BLACK SPRUCE REGENERATION ASSESSMENT - PHASE TWO

PROJECT 94-3-05

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MANITOBA MODEL FOREST PROJECT # 94-3-05

PHASE TWO REPORT

submitted to:

MANITOBA MODEL FOREST

ON BEHALF OF

PINE FALLS PAPER COMPANY

by:

SYNTHEN RESOURCE SERVICES

JANUARY, 1995

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INTRODUCTION

As part of the Advanced Forest Management Practices program, Abitibi-Price (Pine Falls Paper Company) submitted a proposal to determine and analyze limiting factors for natural regeneration of lowland black spruce sites following harvesting. The project was initiated in 1993 and broken down into two phases. Phase One which was completed in the fall of 1993, focused on assessing previous lowland black spruce cutovers for their regeneration success and to determine if there were any specific factors contributing to the failure of those sites not meeting provincial regeneration standards. Based on the study results, there was no direct relationship evident between successful regeneration and any of the variables that were analyzed. The only potential correlation found was with the harvesting method, where topping and delimbing at the stump appeared to slow down regeneration.

Based on the Phase One results the project partners decided that Phase Two should focus on the confirmation of this harvesting method/regeneration relationship. This would be accomplished through the establishment of a harvesting trial on lowland sites to analyze the various harvesting techniques currently being used in the Model Forest. The objectives of Phase Two were as follows:

1. to monitor seedling germination and survival by harvesting method and Forest Ecosystem Classification V-type;

2. to determine the extent of site degradation following harvesting; and

3. to determine the amount of productive land lost, comparing different harvesting methods.

Three harvesting techniques used on nine different sites were selected for analysis; (1) a full tree method, where trees are cut by a feller buncher, skidded to roadside and processed at the landing, (2) a tree length system where trees are cut manually by chainsaw, delimbed and topped on site, and skidded out to roadside and (3) a cut to length system where trees are felled, delimbed, topped and bunched on site by a processor and forwarded out to roadside.

Phase Two of the project was approved for funding in the 1994/95 Model Forest Workplan. Proposed total cost for the project in this fiscal year was $ 13,750.00, with $ 10,500.00 coming from the Model Forest and the balance as in-kind contribution from the sponsor and project partners. Field work, design, analysis and reporting associated with Phase Two of the project was completed by Synthen Resource Services (a project partner).

1.0 Site Location

A total of nine sites, located at Happy Lake, Pointer Lake and Long Lake were selected for analysis in Phase Two. All sites were predominately lowland black spruce stands and were chosen based on the fact that they were scheduled for harvest during the 1993/94 winter season using the harvesting methods discussed previously. The site locations are shown in Figure 1. Table 1 list's the harvesting methods used and the V-types for each site.

2.0 Methodology

Initial field work was undertaken by Synthen Resource Services in the fall of 1993. Prior to harvesting, Forest Ecosystem Classification surveys were completed on the selected stands to determine their V-types and S-types. The FEC surveys were completed in accordance to the Manitoba FEC system currently being developed.

Following harvesting, in the fall of 1994 a survey similar to a Regeneration Performance Assessment survey used by the Department of Natural Resources was carried out. Slight modifications were made to the survey so as to conform to the project.

Prior to surveying, field crew walked the cut-over and identified unproductive areas such as swamps and rock outcroppings. Areas rendered unproductive by harvesting activities, such as trails, slash piles and landings were also identified and marked on aerial photography.

Circular plots measuring 50 m^2 (3.99 m radius) were established randomly throughout the cut-over. A total of five plots were established on each site with the exception of several small cut-overs where the number of plots was reduced. Plot centres were marked by one metre

TABLE 1

Harvesting Method and V-type Summary

for each Site

SITE	TOWNSHIP RANGE	HARVESTING METHOD	V-TYPE
1a	21-14E	Koering feller buncher cut and skid. Trees topped, delimbed and bucked at roadside.	30
1b	21-14E	Timberjack FMG processor cut and forwarded. Trees topped, delimbed and bucked on site.	30
2a	21-14E	Koering feller buncher cut and skid. Trees topped, delimbed and bucked at roadside.	30
2b	21-14E	Timberjack FMG processor cut and forwarded. Trees topped, delimbed and bucked on site.	30
3a	21-14E	Koering feller buncher cut and skid. Trees topped, delimbed and bucked at roadside.	17
3b	21-14E	Timberjack FMG processor cut and forwarded. Trees topped, delimbed and bucked on site.	17
4	21-15E	Koering feller buncher cut and skid. Trees topped, delimbed and bucked at roadside.	32
5	21-15E	Koering feller buncher cut and skid. Trees topped, delimbed and bucked at roadside.	29
6	25-13E	Conventional hand cut and skid. Trees topped and delimbed on site, bucked at roadside.	29
7a	25-13E	Shearhead feller buncher cut and skid. Trees topped, delimbed and bucked at roadside.	32
7b	25-13E	Conventional hand cut and skid. Trees topped and delimbed on site, bucked at roadside	32
8	25-13E	Conventional hand cut and skid. Trees topped and delimbed on site, bucked at roadside.	29
9	22-16E	Conventional hand cut and skid. Trees topped and delimbed on site, bucked at roadside.	29

angle iron stakes and labelled accordingly with the plot number and the bearing and distance to the next plot. Detailed maps showing the plot locations within the cut-overs are contained in the Appendix.

