest bidder to undertake work which has a significant aesthetic impact. Further, where stub cutting has predominated an unacceptable pollarded appearance results, and subsequent sucker growth negates the desired aim of extending cycles. Although initially taking more time, drop crotch and remedial pruning provides trees of more acceptable appearance and longer lasting clearances.

In tender evaluation it is not necessary to accept the lowest tender of those submitted, if adequate justification for so doing can be shown. Adequacy of contractors equipment, ability to perform safely with staff and equipment, and a quality of work which does not impinge on our policy of public relations, must be determining factors. Brush clearing specification, chemical control, and tree removal where the need for supervision and visual impact are substantially less, are more amenable to tender by unit price. Work quality is primarily reflected in adequate disposal of brush and sufficient coverage with chemical control.

A policy being established by the Vegetation Management Section in an E.O.E. should resolve the disagreement between Power Districts and Purchasing regarding the use of the master tree trimming contract, and its sometime flagrant misuse by sequential billing for ongoing work.

4.13 Contract Work Comparison

Advantages:

I. No Region capital investment.

II. Few direct union problems.

III. Low overhead - no direct benefits, holidays, etc.

IV. Higher productivity.

V. Fewer administrative hours

VI. Structure already set up.

VII. Team work

VIII. Versatility.

Disadvantages:

I. Dependency.

II. Unregulated availability (general and emergency).

III. Loss of flexibility.

IV. Extras increasing "real" cost.

V. Rising tender prices.

VI. Price fixing or lack of competition.

VII. Individual jobs require tender preparation time.

VIII. Policing required.

IX. Quality of training and hence standard of work inferior.

X. Unsafe practices.

XI. Insurance (responsibility and liability).

XII. Failure to fulfill contractural requirements.

XIII. No public relations benefits or feedback from customers.

PART V

WORK LOAD ANALYSIS AND DISCUSSION

5.1 Survey Techniques

Total distribution mileage in the Region is estimated as 5,536 miles. 100% survey of the system, although desirable for accuracy, is impractical with constraints of time, distance, and manpower. Since a 100% sample was not feasible a 10% random survey method was evolved. In addition, it was felt that adequate results were obtained with a survey which encompased only nine of the twelve Districts; Quesnel, Vanderhoof and North Peace Power Districts were not surveyed. The results for Burns Lake and Prince George were used to represent survey results for Vanderhoof and Quesnel respectively. Dawson Creek was used to represent North Peace. The results found in the Power Districts which were surveyed were then pro-rated on a miles of line basis to represent results for the Power Districts not surveyed.

5.11 Method

Although a random sample is less accurate than a complete sample, upper and lower confidence limits are predictable and experience in Ontario with this work using control check tests has shown the 10% sample to be very accurate.

Caution must be exercised, however, with extrapolations for specific sites based on tree density per line mile as the random sample method provides only averaged data.

In order to attain the desirable level of accuracy using the random technique, human influence of the sample selection must be reduced to a minimum. Where judgement is necessary in determining the field data it must be evenly applied throughout the study area. Two controls of reliabilty resulting from this recognition were exercised. The sample determination was based on ½ mile sample units randomly chosen from the district grid map record system. Base maps were divided into ½ mile blocks along all of the existing distribution system. These blocks were then numbered sequentially. A scientific random table was then consulted to arbitrarily determine sufficient numbers to the value of one tenth the total of the ½ mile sections. These numbers then corresponded to the actual ½ mile sections which has been pre-designated on the grid maps. This in turn indicated the actual field plots to be visited. The second precaution against influence of the results rested with the choice of one person only to carry out all of the field studies which diminished the possible variability in the recording of data. This person, already with a professional biological background, had field instruction on the recording of information and the determinant factors in assessing vegetation for the purpose of the survey. A form, Appendix Table 4 to record the field data was evolved which allowed information concerning brush growth, danger trees, and tree trimming needs to be assessed at one time.

Where no potential for future vegetative growth exists a NFN (no future needs) was recorded. This method of notation can accommodate situations which preclude or will not support natural regeneration. It does not have the capacity to predict new planting in close proximity to the conductors. A standardized procedure for completing the form was also prepared allowing continued studies using the same criteria for assessment.

Field samples were determined by measurement and occulor assessment. Sample starts were ascertained from the grid map and an International Scout fitted with a Footometer was used to measure the 880 yard plots. A distinction was drawn on the record forms between urban or "built-up" areas and rural or "low-density" areas.

5.12 Tree Trimming

Tree trimming in the Central Interior is primarily a city or urban task where retention of shade or ornamental trees is paramount.

Two criteria determine the expected workload:

- The total number of trees which would require trimming was recorded for the sample by dot tally;

- The urgency for such work was categorized as "immediate", "two to three years", or "future".

Variations of growth within coniferous species in a sample was normally averaged downward, and for deciduous species averaged upward. Where no tree trimming was apparent, this was also recorded.

5.13 Danger Trees

Danger trees were defined as those trees which were dead, damaged, diseased, weak rooted, or leaning towards the conductor, and posed a hazard to the line if they should fall. In addition, healthy trees which had substantially outgrown the average canopy height (wolf trees), and trees of disproportionate height to caliper ratios (whip trees) which occur in dense stands were included in the dot tallies. This latter category are often more hazardous to line security than those apparently unhealthy trees because of their increased susceptibility to wind damage.

5.14 Brush Growth

Species, present condition, and area are determinant factors in assessing brush growth. Distinction was made between coniferous and deciduous brush. Low growing shrubby species were not included. Comments were made if one particular brush species predominated.

Brush acreages were calculated by multiplying the right-of-way maintained width by the proportion of the sample length which did or could support brush growth. Right-of-way width was recorded in increments of five feet. An assessment was also made of the average height class and density of existing brush. Actual height does not necessarily provide an accurate picture of urgency for treatment since factors of terrain and line construction type may significantly increase clearances. Allowance was made for this by separating data into "immediate," "two to three" years, or "future" categories.

PART VI

ANALYSIS OF WORKLOAD AND COSTS

Data from the field survey has been detailed for the districts and accumulated to provide regional totals. All figures have been based on a policy of complete protection and treatment cycles of 5 years for tree removal, 5 years for rural tree trimming, 3 years for urban tree trimming, and 6 years for brush control using chemical methods. In addition, costs based on mechanical treatment have been included as this may be required in initial years where brush height and species composition preclude chemical treatment.

Should further discussion within the Region suggest lines, areas or whole districts which do not require complete protection, there would be a corresponding reduction in workload and programme costs.

Tables have been compiled which outline: Past practices and costs during 1972, 1973, and 1974; Tree removal manhours and costs; Tree trimming manhours and costs for urban and rural areas; Brush control by species, density and cost; and finally urban and rural brush control by height, class, density and cost.

Apparent discrepancies between programme and annual costs and manhours are accounted for by rounding down in division. Where necessary, data for North Peace, Quesnel, and Vanderhoof has been recorded separately to distinguish this pro-rated information from the detailed field data.

6.1 Danger Tree Removal

Removal of existing danger trees has been programmed over a 5 year cycle. This assumes that a two man climbing crew with appropriate chipper truck and chipper undertake the task. Where the preponderance of danger trees are within roadside reach it may be advantageous to consider a trim lift chipper combination for higher productivity. In the tabular compilation of danger tree removal the hourly column deals with job hours, not manhours which are summarized in the following district reviews. In calculating manhours it is assumed that average removal times will be in the order of 7 manhours per tree, or 3.5 crew hours. The location of danger trees has been split between urban and rural to allow for some assessment of possible increases in urban costs due to the more difficult work circumstances. In determining the cost, a blanket \$30 per hour for the two man crew has, however, been used because at present, records do not allow a distinction to be drawn between location costs. More detailed records will allow this in the future. Further, since tree removal is less likely in urban areas because of reluctancy on the part of of owners to give permissions, this category is largely restricted to rural, damaged, hazardous, or severely mutilated trees.

6.2 Tree Trimming

Since clearance in urban areas cannot normally approach that of rural areas as municipal and residental tree owners will not permit substantial trimming of shade trees, a three-year cycle has been adopted for this work. Where normal species predominate in the rural districts it was felt that a concurrent five-year cycle with tree removal was optimum. It is not normally possible to complete the required workload in one year of the cycle at the onset of a new programme. There must be a transitional stage as training, equipment, work programming and budgeting respond to the findings in the analysis. Accordingly, tree trimming needs were categorized by priority, into "immediate", "2 to 3 year", and "future" needs. Only three power districts required immediate work, and it is expected that this will be accommodated by existing planning in 1975. Once a decision on protection policy has been discussed and formulated, the initial cyclical programming can be undertaken by all districts.

In calculating costs it was assumed that resources would include a two-man crew with aerial insulated trim lift truck. The increased cost per hour over tree removal is accounted for in the rate per hour charged for bucket trucks. However, this equipment allows substantially higher productivity on roadside trees than can be obtained with manual tree climbing. An abritrary judgement was made that a two-man crew would require one hour per tree for tree trimming in the first 5-year cycle. This two manhour figure is substantially higher than the current 0.8 to 1.2 manhours presently used by other utilities. However, these figures reflect sophisticated training, substantial expertise, and the passage of up to five 5-year cycles. These utilities now have a minimum of corrective pruning, and removal of deadwood, overhang, or large limbs, left to be carried out, a situation very far from pertinent to B. C. In the Central Interior manhours per tree should also decline with each full cycle and the suggested removal programme of unsound and undesirable species.

6.3 Brush Control

The assessment of workload associated with undesirable brush species must contend with a large number of variables which can and will directly affect the method and cost determinations. The differentiation between urban and rural allows for a distinction to be drawn as regards acceptable aesthetic treatment. Unlike tree trimming and tree removal where single units (per tree) form the basis of calculations, brush control analysis has been based on an acre unit.

Since the proposed P.P.I. on herbicide use precludes spraying roadside brush greater than 3 feet in height, in response to public concern it was felt advantageous to record percent of the deciduous and coniferous brush. Those areas predominantly coniferous in character may be cut without the threat of rapid regrowth since these genera do not regrow readily when cut below the lowest whorl.

As with tree trimming, the priority of work is classed by "immediate", "2 to 3 years", and "future" need. Where chemical control is suggested, it is anticipated that it will be effective for 6 years before retreatment is required. However, where mechanical control is felt necessary by the district, it is anticipated that only 3 years effective control can be expected. To illustrate this, costs have been calculated to provide a comparison yearly cost per acre for a 6 year cycle. Choice of method and of course subsequent cost is to some extent related to brush density. To date, incomplete records do not allow a clear distinction to be drawn on this basis. As more work is undertaken this data will allow detailed cost to be assembled from the analysis, which already distinguishes brush by percent cover. In arriving at the acreage cost, some license was taken with the cost comparison to arrive at a balanced comparison in 1976 dollars.

Mechanical cutting on record has been as high as $325 an acre. Although this partially reflects substantial down time on the equipment and very rough terrain, a continuous productivity rate has been obtained of one-half acre per hour including service and down time in the United States with the Hydro Ax equipment on rolling terrain with a minimum of stumps and rocks. Brush density does not appear to significantly affect productivity except in rocky areas where it obscures visability. Rental and contract cost of the equipment has been taken at $60 per hour. As this equipment cannot manoeuver in some steep locations, it is necessary to supply a banksman who can cut difficult brush by hand and also ensure operator safety. Acreage cost has therefore been set at $150. With a banksman and an operator, an acre of work represents 4 manhours.

With the height constraint of 3 feet for roadside spraying, it will be necessary to initially cut some brush and then subsequently spray deciduous species. In determining the district workloads it has been assumed that 1 year will be required to complete all mechanical cutting. Thereafter maintenance would be carried out by chemical control only. As soon as practicable after cutting, deciduous stumps may be treated with herbicide in oil to prevent pullulation. This work has proven time consuming and difficult to accomplish where debris from the brush cutter is heavy. A second method, which is feasible though possibly undesirable in that it requires a return to the right-of-way a second year, is to allow a complete growing season to elapse after cutting and any resulting sucker growth is then treated with a normal aqueous formulation of selective herbicide. Until more reliable costs are accumulated it will not be possible to judge as to the more efficacious of the two methods. The basic workload information is available which allows for these calculations once the cost data is available in the spring of 1976. The maintenance spraying would require a 2 man crew with backpacks for small acreages or a small 4 wheel drive vehicle and hydraulic sprayer for larger acreages.

As an alternative to intital cutting of tall or dense brush, and where feasible with constraints of soil type and terrain, consideration may be given to bulldozing and burying brush. These areas should be disked and hydro seeded with a mixture of grass species. Care should be taken in the choice of seed to ensure that species are compatible with local soil, drainage and land use. Permission for such work may be necessary from the Department of Highways, or appropriate landowners. Care also should be exercised to protect water courses and water supplies from silting during clearing. The initial cost of this work may be high if the areas are relatively small and remote. Where such work is undertaken, records should be kept which distinguish initial cost and subsequent maintenance cycle costs, to determine if this type of grooming is cost effective.

Power district analyses follow.

6.4 Power District Analyses

BURNS LAKE

Present Practice

An annual maintenance check is made of the whole district. Line Work Orders are completed for danger trees and brush clearing. Vegetation growth rates in the area are estimated to be in the range of 1½ feet per year.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	3,040	21,280	1,520	319,000
1 year of cycle	608	4,256	304	63,840

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
0	40	180	220	4,400	0	220	34	560	11,200	928	18,528
1 yr. of cycle					1 yr. of cycle						
0	13	60	74	1,464	0	44	68	112	2,240	186	3,704

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Urban Costs ($)	12.1	24 $ 1,211	48 $ 1,816	4 $ 202	16 $ 605
Rural Costs ($)	268.3	537 $26,833	1,073 $40,249	89 $4,472	358 $13,416
Total Costs ($)	280.4	561 $28,044	1,122 $42,066	93 $4,674	374 $14,022

CHETWYND

Present Practice

Chetwynd District is patrolled annually in the spring with danger trees, tree trimming, and underbrushing noted on an immediate or following year basis. The district suggests that outside help will be necessary to meet an increasing workload.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	740	5,180	370	77,700
1 year of cycle	148	1,036	74	15,540

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
0	0	80	80	1,600	0	60	40	100	2,000	234	4,660
1 yr. of cycle					1 yr. of cycle						
0	0	27	27	532	0	12	8	20	400	47	932

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

	Acres	6 year programme		1 year of cycle	
		Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Urban Costs ($)	-	-	-	-	-
Rural Costs ($)	384.7	769 $38,472	1,539 $57,708	128 $6,412	513 $19,236
Total Costs ($)	384.7	769 $38,472	1,539 $57,708	128 $6,412	513 $19,236

FORT NELSON

Present Practice

No information on present practices in Fort Nelson was available.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	950	6,650	475	99,750
1 year of cycle	190	1,330	95	19,950

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
0	0	0	0	0	0	120	0	120	2,400	120	2,400
1 yr. of cycle					1 yr. of cycle						
0	0	0	0	0	0	24	0	24	480	24	480

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Urban Costs ($)	27.2	54 2,722	109 4,083	9 454	36 1,361
Rural Costs ($)	109	218 10,906	436 16,359	36 1,818	145 5,453
Total Costs ($)	136	272 13,628	545 20,442	45 2,272	182 6,814

McBRIDE

Present Practice

The district examines the system in each spring. However, lack of staff has precluded underbrushing in the past 2 years and danger tree removal is conducted on a minimal basis. Annual growth rate of up to 4 feet is noted.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	330	2,310	165	34,650
1 year of cycle	66	462	33	6,930

