PLANNING AND ORGANIZING THE PLANTING PROJECT

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Abstract.--Ecological interpretations are used in British Columbia to determine the most suitable site preparation methods and the preferred species for planting. Planting is usually done by contract, and this has allowed Ministry staff to spend more time on planting inspections rather than on administrative details. As a result, the quality of planting has improved.

Résumé.--En Colombie-Britannique, on utilise des interprétations écologiques pour déterminer les meilleures méthodes de préparation de la station et les essences les plus convenables à la plantation. La plantation se fait habituellement par des entrepreneurs, ce qui donne plus de temps au personnel du ministère pour inspecter les plantations au lieu de s'occuper des détails administratifs. Il en est résulté une amélioration de la qualité des plantations.

INTRODUCTION

Fully stocked plantations of vigorous and fast-growing seedlings of the correct species result from careful preplanning and the application of sound economic and biological principles. This paper describes the approach to tree planting taken in British Columbia.

ECOLOGICAL CLASSIFICATION OF FOREST LAND

Forest management, particularly in the field of silviculture, is site-specific. Forest ecosystem identification provides a framework for selecting different management practices and for prescribing particular regeneration techniques on a site-specific basis.

In British Columbia, ecological classification is based on the extensive research of Krajina (1973) and, more recently, Klinka (1977) and others. Ecosystem classifications now exist for all sites in the Vancouver, Kamloops, Nelson, Cariboo and part of the Prince Rupert forest regions. In essence, the system classifies plant associations by characterizing forest sites according to two major soil gradients on an edatopic grid: soil moisture and soil nutrient status (Fig. 1).

This edatopic classification system facilitates selection of suitable tree species and evaluation of the suitability of prescribed burning. More recently, stocking standards have been superimposed on the edatopic grid. It is expected that stock types and stock size standards will be added in future.

The selection of the most suitable tree species for reforestation must be based on both ecological and productivity considerations. The grid, therefore, identifies the most appropriate species, or mixture of species, for the particular forest site on the basis of plant associations and site index (m/100 years). For a complete description of the development and use of the edatopic grid, see Klinka (1977).

Prior to harvesting, a silvicultural field assessment is completed. This assessment identifies the factors which have to be taken into account in determining subsequent

