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1.0 INTRODUCTION

This document is a report on an ecological study of the Oro Gravel Pit Expansion Site, conducted throughout the winter, spring summer and fall of 1991. The site is located on the West 1/2 Part lots 7, 8 and 9, and East 1/2 Part Lot 8 of Concession 7, Township of Oro (Figure 1). This report outlines the methods used and the results of the study.

The goal of the ecological study was to characterize the existing conditions on the site, as a supporting document to a rezoning and licensing application. The study included a review of background information for the general area, including Ministry of Natural Resources (Huronia District) records. The study schedule included winter, spring and late summer components in order to ensure a relatively complete inventory of plants and animals on the site. Our approach was to divide the property into major habitat types based on the dominant overstory and understory vegetation, and to conduct wildlife surveys (winter mammal, winter bird, and breeding bird surveys), and floral inventories to provide species lists for each major habitat. Floral inventories were conducted during spring and late summer in all habitat types. A vegetation map has been produced, and a list of vascular plant species has been prepared for each habitat type. A forest resources survey was conducted to characterize the species and size of trees in the deciduous woodlot portion of the property.

2.0 VEGETATION

2.1 Methods

Airphoto interpretation of a 1979 1:50000 scale airphoto enlarged to approximately 1:5000 was used to delineate initial boundaries of major habitat types. These habitat types and boundaries were field-checked and the dominant tree species recorded during a one day winter reconnaissance. Habitat types and boundaries were further refined and mapped (Figure 2) based on understory and groundcover species information collected during the spring floral inventory. The Canadian Vegetation Classification system (Strong et al. 1990) was used to classify each habitat type as to growth form and dominant and co-dominant species.

Floral inventories were conducted June 6 to 11, August 11, 15, 16, and September 2, 1991. Several hours were spent walking through each habitat type, in conjunction with forestry survey transects, and all understory and groundcover species observed were recorded. At each sampling point along the forestry survey transects (approximately every twenty meters, see section 3.1) a one square meter

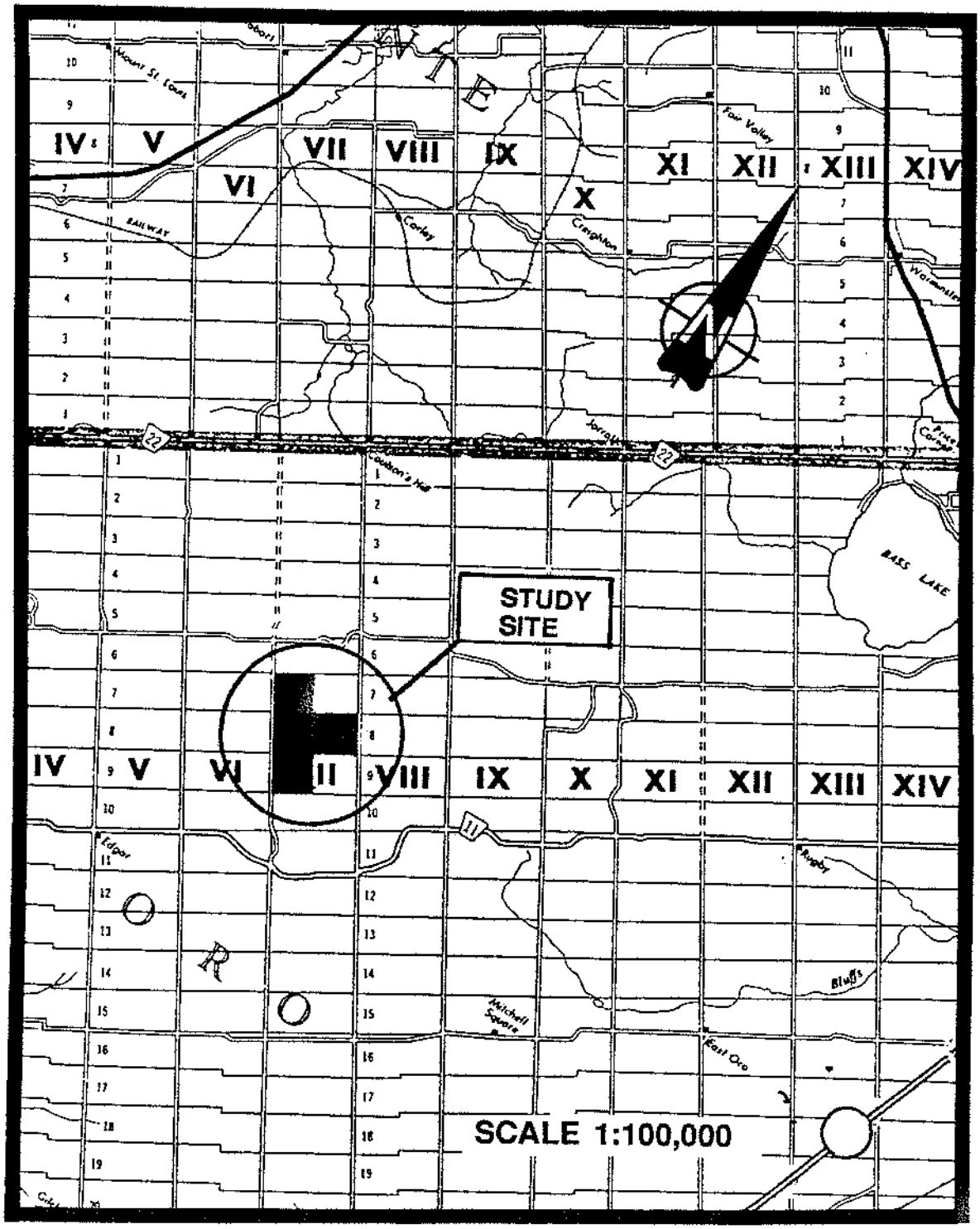

Figure 1. Oro Gravel Pit Expansion Site.

quadrat was intensively inventoried to record all species present. Plants were keyed using Britton and Brown (1970), and Soper and Heimburger (1990), with Scoggan (1979) as the final taxonomic reference. A list of vascular plants has been prepared for each habitat type on the property; this is included as Appendix A. The status of every species recorded was checked to determine its regional distribution and status within the county (Riley 1989).

2.2 Vegetation Description

The 125 ha property is located in the Paleozoic lowland portion of the Great Lakes - St. Lawrence Forest Region (GSC 1969; Rowe 1972). It is on the Bass Lake Moraine, and is hummocky terrain with sandy loam and sandy silt soils (Ingham 1989). Approximately one third of the property is covered by pine plantations which are rapidly succeeding to deciduous species, another third is covered by open old field habitat with scattered young pines and poplars, and the final third is covered by deciduous forest. Each of these major habitat blocks has been subdivided (Figure 2) according to dominant overstory species, age, understory and groundcover into the habitat types described below. Species lists for each of these habitat types are presented in Appendix A. All of the species observed are common in Simcoe County (Riley 1989).

Habitat Descriptions:

- Mature Pine Plantation - Area 1A. This section of plantation is composed of mature Red and Scots Pine with an average DBH (diameter at breast height) of 25 cm, and heights ranging from 14 to 16 m. In this section, the pines are healthy, and the understory is very sparse, consisting of scattered Sugar Maple and Basswood saplings to 7 m tall. The groundcover is limited to a few scattered Wild Lily-of-the-valley, Rattlesnake Fern, and Drooping Wood Sedge.

- Successional Pine Plantation - Area 1B. This semi-mature Scots Pine (10-14 m tall) plantation is succeeding rapidly; the pines are not healthy, and the canopy is fairly open, allowing the formation of a tall (7 to 10 m), dense understory of Sugar Maple, Ironwood, Black Cherry and Beech saplings. Wild Raspberry bushes are present in small openings where some of the pines have died. Groundcover is sparse; the dominant groundcover species are: Wild Lily-of-the-valley, hawkweeds, horsetails and sedges.

- Successional Pine Plantation - Area 1C. This Scots Pine (10 to 12 m high) plantation is also succeeding rapidly; the pines are not very healthy, as indicated by small crowns with yellow needles. The canopy is sparse, and

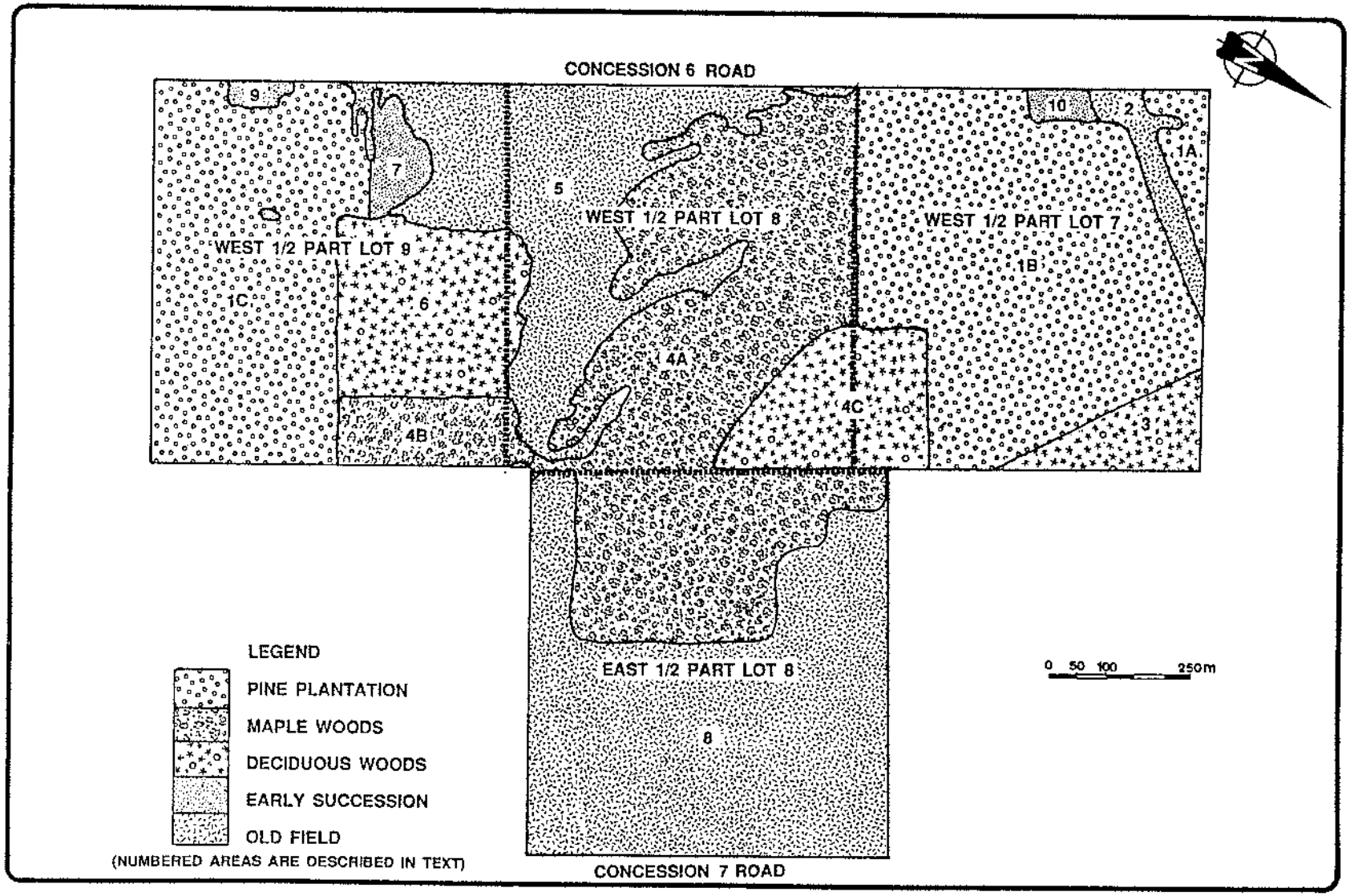

Figure 2. Vegetation Habitat Types.

a dense, tall (3 to 8 m) understory of Sugar Maple and Basswood has formed. Groundcover is sparse; Rattlesnake Fern, Virginia Waterleaf and Clubmoss are the dominant species.