All tree species within the plot were tallied and attributes including species type, the microsite it was growing in and maturity stage were identified and recorded. An ocular estimate of the various ground cover percentages were done as well as an estimate of ground disturbance and intensity. Stump density, water table level and slash cover were also determined. Seedlings and ground disturbances were mapped so as to simplify relocation. Information was recorded on tallysheets shown in Figure 2 and 3 and data compiled in MS Works for Windows.

3.0 Results and Analysis

Year one results of the study are presented in Table 2. This includes V-type, ground cover percentages, percent distribution, stump densities, water table levels and mean seedling densities for each harvesting method on each site. A discussion of the different variables is presented in the following sections.

Vegetation Types

As previously mentioned, V-types were determined for each site previous to harvest. Four different V-types were identified. Two sites were jack pine-black spruce/lichen stands (V30), four were black spruce/feathermoss sites (V29), one was a black spruce mixedwood stand (V17) and two were jack pine-black spruce/feathermoss sites (V32).

Results indicate that V-type 32 has the highest average seedling density one growing season after harvest. V-type 30 and 17 were next with similar densities and V-type 29 has the lowest density. In Phase One of this project no current relationship was found between original stand V-type and ultimate regeneration success. Future monitoring of the Phase Two sites will help to support or diffuse this conclusion.

Figure 2. Tallysheet

Black Spruce Study Regeneration Performance Assessment

Site #_____Twp - Rge_____ Stand # _____ Date_____

Crew_____ Plot # _____

Harvesting method _____ V-type _____

PLOT ASSESSMENT

Stump density _____ Percent slash _____ Water table level _____(cm)

Ground percent cover

Sphagnum moss _____ Feather moss _____ Other moss _____

Dead moss _____ Woody/organic material _____ Rock _____

Water _____ Grass _____ Herbacious plants _____

Shrubs _____ Trees _____

Primary competing species _____

_____

_____

Disturbance Assessment

Percent Cover

Compaction/Rutting _____ intensity _____

Slash pile _____ intensity _____

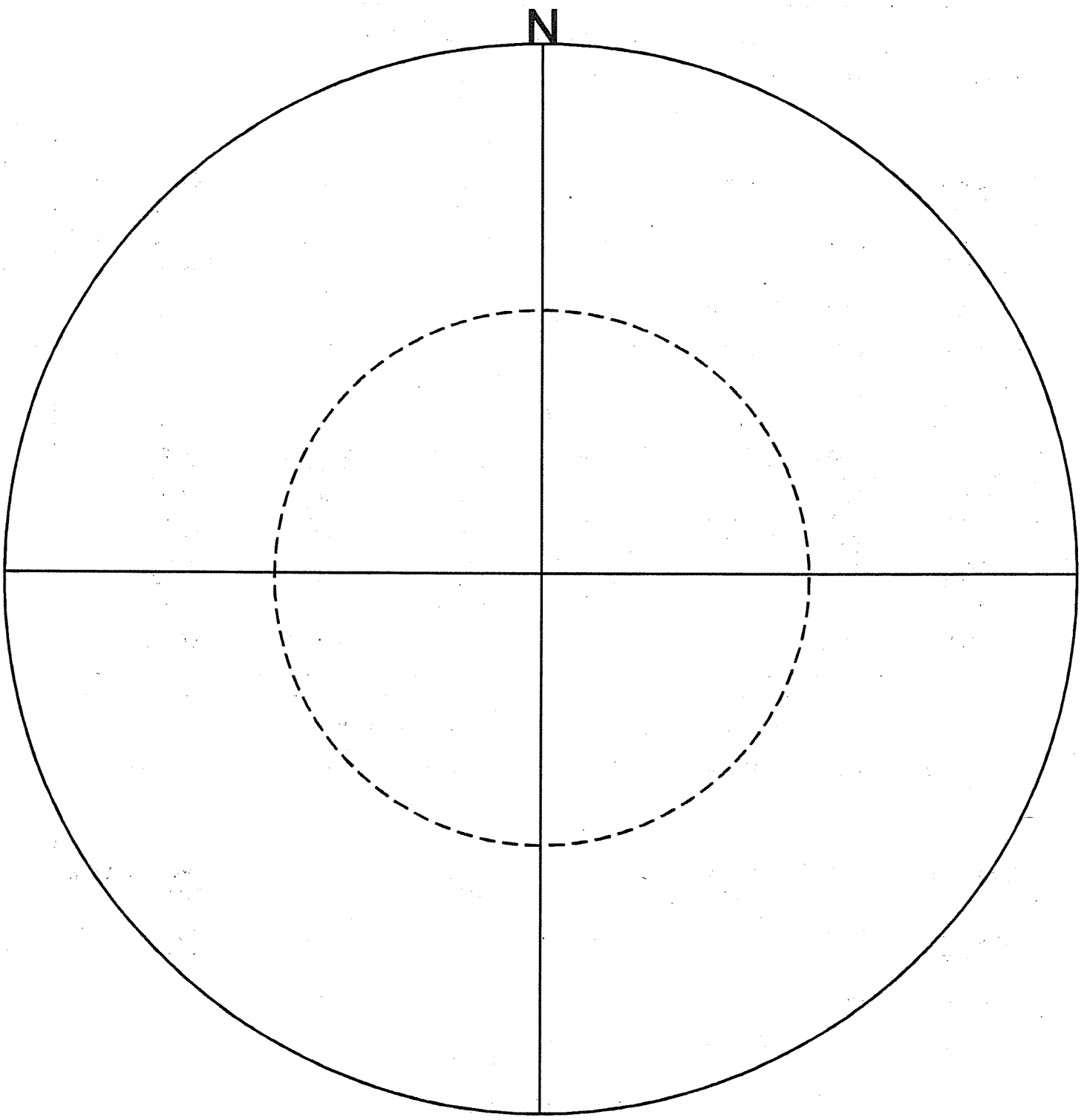
Other _____ intensity _____

Other remarks _____

_____

_____

Figure 3. Tallysheet



PLOT #

● SEEDLING

X ADVANCED

△ RESIDUAL (> 3m height)