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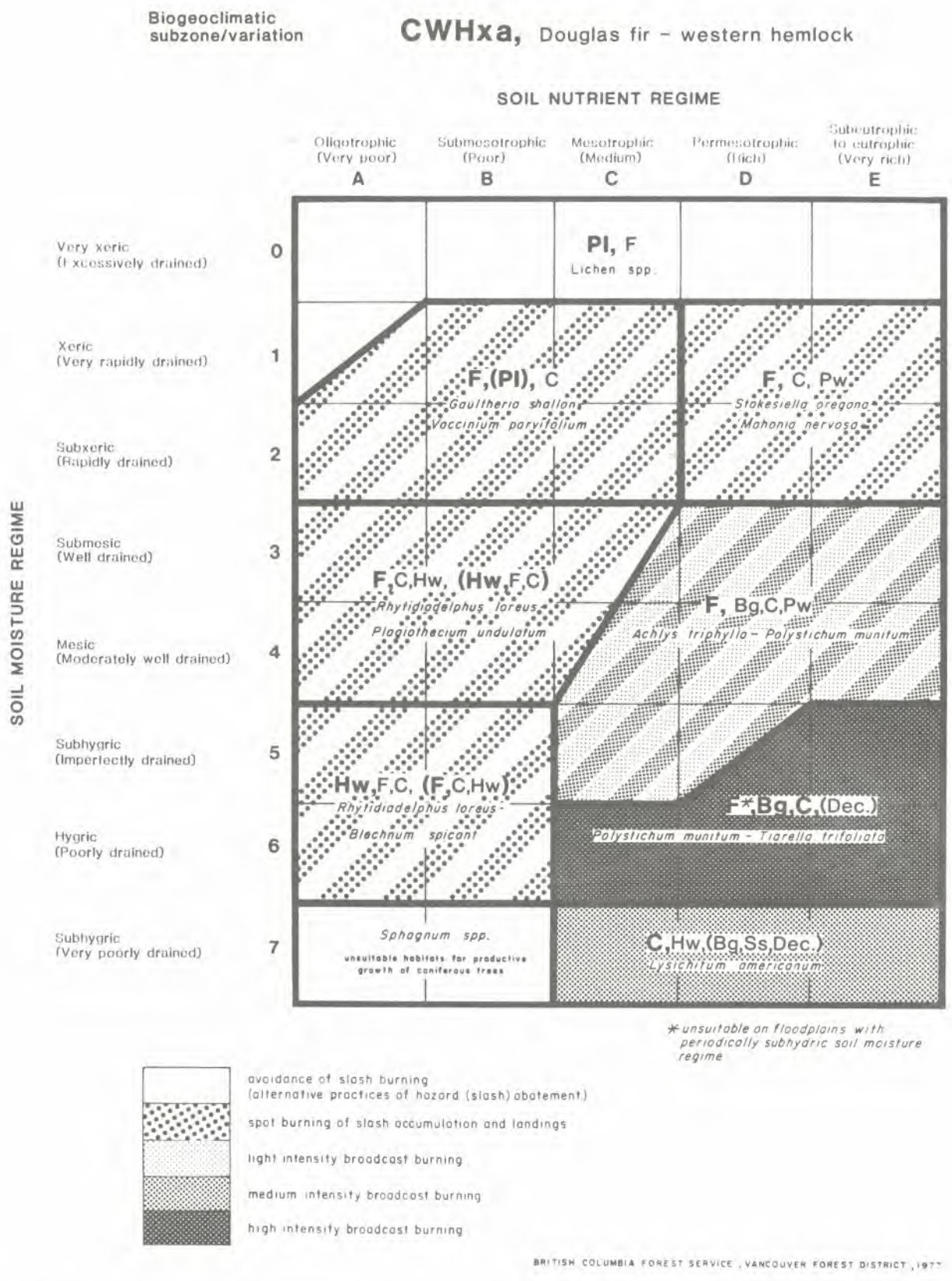

Figure 1. Guide for tree species selection and prescribed burning in the Vancouver Forest Region.

actions. For example, for each ecosystem association within each biogeoclimatic subzone there are management recommendations with regard to prescribed burning, grass seeding, tree species selection, stocking levels, etc. Information on the amount, composition, distribution and vigor of the understory may be used to predict its ability to respond to a partial or total removal of the overstory, and to restock the site fully or partially to produce a satisfactory future stand. Examination of the shrub species and percent cover will allow evaluation of the effects of partial or total cuts on stand structure and possible regeneration problems.

The underlying principle is to ensure that harvesting, site preparation, regeneration and other uses of forest land are compatible with the overall management objective.

SITE PREPARATION

Immediately after cutting, a suitable site treatment on a site-specific basis has to be prescribed. This treatment should be consistent with the management objectives for the area, and must give consideration to site productivity, fire hazard and risk, reforestation objectives and the feasibility of treatment.

PLANTING PRESCRIPTION

Satisfactory plantation establishment depends to a large degree on the recommendations of the examiner. Prescriptions must therefore be made by the most experienced personnel available.

The purpose of the Planting Site Prescription form (Fig. 2) is to ensure that all site factors influencing survival and growth of planted trees are taken into account when the planting program is developed. It also provides a means of recording all the administrative details that must be completed before planting begins. The front of the form becomes part of the planting contract information to assist contractors in their submission of tenders.

The field examiner completes parts A to D which describe the location, site factors, access and recommendations for species, stock type, age class and numbers of trees. Part E is completed by the Regional Office staff when the planting program is finalized and planting stock is allocated.