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
0	340	0	340	6,800	0	0	0	0	0	340	11,332
1 yr. of cycle					1 yr. of cycle						
0	114	0	114	2,266	0	0	0	0	0	114	2,266

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

	Acres	6 year programme		1 year of cycle	
		Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Urban Costs ($)	18	36 1,817	72 2,725	6 303	24 908
Rural Costs ($)	104.7	209 10,472	418 15,708	35 1,745	139 5,236
Total Costs ($)	122	245 12,289	490 18,433	41 2,048	163 6,144

100 MILE HOUSE

Present Practice

No specific information on the present vegetation control programme was provided.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	2,250	15,750	1,125	236,250
1 year of cycle	450	3,150	225	47,250

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
0	0	0	0	0	20	80	0	100	2,000	100	2,000
1 yr. of cycle					1 yr. of cycle						
0	0	0	0	0	4	16	0	20	400	20	400

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Urban		0	0	0	0
Costs ($)	0	0	0	0	0
Rural		907	1,814	151	605
Costs ($)	453	45,356	68,034	7,559	22,678
Total		907	1,814	151	605
Costs ($)	453	45,356	68,034	7,559	22,678

PRINCE GEORGE

Present Practice

No information provided.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	3,100	21,700	1,550	325,500
1 year of cycle	620	4,340	310	65,100

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
200	2,780	320	3,300	66,000	780	4,280	300	5,360	107,200	10,860	217,200
1 yr. of cycle					1 yr. of cycle						
67	927	107	1,100	22,000	156	856	60	1,072	21,440	2,172	43,440

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

	Acres	6 year programme: Herbicide Manhours/$ or	6 year programme: Mechanical Manhours/$	1 year of cycle: Herbicide Manhours/$ or	1 year of cycle: Mechanical Manhours/$
Urban		53	106	9	35
Costs ($)	26.7	2,670	4,006	445	1,335
Rural		1,095	2,189	182	730
Costs ($)	547.31	54,731	82,096	9,122	27,365
Total		1,148	2,296	191	765
Costs ($)	574	57,400	86,100	9,566	28,700

DAWSON CREEK

Present Practice

The district is endeavouring to establish 6 year cycle for brush clearing which will clear two years in advance those sections designated for pole test and treat programmes. This work is normally carried out by contract and is recorded on schematic maps.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	2,520	17,640	1,260	264,600
1 year of cycle	504	3,528	252	52,920

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
0	700	420	1,120	22,400	0	3,780	140	3,920	78,400	5,788	115,728
1 yr. of cycle					1 yr. of cycle						
0	233	140	374	7,464	0	756	28	780	15,680	1,158	23,146

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Urban Costs ($)	6.0	12 605	24 907	2 101	8 302
Rural Costs ($)	803.8	1,608 80,380	3,215 120,570	268 13,397	1,071 40,190
Total Costs ($)	809.8	1,620 80,980	3,239 121,470	270 13,498	1,079 40,492

VALEMOUNT

Present Practice

No information was provided on present vegetation management practices.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	140	980	70	14,700
1 year of cycle	28	196	14	2,940

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
0	560	0	560	11,200	0	0	0	0	0	940	18,720
1 yr. of cycle					1 yr. of cycle						
0	188	0	188	3,760	0	0	0	0	0	188	3,760

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Urban Costs ($)	3	6 300	12 450	1 50	4 150
Rural Costs ($)	509	1,018 50,904	2,036 76,356	170 8,484	679 25,452
Total Costs ($)	512	1,024 51,204	2,048 76,806	171 8,534	683 25,602

WILLIAMS LAKE

Present Practice

Williams lake surveys the system each year and reclearing is done on an "as required" basis. The district feels that they have 1500 acres or right-of-way of which 1000 acres require brush control. This information is in conflict with the survey results of 1050 acres of which only 513 can support brush.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	2,350	16,450	1,175	246,750
1 year of cycle	470	3,290	235	49,350

Tree Trimming

Urban Manhours					Rural Manhours					Grand Total *	
Imm	2-3	F	Total	$	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme					5 yr. programme						
0	0	120	120	2,400	160	80	0	240	4,800	440	8,800
1 yr. of cycle					1 yr. of cycle						
0	0	40	40	800	32	16	0	48	960	88	1,760

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Urban Costs ($)	44.5	89 4,452	178 6,678	15 742	59 2,226
Rural Costs ($)	469	938 46,902	1,876 70,353	156 7,817	625 23,451
Total Costs ($)	513	1,027 51,354	2,054 77,031	171 8,559	685 25,677

NORTH PEACE

Present Practice

Areas which require underbrushing are determined by field inspection and recorded on schematic drawings. Underbrushing work is carried out by temporary summer help.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	2,948	20,636	1,474	309,540
1 year of cycle	589	4,127	295	61,908

Tree Trimming

	Combined Urban and Rural Manhours					Grand Total *	
	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme	0	1,048	234	1,282	25,640	2,140	42,800
1 yr. of cycle	0	350	78	428	8,560	428	8,560

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Total Costs ($)	220	440 22,000	880 33,000	73 3,667	293 11,000

QUESNEL

Present Practice

A survey is presently being conducted to determine underbrushing and tree trimming needs. This information is recorded on schematic maps.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	1,828	12,796	914	191,940
1 year of cycle	365	2,560	183	38,388

Tree Trimming

	Combined Urban and Rural Manhours					Grand Total *	
	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme	90	566	120	776	15,520	1,292	25,840
1 yr. of cycle	30	180	40	258	5,160	258	5,160

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Total Costs ($)	108	216 10,800	432 16,200	36 1,800	144 5,400

VANDERHOOF

Present Practice

No information was available on present practice in this district. However, the district feels that results for Burns Lake and Prince George used to represent Vanderhoof may well over estimate the amount of work since rainfall in that area is substantially less than in the other two districts.

Workload and Cost Analysis

Danger Tree Removal

	No. of Trees	Manhours	Crewdays	$
5 year programme	3,177	22,239	1,588	335,585
1 year of cycle	635	4,448	318	66,717

Tree Trimming

	Combined Urban and Rural Manhours					Grand Total *	
	Imm	2-3	F	Total	$	Manhours	$
3 yr. programme	96	962	288	1,346	26,920	2,242	44,840
1 yr. of cycle	32	320	96	448	8,960	448	8,960

* 3 year cycle pro-rated upwards to give 5 year programme costs.

Brush Control

		6 year programme		1 year of cycle	
	Acres	Herbicide Manhours/$ or	Mechanical Manhours/$	Herbicide Manhours/$ or	Mechanical Manhours/$
Total Costs ($)	162	324 16,200	648 24,300	54 2,700	216 8,100

VII

DISTRICT CONCLUSIONS

Until such time as detailed costs and productivity can be established, arbitrary and averaged figures must be applied to determine the general order of magnitude for each task in the respective districts.

To establish the basic suggestions for each district a number of criteria regarding work time were assumed. An actual working year for a Hydro tradesman who might undertake vegetation management tasks was calculated as: 6 hour working day allowing for travel and set-up time; and 187 working days allowing for vacations, negotiated reduced work weeks, statutory holidays and time off due to illness or incapacity. This equals a yearly manhour value of 1,022. Weeks of work for two-man crews are arrived at by dividing manhours by 60, calculated as 12 hours per crew day x 5 days per week. In determining work weeks it is assumed that crew strength would be maintained with floating personnel to accommodate individuals time off.

Recommendations regarding choice of contract or in house labour and regional tree trimming are based on apparent workload per year and the geographical location of specific districts. When suggestions are made for contract services it should be remembered that some supervision hours must be allowed for by the respective districts.

7.1 Fort Nelson

The 22 weeks' work in danger tree removal and the 0.4 weeks of tree trimming, are not sufficient to warrant a full-time crew. The predominantly dense brush in the 4 - 12 feet range will require initial mechanical cutting and subsequent chemical treatment on the suggested 6 year cycle. Initial cutting will require 3.7 weeks of contract work. Stump treatment should not be necessary at this time. The cut areas should, however, be programmed first in the chemical control cycle which would then subsequently treat the acres in the "2 to 3 year" category, and eventually the acres requiring future control. Spraying the annual 22 acres on the cycle would require only one week per year for a two-man crew with truck and backpack sprayers. The relatively small nature of the programme and the rather remote location of Fort Nelson would indicate that contract work may be the most efficient method of undertaking this district's vegetation management tasks.

7.2 McBride and Valemount

Tree removal in the two districts amounts to 11 work weeks for a two-man crew. Tree trimming would require 5 weeks. The relatively small number of outages in these two districts due to trees certainly does not indicate a more intensive programme.

McBride brush control data would indicate the need for approximately 28 acres of brush requiring immediate control. It would seem best that this be handled by contract. The 40 acres of work in the next 2 - 3 years, and the 7 acres from Valemount could be similarly handled. The work would be accomplished in about 5 weeks. Subsequent control would be effected by foliar spraying of small brush. On a 6 year cycle 110 acres would require treatment, which accounts for 4 weeks' work by a two-man crew. Again, it would seem appropriate to undertake these programmes for the two power districts by contract.

7.3 Chetwynd, Fort St. John, Dawson Creek

The respective tree trimming crew weeks of 0.8, 19.3, and 7.1 in the three districts amount to 27.2 weeks and are insufficient to support a crew alone. However, tree removal at 17.2, 58.8, and 68.7 requires a total of 144.7 crew weeks which will require two crews full-fime with a deficiency of some 40 weeks. A single tree trimming crew could contribute 25 weeks, the remainder being made up by contract. It is suggested therefore that a tree trimming crew be resident in Dawson Creek as the bulk of the workload is in this district, while Chetwynd and Fort St. John each have a tree removal crew which would be assisted in part of the year by the tree trimming staff.

Analysis of brush control in the districts is complicated by the pro-rated information for North Peace. An arbitrary distribution based on Dawson Creek was used to break the total 220 acres into 140 requiring future treatment and presently supporting brush less than 4 feet in height, and 80 acres in the 4 to 12 feet height class. It would appear that the three districts taken as a whole have slightly more than 200 acres requiring immediate control. 13.6 weeks of contract mechanical brush cutting would eliminate this problem. Each year of the subsequent maintenance cycle would then require 235 acres to be treated chemically on the 6 year programme. This amounts to 7.8 weeks of work which either can be undertaken in late spring and early summer by temporary employees, or as contract work.

7.4 Burns Lake, Prince George, and Vanderhoof

The over 80 outages caused by trees in these districts indicate the need for a comprehensive vegetation management programme. Cumulative tree trimming needs for Burns Lake, 100 Mile House, Prince George, Williams Lake, Quesnel and Vanderhoof amount to 52.7 crew weeks. As Prince George is fairly central it would seem possible to establish a trim lift and crew in that district and allow it to service all six districts.

Burns Lake tree removal crew accounts for 70.9 weeks while Prince George and Vanderhoof require 72.3 and 74.1 respectively. Each of these are substantial needs. A possible solution would be to establish 2 two-man crews in Vanderhoof providing a surplus of 30 crew weeks which would be distributed to Prince George and Burns Lake. Prince George's requirement is for some 72.3 weeks. A tree removal crew established here, with 10 weeks assistance from Vanderhoof and a further 10 weeks assistance from Quesnel would meet the workload requirement. Burns Lake with 70.9 weeks would benefit from 20 weeks available from Vanderhoof plus 52 weeks provided by a full-time district crew.

The present brush problem in these districts is greater than in the balance of the region, with some 16 acres in Prince George alone above 12 feet in height and some 180 acres in the three districts between 4 and 12 feet. The total 196 acres should be mechanically cut by contract and subsequently treated during the maintenance cycles with selective herbicide. Initially cutting will require 13 weeks of work. Subsequently annual workload amounts to 170 acres each year on a 6 year cycle which will require 5.6 crew weeks of chemical brush control by either contract personnel or district staff.

7.5 Quesnel, Williams Lake and 100 Mile House

The tree trimming needs of these districts would be met by a travelling crew from Prince George. Annual tree removal for Quesnel amounts to 42.6 weeks; a permanent crew could be established in this district and would also provide 10 weeks of assistance to Prince George. 100 Mile House has workload of 52.5 crew weeks; obviously met by establishing a resident crew. Williams Lake presents a similar siutation with 54.8 crew weeks' work. This work force should substantially reduce the current outage frequencies of 34 in 100 Mile House, 23 in Quesnel, and 10 in Williams Lake which were attributed to vegetation.

Brush control in the three districts amounts to 180 acres requiring mechanical control of brush greater than 4 feet in height. Here it would seem reasonable to cut the brush by contract. This will require 12 weeks' work. Subsequent maintenance will require 166 acres of small brush to be chemically treated annually over the 6 year cycle. This will require 5½ crew weeks of either contract or district work depending on the availability of staff.

7.6 Record Forms

Seven forms are enclosed in this report for interest only as they are designed specifically for use by the Forestry Department of Ontario Hydro. The use of each form is explained by written comment on each.

Historically record-keeping has not received wide acceptance in B. C. Hydro. Where problem management is not conducted on a planned cyclical basis, and where the choice of task methods is limited comprehensive records are not perhaps necessary. However, regional and district managers are presently unable to judge accurately as to their present programme needs or the cost effectiveness of various methods for specific districts. Further, budgeting rationale for 5 or 10 year periods can only be established from a benchmark of current data to be effective.

Present fiscal constraints demand the establishment of reasoned task priorities. Although vegetation management tasks may be delayed for some years, plant growth will ultimately endanger system security. The longer vegetation is allowed to grow, the more expensive and complex become the methods of control. The false economy in delaying vegetation management tasks can be well illustrated with accurate costs. In addition, with the recommended trend towards integrated vegetation management, emphasis must be placed on efficient and effective task scheduling. Some of the attached forms illustrate a method which assists this process.

Similar, though perhaps less sophisticated forms would require preparation to assess the effectiveness of the recommendations contained in this report and for the districts to compile historical profiles of their vegetation management practices. In addition more detailed records would be required to report the work undertaken by contract.

Record-keeping should not be burdensome; properly designed and implemented it should be a flexible, dynamic, management tool which substantially assists in planning, implementing, and maintaining advanced management techniques and field methods.

VIII

RECOMMENDATIONS

I. The region establish some forum for review of the recommendations contained in this Report which allows for free discussion by those affected.

II. The region establish broad guidelines for the districts which outline the policy of protection against outages caused by vegetation.

III. Some distinction be drawn within the policy of protection between various line voltages and criteria established which allow judgements to be made on priority of protection for different lines in the system.

IV. Training at three levels, embracing the subjects detailed in this Report should be undertaken for programme supervisors, tree removal or tree trimming crews, and for supervisors of contract operations.

V. Discussions be opened with the IBEW concerning the establishment of a recognized trades category for utility arborists. Such a category already exists but at present is not part of Local 258.

VI. Where appropriate, staff appointed to vegetation control crews should be given suitable training which will enable them to take out live line caution tags. This will allow work on vegetation which would normally be within the limits of approach.

VII. That the region, Vegetation Management Department of Operations Engineering, and the Safety Engineering Department, review the safety practices of other major utilities engaged in distribution vegetation control with a view to establishing a comprehensive safety practices code.

VIII. That owner's permission be received before any work be undertaken on trees on private property. Where municipalities are the responsible party, written application to trim or remove should be made by B. C. Hydro.

IX. That a booklet detailing the problems faced by the utility in maintaining overhead electrical services, the hazards associated with vegetation growth, and the species of tree compatible with the system, be prepared. This booklet should receive wide customer circulation and be made available at garden centres or plant nuseries.

X. Wherever possible, and within reasonable economic constraints, a programme of incompatible shade tree removal be established by subsidizing replacement of such trees by low or narrow growing specimens.

