MARBLE HILL NUCLEAR GENERATING STATION
UNITS 1 AND 2
REMOTE SENSING AND GROUND TRUTH PROGRAM

FINAL

Prepared for

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FOREWORD

Texas Instruments Incorporated (TI) is pleased to submit this final report summarizing the methodology applied and results obtained during the second year of the remote sensing and ground truth program conducted within the prescribed area on and near the proposed Marble Hill Nuclear Generating Station, Units 1 and 2, near Paynesville, Jefferson County, Indiana.

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SECTION I

INTRODUCTION

A. PROGRAM OBJECTIVES

The specific objectives of the Marble Hill remote sensing and ground truth program are to ascertain and document the existing vegetation cover types, vegetation stress and soil chemistry in the vicinity of the Marble Hill Nuclear Generating Station and to provide cumulative reference information necessary to monitor the potential effects of cooling tower operation and coincident salt deposition on local vegetation and soil. In addition, the annual aerial color infrared photography and the updated vegetation cover type maps will assist Public Service Company of Indiana, Inc. (PSI) in their evaluation of construction impacts on the local environment.

B. PROGRAM SCHEDULE AND STATUS

The scheduled and actual completion dates for each task are listed in Table I-1.

Table I-1

Schedule for the Marble Hill Remote Sensing and Ground Truth Program by Task and Date

Task	Scheduled Completion Date	Actual Completion Date
Aerial CIR photography	15 May 1978	27 April 1978 (initial) 9 June 1978 (reflight)
Photointerpretation	15 June 1978	18 June 1978
Vegetation and soil data collection	31 August 1977	2 September 1977
	31 October 1977	28 October 1977
	31 April 1978	20 April 1978
	31 June 1978	28 June 1978
Reports		
Draft	31 July 1978	24 July 1978
Final	31 August 1978	5 October 1978

Methods of data collection, reduction, and analysis are documented in Section II - Methodology; summarized data are presented in Section III - Results and Discussion.

SECTION II

METHODOLOGY

The objectives of this study have been addressed through application of appropriate methods of data acquisition, handling, analysis, and interpretation. The five major tasks proposed to fulfill the program objectives included:

- Aerial color infrared photography
- Vegetation cover type mapping
- Vegetation stress delineation
- Vegetation sampling and analysis
- Soil chemical sampling and analysis

Methods applied toward completion of each task are discussed in the text that follows.

A. AERIAL COLOR INFRARED PHOTOGRAPHY

Aerial color infrared (CIR) photographs were obtained in May 1978. Five flight lines were required to obtain the May 1978 coverage of the designated area shown in Figure II-1 and maintain a 30-percent side lap. Color infrared photographs were obtained with a 6-inch focal length camera from an altitude of 5000 feet to assure a working scale of 1:10,000 (1 inch = 833 feet). The forward overlap attained was 60 percent and provided the specified stereoscopic viewing conditions.

Film was processed to positive transparencies; these were encased in plastic sleeves for protection during the mapping and ground truth phases of the study.

B. MAPPING VEGETATION COVER TYPES

Vegetation cover type boundaries that were presented in "Vegetation Cover Types in the Vicinity of the Marble Hill Nuclear Generating Station" (Texas Instruments 1977) were refined and redelineated where necessary. This was accomplished through photointerpretation of the May 1978 CIR

Figure II-1. Flight Line Map of Color Infrared Photography Coverage, May 1978

photographs, cross-referencing these with the August 1976 and May 1977 CIR photographs, and through ground truthing during June 1978.

Cover type nomenclature corresponds with those presented in 1977 and follows the designation and types of the Society of American Foresters (1954) with some modification to allow adequate description of locally important vegetation units. The type name was determined upon the basis of predominant canopy species as indicated by composition of the dominant and codominant canopy species. Where no single species comprised 50 percent or more of a given stand, the stand was typed on the basis of numerical plurality of canopy species.

The ground truth examinations were conducted for initial boundary verification and for refinement of vegetation cover type delineations.

Map revisions were incorporated, nomenclature applied, and the vegetation cover type map drafted at a scale of 1:24,000. Sixteen map units were employed to document all important existing features and cover types.

The acreage of each refined map unit was determined from the 1:24,000 scale map by dot sampling with a modified acreage grid (64 dots per square inch).

C. MAPPING VEGETATION STRESS

Areas of apparently stressed vegetation were separately delineated within each cover type. Vegetation under stress from disease, insects or weather was detected on the color infrared photography due to loss in infrared reflectance from affected foliage. The reddish photographic rendition of healthy vegetation grades to magenta, purple, green, and yellow as the loss of infrared progresses due to increased stress. Vegetation stress areas were delineated on the photographs and evaluated by an experienced photointerpreter and independently by an experienced field botanist.

Areas of apparent vegetation stress were noted on photo overlays and each was assigned a reference number. During ground truth reconnaissance, stress areas greater than or equal to 5 acres were field-checked for stress verification and documentation of the causal agent(s). Previously defined stress areas greater than or equal to 5 acres (TI 1977) were examined from CIR photographs and revisited during 1978 ground-truthing to monitor the status of each area.

Stressed areas of less than 5 acres were not field-checked, but locations were plotted on the photo overlays, assigned a reference number for monitoring purposes, and transferred to the vegetation cover type map.

D. VEGETATION SAMPLING AND ANALYSIS

Vegetation cover and condition were sampled by establishing duplicate permanent 100-square-meter quadrats in one characteristic representative unit of each of eight specific cover types delineated from the CIR aerial photographs. Sampling locations for each cover type are shown in Figure II-2. Direction from the cooling towers, proximity to the area of maximum salt deposition, and accessibility were considered in locating the permanent vegetation quadrats.

Duplicate circular nested plots were used to estimate vegetation cover by species in each representative unit. Figure II-3 shows the plot radii and the nesting arrangement of the four plot types to sample the various vegetation strata. Vegetation stratum sampled in each plot, the size inclusion criteria, and the plot area are presented in Table II-1.

Nested circular plots were easy to establish and relocate since only a single stake was required to permanently mark a center point from which all radii were measured. Plot sizes and nesting arrangement were modified from those of Cox (1972) and Ohman (1973). The center of each subplot within each 100-square-meter also was permanently marked.

Figure II-2. General Locations of Permanent Vegetation and Soil Sampling Plots

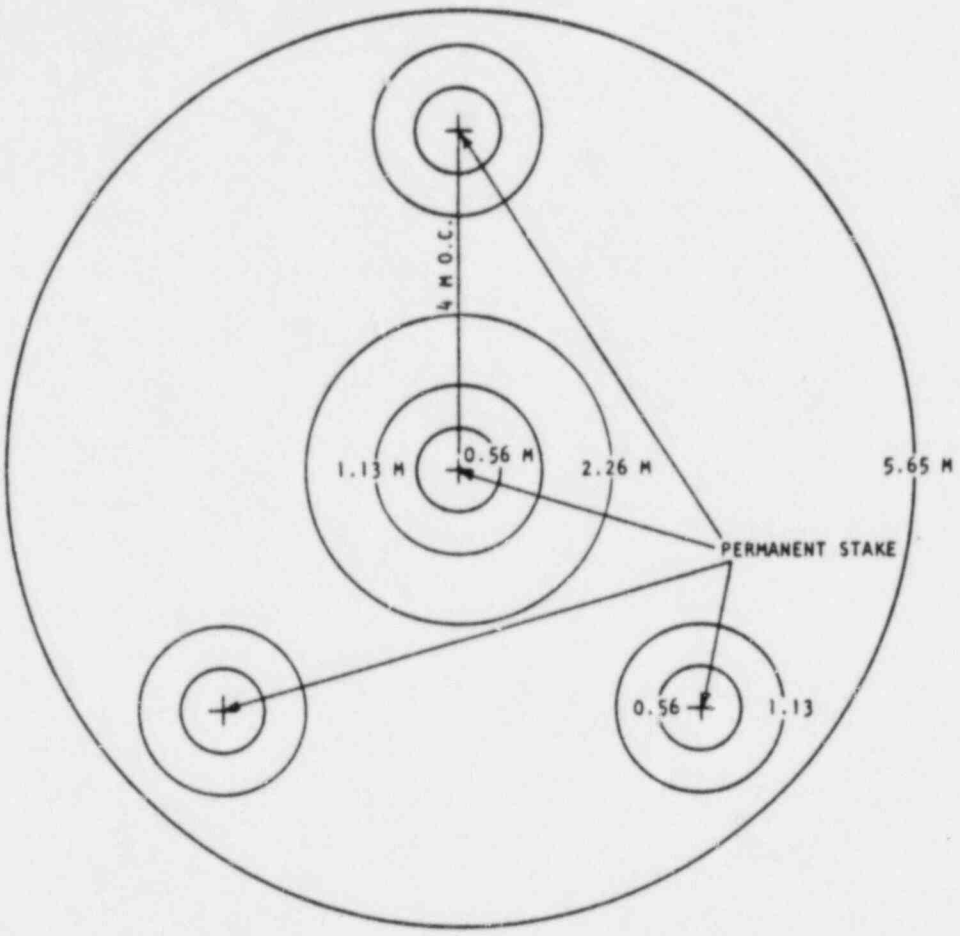

Figure II-3. Nested Circular Plots for Vegetation Sampling (Numbers represent plot radius)

Herbs, grasses, seedlings, shrubs, and vines (plot types 1 and 2) were sampled during September, October 1977 and April, June 1978 in vegetation cover types, 1, 2, 3, 4, 5, 6, 9, and 11. Data recorded within each of eight subplots per cover type included: taxa present, percent cover (percentage of plot area covered by a given taxon), mode condition (most common state of physical or evident physiological condition of a given taxon), and percentage ground cover (percentage of total plot area covered by vegetation and litter). Condition of orchard trees (cover type 10) was recorded during June 1978.

Table II-1

Vegetation Plot Types

Plot Type (Stratum)	Vegetation Included	Stem dbh* (m)		Stem Height (m)	Plot Radius (m)	Plot Area (m^2)
1	Herbs, grasses, low shrubs, and seedlings	<0.025		<1.0	0.56	1.0
2	Shrubs, vines, and seedlings	<0.025		≥1.0	1.13	4.0
3	Saplings	≥0.025	<0.089	≥1.0	2.26	16.0
4	Trees	≥0.089		≥1.0	5.65	100.0

*Diameter at breast height (1.35 meters above the ground surface)

Diameters of saplings and trees (plot types 3 and 4) were individually measured in each of two plots per cover type during September 1977 and April 1978 to determine both species composition and basal area (square meters/hectare). Data recorded for each individual included: taxa, dbh (diameter at breast height) to the nearest 0.1 inch, and condition code (Table II-2). Each individual was numbered with paint to facilitate recognition and identification of temporal change in apparent health or vigor (condition).

Table II-2

Codes Used To Record Apparent Vegetation Condition

Condition Code	Condition Category
1	Healthy
2	Diseased
3	Insect injury
4	Mechanical injury
5	Browsed
6	Dead
7	Dying
8	Dormant

During October 1977 and June 1978 each tree and sapling was inspected for condition; diameter was not remeasured in these months since it was unlikely that this parameter would have changed significantly since the September 1977 and April 1978 measurements, respectively.

Plot data were summarized within cover types and the following standard ecological analyses (Cox 1972) were performed for each taxon according to stratum:

$$\text{Cover (\%)} = \frac{\Sigma \text{ percentage areal cover from plots}}{\text{number of plots}}$$

$$\text{Relative cover} = \frac{\text{cover for a species}}{\text{cover for all species}} \times 100$$

$$\text{Basal area } (m^2/ha) = \frac{\sum_{i}^{n} [(0.5 \text{ dbh in in.})^2 \pi] \, 0.00064516}{\text{area sampled (ha)}}$$

$$\text{Relative Basal area (\%)} = \frac{\text{basal area for a species}}{\text{basal area for all species}} \times 100$$

$$\text{Frequency} = \frac{\text{number of plots in which species occurred}}{\text{number of plots sampled}}$$

$$\text{Relative frequency} = \frac{\text{frequency for a species}}{\text{frequency of all species}} \times 100$$

E. SOIL SAMPLING AND ANALYSIS

Duplicate soil samples (0 to 15 centimeter depth) were collected from each permanent vegetation quadrat during September, October 1977 and April, June 1978. One set of duplicate soil samples was collected from each plot by excavation with a small hand trowel. These samples were placed in appropriately labeled whirlpacs, sealed, and returned to the Dallas laboratory for analysis of pH, conductivity, cation exchange capacity, and percent base saturation.

A second set of duplicate soil samples was collected from each plot for bulk density and soil moisture determinations; sample volume was measured using a sand displacement method (Rice 1968). Percentage moisture

in the oven dry soil was measured in association with bulk density determinations by drying samples at 105°C to constant weight. Results were expressed in appropriate units as determined from the following:

$$\text{Bulk density } (g/cm^3) = \frac{\text{oven dry weight (g) of soil sample}}{\text{sand displacement volume } (cm^3)}$$

$$\text{Moisture } (\%) = \frac{\text{soil wet weight (g) - soil dry weight (g)}}{\text{soil wet weight (g)}} \times 100$$

Soil pH in water was determined by mixing equal portions, by weight, of soil and water in an appropriate container. The mixture was stirred periodically and the solids allowed to settle out. The soil-water suspension was then allowed to settle for a short time, after which the pH was measured using an internal reference glass electrode (Black et al 1965). Results were recorded as soil pH measured in water.

Soil conductivity was determined by mixing each soil sample with distilled water and stirring to form a saturated extract. Either soil or water was added to the extract to form the desired soil-water paste. The paste was allowed to stand for 1 hour, checked for consistency, allowed to stand for 4 additional hours, and vacuum-filtered. Conductivity of the filtrate was measured with a cathode-ray conductivity bridge of the Wheatstone type at 85 Hz using a 1.0 constant cell (Black et al 1965). Results were recorded as micromhos/centimeter at 25°C.

Cation exchange capacity of soils was determined using the ammonium saturation method (Black et al 1965). Samples were air-dried and ground to pass through a 2-millimeter mesh sieve. The sized soil sample was mixed with 1N ammonium acetate, shaken thoroughly, and allowed to stand overnight. The wet sample was filtered, the residue washed with ammonium acetate, and the filtrate set aside for determination of total exchangeable bases (required to calculate percentage base saturation). The residue was then washed several times; once with 99 percent isopropyl alcohol, followed by

several washings with 5 percent potassium chloride to a measured volume. Ammonium ion concentration was determined from the washings using an auto analyzer. Results were recorded in milliequivalents per 100 grams of soil. Percentage base saturation was calculated as follows:

$$\text{Percent base saturation} = \frac{\text{Total exchangeable bases}}{\text{Cation exchange capacity}} \times 100$$

Total exchangeable bases was determined by forced evaporation of the filtrate (set aside during cation exchange processing) to dryness, ignition of the residue in a furnace, and treatment of the cooled residue with 0.1N hydrochloric acid. The acid-treated residue was heated, stirred, and titrated with 0.1N sodium hydroxide to a bromocresol green end-point (Black et al 1965). Results were recorded as milliequivalents per 100 grams of soil based on milliequivalents of standard acid consumed in the titration.

Replicate data from each of the soil chemical analyses were summarized as mean ($\bar{x}$) and standard error (SE) by cover type and date.

SECTION III

RESULTS AND DISCUSSION

The general botanical history of the Marble Hill study area was described, vegetation and land-use categories were mapped, and distinguishing characteristics of each mapped unit were discussed in the first annual report to PSI (TI 1977). During the 1977-1978 sampling period, quantitative and qualitative data were obtained and analyzed. The data, presented in the following paragraphs, were used to characterize the present floristic and soil conditions. Certain comparisons were made with the 1976-1977 sampling period to better describe community dynamics and to delineate any differences or similarities between sampling periods.

Eight of the fifteen map units (Table III-1) were sampled using permanent vegetation plots (cover types 1, 2, 3, 4, 5, 6, 9, and 11). The estimated horizontal acreage of the eight sampled cover types comprised 31.7 percent of the survey area in the current sampling period compared with 32.2 percent during the past sampling period. The differences were attributed to vegetation removal in the types during construction of Marble Hill Units 1 and 2 complex (Figure III-1). An estimated 429 on-site (including railroad spur) acres were disturbed directly through site construction activities, while an estimated 2 off-site acres in the cropland type were developed into private commercial services. Cropland remained the largest map unit, comprising 5,335 acres (31.2 percent).

The distribution of vegetation cover types over the entire survey area is depicted in Figure III-2 (1:24,000 scale map located in the plastic pocket). Most of the Ohio River floodplain area remained in cropland (cover type 8), pasture (7) or forest (5); level uplands were generally cropped (8 and 10) with small areas of pasture (7) and forest (2, 4, and 11). Slopes and small drainage ways were forested (1, 2, 3, 6, and 9). During the 1977-1978 sampling period, 145 plant taxa were observed in the sampling plots (Appendix Table A-1). This is an increase of 15 taxa (11.5 percent) over the first year's sampling. The increase can be attributed to several factors including restablishment of 1 set of plots and through distributional changes of local taxa due to construction activities (e.g., type 05) and through natural dispersal.