Province of British Columbia — Ministry of Forests — Forest Service

PLANTING SITE PRESCRIPTION

A. IDENTIFICATION

1. Forest Region: V 2. Dist. No. and name: 11. CAMPBELL R. (N)
3. Location: HEAD OF BUTE INLET 4. SZ: 1080
5. PSYU/Other: QUADRA 6. UTM grid: 10-395-5632
7. Tenure: C.P.5, T.S.H.L. A00515, RAYONIER
8. Project number and name: 92 K16-5, SOUTH GATE R.

B. SITE FACTORS

	A	B	C
1. Planting unit	A	B	C
2. Former stand: Spp.	FCH	HF	FC
3. Biogeoclimatic subzone	CWHa	CWHa	CWHa
4. Ecosystem			
5. General soil texture: Clay, sand, loam, silt, gravel	S-G	C-G	C-G
6. Moisture: Dry, medium, wet	D	M	M
7. Soil nutrients: Poor, med., rich	M	P	P
8. Veget. compet.: N.L.M.H.	L	L	M
9. Grazing use: N.L.M.H.	N	N	N
10. Slash: % cover and height	15-50	5-20	25-40
11. Organic layer(s): cm	5	7	25
12. Disturbance symbol/year	L74	L75	L75
13. Site prep.: Method/year	B75	B76	B75
14. Aspect and % slope	S20	SE20	E45
15. Elevation: m	140	210	240
16. Planting diffic. class	MOD.	MOD.	DIFF.
17. Existing regen. per ha	210	150	330
18. Spacing: m	2.5	2.5	2.5
19. Plantable spots per ha	1280	1310	1220
20. Net area to be planted: ha	68.1	42.0	30.3

C. ACCESS AND ACCOMMODATION

1. Access: Distances and means: 105 Km by air from Campbell R. to dock at camp, thence 26 Km on mainline and 9 Km on secondary road to area.
2. Access problems: Vehicles to be barged from Campbell R. Spur roads in poor condition.
3. 4 W.D. is required 4. Accommodation: None available - Camp on area.
5. Other: Heel-in site at junction of mainline and Spur road in standing timber - see map.
6. Date prescribed: 20.6.77 By: C. KENDALL

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F.S. 739 (Revised May, 1979)—o

D. EXAMINER'S RECOMMENDATIONS

	A	B	C
1. Planting unit	A	B	C
2. Species	FC	H	F
3. Type of stock	BR	PLUGS	BR
4. Age or size class	2+0	1+0	2+1
5. Type of planting tool	MATT.	DIBBLE	SHOVEL
6. Order of planting	1	3	2
7. 000's of trees	87	55	37

8. Season and year: STB 9. Priority and reason: High: secondary roads due to washout.
10. Access improvement and cost: $750 for miner road repair - D6 available from Logging Camp. also show on map
11. Stock supplied to planters at: Company dock, head of Bute Inlet.
12. To be planted by: F.S. ☐ Contract ☒ Type: Advertised. Licensee ☐ Name: Other ☐
13. Supervisor(s): Forestry Crew No. 6
14. Crew: Contract: minimum of 15 planters.
15. Vehicles: n/a
16. Estim. cost: Total $ 26,490 Per tree: 14.8 ¢
17. Duration: 18 days 18. Start-up time: 7 days
19. Mandatory viewing? No Leaving: at on 20. Special clauses: Screefing in Unit C. Heeling-in of bareroot stock.
21. Advertise in: Campbell R. Upper Islands Vancouver Province.

E. STOCK ALLOCATED (by Regional Office)

Unit	Spp.	Seed Lot	Stock Type	Age/Size Class	Nursery	000's of Trees
A	F	1646	BR	2+0	C.R.	87
B	H	2781	PLUGS	P4	K.	56
C	F	1646	BR	2+0	C.R.	20
	F	1345		2+1	G.T.	17