XI. The regions should consider direct consultation with the Joint Venture Group in order to establish the long-term protection needs of B. C. Telephone and the burden of cost which is appropriate for that degree of protection. Without this information it will not be possible to determine accurate long-term budget expenditures.

XII. Where contract work is undertaken in the region it should conform to clear, detailed specifications, properly supervised and enforced. Tree trimming work should not be conducted on a block basis which has lead to poor workmanship. Where hourly based work is substituted, however, productivity standards should be prepared which indicate if the district is receiving value for money by comparing the number of trees treated with a known manhour per tree element.

XIII. That the region initiate with the Vegetation Management Section of Operations Engineering a standardized record system which provides a comprehensive appraisal of work undertaken.

XIV. That the present vegetation management needs in Fort Nelson, McBride, and Valemount, be handled solely by contract.

XV. That the tree trimming needs of Chetwynd, Fort St. John, and Dawson Creek, be accommodated by establishing a fully trained two-man crew, equipped with an insulated trim lift, in Dawson Creek. Tree removal for the 3 districts should be handled by tree removal crews based in Chetwynd and Fort St. John. Tree removal needs determined by this Report should, however, receive close scrutiney by the districts and the possibility of establishing one removal crew only at this time should be examined. In the future, a crew could be established if complete protection is deemed necessary and the first crew cannot make significant progress in reducing the workload. If only one removal crew is initially planned it should operate from Fort St. John. Any deficiencies precipitated by shared work should be filled by contract. Tall brush should be mechanically cut by contract and subsequent maintenance should be undertaken with selective herbicides. Staff availability will determine if contract work is necessary. As tree trimming and danger tree removal diminishes, the workload involved for brush control may be accommodated by these staff.

XVI. In Burns Lake, Prince George, and Vanderhoof, tree trimming needs of these three districts, plus Quesnel, Williams Lake and 100 Mile House, should be handled by a travelling tree trimming crew established in Prince George. Each of the first three power districts should also have a tree removal crew. In addition, the workload in Vanderhoof should be examined by field sample and the need for a second crew in the future established as soon as possible. Tall brush control in these districts should be undertaken by contract. Subsequent maintenance will depend on the availability of trained staff.

XVII. Quensel, Williams Lake, and 100 Mile House tree trimming needs will be accommodated by the crew from Prince George. Danger tree removal should be undertaken by resident crews in each district with the Quesnel crew assisting in reducing the workload in the southern part of the Prince George District. Again, initial brush control should be undertaken by contract and subsequent maintenance by either B. C. Hydro staff or by tender.

XVIII. Since this workload analysis has been prepared using a sample technique which assesses total workload within a district but does not distinguish trouble spots or determine work schedules, detailed District Vegetation Control Plans should be prepared jointly between the Regional Office and the District Managers. This plan using the system grid maps as a base, should clearly set out District Objectives, planned cyclical programmes and their location, off-cycle trouble spots and their location, areas to be contracted - their location and contract specifications, areas for chemical vegetation control, and other pertinent information to assist the Districts in planning and designing the logistics of their individual programme. Where appropriate this management plan should dovetail with extisting programmes as in the case with test-and-treat cycles.

XIX. Further investigation into the relationship between system reliability and vegetation management expenditures should be pursued. The computerized management information system will provide data on outage duration and cause. The cost system budget will provide information on maintenance projects and expenditures to date. An attempt should be made to reconcile this data and prepare an analysis of programme effectiveness. This study should continue until after the passage of at least two complete cycles for both rural and urban maintenance.

XX. Since this report examined existing workload only, a further long-term study should be undertaken which assesses and accommodates changes in the vegetation management programme precipitated by system expansion. This should be completed by the Fall of 1976 and should examine in depth clearing practices on new distribution lines, and predict modifications to the existing workload analysis based on data collected during 1975 and early 1976. Also at that time a complete assessment should be made of regional vegetation management staff and equipment resources and their effectiveness in the Central Interior Region.

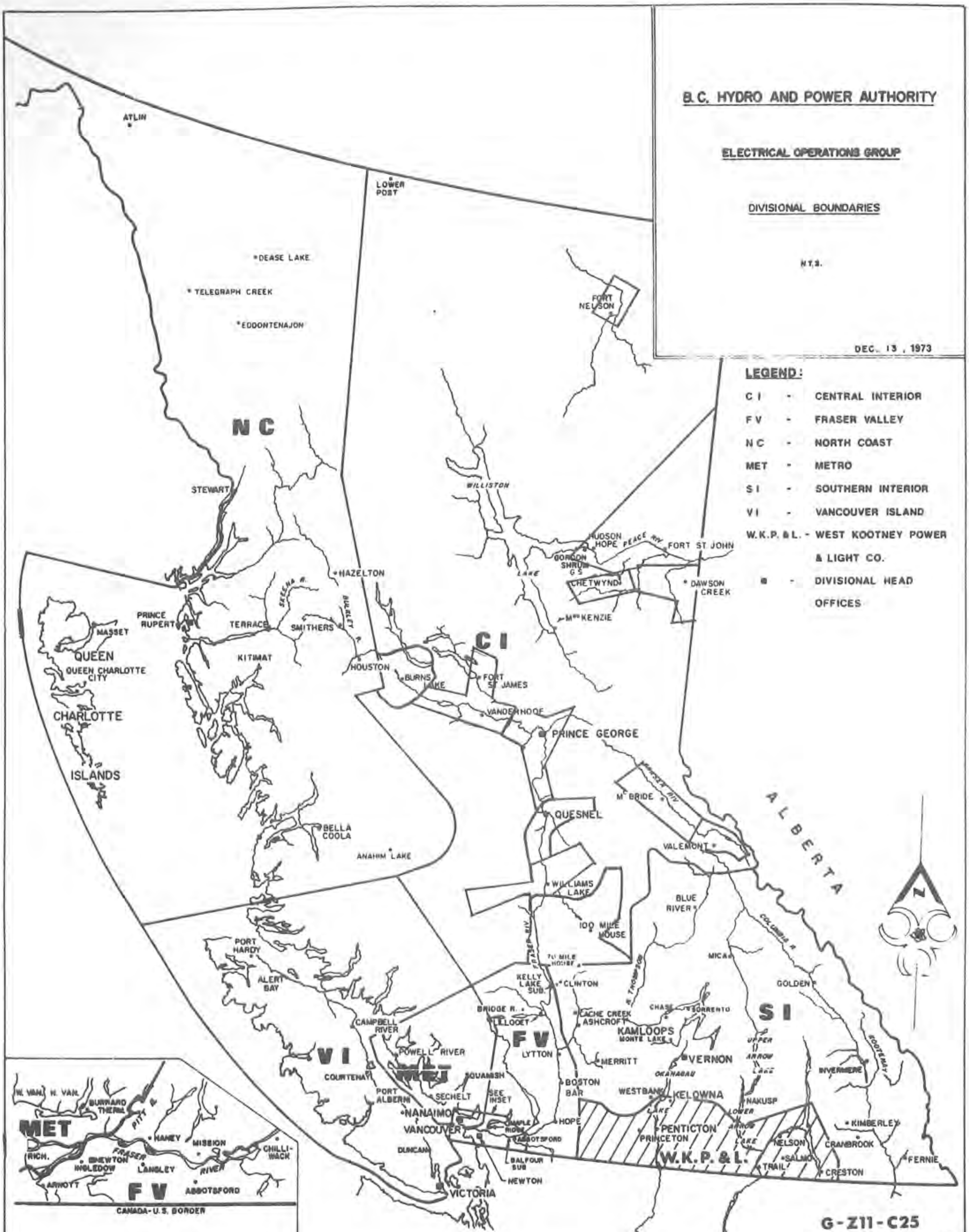
XXI. Since this report has not centred on assessing outage statistics for sub-transmission and their impact on the distribution system, data should be compiled which relfects the relative and absolute number of vegetation caused interruptions on sub-transmission. This information should also be the subject of a supplementary report prepared during 1976.

GLOSSARY OF TERMS

adeciduate	-	evergreen
arborescent	-	having shape or growth like a tree
arboriculture	-	science of tree and shrub care and maintenance
arvicoline	-	growing in countryside
callus	-	undifferentiated parenchyma which covers wounds
cespitous	-	like turf
decadent	-	overmature or moribund
delitescent	-	latent or dormant
deracinate	-	uproot
detruncate	-	lop the top from, obtruncate
fastigate	-	narrowing at apex
fruitescent	-	shrub like
furicate	-	branched
gerontic	-	pertinent to old age
georgic	-	rural
nemoral	-	living in forests
prescription maintenance	-	the choice of maintenance techniques best suited to a particular problem after examination of all influencing factors.
pullulation	-	sprouting, suckering
quiescent	-	resting
saprogenic	-	causing decay

tasks	-	the specific job requirements involved in each of the functions.
task intensity	-	the degree to which any task is carried out. Where the degree is predetermined but flexible for a number of similar tasks it may be termed a guideline, where it is not flexible it may be a standard.
vegetation management	-	the application of most efficient, safe method to the variety of problems encountered in establishment, maintenance, control, or disposal of plant material.

APPENDIX I


B.C. HYDRO AND POWER AUTHORITY
ELECTRICAL OPERATIONS GROUP
DIVISIONAL BOUNDARIES
N.T.S.
DEC. 13, 1973
LEGEND:
C I - CENTRAL INTERIOR
F V - FRASER VALLEY
N C - NORTH COAST
MET - METRO
S I - SOUTHERN INTERIOR
V I - VANCOUVER ISLAND
W.K.P. & L. - WEST KOOTNEY POWER & LIGHT CO.
■ - DIVISIONAL HEAD OFFICES
ATLIN
LOWER POST
DEASE LAKE
TELEGRAPH CREEK
EDDONTENAJON
FORT NELSON
NC
STEWART
WILLISTON LAKE
HUDSON HOPE
PEACE RIV
FORT ST. JOHN
GORDON SHRUM G.S.
CHETWYND
DAWSON CREEK
M^cKENZIE
HAZELTON
PRINCE RUPERT
MASSET
TERRACE
SMITHERS
SKEENA R.
BULKLEY R.
KITIMAT
QUEEN CHARLOTTE ISLANDS
QUEEN CHARLOTTE CITY
HOUSTON
BURNS LAKE
CI
FORT ST. JAMES
VANDERHOOF
PRINCE GEORGE
FRASER RIV
M^c BRIDE
ALBERTA
QUESNEL
VALEMONT
BELLA COOLA
ANAHIM LAKE
WILLIAMS LAKE
BLUE RIVER
100 MILE HOUSE
70 MILE HOUSE
MICA
COLUMBIA R
PORT HARDY
ALERT BAY
KELLY LAKE SUB.
CLINTON
GOLDEN
FRASER RIV
N. THOMPSON
BRIDGE R.
LILLOOET
CACHE CREEK
ASHCROFT
CHASE
SORRENTO
SI
CAMPBELL RIVER
FV
KAMLOOPS
MONTE LAKE
POWELL RIVER
VI
LYTTON
MERRITT
VERNON
UPPER ARROW LAKE
KOOTENAY
COURTENAY
MET
SQUAMISH
OKANAGAN
INVERMERE
PORT ALBERNI
SECHELT
SEE INSET
BOSTON BAR
WESTBANK
KELOWNA
NAKUSP
NANAIMO
VANCOUVER
MAPLE RIDGE
HOPE
LOWER ARROW LAKE
KIMBERLEY
ABBOTSFORD
PENTICTON
PRINCETON
NELSON
CRANBROOK
DUNCAN
BALFOUR SUB
W.K.P. & L.
SALMO
TRAIL
FERNIE
CRESTON
NEWTON
VICTORIA
W. VAN.
N. VAN.
BURRARD THERMAL
PITT L.
MET
HANEY
MISSION
FRASER RIVER
CHILLIWACK
RICH.
NEWTON
INGLEDOW
LANGLEY
ARNOTT
FV
ABBOTSFORD
CANADA-U.S. BORDER
G-Z11-C25

TREE CLEARANCES - DISTRIBUTION LINES

Voltages	14.4 KV to 60 KV				600 Volts to 14.4 KV												120 to 240 Volts	
Cycle	2 Years		3 Years		2 Years			3 Years			4 Years			5 Years			3 to 5 Years	
Growth Rate	Top	Side	Top	Side	Top	Side	Overhang	Top	Side	Overhang	Top	Side	Overhang	Top	Side	Overhang	Side	
Extra Fast	7	5	9	6	6	4	5	9	5	7	11	6	8	14	8	not permissible	6	
Fast	6	5	8	6	5	4	5	7	5	6	9	6	7	11	8	" "	4	
Medium	5	4	6	5	4	3	4	6	3	5	7	4	6	9	6	" "	3	
Slow	4	4	5	5	3	3	3	4	3	4	5	4	5	7	6	" "	2	

EXOTIC AND INDIGENOUS

TREE SPECIES OF THE CENTRAL INTERIOR

Class One - 100%

Botanical Name	*Height	Growth Rate	Common Name
Acer nigrum	60 (90)	S	Black Maple
Acer pensylvanicum	10-30 (40)	M	Striped Maple, Moosewood
Acer tataricum	15-20	S	Tatarian Maple
Betula Verrucosa 'Purpurea'	30	S	Purple leaf Birch
Cladrastis lutea	30-40	M	American Yellow-wood
Cornus alternifolia	15-30	M	Pagoda Dogwood
Fraxinus pennsylvanica lanceolata	40-60 (80)	M	Green Ash
Malus 'Dolgo'	30	M	Dolgo Crab Apple
Malus 'Hopa'	30	M	Hopa Crab Apple
Malus Red Splendor	25	M	Red Splendor Crab Apple
Picea glauca densata	80	M	Black Hills Spruce
Picea pungens	40-80	M	Colorado Spruce
Pinus cembra	30-60	M	Swiss Stone Pine
Pinus sylvestris	40-90	M	Scots Pine
Quercus coccinea	40-75	M	Scarlet Oak
Quercus palustris	30-50 (75)	M	Pin Oak
Quercus rubra	40-75 (100)	M	Red Oak
Tilia americana	60-70 (100)	F	Basswood, American Linden
Ulmus americana	60-120	M	American Elm

Class Two - 80%

Botanical Name	*Height	Growth Rate	Common Name
Abies concolor	100	M	White Fir
Acer ginnala	20	S	Amur Maple
Acer glabrum douglasii	10-25	F	Douglas Maple
Acer rubrum	60 (90)	M	Red Maple
Acer saccharum	60-90 (130)	S	Sugar Maple
Aesculus Glabra	20-60	M	Ohio Buckeye
Betula fontinalis	40	M	Water Birch

Botanical Name	*Height	Growth Rate	Common Name
Class Two - 80% - (cont'd.)			
Betula papyrifera humilis	25-30	S	Alaska White Birch
Betula pendula (verrucosa)	60	M	European Birch
Betula populifolia	20-30	M	Gray Birch
Betula Verrucosa	60	M	European White Birch
Betula Verrucosa 'Fastigiata'	35-45	M	Columnar European Birch
Betula Verrucosa 'Gracilis'	40	M	Cutleaf Weeping Birch
Betula Verrucosa 'Tristis'	40	S	Slender Birch
Betula Verrucosa 'Youngii'	30	S	Young's Weeping Birch
Carpinus caroliniana	20-30	S	American Hornbeam, Bluebeech
Celtis occidentalis	70	S	Common Hackberry
Crataegus crus-galli	15-30	M	Cockspur Thorn
Crataegus mollis	20	M	Downy Hawthorn
Crataegus succulenta	15	M	Fleshy Hawthorn
Elaeagnus angustifolia	20-35	M	Russian-olive
Juglans nigra	50-90	M	Eastern Black Walnut
Juniperus scopulorum	10-30	S	Western Red-Cedar, Rocky Mountain Juniper
Larix decidua	50-80	M	European Larch
Larix laricina	60-90	M	Eastern Larch, Tamarack
Malus 'Almey'	20	M	Almey Crab Apple
Malus baccata	15-30	M	Siberian Crab Apple
Malus 'Royalty'	20	M	Royalty Crab Apple
Ostrya virginiana	25-35 (60)	S	Hop Hornbeam
Picea glauca	60-90 (120)	M	White Spruce
Pinus ponderosa	60-80 (150)	M	Ponderosa Pine
Populus berolinensis	75	XF	Berlin Poplar
Quercus macrocarpa	20-60 (90)	M	Bur Oak
Salix pentandra	25-40	F	Laurel Willow
Sorbus americana	10-30	M	American Mountain-ash
Sorbus decora	15-30	S	Showy Mountain-ash
Syringa amurensis japonica	20-25	S	Japanese Tree Lilac

Each height given is the maximum usually expected under ideal cultural conditions. Many references list only the maximum height for a species when it grows in its native habitat. However, such a height is usually not attained under cultivation. A range is then given, as in "60-100 feet" for Picea Abies, the Norway spruce. The minimum height is the one to be expected under ideal conditions in areas where the species is growing at the limit of its hardiness range. The maximum is the height to which the plant will grow in more favorable climates. Heights in brackets are for trees native to B. C. as found in stands.

