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**APPENDIX I**  
**QUESTIONNAIRE FORM AND RESPONSES**

**QUESTIONNAIRE**

**EVALUATION OF SOIL DEGRADATION AS A FACTOR EFFECTING N.S.R. BACKLOG IN B.C.**

Name of Respondent \_\_\_\_\_  
Position/Agency \_\_\_\_\_  
Address \_\_\_\_\_  
Phone Number \_\_\_\_\_

1. Please list any existing or ongoing studies and/or data that you are aware of regarding soil degradation in your Region.

We are interested in any and all information related to causes and effects as well as methods of rehabilitation and prevention.

1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_  
4. \_\_\_\_\_

2. Please list any studies or data regarding soil degradation that you feel are applicable to your area but were undertaken outside of B.C. For example, the U.S., Alberta, Ontario, Quebec or Europe.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. Given that the major factors of soil degradation are:

	% reduction or increase in productivity (min-max)
1. soil density increase	
2. soil moisture decrease/increase	
3. soil nutrient decrease	
4. loss of surface organic matter	
5. soil acidity increase/decrease	
6. soil erosion and mass movement	
7. increase/decrease in soil bacteria/nematode/actinomycetes	
8. increase in frost depth and/or frost heaving	

From your best guess based on personal experience, or knowledge acquired from the literature, please indicate what you feel is the effect in your Region on conifer productivity for each soil degradation factor (assuming there has been a significant change in soil properties for that factor). This is best given as a % reduction (or increase) in conifer productivity for each factor.

4.1 Please indicate what you feel are the most significant soil degradation processes in your region in decreasing order of importance (please feel free to add any factors which you may feel we have missed).

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## DISCUSSIONS OF RESPONSES TO QUESTIONNAIRE

1. The questionnaire was sent to 26 individuals; 19 government and 7 industry.
2. A total of 18 responses were received.
3. Of the 18 responses, 8 were from the coast and 10 from the interior.
4. The following list ranks soil degradation factors according to questionnaire respondents from most severe to least severe and provides the range of productivity reduction as a percentage:

Soil density increase	5-25%
Soil erosion/mass movement	1-30%
Loss of organic matter	5-20%
Soil moisture increase/decrease	0-15%
Soil biota changes	0-14%
Soil acidity changes	0-10%
Increase in frost depth	0-5%

5. Respondents from industry tended to estimate lower productivity losses than government respondents; respondents from the coast tended to record lower values for productivity losses in comparison to respondents from the interior.
6. 75% of respondents felt that there is no direct link between soil degradation and backlog NSR; 25% felt that there is some connection.
7. 92% of all respondents felt that soil degradation is having a significant effect on conifer productivity; 8% said there wasn't or that more information is required.

**APPENDIX II**  
**ALTERNATIVE PRODUCTIVITY -**  
**LOSS CALCULATION**

## APPENDIX II: ALTERNATIVE PRODUCTIVITY-LOSS CALCULATION

The calculations of decreased forest productivity presented in this appendix are based on the same methods used in Chapters 5 and 6. The differences are in the assumptions of percentages of degraded soil area and yield reductions resulting from that degradation (see tables II.1, II.2 and II.3). The calculations presented previously were conservative interpretations of the available data. The assumptions made here are equally plausible interpretations of the existing data, but not conservatively biased.

Modifications to assumptions employed in Chapters 5 and 6 are summarized as follows:

- \* estimates of harvested area degraded by ground skidding are increased by 3%.
- \* the percent growth reduction due to soil degradation resulting from harvesting is increased to 60% on the coast and 75% in the interior.
- \* an additional 10% of the broadcast burned areas are included as having a 20% reduction in growth.
- \* 5% of the areas receiving "Other Mechanical Site Preparation" are included as having degraded soils.

These alternative assumptions include consideration of factors felt to be likely, but not proven with existing data. For example, the percent area severely disturbed by ground skidding, reported from studies in B.C., ranges from 14 to 58 percent (see table 5.1), with the majority between 20 and 40%. The percentages chosen here are still within that range.

The percent growth changes on skidroads presented in table 6.1 range from -26 to -95% for the impacted area. The studies indicated that in most cases there is a decrease in the size of individual trees, as well as a decrease due to stocking reductions. For the estimates presented here, it is assumed that the decreased size of trees results in further yield losses because many trees on the skidroads are of unmerchantable size when the cutblock has reached rotation age (alternatively the rotation age could be extended also resulting in further long-term yield reductions). For the coast where trees are generally larger, the growth reduction is set at 60%, as opposed to 75% for the interior.

The addition of another loss category for slashburning is to account for long-term site productivity losses of a minor nature from reductions in organic matter and nitrogen. The "other mechanical site preparation" losses likely result from compaction and/or scalping from some types of machinery or operations on moist soils.

These minor adjustments in assumptions have increased the estimated area degraded by forestry practices between 1976 and 1985/86 by 18%, the annual yield losses by 55%, and the current annual loss to the provincial economy to \$126 million (see tables II.4 and II.5). Assuming similar forestry practices and levels of soil degradation, the annual loss to the provincial economy could exceed \$200 million by the year 1991. Given the limited nature of the data available at present, the losses due to forest soil degradation could very well be of this magnitude.

