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Topical Report

Ecological Effects of Pipeline Construction through Deciduous Forested Wetlands, Midland County, Michigan

Prepared by:
Center for Environmental Restoration Systems
Energy Systems Division
Argonne National Laboratory

Gas Research Institute

Environment and Safety Research Group
April 1995

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ECOLOGICAL EFFECTS OF PIPELINE CONSTRUCTION THROUGH DECIDUOUS FORESTED WETLANDS, MIDLAND COUNTY, MICHIGAN

TOPICAL REPORT

(October 1990 - August 1992)

Prepared by

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GRI Project Manager
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16. Abstract (Limit 200 words)

This study is designed to record vegetational changes induced by the construction of a large-diameter gas pipeline through deciduous forested wetlands. Two second-growth wetland sites mapped Lenawee soils were selected in Midland County, Michigan: Site 1, a younger stand subjected to recent selective logging, and Site 2, a more mature stand. The collection of ecological data to analyze plant succession on the right-of-way (ROW) and the effects of the developing ROW plant communities on adjacent forest communities was initiated in 1989. Cover class estimates were made for understory and ROW plant species on the basis of 1 × 1-m quadrats. Individual stem diameters and species counts were recorded for overstory plants in 10-m quadrats. Although long-term studies have not been completed, firm baseline data were established for comparative analyses with future sampling. Current data indicate that vegetation became well-established on the ROW within one year and subsequently increased in coverage. About 65% of the species were wetland indicators, and the dominants included seeded and natural invading species; nevertheless, some elements of the original flora regenerated and persist. The plants of the ecotone understories of both sites changed from their original composition as a result of the installation of the gas pipeline. Although some forest species persist at both sites, the ecotone of Site 1 was influenced more by the seeded species, whereas the natural invaders were more important at Site 2.

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Research Summary

Title	Ecological Effects of Pipeline Construction through Deciduous Forested Wetlands, Midland County, Michigan
Contractor	Argonne National Laboratory
Principal Investigators	J.R. Rastorfer and G.D. Van Dyke
Report Period	October 1990 - August 1992
Objective	To document temporal and spatial aspects of both positive and negative impacts on vegetation resulting from the establishment of a pipeline right-of-way (ROW) through deciduous forested wetlands in east-central Michigan.
Technical Perspective	Environmental concerns and governmental regulations directed towards the protection of wetlands make information on positive and negative impacts of gas pipeline ROWs on wetlands essential for the gas pipeline industry. This study is designed to document the temporal and spatial extent of positive and negative effects on vegetation resulting from the establishment and maintenance of a pipeline ROW through deciduous forested wetlands in east central Michigan. Such information will facilitate the permitting process and may suggest modifications in installation and maintenance practices to mitigate negative impacts.
Results	The results at this time are essentially preliminary, because such ecological studies as the present one must be long-term to properly measure effects that may take decades to develop. Nevertheless, firm baseline data are established for comparative analyses with future sampling. For example, the overstory and forest understory need follow-up sampling before results can be ascertained. On the other hand, the analyses of current data indicate that vegetation became well-established on the ROW within one year and subsequently increased in coverage. The dominant species of the ROW at Site 1 are the seeded species *Lotus corniculata* (Birdfoot Trefoil) and two natural invaders, *Carex lupulina* (Sedge) and *Populus deltoides* (Cottonwood). In contrast, the dominant species of the ROW at Site 2 are the seeded species *Agrostis gigantea* (Redtop Grass) and the invader *Populus deltoides* (Cottonwood). Although the original surface vegetation of the ROWs at both sites was essentially destroyed during the installation of the gas pipeline,

some elements of the original flora have regenerated and persist. The plants of the ecotone understories at both sites changed from their original composition as a result of the installation of the gas pipeline. Although some forest species persist at both sites, the ecotone of Site 1 is influenced more by the seeded species *Agrostis gigantea* and *Lotus corniculata*, whereas the natural invader *Eupatorium perfoliatum* (Boneset) is more important at Site 2. *Populus deltoides* is also an important natural invader of the ecotones at both sites.

Technical Approach

Two sites were selected for this study on the basis of their wetland soils and forest vegetation. Although both sites have the same soil type, Site 1 is a younger second-growth stand resulting from recent selective logging, whereas Site 2 is a more mature second-growth stand with no evidence of logging during the 50 years prior to 1989. Line transects, parallel to the ROW, were established on the ROW and in the forest communities at preselected distances from the northern edge of the ROW. Understory and ROW vegetation are measured by using coverage estimates for each species and selected growth forms within forty 1×1-m quadrats along each of seven 100-m line transects at each site (for a total of 280 quadrats). Stem diameters and numbers of individuals are recorded for each tree species within a set of 10×10-m plots constituting three 10×100-m belt transects in the forest communities of each site. Baseline data were collected at both sites from 1989 through 1992, but not from all transects for each of the four years. After the collection of follow-up field data from 1994 through 1997 (or 1998), a final report will be prepared during the two subsequent years.

Project Implications

Information of the type provided by this study will be increasingly required during the permitting process for future pipeline construction through forested wetlands. Information that suggests ways to (1) minimize the extent and duration of negative impacts on adjacent wetland communities, (2) facilitate reestablishment of wetland vegetation on the ROW, and (3) enhance beneficial aspects with respect to the habitats of wildlife and endangered species can facilitate the permitting process. These data will also be of value in selecting maintenance practices that enhance the wetland value of the ROW.

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Two extraordinary botanists made contributions to the project in different ways. Gerould Wilhelm, research taxonomist at the Morton Arboretum, confirmed the identifications of numerous species and solved the identifications of several difficult taxa. Judith Rastorfer, Park Forest, Illinois, wrote the computer program that was used for the primary reduction of the cover class data, edited manuscripts (including numerous taxon lists), and helped with taxonomic problems. We are indeed grateful for their generous contributions. Thanks are also due to Grace Medert of Columbus, Ohio, for proofreading, especially the tables with lengthy taxon lists, during visits to Park Forest.

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Ecological Effects of Pipeline Construction through Deciduous Forested Wetlands, Midland County, Michigan

Topical Report (October 1990 - August 1992)

by

J.R. Rastorfer, G.D. Van Dyke, S.D. Zellmer, and P.L. Wilkey

1 Introduction

Installation of a large-diameter pipeline through a forest, involving clear cutting of the right-of-way (ROW), ditching, backfilling, grading, and seeding operations, removes or destroys essentially all of the aboveground plant biomass and alters the chemical and physical properties of the soil, as well as the soil profiles (Zellmer and Taylor 1988).

After pipeline installation, secondary vegetational development (succession) occurs on the ROW until stabilized but dynamic treeless plant communities (anthropogenic disclimaxes or stages of arrested succession) develop, as determined by ROW maintenance practices (Niering and Goodwin 1974). Furthermore, the clearing of the forest on the ROW results in the alteration of light, wind, temperature, and microclimatic factors in the new forest edge as compared with the forest interior (Ranney et al. 1981).

The development of vegetation on the ROW results in the formation of zones of integration, called ecotones (Daubenmire 1968; Hansen and diCastri 1992; Spurr and Barnes 1973), where the plant communities of the ROW confront the plant communities of the adjacent forest. Little information is available concerning the temporal and spatial aspects of these ecotones.

Quantitative data concerning the temporal and spatial aspects of edge effects within the forest, the temporal development of the anthropogenic disclimax on the ROW, and the temporal and spatial aspects of the development of ecotones within the forest edge are important to the gas pipeline industry. Such information is essential to provide answers to questions raised by federal, state, and local regulatory agencies responsible for the construction-permitting process. Data related to forested wetlands (for definition, see Cowardin et al. 1979) are growing increasingly important as recently passed federal and state regulations concerning wetland protection (Federal Interagency Committee for Wetland Delineation 1989; Michigan Department of Natural Resources 1988) are enforced. The absence of such data slows the permitting process and adversely affects construction schedules for new gas-transmission pipelines.

The present study is designed to provide the gas pipeline industry with information about both negative impacts and beneficial aspects of gas pipeline ROWs through northern,

broad-leaved, deciduous forested wetlands. Such information will not only facilitate the permitting process but may also suggest possible modifications in pipeline installation and maintenance practices to minimize negative impacts and maximize beneficial aspects. It will provide answers to questions such as these: What type of vegetational community develops on the ROW? Do the ROW segments under study qualify as wetlands? What changes, if any, occur in the forest edge adjacent to the ROW? What species, if any, are lost from the forest edge? What new species, if any, invade the forest edge? How far do any changes at the forest edge extend into the forest? Is the wetland status of the forest edge affected?

2 Background

This review of vegetational and related studies of rights-of-way (ROWs) is primarily concerned with those studies that deal with underground natural gas transmission pipelines (GPLs). However, from a long-term, ecological point of view, vegetational research on GPL ROWs essentially has not been done. In contrast, studies that deal with aboveground, electrical-transmission-line (ETL) ROWs have received considerable attention (Byrnes and Holt 1987; Crabtree 1984; Tillman 1976, 1981); thus, those vegetational studies of ETL ROWs considered relevant to our investigation will be included in this brief review. Although noteworthy vegetational studies are reported for highway and railroad ROWs (Byrnes and Holt 1987; Crabtree 1984; Tillman 1976, 1981), they are not included here because roadways differ sufficiently, with respect to design and post-construction usage, to warrant separate consideration.

Four aspects of GPL ROW installations as they affect vegetation are discussed:

1. The initial clearing of the vegetation,

2. The effects on soil properties,

3. The post-construction establishment and development of vegetation, and

4. The composition of stable plant communities maintained by cyclic maintenance practices.

Generally, the clearing of a strip of vegetation of approximately 25 m (75 ft) in width for the installation of a large-diameter, 38-cm (15-in.) or greater GPL essentially devastates the existing aboveground plant biomass (because of the removal methods employed and mechanical damage). Moreover, any aboveground plant vestiges that remain after the clearing operations disappear, for the most part, during the trenching, pipeline installation, backfilling, and grading activities. In effect, the end result of the GPL emplacement operations leaves a strip of highly disturbed land that is often laid bare (Arner 1966; Egler 1954; Zellmer and Taylor 1988).

Furthermore, the soil is affected by the GPL construction operations. In some situations, vehicular equipment compacts soils on the working side of the ROW (Steinhart et al. 1987). Trenching (especially the single-ditching method), backfilling, and grading operations mix the soil layers, so that the column of soil over the buried pipe has no remaining soil profile. The upper soil layers on either side of the buried pipe soil column may be disturbed by mixing with trench materials and by backfilling and grading work. Hence, the chemical and physical properties of the soils are altered, and soil erosion in hilly areas may be accelerated as a result of the overall GPL construction activities (Arner 1966; DeJong and Button 1973; Taylor et al. 1987; Zellmer and Taylor 1988; Zellmer et al. 1987).

The consequence of GPL emplacement activities, which decimate aboveground vegetation and alter soil characteristics, is the production of highly disturbed or bare areas. Under most climatic conditions, vascular and nonvascular plants will become established on newly formed GPL ROWs; however, this will not occur where soil erosion is too severe or where other edaphic factors have been changed beyond plant tolerances.

Generally, the taxonomic composition and structural features of plant communities on highly disturbed or bare GPL ROWs will be determined by the seed mixtures applied during the closing GPL construction activities and by the reestablishment of native plants. These native plants arise from the preexisting and surrounding vegetation; the soil seed bank; the presence of regenerative roots, rhizomes, stems, and stumps; and the immigration of seeds, spores, and gemmae (Brown 1987; Harper 1977; Hutnik et al. 1987; Leek et al. 1989). Although operational seeding has been a common practice for GPL ROWs, recent reports indicate that under most environmental conditions, natural revegetation and the use of native plant species are considered the most ecologically sound approaches to establishing vegetation on highly disturbed and bare GPL ROWs (Downey 1976; Farnworth 1981; Johnson 1984; Long and Ellis 1984; Odegard et al. 1984).

The successional development of vegetation to stable nonwoody communities (anthropogenic disclimax herbaceous communities) on GPL ROWs depends on the preexisting and surrounding floristic elements, GPL emplacement activities, and maintenance practices. Generally, for GPL ROWs, stable nonwoody plant communities are desired because they are more conducive to inspection activities and allow easier movement of the heavy mechanized equipment needed to repair buried pipelines. Also, nonwoody vegetation is desirable because the discoloration of herbaceous plants by pipeline leaks is detectable by periodic aerial inspections (Arner 1960; Egler 1954). In addition, the root systems of arborescent vegetation may damage the cathodic protection of the GPL if they come into contact with it (J. Rochow, personal communication).

In treeless ecosystems, such as marshes, rapid natural revegetation occurs subsequent to carefully planned GPL emplacement operations. Hence, GPL ROWs in such ecosystems are generally maintenance-free with respect to eliminating woody taxa (Farnworth 1981; Krone 1987; Odegard et al. 1984). For forest ecosystems, on the other hand, maintenance is required to exclude woody plants. Unfortunately, ecological studies concerning methods used to achieve stable herbaceous-dominant communities on GPL ROWs crossing forest (and shrub) habitats are few compared with the similar studies applicable to ETL ROWs (Byrnes and Holt 1987; Crabtree 1984; Nickerson and Thibodeau 1986; Niering et al. 1986; Niering and Goodwin 1974; Thibodeau and Nickerson 1986; Tillman 1976; Tillman 1981). Apparently, mowing and herbicide applications have been used as a general practice to maintain herbaceous communities on GPL ROWs. Nevertheless, studies on ETL ROWs, and to a lesser extent on GPL ROWs, indicate that burning, when applicable, is an effective method, both economically and ecologically, for eliminating woody plants from ROWs (Arner 1960, 1981; Arner et al. 1976, 1987; Huntley and Arner 1984; Olson et al. 1984).

With respect to this study, insufficient information is available to predict the successional stages of vegetational development on the ROW segments to anthropogenic disclimax

communities. Therefore, it will be essential to this investigation that the vegetational development on the ROW and in the forest edge be monitored until a stable anthropogenic disclimax is reached, as determined by the maintenance method and cycle. After firm baseline data have been obtained, studies at four- or five-year intervals over the next one or two decades or longer will likely be required before plant communities on the ROW segments achieve adequate stability to realize results concerning the interactions of ROW plant communities and adjacent forest communities (Magnuson 1990).

3 Goals and Objectives

Our study has four major goals, with designated objectives to meet these goals. The goals and objectives are listed below.

1. To describe the vegetation in the forested wetlands away from the ROW, but within the study sites, to serve as references or controls:

   a. Document the floristic elements of the study area, especially vascular plant species; and

   b. Document natural changes or fluctuations in the vegetational components.

2. To describe the development of plant communities in the forest-ROW ecotone:

   a. Document changes in the vegetational components in the forest edge adjacent to the ROW that might result from the presence of the ROW.

3. To describe the development of vegetation on the ROW into stable plant communities, as determined by maintenance practices:

   a. Document the early stages of plant succession on the ROW, with an assessment of wetland characteristics and the influences of the seeding operations; and

   b. Document later successional stages to the more or less stable anthropogenic disclimax that forms under the maintenance regime employed.

4. To make general recommendations concerning the improvement of gas-pipeline installation operations in forested wetlands.

   a. Evaluate closure and seeding operations and maintenance practices on the ROW in terms of their effects on successional trends, ecotonal development, and wetland characteristics.

4 Selection of Sites

Collaborative and cooperative efforts by representatives from the Gas Research Institute, Consumers Power Company, Argonne National Laboratory, and the property owners resulted in the selection of two suitable plant-ecologic study sites along the Midland County portion of the GPL route (Figure 1).

Both sites are located off the northern edge of the nonimproved section of the Gordonville Road, in Section 25 of Greendale Township (R.25W, T.14N), Midland County, Michigan. Site 1 is on B.J. Haskins's property, situated about 1,450 m (4,690 ft) west of the junction of Gordonville and Castor Roads. Site 2 is on Michigan's Department of Natural Resources property (state forest land), situated about 660 m (2,120 ft) west of the junction of Castor and Gordonville roads.

The selection of the forest stands designated as Sites 1 and 2 was based on their similarities and differences. Both sites represent second-growth deciduous-swamp forest on poorly drained silty-clay-loam soil (Lenawee soil). However, Site 1 is in a younger second-growth stage than Site 2. Additional details on the selection of the two sites are discussed in Zellmer et al. (1991). Comparative vegetational features of the two sites will be covered elsewhere in the present report.