GROWTH RATES: S = SLOW M = MEDIUM F = FAST XF = EXTRA FAST

Botanical Name	*Height	Growth Rate	Common Name
Class Three - 60%			
Acer spicatum	15-20	S	Mountain Maple
Amelanchier canadensis	25	S	Shadblow, Downy Serviceberry
Amelanchier laevis	30	S	Allegany Serviceberry
Betula alleghaniensis	50-70 (100)	M	Yellow Birch
Betula lenta	40-50 (75)	M	Sweet Birch
Betula nigra	40-70	M	River Birch
Betula papyrifera	50-80	M	Canoe Birch
Betula papyrifera sub-cordata	40-60	M	Northwestern White Birch
Crataegus rivularis	25	M	River Hawthorn
Gleditsia triacanthos	50-70	S	Common Honey-Locust
Gleditsia triacanthos inermis	60	S	Thornless Honey-Locust
Gleditsia triacanthos 'Moraine'	50	S	Moraine Honey-Locust
Gleditsia triacanthos 'Sunburst'	40	S	Sunburst Honey-Locust
Juglans cinerea	50-75	M	Butternut
Juniperus virginiana	25-30	S	Eastern Red-Cedar
Picea abies	60-100	M	Norway Spruce
Picea glauca	60-90 (120)	M	White Spruce
Picea glauca albertiana	60-100	M	Western White Spruce
Picea pungens	40-80	M	Colorado Spruce
Pinus contorta latifolia	50-80 (100)	M	Lodgepole Pine
Pinus resinosa	45-100 (125)	M	Red Pine, Norway Pine
Pinus sylvestris	90	M	Scotch Pine
Prunus serotina	40-70 (100)	F	Black Cherry
Pseudotsuga menziesii glauca	50-100	M	Blue Douglas-Fir (Interior)
Rhus typhina	10-25	F	Staghorn Sumac
Sorbus americana	10-30	M	American Mountain-Ash
Sorbus aucuparia	45	M	European Mountain-Ash
Thuja occidentalis	15-45 (60)	S	American Arborvitae
Tilia cordata	40-50	M	Little-leaf Linden
Ulmus americana	60-120	M	American Elm
Class Four - 40%			
Abies balsamea	30-60 (75)	M	Balsam Fir

Botanical Name	*Height	Growth Rate	Common Name
Class Four - 40% - (cont'd.)			
Acer negundo	30-50 (70)	F	Box-Elder, Manitoba Maple
Betula papyrifera commutata	40-80 (100)	M	Western White Birch
Fraxinus nigra	50-70	M	Black Ash
Phellodendron amurense	30-50	M	Amur Cork Tree
Picea engelmannii	60-90 (150)	M	Engelmann Spruce
Pinus banksiana	30-80	M	Jack Pine
Pinus contorta latifolia	50-80 (100)	M	Lodgepole Pine
Populus alba	50-80	XF	White Popular
Populus angustifolia	25-40 (60)	XF	Narrowleaf Cottonwood
Populus balsamifera	50-60 (100)	XF	Balsam Poplar
Populus balsamifera trichocarpa	60-80 (125)	XF	Black Cottonwood
Populus deltoides occidentalis	40-80 (100)	XF	Plains Cottonwood
Populus grandidentata	50-60 (100)	XF	Bigtooth Aspen
Populus nigra 'Italica'	70	XF	Lombardy Poplar
Populus tremuloides	30-40 (90)	F	Quaking Aspen
Prunus emarginata	20-30	S	Bitter Cherry
Prunus virginiana demissa	15-20	M	Western Choke Cherry
Robinia pseudoacacia	30-50	F	Black Locust
Salix alba	60	XF	White Willow
Sorbus aucuparia	45	M	European Mountain-Ash, Rowan Tree
Ulmus pumila	60	M	Siberian Elm
Class Five - 20%			
Acer negundo	30-50 (70)	F	Box-Elder
Acer saccharinum	60-90 (125)	F	Silver Maple
Alnus glutinosa	20-50	F	Black Alder
Alnus incana	15-50	F	Speckled Alder
Alnus rubra	30	M	Red Alder
Alnus tenuifolia	30-40	XF	Mountain Alder
Fraxinus americana	50-70 (100)	F	White Ash
Picea mariana	30-50 (100)	S	Black Spruce
Pinus monticola	90 (150)	M	Western White Pine
Prunus pensylvanica	15-25 (50)	M	Pin Cherry, Wild Red Cherry

TABLE 2. BASIC EVALUATION OF TREES CALCULATED

ON CROSS-SECTION AREA OF THE TRUNK.

Trunk Diameter Inches	Cross Section Area Square Inches	Basic Value [1]* (dollars)	Trunk Diameter Inches	Cross Section Area Square Inches	Basic Value [1] (dollars)
2	3.14	31	31	754.8	7,548
3	7.07	70	32	804.3	8,043
4	12.57	125	33	855.3	8,553
5	19.64	196	34	907.9	9,079
6	28.27	282	35	962.1	9,621
7	38.49	384	36	1017.9	10,179
8	50.27	502	37	1075.2	10,752
9	63.62	636	38	1134.1	11,341
10	78.5	785	39	1194.6	11,946
11	95.0	950	40	1256.6	12,566
12	113.1	1,131	41	1320.3	13,203
13	132.7	1,327	42	1385.4	13,854
14	153.9	1,539	43	1452.2	14,522
15	176.7	1,767	44	1520.5	15,205
16	201.1	2,011	45	1590.4	15,904
17	227.0	2,270	46	1661.9	16,619
18	254.5	2,545	47	1734.9	17,349
19	283.5	2,835	48	1809.6	18,096
20	314.2	3,142	49	1885.7	18,857
21	346.4	3,464	50	1963.5	19,635
22	380.1	3,801	51	2042.8	20,428
23	415.5	4,155	52	2123.7	21,237
24	452.4	4,524	53	2206.2	22,062
25	490.9	4,909	54	2290.2	22,902
26	530.9	5,309	55	2375.8	23,758
27	572.6	5,726	56	2463.0	24,630
28	615.8	6,158	57	2551.8	25,518
29	660.5	6,605	58	2642.1	26,421
30	706.9	7,069	59	2734.0	27,340
			60	2827.4	28,274

* [1]Calculated on the basis of $10.00 per square inch of cross-section trunk area at 4.5 feet above the surface of the ground or as near this height as possible.

TABLE 4(a)

VEGETATION MANAGEMENT WORK LOAD SUMMARY

POWER DISTRICT ____________ NO. OF SAMPLES ____________

LINE CLASS ____________ DATE ____________

BY ____________

BRUSH GROWTH

Height Class	0	0-4'	4-12'	12'+ to 4"DBH	Total
Sq. Footage	____	____	____	____	____
Acreage	____	____	____	____	____

Need	Immediate	2-3 Years	Future	Not Needed	Not Classed	Total
By # of Samples	____	____	____	____	____	____
Sq. Footage	____	____	____	____	____	____
Acreage	____	____	____	____	____	____

Brush Density	Scattered	Dense	No Brush	Not Classed	Total
By # of Samples	____	____	____	____	____

Brush Species Mix - By # Samples												Not Classed	Total
Deciduous %	100	90	80	70	60	50	40	30	20	10	0		
Coniferous %	0	10	20	30	40	50	60	70	80	90	100		
	____	____	____	____	____	____	____	____	____	____	____	____	____

DANGER TREES - (total of all samples) ____________

TRIMMING

Need	Immediate	2-3 Years	Future	No Trees	Not Classed	Total
By # Samples	____	____	____	____	____	____

Trees

Number of Trees (total of all samples) ____________

TABLE 4

DISTRIBUTION LINE VEGETATION MANAGEMENT SURVEY

Division - C.I.
Power District -
Sample Area #
Grid Map #
Length of Sample (feet) -

Date -
Survey by -
Urban -
Rural -
Phases -
Transmission U/B -

Brush Growth

Width of R/W to Maintain 5, 10, 15, ______ feet

Percent of Sample by Characteristic Ht. Class 0 ________ 0-4' ________ 4-12' ________ 12' to 4" DBH ________

Need Immediate ______ 2-3 Years ______ Future ______ No Trees ______

Brush Summary | Total

Square Footage ________ ________ ________ ________ ________

Species Mix % - Deciduous _______ Conifer _______

Density of Brush - Scattered _______ Dense _______

Danger Trees for Removal (largely rural)

Dot Tally | Total

____

Trimming (largely urban)

Need Immediate ______ 2-3 Years ______ Future ______ No Trees ______

Number of Trees

Dot Tally | Total

____

COMMENTS -

53234 (front)
rev. 12 - 73

message class
2574

daily forestry work report

change key			month	day	yr	payroll number		w.r.g.	c/d	crew	
	*	5					*				

	pruned code 83	removed code 84	acres code 82	miles code 81
prune trees				
remove trees				†
cut underbrush				
spray - trans.				
spray - rural				
patrol				
other work				

† *miles to be reported here only when pruning removing, and underbrushing completed.*

no. men	time from	time - to	actual man hrs.
		total	

(1) number of trees reported

(2) number of manhours required

	g.l. control	work order or loc.		work group			function	subaccount
#			#			#		

	code	units		code	units		code	units		code	units		actual man-hrs.
# 000			# 000			# 000			# 000	9 9		+	

(3) For computer, if required

must be completed in full, if used

	g.l. control	work order or loc.		work group			function	subaccount
#			#			#		

	code	units		code	units		code	units		code	units		actual man-hrs.
# 000			# 000			# 000			# 000			+	

supervisor	area

53234 (back)
new 3 - 73

miscellaneous costs	expenses						totals	
	material used							
	solution							

	equipment number *(vehicles, chippers, power saws, etc.)*	weekly hrs use
equipment report		

84054 (front)
new 5 - 74

forestry time & work report

message class		effective date month	day	yr.	payroll no.		w.r.g.	c/d
2079	* 5					*	2 6	0 0 0 0 3 7 7

employee name	employee number	normal time worked	hours	overtime & other code	hours	savh code	hours
	#	+ 5 0 0		# + 0		# + 0	
①	#	+ 5 0 0		# + 0		# + 0	
Time report	#	+ 5 0 0		# + 0		# + 0	
showing hours	#	+ 5 0 0		# + 0		# + 0	
paid for	#	+ 5 0 0		# + 0		# + 0	
	#	+ 5 0 0		# + 0		# + 0	
	#	+ 5 0 0		# + 0		# + 0	
	#	+ 5 0 0		# + 0		# + 0	
	#	+ 5 0 0		# + 0		# + 0	
	#	+ 5 0 0		# + 0		# + 0	
	total - not for input						
	grand total						

note: sum of grand total must equal total of hours distributed †

variable allowance report

message class		effective date month	day	yr.	payroll no.		w.r.g.	chk dig.
2475	* 5					*	2 6	0 0 0 0 3 9 2

employee name	type of allowance	employee number	allow code	+ / –	9 9 hours or units	amount rate *(rate hour or unit)*
		#		+		
		#		+		

certified correct *(for variable allowance)*	approved *(for variable allowance)*	for no of entries
every allow. or ded. code equals 1 entry		

major transport and work equipment - *(see TWE standing instructions A-3, A-5 & A-6.*

class - unit number	hour meter reading end of shift	start of shift	engine hours	down-time hours	miles	total chargeable hours					
			•	•	•		•	•	•	•	•
			•	•	•		•	•	•	•	•
			•	•	•		•	•	•	•	•
			•	•	•		•	•	•	•	•
			•	•	•		•	•	•	•	•
			•	•	•		•	•	•	•	•
			•	•	•		•	•	•	•	•
			•	•	•		•	•	•	•	•
			•	•	•		•	•	•	•	•

time message code

s. s. v. or holidays
05 - unpaid leave of absence (short term)
10 - sickness - all continuing time relating to absence reported by code 11
11 - sickness - first or part day of absence
12 - dental & medical consultation
20 - minor accident
23 - major accident
30 - vacation
40 - statutory holiday
41 - granted days

worked time
50 - normal time
60 - overtime - straight time - evenings
61 - overtime - time and 1/2 - evenings
62 - overtime - double time - evenings
70 - overtime - straight time - nights
71 - overtime - time and 1/2 - nights
72 - overtime - double time - nights
80 - overtime - straight time - days
81 - overtime - time and 1/2 - days
82 - overtime - double time - days

miscellaneous time to be paid
90 - miscellaneous paid time
- extreme weather closure
- inclement weather (sent home)
- reporting allowance
91 - minimum payment - straight time (non-worked time)
92 - travel and/or waiting time - straight time (outside normal working time)
93 - funerals or death in family
94 - jury duty
95 - household moving
96 - grievance
97 - other (includes military pension boards or medicals, quarter century club meetings, military camps, pension board and medicals, voting, etc.)

(over)

84054 (back)
new 5-74

message class	effective date month / day / yr.	payroll no.	w.r.g.	c/d	
2574	* 5		* 2 6		0 0 0 0 4 7 6

if second sheet, hours dist. on 1st sheet here

g.l. control	work order or location	work group	function	sub account	code	units
		#	#		# 0 0 0 9 9	†

code	units	code	units	code	units	man-hours
# 0 0 0		# 0 0 0		# 0 0 0		+

② Blocks showing total work completed

g.l. control	work order or location	work group	function	sub account	code	units
		#	#		# 0 0 0 9 9	†

code	units	code	units	code	units	man-hours
# 0 0 0		# 0 0 0		# 0 0 0		+

g.l. control	work order or location	work group	function	sub account	code	units
		#	#		# 0 0 0 9 9	†

code	units	code	units	code	units	man-hours
# 0 0 0		# 0 0 0		# 0 0 0		+

g.l. control	work order or location	work group	function	sub account	code	units
		#	#		# 0 0 0 9 9	†

code	units	code	units	code	units	man-hours
# 0 0 0		# 0 0 0		# 0 0 0		+

g.l. control	work order or location	work group	function	sub account	code	units
		#	#		# 0 0 0 9 9	†

code	units	code	units	code	units	man-hours
# 0 0 0		# 0 0 0		# 0 0 0		+

g.l. control	work order or location	work group	function	sub account	code	units
		#	#		# 0 0 0 9 9	†

code	units	code	units	code	units	man-hours
# 0 0 0		# 0 0 0		# 0 0 0		+

directs - reasons list below

ason	no. men	time from	time to	

to equal time paid for →

grand total

note: must equal grand total on front of sheet.

for message account class 2574 only

81 - no. of miles treated
82 - no. of acres treated
83 - no. of trees pruned
84 - no. of trees removed
76 - no. of gal. chemical
77 - no. of gal. solution (in 100 gal. quantities)
99 - travel time

pervisor	date	area

84049
new 2 - 74

sheet no. 1

area rural schedule

area			
trees on rural lines	total number of trees on rural lines (work load survey)		
trees on year cycle	number of trees on year cycle: -		
	number of trees on year cycle: -		
	total: -		
weekly schedule trees	(a) year cycle trees		
	÷ years × 52 weeks = no. of trees: -		
	(b) year cycle trees		
	÷ years × 52 weeks = no. of trees: -		
	total number of trees to treat per week =		*note: enter this figure on sheet 2.*
weekly schedule miles	number of trees per mile of line: -		
	therefore, required number of miles per week: -		
	÷ trees to treat per week / trees per mile =		*note: enter this figure on sheet 2.*
remarks	This sheet is prepared from the work load analysis and allows the District Manager to SEE program and yearly scheduled workload.		