• Mature Deciduous Forest - Area 3. Mature White Ash, Black Cherry and Sugar Maple are co-dominant overstory species to 18 m tall, with DBH ranging from 14 to 19 cm. Sugar Maple saplings (to 5 m tall) form a sparse understory. Groundcover is also sparse, and tall forbs such as Blue Cohosh, Virginia Waterleaf and Trilliums dominate.

• Open field - Areas 2, 5 and 8. These are gently rolling old field areas, where the dominant vegetation growth form is forbs. Hawkweeds, Bladder Campion, Red Sorrel, and Rough-fruited Cinquefoil are the dominant species; some Wild Carrot, Ox-eye Daisy, Field Pepper-grass, grasses, lichens, goldenrods and wild strawberries are also present. Young Scots Pine, Trembling Aspen, Sumac, Hawthorns and some wild Red Raspberries are scattered throughout, but cover less than 10 percent of the area. Area 2 is the Hydro right-of-way, and tends to have more strawberry and raspberry patches than the other two areas.

• Sugar Maple Woods - Area 4A. This flatter area of mature, predominantly Sugar Maple woods is currently being selectively logged. There are several logging roads and areas of slash. Several parts have a more open canopy as a result of logging; these areas are dominated by Sugar Maple. The shrub understory is very sparse; however, there is a very dense groundcover layer, composed mainly of Sugar Maple seedlings, Sharp-leaved Hepatica, Bloodroot, Jack-in-the-pulpit, violets and sedges. Some pockets of these woods are dominated by White Ash, or have a mixture of Ironwood, Black Cherry, and White Birch associated with the Sugar Maple.

• Sugar Maple Regeneration - Area 4B. This area was heavily logged several years ago, and is regenerating in an extremely dense shrub layer growing to 6 m tall, dominated by Sugar Maple and Basswood saplings, Red Elderberry, and Wild Red Raspberry.

• Young Deciduous Woods - Areas 4C and 6. This is a hilly deciduous wooded area, where the overstory is composed mainly of young Sugar Maple to 16 m tall, with an average DBH of 12 cm. Co-dominants are White Ash, Black Cherry, Ironwood and Basswood. Black Cherry is more abundant in Area 6, and Basswood, and Butternut are more abundant in Area 4C. The sparse understory is dominated by Sugar Maple saplings, and the sparse but diverse groundcover is typical of cool, dry, deciduous woods in this area.

The dominant groundcover species are Sugar Maple seedlings, Virginia Waterleaf, Trilliums, Northeastern Lady Fern, Wild Sarsaparilla and Mayapple. Several small pockets are dominated by Black Cherry, Trembling Aspen or Basswood, and some small openings in the canopy encourage the growth of a raspberry shrub layer.

- Early Succession - Area 7. This area forms an ecotone from deciduous and plantation areas to the old field habitat. The overstory here is a tall shrub and young tree layer composed of Trembling Aspen, Staghorn Sumac, Basswood and Wild Raspberries. Ground cover is sparse, with weedy forbs such as Garlic Mustard and Ground-ivy dominating.

- Old Homestead - Areas 9 and 10. These two small areas are beside the Concession 7 Road. One is located in plantation 1C, the other is beside the Hydro line, in plantation 1B. They are both characterized by a dense tall shrub layer of Staghorn Sumac, Lilac and young Basswood. A groundcover inventory was not done in these two areas.

3.0 FOREST RESOURCES

3.1 Methods

The study site lies within a large forest production area which covers most of Oro Township north of Suburban Road 11 (Figure 3). This forest production area is composed of agricultural lands of lower classification which are suitable for forestry. This does not mean that these lands are currently forested, but indicates that they have some potential for forestry. Agreement Forests are located adjacent to the study site, on the West 1/2 Part Lots 6 and 10 (Figure 3).

The Ontario Forest Resources Inventory mapping, conducted by the MNR in 1978, was consulted to ascertain the general characteristics of the site and the surrounding land for forest production. Detailed current site information was then compiled using a combination of airphoto interpretation and ground-truthing. Airphoto interpretation of 1979 photos was used to delineate blocks of similar type forest. The information on this photo was updated and refined through a series of forest surveys.

The Point-centered quarter method (Cottam and Curtis 1949, Mueller-Dombois and Ellenberg 1974) was used to collect data on the size distribution and species composition of the woodlots. This method provides the same sort of information as the traditional Quadrat method, but is less time-consuming, and can

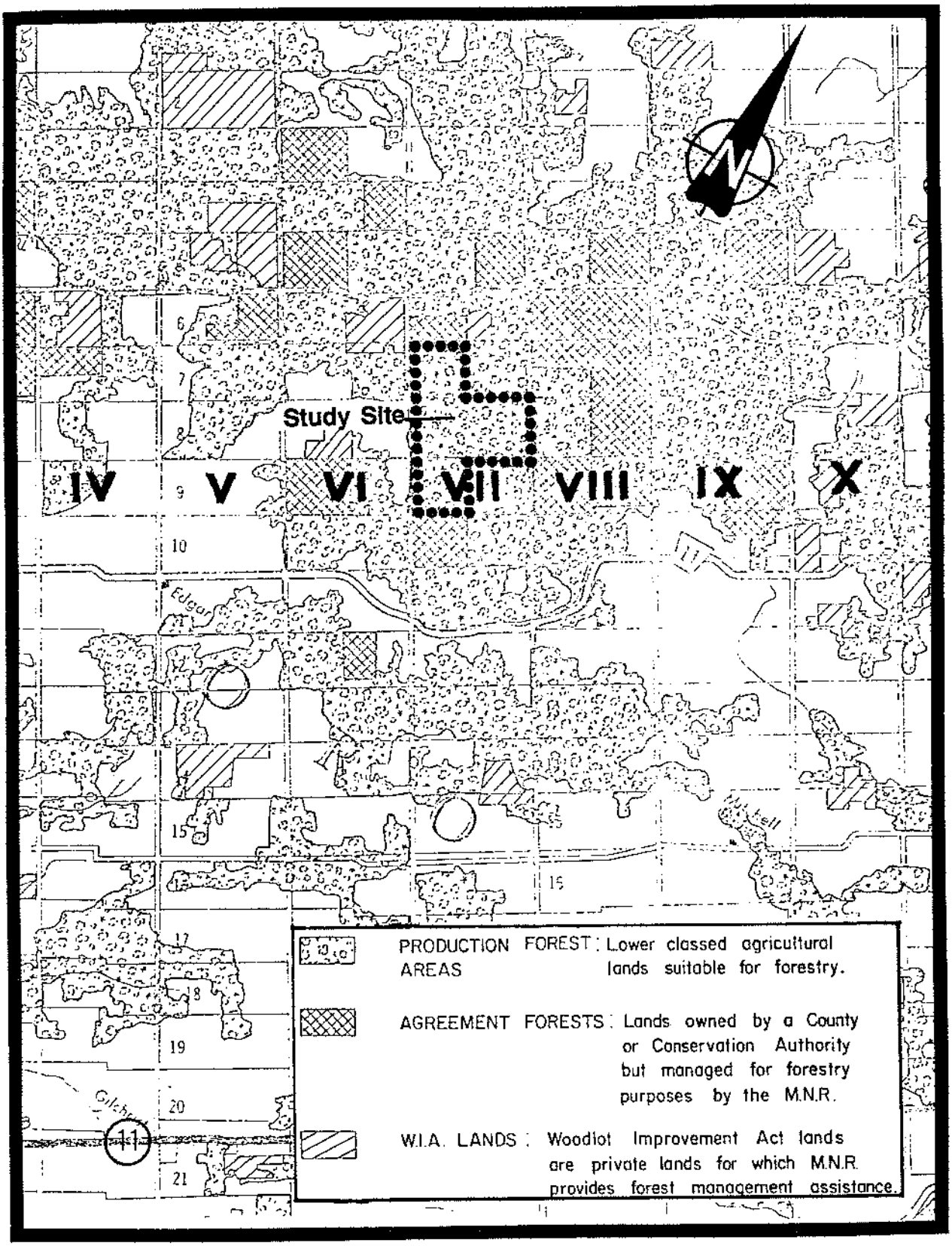

Figure 3. Forest Resources Map.

be performed by one person. A sampling direction was chosen at random and a series of transects were paced through each deciduous woodlot area. A sampling point was set every twenty-five paces (aproximately 20 metres). At this point, a bisect (perpendicularly crossed sticks) was placed, to divide the forest into four quarters, or quadrants. In each quadrant, the distance to the nearest tree and sapling were measured, the tree and sapling species were identified, the tree diameter at breast height was measured, and the heights of tree and sapling were estimated. Notes on understory species and development, and groundcover species present in the area around each point were recorded.

Three transects were used to sample the deciduous woodlot on the West 1/2 Part of Lot 9, using a total of 41 sampling points. Five transects were used to sample the deciduous woodlot on Lot 8, using a total of 49 sampling points. These transects are marked on Map 1 of Appendix B. The Pine plantations were not surveyed: they are even-aged stands of planted Red and Scots Pine.

For each transect, the following statistics were calculated: 1) the total number of stems recorded; 2) the average tree diameter at breast height (DBH); 3) the average distance from centre point to tree; 4) the average canopy height, and 5) the average understory height. Data from transects within one habitat type were pooled, and the data from all sampling points within one habitat type were processed to give the following information:

$$\text{Frequency} = \frac{\text{Number of points at which species is found}}{\text{Total number of data points}} \times 100$$

$$\text{Relative density} = \frac{\text{Number of trees of species recorded at points}}{\text{Total number of trees recorded at all points}} \times 100$$

This summary information is discussed in the following sections, and is presented in Table 1.

3.2 Forest Resource Description

The principal species found in the deciduous woodlot (Areas 4A, 4C, and 6) are Sugar Maple, White Ash, Black Cherry, and Ironwood (Table 1). Sugar Maple is predominant throughout both woodlots, although there were some small pockets dominated by Black Cherry or White Ash. Other species encountered included Butternut, Basswood, Cottonwood, White Birch, Trembling Aspen, Balsam Poplar and Black Walnut.

Table 1. Forest survey summary.

	Area surveyed		
Parameter	Area 6	Area 4A	Area 4C
Number of stems sampled	164	149	45
Average DBH (cm)	11.5	20.6	14.2
Average height (m)	15.6	18.6	18.7
Average understory height (m)	3.5	2	5.9
Dominant Species	Sugar Maple	Sugar Maple	Sugar Maple
frequency	0.89	1	0.5
relative density	0.53	0.91	0.15
Co-dominant Species			
Species 1	Black Cherry		White Ash
frequency	0.42		0.67
relative density	0.17		0.38
Species 2	White Ash		Ironwood
frequency	0.20		0.33
relative density	0.06		0.20
Species 3	Ironwood		Basswood
frequency	0.15		0.25
relative density	0.10		0.11
Species 4			Butternut
frequency			0.25
relative density			0.08

Part of the woodlot on Lot 8 was being selectively logged during the forest surveys; sampling points falling in logged areas were not sampled. Regeneration is good to excellent throughout the woodlots, with maple seedlings often the dominant groundcover. Sugar Maple was the most common understory species, although there was some regeneration to White Ash.

Area 6 (transects 1-3) is a young, mixed species woodlot, dominated by Sugar Maple, but with Black Cherry, White Ash and Ironwood as co-dominants (Table 1). Area 4A is a semi-mature mixed age woodlot, dominated by Sugar Maple. Other species such as White Ash, Black Cherry, Butternut and White Birch occur in this area, but they are sparsely scattered, or concentrated in very small pockets. Area 4C is a semi-mature wood, dominated by Sugar Maple, with White Ash, Ironwood, Basswood and Butternut as co-dominants.

The pine plantation in area 1A is an even-aged stand of approximately 40-45 year old Red and Scots Pine. The average canopy height in this section is approximately 16 m, the average DBH is 25 cm. These pines are well-grown, and healthy. There is very little regeneration in this area. Area 1B is an even-aged

stand of approximately 40 year old Scots Pine, with average DBH of 23 cm, and approximately 14 m tall. Area 1C is a Scots Pine plantation approximately 40 years old, with average heights of about 12 m, and average DBH of 22 cm. The pines in areas 1B and 1C are not healthy, and there is extensive, dense regeneration to Sugar Maple and Basswood in these areas.