Table II.1: Percentage of harvested area degraded by various harvesting systems\* on specified slope classes (assumptions by the authors based on available literature).

	HELI >50%	CABLE <35%	CABLE 35-50%	CABLE >50%	LT FLOT <35%	LT FLOT 35-50%	GR WIN <35%	GR WIN 35-50%	GR WIN >50%	GR SUM <35%	GR SUM 35-50%	GR SUM >50%
COMPACT & DEEP DIST	3	10	10	10	18	20	18	20	23	25	28	28
ERODED	0.5	0.1	0.5	1.0	0.1	0.5	0.1	0.5	1.5	0.2	1.0	2.5
TOTAL DEG	3.5	10.1	10.5	11	18.1	20.5	18.1	20.5	24.5	25.2	29	30.5

\*HELI=helicopter, CABLE=cable yarding, LT=light flotation, GR=ground skidding, WIN=winter, SUM=summer.

Table II.2: Percentage of treated area degraded by specified silvicultural practices (assumptions by the authors based on available literature).

	BURN HEAVY	BURN LIGHT	WINDROW	BUNCH	BLADE SCARIFY	DRAG SCARIFY	OTHER MECH	CHEMICAL
AREA DEGR	10	10	40	30	20	0	5	0

Table II.3: Percentage reduction in growth applied to degraded areas of each degradation class (assumptions by the authors based on available literature).

	HARV DEGR	EROSN DEGR	BURN HEAVY	BURN LIGHT	WINDRW DEGR	BUNCH DEGR	BL SCAR DEGR	OTH MEC DEGR
COAST	60	100	50	20	50	50	50	50
INTERIOR	75	100	50	20	50	50	50	50

Table II.4: Estimate of the current annual growth losses (m<sup>3</sup>/yr) occurring on degraded soils as a result of forestry practices during 1976-1985/86 (derived from tables 5.4, 5.6, II.1, II.2, II.3 and MOF 1980).

FOREST REGION	TOTAL DEGR AREA (ha)	MAI m <sup>3</sup> /ha/yr	HARV DEGR	EROSN DEGR	BURN DEGR	WINDRW DEGR	BUNCH DEGR	BL SCAR DEGR	OTH MEC DEGR	TOTAL LOSS
----- (m <sup>3</sup> /yr) -----										
VANC CST	43148	4.3	87392	5585	11128	127	741	300	83	105356
P RUP CST	7744	2.6	11830	418	*	*	*	*	*	12248
VANC INT	1965	2.8	4044	110	*	*	*	*	*	4155
P RUP INT	53945	1.5	44841	528	14076	522	1652	648	464	62731
PR GEORGE	159573	1.7	140142	1645	18443	6354	10995	6232	578	184389
CARIBOO	76703	1.4	68032	880	4906	104	3833	184	273	78211
KAMLOOPS	78939	2.0	87909	1350	3166	1139	10211	1926	353	106053
NELSON	54565	2.1	70291	1756	1809	290	4027	1915	130	80218
TOTAL	476582		514482	12271	53528	8536	31459	11204	1882	633362

Table II.5: Estimate of the current annual growth losses (m<sup>3</sup>/yr) occurring on degraded soils as a result of forestry practices during 1985/86 (derived from MOFLAR, tables 5.3, II.1, II.2, II.3 and MOF 1980).

FOREST REGION	TOTAL DEGR AREA (ha)	MAI m <sup>3</sup> /ha/yr	HARV DEGR	EROSN DEGR	BURN DEGR	WINDRW DEGR	BUNCH DEGR	BL SCAR DEGR	OTH MEC DEGR	TOTAL LOSS
----- (m <sup>3</sup> /yr) -----										
VANC CST	5383	4.3	11468	733	1100	22	11	8	37	13379
P RUP CST	143	2.6	218	8	*	*	*	*	*	226
VANC INT	351	2.8	723	20	*	*	*	*	*	743
P RUP INT	7276	1.5	5065	60	913	395	209	26	116	6784
PR GEORGE	21480	1.7	15484	182	2796	1994	1084	642	129	22312
CARIBOO	9790	1.4	9313	120	161	65	166	1	122	9949
KAMLOOPS	8603	2.0	10597	163	382	85	525	259	42	12053
NELSON	6318	2.1	7630	191	356	139	676	111	17	9120
TOTAL	59344		60498	1475	5708	2700	2671	1048	465	74565

Table II.4: Estimate of the current annual growth losses (m<sup>3</sup>/yr) occurring on degraded soils as a result of forestry practices during 1976-1985/86 (derived from tables 5.4, 5.6, II.1, II.2, II.3 and MOF 1980).

FOREST REGION	TOTAL DEGR AREA (ha)	MAI m <sup>3</sup> /ha/yr	HARV DEGR	EROSN DEGR	BURN DEGR	WINDRW DEGR	BUNCH DEGR	BL SCAR DEGR	OTH MEC DEGR	TOTAL LOSS
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