84050
rev. 7-74

sheet no. 2

rural line clearing progress

area		section	
month ending			
schedule this year	(a) number of trees per week: - × no. of weeks to date:		
	(b) number of miles per week: - × no. of weeks to date:		
activity last month	(a) number of trees treated during the last month: -		
	(b) number of miles of line cleared during the last month		
activity to date	(a) total number of trees treated this year to date: - field reports		*note: these two figures should be compared*
	(b) total number of miles cleared this year to date:- (a) short cycle = (b) long cycle = (scaled from maps)	total	
trees treated from work load survey	(a) tree density by section, trees / mile: - (a) short cycle = (b) long cycle =		
	trees treated short cycle: miles × density = long cycle: miles × density =	total	
ahead or behind schedule & work load surveyed	(a) number of trees ☐ ahead ☐ behind schedule		
	(b) number of miles ☐ ahead ☐ behind schedule		
line clearing cycle status	on your complete and year line clearing cycle you are: -		
	(a) number of trees ☐ ahead ☐ behind schedule		
	(b) number of miles ☐ ahead ☐ behind schedule		
remarks	This monthly sheet provides the DISTRICT MANAGER with a summary of progress on the program cycle.		

84051
rev. 7-74

sheet no. 3

forestry rating information

		this month	year to date	area
all accounts	total forestry costs			
	total forestry manhours			

current production	trees reported treated		manhours per tree treated	
	miles of line reported cleared		cost per tree treated	
	dollars spent		manhours per mile treated	
	manhours on account		cost per mile of line	
	account number		manhours per tree	
			dollars per tree	

manhours and cost - workload survey	A. trees per mile of line (from survey)	(a) short cycle = (b) long cycle =				
	B. total hydro owned rural miles cleared to date	(a) short cycle = (b) long cycle =				
	number of trees treated (workload)	short cycle = long cycle =	A	× B	=	total

true or annual unit costs	line clearing cycle	years - combining short+long cycle		
	annual manhours per tree ÷	manhours current / years cycle	=	
	annual cost per tree ÷	$ current / years cycle	=	
	annual manhours per mile ÷	manhours current / years cycle	=	
	annual cost per mile ÷	$ current / years cycle	=	

		worked	programmed
budget information	total hours on rural line clearing		
	total hours on low voltage clearing		
	total hours on high voltage clearing		
	total hours on capital (rural and transmission)		
	total hours on recoverable		
	total hours on storm damage		
	total hours on site maintenance		

This sheet accumulates costs and manhours and determines unit costs and productivity.

comments	

84052
new 2-74

sheet no. 4

area forestry workload and staffing data sheet

				remarks			
rural distribution line clearing	year cycle						
	no. of miles			This sheet allows a			
	density			comparison to be			
	total trees			drawn between man-			
	trees per year			hours available and			
	year cycle			manhours needed			
	no. of miles			for the cycle.			
	density						
	total trees						
	trees per year						
	total trees per year			manhours			
	manhours per tree			area total	regular and temp./regular	temporary	contractor
	manhours required per year						
additional work	HV lines						
	L V lines						
	capital						
	municipal						
	brush cutting						
	herbicide application - HV						
	herbicide application - L V						
	herbicide application - rural						
	other - (storms, snow, grass)						
	total manhours required						

hours available	no. of regular men × hours on job	=			total manhours required
	no. of temp/regular × hours on job	=			total manhours available
	temporary and contractor's hours	=			surplus or deficit manhours
	total manhours available	=			

968-5423:3
rev. 5-72

note: *2 copies of this report are required in the regional office within 9 working days from end of fiscal month.*

summary of costs of operations - monthly & annual

region	month	area	foreman

* *includes trailer mounted chippers.*
** *includes truck mounted chippers.*

distribution number	pole line mileage (1)		quantity and manhour analysis: underbrush – acres removed (2)	trees – pruned & cabled	trees – removed	totals no. trees – mhrs. trees & underbrush (3)	cost analysis (use even dollars): labour	expenses	material	motor vehicles *	** mechanized aerial equipment	total cost (4)	for head office use – averages: cost per mhr.	cost per mile	cost per tree	mhrs. per tree
		no. units														
		adj. mhrs.														
		no. units														
		adj. mhrs.														
		no. units														
		adj. mhrs.														
		no. units														
		adj. mhrs.														
		no. units														
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		no. units														
		adj. mhrs.														
		no. units														
		adj. mhrs.														
		no. units														
		adj. mhrs.														

This sheet summarizes all work completed by crews over a period of time – as reported on their work report

HISTORY OF VEGETATION CONTROL (Where available)

BRUSH CONTROL

1974

LOCATION	METHOD	ACRES	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/acre
Burns Lake						
Chetwynd						
Dawson Creek						
Fort St. John	Power Saw-Axe Etc.	24	60	20	$12,600	$525.00
"	New Extensions Clarkson Electric Cat	10	10	4	$ 6,500	$650.00
"	Customers (Cat)	4	2	2.5	$ 1,200	$300.00
"	Customer (Saw & Axe)	2.8	30	2	$ 850	$303.00
McBride	Contractor		2	1.3	$ 430	—
100 Mile House	Hydro Lineman 1 + 2 Labourer		4	3	$ 390	
Quesnel	Hydro Force 4 People Chopper 2 Pick-up Trucks	186	100	40	$ 28,340	$152.00
Williams Lake	District Crew 3 Men	Horsefly	10	4.3		
		Likely	25	7.5		
		Big Lake (Ridge Road)	6	3		
TOTAL			249	87.6	$ 50,310.00	

1973

LOCATION	METHOD	ACRES	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/acre
Burns Lake						$405.00
Chetwynd	Handcutting	15.4		7	$ 6,237	
Dawson Creek	Bulldozer C/IN Brush Blade/Rome Disc/Rotary Mower Hand Clearing	32.5	40 - 60	14	$15,344	$472.12
Fort St. John	Power Saw Axe	15	40	10	$ 6,000	$400.00
"	Construction	25	60	35	$13,000	$520.00
TOTAL		87.9		66	$40,581	$461.60

1972

LOCATION	METHOD	ACRES	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/acre
Burns Lake						
Dawson Creek	1 Man Operation With Temporary or Day Labourer as Required	33.8	40 - 60	15.5	$ 11,921	$352.69
Fort St. John	Power Saw Etc.	6	10	5	$ 1,800	$300.00
TOTAL		39.8	60	20.5	$ 13,721	$344.70

DANGER TREES REMOVED

1974

LOCATION	METHOD	TREES REMOVED	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/tree
Burns Lake	Own Crew	500	done with other maintenance		$ 1,700	$ 3.40
Chetwynd						
Dawson Creek						
Fort St. John	Power Saw-Axe Etc.	60	20		$ 1,400	$ 23.30
McBride	Own Forces	2	.2		$ 40	$ 20.00
100 Mile House	Hydro Lineman 1 Labourer	35	4	12	$ 376	$ 10.74
Quesnel		30	15			
Williams Lake						
TOTAL		627	49.2		$ 3,516	$ 5.88

1973

LOCATION	METHOD	TREES REMOVED	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/tree
Burns Lake	Own Crew	400			$ 2,200	$ 5.50
Chetwynd		30	2	1		
Fort St. John	Power Saws Axe Etc.	50	11		$ 1,200	$ 24.00
McBride	Own Forces	2	2		$ 36	$ 18.00
TOTAL		482	15	1	$ 3,436	$ 7.12

1972

LOCATION	METHOD	TREES REMOVED	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/tree
Burns Lake	Own Crew	200			$ 1,000	$ 5.00
Fort St. John	Power Saws	40	10		$ 800	$ 20.00
TOTAL		240	10		$ 1,800	$ 7.50

TREES TRIMMED

1974

LOCATION	METHOD	TREES TRIMMED	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/tree
Burns Lake	Own Crew 3 Men	20			$ 200	$ 10.00
Chetwynd						
Dawson Creek						
Fort St. John	Tree Trimmer	1,000	5 (not working steady)	2	$ 1,100	$ 1.10
McBride						
100 Mile House						
Quesnel	Coast Utility	117	10	In Town	$ 3,300	$ 28.20
Williams Lake						
TOTAL		1,137	15		$ 4,600	$ 4.04

1973

LOCATION	METHOD	TREES TRIMMED	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/tree
Burns Lake	Own Crew	20			$ 200	$ 10.00
Fort St. John	Tree Trimmer	1,000	4	2	$ 1,100	$ 1.10
TOTAL		1,020	4	2	$ 1,300	$ 1.27

1972

LOCATION	METHOD	TREES TRIMMED	DAYS TO COMPLETE	MILES OF LINE CLEARED	COST	cost/tree
Burns Lake	Own Crew	10			$ 1,100	$ 10.00
Fort St. John	Tree Trimmer	1,000	4	2	$ 900	$ .90
TOTAL		1,010			$ 1,000	$ .90

DANGER TREE REMOVAL

POWER DISTRICT	URBAN	HOURS	COST	RURAL	HOURS	COST	TOTAL TREES	TOTAL HOURS	TOTAL COST
Burns Lake	30	105	$ 3,150	3,010	10,535	$316,050	3,040	10,640	$319,200
5 Year) Each Cycle) Year=	6	21	$ 630	602	2,107	$ 63,210	608	2,128	$ 63,840
Chetwynd	20	70	$ 2,100	720	2,520	$ 75,600	740	2,590	$ 77,700
5 Year) Each Cycle) Year=	4	14	$ 420	144	504	$ 15,120	148	518	$ 15,540
Dawson Creek	20	70	$ 2,100	2,500	8,750	$262,500	2,520	8,820	$264,600
Each Year=	4	14	$ 420	500	1,750	$ 52,500	504	1,764	$ 52,920
Fort Nelson	320	1,120	$33,600	630	2,205	$ 66,150	950	3,325	$ 99,750
Each Year=	64	224	$ 6,720	126	441	$ 13,230	190	665	$ 19,950
McBride	Ø	Ø	Ø	330	1,155	$ 34,650	330	1,155	$ 34,650
Each Year=	Ø	Ø	Ø	66	231	$ 6,930	66	231	$ 6,930
North Peace (based on Dawson Creek)							2,948	10,318	$309,540
Each Year=							589.6	2,063.6	$ 61,908
100 Mile	Ø	Ø	Ø	2,250	7,875	$236,250	2,250	7,875	$236,250
Each Year=	Ø	Ø	Ø	450	1,575	$ 47,250	450	1,575	$ 47,250
Prince George	430	1,505	$45,150	2,670	9,345	$280,350	3,100	10,850	$325,500
Each Year=	86	301	$ 9,030	534	1,869	$ 56,070	620	2,170	$ 65,100
Quesnel (based on Williams Lake & Prince George)							1,828	6,398	$191,940
Each Year=							365.6	1,279.6	$ 38,388
Valemount	Ø	Ø	Ø	140	490	$ 14,700	140	490	$ 14,700
Each Year=	Ø	Ø	Ø	28	98	$ 2,940	28	98	$ 2,940
Vanderhoof (based on Burns Lake and Prince George)							3,177	11,119.5	$333,585
Each Year=							635.4	2,223.9	$ 66,717
Williams Lake	90	315	$ 9,450	2,260	7,910	$237,300	2,350	8,225	$246,750
Each Year=	18	63	$ 1,890	452	1,582	$ 47,460	470	1,645	$ 49,350
TOTAL	910	3,185	$95,550	14,510	50,785	$1,523,550	23,373	81,805.5	$2,454,165
TOTAL PER YEAR FOR FIVE YEARS	182	637	$19,110	2,902	10,157	$304,710	4,674.6	16,361.1	$490,833

* Assumptions
1. Total cost per hour includes two men and one truck.
2. 3.5 two manhours needed to remove one tree.
3. Five year cycle
4. Detailed data not available for -
Quesnel
Vanderhoof
North Peace

URBAN TREE TRIMMING

URBAN POWER DISTRICT	IMMEDIATE	2 - 3 YEARS	FUTURE	TOTAL TREES	TOTAL HOURS	TOTAL COST	3 YEAR CYCLE IMMEDIATE	2 - 3 YEARS	FUTURE	TOTAL TREES PER YEAR	TOTAL COST/YEAR
Burns Lake	Ø	20	90	110	110	$4,400	Ø	6.6	30	37	$1,464
Chetwynd	Ø	Ø	40	40	40	$1,600	Ø	Ø	13.3	13	$ 532
Dawson Creek	Ø	350	210	560	560	$22,400	Ø	116.6	70	187	$7,464
Fort Nelson	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
McBride	Ø	170	Ø	170	170	$6,800	Ø	56.6	Ø	57	$2,266
North Peace (Both Urban & Rural)	Ø	524	117	641	641	$25,640	Ø	175	39	214	$8,560
100 Mile	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Prince George	100	1,390	160	1,650	1,650	$66,000	33.3	463.3	53.3	550	$22,000
Quesnel (Both Urban & Rural)	45	283	60	388	388	$15,520	15	94	20	129	$5,160
Valemount	Ø	280	Ø	280	280	$11,200	Ø	94	Ø	94	$3,760
Vanderhoof (Both Urban & Rural)	48	481	144	673	673	$26,920	16	160	48	224	$8,960
Williams Lake	Ø	Ø	60	60	60	$2,400	Ø	Ø	20	20	$ 800
<u>TOTAL</u>:	193	3,498	881	4,572	4,572	$182,880	64	1,164	293	1,524	$60,966
Assuming $40.00/Hour and 1 hour per tree											

RURAL TREE TRIMMING

RURAL POWER DISTRICT	IMMEDIATE	2 - 3 YEARS	FUTURE	TOTAL TREES	TOTAL HOURS	TOTAL COST	5 YEAR CYCLE IMMEDIATE	2 - 3 YEARS	FUTURE	TOTAL TREES PER YEAR	TOTAL COST/YEAR
Burns Lake	Ø	110	170	280	280	$11,200	Ø	22	34	56	$ 2,240
Chetwynd	Ø	30	20	50	50	$ 2,000	Ø	6	4	10	$ 400
Dawson Creek	Ø	1,890	70	1,960	1,960	$78,400	Ø	378	14	392	$15,680
Fort Nelson	Ø	60	Ø	60	60	$ 2,400	Ø	12	Ø	12	$ 480
McBride	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
North Peace											
100 Mile	10	40	Ø	50	50	$ 2,000	2	8	Ø	10	$ 400
Prince George	390	2,140	150	2,680	2,680	$107,200	78	428	30	536	$21,440
Quesnel											
Valemount	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Vanderhoof											
Williams Lake	80	40	Ø	120	120	$ 4,800	16	8	Ø	24	$ 960
TOTAL RURAL:	480	4,310	410	5,200	5,200	$208,000	96	862	88	1,046	$41,600
TOTAL URBAN:	193	3,498	881	4,572	4,572	$182,880	64	1,164	293	1,524	$60,960
<u>TOTAL</u>:	673	7,808	1,291	9,772	9,772	$390,880	160	2,026	381	2,570	$102,800
Assuming $40.00/Hour and 1 hour per tree											

BRUSH CONTROL BY SPECIES, DENSITY AND COST.