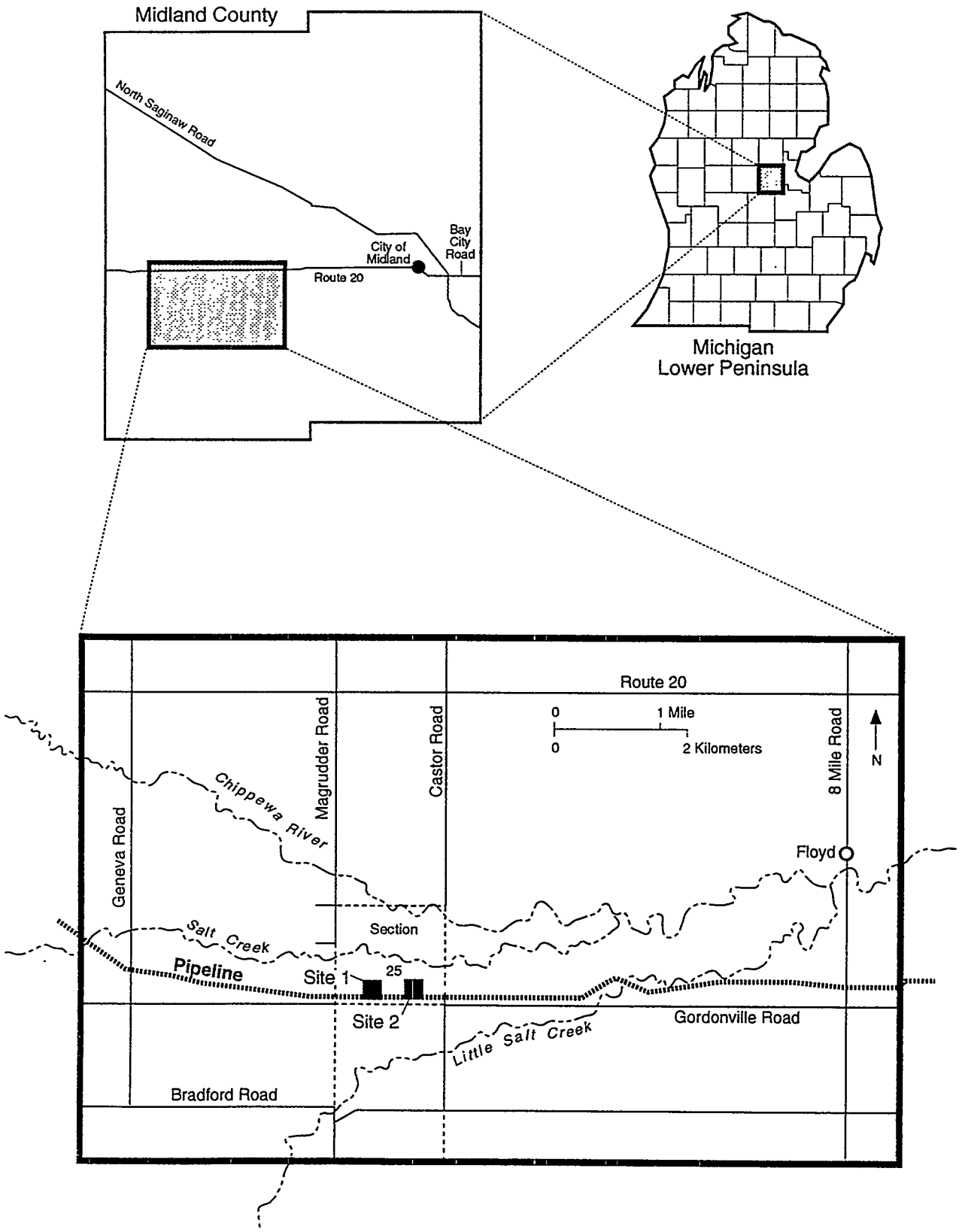

FIGURE 1 Locations of Sites 1 and 2 in Midland County, Michigan

5 Approach

Locations of construction projects for new, large-diameter underground gas transmission lines in the north-central region of the United States were evaluated, and inquiries were made into the possible participation of one or more power companies. Subsequent to the location of a suitable construction project, the proposed route of the ROW was inspected, and potential ecologic study sites within forested wetlands were identified. The criteria used to select study sites called for a high degree of homogeneity of the vegetation, an essentially flat topography, and a single type of soil. Two sites were selected, and the necessary legal agreements between Argonne National Laboratory in collaboration with Consumers Power Company and each of the site owners (B.J. Haskins and Michigan's Department of Natural Resources, State Forest Land) were secured.

This investigation is directed toward the analysis of the compositional and structural features of plant communities adjacent to the ROW as they are affected by the installation of the gas pipeline and maintenance of the ROW. Also, we are interested in the compositional and structural changes that take place during the seral development of plant communities on the ROW itself. To analyze these features of plant communities, we are sampling the understory taxa within 1×1-m plots along permanent transects and the overstory taxa within permanent 10×10-m plots. The understory transects are located on the ROW and in the forest at selected intervals from and adjacent to the ROW, to a distance considered to lie beyond the influence of the ROW. In contrast, the overstory plots are located only in the forest at selected intervals that range from adjacent to the ROW to a distance considered beyond the influence of the ROW. Sampling began immediately after installation of the pipeline and continued annually through the third growing season. After the third growing season, sampling should be repeated every four to five years until a stable anthropogenic disclimax has been substantiated for the ROW plant communities.

In addition to vegetational sampling, we are making a taxonomic inventory, with voucher specimens of the plant species that occur on the sites and immediately surrounding areas. A taxonomic inventory is necessary not only to facilitate identification of species during sampling, but also to evaluate the sites with respect to the invasion of new species, the loss of pre-ROW species, and the assessment of wetland vegetational components. The analysis of field data will provide information useful for determining compositional changes at the species level and compositional and structural changes at the community level.

6 General Site Description

6.1 Location of Sites and Topography

The study sites are located in Midland County, which is situated in the eastern middle region of the southern peninsula of Michigan (Figure 1). Specifically, the sites are in the southern half of the southeast quarter of Section 25, R.25W, T.14N, in Greendale Township. Furthermore, the sites are a short distance north of an nonmaintained section (1.609 km; 1 mi) of Gordonville Road that extends from Castor Road on the east to an unimproved section of Magrudder Road on the west (Figure 1).

Midland County is in the Saginaw Lowland, one of the six physical regional subdivisions for the southern peninsula of Michigan recognized by Veatch (1953). More recently, Albert et al. (1986) have classified the land and mapped Michigan's landscape from an ecosystem perspective. They recognize numerous functional land units that differ appreciably from one another with respect to climatic factors and soil productivity. Hence, Midland County is in the Saginaw District, a sand and clay plain southwest of Saginaw Bay (Figure 2).

Topographically, Midland County is flat to undulating, with low relief. The total area of flat surfaces greatly exceeds the total area of slopes. The slopes generally are low in gradient; if steep, they are short and range from less than one to six percent (Hutchison 1979). Midland County's flatness is a manifestation of its geological history, which is briefly reviewed in Zellmer et al. (1991).

6.2 Climate

Midland County's climate is considered temperate continental, and it is essentially uniform throughout the county (Albert et al. 1986; Hutchison 1979). The average daily temperature in summer is 20.8°C (69.5°F), whereas the average daily temperature in winter falls to -3.8°C (25.1°F). The growing season (or frost-free period) is about 150 days, from about the eighth of May to about the sixth of October.

Precipitation in Midland County is relatively uniform throughout the year, ranging from a monthly average of 4.0 cm (1.57 in.) during the winter to 8.0 cm (3.13 in.) during the summer. The county has a total average annual precipitation of 74.4 cm (29.3 in.), of which 58% falls during the major portion of the growing season, April through September.

Additional information concerning Midland County's climate with respect to temperature, precipitation, relative humidity, and other factors is provided in Zellmer et al. (1991).

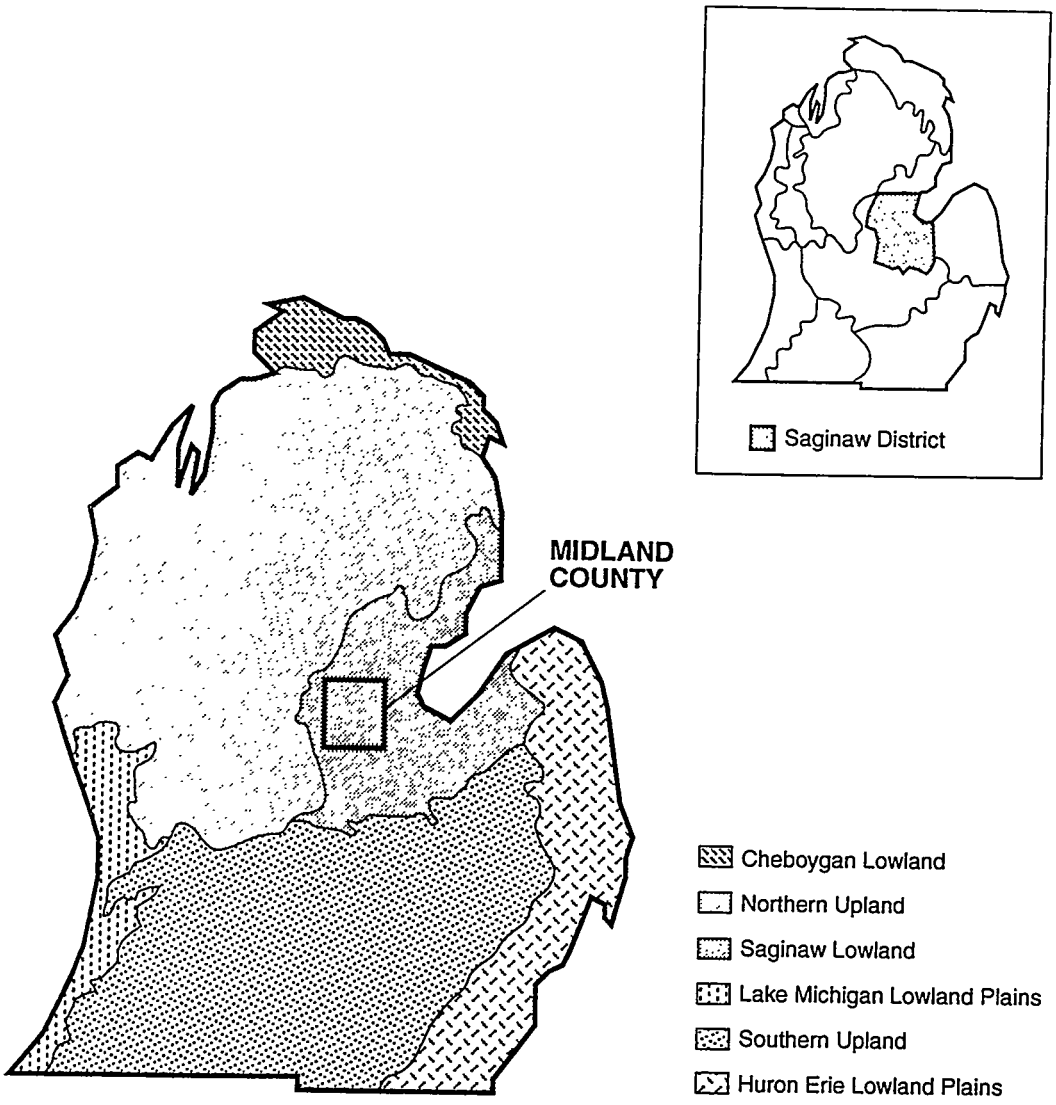

FIGURE 2 Physiogeographic Regional Subdivisions of Michigan's Lower Peninsula (adapted from Veatch 1953) (Note: Insert of Saginaw District adapted from Albert et al. 1986)

6.3 Soils

Midland County has seven major soil associations (Hutchison 1979). In Greendale Township, where our study sites are located, the major soil association is designated Kingsville-Pipestone-Covert. The soils of this association are characterized as nearly level to gently sloping and poorly drained to moderately well drained. They have a sandy subsoil or upper substratum in outwash or glacial lake deposits. Interwoven among the soil units of this association are soil units of other associations. Our study sites are on one of these interweaving soils, a Lenawee soil unit (Lenawee silty clay loam) that is a component of the Lenawee-Bower-Wixom Association. The soils of this association are characterized as nearly level to gently sloping and very poorly drained to somewhat poorly drained. They have either a loamy and clayey subsoil or a sandy and loamy subsoil and were formed in glaciolacustrine and till deposits (Hutchison 1979; Martin 1958).

Lenawee soils were formed in clay or loam lacustrine deposits with zero to two percent slopes that make up broad flat areas and drainage ways. The soils are characterized as moderately slowly permeable, poorly drained or very poorly drained soils that are subject to frequent flooding. The surface layer is typically a black silty clay loam about 23 cm (9 in.) thick. The mottled silty clay subsoil is about 79 cm (31 in.) in thickness (Hutchison 1979). Further information on soil genesis in Midland County and additional pedologic features for the Lenawee soils are reviewed in Zellmer et al. (1991). Of particular importance for our study is the classification of the Lenawee soils as hydric soils (USDA, Soil Conservation Service 1987).

6.4 Vegetation

The study sites are located in the transition zone between the northern and southern climatic climax regions of Michigan's lower peninsula. Some of the salient features concerning the vegetation of these regions, both before and after settlement, are reviewed in Zellmer et al. (1991).

Since the publication of our first report for this study (Zellmer et al. 1991), we have learned of two works pertaining to Midland County presettlement vegetation. Potzger (1948) reported on analyses of pollen profiles of peat cores from different localities in the transition zone, and two of his sample sites were in Midland County. Potzger's results indicated that the initial (following the Wisconsin glacial period) forest trees in Midland County were *Picea glauca* (White Spruce), *Picea mariana* (Black Spruce), and *Pinus banksiana* (Jack Pine). Subsequently, *Pinus strobus* (Eastern White Pine), *Tsuga canadensis* (Eastern Hemlock), and deciduous hardwoods became more prominent.

Kapp (1978) determined the composition of presettlement forest trees by analyzing the witness trees recorded in original land surveys for the Pine River Watershed, which includes parts of Midland County. Kapp's findings indicated that the prominent presettlement trees of Midland County were *Pinus strobus* and *Tsuga canadensis*. Also common were *Tilia americana* (Basswood) and *Acer rubrum* (Red Maple), but in wetlands (swamp forests) *Fraxinus nigra* (Black Ash), *Larix laricina* (Tamarack), *Salix nigra* (Black Willow), *Thuja occidentalis* (Northern White Cedar), and *Ulmus* spp. (Elms) were the most common. *Quercus* spp. (Oaks) were present in various habitats, but apparently they were not common.

More recently, Smith and Kapp (1979) and Profant (1989) made floristic studies of the Chippewa Nature Center in Homer Township of Midland County. They each reported about 260 species of vascular plants from among the different communities they surveyed. Although the land areas surveyed did not have habitats with Lenawee soils, Smith and Kapp (1979) referred to the plants that occurred on the seasonally wet Wixom loamy sand soil as the Swamp Hardwood community. The Wixom loamy sand soil is a component of the Lenawee-Bower-Wixom soil association (Hutchison 1979), but it is probably better drained than the Lenawee silty clay loam soil. Common trees reported for the Swamp Hardwood community were *Acer rubrum*, *Acer saccharinum* (Silver Maple), *Carpinus caroliniana* (Hornbeam), *Fraxinus americana* (White Ash),

Fraxinus nigra (Black Ash), *Ilex verticillata* (Michigan Holly), *Populus deltoides* (Cottonwood), *Quercus bicolor* (Swamp White Oak), and *Ulmus rubra* (Slippery Elm).

In addition, the plant lists and herbarium specimens of Smith and Kapp (1979) and Profant (1989) are important to our study. Comparisons of the plant compositions of selected communities at the Chippewa Nature Center with the forest communities at our sites might help to predict the direction of floristic shifts, if any should occur. Also, an examination of their specimens could provide insights into the morphological variability (range) of different species. A comparison of specimens in the species complexes of *Acer* (Maple), *Fraxinus* (Ash), and *Quercus* (Oak) is particularly desirable in this study, and a comparison of specimens in the difficult graminoid genus *Carex* (Sedge) is also desirable.