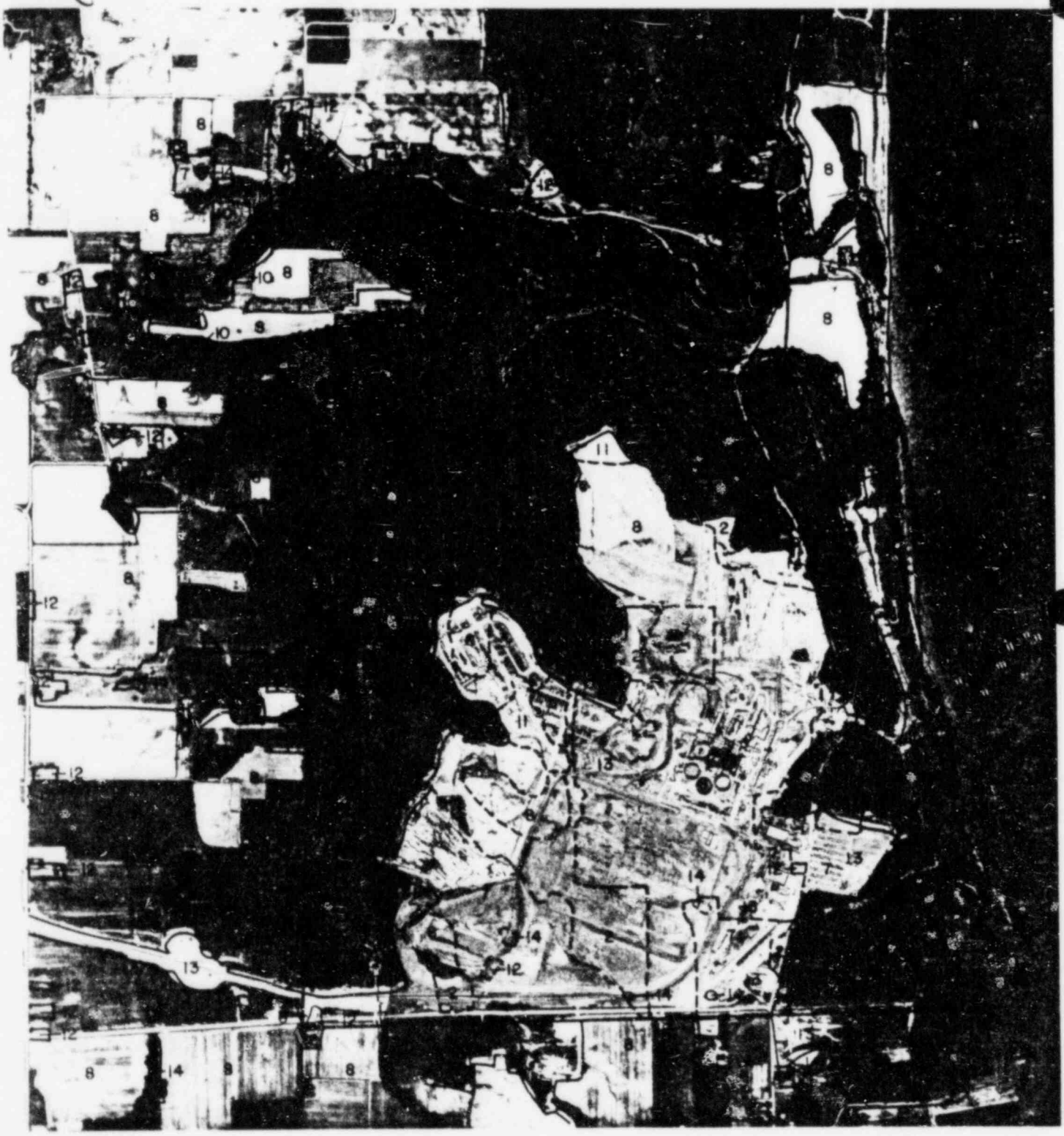

Figure III-1. Color Infrared Aerial Photography (1:20,000 scale), May 1978, Depicting the Marble Hill Site Area and Relationship of Construction Disturbance to May 1977 Vegetation Cover Type

Table III-1

Estimated Horizontal Acreage for Each Vegetation Cover Type (Map Unit) for May 1978 and On-Site Changes Due to Construction of Marble Hill Units 1 and 2

Code	Name	Acreage	Percent of Total	Change from 1977*
1	Maple-Basswood	611	3.6	(2)
2	Oak-Maple	2,115	12.4	(68)
3	Chestnut oak	528	3.1	---
4	Red pine	16	0.1	(1)
5	Sycamore-Boxelder	596	3.5	---
6	Oak-Hickory	686	4.0	---
7	Unimproved pasture (includes scrubland)	2,566	15.0	(115)
8	Cropland	5,335	31.2	(219)
9	Walnut-Hickory-Buckeye	660	3.9	---
10	Orchards	24	0.1	---
11	Virginia pine	190	1.1	(15)
12	Residential/farmsteads	353	2.1	(7)
13	Industrial	510	3.0	429
14	Water	2,883	16.9	(2)
	Cemetery	1	--	---
	Total	17,074	100.0	429

*() = loss, -- = no change

A. COVER TYPE ANALYSIS

1. Vegetation

Total areal cover and vegetation and litter areal cover in the chestnut oak type remained more consistent between the previous sampling [1976-1977 (TI 1977)] and the current sampling (1977-1978), than did the other types (Table III-2). A general reduction of vegetation areal cover, caused by heavy rains and leaf-fall, occurred during the October 1977 sampling. The greatest reduction occurred in the sycamore-boxelder type. An appreciable amount of silting from heavy rains and from construction activities near the sampling plots (Saluda Creek subset) in this type has deposited approximately 0.5 inch of clay in one set of the sampling plots. Significant changes in the Virginia pine type were attributed to the loss and reestablishment of one set of nested plots which were removed during

Table III-2

Percentage of Ground Surface Covered by Vegetation and Litter in the Herbaceous Stratum of Each Vegetation Cover Type during September, October 1977 and April, June 1978

		Areal Cover (%)*											
		Vegetation				Litter				Total			
		1977		1978		1977		1978		1977		1978	
Code	Cover Type	Sep	Oct	Apr	Jun	Sep	Oct	Apr	Jun	Sep	Oct	Apr	Jun
01	Maple-Basswood	13.9	13.5	36.0	20.0	60.5	83.3**	63.5	70.0	74.4	96.9**	99.5	90.0
02	Oak-Maple	23.4	7.6**	17.6**	29.5	73.5	92.5**	81.1	69.1	96.9	100.0	98.7**	98.6
03	Chestnut oak	16.0	11.1	8.8	36.8	79.8	88.9**	85.4	59.5	95.8	100.0	94.2	96.3
04	Red pine	37.5	14.4**	10.6	36.8	62.5	85.6**	89.4	63.2	100.0	100.0	100.0	100.0
05	Sycamore-Boxelder	66.4	19.6**	20.6	90.0**	22.5	80.4**	79.1	10.0**	88.9	100.0	99.7	100.0
06	Oak-Hickory	11.4	2.3	47.0	19.4	55.5	95.8**	47.9	53.3	66.9	98.1**	94.9	72.7
09	Walnut-Hickory-Buckeye	33.8	13.1	30.6**	72.6**	59.3	86.6	67.9**	26.0**	93.1	99.7	98.5	98.6
11	Virginia pine	19.8	3.4**	2.3	12.6**	76.8	96.5**	96.6	72.4	96.6	99.9	98.9	85.0**

*Based on mean of 8 plots per cover type per sample date.

**Significant changes from 1976-1977 sampling period (>10.0%).

ground-clearing operations for site construction. Causes for significant changes in other types cannot be determined at present; natural fluctuations or overall trends should become evident from future sampling.

- Maple - Basswood (01)

The canopy dominants remained sugar maple (Acer saccharum) and basswood (Tilia americana); saplings remained sparsely distributed throughout the type with none occurring in sample plots (Table III-3). One healthy and one dead white ash (Fraxinus americana) were present. A third white ash, present in the 1976-1977 sampling, has died and fallen.

As during the previous sampling, plots in the shrub stratum contained only pawpaw (Asimina triloba) (Table III-4).

Late-flowering thoroughwort (Eupatorium serotinum), wild ginger (Asarum canadense), and sugar maple remained the more important herbaceous species (based on relative cover values over four samplings) in this type (Table III-5); areal cover values and seasonal floristic patterns were similar to the 1976-1977 sampling. Vegetation cover values in April 1978 again were highest of the year with spring ephemerals, especially cut-leaved toothwort (Dentaria laciniata), contributing to most of the areal cover. Five species recorded during the 1976-1977 sampling were not present, and four previously unrecorded species were observed during the current sampling. Each of these nine species contributed relatively little to areal cover. Nineteen taxa were recorded from herbaceous stratum sample plots, three less than from the previous sampling.

- Oak-Maple (02)

Sugar maple predominated with the importance of the other tree species remaining similar to the previous sampling (Table III-6). One sugar maple attained tree class and one flowering dogwood has died and fallen since the last sampling; in the sapling class, one sugar maple has died and fallen. All of the living trees were healthy during June 1978 sampling.

Table III-3

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata, (Plot Type 4 and 3) Maple-Basswood (01) Cover Type, September, October 1977 and April, June 1978

Scientific Name	Common Name	No. Individuals in Sample	Change in No. Individuals in Sample between 1976-1977 and 1977-1978	Frequency (%)	Basal Area (m^2/ha)	Relative Frequency (%)	Relative Basal Area (%)	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Tree stratum											
Live condition											
Acer saccharum	Sugar maple	5	-*	100	14.1	40.0	41.5	1	1	1	1
Fraxinus americana	White ash	1	(1)**	50	1.2	10.0	3.5	1	8	8	1
Juglans nigra	Black walnut	1	-	50	4.0	20.0	11.8	1	8	8	1
Tilia americana	Basswood	3	-	50	14.0	20.0	41.2	3	8	8	1
Total Live		10	(1)	250	33.3	90.0	98.0				
Dead condition											
Fraxinus americana	White ash	1	-	50	0.7	10.0	2.1				
Total Dead		1	-	50	0.7	10.0	2.1				
TOTAL		11	(1)	300	34.0	100.0	100.1				
Sapling stratum											
No saplings occurred in plots											

* - indicates no change

** (n) indicates loss of "n" individuals

*** 1 - Healthy, 3 - Insect damage, 8 - Dormant

Table III-4

Species Composition, Frequency, Areal Cover, and Condition of the Shrub Stratum (Plot Type 2) by Cover Type, September, October 1977 and April, June 1978

Scientific name	Common name	Frequency / Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Relative Frequency / Relative Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Maple-Basswood (01)													
Asimina triloba	Pawpaw	38/1.50	50/0.50	38/1.00	25/1.00	100.0/100.0	100.0/100.0	100.0/100.0	100.0/100.0	1	1	8	1
Oak-Maple (02)													
Acer saccharum	Sugar maple	25/4.10	25/1.75	25/0.63	25/2.00	33.3/ 27.9	39.7/ 60.8	28.1/ 13.6	28.4/ 19.0	1	8	8	1
Cornus florida	Flowering dogwood	25/8.10	13/0.63	25/2.13	25/5.75	33.3/ 55.1	20.6/ 21.9	28.1/ 45.9	28.4/ 54.7	1	8	1	1
Prunus serotina	Black cherry	–	–	13/0.13	*	–	–	14.6/ 2.8	*	–	–	1	*
Smilax sp.	Greenbrier	–	–	–	13/0.13	–	–	–	14.8/ 1.2	–	–	–	1
Ulmus rubra	Slippery elm	25/7.50	25/0.50	13/1.75	25/2.63	33.3/ 17.0	39.7/ 17.4	14.6/ 37.7	26.4/ 25.0	1	8	8	1
Chestnut Oak (03)													
Aesculus octandra**	Ohio buckeye	–	–	13/0.13	–	–	–	12.6/ 4.5	–	–	–	1	–
Celtis occidentalis	Hackberry	*	*	*	50/2.25	*	*	*	28.2/ 21.1	*	*	*	1
Clematis viorna	Leather flower	*	*	*	25/1.38	*	*	*	14.1/ 13.0	*	*	*	1
Diospyros virginiana	Persimmon	–	–	*	*	–	–	*	*	–	–	*	*
Juniperus virginiana	Eastern red cedar	*	*	13/0.50	25/2.00	*	*	12.6/ 17.3	14.1/ 18.8	*	*	1	1
Lonicera japonica	Japanese honeysuckle	–	*	*	13/0.50	–	*	*	7.3/ 4.7	–	*	*	1
Passiflora lutea	Yellow passion-flower	*	*	–	*	*	*	–	*	*	*	–	*
Prunus serotina**	Black cherry	–	–	13/0.63	–	–	–	12.6/ 21.8	–	–	–	1	–
Quercus prinus**	Chestnut oak	13/0.50	13/0.50	13/0.25	–	25.0/ 10.8	50.0/ 62.4	12.6/ 8.7	–	1	8	1	–
Rhus aromatica**	Fragrant sumac	–	–	–	13/0.75	–	–	–	7.3/ 7.0	–	–	–	1
Robinia pseudoacacia	Black locust	13/1.00	*	13/0.25	13/1.25	25.0/21.6	*	12.6/ 8.7	14.1/ 22.4	1	*	1	1
Symphoricarpos orbiculatus**	Coralberry	–	–	13/0.13	–	–	–	12.6/ 4.5	–	–	–	1	–
Ulmus rubra	Slippery elm	38/3.13	13/0.38	25/1.00	25/2.38	50.0/ 67.6	50.0/ 37.6	24.3/ 34.6	7.3/ 11.7	1	8	2	1
Viburnum prunifolium	Black haw	–	–	–	13/0.13	–	–	–	7.3/ 1.2	–	–	–	6
Red Pine (04)													
Acer saccharum	Sugar maple	*	13/0.25	25/0.13	25/1.88	*	20.3/ 14.3	39.7/ 9.4	18.0/ 35.7	*	1	1	1
Cornus florida	Flowering dogwood	25/1.50	13/0.25	*	*	24.8/ 35.2	20.3/ 14.3	*	*	1	1	*	*
Fraxinus americana	White ash	38/2.38	25/0.25	25/0.25	63/2.75	37.6/ 55.9	39.1/ 14.3	39.7/ 18.1	45.3/ 52.3	1	8	2	1
Lonicera japonica	Japanese honeysuckle	25/0.25	13/1.00	–	13/Tr	24.8/ 5.9	20.3/ 57.1	–	9.3/ Tr	1	1	–	1
Parthenocissus quenquefolia	Virginia creeper	13/0.13	–	–	25/0.38	12.9/ 3.1	–	–	18.0/ 7.2	1	–	–	1
Vitis rotundifolia	Muscadine grape	*	*	13/1.00	13/0.25	*	*	20.6/ 72.6	9.3/ 4.8	*	*	8	1
Sycamore-Boxelder (05)													
Aesculus octandra**	Ohio buckeye	–	–	13/0.38	13/Tr	–	–	50.0/ 43.2	33.0/ Tr	–	–	1	1
Cornus florida**	Flowering dogwood	–	–	13/0.50	13/Tr	–	–	50.0/ 56.8	33.0/ Tr	–	–	1	1
Lindera benzoin**	Spicebush	–	13/0.38	–	13/Tr	–	100.0	100.0	–	33.0/ Tr	–	1	–	1
Ulmus rubra	Slippery elm	*	*	*	*	*	*	*	*	*	*	*	*
Oak-Hickory (06)													
Cercis canadensis	Eastern redbud	50/2.50	38/0.63	13/0.75	25/3.38	28.2/ 19.8	33.3/ 14.4	20.3/ 7.2	28.1/ 21.8	1/2	8	1	1
Cornus pricean**	Miss Price's cornel	13/0.75	13/0.75	13/0.63	–	7.4/ 5.9	11.4/ 17.1	20.3/ 6.1	14.6/ 3.2	1	8	1	1
Fraxinus quadrangulata**	Blue ash	38/1.13	–	–	–	21.4/ 8.9	–	–	–	1	–	–	–
Gymnocladus dioica	Kentucky coffee-tree	13/0.50	*	13/ Tr	13/0.88	7.4/ 4.0	*	20.3/ Tr	14.6/ 5.7	2	*	8	1
Juniperus virginiana**	Eastern red cedar	13/0.63	25/0.63	–	–	7.4/ 5.0	21.9/ 14.4	–	–	1	1	–	–
Symphoricarpos orbiculatus**	Coralberry	–	–	–	13/0.38	–	–	–	14.6/ 2.4	–	–	–	1
Ulmus rubra	Slippery elm	50/7.13	38/2.38	25/9.0	25/9.88	28.2/ 56.4	33.3/ 54.2	39.1/ 86.7	28.1/ 63.7	1	8	1	1
Walnut-Hickory-Buckeye (09)													
Acer negundo	Boxelder	*	*	13/0.13	13/0.63	*	*	6.0/ 3.5	4.1/ 2.1	*	*	8	1
Acer saccharum	Sugar maple	25/2.13	*	38/0.88	38/4.25	14.1/ 18.9	*	17.6/ 18.4	12.0/ 14.5	1	–	1	1
Aesculus glabra	Ohio buckeye	*	*	*	–	*	*	*	–	*	*	*	–
Asimina triloba	Pawpaw	13/1.00	25/1.63	*	50/9.00	7.4/ 8.9	22.1/ 20.0	–	15.8/ 30.8	1	8	–	1
Carya ovata	Shagbark hickory	25/1.63	–	–	–	14.1/ 14.5	–	–	–	1/2	–	–	–
Cercis canadensis	Eastern redbud	*	*	*	–	*	*	*	–	*	*	*	–
Fraxinus americana	White ash	25/1.50	*	*	63/2.75	14.1/ 13.3	*	*	19.9/ 9.4	1	*	*	1
Fraxinus quadrangulata	Blue ash	25/2.38	25/0.73	38/0.75	13/2.75	14.1/ 12.1	22.1/ 9.2	17.6/ 20.3	4.1/ 9.4	1	8	8	1
Lindera benzoin	Spicebush	25/1.00	25/0.63	38/0.38	38/5.00	14.1/ 8.9	22.1/ 7.7	17.6/ 10.3	12.0/ 17.1	1	8	8	1
Lonicera japonica	Japanese honeysuckle	13/1.00	38/5.13	50/0.75	75/4.00	7.4/ 8.9	33.6/ 63.0	23.1/ 20.3	23.7/ 13.7	1	1	1	1
Prunus virginiana**	Choke cherry	–	–	13/0.25	–	–	–	6.0/ 6.8	–	–	–	8	–
Quercus prinus	Chestnut oak	*	*	13/0.38	–	*	*	6.0/ 10.3	–	*	*	8	–
Rhus radicans	Poison ivy	13/0.13	*	*	–	7.4/ 1.2	*	*	–	1	*	*	–
Rubus sp.**	Blackberry	–	–	13/0.38	13/0.38	–	–	6.0/ 10.3	4.1/ 1.3	–	–	8	1
Shrub A**		13/0.50	–	–	13/0.50	7.4/ 4.4	–	–	4.1/ 1.7	4	–	–	1
Virginia Pine (11)													
Cercis canadensis**	Eastern redbud	–	–	13/ Tr	*	–	–	20.3/ Tr	*	–	–	8	*
Cornus florida	Flowering dogwood	*	25/0.38	13/ Tr	*	*	50.0/ 43.2	20.3/ Tr	*	*	1/8	8	*
Lonicera tatarica	Tartarian honeysuckle	*	*	*	*	*	*	*	*	*	*	*	*
Prunus serotina	Black cherry	*	75/0.50	38/2.63	*	*	50.0/ 56.8	59.4/100.0	*	*	8	1	*

*Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.
– Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.
**Taxa observed in plots for the first time during 1977-1978 sampling period.
***1 - Healthy, 2 - Diseased, 6 - Dead, 8 - Dormant.
Tr - Trace

Table III-5

Species Composition, Frequency, Areal Cover, and Condition of Herbaceous Stratum (Plot 1), Maple-Basswood (01) Cover Type , 1977 and 1978

Scientific Name	Common Name	Frequency (%)/Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Relative Frequency (%)/Relative Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Acer saccharum	Sugar maple	63/2.38	50/1.63	50/2.88	50/3.38	16.7/17.0	45.0/12.1	8.3/8.0	11.0/16.9	1	1	1	1
Aesculus octandra	Yellow buckeye	*	*	13/0.25	13/0.38	*	*	2.2/0.7	2.9/1.9	*	*	1	1
Anemonella thalictroides	Rue anemone	–	–	*	–	–	–	*	–	–	–	*	–
Arisaema atrorubens	Jack-in-the-pulpit	–	–	*	*	–	–	*	*	–	–	*	*
Asarum canadense	Wild ginger	63/4.13	38/6.13	50/5.38	50/5.00	16.7/29.5	34.2/45.3	8.3/14.9	11.0/25.0	1	1	1	1
Asimina triloba	Pawpaw	13/Tr	*	25/1.00	–	3.4/Tr	*	4.2/2.8	–	1	*	1	–
Carya cordiformis	Yellowbud hickory	–	–	–	13/0.38	–	–	–	2.9/1.9	–	–	–	1
Claytonia virginica	Spring-beauty	–	–	100/3.50	–	–	–	16.6/9.7	–	–	–	1	–
Dentaria laciniata	Cut-leaved toothwort	13/0.13	50/0.38	100/19.38	–	3.4/0.9	4.5/2.8	16.6/53.8	–	1	1	1	–
Erigenia bulbosa	Harbinger-of-spring	–	–	100/1.63	–	–	–	16.6/4.5	–	–	–	1	–
Eupatorium serotinum	Late flowering thoroughwort	38/5.00	50/5.25	38/0.88	38/7.88	10.1/35.7	4.5/38.8	6.3/2.4	8.4/39.3	1	1	1	1
Fraxinus americana	White ash	63/1.25	13/0.13	13/0.13	38/0.88	16.7/8.9	11.7/1.0	2.2/0.4	8.4/4.4	1/2	1	1	1
Galium boreale	Northern bedstraw	–	–	38/0.50	–	–	–	6.3/1.4	–	–	–	1	–
Geum canadense**	Canadian avens	–	–	–	38/0.25	–	–	–	8.4/1.2	–	–	–	1
Maianthemum canadense**	Canada mayflower	–	–	–	38/0.50	–	–	–	8.4/2.5	–	–	–	1
Parthenocissus quinquefolia	Virginia creeper	*	*	–	13/0.50	*	*	–	2.9/2.5	*	*	–	1
Phryma leptostachya	Lopseed	*	*	–	–	*	*	–	–	*	*	–	–
Pilea pumila**	Clear weed	25/0.50	–	–	38/0.63	6.6/3.6	–	–	8.4/3.1	1	–	–	1
Pinus strobus	White pine	*	*	–	–	*	*	–	–	*	*	–	–
Rhus radicans	Poison ivy	50/0.25	*	–	25/0.13	13.2/1.8	*	–	5.5/0.6	1	*	–	1
Sanicula trifoliata	Snakeroot	*	*	–	–	*	*	–	–	*	*	–	–
Tilia americana	Basswood	–	*	–	–	–	*	–	–	–	*	–	–
Ulmus rubra	Slippery elm	*	*	25/Tr	50/Tr	*	*	4.2/Tr	11.0/Tr	*	*	1	1
Viola sororia	Wooly-blue violet	50/0.38	–	50/0.50	38/0.13	13.2/2.7	–	8.3/1.4	8.4/0.6	1/2	1	–	1
Viola sp.	Violet	–	–	–	13/Tr	–	–	–	2.9/Tr	–	–	–	1
Vitis aestivalis	Summer grape	*	*	–	–	*	*	–	–	*	*	–	–

*Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.

– Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.

**Taxa observed in plots for the first time during 1977-1978 sampling period.

***1 - Healthy, 2 - Diseased.

Tr = Trace

Table III-6

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3),Oak-Maple (02) Cover Type, September, October 1977 and April, June 1978

Scientific Name	Common Name	No. Individuals in Sample	Change in No. Individuals in Sample between 1976-1977 and 1977-1978	Frequency (%)	Basal Area (m^2/ha)	Relative Frequency (%)	Relative Basal Area (%)	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Tree stratum											
Live condition											
Acer saccharum	Sugar maple	7	1	100	10.0	20.0	30.2	1	1	1	1
Cornus florida	Flowering dogwood	1	(1)**	50	0.4	10.0	1.2	1	8	8	1
Fraxinus americana	White ash	3	-*	50	5.9	10.0	17.8	1	8	1	1
Juniperus virginiana	Eastern red cedar	1	-	50	0.4	10.0	1.2	2	1	1	1
Prunus serotina	Black cherry	2	-	100	2.9	20.0	8.7	1/7	8	1	1
Quercus prinus	Chestnut oak	1	-	50	5.9	10.0	17.8	1	1	7	1
Quercus velutina	Black oak	1	-	50	6.1	10.0	18.4	1	1	1	1
Total Live		16	-	450	31.6	90.0	95.3				
Dead condition											
Acer saccharum	Sugar maple	1	-	50	1.5	10.0	4.5				
Total Dead		1	-	50	1.5	10.0	4.5				
TOTAL		17	-	500	33.1	100.0	99.8				
Sapling stratum											
Live condition											
Acer saccharum	Sugar maple	4	(1)	100	2.4	100.0	100.0	8	1/8	8	1
Total Live		4	(1)	100	2.4	100.0	100.0				
Dead condition											
None											
Total Dead		0		0	0	0	0				
TOTAL		4	(1)	100	2.4	100.0	100.0				

* - indicates no change

** (n) indicates loss of "n" individuals

*** 1 - Healthy, 2 - Diseased, 7 - Dying, 8 - Dormant

In the shrub stratum, flowering dogwood remained the most important taxa (Table III-4). Greenbriar (Smilax sp.) was first recorded as a minor component in this class during June 1978.

Areal cover of important taxa in the herbaceous stratum was variable between samples in the current sampling period as well as between the 1976-1977 sampling. Slippery elm was the most consistently important species during the current sampling, while flowering dogwood, an important species during the previous sampling, contributed considerably less to the areal cover than it did previously (Table III-7). During May 1978, the spring ephemerals generally had greater areal cover than in the 1976-1977 sampling, but a similar increase in the other species lowered the relative values of the ephemerals. During the current sampling, four previously unrecorded taxa were observed and five taxa, which were observed during the previous sampling were not present. Thirty-three taxa were recorded from the herbaceous stratum sample plots, two less than in the 1976-1977 sampling. Foliage of dwarf larkspur (Delphinium tricorne) (first recorded, April 1978) is very similar to wood anemone (Anemone quinquefolia), and although not recorded during the 1976-1977 sampling may have been present but misidentified as wood anemone.

- Chestnut Oak (03)

Chestnut oak (Quercus prinus) remained dominant in the tree class (Table III-8). One blue ash (Fraxinus quadrangulata) reached tree class, while another individual listed as dead during the 1976-1977 sampling fell during the winter 1978. As indicated by the stand basal area, little change has occurred in this stratum. Reported as dying in the sample plots (TI 1977), blue ash appeared to be healthy during the current sampling. One eastern red cedar (Juniperus virginiana) was again the only sapling present. It appeared healthy, but no growth was apparent.

Twelve taxa were recorded for the shrub stratum during the current sampling; slippery elm (Ulmus rubra), chestnut oak, and black locust (Robinia pseudoacacia) provided the greatest areal cover (Table III-4). Woody shrub and vine species were most important in the herbaceous stratum,

Table III-7

Species Composition, Frequency, Areal Cover, and Condition of Herbaceous Stratum (Plot 1), Oak-Maple (02) Cover Type, 1977 and 1978

Scientific Name	Common Name	Frequency (%)/Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Relative Frequency (%)/Relative Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Acer saccharum	Sugar maple	75/2.13	13/0.63	63/2.00	63/3.75	11.4/9.1	3.2/8.3	7.7/11.5	3.8/12.7	1	1	1	1
Allium canadense	Wild garlic	–	50/1.38	50/1.00	–	–	12.4/18.3	6.1/5.7	–	–	1	1	–
Anemone quinquefolia	Wood anemone	–	–	75/2.88	–	–	–	9.2/16.5	–	–	–	1	–
Anemonella thalictroides	Rue anemone	–	–	13/Tr	–	–	–	1.6/Tr	–	–	–	1	–
Arabis sp.	Mustard	–	–	–	13/0.13	–	–	–	2.0/0.4	–	–	–	1
Aster divaricatus	White-wood aster	13/Tr	13/0.25	–	–	2.0/Tr	3.2/3.3	–	–	1	1	–	–
Aster azureus	Azure aster	–	*	–	*	–	*	–	*	–	*	–	*
Botrychium virginianum	Virginia grape-fern	–	–	–	*	–	–	–	*	–	–	–	*
Carya cordiformis	Yellowbud hickory	–	–	*	*	–	–	*	*	–	–	*	*
Cercis canadensis	Eastern redbud	13/Tr	13/0.13	–	25/Tr	2.0/Tr	3.2/1.7	–	3.8/Tr	1	1	–	1
Cornus florida	Flowering dogwood	63/2.63	13/0.13	*	13/0.13	9.6/11.3	3.2/1.7	*	2.0/0.4	1	1	*	1
Delphinium tricorne	Dwarf larkspur	–	–	25/1.50		–	–	3.1/8.6		–	–	1	–
Dentaria laciniata	Cut-leaved toothwort	–	–	100/2.50	–	–	–	12.1/14.3	–	–	–	1	–
Dicentra cucullaria	Dutchman's breeches	–	–	13/0.13	–	–	–	1.6/0.7	–	–	–	1	–
Dicotyledonae	Dicot	13/0.13	25/0.25	38/1.13	25/2.25	2.0/0.6	6.2/3.3	4.7/6.5	3.8/7.6	1	1	1	1
Elymus virginicus	Virginia wild rye	13/Tr	13/0.13	13/Tr	13/0.25	2.0/Tr	3.2/1.7	1.6/Tr	2.0/0.8	1	1	1	1
Erigena bulbosa	Harbinger-of-spring	–	–	25/Tr	–	–	–	3.1/Tr	–	–	–	1	–
Fraxinus americana	White ash	*	*	*	25/2.75	*	*	*	3.8/9.3	*	*	*	1
Fraxinus quadrangulata	Blue ash	38/1.38	*	25/0.50	*	5.8/5.9	*	3.1/2.9	*	1	*	1	*
Galium boreale	Northern bedstraw	63/0.25	38/0.38	*	13/0.25	9.6/1.1	9.4/5.0	*	2.0/0.8	1	1	*	1
Galium circaezans	White wild licorice	*	–	100/0.13	75/0.38	*	–	12.1/0.7	11.3/1.3	*	–	1	1
Geum canadense	Canadian avens	25/0.38	75/2.38	38/0.89	38/0.75	3.8/1.6	18.6/31.5	4.7/5.1	5.7/2.5	1	1	1	1
Hydrophyllum appendiculatum	Appendiged waterleaf	38/1.63	*	–	–	5.8/7.0	*	–	–	1	*	–	–
Jeffersonia diphylla	Twinleaf	*	*	50/0.75	–	*	*	6.1/4.3	–	*	*	1	–
Lindera benzoin	Spicebush	*	–	–	–	*	–	–	–	*	–	–	–
Osmorhiza claytonii	White snakeroot	–	–	13/0.50		–	–	1.6/2.9		–	–	1	–
Ostrya virginiana	Ironwood	*	*	38/0.13	*	*	*	4.7/0.7	*	*	*	1	*
Parthenocissus quinquefolia	Virginia creeper	50/2.00	25/0.25	25/0.13	75/5.00	7.6/8.6	6.2/3.3	3.1/0.7	11.3/16.9	1	1	1	1
Phryma leptostachya	Lopseed	13/0.38	–	–		2.0/1.6	–	–		1	–	–	–
Prunus serotina	Black cherry	25/0.25	50/0.63	25/0.13	25/0.25	3.8/1.1	12.4/8.3	3.1/0.7	3.8/0.8	1	1	1	1
Quercus prinus	Chestnut oak	13/0.13	*	–	*	13.4/26.8	*	–	*	1	*	–	*
Rhus radicans	Poison ivy	25/1.00	13/0.13	–	13/1.88	3.8/4.3	3.2/1.7	–	2.0/6.4	1	1	–	1
Sanicula trifoliata	Snakeroot	88/6.25	38/0.63	–	75/5.75	13.4/26.8	9.4/8.3	–	11.3/19.5	1	1	–	1
Smilax herbacea	Carrion-flower	13/0.13	*	–	50/2.63	2.0/0.6	*	–	7.5/8.9	1	*	–	1
Symphoricarpos orbiculatus	Coralberry	*	–	–	–	*	–	–	–	*	–	–	–
Ulmus rubra	Slippery elm	75/4.63	25/0.25	38/0.13	38/2.75	11.4/19.9	6.2/3.3	4.7/0.7	15.8/7.5	1	1	1	1
Viburnum prunifolium	Black-haw	–	–	*	*	–	–	*	*	–	–	*	*
Viola sororia	Wooly-blue violet	–	–	50/0.38	75/1.00	–	–	6.1/2.2	11.3/3.4	–	–	1	1

* Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.

– Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.

** Taxa observed in plots for the first time during 1977-1978 sampling period.

*** 1 - Healthy

Tr = Trace

Table III-8

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3), Chestnut Oak (03) Cover Type, September, October 1977 and April, June 1978

Scientific Name	Common Name	No. Individuals in Sample	Change in No. Individuals in Sample between 1976-1977 and 1977-1978	Frequency (%)	Basal Area (m^2/ha)	Relative Frequency (%)	Relative Basal Area (%)	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Tree stratum											
Live condition											
Acer saccharum	Sugar maple	1	-*	50	0.4	10.0	1.9	1	8	8	1
Fraxinus americana	White ash	7	-	100	4.1	20.0	19.3	1	8	1	1
Fraxinus quadrangulata	Blue ash	2	1	50	1.0	10.0	4.7	1	8	1/8	1
Juniperus virginiana	Eastern red cedar	5	-	100	2.9	20.0	13.7	1	1	1	1
Quercus prinus	Chestnut oak	11	-	100	11.1	20.0	52.4	1	8	1	1
Quercus rubra	Red oak	1	-	50	0.6	10.0	2.8	1	8	1	1
Ulmus rubra	Slippery elm	1	-	50	0.4	10.0	1.9	1	8	1	1
Total Live		28	1	450	20.5	90.0	96.7				
Dead condition											
Fraxinus quadrangulata	Blue ash	0	(1)**	0	0	0	0				
Quercus prinus	Chestnut oak	2	-	50	0.7	10.0	3.3				
Total Dead		2	(1)	50	0.7	10.0	3.3				
TOTAL		30	-	500	21.2	100.0	100.0				
Sapling stratum											
Live condition											
Juniperus virginiana	Eastern red cedar	2	-	50	0.5	100.0	100.0	1	1	1	
Total Live		2	-	50	0.5	100.0	100.0				
Dead condition											
None											
Total Dead		0	-	0	0	0	0				
TOTAL		2	-	50	0.5	100.0	100.0				

*- indicated no change

**(n) indicates loss of "n" individuals

***1 - Healthy, 8 - Dormant

although spotted Joe-pye-weed (Eupatorium serotinum) and goldenrod (Solidago ulmifolia) were important herbs during October 1977 and April 1978 (Table III-9). Japanese honeysuckle (Lonicera japonica), an introduced, weedy, twining vine, remained the most important herbaceous class species and seemed to be increasing throughout the plots. This type contained the greatest number of taxa in the herb class. Fifteen new species were recorded, and eight taxa which were recorded during the 1976-1977 sampling were not observed. None of the 23 taxa contributed significantly to the areal cover.

- Red Pine (04)

Approximately 0.5 acres of the red pine cover type were removed during construction of the site parking lot. Although the plots were not directly disturbed by construction, secondary effects have already become apparent. The increase in windfall trees throughout the stand was first apparent during the October 1977 sampling. The direction in which trees have fallen and the increase of wind damage to white pine (Pinus strobus) indicate that clearing has exposed the stand to increased stress from high winds (Figure III-3).

Red pine remained the predominant species during the current sampling period (Table III-10). During the June 1978 sampling, 53 percent of the red pines sampled were dead or dying, 14 percent were diseased, and 29 percent were healthy; two individuals had fallen since the previous sampling, and one individual (42-13) which appeared dead during March and June 1977 appeared to be relatively healthy during the current sampling (Table III-11). During the April 1978 sampling, the needle loss and browning on diseased and dying trees occurred throughout the stand and ranged from 50 to 90 percent (Figure III-4). Two white pines in the plots had recent mechanical damage from wind, but appeared healthy. Red pine is not tolerant to competition from its natural successors such as white pine, expecially in the southern portion of its range (Fowells 1965). The continued trend toward decline of red pine indicates a successional trend toward a white pine dominated stand.

Table III-9

Species Composition, Frequency, Areal Cover, and Condition of Herbaceous Stratum (Plot 1), Chestnut-Oak (03) Cover Type, 1977 and 1978

Scientific Name	Common Name	Frequency (I)/Areal Cover (I) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Relative Frequency (I)/Relative Areal Cover (I) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Acer saccharum**	Sugar maple	-	-	-	13/0.13	-	-	-	1.3/0.3	-	-	-	1
Actinomeris alternifolia**	Wing stem	-	-	-	13/0.13	-	-	-	1.3/0.3	-	-	-	1
Allium canadense	Wild garlic	-	-	63/Tr	-	-	-	6.9/Tr	-	-	-	1	-
Anemone quinquefolia	Wood anemone	-	-	*	-	-	-	*	-	-	-	*	-
Anemone virginica	Thimbleweed	13/0.13	13/0.25	*	13/0.25	1.8/0.8	3.5/2.3	*	1.3/0.6	1	8	*	-
Anemonella thalictroides	Rue anemone	-	-	-	50/1.63	-	-	-	4.9/4.0	-	-	-	1
Arabis laevigata	Smooth rock-cress	-	-	13/0.13	*	-	-	1.4/1.6	*	-	-	1	*
Aster azureus	Azure aster	-	-	-	38/0.38	-	-	-	3.7/0.9	-	-	-	1
Carex sp.**	Sedge	-	-	-	13/0.13	-	-	-	1.3/0.3	-	-	-	1
Celtis occidentalis	Hackberry	13/0.25	13/0.13	*	*	1.8/1.6	3.5/1.2	*	*	1	R	*	*
Cercis canadensis	Eastern redbud	*	*	-	13/0.13	*	*	-	1.3/0.3	1	*	-	1
Clematis viorna	Leather flower	38/0.50	*	63/0.63	88/8.13	5.4/3.2	*	6.9/7.6	8.6/20.1	1	*	1	1
Cornus florida**	Flowering dogwood	13/0.13	-	-	-	1.8/0.8	-	-	-	1	-	-	-
Delphinium tricorne**	Dwarf larkspur	-	-	100/0.25	-	-	-	11.0/3.0	-	-	-	1	-
Dentaria laciniata	Cut-leaved toothwort	-	-	*	-	-	-	*	-	-	-	*	-
Dioscorea villosa	Wild yam	38/1.50	13/0.13	-	100/7.50	5.4/9.6	3.5/1.2	-	9.8/18.6	1	1	-	1
Diospyros virginiana	Persimmon	*	*	-	-	*	*	-	-	*	*	-	-
Elymus virginicus**	Virginia wild rye	13/0.13	-	-	-	3.5/1.2	-	-	-	R	-	-	-
Eupatorium maculatum	Spotted joe-pye-weed	-	50/1.00	-	50/0.88	-	13.5/9.0	-	6.9/2.1	-	1/?	-	1
Fraxinus americana	White ash	13/0.25	*	13/0.13	25/0.63	1.8/1.6	*	1.4/1.6	2.4/1.6	1	*	1	1
Fraxinus quadrangulata	Blue ash	*	*	13/Tr	*	*	*	1.4/Tr	*	*	*	1	*
Galium circaezans	White wild licorice	75/0.63	13/0.13	-	75/0.63	10.5/4.0	3.5/1.2	-	7.3/1.6	1	?	-	1
Geum canadense	Canadian avens	13/Tr	*	-	-	1.8/Tr	*	-	-	1	*	-	-
Helianthus sp.	Sunflower	*	-	-	-	*	-	-	-	*	-	-	-
Hystrix patula	Bottlebrush	-	-	-	*	-	-	-	*	-	-	-	*
Jeffersonia diphylla	Twinleaf	*	-	38/0.50	38/1.00	*	-	4.2/6.0	3.7/2.5	*	-	1	1
Juniperus virginiana	Eastern red cedar	13/Tr	13/0.13	*	-	1.8/Tr	3.5/1.2	*	-	1	1	*	-
Labiatae**	Mint	-	-	25/Tr	-	-	-	2.7/Tr	-	-	-	1	-
Lactuca sp.**	Wild lettuce	-	13/01.3	13/0.13	-	-	3.5/1.2	1.4/1.6	-	-	1	1	-
Lonicera japonica	Japanese honeysuckle	63/4.63	63/6.13	63/1.0	50/7.38	9.1/29.5	17.0/55.4	6.9/12.0	4.9/18.3	1	1	1	1
Maianthemum canadense	Canada mayflower	-	-	*	-	-	-	*	-	-	-	*	-
Muhlenbergia sobolifera	Muhly grass	13/0.13	13/0.25	-	38/0.38	1.8/0.8	3.5/2.3	-	3.7/0.9	1	?	-	1
Oenothera sp.	Evening primrose	*	*	*	*	*	*	*	*	*	*	*	*
Ostrya virginiana	Ironweed	*	*	*	*	*	*	*	*	*	*	*	*
Panicum boscii	Bosc's panicum	25/0.25	13/0.75	13/Tr	*	3.4/1.6	3.5/6.8	1.4/Tr	*	1	?	1	*
Parthenocissus quinquefolia	Virginia creeper	13/0.38	13/0.13	13/Tr	25/1.00	1.8/2.4	3.5/1.2	1.4/Tr	2.4/2.5	1	R	1	1
Pinus virginiana	Virginia pine	*	13/0.13	*	13/0.13	*	3.5/1.2	*	1.3/0.3	*	1	*	1
Polygonatum biflorum	Solomon's seal	-	-	-	50/1.63	-	-	-	4.9/4.0	-	-	-	1
Prunus serotina	Black cherry	25/0.50	25/0.38	63/0.63	38/0.88	3.4/3.2	6.7/3.4	6.9/7.6	3.7/2.1	1	1	1	1
Quercus prinus	Chestnut oak	13/Tr	13/0.13	*	38/1.13	1.8/Tr	3.5/1.2	*	3.7/2.8	1	R	*	1
Quercus velutina	Black oak	13/0.13	*	-	-	1.8/0.8	*	-	-	1	*	-	-
Rhus aromatica	Fragrant sumac	-	-	-	*	-	-	-	*	-	-	-	*
Rhus radicans**	Poison ivy	13/0.13	-	13/Tr	13/0.13	1.8/0.8	-	1.4/Tr	1.3/0.3	1	-	1	1
Robinia pseudoacacia	Black locust	13/1.38	*	*	13/0.50	1.8/8.9	*	*	1.3/1.2	1	*	*	1
Rosa sp.	Rose	13/0.13	13/0.13	13/Tr	13/0.13	1.8/0.8	3.5/1.2	1.4/Tr	1.3/0.3	1	R	1	1
Ruellia caroliniensis	Hairy ruellia	-	-	-	13/0.13	-	-	-	13/0.13	-	-	-	1
Sanguinaria canadensis	Bloodroot	-	-	*	-	-	-	*	-	-	-	*	-
Sanicula trifoliata	Snakeroot	38/0.25	-	63/0.13	50/0.75	5.4/1.5	-	6.9/1.6	4.9/1.9	1	-	1	1
Smilacina racemosa**	False Solomon's seal	-	-	63/1.13	-	-	-	6.9/13.6	-	-	-	1	-
Smilax herbacea**	Carrion-flower	13/0.50	-	-	-	1.8/3.2	-	-	-	1	-	-	-
Solidago ulmifolia	Goldenrod	75/1.63	13/0.25	100/1.00	38/1.88	10.9/1.63	3.5/2.3	11.0/12.0	3.7/4.7	1	?	1	1
Solidago sp.**	Goldenrod	25/0.50	-	-	-	3.4/3.2	-	-	-	1	-	-	-
Symphoricarpos orbiculatus	Coralberry	*	13/0.25	13/0.25	13/0.75	*	3.5/2.3	1.4/2.0	1.3/1.9	*	R	1	1
Taraxacum officinale**	Common dandelion	-	-	13/0.38	13/0.13	-	-	1.4/4.6	1.3/0.3	-	-	1	1
Thalictrum dioicum	Early meadow-rue	38/0.63	25/0.38	63/0.63	-	5.4/4.0	6.7/3.4	6.9/7.6	-	1	1	1	-
Ulmus rubra	Slippery elm	50/0.75	13/0.13	*	38/1.50	7.0/4.8	3.5/1.2	*	3.7/3.7	1	R	*	1
Veratrum sp.**	False helleborne	-	-	-	25/0.25	-	-	-	2.4/0.6	-	-	-	1
Viola sororia**	Woolly-blue violet	13/Tr	-	13/Tr	-	1.8/Tr	-	1.4/Tr	-	1	-	1	-
Vitis aestivalis	Summer grape	13/0.25	-	-	*	1.8/1.6	-	-	*	1	-	-	*
Dicotyledonae	Dicot B	13/0.13	-	-	13/0.13	1.8/0.8	-	-	1.3/0.3	1	-	-	1
Monocotyledonae	Monocot A	-	-	63/1.4	-	-	-	6.9/16.8	-	-	-	1	-

*Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.

- Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.

**Taxa observed in plots for the first time during 1977-1978 sampling period.

***1 - Healthy, ? - Dying, R - Dormant

Tr - Trace

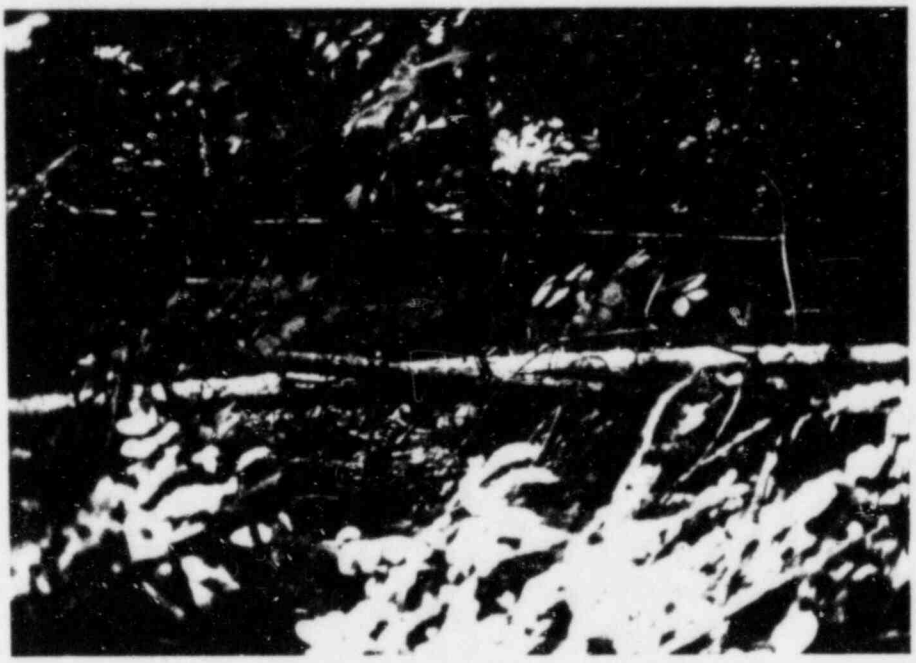

Figure III-3. Windfalls in Red Pine (04) Cover Type, June 1978

Figure III-4. Needle Browning and Loss Contributing to General Decline of Red Pine (04) Cover Type, June 1978

Table III-10

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3), Red Pine (04) Cover Type, September, October 1977 and April, June 1978

Scientific Name	Common Name	No. Individuals in Sample	Change in No. Individuals in Sample between 1976-1977 and 1977-1978	Frequency (%)	Basal Area (m^2/ha)	Relative Frequency (%)	Relative Basal Area (%)	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Tree stratum											
Live condition											
Fraxinus americana	White ash	2	-	50	2.6	13.0	6.5	1	8	1/8	1
Liriodendron tulipifera	Yellow poplar	2	1	50	4.2	13.0	10.5	1/2	8	1/2	1
Pinus resinosa	Red pine	15	1	100	21.2	25.0	53.1	1/2	1	2	1/7
Pinus strobus	White pine	4	(1)**	100	6.3	25.0	15.8	1/4	4	1/4	1
Total Live		23	1	300	34.3	76.0	85.9				
Dead Condition											
Pinus resinosa	Red pine	6	(2)	100	5.6	25.0	14.0				
Total Dead		6	(2)	100	5.6	25.0	14.0				
TOTAL		29	(1)	400	39.9	101.0	99.9				
Sapling stratum											
No saplings occurred in plots											

* - indicates no change

** (n) indicates loss of "n" individuals

*** 1 - Healthy, 2 - Diseased, 4 - Mechanical Injury, 7 - Dying, 8 - Dormant

Table III-11

Change in Condition of Trees in the Red Pine (04) Cover Type between September 1976 and June 1977

Scientific Name	Common Name	Tree No.	Canopy Position 1976-1977	Canopy Position 1977-1978	dbh (inches) May 1978	dbh (inches) Δ*	Condition**** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Pinus resinosa	Red pine	41-1	3	3	5.6	0.8	1	1	1	1
		41-2	3	3	6.2	(0.1)**	7	7	7	6
		41-3	3	***	***	(4.7	6	***	***	***
		41-4	1	2	6.0	(0.1)	2	2	7	6
		41-5	3	3	5.7	---	7	7	7	6
		41-6	1	1	6.5	(2.3)	2	1	2	7
		41-7	4	***	***	(3.6	6	***	***	***
		41-10	1	2	8.6	0.3	2	2	2	7
		41-12	1	1	8.0	---	2	1	7	7
		41-13	1	1	8.0	---	1	1	7	7
		41-14	1	1	9.7	0.2	1	1	7	7
		42-1	3	3	3.6	(0.2)	1	1	1	1
		42-3	1	1	9.0	---	2	2	6	6
		42-4	1	3	6.0	(0.1)	7	7	7	6
		42-5	1	1	6.7	(0.1)	1	1	2	1
		42-8	1	1	8.3	---	1	1	1	1
		42-9	1	2	5.8	0.2	2	2	6	6
		42-10	2	3	5.1	0.1	1	1	1	1
		42-11	2	3	5.1	0.1	2	1	1	1
		42-12	2	3	5.3	0.1	1	1	1	1
		42-13	1	1	8.7	0.2	1	1	2	2
		42-14	1	1	9.5	---	1	1	1	2
		42-15	3	4	4.2	(0.1)	7	7	7	2
Pinus strobus	White pine	41-8	2	2	6.7	0.3	1	4	1	1
		41-11	3	4	5.7	0.1	4	4	1	1/4
		42-2	3	3	12.3	---	4	4	2	4/1
		42-6	1	4	5.0	0.1	1	1	1	1
Fraxinus americana	White ash	42-7	1	2	6.5	0.2	1	8	8	1
		42-16	1	1	7.6	0.2	1	8	1	1
Liriodendron tulipifera	Tulip tree	41-9	1	1	12.3	0.4	1	8	1	1
		41-15		3	3.8	3.8	2	8	2	2
						(4.6)				

*Change from March 1977

**() = reduction

***Individual has fallen

****1-Healthy, 2-Diseased, 4-Mechanical injury, 6-Dead, 7-Dying, 8-Dormant

The sapling, shrub, and herbaceous strata remained similar to the 1976-1977 sampling (Table III-12). A general reduction in areal cover of muscadine grape (Vitis rotundifolia) in the shrub stratum was observed; however, three previously unrecorded species were encountered in the sampling plots. The total number of taxa in the herbaceous stratum remained the same as in the 1976-1977 sampling.

- Sycamore - Boxelder (05)

Little change occurred in the tree stratum. Most of the increase in basal area was attributed to the dominant species sycamore (Platnus

Table III-12

Species Composition, Frequency, Areal Cover, and Condition of Herbaceous Stratum (Plot 1), Red Pine (04) Cover Type, 1977 and 1978

Scientific Name	Common Name	Frequency (%)/Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Relative Frequency (%)/Relative Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Cercis canadensis	Eastern redbud	75/2.63	38/0.50	–	63/2.00	10.1/7.1	10.4/3.5	–	9.2/5.4	1/2	1	–	1
Cornus florida	Flowering dogwood	63/6.50	63/1.38	38/0.13	25/4.63	8.5/17.6	17.2/9.6	7.4/1.2	3.7/12.6	1	8	1	1
Dentaria laciniata	Cut-leaved toothwort	–	–	38/2.13	–	–	–	7.4/20.0	–	–	–	1	–
Eupatorium serotinum	Late-flowering thoroughwort	13/1.00	13/0.50	13/0.13	*	1.7/2.7	3.6/3.5	2.5/1.2	*	1	1	1	*
Fagus grandifolia	Beech	13/0.25	13/0.13	25/0.50	13.0.75	1.7/0.7	3.6/1.0	4.9/4.7	1.9/2.0	1	8	1	1
Fragaria virginiana	Wild strawberry	13/0.25	*	13/Tr	13/Tr	1.7/0.7	*	2.5/Tr	1.9/Tr	1	*	1	1
Fraxinus americana	White ash	63/1.25	*	25/Tr	50/2.63	8.5/3.4	*	4.9/Tr	7.3/7.1	1	*	1	1
Fraxinus quadrangulata	Blue ash	*	25/0.25	13/0.13	–	*	6.8/1.7	2.5/1.2	–	*	8	1	–
Galium asprellum	Northern bedstraw	13/0.13	25/0.25	–	13/0.38	1.7/0.4	6.8/1.7	–	1.9/1.0	1	1	–	1
Galium circaezans	White wild licorice	50/0.50	13/0.13	–	38/0.75	6.7/1.4	3.6/1.0	–	5.6/2.0	1	1	–	1
Galium triflorum	Fragrant bedstraw	*	*	38/0.50	13/0.13	*	*	7.4/4.7	1.9/0.4	*	*	1	1
Geum canadense	Canadian avens	*	–	38/0.13	38/1.13	*	–	7.4/1.2	5.6/3.1	*	–	1	1
Liriodendron tulipifera**	Yellow poplar	–	–	–	13/0.38	–	–	–	1.9/1.0	–	–	–	1
Lonicera japonica	Japanese honeysuckle	50/14.00	50/8.89	*	50/11.25	6.7/37.9	13.7/61.7	*	7.3/30.6	1	1	*	1
Muhlenbergia sobolifera	Muhly grass	–	–	–	13/0.13	–	–	–	1.9/0.4	–	–	–	1
Parthenocissus quinquefolia	Virginia creeper	25/2.13	–	38/0.13	38/2.63	3.4/5.8	–	7.4/1.2	5.6/7.1	1	–	1	1
Phryma leptostachya	Lopseed	8/2.25	*	–	13/1.63	5.1/6.1	*	–	1.9/4.4	1	*	–	1
Pilea pumila**	Clearweed	–	–	–	13/0.13	–	–	–	1.9/0.4	–	–	–	1
Pinus strobus	White pine	25/0.13	25/0.25	13/0.13	*	3.4/0.4	6.8/1.7	2.5/1.2	*	1	1	1	*
Poaceae	Grass	–	–	*	–	–	–	*	–	–	–	*	–
Prunus serotina	Black cherry	50/0.88	13/0.38	75/1.63	50/1.13	6.7/2.4	3.6/2.6	14.7/5.3	7.3/3.1	1	1	1	1
Quercus prinus	Chestnut oak	13/0.25	25/0.88	–	–	1.7/0.7	6.8/6.1	–	–	1	1	–	–
Quercus velutina	Black oak	38/1.13	13/0.25	–	38/1.00	5.1/3.1	3.6/1.7	–	5.6/2.7	1	8	–	1
Rhus radicans	Poison ivy	25/0.63	–	13/Tr	38/0.63	3.4/1.7	–	2.5/Tr	5.6/1.7	1/2	–	1	1
Rosa sp.	Rose	13/0.25	*	13/Tr	25/0.25	1.7/0.7	*	2.5/Tr	3.7/0.7	1	*	1	1
Rubus sp.	Blackberry	13/0.13	–	–	25/0.63	1.7/0.4	–	–	3.7/1.7	1	–	–	1
Sanicula trifoliata	Snakeroot	75/1.75	50/0.63	68/1.88	88/4.25	10.1/4.7	13.7/4.4	–	12.9/11.5	1	1/6	–	1
Sassafras albidum	Sassafras	25/0.50	*	–	*	3.4/1.4	*	–	*	1	*	–	*
Smilax herbacea**	Carrion-flower	13/Tr	–	–	–	1.7/Tr	–	–	–	1	–	–	–
Symphoricarpos orbiculatus	Coralberry	*	–	–	–	*	–	–	–	*	–	–	–
Ulmus rubra	Slippery elm	13/0.13	–	–	13/0.38	1.7/0.4	–	–	1.9/1.0	1	–	–	1
Viola sororia	Wooly-blue violet	13/0.13	–	–	*	1.7/0.4	–	–	*	1	–	–	*
Vitis rotundifolia	Muscadine grape	*	–	–	–	*	–	–	–	*	–	–	–
Dicotyledonae**	Dicot	13/0.13	–	–	*	1.7/0.4	–	–	*	1	–	–	*

*Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.

– Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.

**Taxa observed in plots for the first time during 1977-1978 sampling period.

***1 - Healthy, 2 - Diseased, 6 - Dead, 8 - Dormant.

Tr = Trace

occidentalis), and all trees appeared healthy during June 1978 sampling (Table III-13).

One hackberry (Celtis occidentalis) in the sapling stratum died between the October 1977 and April 1978 sampling; the single boxelder (Acer negundo) remained in a dying condition.

Slippery elm was not observed in the shrub stratum during the current sampling; however, three other understory tree species were present and contributed only minor areal cover.

Six previously unrecorded species were observed in the herbaceous stratum (Table III-14). Of these, stinging nettle (Urtica dioica) became prominent in one set of sampling plots (plots 201-204). Yellow jewelweed (Impatiens pallida), sedge (Carex sp.), and clearweed (Pilea pumila) were consistently important taxa throughout the type during the current sampling period. Flooding and deposition of silt in the previously mentioned plots may have been responsible for introduction of several of the new taxa. Future flooding, which is a natural occurrence in this cover type, will undoubtably continue to influence species composition of these plots.

- Oak-Hickory (06)

Little change occurred in the tree and sampling stratum; one Ohio buckeye (Aesculus glabra) died but remained standing (Table III-15). All trees except black locust (Robinia pseudoacacia) appeared healthy. Four previously unrecorded shrubs were identified during the current sampling, but slippery elm and eastern redbud (Cercis canadensis) remained the more important shrub species (Table III-4).