1. DECIDUOUS BRUSH CONTROL

	RURAL							URBAN						
			MECHANICAL (HYDRO AXE) @ $150/ACRE		HERBICIDE STUBBLE OR FOLIAR @ $100/ACRE					MECHANICAL (HYDRO AXE) @ $150/ACRE		HERBICIDE STUBBLE OR FOLIAR @ $100/ACRE		
POWER DISTRICTS	DENSE ACRES	SCATTERED ACRES	DENSE TOTAL	SCATTERED COST	DENSE TOTAL	SCATTERED ACRES		DENSE ACRES	SCATTERED ACRES	DENSE TOTAL	SCATTERED COST	DENSE TOTAL	SCATTERED ACRES	
Burns Lake	9.00	450.00	$ 1,350.00	$67,500.00	900.00	45,000.00			10.30		1,545.00		1,030.00	
Chetwynd	16.36	323.02	2,454.00	48,453.00	1,636.00	32,302.00								
Fort Nelson	63.41	52.60	9,511.50	7,890.00	6,341.00	5,260.00			27.20		4,080.00		2,720.00	
McBride	30.00	54.54	4,500.00	8,181.00	3,000.00	5,454.00		18.18		2,727.00		1,818.00		
100 Mile House	160.00	249.70	24,000.00	37,455.00	16,000.00	24,970.00								
Prince George	148.00	339.80	22,200.00	50,970.00	14,800.00	33,980.00		11.40	80.50	1,710.00	12,075.00	1,140.00	8,050.00	
(Dawson Creek) South Peace	84.84	631.50	12,726.00	94,725.00	8,484.00	63,150.00								
Valemount	27.26	59.09	4,089.00	8,863.50	2,726.00	5,090.00			3.03		454.50		3,030.00	
Williams Lake	96.36	243.29	14,454.00	36,493.50	9,636.00	24,329.00		6.06	21.81	909.00	3,271.50	606.00	2,181.00	
TOTAL	635.23	2,403.54	$95,284.50	$360,531.00	$63,523.00	$240,354.00		35.64	142.84	5,346.00	21,426.00	3,564.00	17,011.00	

2. CONIFEROUS BRUSH CONTROL

	RURAL							URBAN						
			MECHANICAL (HYDRO AXE) @ $150/ACRE		HERBICIDE STUBBLE OR FOLIAR @ $100/ACRE					MECHANICAL (HYDRO AXE) @ $150/ACRE		HERBICIDE STUBBLE OR FOLIAR @ $100/ACRE		
POWER DISTRICT	DENSE ACRES	SCATTERED ACRES	DENSE TOTAL	SCATTERED COST				DENSE ACRES	SCATTERED ACRES	DENSE TOTAL	SCATTERED COST	DENSE ACRES	SCATTERED ACRES	
Burns Lake		131.70		$19,755.00					1.81	271.50			181.00	
Chetwynd	1.81		$ 271.50											
Fort Nelson		1.80		$ 270.00										
McBride														
100 Mile House	27.80	74.40	4,170.00	1,160.00										
Prince George	24.63	84.36	3,694.50	12,654.00				3.6	1.20	540.00	180.00	360.00	120.00	
South Peace														
Valemount	.60	23.93	90.00	3,589.50										
Williams Lake	18.78	158.40	2,817.00	23,760.00					14.54		2,181.00		1,454.00	
TOTAL	73.62	474.59	$11,043.00	$61,188.50				3.6	17.55	811.50	2,361.00	360.00	1,755.00	

BRUSH CONTROL
FOR NORTH PEACE,
QUESNEL AND VANDERHOOF

	ACREAGE IMMEDIATE	HERBICIDE COST	MECHANICAL COST	ACREAGE 2 - 3 YEARS	HERBICIDE COST	MECHANICAL COST	ACREAGE FUTURE	HERBICIDE COST	MECHANICAL COST	TOTAL ACREAGE	TOTAL HERBICIDE COST	TOTAL MECHANICAL COST	HERB. 6/YR CYCLE COST PER YEAR	MECH. 6/YEAR CYCLE COST PER YEAR *	* CALCULATED ASSUMING 2 TREATMENTS IN 6 YEAR PERIOD
North Peace (Based on Dawson Creek)				62.00	$ 6,200.00	$ 9,300.00	158.00	$15,800.00	$ 23,700.00	220.00	$22,000.00	$33,000.00	$ 3,666.66	$11,000.00	North Peace
Quesnel (Based on Williams Lake & Prince George	4.00	$ 400.00	$ 600.00	48.00	$ 4,800.00	$ 7,200.00	56.00	$ 5,600.00	$ 8,400.00	108.00	$10,800.00	$16,200.00	$ 1,800.00	$ 5,400.00	Quesnel
Vanderhoof (Based on Burns Lake & Prince George)	6.00	$ 600.00	$ 900.00	59.00	$ 5,900.00	$ 8,850.00	97.00	$ 9,700.00	$ 14,550.00	162.00	$16,200.00	$24,300.00	$ 2,700.00	$ 8,100.00	Vanderhoof
TOTAL:	10.00	$ 1,000.00	$ 1,500.00	169.00	$16,900.00	$25,350.00	311.00	$31,100.00	$ 46,650.00	490.00	$49,000.00	$73,500.00	$ 8,166.66	$24,500.00	TOTAL

* Detailed data was not available for these Power Districts. The information has been extrapolated from other Power Districts, without the benefit of distinction between Urban/Rural, Height Class, or Scattered/Dense Brush.

URBAN BRUSH CONTROL BY HEIGHT CLASS, DENSITY AND COST.

POWER DISTRICT	0'						0' - 4'					
	SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST	DENSE ACRES	HERBICIDE COST	MECHANICAL COST	SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST	DENSE ACRES	HERBICIDE COST	MECHANICAL COST
1. IMMEDIATE												
Burns Lake												
Chetwynd												
Fort Nelson												
McBride												
100 Mile												
Prince George	.2272	$ 22.72	$ 34.08				.0757	$ 7.57	$ 11.35			
Dawson Creek												
Valemount												
Williams Lake												
TOTAL:	.2272	$ 22.72	$ 34.08				.0757	$ 7.57	$ 11.35			
2 - 3 Years												
Burns Lake												
Chetwynd												
Fort Nelson												
McBride				7.27	$ 727.00	$ 1,090.00						
100 Mile												
Prince George	1.66	$ 166.00	$ 249.00	.12	$ 12.00	$ 18.00	.60	$ 60.00	$ 90.00			
Dawson Creek												
Valemount												
Williams Lake	8.18	$ 818.00	$ 1,227.00	4.84	$ 484.00	$ 726.00						
TOTAL:	9.84	$ 984.00	$ 1,476.00	12.23	$ 1,223.00	$ 1,834.00	.60	$ 60.00	$ 90.00			
FUTURE												
Burns Lake	10.90	$ 1,090.00	$ 1,635.00				1.21	$ 121.00	$ 181.50			
Chetwynd												
Fort Nelson	24.50	$ 2,450.00	$ 3,675.00				2.72	$ 272.00	$ 408.00			
McBride												
100 Mile												
Prince George	6.75	$ 675.00	$ 1,012.50				.96	$ 96.00	$ 144.00			
Dawson Creek	4.84	$ 484.00	$ 726.00				1.21	$ 121.00	$ 181.50			
Valemount	2.70	$ 270.00	$ 405.00				.303	$ 30.30	$ 45.45			
Williams Lake	24.54	$ 2,454.00	$ 3,681.00				2.12	$ 212.00	$ 318.00			
TOTAL: FUTURE	74.23	$ 7,423.00	$11,134.50				8.523	$ 852.30	$ 1,278.45			
2 - 3 Years	9.84	$ 984.00	$ 1,476.00				.60	$ 60.00	$ 90.00			
IMMEDIATE	.2272	$ 22.72	$ 34.08				.0757	$ 7.57	$ 11.35			
GRAND TOTAL	84.2972	$ 8,429.72	$12,644.58				9.1987	$ 919.87	$ 1,379.80			

POWER DISTRICT	4' - 12'						12' +								
	SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST	DENSE ACRES	HERBICIDE COST	MECHANICAL COST	SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST	DENSE ACRES	HERBICIDE COST	MECHANICAL COST	TOTAL SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST
1. IMMEDIATE															
Burns Lake															
Chetwynd															
Fort Nelson															
McBride															
100 Mile															
Prince George				9.09	$ 9.09	$ 1,363.50							.3029	$ 30.29	$ 45.43
Dawson Creek															
Valemount															
Williams Lake															
TOTAL:				9.09	$ 9.09	$ 1,363.50							.3029	$ 30.29	$ 45.43
2 - 3 Years															
Burns Lake															
Chetwynd															
Fort Nelson															
McBride				10.90	$ 1,090.00	$ 1,635.00									
100 Mile															
Prince George	4.81	$ 481.00	$ 721.50	.48	$ 48.00	$ 72.00				.727	$ 72.70	$ 109.05	7.07	$ 707.00	$ 1,060.50
Dawson Creek															
Valemount															
Williams Lake				1.81	$ 181.00	$ 271.50				3.03	$ 303.00	$ 454.50	8.18	$ 818.00	$ 1,227.00
TOTAL:	4.81	$ 481.00	$ 721.50	13.19	$ 1,319.00	$ 1,978.50				3.75	$ 375.70	$ 563.55	15.25	$ 1,525.00	$ 2,287.50
FUTURE															
Burns Lake													12.11	$ 1,211.00	$ 1,816.50
Chetwynd															
Fort Nelson													27.22	$ 2,722.00	$ 4,083.00
McBride															
100 Mile															
Prince George	1.21	$ 121.00	$ 181.50										8.92	$ 892.00	$ 1,338.00
Dawson Creek													6.05	$ 605.00	$ 907.50
Valemount													3.003	$ 300.30	$ 450.45
Williams Lake													26.66	$ 2,666.00	$ 3,999.00
TOTAL: FUTURE	1.21	$ 121.00	$ 181.50	ø	ø	ø							83.963	$ 8,396.30	$12,594.45
2 - 3 Years	4.81	$ 481.00	$ 721.50	13.19	$ 1,319.00	$ 1,978.50							15.25	1,525.00	2,287.50
IMMEDIATE	ø	ø	ø	9.09	$ 909.00	$ 1,363.50							.3029	30.29	45.43
GRAND TOTAL	6.02	$ 602.00	$ 903.00	22.28	$ 2,228.00	$ 3,342.00							99.5159	$ 9,951.59	$14,927.38

POWER DISTRICT	TOTALS								
	TOTAL DENSE ACRES	HERBICIDE COST	MECHANICAL COST	TOTAL ACRES	TOTAL HERBICIDE COST	TOTAL MECHANICAL COST	SIX YEAR HERBICIDE CYCLE-COST PER YEAR	EQUIVALENT SIX YEAR MECH. CYCLE AS TWO THREE YEAR TREATMENTS	
1. IMMEDIATE									
Burns Lake									
Chetwynd									
Fort Nelson									
McBride									
100 Mile									
Prince George	9.09	$ 909.00	$ 1,363.50	9.392	$ 939.29	$ 1,408.93	$ 156.54	$ 469.64	
Dawson Creek									
Valemount									
Williams Lake									
TOTAL:	9.09	$ 909.00	$ 1,363.50	9.392	$ 939.29	$ 1,408.93	$ 156.54	$ 469.64	
2 - 3 Years									
Burns Lake									
Chetwynd									
Fort Nelson									
McBride	18.17	$ 1,817.00	$ 2,725.50	18.17	$ 1,817.00	$ 2,725.50	$ 302.83	$ 908.50	
100 Mile									
Prince George	1.327	$ 132.70	$ 199.05	8.397	$ 839.70	$ 1,259.55	$ 139.95	$ 419.85	
Dawson Creek									
Valemount									
Williams Lake	9.68	$ 968.00	$ 1,452.00	17.86	$ 1,786.00	$ 2,679.00	$ 297.66	$ 893.00	
TOTAL:	29.177	$ 2,917.70	$ 4,376.55	44.427	$ 4,442.70	$ 6,664.05	$ 740.44	$ 2,221.35	
FUTURE									
Burns Lake				12.11	$ 1,211.00	$ 1,816.50	$ 201.83	$ 605.50	
Chetwynd									
Fort Nelson				27.22	$ 2,722.00	$ 4,083.00	$ 453.66	$ 1,361.00	
McBride									
100 Mile									
Prince George				8.92	$ 892.00	$ 1,338.00	$ 148.66	$ 446.00	
Dawson Creek				6.05	$ 605.00	$ 907.50	$ 100.83	$ 302.50	
Valemount				3.003	$ 300.30	$ 450.45	$ 50.05	$ 150.15	
Williams Lake				26.66	$ 2,666.00	$ 3,999.00	$ 444.33	$ 1,333.00	
TOTAL: FUTURE	ø	ø	ø	83.963	$ 8,396.30	$12,594.45	$ 1,399.36	$ 4,198.15	FUTURE
2 - 3 Years	29.177	2,917.70	4,376.55	44.427	4,442.70	6,664.05	740.44	2,221.35	2 - 3
IMMEDIATE	9.09	909.00	1,363.50	9.392	939.29	1,408.93	156.54	469.64	IMMEDIATE
GRAND TOTAL	38.267	$ 3,826.70	$ 5,740.05	137.782	$13,778.29	$20,667.43	$ 2,296.34	$ 6,889.14	GRAND TOTAL

HERBICIDE = $100/acre
MECHANICAL = $150/acre

RURAL BRUSH CONTROL BY HEIGHT CLASS, DENSITY AND COST.