7 Pipeline Installation

Construction was carried out under Easement Number L-71-06, granted to the Midland Cogeneration Venture. Construction included a survey of the ROW; the clearing of woody vegetation from the ROW; excavation of a ditch approximately two meters in depth and one meter in width; distribution, welding, and installation of the pipe; backfilling of the ditch; and final grading and seeding of the ROW with a mixture of grasses and legumes. Pipeline construction operations through Section 25 of Greendale Township (T.14N, R.2W), the location of the study sites (Figures 1 and 3) in Midland County, took place during the spring and early summer of 1989. Further details concerning pipeline construction activities were discussed in Zellmer et al. (1991).

Although the two seed mixtures used to hand-seed the ROW were reported in Zellmer et al. (1991), they are repeated here because of their importance in the composition and development of the ROW vegetation and their possible effects on plant communities adjacent to the ROW.

- One mixture was designated for use on organic soils and consisted of the following:

  Lotus corniculata, Birdfoot Trefoil, 4 lb/acre;

  Phleum pratense, Timothy, 5 lb/acre;

  Agrostis gigantea, Redtop, 3 lb/acre;

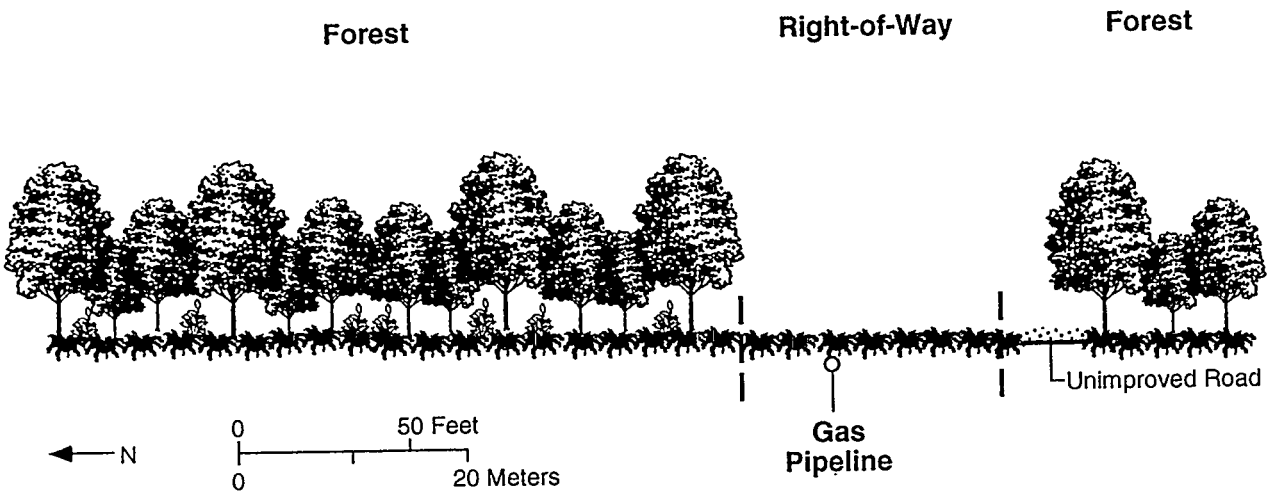

FIGURE 3 Sectional Drawing Typifying the Physiognomy of Sites 1 and 2, Midland County, Michigan

Trifolium hybridum, Alsike Clover, 2 lb/acre; and

Trifolium repens, White Clover, 3 lb/acre.

- A second mixture was designated for use on mineral soils and consisted of the following:

  Festuca rubra, Red Fescue, 30 lb/acre;

  Festuca arundinacea, Tall Fescue, 10 lb/acre;

  Lolium perenne, Perennial Ryegrass, 5 lb/acre;

  Bromus inermis, Smooth Brome, 5 lb/acre;

  Agrostis gigantea, Redtop, 1 lb/acre; and

  Trifolium repens, White Clover, 1 lb/acre.

8 Methods

8.1 Background

This study is comparative in nature with respect to both structural and floristic aspects of plant communities. Thus, it is directed toward the descriptions and analyses of major vegetational synusiae (layers) and designated trees, shrubs, brambles, vines, forbs, graminoids, pteridophytes, and bryophytes. The terms graminoids, pteridophytes, and bryophytes include (respectively) grasses, sedges, and rushes; ferns and fern allies, such as club mosses and horsetails; and mosses, liverworts, and hornworts.

We are using two gross structural components for ecological measurements of vascular plant species and bryophytes, because different methods are required for different vegetational components. The overstories of the adjacent forest communities are analyzed with one set of methods, whereas the understories of the adjacent forest communities and the ROW plant communities are analyzed with a second set of methods.

The overstory component consists of trees with stem diameters (DBH, diameter at breast height) of two centimeters and greater. *Cornus foemina* (Gray Dogwood), *Ilex verticillata* (Michigan Holly), and *Viburnum lentago* (Sheepberry) are included as overstory components because of their predominantly dendroid growth habit on the study sites. The understory component and ROW communities consist of seedlings of trees (stem diameters less than two centimeters), shrubs, brambles, vines, forbs, graminoids, pteridophytes, and bryophytes. The bryophytes are treated collectively for measurements within the understories and ROW communities. On the other hand, ecological measurements for species of bryophytes are handled by a third set of methods.

8.2 Sampling Procedures

The northern edge of the ROW was located at each site by measuring 22.86 m (75 ft) north from boundary markers placed by surveyors along the southern edge of the ROW in 1989. The northern boundary of the ROW at each site was temporarily marked with lath stakes, and permanent reference markers (automobile axle shafts, 17.5 cm long, flange 17.5 cm in diameter) were later driven into the soil to ground level 102 m apart (1 m west of zero and 1 m east of 100) at 13 and 61 m north of the northern edge of the ROW and at 18.5 m south of the northern edge of the ROW. A total of six axle shafts were emplaced at each site. All overstory belt transects and understory and ROW line transects can be relocated from these markers, provided they remain in place.

Belt transects (10×100 m) for overstory sampling consist of ten large plots (10×10 m). The belt transects running west-east are located at 0-10, 10-20, and 40-50 meters

north of the northern edge of the ROW at each site (Figure 4). For identification purposes, the belt transects are numbered as 1000 (plots 1000-1009), 1100 (plots 1100-1109), and 1400 (plots 1400-1409) for Site 1 and as 2000 (plots 2000-2009), 2100 (plots 2100-2109), and 2400 (plots 2400-2409) for Site 2.

Line transects 100 m long are used to locate and position a quadrat frame (1 × 1 m) for sampling the understory and ROW vegetation. The line transects are located at 1, 5, 13, and 41 m north of the northern edge of the ROW and at 3, 7.6, and 14 m south of the northern edge of the ROW (Figure 4). For identification purposes, the transects have the following numbers: 101, 105, 113, and 141 for the understory of Site 1; 201, 205, 213, and 241 for the understory of Site 2; 503, 507 (507.6), and 514 for the ROW vegetation of Site 2; and 603, 607 (607.6), and 614 for the ROW vegetation of Site 2.

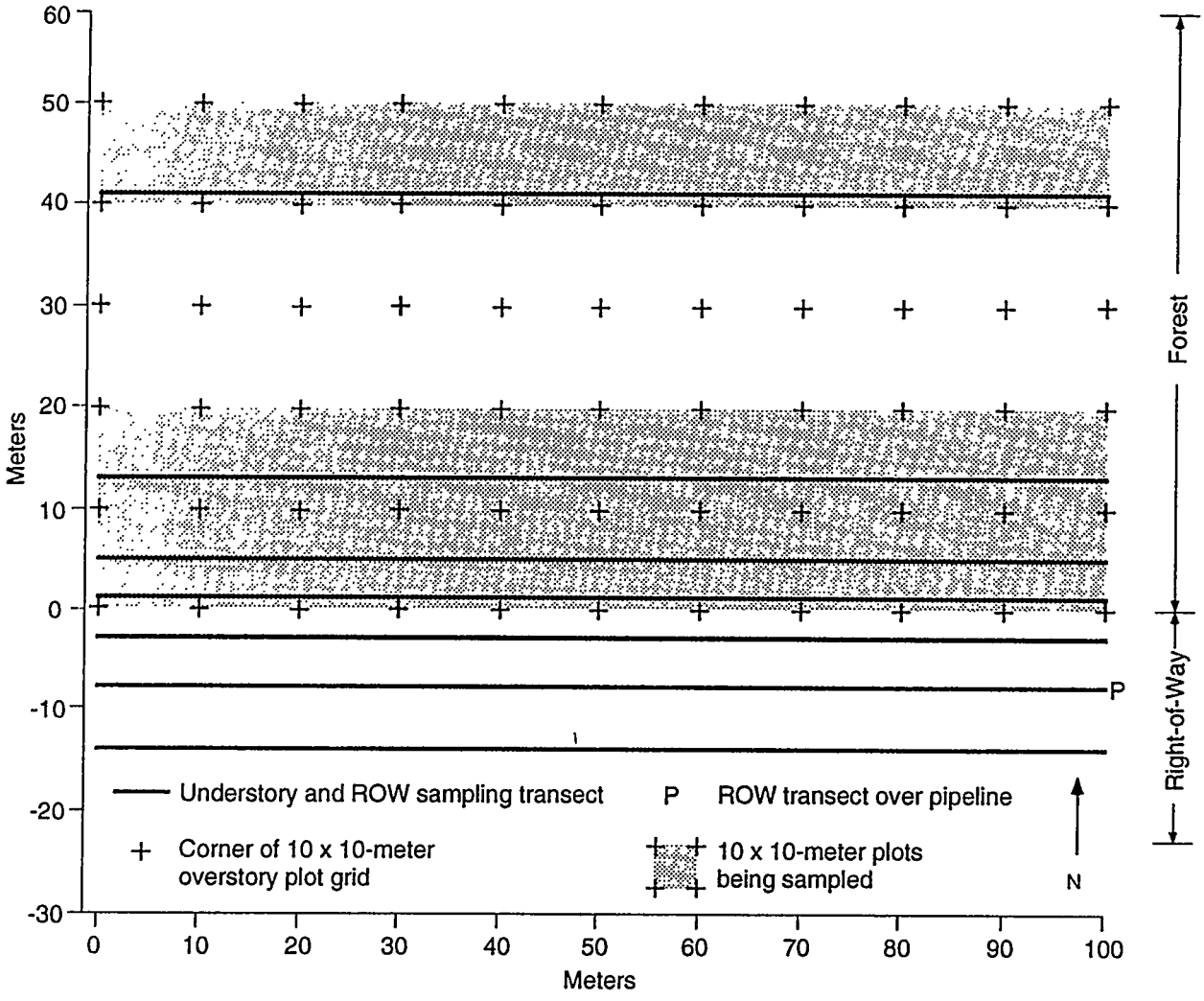

FIGURE 4 Positions of Understory Transects, Right-of-Way Transects, and Overstory Plots for Sites 1 and 2, Midland County, Michigan

Stem diameters are measured for all individuals of each overstory species (trees with DBHs* of two centimeters and greater) in the series of ten 10 × 10-m plots that make up the three belt transects for each site. Prepared data sheets are used to record DBHs (in centimeters) as measured with a diameter tape. In addition, the location of each individual overstory species is mapped in each 10 × 10-m plot. The mapping is done on prepared sheets on which a 10 × 10-m plot is subdivided into 1 × 1-m units.

With respect to understory and ROW vegetation sampling methods, cover-class values and individual counts of selected taxa are being recorded, on prepared data sheets, for four transects in the forested portions and three transects in the ROW segments of each site. The quadrat frame is placed at two-meter intervals along the southern edge of the line transect tape (100 m) by randomly selecting the meter either immediately east or west of the odd-numbered meter marks on the tape. One quadrat is sampled at all odd-numbered meter marks from 5 to 43 m and 55 to 93 m, for a total of 40 quadrats per transect. To avoid sampling in areas of unavoidable trampling, the ends and the centers of the transects are not used.

Systematic core sampling of the bryophyte synusia (layer) to ascertain cover estimates for individual species is being carried out by collecting core specimens along line transects. In the forest portions of each site, a 100-m tape is being used to establish line transects, extending from west to east, at 10 m and 40 m north of the northern edge of the ROW. In the ROW segments of each site, however, line transects are established 5 m south of the northern edge of the ROW. Sampling is done at 0.5-m intervals along the transect tape with a 5.8-cm-diameter coring device. Sample cores are taken near the southern edge of the transect tape in the forest portions of each site and near the northern edge of the transect tape in the ROW segments of each site. Only sample cores that contain shoots of mosses or liverworts or both are retained (in labeled brown paper bags) for laboratory analysis.

Additional details concerning transect locations, sampling methods, and examples of prepared forms used to record field data can be found in the previous report (Zellmer et al. 1991).

8.3 Taxonomy

Voucher specimens of vascular plants are collected for each species, except those considered rare or known to be threatened or endangered. Specimens freshly collected in the field are referenced with collection numbers and field notes and then placed in plant presses for drying. After adequate drying, they are mounted on standard-size herbarium sheets (Porter 1967). When complete with an informational label, each mounted specimen will represent a permanent record for a given species and provide essential documentation for field identifications. Rare and endangered plant species are photographed in situ (in their habitats) rather than being collected.

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* DBH = diameter at breast height.

The numerous taxonomic references being used to identify vascular plant and bryophyte voucher specimens, either to confirm field and laboratory identifications or to identify unknown species, are essentially the same as those listed in Zellmer et al. (1991). However, four important taxonomic works need to be added to those listed in Zellmer et al. (1991): Goff and Rochow (1993) have recently revised their informative booklet on Michigan trees; Crum's (1991) illustrated manual on the liverworts and hornworts of Michigan's lower peninsula is particularly useful for our study; and Schuster (1992a and 1992b) has completed a comprehensive, six-volume taxonomic treatment of the liverworts and hornworts of North America.

8.4 Qualitative Procedures

As we confirm identifications of the vascular plant voucher specimens, we are compiling a master taxon species list by scientific names — that is, by the generic and specific names (Appendix A). This list includes family, common names, and other information. In addition, separate plant lists are compiled periodically for the forest communities and ROW plant communities. Such lists are needed for determining possible additions and/or losses of taxa to or from the site communities. The final list will be compared with a list of the known vascular flora for Midland County to identify new county records (Profant 1989; Smith and Kapp 1979; Voss 1972, 1985).

Taxon lists will be prepared for the bryophytes in the same format used for the vascular plants. However, common names will not appear in the master bryophyte taxon list, because bryophytes are not usually given common names.

We are constructing taxon lists of the vascular plants in reference to different growth-forms: pteridophytes, forbs, graminoids, vines, brambles, shrubs, and trees. Such lists are needed to provide insights into possible structural changes in adjacent forest communities and ROW plant communities.

Taxon lists of vascular plants are being constructed in reference to different wetland indicator categories, as defined by Reed (1988). Such lists are needed to determine changes, if any, in the wetland composition in the adjacent forest communities and ROW communities.

8.5 Quantitative Procedures

Quantitative procedures refer to the means used to quantitatively measure vegetational components. The histories, applications, merits, and limitations of different types of measurements (such as density, cover, and biomass) for vegetational studies are thoroughly reviewed in the ecological literature. Noteworthy references include Bonham (1989), Daubenmire (1968), Greig-Smith (1964), and Mueller-Dombois and Ellenberg (1974). Our studies employ the

units of density, basal area, frequency, and cover, all of which can be measured by nondestructive sampling techniques.

Density refers to the number of individuals per unit area (or volume). We are using density to characterize the woody taxa of the overstories of the forest communities, the understories of the forest communities, and the ROW plant communities. For the overstories, which are trees with stem diameters at breast height (1.5 m or 58.6 in.) of two centimeters (0.79 in.) and greater, counts are made using the 10×10-m plots:

> Density of species A in an overstory plot equals the number of individuals of species A per 100 m^2.

For the understory trees and shrubs with stem diameters (DBHs) of less than two centimeters, and for shoots of brambles and vines, counts are made by using the 1×1-m plots:

> Density of species A in an understory plot equals the number of individuals of species A per 1 m^2.

Counts for determining the density of species of shrubs, brambles, and vines were discontinued after the samplings in 1991 because of the uncertainty in identifying individuals and the excessive damage to the understory and ROW vegetation occasioned in seeking their shoots.