4.0 WILDLIFE

4.1 Methods

4.1.1 Winter Wildlife Surveys

Winter wildlife surveys were conducted from March 6 to 10, 1991, when there was fresh snow cover suitable for mammal track identification. Transects were walked through each habitat type (pine plantation, deciduous forest, old field) and along habitat edges (plantation/open, plantation/deciduous, deciduous/open) to record wildlife use of these areas.

The strip transect method was used; tracks, browse marks and animal sightings were recorded along a 40 m wide strip (20 m on each side of the centerline of the transect) through each habitat. This type of transect information is not suitable for establishing absolute densities of animals, but can be used to establish a crude density index to determine the relative occurrence of mammals in each habitat type (Conner and Dickson 1980; Burnham and Anderson 1984). Because strip transects are long, narrow plots or quadrats, the density index for each species in each quadrat is estimated using the formula:

Density index = number of tracks / length (in km) x width of strip transect (in km)

Data from all transect strips within one habitat type were pooled to indicate relative occurrence for each habitat type. The number of tracks observed for each species was divided by the area sampled to give a standard density index per square kilometer for each species. The total area covered by strip transects in each major habitat block and the area of transects along each edge type are summarized in Table 2.

Table 2. Area of each major habitat type covered by 40 m wide transects. Total length of transects (in km) through each area are summed and multiplied by .04 km to give the total area covered by transect strips for each major habitat block.

Habitat	Total length of transects in each area (m)									Total Area (km^2)
	1A	1B	1C	2	3	4A	4B	5	6	
Pine Plantation	80	950	1380							0.0964
Deciduous Woods					410	1100	470		820	0.1124
Open Field				540				630		0.0468

4.1.2 Breeding Bird Surveys

Surveys of breeding bird populations on the property were conducted primarily to determine if there were any species of concern present. Species of concern are those officially designated as rare, threatened or endangered by the Ontario Ministry of Natural Resources. These designations apply on a provincial scale. Species declared to be endangered are protected under the Endangered Species Act (RSO 1980). There are, in addition, breeding bird species which are considered to be of regional or local concern. Secondarily, the breeding bird surveys were conducted to inventory the species present and to document their abundance and habitat associations.

Surveys of each habitat area were conducted by walking a zigzag route that brought the observer to within hearing and/or viewing distance of most of that habitat area. Such a technique is suitable for the purposes of this study. It allows an inventory to be done quickly and reasonably thoroughly. However, this method does not provide quantative data that can be compared from year to year for a particular area, or from place to place within a season. The method does not provide a complete inventory of all birds nesting on, or otherwise using the property at this time of year but it does provide a representative list of the species present in mid June and an estimate of their relative abundance.

Some species of birds will have completed nesting by mid June when the surveys were conducted and may have moved off the property; other species have not yet begun to nest (e.g., American Goldfinch, Cedar Waxwing). Also, considering that the site was visited only twice during the breeding season and that bird populations change even during the relatively static breeding season, it is impossible to have a truly complete inventory of all birds present without expending considerably more effort.

Surveys were conducted on June 7 and 13, 1991. Details of the dates and times of each area survey are outlined in Table 3 below. In addition, 1.5 hours (03:00-04:30) were spent on June 13 listening and calling for owls and other 'night' birds from Concession 6. The species, numbers, behaviour and location of each bird seen and/or heard were recorded. Separate results were tabulated for 11 of the 12 habitat areas: 1A, 1B, 1C, 2, 3, 4A, 4B, 5, 6, 7, and 8 (see Figure 2). Observations in area 9 were included within area 1C because area 9 was quite small.

Table 3. Dates and times of bird surveys conducted in each habitat area of the property.

Area	Date Surveyed	Observation Period	Time (hrs:mins)
Pine Plantation			
1A	June 7	14:10-15:00	0:50
1B	June 13	05:15-06:30, 06:45-07:30	2:30
1C	June 7	06:45-08:45	2:00
Sugar Maple Woods			
4A	June 7	10:20-12:05	3:10
4A	June 13	09:00-10:25	
4B	June 7	07:45-08:00, 09:50-10:20	0:45
Deciduous Woods			
3	June 13	06:30-06:45	0:15
6	June 7	09:20-09:50	0:30
Old Field			
2	June 7	14:10-14:50	1:45
2	June 13	05:15-06:20	
5	June 7	12:05-12:35	2:45
5	June 13	11:45-14:00	
8	June 13	08:00-09:00, 10:25-11:25	2:00
Regeneration			
7	June 7	09:00-09:20	0:20

4.1.3 Incidental Observations

In addition to these specific wildlife surveys, all incidental wildlife observations (bird songs, animal sightings, tracks, dens or nests, browse marks) made during vegetation inventories on June 6 to 11, 1991 were recorded. All

winter bird observations during the wildlife surveys on March 6 to 10, 1991 were also recorded.

4.2 Mammals

A wide variety of mammal tracks were recorded in the study area during the winter wildlife surveys; these are presented by habitat type in Table 4.

Surprisingly few deer appear to use the property in March; only three tracks were observed, and there were only a few browse marks in the deciduous forest habitat. Thus there is no indication of White-tailed Deer wintering habitat (deer yards) on the property. Very little evidence of deer use was observed during the summer months. Tracks were seen along the edge of plantation area 1C and the old field habitat, as well as in Area 4B during the summer months. Some limited browse marks were observed in the Sugar Maple woods during the floral inventory and forest surveys.

Red Fox and Coyote tracks were observed in all three habitat types, but Coyote appeared to use the old field areas more extensively. A coyote was observed passing through the Sugar Maple woods on September 2, 1991.

Porcupines were abundant; six porcupines were seen in the plantations, and tracks or browse evidence was observed in all habitats. Several individuals were seen in the plantations during the winter and summer surveys.

There was considerable Red Squirrel activity, especially in the deciduous forest and old field habitats. The number of Red Squirrel tracks observed in the old field habitat is likely biased by the high number of tracks observed in the narrow strip of old field habitat (hydro line) separating plantation areas 1A and 1B, as we would expect them to be more abundant in the plantations (Thompson et al 1988).

There were a large number of rabbit and hare tracks in the pine plantation and old field habitats. Numbers of these species vary considerably from year to year due to the cyclical nature of their populations, however, the number of tracks seen here indicates that these species would be an important food source for Coyotes in this area.

Marten tracks were observed throughout the pine plantation habitat during the winter wildlife surveys, but were not recorded on the transects. The pine

Table 4. Relative occurrence of mammals using habitat types and edges between habitats on 6 to 10 March 1991. For ease of comparison, numbers presented are number of tracks per square kilometer, with actual number of observations in brackets underneath.

Species	Plantation (1A, 1B, 1C)	Deciduous Forest (3, 4A, 4B, 6)	Old Field (2, 5, 8)	Plantation/ Deciduous	Plantation/ Open	Deciduous/ Open
Red Fox *Vulpes vulpes*	93 (9)	71 (8)	64 (3)	17 (3)	– (2)	
Coyote *Canis latrans*	10 (1)	71 (8)	213 (10)	-	86 (5)	22 (2)
White-tailed Deer *Odocoileus virginianus*	-	26 (3)	-	-	-	-
Weasel *Mustela* sp.	10 (1)	-	106 (5)	-	17 (1)	-
Meadow Vole *Microtus pennsylvanicus*	145 (14)	88 (10)	21 (1)	34 (4)	86 (5)	22 (2)
Red Squirrel *Sciurius carolinensis*	394 (38)	729 (82)	1346 (63)	137 (16)	173 (10)	67 (6)
White-footed Mouse *Peromyscus leucopus*	10 (1)	-	-	-	-	-
Porcupine *Erethizon dorsatum*	62 (6)	8 (1)	21 (1)	8 (1)	52 (3)	-
Rabbits and Hares *Sylvilagus floridanus* and *Lepus americanus*	1255 (121)	213 (24)	1004 (47)	223 (26)	34 (2)	113 (10)
Raccoon *Procyon lotor*	10 (1)	-	-	-	-	-
Total area sampled (km^2)	0.0964	0.1124	0.0468	0.1164	0.0576	0.0884
Total No. Species	9	7	7	5	6	4

plantations appeared to be used by the greatest number of species (9 in total), and this is also the only habitat where Raccoon and White-footed Mouse tracks were observed. There was no indication of the presence of any rare mammals on the property.

4.3 Birds

A total of 52 species of birds was recorded on the property. Table 5 presents the species, numbers and habitat associations of all birds recorded during the breeding bird surveys. For the most part, the numbers are the number of **breeding pairs** recorded (i.e. the number of singing males recorded). For the following species, however, the total is the number of **individuals** recorded:

Brown-headed Cowbird	Barn Swallow
American Crow	Cedar Waxwing
Bank Swallow	American Goldfinch

Also, the Red-tailed Hawk is recorded for two habitat areas (Table 5); given the large foraging territories of this species it is likely that only one individual was involved. The most abundant species recorded were the Ovenbird (23 pairs), Red-eyed Vireo (13 pairs), Chipping Sparrow (11 pairs) and Least Flycatcher (10 pairs).

Habitat areas differed in species composition and total avian population sizes (Table 5). These differences are functions of several factors,including, for example, physical size of the area and diversity of vegetation within each habitat area. More species were recorded in the deciduous woodland area 4A (24 species), and in old field area 8 (19 species), than in any other habitat areas on the property.

No threatened or endangered bird species were recorded. One pair of astern Bluebirds, a species officially designated as provincially rare, was observed in the northeast corner of Area 5 on June 6, 1991. Bluebird nest boxes were present on the farm property immediately to the west, across Concession 6 Road. Presumably, the Bluebirds that were recorded were nesting there, and were foraging in the old field habitat on the property. Several provincially, regionally or locally uncommon breeding bird species (Devitt 1967; Cadman et al. 1987) were recorded on the property:

Black-billed Cuckoo
Black-throated Blue Warbler
Black-throated Green Warbler
Pine Warbler
Grasshopper Sparrow

Bird sightings were recorded incidentally while conducting the winter mammal survey, 6-10 March. The following species were observed:

Ruffed Grouse	Black-capped Chickadee
Downy Woodpecker	Red-breasted Nuthatch
Hairy Woodpecker	Evening Grosbeak
Pileated Woodpecker	Pine Grosbeak
Blue Jay	

Of these species, all but the Pine Grosbeak probably nest near the property. The Pine Grosbeak is a migrant and a winter visitor.

Table 5. Species and numbers of birds recorded on surveys, 7 and 13 June 1991. In most cases, numbers refer to breeding pairs, but see text for details.

	Habitat and Area										
	Pine Plantation			Sugar Maple Woods		Deciduous Woods		Old Field			Regen-eration
Species	1A	1B	1C	4A	4B	3	6	2	5	8	7
Red-tailed Hawk									1	1	
American Woodcock		1									
Black-billed Cuckoo		1							1	1	
Yellow-bellied Sapsucker				1							
Downy Woodpecker				3							
Hairy Woodpecker		1		1							
Northern Flicker		1		2						1	
Eastern Wood-Pewee			1	3	1						
Least Flycatcher				10							
Great Crested Flycatcher			2								
Eastern Kingbird								1	1	3	
Bank Swallow										1	
Barn Swallow										2	
Blue Jay	1	1	1	1			1				
American Crow			3	1							
Black-capped Chickadee	2	1	1	2			1			1	
White-breasted Nuthatch				1							
House Wren											1
Eastern Bluebird									1		
Veery				3							
Hermit Thrush		3	1				1				
Wood Thrush				1		1					
American Robin		1		4							
Gray Catbird				1	1						
Brown Thrasher									1	1	1
Cedar Waxwing		2									7
European Starling										1	
Red-eyed Vireo		2	1	6		1	2			1	
Nashville Warbler	1										
Chestnut-sided Warbler				2	1						
Black-throated Blue Warbler				1							
Black-throated Green Warbler	1										
Pine Warbler	1										
American Redstart				2							
Ovenbird	2	6	4	5	1	1	4				
Mourning Warbler		1	1								
Scarlet Tanager		1		2							
Rose-breasted Grosbeak		1	1	5		1	1				
Indigo Bunting		1			1			2			
Chipping Sparrow								3	4	3	1
Field Sparrow											2
Vesper Sparrow									1	3	
Grasshopper Sparrow				1					1		
Song Sparrow								1	3	2	1
Bobolink										1	
Red-winged Blackbird										2	
Eastern Meadowlark									1	2	
Brown-headed Cowbird				1	2					3	
Northern Oriole				5					2	1	
Purple Finch									2		
American Goldfinch										1	
No. of Species	6	15	10	24	6	4	6	5	12	19	6

5.0 SIGNIFICANT SPECIES AND NATURAL AREAS

The Ontario Ministry of Natural Resources (OMNR), Central Region, began a Rare Species Mapping Project in 1989. The objective of this project was to assemble data on the locations of rare, threatened and endangered plants, birds, mammals, reptiles, amphibians, fishes and invertebrates in Central Region. These data have been critically reviewed, sorted into historic and recent sightings, and mapped at a scale of 1:10,000. This data base was checked for records of species of concern on or near the Oro Township property. There are no such records on file with the Rare Species Mapping Project (Kim Benner, OMNR, pers. comm.; Duncan et al. 1989).