Thirty-five herbaceous class species were observed during the current sampling; of these, 8 were previously unrecorded. Ten species observed during the 1976-1977 sampling (Table III-16) were not present. The highest ground cover was again observed in the early spring sampling (April 1978) and was attributed to the development of spring ephemerals, which

Table III-13

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3), Sycamore-Boxelder (05) Cover Type, September, October 1977 and April, June 1978

Scientific Name	Common Name	No. Individuals in Sample	Change in No. Individuals in Sample between 1976-1977 and 1977-1978	Frequency (%)	Basal Area (m^2/ha)	Relative Frequency (%)	Relative Basal Area (%)	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Tree stratum											
Live condition											
Acer negundo	Boxelder	1	-*	50	0.5	14.3	1.0	1	8	1	1
Cornus florida	Flowering dogwood	2	-	50	1.2	14.3	2.4	1	8	1	1
Juglans nigra	Black walnut	2	-	50	4.4	14.3	8.7	1	8	8	1
Platnus occidentalis	Sycamore	4	-	50	38.6	14.3	76.7	2	8	1	1
Prunus serotina	Black cherry	1	-	50	0.4	14.3	0.8	2	1	1	1
Tilia americana	Basswood	1	-	50	0.9	14.3	1.8	1	8	1	1
Ulmus rubra	Slippery elm	1	-	50	4.3	14.3	8.5	1	8	1	1
Total Live		12	-	350	50.3	100.2	99.9				
Dead condition											
None		0	-	0	0	0	0				
Total Dead		0	-	0	0	0	0				
TOTAL		12	-	350	50.3	100.2	99.9				
Sapling stratum											
Live condition											
Acer negundo	Boxelder	2	-	50	1.3	33.3	65.0	7	8	7	7
Celtis occidentalis	Hackberry	0	(1)**	0	0.0	0.0	0.0				
Total Live		2	(1)	50	1.3	33.3	65.0				
Dead condition											
Celtis occidentalis	Hackberry	1	1	50	0.5	33.3	25.0				
Ulmus rubra	Slippery elm	1	-	50	0.2	33.3	10.0				
Total Dead		2	1	100	0.7	66.6	35.0				
TOTAL		4	-	150	2.0	99.0	100.0				

*- indicates no change

**(n) indicates loss of "n" individuals

***1 - Healthy, 2 - Diseased, 7 - Dying, 8 - Dormant

Table III-14

Species Composition, Frequency, Areal Cover, and Condition of the Herbaceous Stratum (Plot 1), Sycamore Boxelder (05) Cover Type, 1977 and 1978

Scientific Name	Common Name	Frequency (%)/Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Relative Frequency (%)/Relative Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Acer negundo	Boxelder	*	–	25/Tr	*	*	–	4.1/Tr	*	*	–	1	*
Actinomeris alternifolia	Wing-stem	38/1.00	38/0.63	25/0.75	38/5.75	6.1/1.5	7.2/3.1	4.1/3.6	6.4/6.2	2	7	1	1
Amaranthus sp.	Pigweed	–	*	–	–	–	*	–	–	–	*	–	–
Aster sp.**	Aster	–	13/0.13	–	–	–	2.4/0.6	–	–	–	1	–	–
Bidens sp.**	Beggar's ticks	13/0.63	–	–	–	2.1/0.9	–	–	–	1	–	–	–
Carex sp.	Sedge	50/3.63	50/5.63	50/6.38	50/5.88	8.1/5.4	9.4/27.9	8.2/30.7	8.4/6.3	1	1	1	1
Circaea alpina	Small enchanter's nightshade	*	*	–	13/0.25	*	*	–	2.2/0.3	*	*	–	1
Claytonia virginica	Spring-beauty	–	–	50/1.25	–	–	–	8.2/6.0	–	–	–	1	–
Commelina sp.	Dayflower	13/0.13	13/0.88	–	13/0.38	2.1/0.2	2.4/4.4	–	2.2/0.4	1	7	–	1
Cornus florida	Flowering dogwood	38/1.63	25/0.38	*	13/1.38	6.1/2.4	4.7/1.9	*	2.2/1.5	1	8	*	1
Cryptotaenia canadensis	Honewort	–	–	–	13/0.13	–	–	–	2.2/0.1	–	–	–	1
Dentaria laciniata	Cut-leaved toothwort	13/0.25	13/0.13	50/4.13	–	2.1/0.4	2.4/0.6	8.2/19.9	–	1	1	1	–
Elymus virginicus	Virginia wild rye	25/0.88	25/1.13	13/0.13	38/1.50	4.0/1.3	4.7/5.6	2.1/0.6	6.4/1.6	1	1	1	1
Eupatorium serotinum	Late-flowering thoroughwort	25/2.26	88/4.75	–	50/5.63	4.0/3.3	16.6/23.5	–	8.4/6.1	1	1	–	1
Galium circaezans	White wild licorice	13/0.13	13/0.13	25/0.25	13/0.13	2.1/0.2	2.4/0.6	4.1/1.2	2.2/0.1	1	1	1	1
Galium triflorum	Fragrant bedstraw	–	–	13/0.25	–	–	–	2.1/1.2	–	–	–	1	–
Geum canadense	Canadian avens	50/1.63	50/0.63	13/0.13	50/4.88	8.1/2.4	9.4/3.1	2.1/0.6	8.4/5.3	1	1	1	1
Impatiens pallida	Yellow jewelweed	50/6.50	38/0.38	50/3.75	63/27.38	8.1/9.7	7.2/1.9	8.2/18.0	10.6/29.5	1	6	1	1
Jeffersonia diphylla	Twinleaf	–	–	*	–	–	–	*	–	–	–	*	*
Urtica dioica**	Wood nettle	50/4.25	–	–	13/6.00	8.1/6.3	–	–	2.2/6.5	1	–	–	1
Lindera benzoin**	Spicebush	13/0.38	–	–	–	2.1/0.6	–	–	–	1	–	–	–
Osmorhiza claytonii**	White snakeroot	–	–	50/0.88	–	–	–	8.2/4.2	–	–	–	1	–
Parthenocissus quinquefolia	Virginia creeper	25/1.00	*	13/0.13	25/2.00	4.0/1.5	*	2.1/0.6	4.2/2.2	1	*	1	1
Pilea pumila	Clearweed	88/10.75	63/4.00	50/Tr	63/26.88	14.2/60 5	11.9/19.8	8.2/Tr	10.6/29.0	1	6	1	1
Polygonum cespitosum	Long-bristled smartweed	*	13/0.13	–	–	*	2.4/0.6	–	–	*	1	–	–
Rhus radicans	Poison ivy	13/0.25	13/0.13	25/0.38	13/0.63	2.1/0.4	2.4/0.6	4.1/1.8	2.2/0.7	1	8	1	1
Sanicula trifoliata	Snakeroot	13/0.38	25/0.13	68/0.88	63/1.63	2.1/0.6	4.7/0.6	11.2/4.2	10.6/1.8	6	1	1	1
Smilax herbacea	Carrion-flower	13/0.25	13/0.38	–	–	2.1/0.4	2.4/1.9	–	–	1	1	–	–
Solidago sp.	Goldenrod	25/0.50	*	13/0.25	25/0.88	4.0/0.7	*	2.1/1.2	4.2/0.9	1	*	1	1
Umbelliferae sp.**		–	–	13/0.13	–	–	–	2.1/0.6	–	–	–	1	–
Viola eriocarpa	Smoothish yellow violet	13/0.25	13/0.38	13/0.13	*	2.1/0.4	2.4/1.9	2.1/0.6	*	1	1	1	*
Viola sororia	Wooly-blue violet	38/0.63	25/0.25	50/1.00	38/1.38	6.1/0.9	4.7/1.2	8.2/4.8	6.4/1.5	1	1	1	1

*Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.

– Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.

**Taxa observed in plots for the first time during 1977-1978 sampling period.

***1 - Healthy, 2 - Diseased, 6 - Dead, 7 - Dying, 8 - Dormant.

Tr = Trace

Table III-15

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3), Oak-Hickory (06) Cover Type, September, October 1977 and April, June 1978

Scientific Name	Common Name	No. Individuals in Sample	Change in No. Individuals in Sample between 1976-1977 and 1977-1978	Frequency (%)	Basal Area (m^2/ha)	Relative Frequency (%)	Relative Basal Area (m^2/ha)	Mode Condition *** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Tree stratum											
Live condition											
Aesculus glabra	Ohio buckeye	4	(1)**	100	2.7	18.2	7.1	2	8	1	1
Catalpa speciosa	Northern catalpa	1	-*	50	3.6	9.1	9.4	1	8	8	1
Fraxinus americana	White ash	1	-	50	1.0	9.1	2.6	1	8	8	1
Fraxinus quadrangulata	Blue ash	7	-	100	15.7	18.2	41.1	1	8	8	1
Quercus rubra	Red oak	2	-	50	12.3	9.1	32.2	1	8	1	1
Ulmus ruura	Slippery elm	1	-	50	0.9	9.1	2.4	2	8	1	1
Total Live		16	(1)	400	36.2	72.8	94.8				
Dead condition											
Aesculus glabra	Ohio buckeye	1	1	50	0.5	9.1	1.3				
Fraxinus quadrangulata	Blue ash	3	-	100	1.5	18.2	3.9				
Total Dead		4	1	150	2.0	27.3	5.2				
TOTAL		20	-	550	38.2	100.1	100.0				
Sapling stratum											
No saplings occurred in plots											

*- indicates no change

**(n) indicates loss of "n" individuals

***1 - Healthy, 2 - Diseased, 8 - Dormant

Table III-16

Species Composition, Frequency, Areal Cover, and Condition of the Herbaceous Stratum (Plot 1), Oak-Hickory (06) Cover Type, 1977 and 1978

Scientific Name	Common Name	Frequency (%)/Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Relative Frequency (%)/Relative Areal Cover 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Acer saccharum	Sugar maple	–	–	–	13/Tr	–	–	–	3.2/0.7	–	–	–	1
Allium canadense	Wild garlic	–	–	25/Tr	–	–	–	3.5/Tr	–	–	–	1	–
Amaranthus sp.	Pigweed	*	–	–	–	*	–	–	–	*	–	–	–
Anemone canadensis	Canada anemone	–	–	*	–	–	–	*	–	–	–	*	–
Anemonella thalictroides	Rue anemone	–	–	*	–	–	–	*	–	–	–	*	–
Asarum canadense	Wild ginger	–	–	–	13/Tr	–	–	–	3.2/Tr	–	–	–	1
Aster azureus	Azure aster	*	*	–	*	*	*	–	*	*	*	–	*
Cardamine douglassii	Purple cress	13/0.13	–	25/Tr	*	3.1/1.1	–	3.5/Tr	*	6	–	1	*
Carya cordiformis	Yellowbud hickory	–	*	–	–	–	*	–	–	–	*	–	–
Cercis canadensis	Eastern redbud	13/0.28	*	50/0.25	38/1.63	3.1/3.3	*	7.0/0.7	9.4/8.4	1	*	1	1
Circaea alpina	Small enchanter's nightshade	13/0.13	25/0.25	–	–	3.1/1.1	19.5/11.0	–	–	1	1/8	–	–
Commelina sp.	Dayflower	*	–	–	–	*	–	–	–	*	–	–	–
Compositae**	Sunflower	13/0.25	–	–	13/0.25	3.1/2.2	–	–	3.2/1.3	1	–	–	1
Cornus priceae	Miss Price's cornel	–	–	–	–	–	–	–	–	–	–	–	–
Carex sp.	Sedge	25/0.25	–	–	*	5.9/2.2	–	–	*	1	–	–	*
Delphinium tricorne**	Dwarf larkspur	–	–	88/4.88	–	–	–	12.3/14.1	–	–	–	1	–
Dentaria laciniata	Cut-leaved toothwort	–	–	88/2.00	–	–	–	12.3/5.8	–	–	–	1	–
Erythronium albidum	White trout-lily	–	–	75/6.13	–	–	–	10.5/17.8	–	–	–	1	–
Eupatorium serotinum	Late-flowering thoroughwort	50/1.13	13/0.13	–	50/2.25	11.8/9.8	10.2/5.7	–	12.3/11.6	1	1	–	1
Fraxinus americana	White ash	*	*	–	–	*	*	–	–	*	*	–	–
Fraxinus quadrangulata	Blue ash	13/Tr	13/0.25	–	*	3.1/Tr	10.2/11.0	–	*	1	1	1	1
Geum canadense	Canadian avens	13/0.38	13/0.13	25/0.38	25/0.50	3.1/3.3	10.2/5.7	3.5/1.1	6.2/2.6	1	1	1	1
Galium circaezans**	White wild licorice	–	–	25/Tr	–	–	–	3.5/Tr	3.2/Tr	–	–	1	–
Gleochoma hederacea**	Gill-over-the-ground	13/0.13	–	–	–	3.1/1.1	–	–	–	1	–	–	–
Hydrophyllum appendiculatum	Appendaged water leaf	*	*	–	–	*	*	–	–	*	*	–	–
Hystrix patula	Bottlebrush	*	*	*	38/Tr	*	*	*	9.4/Tr	*	*	*	1
Lonicera japonica	Japanese honeysuckle	13/0.25	*	–	13/1.13	3.1/2.2	*	–	3.2/5.8	1	*	–	1
Mertensia virginica	Bluebells	–	–	100 5.5	–	–	–	14.1-44..	–	–	–	1	–
Muhlenbergia sobolifera	Muhly grass	*	*	*	*	*	*	*	*	*	*	*	*
Neptea cataria**	Catnip	13/Tr	–	–	–	3.1/Tr	–	–	–	2	–	–	–
Parthenocissus quinquefolia	Virginia creeper	88/6.50	13/0.13	75/0.25	75/9.63	20.9/56.2	10.2/5.7	10.5/0.7	49.6	1	1	1	1
Polygonatum biflorum	Solomon's seal	*	*	25/0.75	–	*	*	3.5/2.2	–	*	*	1	–
Quercus sp.	Oak	–	–	–	13/0.13	–	–	–	3.2/0.7	–	–	–	1
Rhus radicans	Poison ivy	25/0.38	–	–	13/0.13	5.9/3.3	–	–	3.2/0.7	1	–	–	1
Robina pseudoacacia	Black locust	*	*	*	*	*	*	*	*	*	*	*	*
Rubus sp.**	Blackberry	13/0.38	–	–	–	3.1/3.3	–	–	–	1	–	–	–
Sanguinaria canadensis	Bloodroot	–	–	13/1.50	13/1.00	–	–	1.8/4.3	3.2/5.2	–	–	1	1
Sanicula trifoliata	Snakeroot	13/0.13	–	–	13/0.25	3.1/1.1	–	–	3.2/1.3	1	–	–	1
Smilacina racemosa	False Solomon's-seal	*	–	–	13/0.50	*	–	–	3.2/2.6	*	–	–	1
Solidago sp.**	Goldenrod	13/0.25	13/0.13	–	–	3.1/2.2	10.2/5.7	–	–	1	1	–	–
Symphoricarpos orbiculatus	Coralberry	*	*	13/0.25	*	*	*	1.8/0.7	*	*	*	1	*
Trillium sessile	Toadshade	–	–	50/1.75	13/0.25	–	–	7.0/5.1	3.2/1.3	–	–	–	1
Ulmus rubra	Slippery elm	38/0.50	38/1.25	38/0.88	50/1.75	9.0/4.3	29.7/55.1	5.3/2.5	12.3/9.0	2	1/6	1	1
Viola sororia**	Wooly-blue violet	13/0.13	–	–	–	3.1/1.1	–	–	–	1	–	–	–
Vitis aestivalis	Summer grape	13/0.38	*	–	75/9.63	3.1/3.3	*	–	18.5/49.6	1	*	–	1

*Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.

– Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.

**Taxa observed in plots for the first time during 1977-1978 sampling period.

***1 - Healthy, 6 - Dead, 8 - Dormant.

Tr = Trace

contributed 92 percent of the vegetation ground cover. Bluebells (Mertensia virginica) was most important of these, with 44.9 percent of the ground cover. The location of this cover type on steep slopes makes it especially susceptible to water scouring; this attributed to the low ground cover in September and October 1978

- Walnut - Hickory - Buckeye (09)

One blue ash (Fraxinus quadrangulata) reached tree class, and one Ohio buckeye and one white ash died, but remained standing (Table III-17). All species appeared healthy during June 1978 sampling. This type contained the greatest number of shrub species: 13 including 3 previously unrecorded taxa (Table III-4). Japanese honeysuckle and blue ash remained the most important, and sugar maple declined in importance.

The Herbaceous stratum contained 41 species, 12 of which were not previously observed (Table III-18). Japanese honeysuckle remained the most important herbaceous species and appeared to be increasing in the study plots. In general, the herbaceous strata followed the same patterns as during the 1976-1977 sampling.

- Virginia Pine (11)

One set of sample plots (11-101) was destroyed from the ground-clearing operations between September and October 1977 samplings, but was reestablished in October. The differences in vegetation and soil data between the 1976-1977 and current samplings reflect the loss of these plots. In April 1978, Virginia pine (Pinus virginiana) comprised 77 percent of the basal area and eastern redbud comprised nearly 14 percent (Table III-19). Because of the relocation, one dead and four living saplings were lost. The remaining saplings had a total basal area of 0.6 m^2/ha.

The shrub class still had a low ground cover. Tartarian honeysuckle (Lonicera tartarica) was lost and eastern redbud was observed. Areal ground cover in the herbaceous class remained the lowest of all cover types (Table III-20). Flowering dogwood and Virginia creeper (Parthenocissus

Table III-17

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3) Walnut-Hickory-Buckeye (09) Cover Type, September, October 1977 and April, June 1978

Scientific Name	Common Name	No. Individuals in Sample	Change in No. Individuals in Sample between 1976-1977 and 1977-1978	Frequency (%)	Basal Area (m^2/ha)	Relative Frequency (%)	Relative Basal Area (m^2/ha)	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Tree stratum											
Live condition											
Aesculus glabra	Ohio buckeye	7	(1)	50	7.6	10.0	23.2	1	8	1	1
Carya ovata	Shagbark hickory	2	-*	50	8.8	10.0	26.8	2	8	8	1
Cercis canadensis	Eastern redbud	2	-	50	0.8	10.0	2.4	2	8	8	1
Fraxinus americana	White ash	1	(1)**	50	3.4	10.0	10.4	1	8	1	1
Fraxinus quadrangulata	Blue ash	2	1	50	0.7	10.0	2.1	1	8	8	1
Juglans nigra	Black walnut	1	-	50	9.0	10.0	27.4	7	8	7	1
Ulmus rubra	Slippery elm	2	-	50	0.8	10.0	2.4	2	8	1	1
Total Live		18	(1)	350	31.1	70.0	94.7				
Dead condition											
Aesculus glabra	Ohio buckeye	1	1	50	0.6	10.0	1.8				
Fraxinus americana	White ash	1	1	50	0.5	10.0	1.5				
Ulmus rubra	Slippery elm	1	-	50	0.6	10.0	1.8				
Total Dead		3	2	150	1.7	30.0	5.1				
TOTAL		21	2	500	32.8	100.0	99.8				
Sapling stratum											
No saplings occurred in plots											

* - indicates no change

** (n) indicates loss of "n" individuals

*** 1 - Healthy, 2 - Diseased, 7 - Dying, 8 - Dormant

Table III-18

Species Composition, Frequency, Areal Cover, and Condition of Herbaceous Stratum (Plot 1), Walnut-Hickory-Buckeye (09) Cover Type, 1977 and 1978