Basal area, which provides an assessment of dominance, refers to the aggregate cross-sectional area at or near ground level of individual plants in a specified area. We are determining the basal areas of the trees in the overstories of our sites. Stem diameters (DBHs) of two centimeters and greater are being measured within 10×10-m plots, converted to circular areas, and then summed for each species:

> Basal Area (square centimeters) of species A in an overstory plot equals the sum of individual cross-sectional areas of species A per 100 m^2, where the cross-sectional area (square centimeters) of an individual equals $\pi/4$ (approximately 0.7854) times its diameter squared.

Frequency provides information about the distribution of a taxon, but without regard to its density or dominance; it is expressed as a percentage of occurrence of a taxon in a series of plots of the same size. In our study, frequency is calculated for the overstory species from the data recorded to determine basal areas:

> Frequency (%) of species A in an overstory belt transect equals the number of plots in which species A occurs, divided by 10, times 100.

For the understory species, except for species of bryophytes, frequency is calculated from the data recorded to determine percent cover:

> Frequency (%) of species A for an understory line transect equals the number of plots in which species A occurs, divided by 40 times 100.

In our study, frequencies cannot be combined or meaningfully compared between understory and overstory taxa, not even for the same species, because plots (quadrats) of different size are being used — 1×1 m and 10×10 m, respectively.

With respect to the mosses and liverworts, the frequency of each taxon is ascertained from core specimens.

Cover for a plant species is a measure of dominance and is expressed as the percentage of the ground surface covered by the vertical projection of the total foliar spread of all individuals of a species in a specified area. In addition, the concept of cover can include inanimate environmental components, such as rocks, logs, and water. In our study, cover estimates are made by recording cover-class values for the understory taxa of the forest communities, ecotone communities, and ROW plant communities in 1×1-m plots. Cover estimates are made for the following components: bryophytes, pteridophytes, graminoids, and forbs. Cover estimates also are being made for individual species of ferns, fern allies, grasses, sedges, rushes, vines, brambles, and seedlings of trees and shrubs (DBHs less than two centimeters). Where applicable, cover estimates are being made for exposed mineral soil, bare logs, stumps, and standing water.

After field sampling, the cover-class values (1, 2, 3, 4, 5, and 6, representing cover ranges of 0-5, 5-25, 25-50, 50-75, 75-95, and 95-100%, respectively) are converted to their midpoint values (2.5, 15, 37.5, 62.5, 85, and 97.5 %, respectively) to calculate the average percent cover:

> Average percent cover of species A equals the sum of midpoint values of species A, divided by 40.

Cover estimates for individual species of mosses and liverworts are being made from field-collected sample cores (5.8 cm or about 2.3 in.). Because of the small size of bryophytes and the need for microscopy to identify species of mosses and liverworts, the sample cores are being analyzed in one of our laboratories.

Importance values are used to rank or index species of a heterogeneous community and thus provide an overall estimate of the influence or importance in the community of each species (Smith 1980). In our study, importance values (IV) are calculated for overstory species on the basis of densities, basal areas, and frequencies:

> IV of species A equals the sum of RD plus RB plus RF of species A, where RD equals relative density (the total number of individuals of species A, divided by the total number of individuals of all species, times 100), RB equals relative basal area

(the total basal area of species A, divided by the total basal area of all species, times 100), and RF equals relative frequency (the frequency value of species A, divided by the total frequency values of all species, times 100).

9 Selected Summaries

Summaries of field trips (Appendix B) from October 1990 through July 1992 are taken from a series of reports prepared shortly after each field trip for internal records. Still photographs were taken as a standard method of documenting selected field observations during each field trip; hence, these photos will not be mentioned in the summaries.

9.1 Summary of Herbarium Collection

The herbarium collection, comprising several hundred voucher specimens, provides essential documentation for field identifications. All critical field-collected specimens through 1992 have been mounted on standard herbarium sheets and primary identifications have been completed. The entry of voucher specimen data into a computerized database program is completed through the 1992 collection, but the records still need to be edited. Once completed, this database will be used to generate labels (Appendix C) for the voucher specimens mounted on the herbarium sheets and to generate plant lists (by generic and common names) on the basis of such criteria as collection number, family, growth form, or wetland indicator.

9.2 Summary of Data Collection and Data Reduction

9.2.1 Background

We now recognize four vegetational units for our study sites that serve as meaningful references in data collection and analysis. These four units are as follows:

1. *Forest Overstory*, sampled in three belt transects at each site, ten 10 × 10-m plots per transect, belt transect numbers 1000, 1100, and 1400 at Site 1 and belt transect numbers 2000, 2100, and 2400 at Site 2;

2. *Forest Understory*, sampled along three line transects at each site, 40 1 × 1-m plots per transect, line transect numbers 105, 113, and 141 at Site 1 and line transect numbers 205, 213, and 241 at Site 2;

3. *Ecotone Understory*, sampled along one transect at each site, forty 1 × 1-m plots per transect, line transect number 101 at Site 1 and line transect number 201 at Site 2; and

4. *ROW Vegetation*, sampled along three transects at each site, forty 1 × 1-m plots per transect, line transect numbers 503, 507, and 514 at Site 1 and line transect numbers 603, 607, and 614 at Site 2.

Further sampling and data analyses could lead to the recognition of additional vegetational units. For example, the information for the 1000 and 2000 belt transects might be viewed as ecotone overstory, rather than general forest overstory.

9.2.2 Data Collection

Forest Overstory. Thirty plots were sampled among the three belt transects at each site in 1989 (a total of 60 plots for the two sites). These plots were re-examined in 1990 and 1991 to clarify taxonomic problems; also, dead or missing individuals were noted.

Forest Understory. The three forest understory line transects at each site were sampled in 1989, 1990, and 1991. Hence, a total of 720 plots have been sampled in the forest understory for the two sites since the installation of the pipeline.

Ecotone Understory. The ecotone understory line transect at each site was sampled in 1989, 1990, 1991, and 1992. Hence, a total of 320 plots have been sampled for the two sites since the installation of the pipeline.

ROW Vegetation. In addition to some preliminary sampling in 1989, the three ROW vegetation line transects at each site were sampled in 1990, 1991, and 1992. Thus, for the period 1990-1992, a total of 720 plots have been sampled at the two sites since the installation of the pipeline.

9.2.3 Data Reduction

Forest Overstory. Reduced field data (taxa, DBHs, and plot maps) include, but are not limited to, the following data sets: (1) redrawn taxon plot maps that incorporate taxonomic changes and other corrections (Appendix D), with a list of annotations; (2) summary sheets with basal areas, densities, and annotations for each species in each plot (Appendix E); (3) printouts of trunk diameters and numbers of individuals for each species per plot, with the calculated basal areas and densities for each species in each belt transect; (4) taxon summary sheets, with basal areas and densities for each plot and transect totals; (5) printouts of size distributions for each

species per transect and per site; and (6) summary sheets of relative basal areas, densities, and frequencies, as well as importance values for each species per transect.

Forest Understory, Ecotone Understory, and ROW Vegetation. Because the methods of sampling and ecological measures were the same for these vegetational units, the protocol for data reduction was the same also. Field data for taxa and their cover values were reduced by means of a computer program written by Judith B. Rastorfer (personal communication). The printouts of this program provided identification information, the original cover values per plot, average percent coverage, and percent frequency for each taxon per transect (see Appendix K in Zellmer et al. 1991).

Next, summary sheets were put together in a spreadsheet format that provides average percent cover, percent frequency, density (for selected taxa), growth form category, and wetland indicator category for each species of a line transect sampling, with the species identified by its file name (Appendix F). The data for a taxon can be tracked among different transects and sampling years, because each time a line transect is sampled it is given a serial number; hence, a given taxon for a given line transect for a given data has a unique file name consisting of its five-letter code name and serial number.

9.2.4 Bryophyte Layer

The information provided above concerning the sampling, data reduction, and collection of voucher specimens of ROW and transition zone vegetation, forest understory, and forest overstory applies to the vascular plants, but it does not include field and laboratory work for bryophyte taxa (mosses and liverworts). Because bryophytes are small plants that require microscopic examination for accurate identification, they are being handled differently than vascular plants. Numerous packet specimens for a taxonomic inventory and voucher specimens have been collected, but the laboratory identifications have not been completed. Plug samples for coverages and frequencies were collected across two transects in the forest component of each site in 1989, and preliminary plug samples were collected across one transect on the ROW of each site in 1990. Because of time limitations, these plug samples have not been analyzed with respect to species identifications and coverages.

10 Results and Discussion

10.1 Qualitative Aspects

10.1.1 Overview of the Sites

We identified 311 species of vascular plants occurring in the study sites and surrounding areas (Appendix G). These 311 species represent 171 genera and 65 families. Family names, common names, and additional information for each species are provided in the master taxon list in Appendix A.

An analysis of the occurrence data in Appendix G reveals that 209 species occur within the boundaries of the two study sites and 139 species are common to both sites, whereas 50 species are unique to Site 1 and 20 species are unique to Site 2. Hence, the known numbers of species are 189 for Site 1 and 159 for Site 2, which indicates a higher species richness for Site 1 than for Site 2. The remaining 102 species occur in the surrounding areas, but usually on soils that are more mesic than the Lenawee soils of our sites.

The occurrence of 209 species of vascular plants on the study sites indicates a relatively rich flora with respect to essentially a single type of habitat. Smith and Kapp (1979) and, later, Profant (1989) reported 265 and 261 species of vascular plants, respectively, for the Chippewa Nature Center (Midland County), which represents a larger area and several different types of habitats. (Note: The number of species reported by Smith and Kapp (1979) and Profant (1989) probably exceeds 265, because the two lists have not been collated to check for new additions in Profant's list. Also, additional surveys during different seasons and different years undoubtedly would result in new additions to their lists of taxa.)

Although the number of species of vascular plants for the study area is relatively large, they are not equally distributed among different growth form categories. Most of the species are forbs, followed by graminoids and trees; about 90% of the species belong in these three categories (Table 1). Within the forb and graminoid categories, most of the forb species are dicots and most of the graminoid species are sedges and grasses (nearly equal percentages of each).

The study sites are well-represented by wetland indicator plants, and appreciable numbers of species are represented among the wetland indicator categories (Table 2). Collectively, 83 and 85% are in the major three categories (obligate-OBL, facultative wetland-FACW, and facultative-FAC) for Sites 1 and 2, respectively, which indicates a substantial number of wetland floristic elements with respect to species composition.

TABLE 1 Percent of Species in Growth Form Categories for Sites 1 and 2, Midland County, Michigan

Growth Form	Site 1[a]	Site 2[a]
Ferns[b]	4.2	3.8
Forbs	44	45
Dicots	40	39
Monocots	4.2	5.7
Graminoids	25	28
Sedges	9.5	13
Rushes	4.8	3.8
Grasses	11	12
Brambles	3.7	3.2
Vines	3.2	3.8
Shrubs	3.2	0.63
Trees	17	16

[a] Number of taxa in Site 1 is 189; in Site 2, 159.

[b] Ferns and fern allies.

TABLE 2 Percent of Species in Wetland Indicator Categories for Sites 1 and 2, Midland County, Michigan

Wetland Indicator[a]	Site 1[b]	Site 2[b]
Obligate Wetland	20	25
Facultative Wetland	24	26
Facultative	21	21
Facultative Upland	22	18
Other	13	10

[a] For more information on the definitions of the wetland indicator categories, see Appendix A and Reed (1988). Within the "Other" category, no species, except for about 1% (NIs), were listed in any category in Reed (1988).

[b] Number of taxa in Site 1 is 189; in Site 2, 159.

10.1.2 Forest Overstory

The information presented here is based on a one-time sampling in 1989, with follow-up examinations for taxonomic clarification in 1990 and 1991.

Twenty-six species of trees were recognized in the overstory; however, the species distributions are not equal between the two sites (Table 3). Site 1, with 26 species, is more heterogeneous than Site 2, with only 17 species. No species are unique to Site 2; and many of those occurring in Site 1, but not in Site 2, represent early successional species — for example, *Populus* spp. (Aspens) and *Prunus* spp. (Cherries). The compositional aspects of the forest portion of Site 1 are indicative of its being a younger second growth than the forest portion of Site 2.

TABLE 3 Species Occurring in the Forest Overstory of Sites 1 and 2, Midland County, Michigan

Taxon Scientific Name	Site 1	Site 2	Wetland Indicator[a]
Acer rubrum	P[b]	P	FAC
Acer saccharinum	P	P	FACW
Acer rubrum/saccharinum	P	P	NP
Alnus rugosa	P	P	OBL
Betula papyrifera	P	P	FACU
Carpinus caroliniana	P	P	FAC
Fagus grandifolia	P	P	FACU
Fraxinus nigra	P	P	FACW
Fraxinus pennsylvanica	P	P	FACW
Ilex verticillata	P	P	FACW
Populus deltoides	P	P	FAC
Quercus bicolor	P	P	FACW
Quercus palustris	P	P	FACW
Quercus rubra	P	P	FACU
Tilia americana	P	P	FACU
Ulmus americana	P	P	FACW
Viburnum lentago	P	P	FAC
Acer saccharum	P	A[b]	FACU
Acer nigrum	P	A	FACU
Amelanchier arborea	P	A	FACU
Cornus foemina	P	A	FACW
Crataegus sp.	P	A	NP
Populus grandidentata	P	A	FACU
Populus tremuloides	P	A	FAC
Prunus serotina	P	A	FACU
Prunus virginiana	P	A	FAC

[a] See Appendix A for definitions of the wetland indicators.

[b] P = presence, A = absence.

The distribution of the number of tree species among the three belt transects of Site 1 is somewhat variable, with 25 species in belt transect 1100 but 20 and 19 species in belt transects 1400 and 1000, respectively (Appendix H). On the other hand, the number of tree species among the belt transects of Site 2 is nearly the same, with 16 species in belt transect 2100 and 14 species in each of the other two belt transects (Appendix H).

The wetland status of the overstory with respect to species composition is noteworthy but differs between the two sites. In Site 1, 58% of the species are in the three major wetland indicator categories, whereas in Site 2, 71% of the species are in the same categories (Table 4). From the composition of the overstory species, Site 2 can be considered a more hydric habitat than Site 1. Furthermore, five of the species unique to Site 1 are facultative upland species, which dilutes the wetland status of the site.

After further sampling of the two overstories (1995 or 1996), the species composition and wetland status of the same belt transects will be compared using the present data and the new data. We will be particularly interested in any possible floristic changes that might take place in the overstories adjacent to the ROW (belt transects 1000 and 2000 for Site 1 and Site 2, respectively). Resampling of the overstories will provide an opportunity to make comparative data analyses of the responses between the two different overstory communities with respect to heterogeneity, as affected by the ROW. Information concerning the concept of heterogeneity and responses to disturbances might have important implications for gas pipeline right-of-way selection.

TABLE 4 Percent of Species in Wetland Indicator Categories for Forest Overstories of Sites 1 and 2, Midland County, Michigan

Wetland Indicator[a]	Site 1[b]	Site 2[b]
Obligate Wetland	3.8	5.9
Facultative Wetland	31	41
Facultative	23	24
Facultative Upland	35	24
Other	7.7	5.9

[a] For more information on the definitions of the wetland indicator categories, see Appendix A and Reed (1988). Within the "Other" category, no species, except about 1% (NIs), were listed in Reed (1988).

[b] Number of taxa in Site 1 is 26; in Site 2, 17.

10.1.3 Forest Understory, Ecotone Understory, and ROW Vegetation

The data presented here are based on three years of sampling for the forest understory (1989-1991) and the ROW vegetation (1990-1992) and on four years of sampling for the ecotone understory (1989-1992). For example, where presence (P) is marked for a species representing a line transect, this indicates that it was found at least once during the three- or four-year sampling period. Presence data (appendices) and other information were reduced from data on each species for each sampling year and

for each line transect, but these detailed data are not provided in this report. Yearly trends for some selected species are discussed later on.

Forest Understory. The forest understory of Site 1 (Appendix I) comprises 122 species of vascular plants, and 53% of the species are widely distributed, as indicated by their occurrences in all three transects. The largest portion of species are dicot forbs, followed by sedges and trees (Table 5). About 53% of the species are in the major wetland categories (OBL, FACW, and FAC; see Table 6). Most of the species are in the facultative wetland category; the percentages of species in each of the major wetland categories are essentially the same among the three line transects.