LEGEND

Species	Microsite
S - spruce	F - Feather Moss
J - jack pine	S - Sphagnum Moss
L - larch	O - Other Moss
B - balsam fir	D - Dead Moss
T - trembling aspen	W - Woody/Organic
BP - balsam poplar	
A - ash	

Table 2. Summary Results

Site 1a - Feller Buncher cut and skid full tree

stumps/ha	150.0	% slash	5.0	water table (cm)	37.3	V-type 30	

Ground Cover %

Sphagnum Moss	4.5	Feather Moss	3.0	Other Moss	1.0	Dead Moss	5.8
Woody Organic	22.5	Rock	0.0	Water	0.5	Grass Sedges	7.8
Plants	33.8	Shrubs	22.5	Trees	2.5		
Rutting	8.8	Slash Pile	3.8	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead moss	Woody/organic	Total
Spruce	400.0	50.0	100.0	50.0	4450.0	5050.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	150.0	0.0	0.0	500.0	450.0	1100.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	750.0	750.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	550.0	50.0	100.0	550.0	5650.0	6900.0

Site 1b - Processor and Forwarded cut to length

stumps/ha	1566.7	% slash	15.8	water table (cm)	38.7	V-type 30	

Ground Cover %

Sphagnum Moss	2.7	Feather Moss	1.0	Other Moss	1.0	Dead Moss	59.2
Woody Organic	23.3	Rock	0.0	Water	0.8	Grass Sedges	2.7
Plants	15.8	Shrubs	3.3	Trees	0.0		
Rutting	6.7	Slash Pile	9.2	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	1666.7	0.0	0.0	700.0	166.7	2533.3
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	0.0	0.0	0.0	166.7	0.0	166.7
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	1666.7	0.0	0.0	866.7	166.7	2700.0

Table 2. Summary Results

Site 2a - Feller buncher cut and skid full tree

stumps/ha	1760.0	% slash	3.0	water table (cm)	25.0	V-type 30	

Ground Cover %

Sphagnum Moss	4.8	Feather Moss	1.0	Other Moss	1.0	Dead Moss	20.4
Woody Organic	37.8	Rock	0.0	Water	2.2	Grass Sedges	20.4
Plants	19.0	Shrubs	2.0	Trees	0.0		
Rutting	22.0	Slash Pile	1.0	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	3440.0	0.0	0.0	1120.0	760.0	5320.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	40.0	0.0	0.0	40.0	0.0	80.0
Fir	0.0	0.0	0.0	0.0	0.0	0.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	3480.0	0.0	0.0	1160.0	760.0	5400.0

Site 2b - Processor and Forwarded cut to length

stumps/ha	2000.0	% slash	21.0	water table (cm)	28.0	V-type 30	

Ground Cover %

Sphagnum Moss	7.0	Feather Moss	13.0	Other Moss	1.0	Dead Moss	19.0
Woody Organic	55.0	Rock	0.0	Water	0.0	Grass Sedges	0.4
Plants	6.0	Shrubs	2.0	Trees	2.0		
Rutting	24.0	Slash Pile	15.0	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	1400.0	520.0	0.0	640.0	80.0	2640.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	0.0	0.0	0.0	0.0	0.0	0.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	1400.0	520.0	0.0	640.0	80.0	2640.0

Table 2. Summary Results

Site 3a - Processor and Forwarded cut to length

stumps/ha	400.0	% slash	14.0	water table (cm)	21.8	V-type 17	

Ground Cover %

Sphagnum Moss	2.8	Feather Moss	8.2	Other Moss	1.0	Dead Moss	1.8
Woody Organic	20.0	Rock	0.0	Water	3.4	Grass Sedges	26.0
Plants	42.0	Shrubs	17.2	Trees	0.0		
Rutting	6.0	Slash Pile	9.0	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	120.0	0.0	0.0	40.0	520.0	680.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	160.0	80.0	0.0	0.0	0.0	240.0
Fir	320.0	0.0	0.0	0.0	760.0	1080.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	600.0	80.0	0.0	40.0	1280.0	2000.0

Site 3b - Feller buncher cut and skid full tree

stumps/ha	560	% slash	6.4	water table (cm)	21.2	V-type 17	

Ground Cover %

Sphagnum Moss	32.0	Feather Moss	4.8	Other Moss	1.0	Dead Moss	1.0
Woody Organic	21.0	Rock	0.0	Water	5.2	Grass Sedges	41.0
Plants	22.0	Shrubs	21.0	Trees	2.0		
Rutting	8.0	Slash Pile	4.2	Other Disturbance	12.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	1360.0	40.0	0.0	120.0	520.0	2040.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	960.0	280.0	0.0	120.0	0.0	1360.0
Fir	880.0	120.0	0.0	80.0	480.0	1560.0
T. aspen	40.0	0.0	0.0	0.0	0.0	40.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	3240.0	440.0	0.0	320.0	1000.0	5000.0