During the course of the ecological study of the site, only one sighting of a significant species was recorded. This was the pair of bluebirds observed feeding in the old field habitat in the northwest corner of the property. These birds are probably nesting across the road in the box provided, and would presumably be able to forage in the fields on that side of the road. No rare plants were observed on the property.

The Ontario Ministry of Natural Resources records were checked to determine whether any provincially, regionally or locally significant natural resources (important fish or wildlife areas, wetlands, Areas of Natural and Scientific Interest - ANSI) were located on or adjacent to the property. Figure 4 shows all such areas in the area around the study site. The study site is a dry upland area, with no streams or wetlands on or adjacent to the property. The MNR recognizes no significant fish or wildlife areas on the property.

A regionally significant Life ANSI, a natural area recognized as representative of the forests of the Simcoe Uplands Kame Hills (Hanna 1984), is located south of the study site, on Lots 9, 10 and 11, Concession 6, and Lots 10 and 11, Concession 7, Oro Township (Figure 4). This area was originally identified during reconnaissance level surveys (Hanna 1984) as one of several potential sites for establishment of a provincially significant ANSI; however another site (Rugby West, on Concession XI-XII, Lots 7,8,9,10) was chosen instead (Roy Alchema, MNR senior planner, pers. comm.).

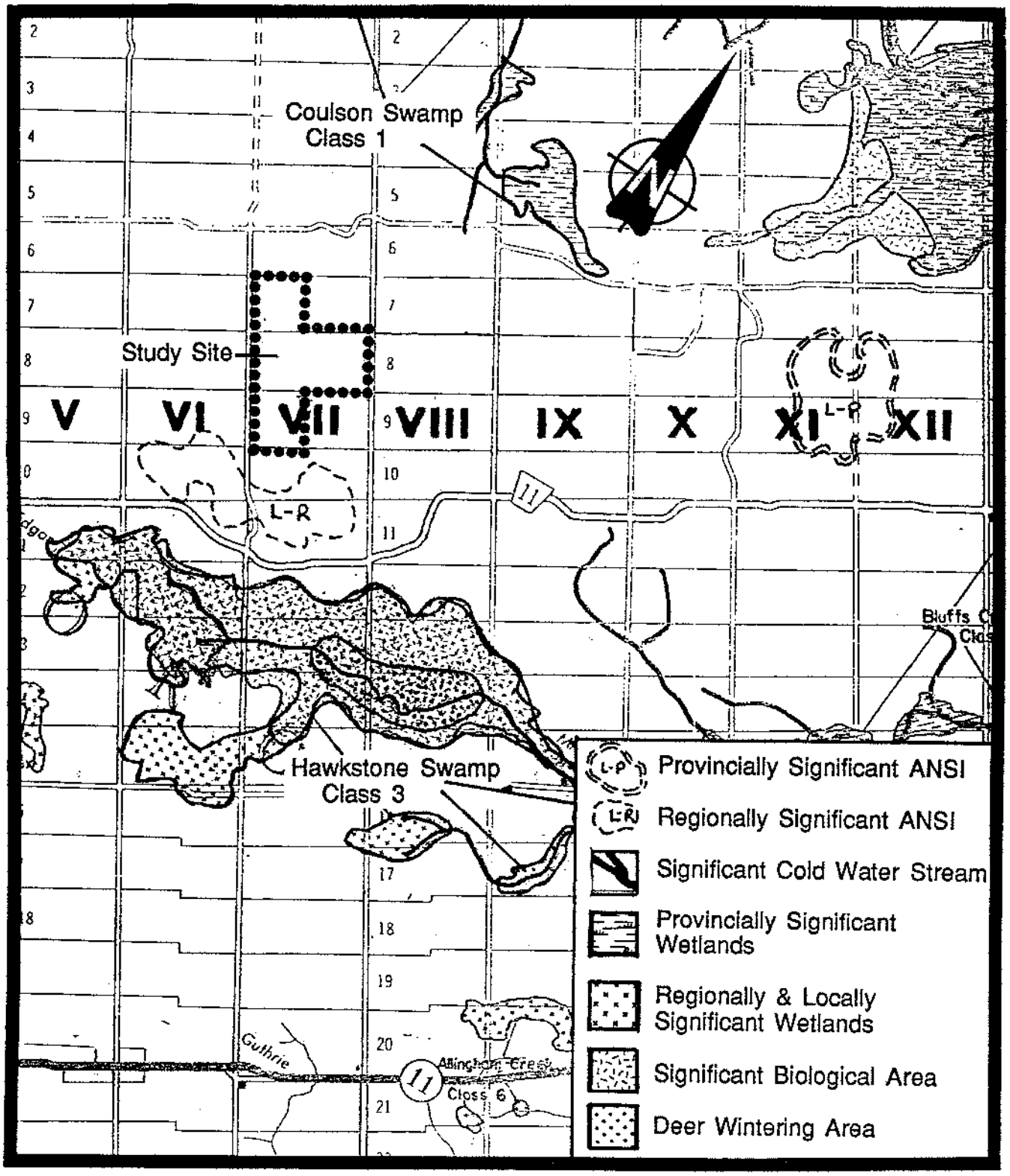

Figure 4. Significant Natural areas in the vicinity of the study site.

6.0 SUMMARY

The study area contains three major habitat types: pine plantation, deciduous forest, and old field. The pine plantations are not vigorous, and for the most part are rapidly reverting to deciduous species such as Sugar Maple, Basswood, Black Cherry, Beech and Ironwood. The majority of the deciduous forest area is dominated by mature Sugar Maple; co-dominants are Ironwood, White Ash, Black Cherry, and Basswood. The groundcover in most of the deciduous forest is diverse, and representative of well-drained, cool woods. Sections of the deciduous woods which have been selectively logged have developed very dense Sugar Maple regeneration, which dominates the groundcover in these areas. The old field areas are predominantly herbaceous, with a high proportion of weedy species. A floral inventory has been completed for all habitat types. All vascular plant species identified on the property are commonly distributed in the region.

The high diversity of the study area encourages use of the area by a variety of wildlife species. Winter wildlife surveys conducted along strip transects through each habitat type were used to indicate relative occurrence of mammals. Red Fox and Coyote use most of the area heavily, probably feeding on the Red Squirrels and White-footed Mice in the old field and plantation habitats, respectively. Very little evidence was found of use by White-tailed Deer; no winter deer yarding areas are located on the property. Porcupine are abundant, especially in the plantation areas. Marten tracks were observed in the plantation habitat during the winter surveys. No evidence of rare or endangered mammals was found.

A total of 52 bird species were recorded on the site through breeding bird surveys and incidental winter and spring observations. The species observed are representative of the species typically found nesting in these types of habitat in southern Ontario. The only official species of concern recorded was the Eastern Bluebird; it appeared to be nesting outside of the property and foraging in the old field habitat on the property.

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APPENDICES

APPENDIX A

VASCULAR PLANT SPECIES

OF THE JAMES DICK PROPERTY

The following table is a list of the vascular plant species observed during spring and late summer floral inventories, organized by habitat type. Species are listed in order of dominance.

Vascular plant species observed in 1991 on West 1/2 Lots 7, 8 and 9, and East 1/2 Lot 8, Concession 7, Oro Township, arranged by habitat type.

Scientific Name	Common Name
Mature Pine Plantation - Area 1A	
Overstory:	
Pinus sylvestris	Scots Pine
Pinus resinosa	Red Pine
Understory (Very sparse):	
Acer saccharum	Sugar Maple saplings
Tilia americana	Basswood saplings
Groundcover:	
Maianthemum canadense	Wild Lily-of-the-valley
Botrychim virginianun	Rattlesnake Fern
Carex arctata	Drooping Wood Sedge
Successional Pine Plantation - Area 1B	
Overstory:	
Pinus sylvestris	Scots Pine
Pinus resinosa	Red Pine
Understory:	
Acer saccharum	Sugar Maple
Prunus serotina	Black Cherry
Fagus grandiflora	Beech
Ostrya virginiana	Ironwood
Abies balsamea	Balsam Fir
Rubus idaeus	Wild Red Raspberry
Groundcover:	
Maianthemum canadense	Wild Lily-of-the-valley
Geraniuim Robertianum	Herb-robert
Hieracium pratense	Yellow Hawkweed
Equisetum arvense	Field Horsetail
Carex arctata	Drooping Wood Sedge
Carex communis	Fibrous-rooted Sedge

Continued...

Scientific Name	Common Name
Successional Pine Plantation - Area 1C	
Overstory:	
Pinus sylvestris	Scots Pine
Understory (3-6 m):	
Tilia americana	Basswood
Fraxinus americana	White Ash
Acer saccharum	Sugar Maple
Groundcover:	
Hydrophyllum virginianum	Virginia Waterleaf
Botrychium virginianum	Rattlesnake Fern
Lycopodium sp.	Clubmoss
Goodyera oblongifolia	Menzies' Rattlesnake-plantain
Carex arctata	Drooping Wood Sedge
Carex communis	Fibrous-rooted Sedge
Trientalis borealis	Starflower
Old Field - Areas 2 (Hydro Right-of-Way), 5, and 8	
Forb layer:	
Hieracium auranticum	Orange Hawkweed
Hieracium pilosella	Mouse-eared Hawkweed
Hieracium pratense	Yellow Hawkweed
Rumex acetosella	Red Sorrel
Hypericum perforatum	Common St. John's-wort
Lepidium campestre	Field Pepper-grass
Daucus carota	Wild Carrot
Potentilla recta	Rough-fruited Cinquefoil
Solidago graminifolia	Narrow-leaved Goldenrod
Solidago canadensis	Canada Goldenrod
Aster novae-angliae	New England Aster
Erigeron philadelphicus	Common Fleabane
Poa pratensis	Kentuckky Blue Grass
Bromus inermis	Smooth Brome Grass
Dactylis glomerata	Orchard Grass
Agrostis scabra	Ticklegrass
Agrostis gigantea	Redtop
Setaria viridis	Green Foxtail
Fragaria virginiana	Common Strawberry
Chyrsanthemum leucanthemum	Ox-eye Daisy
Aster latiflorus	Calico Aster
Silene cucubalis	Bladder Campion

Continued....

Scientific Name	Common Name
Old Field continued...	
Shrub layer (1-4m):	
Rubus idaeus	Wild Red Raspberry
Crataegus mollis	Hawthorn
Populus tremuloides	Trembling Aspen
Rhus typhina	Staghorn Sumac
Pinus sylvestris	Scots Pine
Mature Deciduous Woods - Area 3	
Overstory:	
Fraxinus americana	White Ash
Prunus serotina	Black Cherry
Acer saccharum	Sugar Maple
Understory (up to 5 m):	
Acer saccharum	Sugar Maple saplings
Fraxinus americana	White Ash
Ostrya virginiana	Ironwood
Groundcover (Very sparse):	
Caulophyllum thalictroides	Blue Cohosh
Hydrophyllum virginianum	Virginia Waterleaf
Trillium grandiflorum	White Trillium
Actaea pachypoda	White Baneberry
Arisaema triphyllum	Jack-in-the-pulpit
Mature Sugar Maple Woods - Area 4A	
Overstory:	
Acer saccharum	Sugar Maple
Fraxinus americana	White Ash
Ostrya virginiana	Ironwood
Betula papyrifera	White Birch

Continued....