TABLE 5 Percent of Species in Growth Form Categories for the Forest Understory Transects of Site 1, Midland County, Michigan

	Transect No.[a]		
Growth Form	141	113	105
Ferns[b]	3.8	6.1	5.3
Forbs	35	36	36
Dicots	32	29	32
Monocots	2.8	7.1	3.5
Graminoids	16	19	23
Sedges	9.3	12	14
Rushes	0	0	1.8
Grasses	6.5	7.1	7
Brambles	5.6	5.1	7
Vines	5.6	5.1	4.4
Shrubs	5.6	3	3.5
Trees	21	21	17
Unknowns	8.4	4	4.4

[a] Number of taxa in Transect 141 is 107; in Transect 113, 99; and in Transect 105, 114.

[b] Ferns and fern allies.

TABLE 6 Percent of Species in Wetland Indicator Categories for the Forest Understory Transects of Site 1, Midland County, Michigan

	Transect No.[a]		
Wetland Indicator[b]	141	113	105
Obligate Wetland	11	12	10
Facultative Wetland	23	25	28
Facultative	17	18	16
Facultative Upland	18	17	14
Other	31	27	36

[a] Number of taxa in Transect 114 is 107; in Transect 113, 99; and in Transect 105, 114.

[b] For more information on the definitions of the wetland indicator categories, see Appendix A and Reed (1988). Within the "Other" category, no species, except about 1% (NIs), were listed in Reed (1988).

Site 2 has 90 species of vascular plants (Appendix I), and 56% of the species occur in three line transects. Most of the species are dicot forbs, but there are also notable numbers of species in the sedge and tree categories (Table 7). About 59% of the species are in the three major wetland indicator categories, most being facultative wetland species (Table 8). In relative terms, a low percentage of obligate species is found in line transect 213, and a high percentage of facultative species is found in line transect 205.

Site 1 has 35% more vascular plant species than Site 2, which indicates that Site 1 has a more heterogeneous plant community. Although the two sites differ in the number of species, they are remarkably similar with respect to the percentages of species occurring among the growth form and wetland indicator categories.

TABLE 7 Percent of Species in Growth Form Categories for the Forest Understory Transects of Site 2, Midland County, Michigan

	Transect No.[a]		
Growth Form	241	213	205
Ferns[b]	5.5	4.5	5.6
Forbs	36	39	39
Dicots	32	36	37
Monocots	4.1	3.4	2.2
Graminoids	21	17	17
Sedges	16	12	11
Rushes	0	0	0
Grasses	4.1	4.5	5.6
Brambles	4.1	4.5	2.2
Vines	8.3	6.7	6.7
Shrubs	0	0	0
Trees	25	21	22
Unknowns	1.4	6.7	6.7

[a] Number of taxa in Transect 241 is 73; in Transect 213, 89; and in Transect 205, 89.

[b] Ferns and fern allies.

TABLE 8 Percent of Species in Wetland Indicator Categories for the Forest Understory Transects of Site 2, Midland County, Michigan

	Transect No.[a]		
Wetland Indicator[b]	241	213	205
Obligate Wetland	14	10	15
Facultative Wetland	30	30	27
Facultative	16	16	20
Facultative Upland	14	16	10
Other	26	28	28

[a] Number of taxa in Transect 241 is 73; in Transect 213, 89; and in Transect 205, 89.

[b] For more information on the definitions of the wetland indicator categories, see Appendix A and Reed (1988). Within the "Other" category, no species, except for about 1% (NIs), were listed in Reed (1988).

Ecotone Understory. The ecotone understory of Site 1 has 123 species (Appendix J), most of these being dicot forbs, sedges, and trees (Table 9). Sixty percent of the species are in the three major wetland indicator categories (Table 10).

Site 2 has 114 species (Appendix J), most of these being dicot forbs, sedges, and trees (Table 9). Sixty-three percent of the species are in the three major wetland indicator categories (Table 10).

The percentage distributions of the species among the growth form categories are very similar between the two sites. Also, the percentage distribution of species among the three major wetland categories is about the same within each site and between the two sites (Table 8).

TABLE 9 Percent of Species in Growth Form Categories for the Ecotone Understory Transects of Sites 1 and 2, Midland County, Michigan

	Transect No.[a]	
Growth Form	101	201
Ferns[b]	2.4	3.5
Forbs	40	44
Dicots	38	40
Monocots	1.6	3.5
Graminoids	25	27
Sedges	13	15
Rushes	3.3	3.5
Grasses	8.9	8.8
Brambles	4.1	3.5
Vines	4.1	2.6
Shrubs	1.6	0.88
Trees	18	15
Unknowns	4.9	3.5

[a] Number of taxa in Transect 101 is 123; in 201, 114.

[b] Ferns and fern allies.

TABLE 10 Percent of Species in Wetland Indicator Categories for the Ecotone Understory Transects of Sites 1 and 2, Midland County, Michigan

	Transect No.[a]	
Wetland Indicator[b]	101	201
Obligate Wetland	20	20
Facultative Wetland	22	24
Facultative	18	19
Facultative Upland	13	12
Other	33	25

[a] Number of taxa in Transect 101 is 123; in Transect 201, 114.

[b] For more information on the definitions of the wetland indicator categories, see Appendix A and Reed (1988). Within the "Other" category, no species, except for about 1% (NIs), were listed in Reed (1988).

ROW Vegetation. The ROW vegetation of Site 1 consists of 126 species, with 51% occurring among the three line transects (Appendix K). The growth form categories with the highest percentage of species are dicot forbs, sedges, grasses, and trees (Table 11). The three major wetland indicator categories comprise 63% of the species (Table 12).

The ROW vegetation of Site 2 has 113 species, with 42% occurring among all three line transects (Appendix K). Most of the species are dicot forbs, sedges, and trees (Table 13). Sixty-six percent of the species are in the three major wetland indicator categories (Table 14).

The ROW of Site 1 has a higher plant diversity and a higher percentage of species with wide distributions than does Site 2.

TABLE 11 Percent of Species in Growth Form Categories for the ROW Vegetation Transects of Site 1, Midland County, Michigan

	Transect No.[a]		
Growth Form	503	507	514
Ferns[b]	3.1	4.1	2.6
Forbs	40	43	46
Dicots	38	41	43
Monocots	2.1	2.4	2.6
Graminoids	32	31	31
Sedges	16	13	12
Rushes	4.2	4.1	7
Grasses	13	14	11
Brambles	4.2	3.3	3.5
Vines	3.1	2.4	2.6
Shrubs	1	1.6	1.8
Trees	10	11	8.8
Unknowns	6.3	3.3	4.4

[a] Number of taxa in Transect 503 is 96; in Transect 507, 123; and in Transect 514, 114.

[b] Ferns and fern allies.

TABLE 12 Percent of Species in Wetland Indicator Categories for the ROW Vegetation Transects of Site 1, Midland County, Michigan

	Transect No.[a]		
Wetland Indicator[b]	503	507	514
Obligate Wetland	25	20	25
Facultative Wetland	20	23	19
Facultative	19	18	20
Facultative Upland	10	15	12
Other	25	25	23

[a] Number of taxa in Transect 503 is 96; in Transect 507, 123; and in Transect 514, 114.

[b] For more information on the definitions of the wetland indicator categories, see Appendix A and Reed (1988). Within the "Other" category, no species, except for about 1% (NIs), were listed in any category in Reed (1988).

TABLE 13 Percent of Species in Growth Form Categories for the ROW Vegetation Transects of Site 2, Midland County, Michigan

	Transect No.[a]		
Growth Form	603	607	614
Ferns[b]	2	2.4	2.2
Forbs	40	45	43
Dicots	33	40	38
Monocots	6.9	4.8	5.4
Graminoids	29	31	33
Sedges	14	13	15
Rushes	2.9	6	6.4
Grasses	13	12	12
Brambles	3.9	1.2	1.1
Vines	2	1.2	3.2
Shrubs	0.98	1.2	0
Trees	19	12	13
Unknowns	3	6	4.3

[a] Number of taxa in Transect 603 is 102; in Transect 607, 84; and in Transect 614, 93.

[b] Ferns and fern allies.

TABLE 14 Percent of Species in Wetland Indicator Categories for the ROW Vegetation Transects of Site 2, Midland County, Michigan

	Transect No.[a]		
Wetland Indicator[b]	603	607	614
Obligate Wetland	25	28	27
Facultative Wetland	24	20	20
Facultative	17	19	19
Facultative Upland	13	10	10
Other	22	22	24

[a] Number of taxa in Transect 603 is 102; in Transect 607, 84; and in Transect 614, 93.

[b] For more information on the definitions of the wetland indicator categories, see Appendix A and Reed (1988). Within the "Other" category, no species, except for about 1% (NIs), were listed in any category in Reed (1988).

Summary. Comparing the growth form categories among the vegetational units shows (Table 15) that the dicot forbs are the major growth form components in all three vegetational units, with the highest percentages of species in the ecotone and ROW units. Among the graminoids, there is a marked increase in the percentage of grass species between the forest units and ROW units, with an intermediate percentage of species for the ecotone units. In contrast, the percentage of tree species tends to decrease from the forest to the ROW units.

With respect to a comparison of the wetland indicator categories among the three vegetation units (Table 16), the percentage of obligate wetland species is highest for the ROW vegetation, lowest for the forest understory, and intermediate for the ecotone understory. In contrast, the

TABLE 15 Average Percent of Species in Growth Form Categories for the Forest Understory, Ecotone Understory, and ROW Vegetation, Midland County, Michigan

	Forest Understory		Ecotone Understory		ROW Vegetation	
Growth Form	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Ferns	5.1	5.2	2.4	3.5	3.3	2.2
Forbs						
Dicots	31	35	38	40	41	37
Monocots	4.5	3.2	1.6	3.5	2.4	5.7
Graminoids						
Sedges	12	13	13	15	14	14
Rushes	0.6	0	3.3	3.5	5.1	5.1
Grasses	6.9	4.7	8.9	8.8	13	12
Brambles	5.9	3.6	4.1	3.5	3.7	2.1
Vines	5.0	7.2	4.1	2.6	2.7	2.1
Shrubs	4.0	0	1.6	0.88	1.5	0.73
Trees	20	23	18	15	9.9	15
Unknowns	5.6	4.9	4.9	3.5	4.7	4.4

TABLE 16 Average Percent of Species in Wetland Indicator Categories for Forest Understory, Ecotone Understory, and ROW Vegetation, Midland County, Michigan

	Forest Understory		Ecotone Understory		ROW Vegetation	
Wetland Indicator	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Obligate	11	13	20	20	23	27
Facultative Wetland	25	29	22	24	21	21
Facultative	17	17	18	19	19	18
Facultative Upland	16	13	13	12	12	11
Other	31	27	33	25	24	23

percentage of facultative wetland species is highest for the forest understory, lowest for the ROW vegetation, and intermediate for the ecotone understory. On the other hand, the percentage of facultative species is about the same for all three vegetational units. These results may indicate that the ROW is supporting more obligate wetland species than the same forested land did prior to the installation of the gas pipeline.

The materials presented here provide a solid data baseline on which to compare future samplings and analyses among the same vegetational units and among different vegetational units.

10.2 Quantitative Aspects

10.2.1 Forest Overstory

The relative status of the overstory species, based on importance values (IV), is given for the three belt transects in Site 1 and Site 2 (Appendix L). Within the sites, importance values for the major species (with largest IVs) are distributed with remarkable uniformity among the three belt transects. On the other hand, the importance values are considerably more variable among the subordinate species, especially in Site 1.

Average importance values for each species of Sites 1 and 2 are given in Table 17. On the basis of these values, *Quercus bicolor* (Swamp White Oak), *Fraxinus pennsylvanica* (Green Ash), and *Acer rubrum/saccharinum* (hybrid maple) are the most important or dominant species.

However, the relative status of the subordinate species differs between the two sites. *Tilia americana* (Basswood), *Fraxinus nigra* (Black Ash), *Carpinus caroliniana* (Hornbeam), and *Quercus palustris* (Pin Oak) are more important in Site 2 than in Site 1, indicating a more mature second growth in Site 2. In contrast, *Ulmus americana* (American Elm), *Betula papyrifera* (Paper Birch), *Alnus rugosa* (Speckled Alder), and *Populus tremuloides* (Quaking Aspen) are more important in Site 1 than in Site 2, indicating a younger second growth in Site 1.

Although *Acer rubrum* (Red Maple) and *Acer saccharinum* (Silver Maple) occur in both sites, their influences within the plant communities are very different. *Acer rubrum* has importance values of 23.8 and 1.8 for Sites 1 and 2, respectively; in contrast, *Acer saccharinum* has importance values of 5.8 and 25.6 for Sites 1 and 2, respectively.

Similar importance values, or even more fundamentally, the same basal areas, for a given species from two different areas may represent entirely different numbers of individuals and ages. For example, *Quercus bicolor* has an average basal area of 4,200 cm^2 for 38 individuals per 0.1 ha for Site 1, but its basal area is 12,000 cm^2 for 19 individuals per 0.1 ha for Site 2. In Site 2, therefore, *Quercus bicolor* has about three times the basal area but only one-half the number of individual standing trees, compared with Site 1.

To analyze this aspect of overstory structure, size-class distribution bar graphs are shown here for selected species, showing the numbers of individuals in trunk-diameter (DBHs) ranges. *Quercus bicolor* in Site 2 has more individuals across the ranges of size classes than it has in Site 1 (Figure 5). On the other hand, the species has considerably more young individuals in Site 1 than in Site 2. The size-class distribution pattern and the presence of stumps of *Quercus bicolor* in Site 1 are indicative of recent, selective logging.

Fraxinus pennsylvanica (Figure 6) has considerably more individuals in the smallest size class (2-7 cm range) in Site 2 than in Site 1, but the number of individuals quickly drops off in the subsequent size classes. This indicates a much higher mortality rate in Site 2 than in Site 1, which may indicate that *Fraxinus pennsylvanica* is a preclimax species.

Acer rubrum/saccharinum has nearly the same importance values between the two sites, but its size distributions are quite different (Figure 7). The relative number of individuals follows a similar pattern for the first three to four size classes in both sites; subsequently, however, there are only three individuals among the higher size classes in Site 1. As mentioned for *Quercus bicolor*, the size-class distribution for *Acer rubrum/saccharinum* is indicative of recent logging.

TABLE 17 Average Importance Values for the Forest Overstory Species in the Belt Transects of Sites 1 and 2, Midland County, Michigan (%)

Taxon Scientific Name	Site 1	Site 2
Quercus bicolor	46.7	55.8
Fraxinus pennsylvanica	41.1	47.2
Acer rubrum\saccharinum	28.5	32.6
Tilia americana	3.7	30.1
Fraxinus nigra	2.2	29.5
Acer saccharinum	5.8	25.6
Carpinus caroliniana	7.5	22.5
Quercus palustris	11.2	20.5
Ulmus americana	29	15.2
Quercus rubra	7.2	5.6
Populus deltoides	6.7	5.3
Betula papyrifera	13.1	2.9
Viburnum lentago	8.8	2.9
Acer rubrum	23.8	1.8
Ilex verticillata	1.5	1.2
Alnus rugosa	10.5	0.9
Fagus grandifolia	0.4	0.5
Acer nigrum	0.6	0
Acer saccharum	0.4	0
Amelanchier arborea	2	0
Cornus foemina	9	0
Crataegus sp.	2.3	0
Populus grandidentata	8.9	0
Populus tremuloides	23.7	0
Prunus serotina	3.1	0
Prunus virginiana	2.9	0

In Site 1, the size-class distribution of *Populus deltoides* (Cottonwood) indicates that it is a recent invader (Figure 8) of a disturbed forest. On the other hand, the three individuals in the upper size classes of Site 2 may represent old relics from earlier successional stages.