Table 2. Summary Results

Site 4 - Feller buncher cut and skid full tree

stumps/ha	1520.0	% slash	4.6	water table (cm)	22.4	V-type 32	

Ground Cover %

Sphagnum Moss	4.4	Feather Moss	1.0	Other Moss	1.0	Dead Moss	12.0
Woody Organic	72.0	Rock	0.0	Water	0.4	Grass Sedges	25.2
Plants	10.2	Shrubs	7.6	Trees	0.0		
Rutting	6.0	Slash Pile	0.0	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	680.0	0.0	0.0	1400.0	360.0	2440.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	40.0	0.0	0.0	0.0	0.0	40.0
T. aspen	0.0	0.0	0.0	0.0	640.0	640.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	720.0	0.0	0.0	1400.0	1000.0	3120.0

Site 5 - Feller buncher cut and skid full tree

stumps/ha	1360.0	% slash	12.0	water table (cm)	22.2	V-type 29	

Ground Cover %

Sphagnum Moss	17.0	Feather Moss	3.8	Other Moss	1.0	Dead Moss	16.2
Woody Organic	15.0	Rock	0.0	Water	2.6	Grass Sedges	40.0
Plants	23.0	Shrubs	18.0	Trees	3.0		
Rutting	4.0	Slash Pile	0.6	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	1240.0	0.0	0.0	0.0	0.0	1240.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	680.0	0.0	0.0	0.0	0.0	680.0
Fir	0.0	0.0	0.0	0.0	80.0	80.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	880.0	880.0
Total	1920.0	0.0	0.0	0.0	960.0	2880.0

Table 2. Summary Results

Site 6 - Hand cut and skid tree length

stumps/ha	3040.0	% slash	12.0	water table (cm)	22.6	V-type	29

Ground Cover %

Sphagnum Moss	4.6	Feather Moss	4.0	Other Moss	0.8	Dead Moss	36.2
Woody Organic	44.0	Rock	0.0	Water	0.8	Grass Sedges	9.0
Plants	7.8	Shrubs	0.2	Trees	0.0		
Rutting	2.0	Slash Pile	6.0	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	3280.0	40.0	0.0	80.0	360.0	3760.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	0.0	0.0	0.0	0.0	0.0	0.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	3280.0	40.0	0.0	80.0	360.0	3760.0

Site 7a - Snip cut and skid full tree

stumps/ha	1200.0	% slash	20.0	water table (cm)	20.5	V-type	32

Ground Cover %

Sphagnum Moss	5.5	Feather Moss	1.0	Other Moss	1.0	Dead Moss	25.5
Woody Organic	69.0	Rock	0.0	Water	1.0	Grass Sedges	1.0
Plants	3.0	Shrubs	0.0	Trees	0.5		
Rutting	7.5	Slash Pile	10.0	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody	Total
Spruce	1100.0	100.0	0.0	200.0	1400.0	0.0
Pine	0.0	0.0	0.0	0.0	2000.0	0.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	0.0	0.0	0.0	0.0	0.0	0.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	1100.0	100.0	0.0	200.0	3400.0	4800.0

Table 2. Summary Results

Site 7b - Hand cut and skid tree length

stumps/ha	1266.7	% slash	16.7	water table (cm)	24.7	V-type 32	

Ground Cover %

Sphagnum Moss	5.0	Feather Moss	1.0	Other Moss	1.0	Dead Moss	16.7
Woody Organic	60.0	Rock	0.0	Water	0.3	Grass Sedges	5.0
Plants	33.3	Shrubs	0.3	Trees	0.3		
Rutting	0.0	Slash Pile	10.0	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	1000.0	0.0	0.0	3066.7	1400.0	5466.7
Pine	0.0	0.0	0.0	0.0	200.0	200.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	0.0	0.0	0.0	0.0	0.0	0.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	1000.0	0.0	0.0	3066.7	1600.0	5666.7

Site 8 - Hand cut and skid tree length

stumps/ha	1400.0	% slash	21.0	water table (cm)	20.6	V-type 29	

Ground Cover %

Sphagnum Moss	6.0	Feather Moss	1.4	Other Moss	1.0	Dead Moss	16.0
Woody Organic	77.0	Rock	0.0	Water	2.8	Grass Sedges	6.0
Plants	4.6	Shrubs	0.6	Trees	0.0		
Rutting	9.0	Slash Pile	13.0	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	1280.0	80.0	0.0	280.0	2160.0	3800.0
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	0.0	0.0	0.0	0.0	0.0	0.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	1280.0	80.0	0.0	280.0	2160.0	3800.0

Table 2. Summary Results

Site 9 - Hand cut and skid tree length

stumps/ha	1533.3	% slash	11.7	water table (cm)	20.0	V-type	29

Ground Cover %

Sphagnum Moss	9.0	Feather Moss	1.0	Other Moss	1.0	Dead Moss	31.7
Woody Organic	51.7	Rock	0.0	Water	6.3	Grass Sedges	7.0
Plants	2.7	Shrubs	0.0	Trees	0.0		
Rutting	21.7	Slash Pile	6.7	Other Disturbance	0.0		

Density seedling/ha

	Sphagnum	Feather	Other moss	Dead	Woody/organic	Total
Spruce	800.0	66.7	0.0	733.3	133.3	1733.3
Pine	0.0	0.0	0.0	0.0	0.0	0.0
Tamarack	0.0	0.0	0.0	0.0	0.0	0.0
Fir	0.0	0.0	0.0	0.0	0.0	0.0
T. aspen	0.0	0.0	0.0	0.0	0.0	0.0
B. poplar	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	0.0	0.0	0.0	0.0
Total	800.0	66.7	0.0	733.3	133.3	1733.3

Seedling Density, Growing Medium and Competing Vegetation

Seedling densities ranged from 1730 seedlings\ha to 6900 seedlings\ha. Sites which were harvested using the full tree system had the highest average densities (4680/ha), followed by the cut and skid system (3740/ha). Sites which were harvested using the cut to length method had the lowest average densities (2450/ha).