Scientific Name	Common Name	Frequency (%)/Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Relative Frequency (%)/Areal Cover (%) 1977 Sep	1977 Oct	1978 Apr	1978 Jun	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Acer negundo	Boxelder	13/0.13	13/0.13	13/0.25	*	1.3/0.4	3.0/1.0	1.7/0.9	*	1	1	1	*
Acer saccharum**	Sugar maple	13/Tr	–	13/Tr	25/Tr	1.3/Tr	1.7/Tr	–	2.8/Tr	1	–	1	1
Actinomeris alternifolia	Wingstem	38/0.88	–	–	38/1.25	3.8/2.6	–	–	4.2/1.7	1	–	–	1
Allium canadense	Wild garlic	–	–	*	–	–	–	*	–	–	–	*	–
Anemone canadensis	Canada anemone	–	–	–	13/0.38	–	–	–	1.4/0.5	–	–	–	1
Arabis laevigata	Smooth rock-cress	13/0.13	–	–	13/0.25	1.3/0.4	–	–	1.4/0.3	1	–	–	1
Asimina triloba	Pawpaw	25/1.13	*	*	25/2.75	2.5/3.4	*	*	2.8/3.8	1	*	*	1
Cardamine douglassii	Purple cress	–	–	–	*	–	–	–	*	–	–	–	*
Carex sp.**	Sedge	–	–	–	25/0.13	–	–	–	2.8/0.2	–	–	–	1
Carya cordiformis	Yellowbud hickory	13/0.25	*	–	*	1.3/0.7	*	–	*	1	*	–	*
Carya ovata	Shagbark hickory	–	*	–	–	–	*	–	–	–	*	–	–
Cercis canadensis	Eastern redbud	50/0.13	*	–	63/0.88	5.1/0.4	*	–	7.0/1.2	1	*	–	1
Circaea alpina	Small enchanter's nightshade	38/0.50	–	–	13/0.38	3.8/1.5	–	–	1.4/0.5	1	–	–	1
Convolvulus sp.	Bindweed	*	–	–	–	*	–	–	–	*	–	–	–
Carex sp.	Sedge	50/0.38	13/Tr	13/Tr	*	5.1/1.1	3.0/Tr	1.7/Tr	*	1	1	1	*
Dentaria laciniata	Cut-leaved toothwort	–	–	100/7.63	–	–	–	13.0/28.9	–	–	–	1	–
Dicotolydonae**	Dicot A	13/Tr	–	–	–	1.3/Tr	–	–	–	1	–	–	–
Dicotolydonae**	Dicot B	25/0.63	–	–	–	2.5/1.9	–	–	–	1	–	–	–
Erigenia hulbosa	Harbinger-of-spring	–	–	88/1.38	–	–	–	11.4/5.2	–	–	–	1	–
Eupatorium serotinum	Late-flowering thoroughwort	63/1.63	75/1.63	–	88/3.25	6.3/4.8	17.5/12.3	–	9.7/4.5	1	1	–	1
Fraxinus americana	White ash	38/1.38	–	13/0.13	63/2.63	3.8/4.1	–	1.7/0.5	7.0/3.6	1	–	1	1
Fraxinus quadrangulata	Blue ash	38/1.13	*	*	*	3.8/3.4	*	*	*	1	*	*	6
Galium aparine**	Bedstraw	–	–	50/Tr	–	–	–	6.5/Tr	–	–	–	1	–
Geum canadense	Canadian avens	13/0.25	25/0.25	50/0.75	25/0.63	1.3/0.7	5.8/1.9	6.5/2.8	2.8/0.9	–	1/6	1	1
Glechoma hederacea	Gill-over-the-ground	13/0.13	13/0.13	*	–	1.3/0.4	3.0/1.0	*	–	1	1	*	–
Helianthus sp.	Sunflower	*	–	–	–	*	–	–	–	*	–	–	–
Hydrophyllum appendiculatum	Appendaged water leaf	*	–	–	–	*	–	–	–	*	–	–	–
Linderia benzoin	Spicebush	25/0.25	13/0.13	–	25/0.38	2.5/0.7	3.0/1.0	–	2.8/0.5	1	8	–	1
Lonicera japonica	Japanese honeysuckle	100/12.75	100/8.63	88/11.50	[illegible]	10.0/3[illegible]	23.3/64.9	11.4/43.5	11.0/50.0	1	1	1	1
Parthenocissus quinquefolia	Virginia creeper	88/3.63	*	25/0.13	[illegible]	8.8/[illegible]		3.3/0.5	11.0/9.0	1	*	1	1
Ranunculus sp.**	Buttercup	–	–	13/0.13	–	–	–	1.7/0.5	–	–	–	1	–
Rhus radicans	Poison ivy	88/4.75	38/0.38	63/0.25	75/12.25	8.8/14.1	8.9/2.9	8.2/0.9	8.3/16.9	1	8	1	1
Rosa sp.**	Rose	25/0.38	25/0.25	–	25/0.75	2.5/1.1	5.8/1.9	–	2.8/1.0	1	1	–	1
Rubus sp.	Blackberry	*	13/0.63	*	13/1.25	*	3.0/4.7	*	1.4/1.7	*	1	*	1
Sanicula trifoliata	Snakeroot	75/1.25	63/0.75	63/1.38	75/1.88	7.5/3.7	14.7/5.6	8.2/5.2	8.3/2.6	1	1	1	1
Saxifragaceae**	Saxifrage	13/0.13	25/0.25	–	–	1.3/0.4	5.8/1.9	–	–	1	1	–	–
Symphoricarpos orbiculatus	Coralberry	50/1.25	13/0.13	63/1.13	25/0.50	5.1/3.7	3.0/1.0	8.2/4.3	2.8/0.7	1	1	1	1
Taraxacum officinale**	Dandelion	–	–	–	13/0.13	–	–	–	1.4/0.2	–	–	–	1
Trillium sessile	Toadshade	–	–	13/0.38	–	–	–	1.7/1.4	–	–	–	1	–
Ulmus rubra	Slippery elm	38/0.38	–	25/Tr	38/Tr	3.8/1.1	–	3.3/Tr	4.2/Tr	1	–	1	1
Viola sororia**	Wooly-blue violet	25/0.13	–	13/0.13	13/Tr	2.5/0.4	–	1.7/0.5	1.4/Tr	1	–	1	1
Umbelliferae**	Umbel	–	–	63/1.25	–	–	–	8.2/4.7	–	–	–	1	–
Vitis aestivalis	Summer grape	13/0.13	*	–	13/0.13	1.3/0.4	*	–	1.4/0.2	1	*	–	1

*Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.

– Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.

**Taxa observed in plots for the first time during 1977-1978 sampling period.

***1 - Healthy, 6 - Dead, 8 - Dormant.

Tr = Trace

Table III-19

Species Composition, Frequency, Basal Area, and Condition of the Tree and Sapling Strata (Plot Type 4 and 3), Virginia Pine (11) Cover Type, September, October 1977 and April, June 1978

Scientific Name	Common Name	No. Individuals in Sample	Change in No. Individuals in Sample between 1976-1977 and 1977-1978	Frequency (%)	Basal Area (m^2/ha)	Relative Frequency (%)	Relative Basal Area (m^2/ha)	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Tree stratum											
Live condition											
Cercis canadensis	Eastern redbud	8	6*	100	3.9	28.6	13.8	1	8	8	1
Cornus florida	Flowering dogwood	1	(2)**	50	0.8	14.3	2.8	1	8	8	1
Diospyros virginiana	Persimmon	0	(1)	0	0.0	0.0	0.0				
Juniperus virginiana	Eastern red cedar	1	(1)	50	1.4	14.3	4.9	1	2	1	1
Liriodendron tulipifera	Yellow poplar	1	-	50	0.3	14.3	1.1	1	8	1	1
Pinus virginiana	Virginia pine	11	(1)	100	21.[illegible]	28.6	77.4	1/2	1	1	1
Total Live		22	1	350	28.3	100.1	100.0				
Dead condition											
None											
Total Dead		0	-	0	0.0	0.0	0.0				
TOTAL		22	1	350	28.3	100.1	100.0				
Sapling stratum											
Live condition											
Cercis canadensis	Eastern redbud	1	-	50	0.2	33.3	33.3	2	8	8	1
Cornus florida	Flowering dogwood	1	(1)	50	0.2	33.3	33.3	1	8	8	1
Juniperus virginiana	Eastern red cedar	0	(1)	0	0.0	0.0	0.0				
Liriodendron tulipifera	Yellow poplar	0	1	0	0.0	0.0	0.0				
Pinus virginiana	Black cherry	0	(1)	0	0.0	0.0	0.0				
Total Live		2	(4)	100	0.4	66.6	66.6				
Dead condition											
Cercis canadensis	Eastern redbud	0	(1)	0	0.0	0.0	0.0				
Cornus florida	Flowering dogwood	1	1	50	0.2	33.3	33.3				
Total Dead		1	-	50	0.2	33.3	33.3				
TOTAL		3	(4)	150	0.6	99.9	99.9				

* - indicates no change

** (n) indicates loss of "n" individuals

*** 1 - Healthy, 2 - Diseased, 8 - Dormant

Table III-20

Species Composition, Frequency Areal Cover, and Condition of Herbaceous Stratum (Plot 1), Virginia Pine (11) Cover Type, 1977 and 1978

Scientific Name	Common Name	Frequency (%)/Areal Cover (%) 1977 Sep	1977 Oct†	1978 Apr†	1978 Jun†	Relative Frequency (%)/Relative Areal Cover (%) 1977 Sep	1977 Oct†	1978 Apr†	1978 Jun†	Mode Condition*** 1977 Sep	1977 Oct	1978 Apr	1978 Jun
Acer saccharum**	Sugar maple	13/0.25	13/0.13	–	13/Tr	2.8/1.3	4.1/3.6	–	2.3/Tr	1	1	–	1
Allium canadense	Wild garlic	–	38/0.25	38/0.13	–	–	11.9/6.8	7.9/6.0	–	–	1	1	–
Asplenium platyneuron	Ebony spleenwort	25/0.50	*	*	*	5.3/2.5	*	*	*	1	*	*	*
Botrychium virginianum	Virginia grape-fern	*	–	–	*	*	–	–	*	*	–	–	*
Bryophyta	Mosses	–	–	*	*	–	–	*	*	–	–	*	*
Campsis radicans	Trumpet vine	*	*	–	*	*	*	–	*	*	*	–	*
Carex leersii	Little prickly sedge	25/0.13	38/0.38	25/0.13	13/0.13	5.3/0.7	11.9/10.4	5.2/6.0	2.3/1.0	1	1	1	1
Carex sp.	Sedge	–	–	–	25/0.25	–	–	–	4.5/2.0	–	–	–	1
Carya cordiformis	Yellowbud hickory	*	*	–	*	*	*	–	*	*	*	–	*
Cercis canadensis**	Eastern redbud	13/Tr	–	–	50/Tr	2.8/Tr	–	–	9.0/Tr	1	–	–	1
Compositae**	Sunflower	–	–	13/Tr	–	–	–	2.7/Tr	–	–	–	1	–
Cornus florida	Flowering dogwood	100/4.88	38/0.38	88/0.75	100/3.38	21.3/24.7	11.9/10.4	18.3/34.7	18.0/26.8	1	8	1	1
Desmodium paniculatum	Panicled tick-trefoil	*	*	–	13/0.13	*	*	–	2.3/1.0	*	*	–	1
Dioscorea villosa**	Wild yam	13/0.25	–	–	–	2.8/1.3	–	–	–	1	–	–	–
Eupatorium serotinum	Late-flowering thoroughwort	*	*	–	*	*	*	–	*	*	*	–	*
Fragaria virginiana	Wild strawberry	13/0.25	*	*	*	2.8/1.3	*	*	*	1	*	*	*
Fraxinus americana	White ash	13/0.13	*	25/0.25	–	2.8/0.7	*	5.2/11.6	–	1	*	1	–
Fraxinus quadrangulata	Blue ash	25/0.50	*	–	38/1.25	5.3/2.5	*	–	6.8/9.9	1	*	–	1
Gallium circaezans	White wild licorice	13/0.13	13/0.13	38/0.13	50/0.25	2.8/0.7	4.1/3.6	7.9/6.0	9.0/2.0	1	1	1	1
Geum canadense	Canadian avens	*	*	–	25/0.25	*	*	–	4.5/2.0	*	*	–	1
Hamamelis virginiana**	Witch-hazel	–	13/0.25	13/0.13	–	–	4.1/6.8	2.7/6.0	–	–	8	1	–
Jeffersonia diphyla	Twinleaf	–	–	–	13/0.13	–	–	–	2.3/1.0	–	–	–	1
Lonicera japonica	Japanese honeysuckle	25/6.38	13/0.50	13/0.13	13/0.25	5.3/32.2	4.1/13.7	2.7/6.0	2.3/2.0	1	1	1	1
Osmorhiza claytonii**	Sweet cicely	13/Tr	–	–	–	2.8/Tr	–	–	–	1	–	–	–
Parthenocissus quinquefolia	Virginia creeper	13/2.38	13/0.13	50/0.13	38/4.38	2.8/12.0	4.1/3.6	10.4/6.0	6.8/34.7	1	8	1	–
Phryma leptostachya**	Lopseed	–	13/0.50	–	–	–	2.8/2.5	–	–	–	1	–	–
Pinus virginiana**	Virginia pine	–	13/0.13	–	–	–	4.1/3.6	–	–	–	1	–	–
Podophyllum peltatum**	May-apple	–	–	13/Tr	13/0.13	–	–	2.7/Tr	2.3/1.0	–	–	1	1
Prunus serotina	Black cherry	13/0.13	75/1.00	63/0.38	38/0.38	2.8/0.7	23.6/27.4	13.1/17.6	6.8/3.0	1	1	1	1
Quercus rubra	Red oak	*	*	13/Tr	25/0.38	*	*	2.7/Tr	4.5/3.0	*	*	1	1
Rhus radicans	Poison ivy	38/2.50	–	–	13/0.38	8.1/12.6	–	–	2.3/3.0	1	–	–	1
Robinia pseudoacacia**	Black locust	25/0.38	–	–	–	5.3/1.9	–	–	–	1	–	–	–
Rosaceae**	Rose family	13/0.25	–	–	–	2.8/1.3	–	–	–	1	–	–	–
Rubus sp.	Blackberry	*	*	–	*	*	*	–	*	*	*	–	*
Sanicula trifoliata	Snakeroot	50/0.25	38/0.25	88/Tr	50/0.88	10.7/1.3	11.9/6.8	18.3/Tr	9.0/7.0	–	1	1	1
Smilax sp.	Greenbriar	*	*	–	–	*	*	–	–	*	*	–	–
Smilax herbacea	Carrion-flower	*	13/0.13	–	*	*	4.1/3.6	–	*	*	1	–	*
Solidago sp.	Goldenrod	*	*	–	*	*	*	–	*	*	*	–	*
Taraxacum sp.**	Common dandelion	–	–	–	13/0.13	–	–	–	2.3/1.0	–	–	–	1
Ulmus rubra	Slippery elm	*	–	–	–	*	–	–	–	*	–	–	–
Viola sororia**	Wooly-blue violet	13/Tr	–	–	13/Tr	2.8/Tr	–	–	2.3/Tr	1	–	–	1

*Taxa was observed in plots during indicated previous sampling period (1976-1977), but not during the current sampling period.

– Taxa was not observed in plots during indicated sampling period previously nor during the current sampling period.

**Taxa observed in plots for the first time during 1977-1978 sampling period.

***1 - Healthy, 8 - Dormant.

†Sampling station 101 relocation may reflect some differences between years.

Tr = Trace

quinquefolia) comprised 62 percent of the vegetative ground cover in June 1978. Thirty-four taxa, including 13 previously unrecorded species, were observed during the current sampling.

Ground was cleared to within approximately 30 feet of the remaining original set of plots. An increase in light intensity is reflected by an increase in vegetative ground cover between the cleared area and the sampling plots. Flowering dogwood, wild garlic (Allium canadense), and poison ivy (Rhus radicans) formed the majority of areal ground cover and probably will increase in the plots in future samplings.

- Orchard (10)

The CIR photo overlay (Figure III-5) shows current status of individual apple and peach sets (plantings) on the Reed Orchard Company property; Table III-21 lists the type, age, and condition of the individual sets. All Peach Sets except P5, P6, and P9 are recovering from cold injury received during the 1976-1977 winter; P5, P6, and P9 received additional slight cold injury during the 1977-1978 winter. Severe infection by peach tree borers in P6 and P9 have further deteriorated these sets. Extensive pruning, including thinning of many trees, accompanied by replanting of several hundred individuals in P6 were in progress during June 1978 sampling. No cold injury or other disease was evident in the seven apple sets, and abundant fruit was present. Where fruit was present on peach trees it was healthy, although a less than average peach crop for 1978 was expected.*

2. Soils

- Moisture

Soil moisture values for the current sampling period (Table III-22) were generally lower than values for the previous period (1976-1977), especially in April and June. However, September 1977 values were

*Personal Communication - Mr. Reed, Reed Orchard Company, R.R.1, Hanover, Indiana, 47243

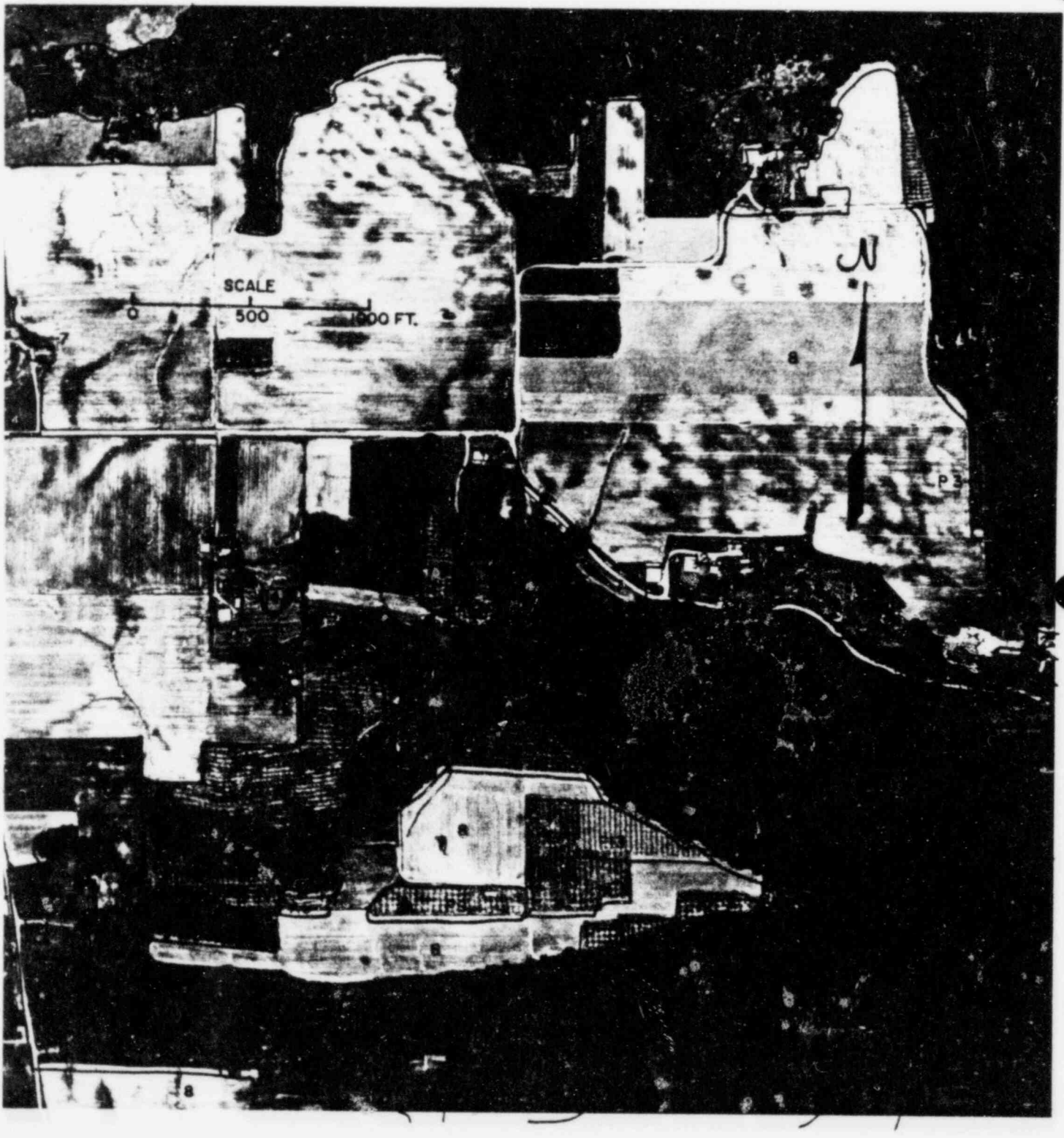

Figure III-5. Color Infrared Aerial Photograph of Reed Orchard Company Property with Overlay Depicting Vegetation Cover Types and Location of Orchard Sets, May 1978

Table III-21

Fruit Tree Type, Condition and Age of Sets for the Orchard Type (10), Reed Orchard Company Property, June 1978

Code*	Set Type	Age of Set (yr)**	Vegetative	Fruit	Remarks
P1	Peach	6	Healthy	Healthy	Recovering from 1976 cold injury
P2	Peach	13	Healthy	Healthy	Recovering from 1976 cold injury
P3	Peach	4	Healthy	Healthy	Recovering from 1976 cold injury
P4	Peach	11	Healthy	Healthy	Recovering from 1976 cold injury
P5	Peach	11	Diseased	Reduced yield	Peach borer and cold injury
P6	Peach	16/1	Diseased/mechanical injury	None	Peach borer and cold injury
P7	Peach	14	Healthy	Healthy	Recovering from 1976 cold injury
P8	Peach	6	Healthy/diseased	Healthy	Peach borer and cold injury
P9	Peach	19	Diseased/mechanical injury	Reduced yield	Peach borer and cold injury
P10	Peach	32	Healthy/diseased	Healthy	Slight peach borer damage
P11	Peach	32	Healthy	Healthy	Recovering from 1976 cold injury
P12	Peach/Apple	14	Healthy	Healthy	Recovering from 1976 cold injury
P13	Peach	4	Healthy	Healthy	Recovering from 1976 cold injury
P14	Peach	6	Healthy	Healthy	Recovering from 1976 cold injury
P15	Peach	Mixed	Healthy/mechanical injury	Healthy	Recovering from 1976 cold injury
A1	Apple	6	Healthy	Healthy	Recovering from 1976 cold injury
A2	Apple	6	Healthy	Healthy	Recovering from 1976 cold injury
A3	Apple	12	Healthy	Healthy	Recovering from 1976 cold injury
A4	Apple	12	Healthy	Healthy	Recovering from 1976 cold injury
A5	Apple	12	Healthy	Healthy	Recovering from 1976 cold injury
A6	Apple	6	Healthy	Healthy	Recovering from 1976 cold injury

*Code identifies location of individual sets on photo overlay (Figure

**Personal Communication - Mr. Reed, Reed Orchard Company, R.R. 1, Hanover, Indiana 47243

higher than September 1976 values. The maple-basswood, walnut-hickory-buckeye, and oak-maple cover types generally had high soil mositure values while the red pine, Virginia pine, sycamore-boxelder, and orchard types had low soil moisture values.