In summary, trees provide the basic structure to forest communities, but because of their long life spans and relative durability, individual trees, especially large ones, may not show immediate responses to disturbances. However, the population dynamics of tree species may be affected by disturbances within a relatively short time. Therefore, the findings presented here provide baseline data on which to make comparative studies following another sampling (1994 or

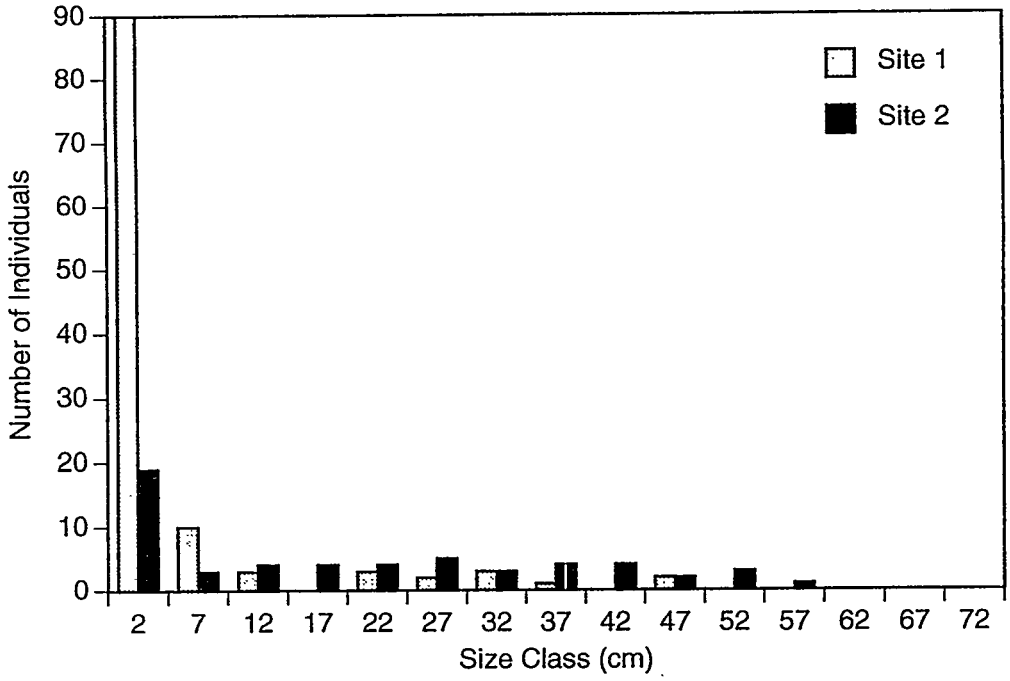

FIGURE 5 Size-Class Distributions of *Quercus bicolor* (Swamp White Oak) for Sites 1 and 2, Midland County, Michigan (sample area = 3,000 m^2)

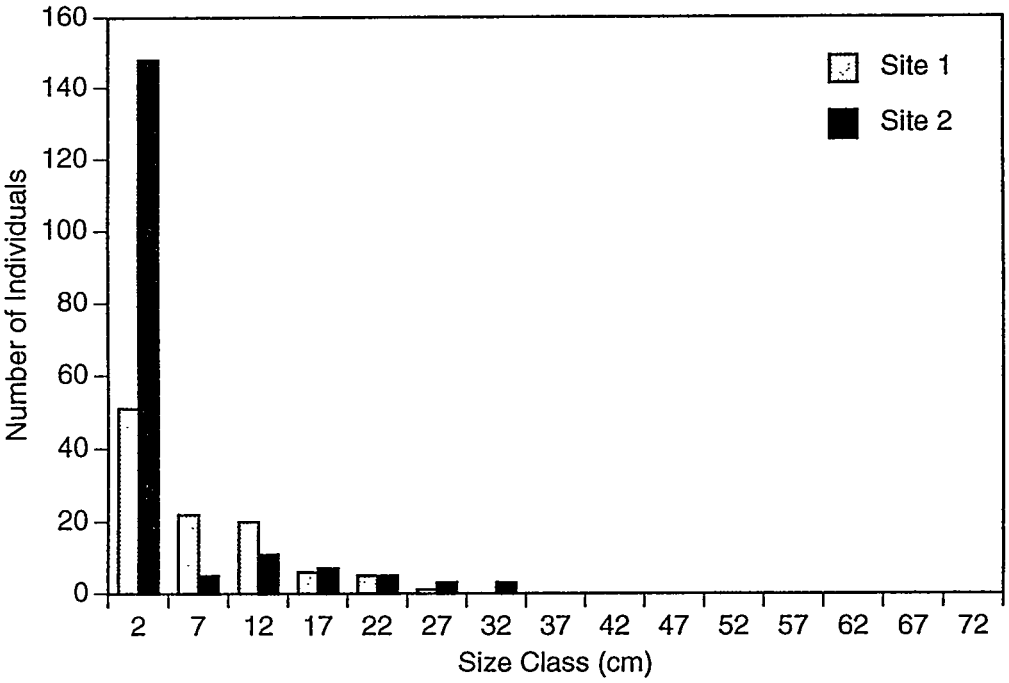

FIGURE 6 Size-Class Distributions of *Fraxinus pennsylvanica* (Green Ash) for Sites 1 and 2, Midland County, Michigan (sample area = 3,000 m^2)

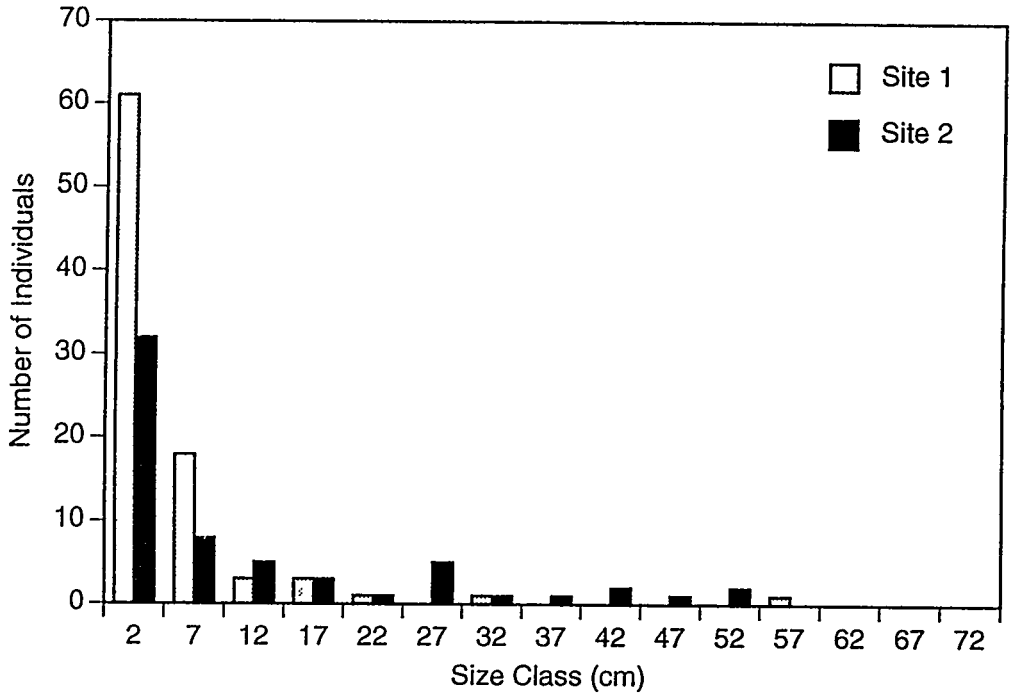

FIGURE 7 Size-Class Distributions of *Acer rubrum/saccharinum* (Hybrid Maple) for Sites 1 and 2, Midland County, Michigan (sample area = 3,000 m^2)

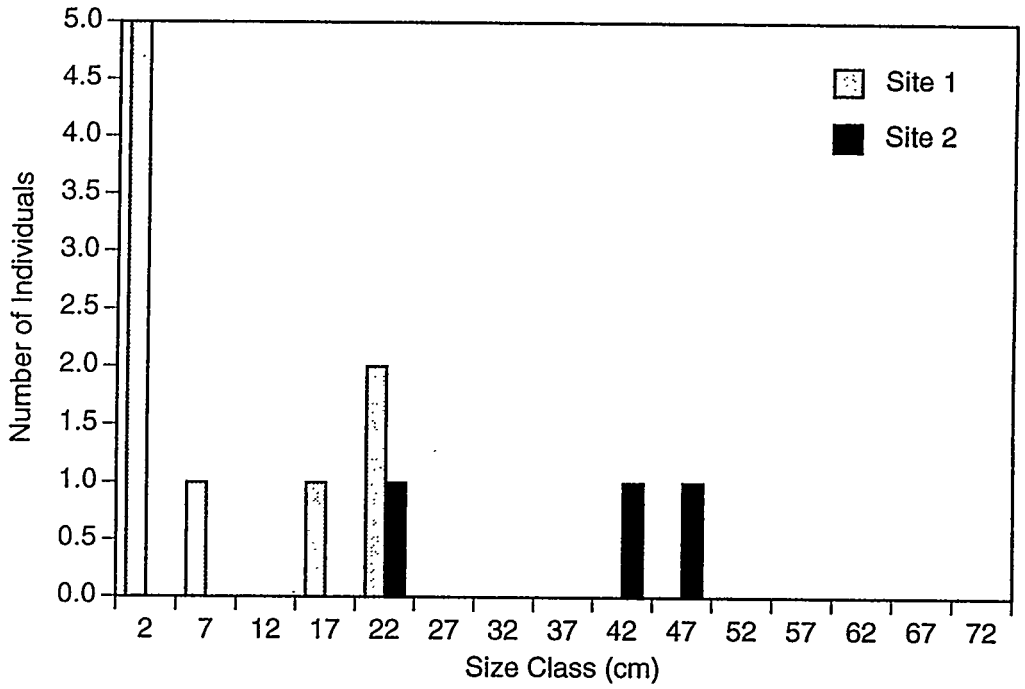

FIGURE 8 Size-Class Distributions of *Populus deltoides* (Cottonwood) for Sites 1 and 2, Midland County, Michigan (sample area = 3,000 m^2)

1995) of the same belt transects. A comparative study between two sampling dates of at least four or more years apart is needed to determine whether the construction of the ROW has effected any changes in the adjacent overstory communities. Particularly important will be the use of species composition data and importance values to calculate similarity coefficients (Mueller-Dombois and Ellenberg 1974; Ludwig and Reynolds 1988) for obtaining mathematical values that will be used to assess the similarity between sampling dates for the same belt transects.

10.2.2 Forest Understory, Ecotone Understory, and ROW Vegetation

Because of the large number of species for each of the line transects sampled, only the dominant species within growth form categories are discussed here. The selection of the dominant species is based on percent cover and, to some degree, on consistency over the three-year sampling period for the forest understory and ROW vegetation and the four-year sampling period for the ecotone understory. Tree seedlings of *Acer* (Maple), *Fraxinus* (Ash), and *Quercus* (Oak) usually are not identifiable as to species during field studies. The data presented here are collective for the species of these genera, with *Quercus* divided into the Black Oaks and White Oaks.

In addition to presenting and discussing cover values for the selected species, we present cover values for selected herbaceous growth form categories evaluated during line transect studies. This is done to ascertain the influence of these groups collectively, which often gives information not readily seen by examining a list of cover values for each species within a group. For example, a group of 10-15 species of sedges may not have a dominant species in reference to all of the species of the sample unit, but collectively, they may have a cover value exceeding any of the dominants.

Forest Understory. The dominant species for the forest understory of Site 1 are *Onoclea sensibilis* (Sensitive Fern), *Pteridium aquilinum* (Bracken Fern), and *Rubus pubescens* (Dwarf Raspberry) (Appendix M). Important subordinates are *Aster umbellatus* (Michaelmas Daisy), *Carex tenera* (Sedge), *Parthenocissus quinquefolia* (Woodbine), and the species of trees. Among the herbaceous growth form categories, the ferns, forbs, and sedges have the highest cover percentages, amounting to averages (n = 6) of 42, 35, and 32%, respectively (Table 18). (The number of species of ferns is small compared with the numbers of species in the other two categories.)

The dominant species for the forest understory of Site 2 are *Onoclea sensibilis*, *Amphicarpaea bracteata* (Hog-peanut), *Carex rosea*, and the species of *Fraxinus* (Appendix M). Noteworthy subordinates are *Rubus pubescens*, *Parthenocissus quinquefolia*, *Carpinus caroliniana* (Hornbeam), *Ilex verticillata* (Michigan Holly), and species of *Acer*. The herbaceous growth forms with the highest percentage covers are the ferns, forbs, and sedges with average (n = 6) covers of 24, 14, and 27%, respectively (Table 19).

TABLE 18 Percent Cover and Number of Species (#) of Selected Growth Forms in the Forest Understory Transects of Site 1, Midland County, Michigan

Growth Form	141		113		105	
	1990	1991	1990	1991	1990	1991
Ferns[a]	29 (3)	36 (4)	59 (5)	70 (3)	52 (6)	61 (4)
Forbs	35 (32)	31 (27)	43 (26)	45 (25)	31 (28)	24 (29)
Graminoids	40 (11)	45 (11)	22 (15)	24 (12)	52 (21)	56 (22)
Sedges[b]	37 (7)	35 (7)	18 (9)	14 (8)	41 (13)	44 (14)
Grasses	2.7 (4)	7.9 (4)	4.4 (6)	6.8 (4)	10 (8)	13 (8)
Mosses[c]	6.8	12	3.4	5	3.9	5.3

[a] Ferns and fern allies.

[b] Sedges and rushes.

[c] Species were not identified in the field.

Onoclea sensibilis is a dominant species in both sites, but the codominants and most of the important subordinates differ. The cover values for the herbaceous growth forms are larger for Site 1 than for Site 2. The mosses have about twice as much coverage in Site 2 as in Site 1.

Ecotone Understory. The ecotone transects of both sites show a similar response to the installation of the gas pipeline: the considerable disturbance of the understory vegetation along the northern edge of the ROW. This is illustrated by the very low cover values or absence of species for the 1989 sampling (Appendix N). Dominant plants for the 1989 sampling are *Populus deltoides* (Cottonwood) and species of *Trifolium* (Clover). Subsequently, vegetation became well-established, as indicated by our results for 1990-1992 samplings.

TABLE 19 Percent Cover and Number of Species (#) of Selected Growth Forms in the Forest Understory Transects of Site 2, Midland County, Michigan

Growth Form	241		213		205	
	1990	1991	1990	1991	1990	1991
Ferns[a]	28 (3)	27 (3)	22 (3)	30 (3)	19 (4)	20 (4)
Forbs	5.9 (18)	11 (19)	12 (23)	18 (24)	17 (27)	21 (22)
Graminoids	27 (10)	28 (11)	25 (12)	29 (10)	23 (10)	38 (11)
Sedges[b]	26 (8)	28 (9)	23 (9)	28 (8)	23 (6)	35 (8)
Grasses	0.9 (10)	1.7 (11)	1.3 (12)	1.3 (10)	0.8 (10)	1.7 (11)
Mosses[c]	14	13	11	18	8.8	7.3

[a] Ferns and fern allies.

[b] Sedges and rushes.

[c] Species not identified in the field.

The dominant species for the ecotone understory of Site 1 (1990-1992 samplings) are *Onoclea sensibilis*, *Lotus corniculata* (Birdfoot Trefoil), *Agrostis gigantea* (Redtop Grass), and *Populus deltoides*. Important subordinates are *Eupatorium perfoliatum* (Boneset), *Carex cristatella*, *Carex lupulina*, and *Spiraea alba* (Meadowsweet). The major growth forms are forbs, sedges, and grasses (Table 20), with average (n = 3) covers of 49, 40, and 47%, respectively.

In the ecotone understory of Site 2, the dominant species are *Onoclea sensibilis*, *Eupatorium perfoliatum*, *Carex cristatella*, *Carex lupulina*, and *Populus deltoides* (Appendix N), and the important subordinates are *Glyceria striata* (Fowl Manna Grass), *Salix amygdaloides* (Peach-leaved Willow), and species of *Acer* and *Fraxinus*. The major herbaceous growth forms are ferns, forbs, and sedges (Table 20), with average (n = 3) covers of 12, 23, and 44%, respectively.

TABLE 20 Percent Cover and Number of Species (#) of Selected Growth Forms in the Ecotone Understory Transects of Sites 1 and 2, Midland County, Michigan

Growth Form	101			201		
	1990	1991	1992	1990	1991	1992
Ferns[a]	10 (3)	12 (3)	12 (3)	6.9 (3)	13 (4)	17 (3)
Forbs	59 (33)	45 (21)	44 (26)	18 (30)	28 (29)	22 (31)
Graminoids	80 (23)	89 (21)	72 (23)	38 (18)	61 (19)	53 (20)
Sedges[b]	25 (13)	47 (13)	47 (16)	30 (10)	53 (14)	49 (15)
Grasses	56 (10)	58 (8)	28 (7)	5.6 (8)	12 (5)	3.8 (5)
Mosses[c]	5.9	5.2	3.4	1	6.1	6.9

[a] Ferns and fern allies.