Approved: H. Hoho Date: Jan. 3/79 Total: 180

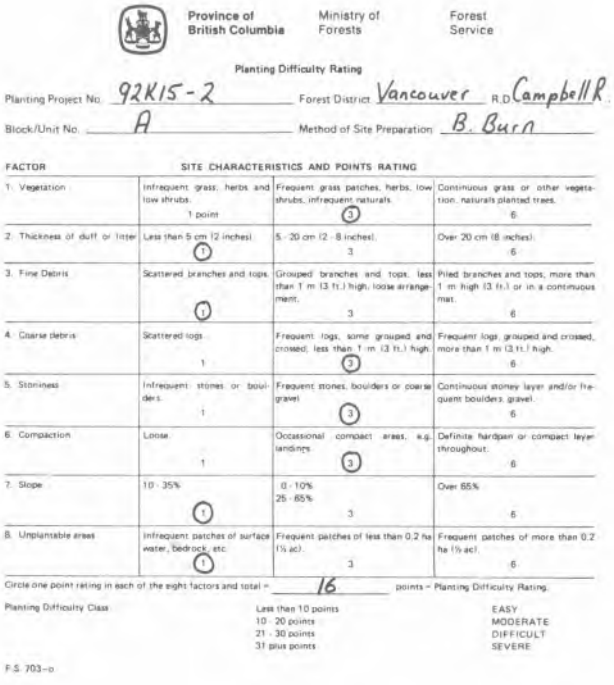
Figure 2. Planting site prescription.

An accurate map is an integral part of the prescription. This map can also be used to record information for which there may be insufficient space on the prescription form, including the identification of various ecological units.

Prescriptions may become out of date rapidly. If there has been an appreciable delay between prescription and planting, there must be a further ground check to note any changes in items such as natural regeneration, brush competition, access, and so on.

Planting Difficulty Rating

An important consideration in the planting prescription is an assessment of the difficulty of planting. This assessment will assist in the choice of suitable planting stock types and will provide an indication of planting productivity and, therefore, expected costs in relation to site conditions and classes of stock (Fig. 3). The point rating obtained from an assessment of the factors is applied to the production table to establish the number of trees that should be planted per man-day for the class or classes of stock assigned to the project (Table 1).



Province of British Columbia — Ministry of Forests — Forest Service

Planting Difficulty Rating

Planting Project No. 92K15-2 Forest District Vancouver R.D. Campbell R.

Block/Unit No. A Method of Site Preparation B. Burn

FACTOR	SITE CHARACTERISTICS AND POINTS RATING		
1. Vegetation	Infrequent grass, herbs and low shrubs. 1 point	Frequent grass patches, herbs, low shrubs, infrequent naturals. (3)	Continuous grass or other vegetation, naturals planted trees. 6
2. Thickness of duff or litter	Less than 5 cm (2 inches). (1)	5 - 20 cm (2 - 8 inches). 3	Over 20 cm (8 inches). 6
3. Fine Debris	Scattered branches and tops. (1)	Grouped branches and tops, less than 1 m (3 ft.) high, loose arrangement. 3	Piled branches and tops, more than 1 m high (3 ft.) or in a continuous mat. 6
4. Coarse debris	Scattered logs. 1	Frequent logs, some grouped and crossed, less than 1 m (3 ft.) high. (3)	Frequent logs, grouped and crossed, more than 1 m (3 ft.) high. 6
5. Stoniness	Infrequent stones or boulders. 1	Frequent stones, boulders or coarse gravel. (3)	Continuous stoney layer and/or frequent boulders, gravel. 6
6. Compaction	Loose. 1	Occassional compact areas, e.g. landings. (3)	Definite hardpan or compact layer throughout. 6
7. Slope	10 - 35%. (1)	0 - 10% 25 - 65% 3	Over 65%. 6
8. Unplantable areas	Infrequent patches of surface water, bedrock, etc. (1)	Frequent patches of less than 0.2 ha (½ ac). 3	Frequent patches of more than 0.2 ha (½ ac). 6

Circle one point rating in each of the eight factors and total = 16 points = Planting Difficulty Rating.

Planting Difficulty Class	
	Less than 10 points — EASY
	10 - 20 points — MODERATE
	21 - 30 points — DIFFICULT
	31 plus points — SEVERE

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Figure 3. Planting difficulty rating.

Table 1. Expected tree planting production per 8-hour day.