Scientific Name	Common Name
Mature Sugar Maple Woods continued...	
Understory:	
Acer saccharum	Sugar Maple saplings
Rubus idaeus	Red Raspberry
Rubus allegheniensis	Common Blackberry
Sambucus pubescens	Red Elderberry
Ribes cynosbati	Prickly Gooseberry
Groundcover:	
Acer saccharum	Sugar Maple seedlings
Viola canadensis	Canada Violet
Viola pubescens	Downy Yellow Violet
Viola pallens	Smooth White Violet
Maianthemum canadense	Wild Lily-of-the-valley
Geranium robertianum	Herb Robert
Smilacina racemosa	False Solomon's Seal
Caulophyllum thalictroides	Blue Cohosh
Carex arctata	Drooping Wood Sedge
Hepatica acutiloba	Sharp-leaved Hepatica
Sanguinaria canadensis	Bloodroot
Actaea pachypoda	White Baneberry
Actaea rubra	Red Baneberry
Galium aparine	Cleavers
Anemone virginiana	Thimbleweed
Allium tricoccum	Wild Leek
Hydrophyllum virginianum	Virginia Waterleaf
Circaea quadrisulcata	Enchanter's Nightshade
Adiantum pedatum	Northern Maidenhair Fern
Dryopteris marginalis	Marginal Wood Fern
Epipactis helleborine	Helleborine
Arisaema triphyllum	Jack-in-the-pulpit
Carex communis	Fibrous-rooted Sedge
Eupatorium rugosum	White Snakeroot
Asarum canadense	Wild Ginger
Polygonatum pubescens	Solomon's-seal
Osmorrhiza claytonii	Sweet Ciceley
Osmorrhiza longistylis	Anise-root
Leonurus cardiaca	Motherwort
Phryma leptostachys	Lopseed

Continued....

Scientific Name	Common Name
Sugar Maple Regeneration - Area 4B	
Overstory (Very sparse):	
Acer saccharum (80-100 mm DBH)	Sugar Maple
Understory (Very dense):	
Acer saccharum	Sugar Maple saplings
Sambucus pubescens	Elderberry
Rubus allegheniensis	Common Blackberry
Rubus idaeus	Wild Red Raspberry
Rubus occidentalis	Black Raspberry
Tilia americana	Basswood saplings
Groundcover:	
Tiarella cordifolia	Foam Flower
Athyrium filix-femina	Northeastern Lady Fern
Carex communis	Fibrous-rooted Sedge
Young Deciduous Woods - Areas 4C and 6	
Overstory:	
Acer saccharum	Sugar Maple
Fraxinus americana	White Ash
Ostrya virginiana	Ironwood
Prunus serotina	Black Cherry
Tilia americana	Basswood
Betula papyrifera	White Birch
Populus tremuloides	Trembling Aspen
Populus balsamifera	Balsam Poplar
Populus deltoides	Cottonwood
Populus grandidentata	Large-toothed Aspen
Juglans cinerea	Butternut
Understory:	
Acer saccharum	Sugar Maple Saplings
Rubus idaeus	Wild Red Raspberry
Rubus allegheniensis	Common Blackberry
Prunus virginiana	Choke Cherry

Continued...

Scientific Name	Common Name

Young Deciduous Woods continued...

Groundcover:

Acer saccharum	Sugar Maple seedlings
Hydrophyllum virginianum	Virginia Waterleaf
Athyrium filix-femina	Northeastern Lady Fern
Botrychium virginianum	Rattlesnake Fern
Trillium grandiflorum	White Trillium
Trillium erectum	Purple Trillium
Polygonatum pubescens	Solomon's Seal
Maianthemum canadense	Wild Lily-of-the-valley
Asarum canadense	Wild Ginger
Geranium robertianum	Herb Robert
Aralia nudicaulus	Wild Sarsaparilla
Arisaema triphyllum	Jack-in-the-pulpit
Hepatica acutiloba	Sharp-lobed Hepatica
Smilax herbacea	Carrion-flower
Smilacina racemosa	False Solomon's Seal
Adiantum pedatum	Northern Maidenhair Fern
Podophyllum peltatum	May-apple
Caulophyllum thalictroides	Blue Cohosh
Actaea pachypoda	White Baneberry
Actaea rubra	Red Baneberry
Galium aparine	Cleavers
Polystichum acrostichoides	Christmas Fern
Viola canadense	Canada Violet
Viola pubescens	Downey Yellow Violet
Carex arctata	Drooping Wood Sedge
Carex communis	Fibrous-rooted Sedge

Early Successional Scrub - Area 7

Overstory (Tall shrub/Young tree layer):

Populus tremuloides	Trembling Aspen
Tilia americana	Basswood
Rhus typhina	Staghorn Sumac
Rubus idaeus	Wild Red Raspberry

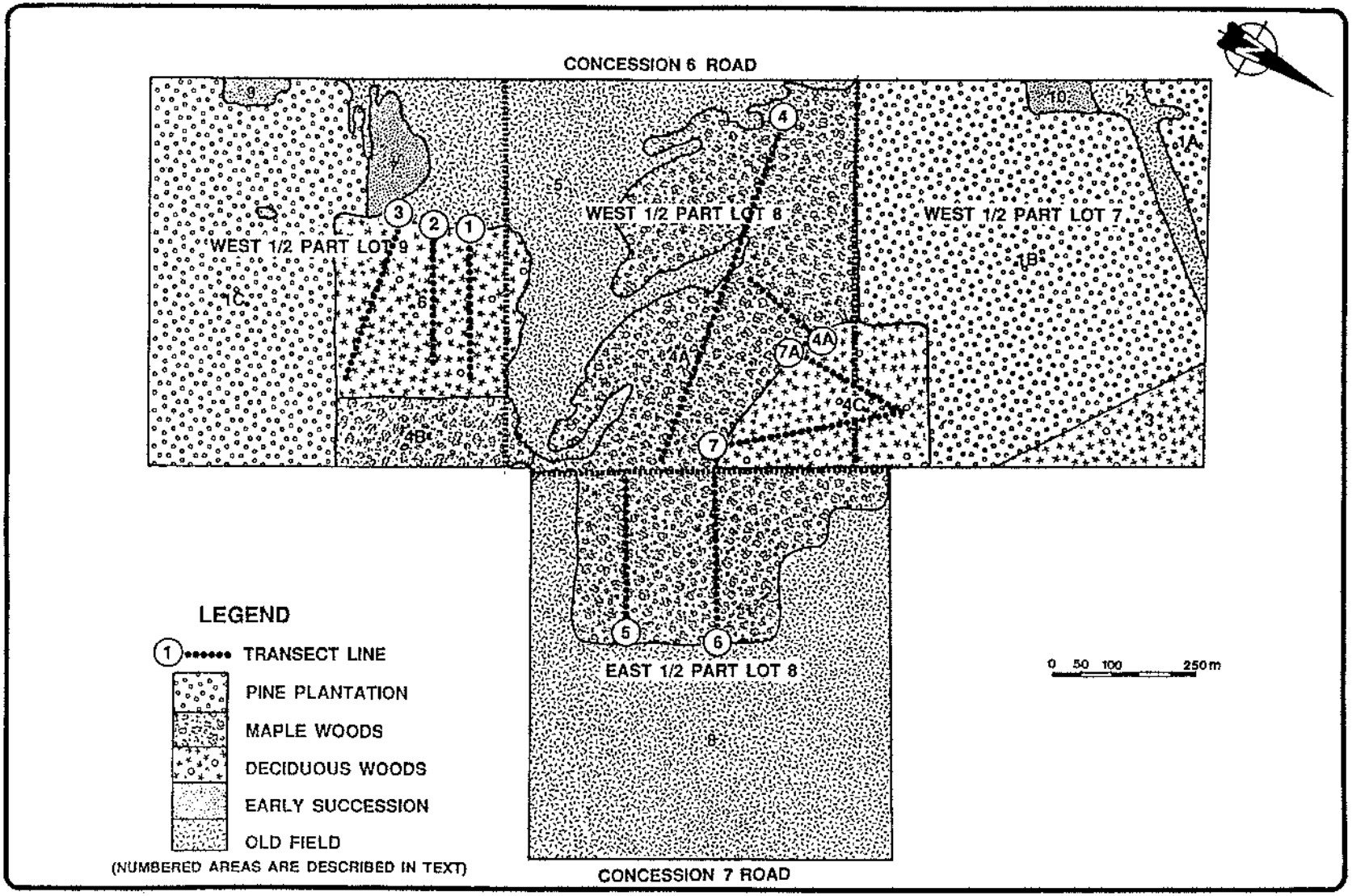
Continued....

Scientific Name	Common Name
Early Successional Scrub continued...	
Groundcover:	
Trientalis borealis	Star-flower
Botrychium virginianum	Rattlesnake Fern
Glechoma hederacea	
Alliaria petiolata	Garlic Mustard
Leonurus cardiaca	Motherwort

APPENDIX B

FORESTRY SURVEY DATA

Tables of point-centered quadrant data from transects 1 to 8 through deciduous woodlot, West 1/2 Part Lots 7,8,9 and East 1/2 Part Lot 8, 1991. Please refer to Appendix Map 1 for location of transects.



Appendix Map 1. Forestry survey transects.

Table 1. Transect 1, through deciduous mixed woodlot, vegetation unit 6.

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
1	1	1	Sugar Maple	6.25	105	15	Sugar Maple	6.50	3.00
1	1	2	Black Cherry	1.10	172	20	Sugar Maple	0.82	2.00
1	1	3	White Ash	1.00	95	15	Sugar Maple	2.90	5.00
1	1	4	White Ash	1.20	80	15	Sugar Maple	2.90	3.00
1	2	1	Ironwood	2.50	71	17	Sugar Maple	2.50	1.50
1	2	2	Ironwood	1.06	76	17	Sugar Maple	3.00	2.00
1	2	3	White Ash	3.30	99	17	Sugar Maple	1.90	3.00
1	2	4	White Ash	4.90	108	18	Sugar Maple	5.80	1.50
1	3	1	Basswood	4.50	95	18	Sugar Maple	1.10	3.00
1	3	2	Basswood	3.80	172	20	Sugar Maple	1.00	3.00
1	3	3	Black Cherry	2.75	197	20	Sugar Maple	1.00	7.00
1	3	4	Black Cherry	6.00	216	20	Sugar Maple	1.00	1.00
1	4	1	Sugar Maple	3.00	191	17	Chokecherry	1.50	2.00
1	4	2	Sugar Maple	4.50	255	18	Sugar Maple	0.50	4.00
1	4	3	Basswood	4.00	111	18	Sugar Maple	1.00	4.00
1	4	4	Sugar Maple	2.00	92	15	Sugar Maple	1.00	0.00
1	5	1	Sugar Maple	1.20	115	18	Sugar Maple	1.10	4.00
1	5	2	Sugar Maple	2.30	76	15	Sugar Maple	2.75	4.00
1	5	3	Sugar Maple	1.20	76	15	Sugar Maple	2.20	4.00
1	5	4	Sugar Maple	2.00	80	15	Sugar Maple	2.40	3.00
1	6	1	Sugar Maple	1.00	102	17	Sugar Maple	1.60	0.00
1	6	2	White Ash	1.40	166	20	Sugar Maple	6.00	5.00
1	6	3	Sugar Maple	3.00	92	15	Sugar Maple	2.50	6.00
1	6	4	Sugar Maple	5.50	70	14	Sugar Maple	7.00	6.00