POWER DISTRICT	0'						0' - 4'		
IMMEDIATE	SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST	DENSE ACRES	HERBICIDE COST	MECHANICAL COST	SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST
Burns Lake									
Chetwynd									
Dawson Creek									
Fort Nelson									
McBride	18.18	$ 1,818.00	$ 2,727.00						
100 Mile House									
Prince George				4.84	$ 484.00	$ 726.00			
Valemount									
Williams Lake									
TOTAL:	18.18	$ 1,818.00	$ 2,727.00	4.84	$ 484.00	$ 726.00			
2 - 3 years									
Burns Lake	1.81	$ 181.00	$ 271.50	8.18	$ 818.00	$ 1,227.00	9.09	$ 909.00	$ 1,363.50
Chetwynd	6.66	666.00	999.00	5.45	545.00	817.50			
Fort Nelson	17.27	1,727.00	2,590.50	9.08	908.00	1,362.00			
McBride	.54	54.00	81.00	7.27	727.00	1,090.50			
100 Mile House	25.15	2,515.00	3,772.50	50.57	5,057.00	7,585.50			
Prince George	27.26	2,726.00	4,089.00	25.90	2,590.00	3,885.00			
Dawson Creek	52.44	5,244.00	7,866.00	21.21	2,121.00	3,181.50	1.21	121.00	181.50
Valemount	15.75	1,575.00	2,362.50	19.39	1.939.00	2,908.50	3.03	303.00	454.50
Williams Lake	28.78	2,878.00	4,317.00	31.21	3,121.00	4,681.50			
TOTAL:	175.66	$17,566.00	$26,349.00	178.26	$17,826.00	$26,739.00	13.33	$ 1,333.00	$ 1,999.50
FUTURE									
Burns Lake	208.54	20,854.00					32.23	$ 3,223.00	$ 4,835.00
Chetwynd	294.23	29,423.00	44,135.40				42.34	4,234.00	6,351.00
Fort Nelson	19.08	1,980.00	2,862.00				2.73	273.00	409.50
McBride	43.60	4,360.00	6,540.00				5.44	544.00	816.00
100 Mile House	214.84	21,484.00	32,226.00	9.69	969.00	1,453.50	43.33	4,333.00	6,499.50
Prince George	276.50	27,650.00	41,475.00	51.21	5,121.00	7,681.50	45.30	4,530.00	6,795.00
Dawson Creek	539.08	53,908.00	80,862.90	6.36	636.00	954.00	75.45	7,545.00	11,317.50
Valemount	431.82	43,182.00	64,773.00	3.63	363.00	544.50	17.87	1,787.00	2,680.50
Williams Lake	342.11	34,211.00	51,316.50				5.15	515.00	772.50
"FUTURE" TOTAL	2,369.80	$236,980.00	$355,470.00	70.89	$7,089.00	$10,633.50	267.11	$26,711.00	$40,476.50
"2 - 3 Year" TOTAL	175.66	17,566.00	26,349.00	178.26	17,826.00	26,739.00	13.33	1,333.00	1,999.50
"IMMEDIATE" TOTAL	18.18	1,818.00	2,727.00	4.84	484.00	726.00			
GRAND TOTAL:	2,563.64	$256,364.00	$384,546.00	253.99	$25,399.00	$38,098.50	280.44	$28,044.00	$42,476.00

POWER DISTRICT	0' - 4'			4' - 12'					
IMMEDIATE	DENSE ACRES	HERBICIDE COST	MECHANICAL COST	SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST	DENSE ACRES	HERBICIDE COST	MECHANICAL COST
Burns Lake									
Chetwynd									
Dawson Creek									
Fort Nelson									
McBride									
100 Mile House									
Prince George									
Valemount									
Williams Lake									
TOTAL:									
2 - 3 years									
Burns Lake				1.21	$ 121.00	$ 181.50	7.27	$ 727.00	$ 1,090.50
Chetwynd				5.45	545.00	817.50	12.72	1,272.00	1,908.00
Fort Nelson				10.00	1,000.00	1,500.00	45.45	4,545.00	6,817.50
McBride				.60	60.00	90.00	29.09	2,909.00	4,363.50
100 Mile House	24.24	2,424.00	3,636.00	21.51	2,151.00	3,226.50	63.33	6,333.00	9,499.50
Prince George	.90	90.00	135.00	9.30	930.00	1,395.00	42.34	4,234.00	6,351.00
Dawson Creek	7.87	787.00	1,180.00	20.20	2,020.00	3,030.00	39.39	3,939.00	5,908.50
Valemount	5.45	545.00	817.50	4.84	484.00	726.00	ø	ø	ø
Williams Lake				5.11	511.00	766.50	50.60	5,060.00	7,590.00
TOTAL:	38.46	$ 3,846.00	$ 5,768.50	78.22	$ 7,822.00	$11,733.00	290.19	$29,019.00	$43,528.50
FUTURE									
Burns Lake									
Chetwynd				17.87	1,787.00	2,680.50			
Fort Nelson				5.45	545.00	817.50			
McBride									
100 Mile House				.90	90.00	135.00			
Prince George	5.45	545.00	817.50	41.50	4,150.00	6,225.00			
Dawson Creek	9.39	939.00	1,408.50	30.00	3,000.00	4,500.00			
Valemount	5.45	545.00	817.50	1.81	181.00	271.50			
Williams Lake	6.06	606.00	909.00						
"FUTURE" TOTAL	26.35	$ 2,635.00	$ 3,952.50	97.53	$ 9,753.00	$14,629.50			
"2 - 3 Year" TOTAL	38.46	$ 3,846.00	$ 5,768.50	78.22	7,822.00	$11,733.00	290.19	$29,019.00	$43,528.50
"IMMEDIATE" TOTAL									
GRAND TOTAL:	64.81	$ 6,481.00	$ 9,721.00	175.75	$17,575.00	$26,362.50	290.19	$29,019.00	$43,528.50

POWER DISTRICT	12' +									
IMMEDIATE		SCATTERED ACRES	HERBICIDE COST	MECHANICAL COST	DENSE ACRES	HERBICIDE COST	MECHANICAL COST	TOTAL SCATTERED ACRES	TOTAL HERBICIDE COSTS	TOTAL MECHANICAL COSTS
Burns Lake										
Chetwynd										
Dawson Creek										
Fort Nelson										
McBride								18.18	$ 1,818.00	$ 2,727.00
100 Mile House										
Prince George					1.21	$ 121.00	$ 181.50			
Valemount										
Williams Lake										
TOTAL:					1.21	$ 121.00	$ 181.50	18.18	$ 1,818.00	$ 2,727.00
2 - 3 years										
Burns Lake								12.11	$ 1,211.00	$ 1,816.50
Chetwynd								12.11	1,211.00	1,816.50
Fort Nelson								27.27	2,727.00	4,090.50
McBride								1.14	114.00	171.00
100 Mile House								46.66	4,666.00	6,999.00
Prince George					15.00	$ 1,500.00	$ 2,250.00	36.56	3,656.00	5,484.00
Dawson Creek					1.21	$ 121.00	$ 181.50	73.85	7,385.00	11,077.50
Valemount								23.62	2,362.00	3,543.00
Williams Lake								33.89	3,389.00	5,083.50
TOTAL:					16.21	$ 1,621.00	$ 2,431.50	267.21	$26,721.00	$40,081.50
FUTURE										
Burns Lake								240.77	$24,077.00	$36,116.00
Chetwynd								354.44	$35,444.00	$53,166.00
Fort Nelson								27.26	2,726.00	4,089.00
McBride								49.04	4,904.00	7,356.00
100 Mile House								259.07	25,907.00	38,860.00
Prince George					.60	$ 60.00	$ 90.00	363.30	36,330.00	54,495.00
Dawson Creek								644.53	64,453.00	96,679.50
Valemount								451.50	45,150.00	67,725.00
Williams Lake								347.26	34,726.00	52,089.00
"FUTURE" TOTAL					.60	$ 60.00	$ 90.00	2,737.17	$ 273,717.00	$ 410,575.50
"2 - 3 Year" TOTAL					16.21	$ 1,621.00	$ 2,431.5	267.21	26,721.00	$40,081.50
"IMMEDIATE" TOTAL					1.21	121.00	181.50	18.18	1,818.00	$ 2,727.00
GRAND TOTAL:					18.02	$ 1,802.00	$ 2,703.00	3,022.56	$ 302,256.00	$ 453,384.00

POWER DISTRICT	TOTALS								
IMMEDIATE	TOTAL DENSE ACRES	HERBICIDE COSTS	MECHANICAL COSTS	TOTAL ACRES	TOTAL HERBICIDE COSTS	TOTAL MECHANICAL COSTS	OVER A SIX YEAR CYCLE TOTAL HERBICIDE COSTS PER YEAR *	OVER AN EQUIVALENT SIX YEAR CYCLE AS TO THREE-YEAR MECHANICAL TREATMENTS	
Burns Lake									
Chetwynd									
Dawson Creek									
Fort Nelson									
McBride				18.18	$ 1,818.00	$ 2,727.00	$ 303.00	$ 909.00	
100 Mile House									
Prince George	6.05	$ 605.00	$ 907.50	6.05	$ 605.00	$ 907.50	$ 101.00	$ 302.50	
Valemount									
Williams Lake									
TOTAL:	6.05	$ 605.00	$ 907.50	24.23	$ 2,423.00	$ 3,634.50	$ 404.00	$ 1,211.50	
2 - 3 years									
Burns Lake	15.45	$ 1,545.00	$ 2,317.50	27.56	$ 2,756.00	$ 4,134.00	$ 459.00	$ 1,378.00	
Chetwynd	18.17	$ 1,817.00	$ 2,725.50	30.28	$ 3,028.00	$ 4,542.00	$ 504.00	$ 1,514.00	
Fort Nelson	54.53	$ 5,453.00	$ 8,179.50	81.80	$ 8,180.00	$12,270.00	$ 1,363.00	$ 4,090.00	
McBride	36.36	$ 3,636.00	$ 5,454.00	37.50	$ 3,750.00	$ 5,625.00	$ 625.00	$ 1,875.00	
100 Mile House	138.14	$ 13,814.00	$ 20,721.00	184.80	$18,480.00	$ 27,720.00	$ 3,080.00	$ 9,240.00	
Prince George	84.14	$ 8,414.00	$ 12,621.00	120.70	$12,070.00	$ 18,105.00	$ 2,011.66	$ 6,035.00	
Dawson Creek	69.68	$ 6,968.00	$ 10,452.00	143.53	$14,353.00	$ 21,529.50	$ 2,392.16	$ 7,176.50	
Valemount	24.84	$ 2,484.00	$ 3,726.00	48.46	$ 4,846.00	$ 7,269.00	$ 807.00	$ 2,423.00	
Williams Lake	81.81	$ 8,181.00	$ 12,271.50	115.70	$11,570.00	$ 17,355.00	$ 1,928.00	$ 5,785.00	
TOTAL:	523.12	$ 52,312.00	$ 78,468.00	790.33	$79,033.00	$118,549.50	$13,172.16	$39,516.50	
FUTURE									
Burns Lake				240.77	$24,077.00	$36,115.50	$ 4,013.00	$12,038.50	
Chetwynd				354.44	$35,444.00	$53,166.00	$ 5,907.00	$17,722.00	
Fort Nelson				27.26	$ 2,726.00	$ 4,089.00	$ 455.00	$ 1,363.00	
McBride				49.04	$ 4,904.00	$ 7,356.00	$ 817.00	$ 2,452.00	
100 Mile House	9.69	$ 969.00	$ 1,453.50	268.76	$26,876.00	$40,314.00	$ 4,479.00	$13,438.00	
Prince George	57.26	$ 5,726.00	$ 8,589.00	420.56	$42,056.00	$63,084.00	$ 7,009.33	$21,028.00	
Dawson Creek	15.75	$ 1,575.00	$ 2,362.50	660.28	$66,028.00	$99,042.00	$11,004.66	$33,014.00	
Valemount	9.08	$ 908.00	$ 1,362.00	460.58	$46,058.00	$69,087.00	$ 7,676.00	$23,029.00	
Williams Lake	6.06	$ 606.00	$ 909.00	353.32	$35,332.00	$52,998.00	$ 5,889.00	$17,666.00	
"FUTURE" TOTAL	97.84	$ 9,784.00	$ 14,676.00	2,835.01	$ 283,501.00	$ 425,251.50	$ 47,250.16	$141,750.50	FUTURE
"2 - 3 Year" TOTAL	523.12	$ 52,312.00	$ 78,468.00	790.33	$ 79,033.00	$ 118,549.50	$ 13,172.16	$ 39,516.50	2 - 3 Years
"IMMEDIATE" TOTAL	6.05	605.00	$ 907.50	24.23	$ 2,423.00	$ 3,634.50	$ 404.00	$ 1,211.50	IMMEDIATE
GRAND TOTAL:	627.01	$ 62,701.00	$ 94,051.50	3,649.57	$ 3,649.57	$ 547,435.50	$ 60,826.16	$182,478.50	GRAND TOTAL

A) To determine costs per year for herbicide & mechanical treatment
1. Assume herbicide treatment effective over 6 year cycle.
2. Assume mechanical treatment effective over three year cycle and that it DOES NOT include chipping or burning of waste products.

B) Herbicide - Stubble or Foliar.

* The cycle differential for control between chemical & mechanical is based on extremely accurate records kept by Ontario Hydro.

COMBINED GRAND TOTAL - BRUSH CONTROL CENTRAL INTERIOR REGION

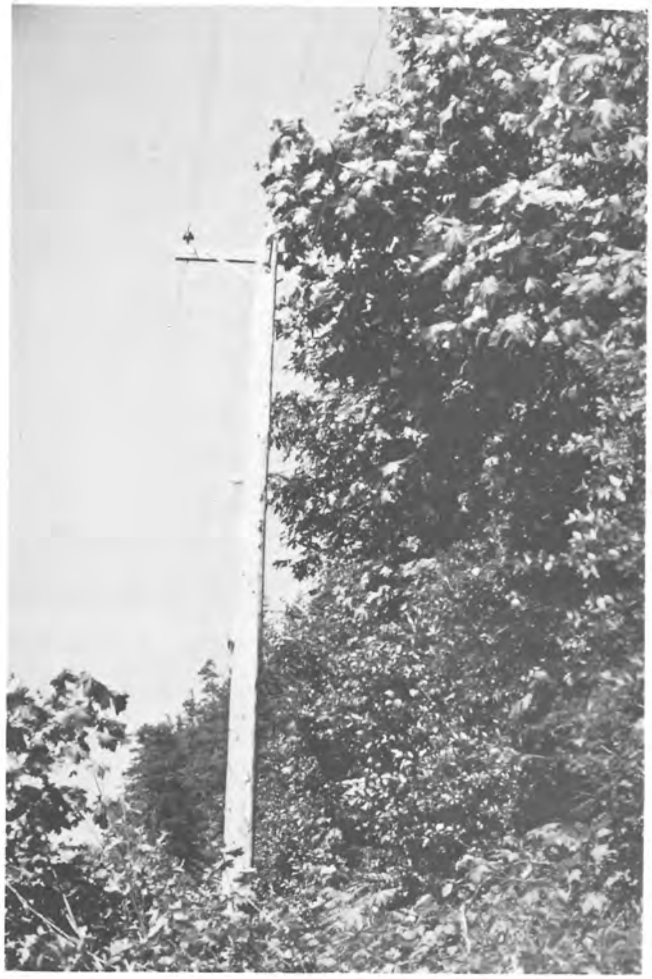
	TOTAL ACREAGE	TOTAL HERBICIDE COST	TOTAL MECHANICAL COST	SIX YEAR CYCLE		* Assuming two treatments in the six-year cycle.
				HERBICIDE COST PER YEAR	* MECHANICAL COST PER YEAR	
(North Peace Quesnel and Vanderhoof)	490.00	$ 49,000.00	$ 73,500.00	$ 8,166.66	$ 24,500.00	TOTAL
(URBAN)	137.78	$ 13,778.29	$ 20,667.43	$ 2,296.34	$ 6,889.14	"URBAN" BRUSH CONTROL
(RURAL)	3,649.57	$ 364,957.00	$ 547,435.50	$ 60,826.16	$ 182,478.50	"RURAL" BRUSH CONTROL
(GRAND TOTAL)	4,277.35	$ 427,735.29	$ 641,602.93	$ 71,289.16	$ 213,867.64	GRAND TOTAL

APPENDIX II

1. Safety Officer showing tree top that has touched the conductor and burned.

2. Not only do trees become an electrical hazard in this way, they can also induce intermittent service interruptions.

3. Deciduous tree species rapidly grow into the conductor if not trimmed on a consistent basis.



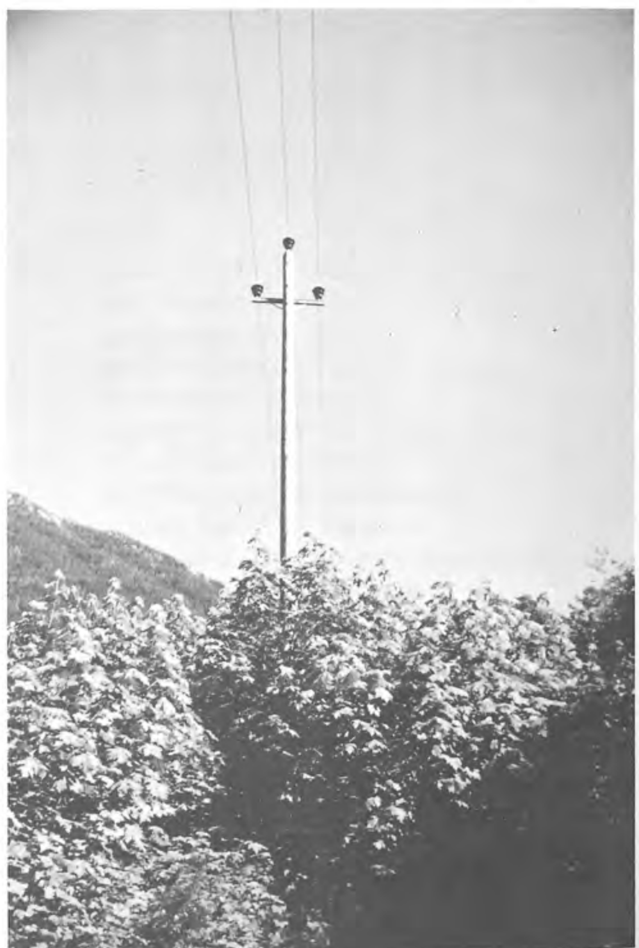
4. Removal of overhanging branches, reduction of crown size and weak crotches can significantly reduce winter outages.