- Bulk Density

Soil bulk density values (Table III-23) were slightly lower in September and October of the current sampling period than during the same months during 1976 of the previous sampling period. This was probably due to the high soil moisture during the spring of the previous sampling period. In general, increases in soil moisture tend to promote conditions that decrease bulk density thereby increasing the porespace of the soil. Vegetation cover types with low soil moisture (e.g. red pine, Virginia pine,

Table III-22

Mean ($\bar{x}$) and Standard Error (SE) Values* for Soil Moisture (%) from Each Vegetation Cover Type for September, October 1977 and April, June 1978

		1977				1978			
		SEP		OCT		APR		JUN	
Code	Cover Type	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
01	Maple-Basswood	66.1	3.0	40.2	2.0	39.3	6.6	38.8	4.6
02	Oak-Maple	73.2	3.2	32.8	3.5	35.9	1.2	32.8	1.5
03	Chestnut oak	77.8	3.2	30.0	5.6	29.6	6.4	31.2	1.4
04	Red pine	80.2	3.9	25.8	1.8	28.1	2.0	25.5	0.7
05	Sycamore-Boxelder	79.0	4.7	27.3	2.5	24.8	4.9	27.8	3.2
06	Oak-Hickory	83.5	1.5	27.4	2.2	29.5	1.2	22.1	0.6
09	Walnut-Hickory-Buckeye	65.5	3.0	39.2	4.7	34.3	6.0	41.3	4.4
10	Orchard	85.5	8.6	24.6	1.4	24.6	2.0	23.4	1.3
11	Virginia pine	79.1	4.1	26.7	1.8	26.7	1.7	24.4	2.4

*Based on 4 replicates per cover type per date sampled

Table III-23

Mean ($\bar{x}$) and Standard Error (SE) Values* for Soil Bulk Density (g/cm^3) from Each Vegetation Type for September, October 1977 and April, June 1978

		1977				1978			
		SEP		OCT		APR		JUN	
Code	Cover Type	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
01	Maple-Basswood	0.711	0.126	0.505	0.114	0.718	0.113	0.729	0.079
02	Oak-Maple	0.743	0.054	0.434	0.137	0.744	0.101	0.863	0.075
03	Chestnut oak	0.737	0.085	0.417	0.126	0.729	0.080	0.810	0.047
04	Red pine	0.870	0.121	0.385	0.110	0.941	0.036	0.969	0.154
05	Sycamore-Boxelder	0.731	0.051	0.386	0.103	0.937	0.092	1.004	0.069
06	Oak-Hickory	0.805	0.068	0.373	0.103	0.728	0.131	0.845	0.107
09	Walnut-Hickory-Buckeye	0.773	0.079	0.394	0.137	0.701	0.063	0.661	0.092
10	Orchard	0.923	0.131	0.404	0.033	0.848	0.181	0.939	0.090
11	Virginia pine	1.009	0.100	0.346	0.028	0.743	0.188	0.788	0.097

*Based on 4 replicates per cover type per date sampled

sycamore-boxelder, and the orchard types) also had high bulk density soils. High bulk density of soils in the orchard type were similar to the 1976-1977 sampling season values and were probably due to machinery compaction.

- pH

Soil pH values (Table III-24) were about the same for September and March-April of both sampling periods, while values for October and June of the current sampling period were slightly lower than during the same months in 1976 and 1977 respectively. Soil pH fluctuations usually reflect changes in soil moisture preceding the actual pH measurement and are caused primarily by chemical changes in sulfate and carbonate compounds upon drying. Cover types with low soil types continued to exibit the lowest soil pH values. Lower pH values may also be related to greater soil leaching in these types.

- Conductivity

Electrical conductivity (soil salinity) values (Table III-25) were about the same for September and October of the current and 1976-1977 sampling periods. However, during April and June 1978, values differed significantly between values for 1977. Values for April 1978 were the lowest of all values recorded during the monitoring period. This was probably due to leaching within the soil profile from heavy winter and spring precipitation. Salinity values in June 1978 were the highest recorded during the monitoring period and may have reflected the low soil moisture and general drying of the soil which resulted in surface-salt accumulations.

To understand existing salt accumulation patterns in the soil, it is necessary to briefly describe a few characteristics of soluble salts. Naturally occurring soluble salts tend to move with water and may be carried by precipitation or runoff into topographically lower areas where percolation allows salts to move deep in the soil-forming layers. This process of outward movement of salts is called leaching.

Table III-24

Mean ($\bar{x}$) and Standard Error (SE) Values* for Soil pH (measured in water) from Each Vegetation Cover Type for September, October 1977 and April, June 1978

		1977				1978			
		SEP		OCT		APR		JUN	
Code	Cover Type	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
01	Maple-Basswood	7.3	0.1	7.5	0.0	7.1	0.3	6.3	0.1
02	Oak-Maple	7.2	0.5	6.9	1.1	7.3	0.2	6.7	0.2
03	Chestnut oak	7.3	0.4	7.6	0.3	7.2	0.1	6.6	0.1
04	Red pine	5.8	0.3	5.6	0.6	6.2	0.2	6.1	0.1
05	Sycamore-Boxelder	6.7	1.1	7.0	1.1	6.5	0.7	6.1	0.4
06	Oak-Hickory	7.7	0.2	7.9	0.1	7.5	0.2	6.6	0.1
09	Walnut-Hickory-Buckeye	7.5	0.1	7.4	0.2	7.1	0.1	6.6	0.1
10	Orchard	6.9	0.4	7.1	0.4	6.1	0.2	6.3	0.5
11	Virginia pine	5.9	0.5	5.4	0.3	5.6	0.3	5.7	0.1

*Based on 4 replicates per cover type per date sampled

Table III-25

Mean ($\bar{x}$) and Standard Error (SE) Values* for Soil Conductivity (μmho/cm) from Each Vegetation Cover Type for September, October 1977 and April, June 1978

		1977				1978			
		SEP		OCT		APR		JUN	
Code	Cover Type	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
01	Maple-Basswood	232	41	272	41	76	15	567	107
02	Oak-Maple	207	33	210	38	90	10	407	93
03	Chestnut oak	225	22	230	62	113	39	426	50
04	Red pine	159	26	192	92	46	7	119	10
05	Sycamore-Boxelder	260	30	192	39	144	71	328	128
06	Oak-Hickory	278	38	228	28	137	81	388	60
09	Walnut-Hickory-Buckeye	235	26	290	56	169	59	321	63
10	Orchard	247	44	183	57	246	35	403	222
11	Virginia pine	166	27	158	19	59	35	106	21

*Based on 4 replicates per cover type per date sampled

Soluble salt concentrations in the surface soil vary seasonally and are highly related to the precipitation-evaporation characteristics of a site. After periods of considerable precipitation, salts may be leached from the site or deposited deeper in the soil layers at the same site. During dry periods, evaporation of soil moisture draws salts to the surface where accumulation results.

Drainage patterns, largely influenced by topography, and physical characteristics of the soil determine salt deposition patterns for any given area. Ridges or hilltops in an area often have greater leaching of the soil due to runoff characteristics while moist areas or lowland basins receive runoff waters high in soluble salts from other areas.

Vegetation cover types in an area are often correlated with drainage and salt accumulation patterns. This is well illustrated by the vegetation cover types within the study area. For example, the Virginia pine and red pine cover types both occur on the ridgetops and have the lowest soil moisture and soluble salt concentrations when compared with soils of other cover types (Table III-26 and Figure III-6). Similarly, the maple-basswood, oak-hickory and walnut-hickory-buckeye have the highest soil moisture and soluble salt concentrations. The high salinity values for soils in the Reed Orchard Company site are probably a result of fertilizer applications. Based on other soil parameters the orchard type is more similar to the pine cover types.

The effects of salts on vegetation are often evaluated on the basis of electrical conductivity of an aqueous solution (e.g., soil, irrigation, or rainwater). As shown in Figure III-7, salt solutions with electrical conductivity values of 0 to 2,000 micromhos/cm at 25° usually have negligible effects on plants; values from 2,000 to 4,000 may restrict the yield of salt-sensitive crops; values from 4,000 to 8,000 restrict the yield of many plant species, and at values over 8,000 micromhos/cm only salt-tolerant species yield satisfactorily (Richards 1954). As shown in Table III-26 the highest single electrical conductivity value encountered was 710 micromhos/cm in the Orchard Cover type. This is still far below salinity levels

Table III-26

Mean ($\bar{x}$) and Standard Error (SE) for Soil Conductivity (micromhos/cm at 25°C) from Each Vegetation Cover Type for the Period of Sampling (September 1977 to June 1978)

Code	Cover Type	Soil Moisture (%) $\bar{x}$	SE	Rank	Soil Conductivity (micromhos/cm) $\bar{x}$	SE	Rank	Maximum Single Value (Sep 77-Jun 78)
01	Maple-Basswood	46.1	13.3	1	286.8	205.1	1	698*
02	Oak-Maple	43.7	19.7	3	228.5	131.5	7	525*
03	Chestnut oak	42.2	23.8	4	248.5	130.1	5	500*
04	Red pine	39.9	26.9	6	129.0	62.9	8	328**
05	Sycamore-Boxelder	39.7	26.2	7	231.0	80.3	6	515*
06	Oak-Hickory	40.6	28.8	5	257.8	104.6	3	478*
09	Walnut-Hickory-Buckeye	45.1	13.9	2	253.8	66.8	4	370*
10	Orchard	39.5	30.7	8	269.8	93.7	2	710*
11	Virginia pine	39.2	26.6	9	122.3	49.9	9	203***

*In June 1978
**In October 1977
***In September 1977

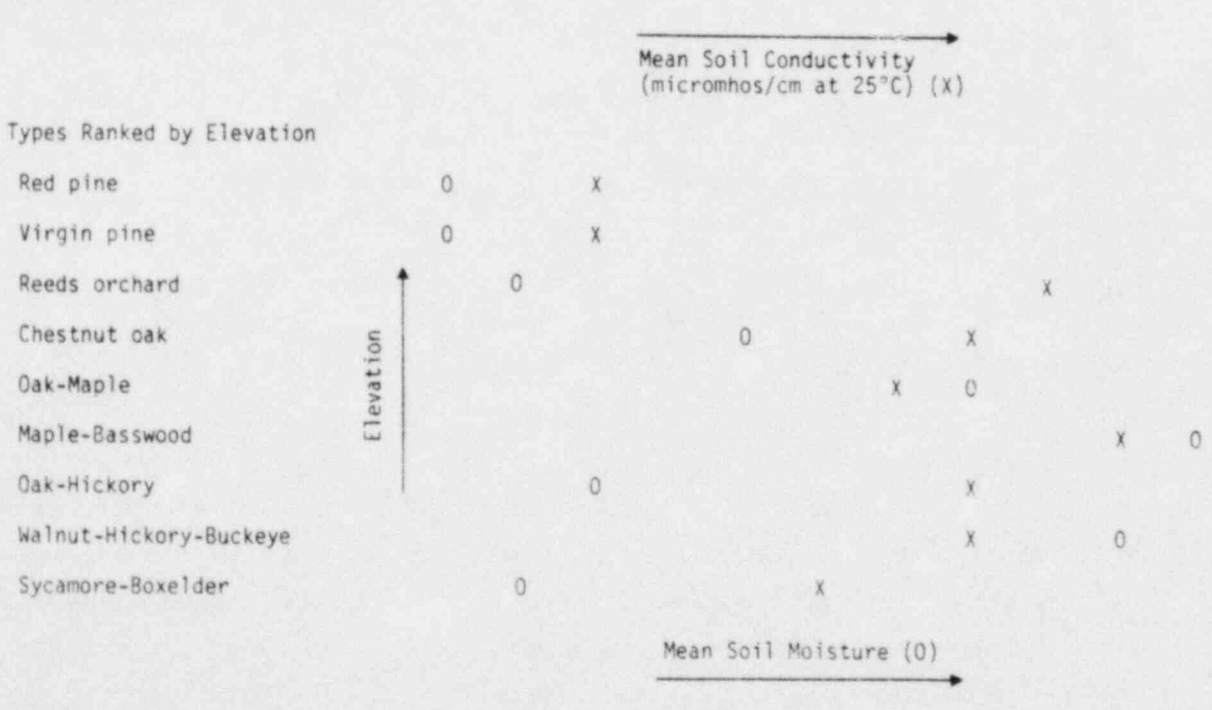

Figure III-6. Relationship of Vegetation Types, Elevation, Mean Soil Conductivity, and Mean Soil Moisture for Sample Plots in the Marble Hill Units 1 and 2 Study Area

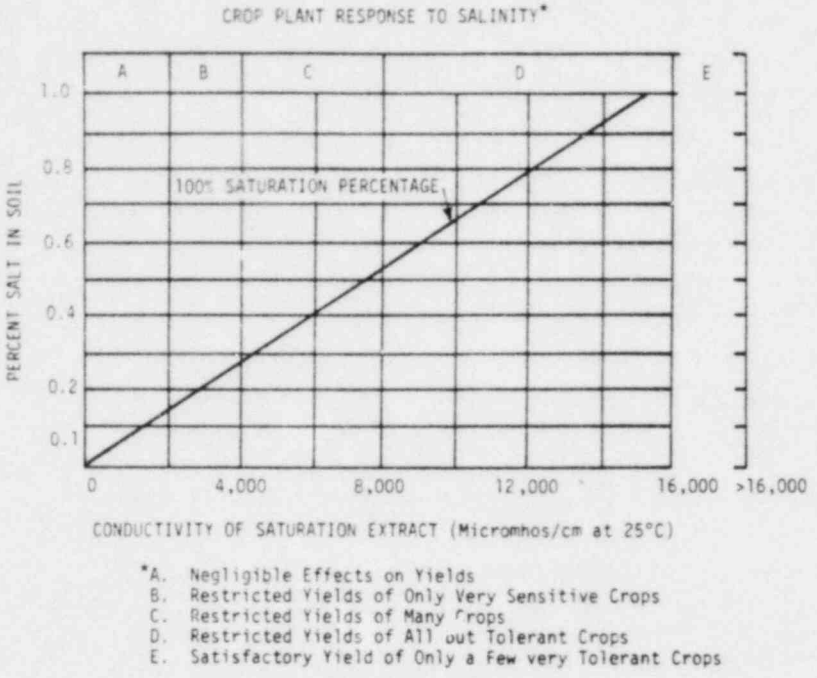

Figure III-7. Relation of the Percent Salt in the Soil to the Electrical Conductivity of the Saturation Extract to Crop Response in the Conductivity Ranges Designated by Letters (A, B, C, D, E). (These ranges are related to crop response by salinity scale, after Richards 1954, p. 9).

that might be harmful to crop or native plant species. From the existing data collected to date it does not appear that natural salinity levels reach sufficient concentrations to create serious soil salinity problems.

- Cation Exchange Capacity and Base Saturation Percentage

During September and October of the current sampling period, cation exchange capacity values of the soil (Table III-27) were slightly lower than values from September and October 1976. This is probably due to decomposition of organic matter that resulted from moist soil conditions during the spring of 1977. Similarly, cation exchange capacity of the soils in April and June of the current sampling period were slightly lower than April and June 1977, and may have also resulted from the moist soil conditions during the winter and spring (1978) of the current sampling period.

Table III-27

Mean ($\bar{x}$) and Standard Error (SE) Values* for Soil Cation Exchange Capacity (meq/100g) from Each Vegetation Cover Type for September, October 1977 and April, June 1978

		1977				1978			
		SEP		OCT		APR		JUN	
Code	Cover Type	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
01	Maple-Basswood	50.4	40.9	12.5	2.1	42.9	7.1	49.4	6.4
02	Oak- Maple	18.7	9.1	13.5	2.9	40.1	9.3	35.6	3.5
03	Chestnut oak	23.6	4.1	13.2	2.5	41.5	6.5	42.4	2.8
04	Red pine	18.2	2.3	10.6	1.8	20.9	4.1	19.1	2.1
05	Sycamore-Boxelder	18.9	1.7	12.6	0.8	21.0	4.7	28.6	9.3
06	Oak-Hickory	23.1	2.3	15.8	2.6	27.1	8.9	30.7	3.6
09	Walnut-Hickory-Buckeye	25.2	3.5	16.6	8.0	43.5	5.8	41.5	12.6
10	Orchard	18.2	2.6	10.8	2.4	14.3	2.1	15.6	0.7
11	Virginia pine	14.9	1.5	11.5	1.9	20.7	4.0	17.1	1.3

*Based on 4 replicates per cover type per date sampled

The removal of organic matter by extensive decomposition following periods of high soil moisture causes significant reductions in cation exchange capacity. Such reductions release soluble salts in the form of cations and anions that were previously loosely attracted to charged surfaces on the organic matter. After release, the soluble salts are more subject to leaching within or from the soil area.

Substantial fluctuations in the cation exchange capacity from season to season suggest that organic matter contributes significantly to the cation exchange capacity of soils in the study area, especially cover types with moist soil. That soil moisture is a key factor is also supported by the fact that cover types with the lowest soil moisture (e.g., red pine, Virginia pine, sycamore-boxelder and orchard types) also had the lowest cation exchange capacities. Conversely, those cover types with high soil moisture also had high cation exchange capacities.

Cover types with low soil moisture probably have low organic matter in the soil as well, and clay particles would be primarily responsible for determining the cation exchange capacity of the soil. Seasonal moisture fluctuations that result in decomposition of organic matter therefore do not result in large fluctuations in either the soil cation exchange capacity or the soil base saturation (Table III-28) in these cover types with low soil moisture. This is supported by the fact that cover types with low soil moisture had the lowest variance around the mean (standard error) for both cation exchange capacity and soil base saturation, while cover types with high soil moisture had the highest seasonal variance for these soil parameters.