Table 1. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
1	7	1	Sugar Maple	1.10	102	17	Sugar Maple	4.40	6.00
1	7	2	Sugar Maple	2.00	140	17	Sugar Maple	4.30	5.00
1	7	3	Ironwood	4.00	95	17	Sugar Maple	7.00	6.00
1	7	4	Sugar Maple	2.00	95	15	Sugar Maple	2.10	6.00
1	8	1	Sugar Maple	4.00	105	17	Sugar Maple	6.40	6.00
1	8	2	Sugar Maple	3.00	89	15	Sugar Maple	1.00	6.00
1	8	3	White Ash	2.00	115	18	Sugar Maple	3.00	4.00
1	8	4	Ironwood	2.00	80	17	Sugar Maple	5.00	4.00
1	9	1	Sugar Maple	2.20	95	15	Sugar Maple	2.90	0.00
1	9	2	Sugar Maple	2.00	94	15	Sugar Maple	5.80	4.00
1	9	3	Sugar Maple	4.70	73	14	Sugar Maple	2.10	3.00
1	9	4	Sugar Maple	2.10	92	15	Sugar Maple	1.30	1.00
1	10	1	White Ash	3.20	188	20	Sugar Maple	4.20	6.00
1	10	2	Black Cherry	3.00	169	20	Sugar Maple	9.00	5.00
1	10	3	Sugar Maple	2.30	131	18	Sugar Maple	1.90	6.00
1	10	4	Sugar Maple	1.00	121	17	Sugar Maple	2.00	3.00
1	11	1	Black Cherry	2.50	127	18	Sugar Maple	7.00	3.00
1	11	2	White Birch	3.50	99	15	Sugar Maple	1.00	6.00
1	11	3	Black Cherry	2.00	121	18	Sugar Maple	4.00	3.00
1	11	4	Black Cherry	3.40	121	18	Sugar Maple	6.00	4.00
1	12	1	Black Cherry	2.40	83	15	Sugar Maple	1.10	4.00
1	12	2	Black Cherry	4.50	99	15	Sugar Maple	5.00	3.00
1	12	3	Sugar Maple	2.30	76	14	Sugar Maple	1.20	4.00
1	12	4	Black Cherry	3.00	108	17	Sugar Maple	1.00	3.00

Table 1. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
1	13	1	Sugar Maple	1.90	99	15	Black Cherry	8.00	3.00
1	13	2	Sugar Maple	1.50	80	15	Sugar Maple	9.00	1.00
1	13	3	Black Cherry	1.00	73	14	Black Cherry	6.00	1.50
1	13	4	Trembling Aspen	2.00	95	15	White Ash	1.20	1.50
1	14	1	Sugar Maple	2.80	119	17	White Ash	1.10	3.00
1	14	2	Sugar Maple	1.80	143	18	Sugar Maple	1.10	1.00
1	14	3	Black Cherry	3.10	108	18	Sugar Maple	1.80	1.50
1	14	4	Sugar Maple	3.40	108	18	Sugar Maple	2.00	2.00
1	15	1	Sugar Maple	3.50	159	20	Sugar Maple	7.00	5.00
1	15	2	Black Cherry	2.40	89	15	Sugar Maple	7.00	4.00
1	15	3	Sugar Maple	2.00	89	15	Ironwood	8.00	5.00
1	15	4	Sugar Maple	1.40	89	15	Sugar Maple	1.20	4.00
1	16	1	Black Cherry	4.00	127	17	Sugar Maple	1.40	4.00
1	16	2	Sugar Maple	3.00	92	15	Sugar Maple	1.00	3.00
1	16	3	Basswood	1.00	267	21	Sugar Maple	1.40	2.00
1	16	4	Sugar Maple	1.00	81	15	Sugar Maple	2.00	2.00
1	17	1	Ironwood	3.40	83	14	Sugar Maple	6.00	3.00
1	17	2	Walnut	2.00	140	17	Sugar Maple	1.10	3.00
1	17	3	Black Cherry	2.30	84	15	Chokecherry	1.70	4.00
1	17	4	Sugar Maple	9.90	73	14	Ironwood	2.60	2.00

Number of Stems	69
Average DBH	114
Average Canopy Height	16
Average Understory Height	3.38

Table 2. Transect 2, through deciduous mixed woodlot, vegetation unit 6.

			Tree				Sapling	
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
2	1	1	Sugar Maple	8.00	121	17	Sugar Maple	1.05	1.00
2	1	2	Green Ash	1.00	111	17	Sugar Maple	1.40	4.00
2	1	3	Sugar Maple	2.00	134	17	Sugar Maple	7.00	2.00
2	1	4	Sugar Maple	1.75	118	17	Sugar Maple	9.00	4.00
2	2	1	White Ash	1.00	83	15	Sugar Maple	2.00	2.00
2	2	2	Sugar Maple	5.60	121	17	Sugar Maple	1.00	1.00
2	2	3	Sugar Maple	3.30	115	17	Sugar Maple	0.80	4.00
2	2	4	Black Cherry	0.90	67	14	Sugar Maple	0.38	4.00
2	3	1	Black Cherry	3.10	150	18	Sugar Maple	0.50	3.00
2	3	2							
2	3	3	Black Cherry	1.30	118	17	Sugar Maple	2.70	4.00
2	3	4	Black Cherry	3.00	191	18	Sugar Maple	0.90	2.00
2	4	1	Sugar Maple	1.10	76	14	Sugar Maple	4.80	3.00
2	4	2	Sugar Maple	4.80	111	15	Sugar Maple	0.90	3.00
2	4	3	Sugar Maple	2.00	73	14	Sugar Maple	0.45	2.00
2	4	4	Sugar Maple	2.00	89	14	Sugar Maple	0.90	3.00
2	5	1	Sugar Maple	4.10	76	14	Sugar Maple	0.20	1.50
2	5	2	Sugar Maple	3.30	105	15	Sugar Maple	0.60	2.00
2	5	3	Black Cherry	3.30	140	18	Sugar Maple	0.25	6.00
2	5	4	Black Cherry	0.90	127	17	Sugar Maple	0.20	6.00
2	6	1	White Elm	6.80	102	17	Sugar Maple	6.10	2.00
2	6	2	Sugar Maple	2.25	80	14	Sugar Maple	2.40	2.00
2	6	3	Basswood	4.80	73	15	Sugar Maple	2.30	2.00
2	6	4	Black Cherry	3.10	89	17	Chokecherry	0.70	1.00

Table 2. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
2	7	1	Sugar Maple	1.20	91	15	Sugar Maple	0.20	6.00
2	7	2	Sugar Maple	2.70	137	14	Sugar Maple	7.00	5.00
2	7	3	White Ash	4.30	146	15	Sugar Maple	2.90	4.00
2	7	4	Black Cherry	0.80	143	15	Sugar Maple	1.70	2.00
2	8	1	Sugar Maple	1.40	89	14	Sugar Maple	9.00	4.00
2	8	2	Sugar Maple	1.20	89	14	Sugar Maple	9.00	3.00
2	8	3	Sugar Maple	4.20	137	15	Sugar Maple	1.80	4.00
2	8	4	Sugar Maple	5.90	99	14	Ironwood	1.20	4.00
2	9	1	Sugar Maple	3.00	140	15	Sugar Maple	1.10	2.00
2	9	2	Sugar Maple	2.90	97	14	Sugar Maple	1.40	6.00
2	9	3	Sugar Maple	4.10	83	14	Sugar Maple	2.50	3.00
2	9	4	Sugar Maple	2.10	86	14	Sugar Maple	1.90	5.00
2	10	1	Basswood	2.40	283	21	Sugar Maple	9.00	2.00
2	10	2	White Birch	3.60	84	14	Sugar Maple	2.00	2.00
2	10	3	Poptrem	6.50	89	15	White Ash	1.00	2.00
2	10	4	Poptrem	3.20	97	15	Sugar Maple	0.90	1.00
2	11	1	Sugar Maple	2.00	236	21	Sugar Maple	9.00	6.00
2	11	2	Sugar Maple	4.00	68	14	Sugar Maple	8.00	6.00
2	11	3	Ironwood	3.40	137	17	Sugar Maple	4.10	4.00
2	11	4	Ironwood	4.40	154	17	Sugar Maple	1.00	5.00
2	12	1	Sugar Maple	1.20	131	15	Sugar Maple	5.00	4.00
2	12	2	Sugar Maple	2.90	127	15	Sugar Maple	1.00	4.00
2	12	3	Sugar Maple	2.10	131	15	Sugar Maple	1.00	5.00
2	12	4	Sugar Maple	1.00	134	15	Sugar Maple	1.10	6.00

Table 2. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
2	13	1	Basswood	5.50	102	17	Ironwood	2.10	6.00
2	13	2	Sugar Maple	3.00	92	14	Ironwood	1.50	6.00
2	13	3	Ironwood	4.00	95	14	Sugar Maple	1.10	2.00
2	13	4	Sugar Maple	2.00	99	14	Sugar Maple	1.20	4.00

Number of Stems	51
Average DBH	115
Average Canopy Height	15
Average Understory Height	3.48

Table 3. Transect 3, through deciduous mixed woodlot, vegetation unit 6.

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
3	1	1	Sugar Maple	2.20	70	12	Sugar Maple	9.00	4.00
3	1	2	Ironwood	1.00	108	15	Sugar Maple	1.00	6.00
3	1	3	Sugar Maple	3.80	95	14	Sugar Maple	1.10	3.00
3	1	4	Ironwood	1.00	78	14	Sugar Maple	9.00	3.00
3	2	1	Sugar Maple	4.00	80	14	Sugar Maple	1.50	6.00
3	2	2	Sugar Maple	3.70	115	15	Sugar Maple	9.50	6.00
3	2	3	Sugar Maple	1.30	154	15	Sugar Maple	1.40	6.00
3	2	4	Sugar Maple	4.10	95	14	Sugar Maple	4.35	6.00
3	3	1	Sugar Maple	3.50	83	14	Sugar Maple	1.30	5.00
3	3	2	Basswood	1.70	83	15	Sugar Maple	1.10	4.00
3	3	3	Sugar Maple	3.30	207	20	Sugar Maple	1.50	6.00
3	3	4	White Elm	2.00	143	18	Sugar Maple	1.40	6.00
3	4	2	Butternut	2.90	239	20	Basswood	1.15	4.00
3	4	3	Sugar Maple	3.48	75	14	Sugar Maple	3.38	7.00
3	4	4	Sugar Maple	2.55	73	14	Sugar Maple	3.15	0.00
3	4	1	Sugar Maple	2.85	150	17	Sugar Maple	0.65	6.00
3	5	2	Sugar Maple	2.10	232	20	Sugar Maple	0.65	4.00
3	5	3	Sugar Maple	2.83	108	15	Sugar Maple	1.65	3.00
3	5	4	Sugar Maple	1.90	95	15	Sugar Maple	2.58	2.00
3	5	1	Sugar Maple	4.90	137	15	Sugar Maple	1.75	7.00
3	6	1	Sugar Maple	3.90	140	17	Sugar Maple	2.35	5.00
3	6	4	Cottonwood	2.40	158	17	White Birch	1.00	7.00
3	6	3	Cottonwood	1.13	140	17	Sugar Maple	1.03	3.00
3	6	2	Cottonwood	2.18	239	18	Sugar Maple	1.08	6.00

Table 3. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
3	7	1	Sugar Maple	4.70	80	14	Sugar Maple	0.43	7.00
3	7	4	Black Cherry	3.23	172	20	Sugar Maple	1.15	3.00
3	7	3	Cottonwood	3.10	159	20	Sugar Maple	1.53	3.00
3	7	2	Cottonwood	3.68	162	20	Sugar Maple	0.45	3.00
3	8	1	Sugar Maple	5.55	210	20	Sugar Maple	0.30	7.00
3	8	4	Black Cherry	3.28	92	14	Sugar Maple	0.50	7.00
3	8	3	Sugar Maple	3.48	91	15	Sugar Maple	0.75	7.00
3	8	2	Ironwood	1.78	95	15	Cottonwood	0.35	1.00
3	9	1	Sugar Maple	2.85	89	15	Sugar Maple	0.65	3.00
3	9	4	Black Cherry	1.23	95	15	Sugar Maple	1.28	1.00
3	9	3	Sugar Maple	4.90	76	14	Sugar Maple	1.35	4.00
3	9	2	Black Cherry	4.60	107	17	Sugar Maple	0.30	3.00
3	10	1	Black Cherry	1.20	102	17	Sugar Maple	0.43	3.00
3	10	2	Sugar Maple	0.48	207	20	Sugar Maple	0.78	4.00
3	10	3	Black Cherry	2.20	67	14	Sugar Maple	0.75	2.00
3	10	4	Sugar Maple	4.40	70	14	Sugar Maple	0.53	2.00
3	11	1	Sugar Maple	1.75	73	14	Sugar Maple	0.85	0.00
3	11	4	Butternut	1.83	111	15	Sugar Maple	0.78	0.00
3	11	3	White Ash	2.13	119	15	Black Cherry	0.90	0.00
3	11	2	Butternut	0.90	86	14	Sugar Maple	0.75	7.00

Number of Stems	44
Average DBH	122
Average Canopy Height	16
Average Understory Height	4.14

Table 4. Transect 4, through deciduous mixed woodlot, vegetation unit 4A.