[b] Sedges and rushes.

[c] Species were not identified in the field.

Comparatively, the ecotone understories (represented by transects 101 and 201 for Sites 1 and 2, respectively) were disturbed about equally by the installation of the gas pipeline. For the 1989 sampling, both sites have *Onoclea sensibilis* and *Populus deltoides* as the dominant species, but Site 1 has a considerable coverage of species of *Trifolium* for the 1989 and 1990 samplings. For the 1990-1992 samplings, two seeded species, *Lotus corniculata* and *Agrostis gigantea*, have high cover values in Site 1. Although they occur in Site 2, they are not as important as in Site 1. On the other hand, the invading species, *Eupatorium perfoliatum* and *Glyceria striata*, are more important in Site 2 than in Site 1. In addition to *Populus deltoides*, the invasion of species of *Salix* (Willow) into both sites is noteworthy.

ROW Vegetation. The dominant species for the ROW vegetation of Site 1 are *Lotus corniculata*, *Carex lupulina*, and *Populus deltoides*, but *Onoclea sensibilis*, *Eupatorium perfoliatum*, *Carex cristatella*, *Scirpus cyperinus* (Bulrush, Wool-grass) and *Salix amygdaloides*

are important subordinates (Appendix O). The herbaceous growth forms with the highest covers are forbs, sedges, and grasses (Table 21), averaging (n = 9) 41, 42, and 43%, respectively.

For the ROW vegetation of Site 2, the dominant species are *Agrostis gigantea* and *Populus deltoides*; however, *Onoclea sensibilis*, *Eupatorium perfoliatum*, *Carex lupulina*, *Carex cristatella*, and *Scirpus cyperinus* are very important subordinates (Appendix O). *Lotus corniculata* and *Festuca ovina* (Sheep Fescue) have appreciable coverages in transects 607 and 614 but very little coverage in transect 603. The major herbaceous growth forms are forbs, sedges, and grasses (Table 22), with average covers of 29, 34, and 32%, respectively.

Although the original surface vegetation of the ROW at both sites was essentially destroyed during the installation of the gas pipeline, some elements of the original flora regenerated and persist; these include *Onoclea sensibilis*, *Maianthemum canadense* (Wild Lily-of-the-valley), *Carex cristatella*, *Rubus pubescens*, *Parthenocissus quinquefolia*, and species of *Acer* and *Fraxinus*. However, these species are subordinate to the seeded species *Lotus corniculata*, *Agrostis gigantea*, and *Phleum pratense* (Timothy) and the natural invaders *Populus deltoides* and *Eupatorium*

TABLE 21 Percent Cover and Number of Species (#) of Selected Growth Forms in the ROW Vegetation Transects of Site 1, Midland County, Michigan

Growth Form	503			507			514		
	1990	1991	1992	1990	1991	1992	1990	1991	1992
Ferns[a]	3.3 (1)	4.1 (2)	7.5 (3)	4.6 (3)	7.9 (3)	13 (4)	3.1 (3)	5.6 (3)	13 (3)
Forbs	39 (19)	33 (25)	51 (28)	34 (32)	38 (37)	48 (2)	44 (16)	37 (34)	47 (37)
Graminoids	76 (19)	89 (22)	86 (20)	30 (24)	72 (29)	65 (22)	73 (22)	92 (28)	91 (23)
Sedges[b]	23 (11)	38 (13)	43 (13)	18 (13)	44 (18)	47 (23)	25 (12)	67 (18)	71 (16)
Grasses	57 (8)	64 (9)	51 (7)	12 (11)	24 (11)	26 (9)	59 (10)	57 (10)	29 (7)
Mosses[c]	3.3	11	5.8	5.3	16	18	5.3	12	6.9

[a] Ferns and fern allies.

[b] Sedges and rushes.

[c] Species were not identified in the field.

TABLE 22 Percent Cover and Number of Species (#) of Selected Growth Forms in the ROW Vegetation Transects of Site 2, Midland County, Michigan

Growth Form	603			607			614		
	1990	1991	1992	1990	1991	1992	1990	1991	1992
Ferns[a]	6.8 (2)	9.4 (2)	14 (2)	2.3 (2)	2.4 (2)	4.8 (2)	1.8 (1)	1.9 (1)	4.7 (1)
Forbs	16 (20)	37 (27)	24 (25)	27 (18)	36 (20)	26 (26)	28 (17)	35 (23)	35 (23)
Graminoids	35 (20)	75 (20)	66 14)	42 (17)	69 (18)	77 (18)	38 (15)	62 (24)	64 (24)
Sedges[b]	23 (9)	61 (13)	62 (11)	9.1 (8)	31 (11)	51 (13)	4.2 (7)	21 (14)	41 (14)
Grasses	12 (11)	28 (7)	5.4 (3)	32 (9)	46 (7)	33 (5)	33 (8)	31 (10)	33 (10)
Mosses[c]	3.7	20	9.1	2.2	25	22	2.5	7.9	13

[a] Ferns and fern allies.

[b] Sedges and rushes.

[c] Species were not identified in the field.

perfoliatum. Other natural invaders include *Lycopus americanus* (Water Horehound), *Lycopus virginicus* (Bugle-weed), *Penthorum sedoides* (Ditch Stone Crop), *Bidens frondosa* (Beggar-ticks), *Carex vulpinoides*, *Scirpus cyperinus*, *Juncus effusus* (Rush), and species of *Salix* (Willow). The coverages for the herbaceous growth forms are lower for Site 2 than for Site 1, except for the mosses.

Summary. The forest understories of Sites 1 and 2 both have *Onoclea sensibilis* as a dominant species, but the codominants differ between the two sites. The major herbaceous growth forms are ferns, forbs, and sedges, but their cover values differ, being higher in Site 1 than in Site 2 except for the mosses.

The plants of the ecotone understories of Sites 1 and 2 have changed from their original composition as a result of the installation of the gas pipeline. Although some forest species persist at both sites, such as *Onoclea sensibilis*, *Fragaria virginiana* (Wild Strawberry), *Maianthemum*

canadense, *Carex cristatella*, *Rubus pubescens*, *Parthenocissus quinquefolia*, and species of *Acer* and *Fraxinus*, Site 1 is influenced more by the seeded species *Agrostis gigantea* and *Lotus corniculata*. The natural invader *Eupatorium perfoliatum* is more important at Site 2. *Populus deltoides* is an important natural invader at both sites.

The results concerning the cover values of herbaceous growth forms show that grasses are of minor importance in the forest understories of both sites. On the other hand, grasses are major components in the ecotone understory of Site 1 and in the ROW vegetation of Sites 1 and 2.

Repeated observations for the ecotone understories and the ROW vegetation (see Appendix P) show that these vegetation units are in a state of relatively rapid change. Particularly noteworthy, for example, in the ROW of Site 1 are the yearly increasing cover values for *Onoclea sensibilis*, a forest dominant, and *Scirpus cyperinus* and *Juncus effusus*, two natural invaders. The latter two species are especially interesting because species of these genera are absent — or at best, very rare — in the forest understory communities.

The information presented here highlights the major species and herbaceous growth forms of the three vegetational units. The more detailed data, as illustrated in Appendix F, provide a firm information baseline for comparisons with data obtained from sampling the same line transects in the near future (1995 and 1996). In particular, the succession of the ROW plant communities and ecotone understories needs to be followed and sampled periodically. The forest understories also need to be resampled to determine whether any significant changes have occurred as a result of the gas pipeline installation.

10.2.3 Logs and Mineral Soil

Fallen and placed bare logs and mineral soil* are evaluated by cover-class values concurrently with understory and ROW vegetation. Logs or portions of logs covered with mosses or other plants are evaluated as vegetational components.

Logs. Our data show that bare logs on the forest floor, under natural conditions, have about a 2-3% cover (Table 23, transects 141, 113, and 105 for Site 1; transects 241 and 213 for Site 2). However, transects 205 and 201 of Site 2 have unusually high cover values for bare logs, amounting to about 20% (nearly ten times higher than expected) (see Figure 9). This high coverage resulted from the placement of saw logs along the northern edge of the ROW during tree-clearing operations and their subsequent pushing into the forest (Zellmer et al. 1991). Saw logs were not placed along the northern edge of the ROW at Site 1; hence, the cover of bare logs for transect 105 is in the 2-3% range. The cover for transect 101 (ecotone) is less than 1%, probably

* Mineral soil refers to bare soil of very low organic content brought to the surface by the gas pipeline installation activities, such as trenching, backfilling, and grading.

TABLE 23 Percent Cover of Bare Logs for All of the Line Transects in Sites 1 and 2, Midland County, Michigan

Site	Vegetation Unit	TN[a]	1990	1991	1992
1	Forest	141	2.1	2.3	NS[b]
		113	3.2	2.8	NS
		105	2.1	2.1	NS
	Ecotone	101	0.6	0.4	0.4
	ROW	503	0.2	0.6	0.1
		507	0.4	0.4	0.2
		514	2.1	1.1	0.6
2	Forest	241	2.4	1.6	NS
		213	2.1	2.8	NS
		205	21	19	NS
	Ecotone	201	20	21	20
	ROW	603	2.3	2.7	1.3
		607	1.8	1.3	1.3
		614	7.6	5.1	4.6

[a] TN = Transect Number.

[b] NS = Not Sampled.

as a result of grading past the northern edge of the ROW. The cover of bare logs is variable among the transects for the ROW, ranging from 0.2 to 7.6% in 1990. However, the cover values for transacts 514 and 614 for Sites 1 and 2, respectively, are higher than for the other transects in their respective sites. Transects 514 and 614, on the working side of the gas pipeline, were marked by the placement of small saw logs to form a corrugated road. Particularly noteworthy is the annual decrease in their coverages, undoubtedly as a result of bacterial and fungal decay.

Mineral Soil. The deepest (distances measured from the northern edge of the ROW) forest transects (Table 24; transects 141 and 113 for Site 1; transects 241 and 213 for Site 2) have no mineral soil deposits. The forest transect 105 (Site 1) has a trace (0.4%) of mineral soil, whereas the forest transect 205 (Site 2) has a considerable coverage of mineral soil, which actually increased from 1990 (13%) to 1991 (24%). The higher cover value for transect 205 than for transect 105 is the result of the placement of trenching soil over the saw logs. Most of the soil was

FIGURE 9 Saw Logs Placed along the Northern Edge of the Right-of-Way of Site 2, Midland County, Michigan

not recovered during the backfilling and grading operations (Zellmer et al. 1991). Thus, the increase (from 13% to 24%) resulted from the soil being washed from the logs onto the forest floor.

The ecotone transects (101 for Site 1; 201 for Site 2) have appreciable coverages of mineral soil. The exposed mineral soil (23% in 1990) of the ecotone for Site 1 resulted from the grading operations, which reached past the northern edge of the ROW. The exposed mineral soil (55% in 1990) for Site 2 resulted from the saw log and trenching soil deposits mentioned above for transect 205. In both ecotones, the coverage of mineral soil decreased from 1990 to 1992. The cover of mineral soil for the ROW segments for both sites ranges from 18 to 60% (1990), but in each transect the coverages decrease annually (1990-1992), which is indicative of increasing plant coverages.

Summary. Bare logs usually have a 2-3% cover in the undisturbed forest understories of the study sites. The placement of saw logs along the northern boundary of the ROW of Site 2 resulted in a large coverage (±20%) of bare logs in the ecotone (transect 201) and first forest understory zone (transect 205). Because trenching soil was placed over these logs and not

TABLE 24 Percent Cover of Mineral Soil for All of the Line Transects in Sites 1 and 2, Midland County, Michigan

Site	Vegetation Unit	TN[a]	1990	1991	1992
1	Forest	141	0	0	NS[b]
		113	0	0	NS
		105	0.4	0	NS
	Ecotone	101	23	8.4	1.0
	ROW	503	18	12	3.1
		507	61	32	4.5
		514	27	3.0	2.0
2	Forest	241	0	0	NS
		213	0	0	NS
		205	13	24	NS
	Ecotone	201	55	32	8.8
	ROW	603	60	23	16
		607	52	39	12
		614	48	41	9

[a] TN = Transect Number.

[b] NS = Not Sampled.

recovered for backfilling, mineral soil was deposited on the forest floor, which enhanced the establishment of natural invader plants, such as *Carex vulpinoides* (Sedge), *Conyza canadensis* (Horseweed), *Ludwigia polycarpa* (False Loosestrife), *Penthorum sedoides* (Ditch Stone Crop), *Poa pratensis* (Kentucky Bluegrass), and *Salix amygdaloides* (Peach-leaved Willow).

The log/soil situation had an indirect effect on the grading operation. Because the soil placed over the logs was not recovered (or not recoverable) to fill the gas pipeline ditch, soil was taken from an area parallel to the northern side of the ditch. This resulted in an intermittent channel up to 50 cm in depth that parallels the northern side of the gas pipeline zone (see Figure 10). This channel retains water for longer periods and retards plant growth more than do other portions of the ROW segment.

FIGURE 10 Intermittent Channel Paralleling the Pipeline on the Storage Side of the Right-of-Way of Site 2 Excavated during Backfilling and Grading, Midland County, Michigan

11 Summary and Conclusions

11.1 Summary

This portion of the report addresses the first three major items presented in Section 3 (Goals and Objectives) on the basis of the project work that was effectively achieved within the time framework and with the resources available.*

11.1.1 Undisturbed Forested Wetlands

The first goal of the study is to describe the undisturbed forested wetlands. The following paragraphs focus on and summarize the floristic elements of those portions of the study sites projected to be unaffected by the installation of the GPL.

The study area has a rich vascular flora consisting of 311 species, of which 67% occur within the boundaries of Sites 1 and 2. The present known numbers of species for the sites are 189 and 159, respectively; this indicates a higher species richness for Site 1 than for Site 2.

Nearly 90% of the number of species in the sites are in three of the seven major growth form categories: forbs (45%), graminoids (27%), and trees (17%). Each of the other four categories (ferns, brambles, vines, and shrubs) has less than 5% of the species. The percent of species among the different growth forms is essentially the same for the two sites.

The sites are well represented by wetland indicator taxa. Collectively, 65% and 72% of the species for Site 1 and Site 2, respectively, are in the three major wetland indicator categories (obligate, facultative wetland, and facultative).

Twenty-six species of trees were recognized in the overstory; however, the species distributions are not equal between the two sites. Site 1 is more heterogeneous, with 26 species, than Site 2, with only 17 species. No species are unique to Site 2.

On the basis of importance values, *Quercus bicolor* (Swamp White Oak), *Fraxinus pennsylvanica* (Green Ash), and *Acer rubrum/saccharinum* (Hybrid Maple) are the predominant species in both sites. Hence, the forest communities at both sites may be classified as Swamp White Oak-Green Ash-Hybrid Maple Forested Wetlands or Swamps. However, the relative status of the subordinate tree species differs between the two sites.

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* For example, objectives 1b and 3b could not be fully realized within the short ecological time of the project's work period reported here. However, the achievement of these objectives is addressed, with other important activities, in Section 13 (Recommendations for Continuing Studies).

Ulmus americana (American Elm), *Betula papyrifera* (Paper Birch), *Alnus rugosa* (Speckled Alder), and *Populus tremuloides* (Quaking Aspen) are more important in Site 1 than in Site 2. This is indicative of a younger, second-growth forest for Site 1.

In contrast, *Tilia americana* (Basswood), *Fraxinus nigra* (Black Ash), *Carpinus caroliniana* (Hornbeam), and *Quercus palustris* (Pin Oak) are more important in Site 2 than in Site 1. This is indicative of a more mature, second-growth forest for Site 2.

There are 122 species of vascular plants that make up the forest understory of Site 1. Seventy-five percent of species are forbs, graminoids, and trees; 53% of the species are in the major wetland indicator categories.

On the other hand, 90 species of vascular plants compose the forest understory of Site 2. Seventy-nine percent of the species are forbs, graminoids, and trees; 59% of the species are in the three major wetland indicator categories.

Site 1 has 35% more species than Site 2; this is indicative of a more heterogeneous plant community. Although the two sites differ in number of species, they are remarkably similar with respect to the percent of species occurring among the growth-form and wetland indicator categories.