Table III-28

Mean ($\bar{x}$) and Standard Error (SE) Values* for Soil Base Saturation (%) from Each Vegetation Cover Type for September, October 1977 and April, June 1978

		1977				1978			
		SEP		OCT		APR		JUN	
Code	Cover Type	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
01	Maple-Basswood	36.0	33.7	58.8	40.0	23.8	10.7	33.9	10.9
02	Oak-Maple	61.0	29.7	63.6	30.0	20.0	9.3	29.9	9.0
03	Chestnut oak	48.5	18.4	89.0	18.7	28.8	6.4	23.2	2.4
04	Red pine	27.6	3.6	27.1	8.5	23.4	10.3	25.4	5.9
05	Sycamore-Boxelder	71.8	40.6	55.8	16.5	36.3	13.5	48.5	17.9
06	Oak-Hickory	74.2	11.6	66.5	18.6	41.1	13.5	51.3	11.1
09	Walnut-Hickory-Buckeye	81.1	13.5	94.9	76.0	37.4	12.2	32.1	6.1
10	Orchard	29.6	3.7	49.2	11.2	31.6	14.9	31.0	2.7
11	Virginia pine	22.9	5.4	25.8	3.9	34.6	15.4	27.1	8.6

*Based on 4 replicates per cover type per date sampled

3. Predicted Cooling Tower Drift

Salt deposition from cooling towers could potentially stress vegetation through long-term accumulations in the soil medium or by short-term impingement on leaf surfaces.

Where salt accumulations in the soil are substantial, depression of plant growth may occur. This depression of growth may be due to the direct effect of salt in reducing water uptake by plants, the direct effect of salt in disturbing the plant's nutrition and metabolism, and the indirect effects of salt in changing soil sturcture, permeability, and aeration. The salt content at which plant growth is impaired is dependent upon the moisture characteristics of the soil, the distribution of the salt in the profile, the chemical composition of the salt, and the type of plant.

The soil-parameter data collected over the past several seasons will provide a reasonable means of evaluating fluctuations in soil salinity or other parameters to determine if such fluctuations are within naturally occurring fluctuations or whether fluctuations are significantly different and possibly the result of cooling tower drift. However, current drift modeling based on published deposition rates and average monthly precipitation near the site (Public Service Company of Indiana, Inc., 1976) indicates that no significant salt accumulations are expected.

The estimated mean electrical conductivity (micromhos/cm at 25°C) of the soil solution at several distances and directions from the cooling towers shown in Table III-29. Electrical conductivity values were calculated using the mean monthly precipitation at Madison, Indiana for the period of record (1941 to 1970) as published in the Marble Hill Environmental Report (Table 2.6-8, 1976) and the expected rate of deposition of drift solids (Table 5.1-15, 1976). The assumptions in the calculations are that 1) the salts from the drift are uniformly distributed on the ground surface until the end of a given time period (e.g., 1 month) at which time all of the expected precipitation arrives and dissolves the salts, and 2) that the salts are completely soluble. The concentration of soluble salts in the soil solution by evapotranspiration during the time period and residual salts from the previous time periods are not considered in the calculations. Electrical conductivity values were calculated from the following formula (Bower and Wilcox, 1965):

$$EC = \left[\frac{S\ (453592.37)}{P\ (102796.53)}\right]\ \left[\frac{1000}{640}\right]$$

where

EC = electrical conductivity in micromhos/cm at 25°

S = lb of salt deposited per acre-month (or year)

P = inches of precipitation per month (or year)

1 lb per acre = 453,592.35 mg per acre

1 inch of precipitation = 102,976.5262 liters per acre

Table III-29

Estimated Mean Electrical Conductivity in Micromhos/cm at 25°C of the Soil Solution Based on Mean Monthly Precipitation at Madison, Indiana for the Period of Record (1941-1970) [Table 2.6-8, MH-ER(CP) 1976] and the Expected Rate of Deposition of Drift Solids [Table 5.1-15, MH-ER(CP) 1976]

Direction from Cooling Towers	Distance from Cooling Towers (meters)						
	100	200	300	500	1,000	5,000	10,000
N	70	177	77	53	40	4	1
NNE	84	233	100	70	53	5	2
NE	73	86	82	61	45	4	1
ENE	35	89	45	44	32	2	1
E	23	61	34	41	30	2	1
ESE	22	59	35	45	33	2	1
SE	21	54	29	33	25	2	1
SSE	12	32	21	31	22	1	<1
S	21	55	27	26	20	2	<1
SSW	21	55	26	22	16	1	<1
SW	23	60	29	28	20	2	<1
WSW	27	70	30	22	16	2	<1
W	30	77	33	23	17	2	1
WNW	30	74	30	16	12	1	<1
NW	38	97	38	17	13	2	1
NNW	36	91	39	26	16	2	1

The maximum electrical conductivity value expected to occur is 233 micromhos/cm in a NNE direction 200 meters from the tower. By 1,000 meters from the cooling towers, the concentrations drop to levels comparable to reported values for rainwater (2 to 42 micromhos/cm). The estimated salinity concentrations could be greater by a factor of 10 and still result in negligible effects on crop yields. Therefore if the deposition modeling is correct, it is unlikely that cooling tower drift will contribute to vegetation stress through long-term accumulations in the soil medium, especially since established precipitation exceeds the evapotranspiration potential for the area.

If vegetation stress is created by salt deposition from the cooling tower it will most likely result from salt impingement on the leaf surfaces. The potential for vegetation damage is greatest under strong air turbulance and high salt concentrations that might occur in summer months when salt concentrations of the water supply are highest due to high evaporative losses from the river. Such vegetation stress will be readily apparent in color infrared coverage of the area.

Tolerance to damage caused by salt impingement on the leaf surfaces is variable among plant species. Tolerance also varies according to the stage of growth development and is also influenced by synergistic effects of other stresses (e.g., drought, insect, wind, and frost damage). In general, broadleaf deciduous species are more susceptible to leaf damage than needleleaf evergreen species. Most species can tolerate a certain amount of leaf damage before severe physiological problems develop that might affect the long-term vitality of individual plants.

In all probability, it is likely that some years will have significantly greater potential for leaf damage from drift salts than others (e.g., drought years with little precipitation to remove accumulations on leaves). Here again, most species will recover even after substantial damage if subsequent climatological conditions are favorable. Impacts under

such conditions may be primarily visual with alterations in the aesthetic quality of the environment. However, it is also possible that more significant impacts (e.g., reduced seed production, elimination of vulnerable age classes of seedlings or saplings, and minor alterations in the fauna of the area) could result if stress conditions are severe.

B. VEGETATION STRESS

Sixty-two discrete areas of apparent vegetation stress were delineated within the survey area (Figure III-2); 45 were less than 5 acres and are listed by cover type and location in Table III-30. Most of these small areas consisted of only one to five trees exhibiting various stress reactions.

Table III-30

Cover Type and Location of Vegetation Stress Areas Covering Less Than 5 Acres within the Marble Hill Survey Area, May 1978

Cover Type	Location*	Number of Stress Areas	Comments
9	1C**	1	Generally recovering
2	2B	1	Single trees
9/2	2B	1	Sprayed right-of-way
5	2C**	4	Sprayed trees
6	2D**	1	Single trees
3	3A**	1	Single trees
9	3A**	3	Single trees
9	3A	2	Single trees
7	3A	2	Single trees
9	3B**	2	Single trees
7	3B	2	Single trees
3	4A	2	Single trees
1	4A	2	Single trees
2	4A	1	Single trees
9	4B**	4	Generally recovering
6	4C**	1	Single tree
2	5A	2	Locust leaf miner
2	5A**	1	Single tree
11	6A	1	Single tree
11	6B	1	Single tree
7	7A	1	Single tree
4	7A	1	Single tree
1	7B**	1	Single tree
9	8D	1	Single tree
2	11B	3	Locust leaf miner
1	11C	1	Undetermined stress in Virginia pine
2	12C	2	Single trees

*Keyed to location grid on vegetation cover type map (Figure III-2) and within a grid unit from north to south

**Stress areas first recorded during previous sampling (May 1977)

Causal agents that were identified included cold weather, bagworms, various blights, insects, general decline, and herbicides. Seventeen areas are listed in Table III-31 by cover type, location, and causal agent (if known). During June 1978 sampling, no indication of SO_2 stress was observed. The areas affected by this agent during the previous sampling (TI 1977) were generally recovering.

Table III-31

Cover Type, Location and Causal Agent of Vegetation Stress for Areas 5 Acres within the Marble Hill Survey Area, May 1978

Cover Type	Location*	Number of Stress Areas	Comments
6	2C**	1	Generally recovering: locust leaf miner
5	4C**	1	Generally recovering
2	4C**	1	Generally recovering
9	4C**	2	Partial recovery: locust leaf miner
1	6B**	1	Pipeline effluent***
6/2	9D	1	Locust leaf miner
10	9A**	1	Generally recovering: cold weather and peach tree borer
10	9B**	1	Generally recovered
2	9B	1	Sprayed right-of-way
2/6	9C	1	Locust leaf miner
2	10B	1	Dieback on sycamores
4	10C**	1	General decline of red pine
2	11A	1	Locust leaf miner
2	11B	3	Locust leaf miner

*Keyed to location grid on vegetation cover type map (Figure III-1) and within a grid unit from north to south.

**Stress areas first recorded during previous sampling (May 1977).

***Apparent source of stress.

Area 10-9A, Reed Orchard Company, generally was recovering from the previous year's frost damage (TI 1977). However, two peach sets had severe infections of peach tree borer (refer to Figure III-5, Table III-21, and associated text).

Area 4-10B continued to exhibit stress on the red pine trees. A general trend toward decline in stand quality was apparent (Figures III-3 and III-4 and Table III-11).

At location 2-10B, stress was limited to scattered sycamore trees and was apparent as dieback of some crown branches. The stress appeared to be from general decline. The exact causal agent could not be determined (refer to Figures III-1 and III-2) however, and the decline could have been caused by cold weather, or by a change in the local drainage pattern, which may have developed from the construction of the settling pond on the Marble Hill Construction site.

Infestation of the locust leaf miner (Chalepus dorsalis) occurred in nearly all stands of black locust trees. The locust leaf miner is a common enemy of the black locust in the Marble Hill area, but apparently does little damage other than limit seasonal growth (personal communication - James Newman, forester, Kentucky agricultural extension service). The locust leaf miner attacks the leaves in early spring and by mid-June trees show a conspicuous "burned" appearance (Figure III-8) (Fowells 1965). Because areas of stress from this agent were extensive both in and outside the study area, only the stands with severe infestations were mapped (Figure III-9). These areas are presented in Tables III-30 and III-31 and in Figure III-2. Generally, black locust most commonly is associated with oak-maple (02), sycamore-boxelder (05), oak-hickory (06), and walnut-hickory-buckeye (09) cover types in the s y area.

Figure III-8. Leaf Damage on Black Locust from Locust Leaf Miner

Figure III-9. Stand of Black Locust with Severe Infestation of Locust Leaf Miner

SECTION IV

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APPENDIX A

TAXA PRESENT IN SAMPLED COVER TYPES, SEPTEMBER 1976 THROUGH JUNE 1978

Table A-1

List of Plant Taxa Present in Sampled Cover Types, September 1976 through June 1978

Scientific Name	Common Name	Cover Type 01	02	03	04	05	06	09	11
Acer negundo	Boxelder					X		X	
Acer saccharum	Sugar maple	X	X	X	X		X	X	●
Actinomeris alternifolia	Wingstem			●		X		X	
Aesculus glabra	Ohio buckeye					●	X	X	
Aesculus octandra	Yellow buckeye	X		●					
Allium canadense	Wild garlic		X	X			X	X	X
Amaranthus sp.	Pigweed					X	X		
Anemone canadensis	Canada anemone						X		
Anemone quinquefolia	Wood anemone		X	X					
Anemone virginica	Thimbleweed			X					
Anemonella thalictroides	Rue anemone	X	X	X			X		
Arabis laevigata	Smooth rock-cress		●	X				X	
Aralia spinosa	Hercules-club		X						
Arisaema atrorubens	Jack-in-the-pulpit	X							
Asarum canadense	Wild ginger	X							
Asimina triloba	Pawpaw	X						X	
Asplenium platyneuron	Ebony spleenwort								X
Aster sp.	Aster		X			X			
Aster azureus	Azure aster		X	X			X		
Aster divaricatus	White wood aster		●						
Bidens sp.	Beggar's ticks					●			
Botrychium virginianum	Virginia grape-fern		X						X
Bryophyta	Mosses								X
Bumelia lanuginosa	Chittamwood						X		
Campsis radicans	Trumpet vine								X
Cardamine douglassii	Purple cress						X	X	
Carex leersii	Little prickly sedge								X
Carex sp.	Sedge			●		●	X	●	
Carpinus caroliniana	Blue beech	X	X						
Carya sp.	Hickory							X	
Carya cordiformis	Yellowbud hickory	X	X				X	X	X
Carya ovata	Shagbark hickory							X	
Catalpa speciosa	Northern catalpa						X		
Celtis occidentalis	Hackberry			X		X		X	
Cercis canadensis	Eastern redbud		X	X	X		X	X	X
Circaea alpina	Small enchanter's nightshade					X	X	X	
Claytonia virginica	Spring-beauty	X	X			X			
Clematis viorna	Leather flower			X					
Commelina sp.	Dayflower					X	X		
Convolvulus sp.	Bindweed							X	
Cornus florida	Flowering dogwood		X	●	X	X			X
Cornus prieeae	Miss Price's cornel						X		
Cryptotaenia canadensis	Honewort					X			
Delphinium tricorne	Dwarf larkspur		●	●			●		
Dentaria laciniata	Cut-leaved toothwort	X	X	X	X	X	X	X	
Desmodium glutinosum	Pointed-leaved tick-trefoil		X						
Desmodium paniculatum	Panicled tick-trefoil								X
Dicentra sp.	Bleeding heart								X
Dicentra cucullaria	Dutchman's breeches		X						
Dioscorea villosa	Wild yam			X					●
Diospyros virginiana	Persimmon			X					X
Elymus virginicus	Virginia wild rye		X	●		●			
Erigenia bulbosa	Harbinger-of-spring	X	X					X	
Erythronium albidum	White trout-lily						X		
Erythronium americanum	Adder's-tongue		X						
Euonymus americanus	American strawberry-bush						X		
Eupatorium maculatum	Spotted joe-pye-weed			X					
Eupatorium serotinum	Late-flowering thoroughwort	X			X	X	X	X	X
Fagus grandifolia	Beech	X	X		X				
Fragaria virginiana	Wild strawberry				X				X
Fraxinus americana	White ash	X	X	X	X		X	X	X
Fraxinus quadrangulata	Blue ash		X	X	X		X	X	X
Galium aparine	Bedstraw							●	
Galium asprellum	Rough bedstraw				X				
Galium boreale	Northern bedstraw	X	X						
Galium circaezans	White wild licorice		X	X	X	X	●		X
Galium triflorum	Fragrant bedstraw	X			X	X			
Geum canadense	Canadian avens	●	X	X	X	X	X	X	X
Glechoma hederacea	Gill-over-the-ground						●	X	
Gleditsia triacanthos	Honey locust					X	X		
Goodyera sp.	Rattlesnake plantain				X				
Gymnocladus dioica	Kentucky coffee-tree						X	X	
Hamamelis virginiana	Witch-Hazel								●
Helianthus sp.	Sunflower			X				X	
Hemerocallis fulva	Daylily	X							
Hydrophyllum appendiculatum	Appendaged water leaf		X					X	
Hystrix patula	Bottlebrush			X			X		

X – Taxa observed during 1977-78 sampling.

● – Taxa observed for the first time during 1977-78 sampling.

Table A-1 (Contd)

Scientific Name	Common Name	Cover Type 01	02	03	04	05	06	09	11
Impatiens biflora	Jewelweed					●			
Impatiens pallida	Yellow jewelweed				●	●			
Jeffersonia diphylla	Twinleaf		X	X		X			
Juglans nigra	Black walnut	X				X		X	
Juniperus virginiana	Eastern red cedar	X	X	X	X		X	X	X
Lactuca sp.	Lettuce			●					
Laportea canadensis	Wood nettle					●			
Linderia benzoin	Spicebush	X	X	X		●		X	
Liriodendron tulipifera	Yellow poplar		X		X				X
Lonicera japonica	Japanese honeysuckle			X	X		X	X	X
Lonicera tatarica	Tartarian honeysuckle								X
Mertensia virginica	Bluebells						X		
Maianthemum canadense	Canada mayflower	●		X					
Muhlenbergia sobolifera	Muhly grass			X	X		X		
Nepeta cataria	Catnip						●		
Oenothera sp.	Evening primrose			X					
Osmorhiza claytonii	White snakeroot		●			●			●
Ostrya virginiana	Ironwood		X	X					
Panicum boscii	Bosc's panicum			X					
Panicum clandestinum	Corn grass								X
Parthenocissus quinquefolia	Virginia creeper	X	X	X	X	X	X	X	X
Passiflora lutea	Yellow passion-flower			X					
Phryma leptostachya	Lopseed	X	●		X				
Pilea pumila	Clearweed	●			●	X			
Pinus resinosa	Red pine				X				
Pinus strobus	White pine	X			X				
Pinus virginiana	Virginia pine			X					X
Platanus occidentalis	Sycamore		X			X		X	
Poaceae	Grasses				X				
Podophyllum peltatum	May apple								●
Polygonatum biflorum	Solomon's-seal			X			X		
Polygonum cespitosum	Long-bristled smartweed					X			
Prunus serotina	Black cherry		X	X	X	X			X
Prunus virginiana	Choke cherry							●	
Quercus coccinea	Scarlet oak		X				X		
Quercus falcata	Southern red oak		X						
Quercus palustris	Pin oak		X						
Quercus prinus	Chestnut oak		X	X	X			X	
Quercus rubra	Red oak			X					X
Quercus velutina	Black oak		X	X	X		X		
Ranunculus sp.	Buttercup							●	
Rhus aromatica	Fragrant sumac			X					
Rhus radicans	Poison ivy	X	X	X	X	X	X	X	X
Robinia pseudoacacia	Black locust			X			X	X	●
Rosa sp.	Rose			X	X		●	●	
Rubus sp.	Blackberry				X			X	X
Ruellia caroliniensis	Hairy ruellia			X					
Sanguinaria canadensis	Bloodroot		X	X			X		
Sanicula trifoliata	Snakeroot	X	X	X	X	X	X	X	X
Sassafras albidum	Sassafras		X	●	X				
Smilacina racemosa	False Solomon's-seal			●			X		
Smilax sp.	Greenbriar								X
Smilax herbacea	Carrion-flower		X	●	●	X			X
Solidago sp.	Goldenrod			●		●	●		X
Solidago ulmifolia	Goldenrod			X					
Symphoricarpos orbiculatus	Coralberry		X	X	X		X	X	
Taraxacum officinale	Common dandelion			X					
Thalictrum dioicum	Early meadow-rue			X					
Tilia americana	Basswood	X				X			
Tradescantia virginiana	Spiderwort						X		
Trillium sessile	Toadshade	X	X				X	X	
Ulmus rubra	Slippery elm	X	X	X	X	X	X	X	X
Ulmus thomassi	Rock elm								X
Viburnum prunifolium	Black-haw		X	X					
Viola sororia	Wooly-blue violet	X	X	●	X	●	●	●	●
Viola eriocarpa	Smoothish-yellow violet		X			X			
Vitis aestivalis	Summer grape	X		X			X	X	
Vitis rotundifolia	Muscadine grape				X				

X – Taxa observed during 1977-78 sampling.

● – Taxa observed for the first time during 1977-78 sampling.

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