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
4	0	1	Sugar Maple	5.93	191	18	Sugar Maple		
4	0	4	Sugar Maple	1.98	102	14	Ironwood	4.05	1.00
4	0	3	Sugar Maple	1.50	185	18	Ironwood	1.95	1.00
4	0	2	Sugar Maple	3.90	216	18	Ironwood	5.65	1.00
4	1	1	Basswood	3.28	257	18	Ironwood	1.20	1.80
4	1	2	Sugar Maple	1.24	192	18	Ironwood	1.09	1.35
4	1	3	Sugar Maple	4.56	189	18	Sugar Maple	0.46	1.20
4	1	4	Sugar Maple	3.25	224	18	Sugar Maple	3.52	1.50
4	2	1	Sugar Maple	1.15	255	18	Sugar Maple	3.66	1.00
4	2	2	Sugar Maple	1.87	244	18	Ironwood	7.27	1.20
4	2	3	Sugar Maple	4.19	256	18	Ironwood	3.15	2.00
4	2	4	Sugar Maple	3.39	118	14	Sugar Maple	3.54	0.00
4	3	1	Sugar Maple	4.84	329	21	Sugar Maple	4.80	3.00
4	3	2	Sugar Maple	6.29	137	12	Sugar Maple	1.77	1.30
4	3	3	Sugar Maple	5.20	173	15	Sugar Maple	2.91	1.00
4	3	4	Sugar Maple	6.91	230	20	Ironwood	4.71	2.00
4	4	1	Sugar Maple	3.43	404	20	Sugar Maple	3.24	1.80
4	4	2	Sugar Maple	6.59	280	20	Sugar Maple	4.78	1.30
4	4	3	Sugar Maple	4.73	204	15	Sugar Maple	4.32	1.50
4	4	4	Sugar Maple	3.70	242	18	Sugar Maple	1.88	1.20
4	5	1	Sugar Maple	6.03	191	20	Sugar Maple	10.25	1.00
4	5	2	Sugar Maple	4.73	237	18	Sugar Maple	11.11	1.80
4	5	3	Sugar Maple	2.97	193	20	Ironwood	6.14	0.00
4	5	4	Sugar Maple	4.53	151	15	Sugar Maple	3.11	1.30

Table 4. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
4	6	1	Sugar Maple	4.98	288	20	Green Ash	1.19	1.00
4	6	2	Sugar Maple	4.23	144	15	Sugar Maple	1.47	1.20
4	6	3	Sugar Maple	2.95	141	15	Sugar Maple	2.23	1.00
4	6	4	Sugar Maple	3.05	142	15	Ironwood	4.28	2.20
4	7	1	Sugar Maple	6.96	215	17	Sugar Maple	1.00	1.20
4	7	2	Sugar Maple	6.54	179	15	Sugar Maple	4.27	1.50
4	7	3	Sugar Maple	1.87	201	17	Sugar Maple	4.16	1.00
4	7	4	Sugar Maple	9.12	191	17	Ironwood	6.61	2.50
4	8	1	Sugar Maple	6.27	228	17	Sugar Maple	2.93	1.50
4	8	2	Sugar Maple	3.81	197	18	Sugar Maple	5.54	1.50
4	8	3	Sugar Maple	6.16	208	18	Sugar Maple	7.08	1.80
4	8	4	Sugar Maple	3.29	262	18	Sugar Maple	8.11	1.60
4	9	1	Sugar Maple	3.52	173	12	Sugar Maple	3.88	1.75
4	9	2	Basswood	5.79	359	14	Sugar Maple	0.38	1.30
4	9	3	Sugar Maple	2.65	194	17	Sugar Maple	3.50	1.10
4	9	4	Butternut	6.00	419	21	Sugar Maple	6.18	2.00
4	10	1	Sugar Maple	2.00	302	20	Ironwood	4.00	1.50
4	10	2	Sugar Maple	3.00	255	20	Ironwood	2.40	1.50
4	10	3	Sugar Maple	3.32	264	18	Ironwood	3.53	1.75
4	10	4	Sugar Maple	3.20	108	14	Ironwood	2.28	1.10
4	11	1	Butternut	6.02	446	29	Green Ash	6.66	1.00
4	11	2	Sugar Maple	5.26	207	18	Ironwood	9.65	1.50
4	11	3	Sugar Maple	5.39	124	15	Ironwood	2.49	1.50
4	11	4	Sugar Maple	2.82	258	23	Sugar Maple	8.10	1.00

Table 4. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
4	12	1	Sugar Maple	4.27	178	18	Green Ash	0.84	1.00
4	12	2	Sugar Maple	1.37	180	18	Sugar Maple	8.55	1.00
4	12	3	Butternut	10.67	350	28	Ironwood	7.90	1.75
4	12	4	Butternut	6.51	334	24	Sugar Maple	4.47	1.90
4	13	1	Sugar Maple	1.42	121	15	Sugar Maple	3.67	2.50
4	13	2	Sugar Maple	3.10	201	20	Sugar Maple	5.10	1.00
4	13	3	Sugar Maple	2.46	253	21	Sugar Maple	3.63	1.00
4	13	4	Sugar Maple	2.57	245	21	Ironwood	6.59	1.75
4	14	1	Sugar Maple	2.37	146	15	Sugar Maple	6.33	2.00
4	14	2	Sugar Maple	2.44	105	15	Sugar Maple	4.78	1.00
4	14	3	Sugar Maple	1.82	223	20	Sugar Maple	6.67	1.00
4	14	4	Sugar Maple	1.77	92	15	Ironwood	10.13	1.20
4	15	1	Sugar Maple	2.39	102	15	Sugar Maple	12.35	3.00
4	15	2	Sugar Maple	1.61	76	12	Ironwood	5.95	1.00
4	15	3	Sugar Maple	1.67	142	21	Ironwood	4.82	1.00
4	15	4	Sugar Maple	1.25	86	15	Sugar Maple	5.22	1.00
4	16	1	Sugar Maple	4.80	140	17	Sugar Maple	7.03	2.00
4	16	2	Sugar Maple	3.32	150	18	Sugar Maple	1.37	7.50
4	16	3	Sugar Maple	3.63	207	17	Sugar Maple	7.68	1.20
4	16	4	Sugar Maple	3.51	118	14	Sugar Maple	4.14	8.10
4	17	1	Sugar Maple	5.18	159	18	Sugar Maple	5.18	3.00
4	17	2	Sugar Maple	7.42	255	26	Sugar Maple	3.17	2.00
4	17	3	Sugar Maple	2.64	250	24	Sugar Maple	0.86	2.50
4	17	4	Sugar Maple	5.23	196	24	Sugar Maple	7.28	1.50

Table 4. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
4	18	1	Sugar Maple	9.13	286	24	Sugar Maple	7.40	1.50
4	18	2	Sugar Maple	4.13	207	21	Sugar Maple	7.43	1.00
4	18	3	Sugar Maple	1.00	84	12	Sugar Maple	1.22	2.00
4	18	4	Sugar Maple	2.40	279	23	Sugar Maple	2.97	4.00
4	19	1	Sugar Maple	8.94	248	15	Sugar Maple	4.23	1.00
4	19	2	Sugar Maple	4.28	337	24	Sugar Maple	0.94	1.00
4	19	3	Sugar Maple	1.23	244	21	Sugar Maple	2.88	1.00
4	19	4	White Elm	2.74	231	20	Sugar Maple	4.69	1.00
4	20	1	Sugar Maple	7.95	124	9	Ironwood	8.62	1.00
4	20	2	Sugar Maple	2.34	223	17	Sugar Maple	5.11	1.00
4	20	3	Butternut	3.48	334	21	Sugar Maple	9.05	7.00
4	20	4	Sugar Maple	8.66	331	21	Black Cherry	5.49	1.50

Number of Stems	82
Average DBH	214
Average Canopy Height	18
Average Understory Height	1.68

Table 4A. Transect 4A, through deciduous mixed woodlot, vegetation unit 4A.

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
4A	1	1	Sugar Maple	3.45	178	17	Sugar Maple	0.87	
4A	1	2	Basswood	2.72	197	23	Sugar Maple	1.68	
4A	1	3	Sugar Maple	1.94	94	15	Sugar Maple	2.37	
4A	1	4	Sugar Maple	1.26	67	14	Sugar Maple	1.04	
4A	2	1	Sugar Maple	2.87	180	17	Sugar Maple	5.49	
4A	2	2	Sugar Maple	3.93	173	17	Sugar Maple	2.62	
4A	2	3	Poptrem	2.80	121	17	Sugar Maple	2.61	
4A	2	4	Sugar Maple	2.32	131	17	Sugar Maple	1.32	
4A	3	1	Sugar Maple	2.92	127	17	Sugar Maple	0.86	
4A	3	2	Sugar Maple	3.16	175	18	Sugar Maple	4.46	
4A	3	3	Sugar Maple	4.34	255	20	Sugar Maple	3.54	
4A	3	4	Sugar Maple	2.08	140	18	Sugar Maple	2.30	

Number of Stems	12
Average DBH	153
Average Canopy Height	16.7
Average Understory Height	--

Table 5. Transect 5, through deciduous mixed woodlot, vegetation unit 4A.

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
5	1	1	Sugar Maple	2.89	286	18	Faggra	2.76	1.00
5	1	2	Sugar Maple	6.03	67	12	Sugar Maple	3.37	2.00
5	1	3	Sugar Maple	4.22	302	23	Sugar Maple	8.12	1.50
5	1	4	Sugar Maple	2.68	312	24	Sugar Maple	4.78	1.50
5	2	1	Sugar Maple	1.68	282	24	Sugar Maple	2.29	1.00
5	2	2	Sugar Maple	3.54	216	24	Sugar Maple	2.96	1.30
5	2	3	Sugar Maple	2.77	105	20	Sugar Maple	3.74	1.30
5	2	4	Sugar Maple	3.29	115	20	Ironwood	4.44	1.30
5	3	1	Sugar Maple	3.18	242	24			
5	3	2	Sugar Maple	2.30	181	24			
5	3	3	Ironwood	6.16	121	21			
5	3	4	Sugar Maple	10.37	296	24			
5	4	1	Sugar Maple	4.44	142	18			
5	4	2	Sugar Maple	2.13	290	26			
5	4	3	Sugar Maple	4.20	181	26			
5	4	4	Sugar Maple	2.78	188	26			
5	5	1	Sugar Maple	1.52	123	17	Sugar Maple	3.83	10.50
5	5	2	Sugar Maple	3.81	121	17			
5	5	3	Black Cherry	1.53	239	23	Sugar Maple	1.69	1.00
5	5	4	Sugar Maple	4.80	116	15	Sugar Maple	3.76	9.00
5	6	1	Sugar Maple	4.12	173	18	Sugar Maple	3.04	9.00
5	6	2	Sugar Maple	2.17	186	18			
5	6	3	Sugar Maple	2.24	126	14			
5	6	4	Sugar Maple	1.13	76	11	Sugar Maple	1.63	7.50

Table 5. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
5	7	1	Sugar Maple	1.78	210	20			
5	7	2	Sugar Maple	3.84	102	14			
5	7	3	Sugar Maple	1.80	88	14	Sugar Maple	2.23	3.00
5	7	4	Sugar Maple	1.94	80	12			
5	8	1	Sugar Maple	5.82	369	27	Ironwood	3.70	1.50
5	8	2	Sugar Maple	2.36	279	24	Sugar Maple	8.07	7.50
5	8	3	Sugar Maple	5.15	197	15	Sugar Maple	5.33	1.75
5	8	4	Sugar Maple	5.30	291	26	Ironwood	5.15	1.50
5	9	1	Sugar Maple	3.88	341	26			
5	9	2	Sugar Maple	1.81	360	27			
5	9	3	Sugar Maple	2.34	232	23			
5	9	4	Sugar Maple	4.71	325	24			

Number of Stems	36
Average DBH	204
Average Canopy Height	20
Average Understory Height	3.51

Table 6. Transect 6, through deciduous mixed woodlot, vegetation unit 4A.