Ground cover information was collected in order to determine the seed bed availability on each site. Sphagnum moss which is an excellent microsite for black spruce was found in various amounts on different sites. Percentage ranged from 3 to 35 percent. Woody organic material tended to be the most abundant ground cover on most of the sites while feather moss and other mosses were the least abundant. As part of the survey assessment, the type of ground cover in which the seedling was growing in, was noted. For black spruce 45% of the seedlings were growing in sphagnum, 31% in woody organic microsites, 21% in dead moss (mostly dead sphagnum) and the remaining 3% was found growing in feather and other moss. This concurs with other studies showing sphagnum moss as the preferred microsite for black spruce regeneration on lowland sites.

A survey of the competing vegetation was also done. Vegetation was classified in one of four categories; grasses, herbaceous plants, shrubs and trees. Results show that competition levels were higher on sites where a full tree system was used as compared to the other harvesting systems. This was probably due to heavier slash load created by the tree length and cut to length systems which potentially inhibited vegetation growth.

Site Disturbance

One important objective of the study was to assess the extent of site disturbance created on the site and to determine the amount of productive land lost due to harvesting. Disturbances were grouped into three categories; compaction and rutting, slash piles and other disturbances such as upturned stumps and flooding.

According to initial observations, it appeared that the amount of productive land lost due to

site compaction was very low. This was probably due to the fact that harvesting was carried out during the winter. With a few exceptions, rutting and compaction was not a serious problem on any of the sites. The cut-to-length system using the FMG processor yielded the best results in terms of site compaction. The advantages of this system is that no skid trails are created and the machines are equipped with double bogie wheels which reduce rutting significantly. The full tree system also had good results. Compaction was only a problem on the skid trails which had a tendency to accumulate water. The hand cut and skid method did create some problems, particularly on sites 8 and 9, where some intense rutting was present. Slash did not appear to be a serious problem on any of the sites either. Slash loads on sites where the full tree system was used, were very low. However some area is lost due to heavy slash piles at the landings where the processing is done. The cut-to-length and cut and skid systems produced moderate slash loads on the sites, however it is still too early to determine whether the slash is significant enough to impact regeneration.

Other disturbances such as upturned stumps and flooding was not significant on any of the sites. Lost productive area summaries are listed for each site in Table 3.

The results in Table 3 and 4 show that full tree harvesting tends to produce a higher loss of productive area as compared to the other systems. This is mainly due to an extensive network of skid trails and large slash piles at the landings. The average loss of productive area on these sites was 5.0%. The tree length system and cut to length system were virtually the same at 3.6% and 3.7% respectively. Heavy slash loads accounted for most of the land loss on these sites.

Stump Count

Stump counts were completed in order to obtain stand densities prior to harvest and to see if there is any relationship between original stand density, slash loading on the site and seedling density. Stump densities ranged from 150 to 3000 stumps per hectare, although most sites had densities of between 1000 and 2000. There appeared to be no clear correlation between stand density and the amount of slash load found on the site or between stand density and current seedling density.

TABLE 3

Summary of Lost Productive Area by Site

SITE #	HARVESTING METHOD	TOTAL AREA (m^2)	LOST PRODUCTIVE AREA (m^2)	PERCENT OF TOTAL AREA
1a	Full Tree	7590	470	6.1%
2b	Cut to Length	13910	None	0%
1a	Full Tree	32880	900	2.7%
2b	Cut to Length	18970	380	2.0%
3a	Full Tree	40470	5440	13.5%
3b	Cut to Length	30350	2730	9.0%
4	Full Tree	15175	607	4.0%
5	Full Tree	20235	None	0%
6	Tree Length	143750	1440	1%
7a	Full Tree	5060	180	3.6%
7b	Tree Length	15175	525	3.5%
8	Tree Length	12645	680	5.4%
9	Tree Length	59375	2970	5.0%

Table 4

Summary of Average Lost Productive Area by Harvesting Method

HARVESTING METHOD	AVERAGE LOST PRODUCTIVE AREA (m^2)	AVERAGE PERCENT LOSS
Full Tree	1266	5.0%
Cut to Length	1037	3.7%
Tree Length	1404	3.6%

Water Table

Water table depths ranged from 20 to 39 cm with an average of 25 cm. Unfortunately a direct comparison of pre and post harvest water tables can not be made as exact depths were not noted during the pre-harvest assessment. This average depth is very similar to the average water table depth found for the residual stands in Phase One of this project (25.4 cm), but lower than the cutovers whose average was 17.2 cm.

At present there appears to be no relationship between post-harvest water tables and initial seedling establishment. Future changes to the water table will be monitored to determine if there is any impact on both seedling establishment and future seedling growth.

4.0 Recommendations

Based on information gathered in the study the following recommendations have been proposed.