Difficulty rating class	Class of stock and planting tool: Small B/R[a] mattock	Regular B/R[a] mattock	Large transplants (shovel)	Large transplants (mattock)	Styro-2 dibble	5"[b] M.P.[c] dibble	7"[b] M.P.[c] dibble
Easy: less than 10 points	800-1,000	650-800	350-700	450-600	1,300-1,600	1,100-1,400	950-1,200
Moderate: 10-20 points	600-800	450-650	400-550	300-450	1,000-1,300	800-1,100	700-950
Difficult: 21-30 points	400-600	300-450	250-400	200-300	700-1,000	600-800	500-700
Severe: 31 + points	less than 400	less than 300	less than 250	less than 200	less than 700	less than 600	less than 500

[a]2-yr-old bare-root seedling
[b]1 in. = 2.54 cm
[c]Mud-packed seedling

Selection of Planting Stock Type

Where less than optimum site conditions exist the selection of stock type is based on the limiting factors shown in Table 2. In addition, a comparison of establishment costs is made for various site preparation and planting alternatives based on observed field performance and estimated costs (Table 3). Although the costs shown in this table are provided as examples only, the methodology allows individual regions to conduct their own cost comparisons, based on current and local costs and survival rates.

Recently, the British Columbia Ministry of Forests commissioned B.C. Research to refine this method of cost comparison, to investigate the factors which affect the selection of planting stock type, and to provide a methodology for comparing alternatives (Anon. 1979). The methodology developed by B.C. Research is described elsewhere in these Proceedings (Tunner 1982).

Sowing Request

In British Columbia, the Regional Manager is responsible for collating and submitting sowing requests for all agencies that will plant on Crown lands in the region. These requests are submitted to the Silviculture Branch by 15 September of the year preceding the spring sowing.

The submission of a sowing request constitutes a commitment by the Region to undertake the necessary preparation to ensure that sites will be ready for seedlings and that funds will be budgeted at the appropriate time. The Regions are advised of the approximate sowing capability in Ministry and private nurseries in July preceding the sowing request submission.

Because of the lead time required to produce most bare-root stock types, container-grown stock is increasingly becoming the preferred stock type. The demand for container-grown stock currently exceeds production capacity. The additional time required to produce bare-root stock types often means that a revised planting prescription is necessary.

CONTRACT PLANTING

Contract planting developed in British Columbia in the late 1960s and increased during the 1970s; today the majority of planting is done by contract. Contracts are awarded by both the forest industry and the Ministry. Although this paper deals exclusively with Ministry contracts, the contract document used by the Ministry is similar to those used by the private forest companies.

Pre-award Procedure

The pre-award procedure, up to award, takes at least one month from receipt of a contract proposal at the Regional Office. Whenever possible, information on spring contracts should be prepared the preceding fall to allow the prospective bidder to conduct a ground assessment of the planting site prior to the onset of winter.

The Regional staff must ensure that a current Planting Site Prescription is in effect, and that any areas which are satisfactorily restocked are blocked out or avoided when the arrangement of planting units is being drawn up. Each planting unit should have approximately 20 randomly established planting inspection plots (see section on Planting Quality Inspection) to determine the average number of plantable spots per hectare at the required spacing standard and, consequently, the number of seedlings to be assigned to the contract.

At this point, the ground must be in a plantable condition. It is unwise to anticipate that site preparation will be done prior to the planting date; one should wait until it has been done before proceeding with any contract proposals. It should also have been confirmed that the area is unencumbered by any reserves such as rights-of-way, grazing, recreation, gravel pits, etc.

It is important as well to ensure that the area will be accessible during the planting season. If road improvements are required, these should be made well in advance of the proposed contract period. Where road conditions or on-site conditions are unpredictable it may be advisable to specify a requirement for four-wheel drive or all-terrain vehicles on the contract particulars.

A check with the nursery is required to ensure that adequate and suitable planting stock can be allocated to the contract. It is probably unwise to allocate an entire seedlot to a contract, particularly with bare-root planting stock. Abnormal losses or extra-heavy culling may reduce the plantable inventory when lifting has been completed. This problem is much less severe with container-grown stock and is a further reason it is preferred over bare-root stock in many situations.