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
6	1	1	Sugar Maple	1.78	153	18	Ironwood	3.58	2.50
6	1	2	Sugar Maple	1.86	193	23	Ironwood	2.47	2.50
6	1	3	Sugar Maple	2.47	111	14			
6	1	4	Sugar Maple	0.84	251	21			
6	2	1	Sugar Maple	4.06	253	21			
6	2	2	Sugar Maple	7.25	232	21			
6	2	3	Sugar Maple	8.13	242	21			
6	2	4	Sugar Maple	2.24	353	24			
6	3	1	Sugar Maple	1.11	232	21			
6	3	2	Sugar Maple	0.83	282	24			
6	3	3	Sugar Maple	3.20	220	20			
6	3	4	Sugar Maple	6.09	135	12	Ironwood	1.59	2.50
6	4	1	Sugar Maple	2.88	279	21			
6	4	2	Sugar Maple	2.55	266	24			
6	4	3	Sugar Maple	3.06	229	24			
6	4	4	Sugar Maple	6.30	162	18			
6	5	1	Butternut	7.65	329	21			
6	5	2	Sugar Maple	6.71	279	23			
6	5	3	Sugar Maple	3.92	345	20			
6	5	4	Sugar Maple	6.41	140	15			

Number of Stems	19
Average DBH	234
Average Canopy Height	20
Average Understory Height	2.5

Table 7. Transect 7, through deciduous mixed woodlot, vegetation unit 4C.

			Tree				Sapling	
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
7	1	1	Sugar Maple	3.26	113	15			
7	1	2	Butternut	5.46	264	27	Sugar Maple	0.95	3.60
7	1	3	White Birch	5.41	151	24	Sugar Maple	1.39	4.50
7	1	4	Butternut	7.91	269	27	Sugar Maple	0.99	4.50
7	2	1	White Ash	4.23	146	20	Sugar Maple	1.34	4.50
7	2	2	Sugar Maple	2.11	134	18	Sugar Maple	2.14	3.60
7	2	3	Butternut	4.35	323	27	Sugar Maple	1.90	10.50
7	2	4	Basswood	1.12	88	21	Sugar Maple	4.31	
7	3	1	White Ash	4.27	172	23	Sugar Maple	0.90	3.60
7	3	2	White Ash	2.99	164	21	Sugar Maple	1.44	6.00
7	3	3	White Ash	3.02	205	24	Sugar Maple	1.26	9.00
7	3	4	White Ash	2.04	151	18	Sugar Maple	2.36	7.50
7	4	1	White Ash	1.86	99	15	Sugar Maple	1.00	
7	4	2	White Ash	1.98	159	24	Sugar Maple	0.89	3.00
7	4	3	White Elm	1.83	140	18	Sugar Maple	0.81	9.00
7	4	4	Butternut	1.17	116	17	Sugar Maple	0.61	3.60
7	5	1	Basswood	1.09	83	18	Sugar Maple	2.02	
7	5	2	Basswood	1.27	137	18	Sugar Maple	1.47	
7	5	3	White Ash	3.84	150	21	Sugar Maple	0.95	
7	5	4	Basswood	2.51	134	18	Sugar Maple	1.92	
7	6	1	White Ash	2.22	100	18	Sugar Maple	0.94	
7	6	2	Sugar Maple	3.00	95	15	Sugar Maple	0.92	
7	6	3	White Ash	2.21	137	21	Sugar Maple	3.03	
7	6	4	White Ash	1.93	183	21	Sugar Maple	1.64	

Table 7. Continued...

			Tree				Sapling		
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
7	7	1	White Ash	6.71	153	21	Sugar Maple	2.26	
7	7	2	White Ash	3.26	162	21	Sugar Maple	1.60	
7	7	3	White Ash	2.22	118	18	Sugar Maple	2.59	
7	7	4	White Ash	1.52	181	21	Sugar Maple	1.03	
7	8	1	Sugar Maple	2.61	102	15	Sugar Maple	1.22	
7	8	2	Sugar Maple	4.27	95	15	Sugar Maple	2.29	
7	8	3	Black Cherry	2.69	251	21	Sugar Maple	1.97	
7	8	4	White Ash	2.18	169	21	Sugar Maple	1.86	

Number of Stems	30
Average DBH	156
Average Canopy Height	20
Average Understory Height	6

Table 7A. Transect 7A, through deciduous mixed woodlot, vegetation unit 4C.

			Tree				Sapling	
Transect	Point	Quadrant	Species	Distance (m)	DBH (mm)	Height (m)	Species	Distance (m)	Height (m)
7A	1	1	Ironwood	2.74	76	14	Sugar Maple	2.13	
7A	1	1	Sugar Maple	1.15	70	14	Sugar Maple	1.40	
7A	1	2	Basswood	1.86	162	21	Basswood	1.82	
7A	2	1	Ironwood	1.78	64	14	Sugar Maple	0.91	
7A	2	2	Ironwood	1.35	121	18	Sugar Maple	1.56	
7A	2	3	Ironwood	1.32	73	14	Sugar Maple	1.41	
7A	2	4	Ironwood	1.27	103	15	Sugar Maple	1.47	
7A	3	1	Black Cherry	3.06	121	17	Sugar Maple	1.68	
7A	3	2	Ironwood	0.58	83	14	Sugar Maple	1.05	
7A	3	3	Ironwood	0.83	80	14	Sugar Maple	2.23	
7A	3	3	Ironwood	2.66	116	18	Ironwood	1.47	
7A	4	1	Ironwood	5.08	100	17	Sugar Maple	2.00	
7A	4	2	Sugar Maple	5.07	89	15	White Ash	3.37	
7A	4	3	White Ash	2.06	290	24	Sugar Maple	0.96	
7A	4	4	White Elm	2.73	146	18	Sugar Maple	2.23	
Number of Stems			15						
Average DBH			113						
Average Canopy Height			18						

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August 16, 1991

re: Oro Pit Expansion Site Revegetation Program

Dear Mr. Sweetnam:

In response to your request during our telephone conversation on August 9, 1991, I have put together some brief comments regarding the problems associated with establishment of a natural hardwood community and the suitability of certain species for revegetation at the Oro Pit expansion site.

I understand that the original proposal for revegetation of the Oro site involved an initial planting of Red and Scots Pine, to be followed by a second planting of native hardwood species after a few years. There was concern that the native species would be unable to grow under a healthy stand of pines. This is a quite valid concern: although there is presently considerable regeneration under the existing pine (*Pinus resinosa*, *Pinus sylvestris*) plantations on the site, this may only be because these pines are not healthy. There are several other healthy plantations of similar age in the area which have no understory development at all. Also, the existing pine plantations are fairly old (40-70 years), whereas the understory species (*Tilia americana*, *Acer saccharum*) have only recently become established. A healthy pine plantation with a closed canopy and well-developed root system may effectively suppress native species.

The specified goal of the Oro Pit rehabilitation program is to acheive a diverse community of native hardwood species which would approximate the natural vegetation of the region. The most effective way to establish natural communities would be to ensure that natural seeds have suitable conditions for germination and survival.

Microsite conditions including temperature, moisture and light can affect the survival and growth of invading species. Initial site vegetation influences these environmental conditions. Shade from dense canopies reduces light available for secondary plantings, and lowers the temperatures near the soil surface (Holmes and Smith 1977, Burton 1982). Soil moisture levels may be enhanced or decreased depending on the cover species. Generally, a canopy will tend to increase soil moisture by reducing the soil-to-air vapour pressure gradient, as well as air movement, resulting in decreased evaporation (Geiger, 1965). However, a dense, fast-growing canopy composed of an overstory species with a shallow root system can reduce water availability at the soil surface (Rosenberg, Blad and Verma 1983). Niering and Egler (1955) found that even a closed canopy of shrubs (*Viburnum lentago*) could prevent the invasion of trees for as long as twenty-five years. Root competition can suppress late succession seedlings, even in forests with good light penetration: young trees will often grow only when root competition from older trees is removed (Korstian and Coile 1938).

Burton and Bazzaz (1991) considered effects of various environmental conditions as well as the effects of different successional stages of existing old field vegetation on the germination and establishment of several native tree species (*Acer saccharum, Prunus serotina, Fraxinus americana, Crataegus mollis*) in Illinois. They determined that existing vegetation could have a greater effect on the establishment of tree species than soil type, soil moisture, or temperature. The different species investigated became established more easily in different types of vegetation. The successional stage which appeared to encourage establishment most often was the lightly shaded young tree (*Gleditsia triacanthos, Prunus serotina*) vegetation.

Revegetation after a major disturbance (ie. the removal of all plants) may follow one of three models (Connell and Slatyer 1977):

1. Facilitation model, whereby early successional pioneer species are required to improve environmental conditions so they are more suitable for later-succession species. The pioneer species thus encourages the growth of later successional species by improving soil conditions and providing shade.

2. Tolerance model, whereby the pioneer species are gradually replaced by species more tolerant of limiting resources at the site. Invading secondary species are able to grow despite the presence of healthy pioneer species, and do not require environmental modifications by the pioneer species in order to grow.

3. Inhibition model, whereby pioneer species establish a dense cover which discourages invasion by later successional species.

The appropriate plan to encourage a return to the original, naturally occurring forest community depends on which type of successional model is likely to operate. The choice of pioneer species must be carefully considered according to which model it is likely to precipitate.

A vegetative cover must be established as soon as possible after mining to control erosion and to facilitate the invasion of later successional native species. The establishment of early succession species which would suppress the invasion and growth of late succession hardwood species should be discouraged, as their presence would reduce the rate of recovery. I feel that the establishment of Red and Scots Pine as the pioneer species would probably result in inhibition, and do not recommend this approach. It is unlikely that these species would improve environmental conditions and encourage the establishment of native hardwoods over the short term.

The rate of recovery of the area could be increased by planting suitable early-succession species which will encourage the invasion and growth of late-succession species (Connell and Slatyer 1977). Characteristics of suitable "nurse" species (after Morrison 1982) are as follows:

1. Capable of surviving with minimal inputs of fertilizers or other soil amendments.

2. Capable of surviving on the site without extensive irrigation.

3. Capable of modifying the environment so that it is more suitable for secondary planting species or for invasion by volunteer native hardwood species.

4. No allelochemicals produced which would discourage growth of other species.

5. Should not be strong invasive species which will create monocultures and inhibit the invasion of subsequent colonizing species.

Native plant species are good choices for initiating revegetation because they have become adapted to regional climate and topography through years of natural selection. DePuit (1980) has shown that native species can acheive an excellent rate of establishment and site stabilization, provided the species is compatible with the soil conditions. Introduced species are often chosen over native species simply because they are more commonly available from nurseries. However, in many cases, seedlings or small trees are available on other parts of the property.

Native trees which are regionally common and would likely be suitable pioneer species for the Oro site include:

Populus tremuloides/Trembling Aspen - This native deciduous tree is widely distributed, and is commonly found growing naturally in pits and quarries. It prefers well-drained sandy or gravelly loams, but tolerates a wide range of growing conditions, including infertile and dry soil. This species is quite intolerant of shade, and is usually succeeded by the shade tolerant hardwoods and conifers that it provides shade for. This species is currently regenerating naturally on the site, invading the old field habitat along the edges of the deciduous woods.

Populus balsamifera/Balsam Poplar - This native species is also commonly found growing naturally in pits and quarries. It grows rapidly, and is adaptable to a wide range of conditions from dry to wet soil with low to medium fertility.

Fraxinus pennsylvanica var.*subintegerrima*/Green Ash - This wide-ranging native tree will grow in upland areas where competition from other species is not strong. It tolerates dry to moist soils, and low fertility.

Suitability of these species was determined with reference to their winter hardiness, soil conditions tolerated, and their natural occurrence (Lowe 1979, Hosie 1990). These species may all be planted as a "nurse" crop to provide shelter for other native species such as *Fraxinus americana*/White Ash, *Acer saccharum*/Sugar Maple, *Pinus strobus*/White Pine, and *Tilia americana*/Basswood.

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I trust these comments will be of some use to you. I would be pleased to review the existing revegetation plans and suggest appropriate modifications. I will be back in the office August 26, 1991, please call me if you require further information.

Sincerely,

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Vicki H. Young.

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Biologist