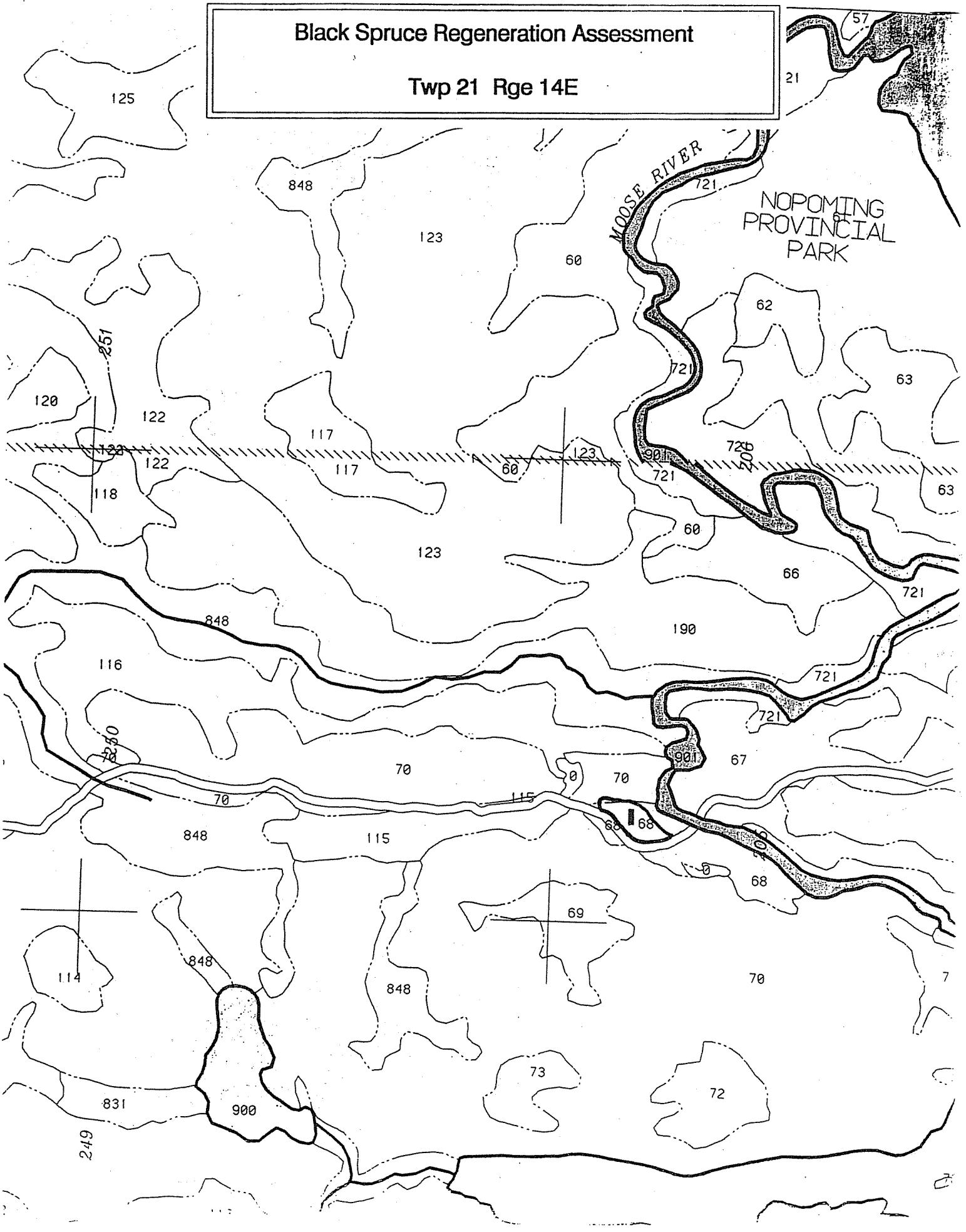
1. Survey plots should be re-assessed two years from now (1996). This would involve pinning every seedling within the plot and recording root collar diameter, height and vigour. Ground cover, site disturbance and water tables would also be assessed. Subsequent ongoing assessments would be required to monitor seedling development and site change over time.

2. A regeneration survey must be done in order to determine the stocking status of each site. This would be done by Pine Falls Paper Company in conjunction with their regeneration survey program.