Table 2. Preferred type of stock for sites with less than optimum conditions.

Limiting factors	Bare-root			Plugs[a]			Container[b]
	2-0	1-1 2-1	1-2 2-2	PSB 211	PSB 313	PSB 415	CBW 210
Limited moisture	-	X	-	X	-	-	X
Heavy veg. competition	-	X	X	-	X	X	-
Heavy slash	-	-	-	X	X	-	X
Organic layer 15+ cm	X	X	X	-	X	X	-
Soils: shallow	-	-	-	X	-	-	X
Soils: rocky	-	-	-	X	X	-	-
Soils: loose	X	X	X	-	-	-	X
Soils: compacted	X	X	X	-	-	-	-

[a]1-yr-old seedlings grown in styroblock containers
[b]1-yr-old seedlings grown in Walters' plastic bullet containers

Table 3. Example: comparison of establishment costs for various site preparation/planting alternatives on the basis of observed field performance and estimated costs.

Stock type	Nurs. cost ($/1000)	Site Preparation				Contract ($/tree)	Survival (%)	No. of trees for 1000 live trees/ha at 5 years	Planting ($/ha)	Nurs. costs ($/ha)	Total establ. costs ($/ha)
		None	Burn ($/ha)	Strip clearing[a] ($/ha)	Piling ($/ha)						
BR 2-0	130	0				0.28	50	2000	560	260	820
			90			0.20	65	1538	308	200	598
				120		0.18	75	1333	240	173	533
					160	0.15	60	1667	250	217	627
BR 2-1	250	0				0.30	75	1333	400	333	733
			90			0.25	80	1250	313	313	716
				120		0.20	80	1250	250	313	683
					160	0.18	75	1333	240	333	733
PSB 211	130	0				0.23	75	1333	307	173	480
			90			0.15	80	1250	188	163	441
				120		0.13	80	1250	163	163	446
					160	0.12	75	1333	160	173	493
PSB 415	325	0				0.26	75	1333	347	433	780
			90			0.18	80	1250	225	406	721
				120		0.16	80	1250	200	406	726
					160	0.14	75	1333	187	433	780

[a]Clearing by a 'V' plow in continuous strips

Finally, a small amount of extra plantable area should be available in the event that there is stock left over after the contract area, as mapped, has been completed. (The contract administered by the British Columbia Ministry of Forests is for a specific number of trees, not hectares.) A map, clearly outlining the proposed planting area, must be submitted with the contract proposal.

Advertising and Award

Government policy dictates that all interested parties should have the opportunity to bid on contracts. Therefore, all planting contracts must be advertised.

The Regional Office prepares the advertising for all contracts. Advertisements are

placed in the British Columbia Gazette (a weekly government publication), in a Vancouver daily paper (usually the Saturday edition), in a regional headquarters daily paper, and in a local paper serving the community nearest the planting project. Thus, contractors throughout the province are advised of potential work.

Tenders must be submitted on the proper form and must be accompanied by a bid deposit fee, currently $50. Certain qualifications are necessary to undertake planting contracts. Bids will be considered only from those who are qualified by planting experience and citizenship (including landed immigrants or persons who hold an employment visa), and from those contractors who have viewed the planting site where that requirement has been specified in the advertisement.

Government policy is to accept the low bid on a contract unless there are extenuating circumstances. For example, a contractor may already have received a substantial number of trees from other contracts and it may be felt that additional trees would tax the contractor's resources and ability to complete the contract. In cases where the bid appears excessively low for the known site conditions, the contractor is consulted and is given the opportunity to withdraw his bid.

When the contract has been awarded the contractor is given a date by which the security deposit, amounting to 5% of the total value of the contract, is to be submitted.

Pre-work Conference

It is essential that both the Forest Officer who will be in charge of the contract and the contractor meet before planting begins. The purpose of this meeting is to review the contract requirements and develop a work progress plan for the contract. Details are specified on the Work Progress Plan form and become an integral part of the contract.