5. In addition to tree trimming, tree removal in rural areas will reduce the number of outages caused by weak trees bending or breaking under snow weight.

6. Unstable, weak, or unhealthy trees on the periphery of rights-of-way can be the victims of wind-blow, again causing conductor damage.

7. New construction, logging, or clearing may effect the stability of vegetation. Adequate line security can only be maintained with a regular tree removal programme.

8. Emphasis on aesthetics is displayed at road crossings where vegetation has been left to screen the right-of-way. In time these tree screens will require trimming to maintain adequate clearance.



9. Although acceptable at road crossings, long stretches of underbrush present an obvious hazard to the integrity of the system. If allowed to grow this tall, eventually treatment will significantly effect roadside appearance which can draw public criticism. Maintenance practices should aim at maximum control with least impact.

10. Owners of private property and municipalities may compound the problem of maintaining clearances by planting fast growing species under or close to distribution lines. More active public education could help to reduce this problem by recommending small compatible tree species.

11. Municipality or privately owned undeveloped land even in the far north of the region may support tree species which will eventually require control.

12. The crucial element in a vegetation management programme is one of properly equipped and trained staff. This utility arborist is equipped for winter work in northern Ontario where conditions are very similar to the Central Interior. He will have completed a four year journeyman course and is skilled in the use of tools, equipment, and vegetation control techniques.

13. A utility arborist must be able to work safely close to energized conductors. He must be properly equipped and able to attain the maximum clearance for the longest period of time with the minimum impact on the appearance of shade and ornamental trees.

14. The advent of the mechanized trim lift has reduced but not eliminated the need for skilled tree climbers. Crew size, productivity, and equipment will be contingent on programme size, availability of trained staff, cycles and past practices.

15. The journeyman's skill must enable him to remove large hazardous trees with safety for himself, the general public, and the electrical system. Training and practical experience are essential.

16. Wherever possible tree work should not conflict with normal operation of the system. With proper techniques and equipment it is possible to carry out safely, major tasks without service interruptions.

17. Tree trimming may be undertaken using a wide range of techniques from the simple hand held pruner through to specialized off-road equipment.

18. Mechanized equipment may include such vehicles as the four-wheel drive ladder truck used by many utilities as a basic vehicle in their distribution line maintenance operations.

19. A more sophisticated adaptation of the ladder truck is an off-road vehicle using the same aerial device but a more versatile prime mover. Attached to this Bombadier is also a chipper for brush disposal.

18. Mechanized equipment may include such vehicles as the four-wheel drive ladder truck used by many utilities as a basic vehicle in their distribution line maintenance operations.

19. A more sophisticated adaptation of the ladder truck is an off-road vehicle using the same aerial device but a more versatile prime mover. Attached to this Bombadier is also a chipper for brush disposal.

20. The most efficient combination of aerial bucket device is as shown here, with a brush chipper. This device is towed and can load directly into the vehicle box.

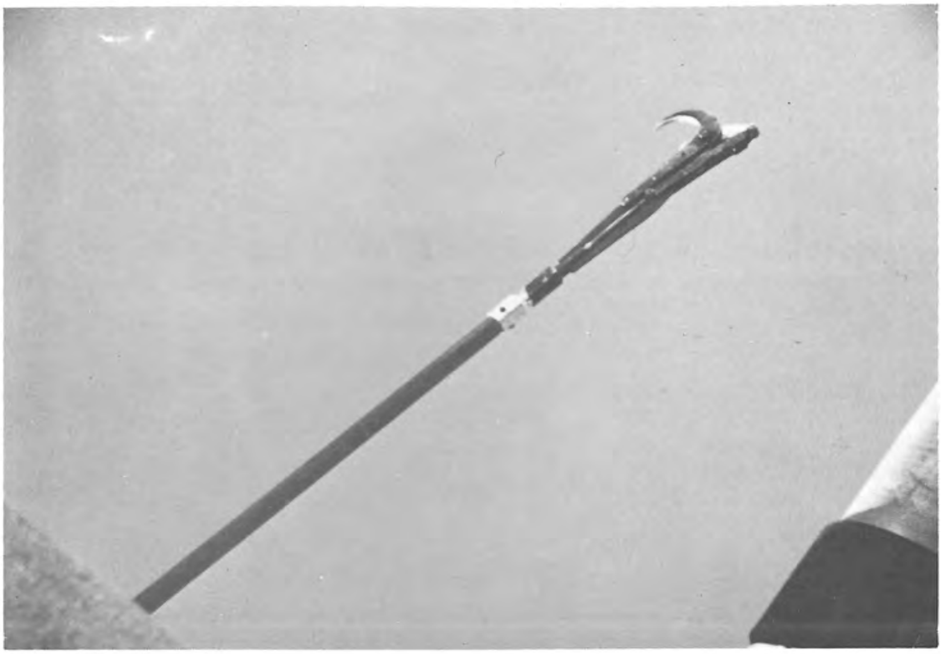
21. Since few highway authorities or private owners, will allow cut brush to be left at road sides, chippers are almost always required for brush disposal. Some authorities especially in rural districts may allow the chips to be returned to the road allowance.

22. The ladder truck has now given way to the trim lift. The versatility of this aerial bucket device can be seen in its ability to pass under the line and work behind the conductor to remove overhanging branches. Safe limits of approach have been established for these insulated vehicles for use in live line operations. They must, however, be properly maintained and dielectricly tested on a regular basis.

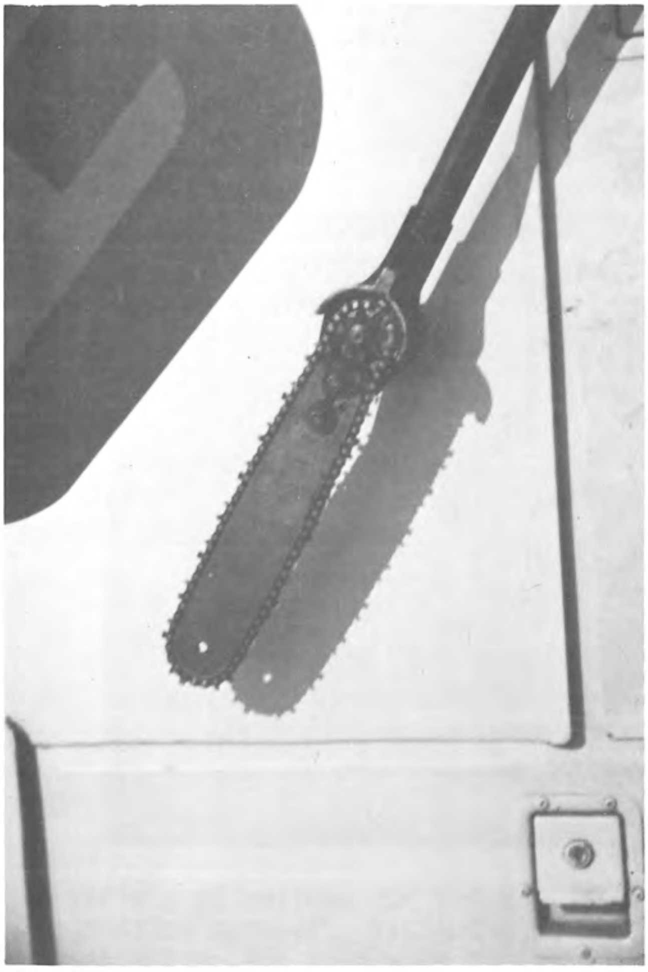
23. Squirt booms have been used by some utilities for vegetation work but are not favoured since they lack the articulated boom and reach of trim lifts.

24. Where lines pass through heavily vegetated areas without road access, trim lift vehicles have been developed which can be used on a wide variety of terrain under all weather conditions.

25. Three hand tools form the basis of equipment used from aerial bucket devices. This electrical start saw was introduced to obviate the hazard associated with pull start saws.



26. The hydraulically operated pruner is an insulated tool which can be used from the basket for tree trimming. Although slower than the commonly used hydraulic circular saw, it allows the operator to drop crotch prune without damage to lateral growth.



27. Branches over 3" or 4" in diameter can be cut using this hydraulically operated chain saw which has a similar reach to the pruner.

28. Continuous development of new equipment has resulted in the hydraulically operated Ackley chain saw. It appears to have few advantages, however, over the conventional chain saw, especially those of the light weight electrical start type.

29. A variety of methods for the control of underbrush are available to the vegetation manager. Various makes of chain saw and shoulder slung brush cutter are available on the commercial market.

30. Mechanized brush cutting equipment has been developed by some manufacturers. A few contractors offer services with this type of machine.

31. Slope and ruggedness of terrain as well as rocks and stumps limit the accessibility by both the tracked and rubber tired brush cutters.

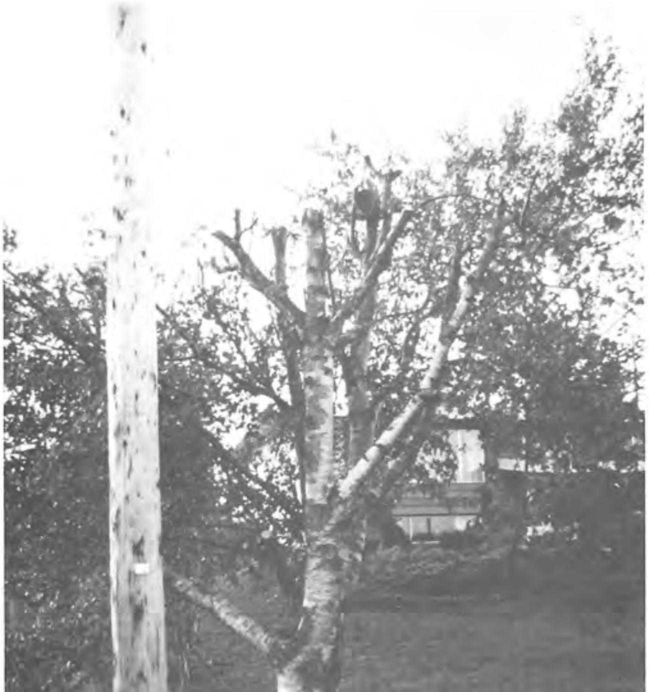
32. Fast growing deciduous species of underbrush are most efficiently controlled with selective herbicides. They may be applied either as foliar treatments, stump treatments after mechanical cutting, or as pellets.

33. With distribution lines which are primarily along road sides, brush species should be treated below three feet in height. Here hand treatment of pellets gives specific control of individual stumps.

34. As brush density increases it may be more appropriate to use back pack sprayers. Liquid sprays also may be applied over a longer portion of the year, and are more effective for stump treatment.

35. Power knapsack sprayers are an effective way of applying both liquid and pellets for broadcast control of dense growth.

36. Once grass species become well established, cycles increase and retreatment becomes simpler. Here a boom truck with folding hydraulic arm can treat sparse brush efficiently.



37. Present tree trimming practice in B. C. often carried out by contractors perpetuates unacceptable arboricultural practice. Here stub cutting of an ornamental birch has badly mutilated a garden shade tree.

38. This road side maple has been severely stub cut giving a grotesque appearance and leaving no growing branches to absorb the energy of a large root system.

39. Dormant and adventitious buds become the source of rapid growing suckers. These soft tissue stems may grow 6 feet per annum, completely negating the intent of original pruning for line clearance.

40. On the left can be seen a boulevard tree of the same size and species as that on the right. The tree on the left has been stub cut with only a few laterals retained. Although top height is similar to the tree on the right, appearance is unnatural and will promote suckering. The tree on the right has been drop crotch pruned giving good crown symmetry and pleasing appearance.

41. Tall Lombardy Poplars have been stub cut with the resulting proliferation of sucker growth.

42. Chestnut has been cut flat to attain line clearance. Dead wood has not been removed and stubs will sucker rapidly.

43. This proliferation of suckers has grown in less than three months after pruning. Note the untreated wounds where limbs have been removed. Fortified tree wound dressings combined with drop crotch pruning can significantly reduce regrowth from these cuts.

44. The appearance of these conifers after frontal pruning is not acceptable. Original provision of offset cross arms would have reduced the problem. However, present pruning practice draws maximum attention to the conductor. Although contract specifics embody the basic requirements for proper pruning, jobs must be properly supervised. Dead hangers left in the tree do not indicate proper attention.

45. This boulevard tree has been cut allowing the branches to encircle the conductor. With fast growing species this type of pruning results in tunneling; the most hazardous work situation for the utility arborist. The tree is badly decayed and would be a good candidate for a cooperative replacement programme.

46. Improper pruning practice can result in this type of hinge tear. Proper training, and hence knowledge of arboricultural techniques, overcomes this unsightly and dangerous problem. This wound will not properly callous in the way the other branches removed below this cut have healed and decay will start in the scar.

47. Although common practice for many years the technique of pollarding (removing all growing branches in the Fall) results in this grotesque appearance and rapid proliferation of suckers. It is also undesirable, since it requires a one-year pruning cycle.

48. Poor crown symmetry has resulted from inattention to arboricultural techniques and emphasis only on conductor clearance. Such trees should be managed as a whole entity with crowns properly contained and dead wood removed. It is more desirable to have healthy trees, properly pruned, than unsightly and weakened specimens which in themselves may eventually become a hazard.

49. Vegetation on the edge of the right-of-way can be retained as a subtle mask for the impact of lines. Selective clearing with the retention of low growing shrubs and woody plants becomes possible after cycles which deplete brush density. Scattered undesirable woody plants may then be treated on an individual basis.

50. On this urban street large forest trees have been replaced with compatible ornamental trees. These will require only a minimum of care at maturity. Appropriate pole height allows some species to grow to their final size without any need for pruning. Replacement of undesirable species with compatible trees should form part of any urban vegetation management programme.

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