APPENDIX

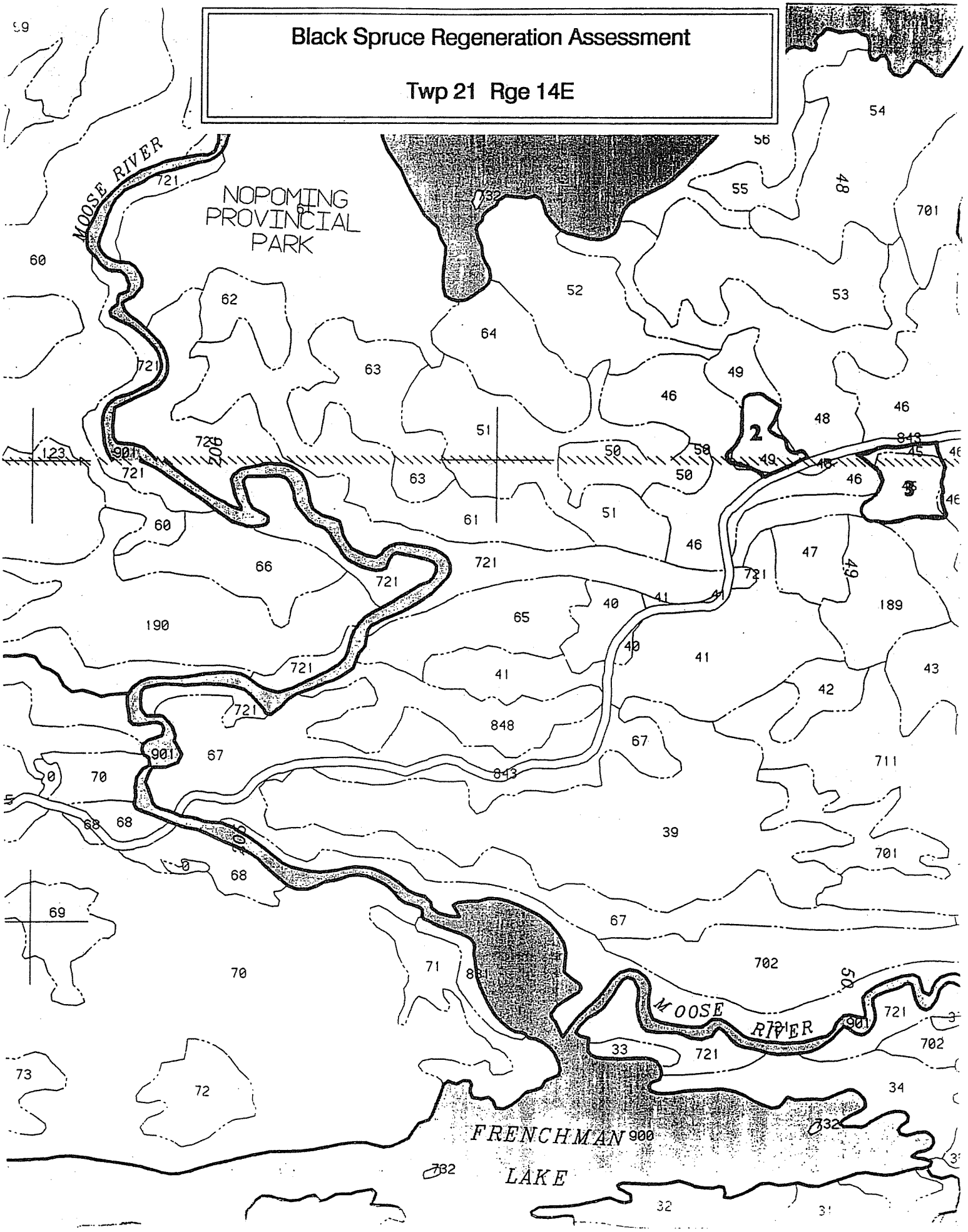
Black Spruce Regeneration Assessment

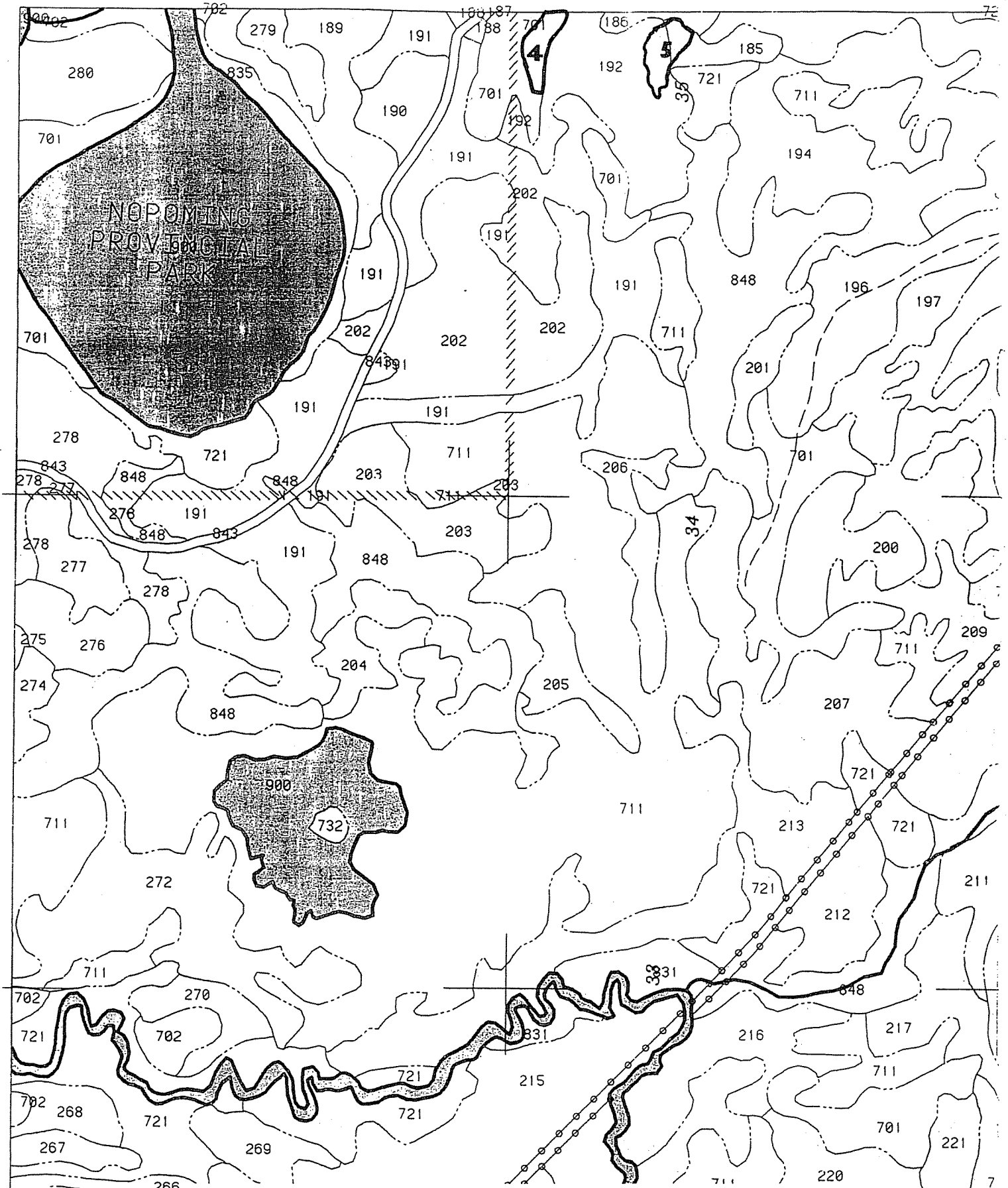
Twp 21 Rge 14E



Black Spruce Regeneration Assessment

Twp 21 Rge 14E




NOPOMING PROVINCIAL PARK