Many misunderstandings that could arise during the contract may be prevented by taking care during the pre-work conference to ensure that the contractor knows the ground rules for his performance and the manner in which his work will be inspected and evaluated.

Points that must be covered are:

a) appointment by the contractor of a representative who will act on his behalf during his absence;

b) confirmation of the starting date for the contract;

c) arrangements and schedule for delivery of planting stock to the contractor;

d) arrangements for field storage (locations and field facilities should be approved);

e) determination of the number of planters required and the foreman to be employed by the contractor, and the order of planting by unit;

f) the address to which correspondence and payments in connection with the contract should be sent during the period of the contract, the need for early reply or action being kept in mind;

g) an explanation of the planting quality inspection procedure.

Planting Quality Inspection

The introduction of a rigorous planting evaluation procedure has resulted in a substantial improvement in the quality of planting in British Columbia.

The purpose of the inspection is to estimate the total number of trees planted on the project to ensure that the stock is used properly. It is a useful check against trees issued to determine if seedlings are being buried or otherwise destroyed. In addition, the inspection provides an estimate of the planting quality percent (ratio of the number of trees judged to be satisfactorily planted to the ideal number of trees for that area). The ideal number of trees is determined through an estimate of plantable spots for the required tree spacing, and this ratio, or percentage, is a measure of how well the trees have been planted.

Details of the planting quality inspection procedure are contained in the B.C. Ministry of Forests Silviculture Manual and in a publication by the Ministry entitled "Planting Quality Inspection" (Anon. 1980). Briefly, inspections are based on a statistical sampling of 50 m^2 plots with the inspector assessing the number of trees planted and the number of trees judged to be planted satisfactorily.

In assessing plantable spots, the inspector checks the number of trees planted within the plot. Where spacing has been maintained, the number of plantable spots (allowing for areas that are unplantable because of slash, rock or other obstructions) equals the number of trees planted, up to the maximum

allowable number. However, if spacing is wider or closer than specified in the contract, the estimate of plantable spots is adjusted upward or downward, respectively. Table 4 shows the relationship between spacing and plantable spots.

Table 4. Relationship between inter-tree spacing and plantable spots.

Inter-tree spacing (contract spec.) (m)	Density (trees per ha)	Maximum allowable number of plantable spots per 50 m^2 plot
2.29	2200	11
2.40	2000	10
2.53	1800	9
3.10	1200	6
3.40	800	4
4.39	600	3

In determining the number of plantable spots within the plot, the inspector must consider the growing space occupied by any naturals (or previously planted trees) either just outside the boundary of the plot or inside the plot. This space, which is unavailable for planting, is a circle around the tree with a radius equal to the prescribed spacing less 0.5 m. It is important that inspectors understand this concept and the influence which a tree just outside the plot has on the number of allowable plantable spots within the plot.

Trees are then assessed for planting quality on the basis of the usual factors: planting spot selection; screefing, scalping or clearing; preparation of a suitable planting hole; tree placement within the hole; firmness; and the position of the crown and stem.

Contract Planting Payments

The first contract payment is made as soon as the inspection of a pay area is completed. Payment is based on the numbers of trees and on the quality of planting. Because this is a statistical sampling of the actual work done, a tolerance is added to the calculations to arrive at the pay rate.

In 1980, from a total of 500 payment certificates processed, 62% received no penalty for poor planting quality, while only 1% failed to receive any payment because planting quality was less than 85% (the minimum acceptable planting quality for payment).

CONCLUSIONS

Contract planting has proven to be a suitable method for carrying out the annual planting program. Government forest officers are able to concentrate on the monitoring of planting quality rather than spending their time on the many administrative and organizational aspects of planting projects. Plantation survival and growth performance are often dependent upon making the best use of a limited planting season; flexibility and speed are required in arranging the planting project. Contract planting has provided this flexibility and has been widely accepted by Ministry and industry staff as a means of meeting planting objectives.

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