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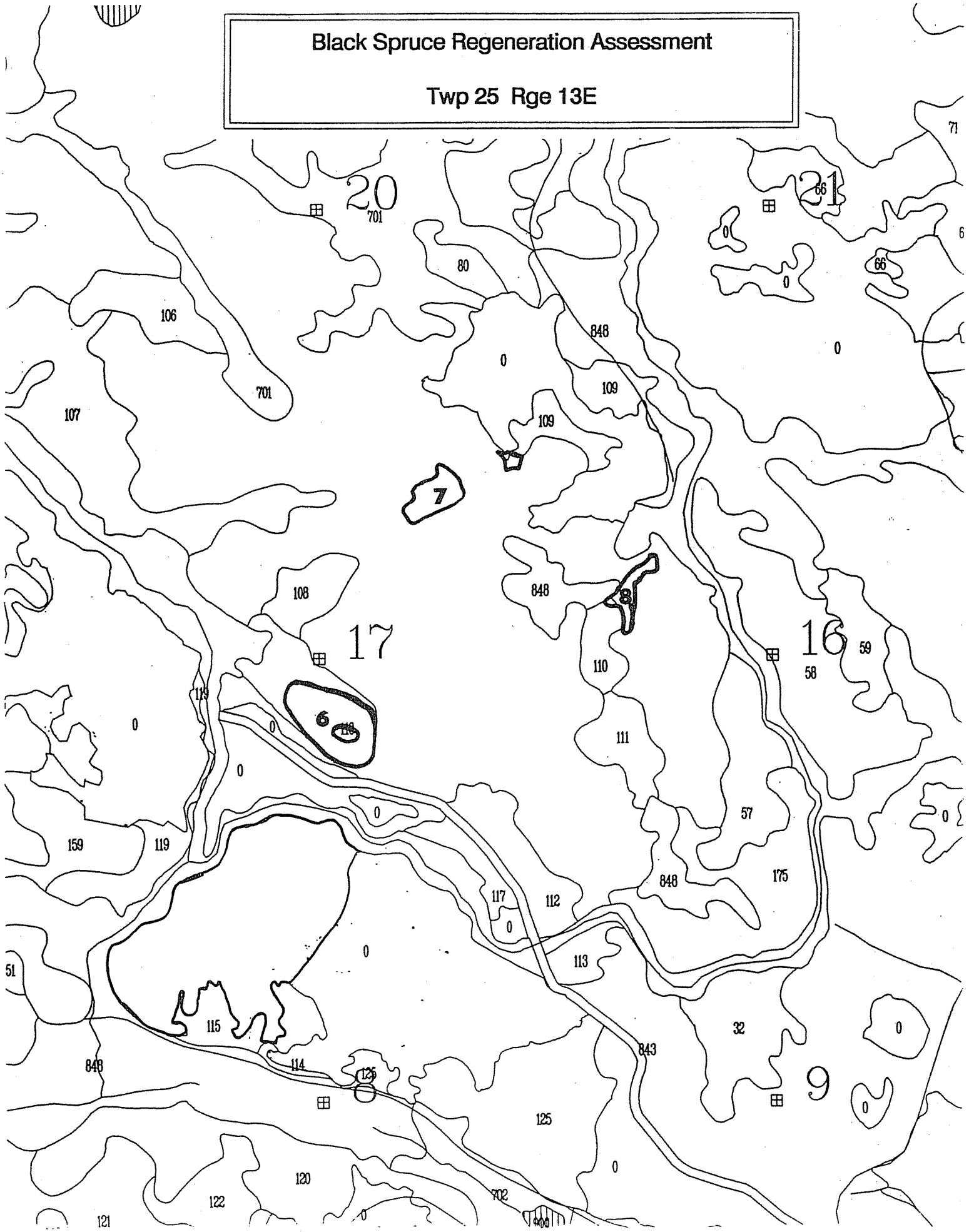
5
34
35
900
732
Black Spruce Regeneration Assessment
Twp 21 Rge 15E

Black Spruce Regeneration Assessment

Twp 25 Rge 13E



Black Spruce Regeneration Assessment

Twp 22 Rge 16E