The dominant species for the forest understory of Site 1 are *Onoclea sensibilis* (Sensitive Fern), *Pteridium aquilinum* (Bracken Fern), and *Rubus pubescens* (Dwarf Raspberry). Important subordinates are *Aster umbellatus* (Michaelmas Daisy), *Carex tenera* (Sedge), *Parthenocissus quinquefolia* (Woodbine), and seedlings of tree taxa.

The dominant species for the forest understory of Site 2 are *Onoclea sensibilis* (Sensitive Fern), *Amphicarpaea bracteata* (Hog-peanut), *Carex rosea* (Sedge), and the species of *Fraxinus* (Ash). Noteworthy subordinates are *Rubus pubescens* (Dwarf Raspberry), *Parthenocissus quinquefolia* (Woodbine), *Carpinus caroliniana* (Hornbeam), *Ilex verticillata* (Michigan Holly), and seedlings of *Acer* (Maple).

Onoclea sensibilis (Sensitive Fern) is dominant in both sites, but the codominants and most of the important subordinates differ. The cover values for the herbaceous growth forms are larger for Site 1 than for Site 2. On the other hand, the mosses have about twice as much coverage in Site 2 as in Site 1.

11.1.2 Plant Communities' Development in Forest-ROW Ecotone

The second goal is to describe the development of plant communities in the forest-ROW ecotone. The following paragraphs summarize the vegetational features of the communities in the forest edge adjacent to the ROW, within the scope of the study's time period.

The ecotone understory of Site 1 has 123 species, of which 83% are forbs, graminoids, and trees. Sixty percent of the species are in the three major wetland indicator categories.

The ecotone understory of Site 2 has 114 species, of which 86% are forbs, graminoids, and trees. Sixty-three percent of the species are in the three major wetland indicator categories.

The dominant species for the ecotone understory of Site 1 are *Onoclea sensibilis* (Sensitive Fern), *Lotus corniculata* (Birdfoot Trefoil), *Agrostis gigantea* (Redtop Grass), and *Populus deltoides* (Cottonwood). Important subordinates are *Eupatorium perfoliatum* (Boneset), *Carex cristatella* (Sedge), *Carex lupulina* (Sedge), and *Spiraea alba* (Meadowsweet).

In the ecotone understory of Site 2, the dominant species are *Onoclea sensibilis* (Sensitive Fern), *Eupatorium perfoliatum* (Boneset), *Carex cristatella* (Sedge), *Carex lupulina* (Sedge), and *Populus deltoides* (Cottonwood). The important subordinates are *Glyceria striata* (Fowl Manna Grass), *Salix amygdaloides* (Peach-leaved Willow), and species of *Acer* (Maple) and *Fraxinus* (Ash).

The ecotone understories of both sites were about equally disturbed by the installation of the gas pipeline. However, in the forest understory, the dominant *Onoclea sensibilis* (Sensitive Fern) is still among the dominant species.

On the other hand, the seeded species, *Lotus corniculata* (Birdfoot Trefoil) and *Agrostis gigantea* (Redtop Grass), are more important in Site 1 than in Site 2, whereas the natural invading species, *Eupatorium perfoliatum* (Boneset) and *Glyceria striata* (Fowl Manna Grass), are more important in Site 2 than in Site 1. In addition, the invasion of *Populus deltoides* (Cottonwood) and species of *Salix* (Willow) into the ecotone understories of both sites is noteworthy because these taxa represent an early successional stage.

11.1.3 Vegetational Development on ROW

The third goal is to describe the development of vegetation on the ROW into stable anthropogenic disclimax plant communities. However, the study's time frame only covers the very early stages of vegetational establishment and development; the study occurs prior to the application of maintenance practices that essentially eliminate tree species and eventually lead to disclimax (arrested succession) communities. The following paragraphs summarize early successional plant taxonomic and structural features of the ROW communities.

The ROW vegetation of Site 1 has 126 species, of which 84% are forbs, graminoids, and grasses. Sixty-three percent of the species are in the three major wetland indicator categories.

The ROW vegetation of Site 2 has 113 species, of which 89% are forbs, graminoids, and trees. Sixty-six percent of the species are in the three major wetland indicator categories.

The dominant species for the ROW vegetation of Site 1 are *Lotus corniculata* (Birdfoot Trefoil), *Carex lupulina* (Sedge), and *Populus deltoides* (Cottonwood), but *Onoclea sensibilis* (Sensitive Fern), *Eupatorium perfoliatum* (Boneset), *Carex cristatella* (Sedge), *Scirpus cyperinus* (Bulrush), and *Salix amygdaloides* (Peach-leaved Willow) are important subordinates.

For the ROW vegetation of Site 2, the dominant species are *Agrostis gigantea* (Redtop Grass) and *Populus deltoides* (Cottonwood); however, *Onoclea sensibilis* (Sensitive Fern), *Eupatorium perfoliatum* (Boneset), *Carex lupulina* (Sedge), *Carex cristatella* (Sedge), and *Scirpus cyperinus* (Bulrush) are very important subordinates.

Although the original surface vegetation of the ROW at both sites was disturbed during the installation of the gas pipeline, some elements of the original flora have regenerated and persist; these include *Onoclea sensibilis* (Sensitive Fern), *Maianthemum canadense* (Wild Lily-of-the-valley), *Carex cristatella* (Sedge), *Rubus pubescens* (Dwarf Raspberry), *Parthenocissus quinquefolia* (Woodbine), and species of *Acer* (Maple) and *Fraxinus* (Ash).

However, these species are subordinate to the seeded species *Lotus corniculata* (Birdfoot Trefoil), *Agrostis gigantea* (Redtop Grass), and *Phleum pratense* (Timothy), as well as to the natural invaders *Populus deltoides* (Cottonwood) and *Eupatorium perfoliatum* (Boneset).

Other natural invaders include *Lycopus americanus* (Water Horehound), *Lycopus virginicus* (Bugle-weed), *Penthorum sedoides* (Ditch Stone Crop), *Bidens frondosa* (Beggar-ticks), *Carex vulpinoides* (Sedge), *Scirpus cyperinus* (Bulrush), *Juncus effusus* (Rush), and species of *Salix* (Willow).

11.1.4 General Comparisons

The following paragraphs summarize several general comparisons between the sites and among the vegetational units (forest, ecotone, and ROW).

Comparing the growth form categories among the vegetational units shows some important trends. The dicot forbs are the major growth form components in all three vegetational units.

Among the graminoids, there is a larger number of grass species on the ROW compared to the understory.

Results concerning cover values of herbaceous growth forms show that grasses are of minor importance in the forest understories of both sites. On the other hand, grasses are major components in the ecotone understory of Site 1 and the ROW vegetation of Sites 1 and 2, undoubtedly as a consequence of seeding operations.

Observations to date for the ecotone understories and the ROW vegetation indicate that these vegetation units are in a state of relatively rapid change (or flux).

Particularly noteworthy, for example, in the ROW of Site 1, are the yearly increasing cover values for *Onoclea sensibilis* (Sensitive Fern), a forest dominant, and *Scirpus cyperinus* (Bulrush) and *Juncus effusus* (Rush), two natural invaders.

The placement of saw logs along the northern boundary of the ROW of Site 2 resulted in a large coverage (ca. 20%) of bare logs in the ecotone and beyond. Because trenching soil was placed over these logs and not recovered for backfilling, mineral soil was deposited on the forest floor, which enhanced the establishment of such natural invader plants as *Carex vulpinoides* (Sedge), *Conyza canadensis* (Horseweed), *Ludwigia polycarpa* (False Loosestrife), *Penthorum sedoides* (Ditch Stone Crop), *Poa pratensis* (Kentucky Bluegrass), and *Salix amygdaloides* (Peach-leaved Willow).

The log/soil situation indirectly affected the grading operation. Because the soil placed over the logs was not recovered (or was not recoverable) to fill the gas pipeline ditch, soil was taken from an area parallel to the northern side of the ditch. This resulted in a channel that parallels the northern side of the gas pipeline zone; this channel retains water for longer periods and retards plant growth more than do other portions of the ROW segment.

11.2 Conclusions

Ecologic features of the overstories at both sites were documented in detail during the first year following the installation of the GPL in 1989; some observations were recorded subsequently, in 1990 and 1991. But the minimal time lapse between effective samplings for overstories is usually five or more years; because of time and resource limitations, the overstories were not resampled. Hence, no conclusions can be made at this time concerning natural or ROW-induced changes in the overstories.

Ecologic features of the understories in the forested portions of the sites were thoroughly documented over a three-year period (1989-1991) to serve as controls. On the basis of analytical techniques employed for this period, no appreciable natural or ROW-induced changes in the vegetational components are indicated.

A considerable amount of ecologic data was collected along the forest-ROW boundary over a four-year period (1989-1992). Forest-ROW ecotone plant communities are discernible at both sites; they consist of natural, natural invader, and seeded invader species. To date, no species is recognized as unique to the ecotone communities. The immature ecotone communities are in a high degree of vegetational change and will remain so until some time after the ROW communities reach their anthropogenic disclimaxes (arrested successions).

Early successional stages of the ROW were thoroughly documented over a three-year period (1990-1992). During this time, plant communities developed on the ROW progressively, with increasing coverage and wetland characteristics. However, the composition of the ROW plant communities differs from those of the forest understories, which the ROW communities have replaced. The dominant plants on the ROW are seeded and natural invader species; nevertheless, some important original floristic elements persist and may be increasing in abundance. Whether the seeded species will be essentially replaced by the natural species cannot be ascertained at present because the available time and resources did not permit the documentation of later stages of succession; for the same reasons, the relative importance of the original floristic elements cannot be determined.

Factors that probably slowed plant succession on the ROW at the study sites are attributable to construction techniques. The log riprap (and soils placed over the logs) along the forest-ROW boundary (Site 2) reduced the ability to replace saved topsoil and seemingly affected the surface hydrology. The logs and associated soils initially reduced vegetation cover, and subsequently, the exposed mineral soil promoted the invasion of seeded and natural invader species. The seeding of the ROW, although perhaps of short-term benefit, has the long-term effect of delaying (if not preventing) the establishment of and reducing the abundance of natural wetland species. Native species have adapted to the wetland environment, but seeding with nonnative species and leaving mineral soil at the surface has disrupted natural ecological processes.

12 Recommendations

12.1 General Recommendations

The following statements address the fourth goal (see Section 3) with regard to general recommendations concerning GPL construction methods.

1. Construction contracts should ensure that the logs from the ROW are properly removed to avoid potential adverse ecological impacts on native plant communities.

2. Care should be taken to ensure that excavated soil does not spill beyond the boundaries of the ROW, causing adverse ecological impacts on adjacent native plant communities.

3. Water pumped from the pipe ditch should be directed so that it will not cause soil erosion or deposition that could adversely affect adjacent native plant communities.

4. Stumps that were allowed to remain on the ROW, even when cut to ground level, did provide protection to some floristic elements throughout the construction activities. Hence, the policy of removing only those stumps necessary for installation of the pipe should be continued.

5. Seeding the ROW of the study sites was probably unnecessary because of its level topography, poor drainage, and apparently abundant soil reserve of native plant propagules. The seeding of areas consisting of native vegetation should only be done when deemed necessary to control erosion. Furthermore, such seeding should be done with native species, if at all possible, and should use methods involving minimal soil disturbance to conserve the soil bank of plant propagules.

12.2 Recommendations for Continuing Studies, 1995-2001

12.2.1 Sampling

Resampling of the designated vegetation units is needed so that results can be compared to ascertain whether or not changes have occurred in the adjacent forest communities as a

consequence of pipeline installation on the ROW and to document the succession of vegetation on the ROW:

1. *1995.* Sample the forest overstory, which was last sampled in 1989; the ROW bryophyte layer, which was sampled only on a preliminary basis in 1990; and the ROW vegetation and ecotone understory, if such sampling is considered essential after inspection.

2. *1996.* Sample the forest understory, which was last sampled in 1991, and the ROW vegetation and ecotone understory, if considered essential after inspection and if not sampled in 1995.

3. *1997.* Sample the forest bryophyte layer and the ROW vegetation and ecotone understory, if considered essential after inspection and if not sampled in 1996.

4. *1998.* Sample the ROW vegetation and ecotone understory, if considered essential after inspection and if not sampled in 1997.

12.2.2 Preparation of First-Phase Final Report, 1989-2001

1. *Taxonomy.* Identify newly collected vascular plant species and prepare them for herbarium; complete herbarium labels; identify previously collected and newly collected bryophytes (include the analysis of the bryophyte plug samples); complete the editing of the herbarium labels; print and attach herbarium labels to the existing herbarium sheets; prepare floristic analyses from voucher specimen database.

2. *Data Reduction.* Reduce primary and secondary field data collected during the upcoming sampling periods.

3. *Data Synthesis.* Prepare data for comparative analyses between sampling dates of the same habitat (e.g., forest overstory 1989 vs. forest understories 1994) and among different habitats (e.g., ROW plant communities vs. ecotone understories). Data reduction at this level involves the calculation of relative quantitative values, site importance values, and similarity indexes.

4. *Concepts for Reports, Papers, Presentations, and Other Accounts*

    a. Perform comparative analyses of the forest overstories on the basis of 1989 and 1995 samplings. [Questions: What compositional, structural, and

wetland status changes occurred (if any)? What changes were effected by the ROW?]

b. Perform comparative analyses of the forest understories on the basis of 1989-1991 and 1995 samplings. [Questions: What compositional, structural, and wetland status changes occurred? What changes were effected by the ROW?]

c. Perform comparative analyses of the forest and ROW bryophyte layers. [Questions: Does the bryophyte layer of the ROW differ from the bryophyte layer of the forest? Did any compositional changes occur in the forest bryophyte layer, and if so, what changes were effected by the ROW?]

d. Perform comparative analyses of the ecotone understories on the basis of 1989-1992, 1995 (or 1996), and subsequent samplings. [Questions: What was the compositional and structural development of the ecotone understories? Were the developmental stages of the ecotone understories affected more by ROW plant communities or by forest communities?]

e. Perform comparative analyses of the ROW vegetation on the basis of 1990-1992, 1995 (or 1996), and subsequent samplings. [Questions: What was the compositional and structural development of the ROW plant communities? What was the source of plant seeds, spores, etc. during the developmental stages of the ROW plant communities? Has the wetland status of the ROW plant communities changed with respect to forest communities?]

f. Produce a floristic report. This aspect of the study should provide floristic data input to our national plant inventory database through Michigan State University or the Missouri Botanical Garden.

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Appendix A:

Master Taxon List

Appendix A: Master Taxon List

Format:

Taxon	Name for biotic (scientific names for plants) and abiotic factors
Taxon CODE	Taxon code for plant names comprises three letters of generic name plus two letters of species name. Taxon codes for other biotic factors and for abiotic factors have been designated. File Name = Taxon Code + Serial Number. Also, Sp = unknown species for a known genus; for example, in the taxon code XXXSP, the XXX is the three-letter code for the genus.
Family Name	
Common Name	
Reference	Refers to the floristic authority for the plant name being used. The letter V = Voss (1972 and 1985), and G = Gleason (1952 a, b, and c). The number next to the letter refers to the volume number of either Voss or Gleason.

Growth Form [See Note A] *Wetland Indicator* [See Note B]

NOTE A: Codes/Applications for Growth Forms and Other Factors

ABIO	Abiotic factors (water etc.)
BIOD	Biotic nonliving factors (logs etc.)
BRAM	Species of brambles
FERN	Species of pteridophytes
FEAL	Pteridophytes, collectively (ferns and fern allies)
FOAL	Forbs, collectively
FODI	Species herbaceous dicot
FOMO	Species herbaceous monocot
GRAL	All graminoids (grasses, rushes, and sedges)
GRCY	Species of sedges, Cyperaceae
GRKS	Grasses, collectively
GRJU	Species of rushes, Juncaceae
GRPO	Species of grasses, Poaceae
GRCJ	Sedges and rushes, collectively
MOSS	Bryophytes, collectively
SHRU	Species of shrubs
TREE	Species of overstory trees; white oak and black oak groups
TRES	Species of overstory, small trees (or shrubs); *Cornus foemina*, *Ilex verticillata*, and *Viburnum lentago*
UNKN	Unknown plants
VINE	Species of vines

NOTE B: Wetland Indicator Codes/Categories (Source: Reed 1988)

OBL	Obligate: Occur almost always under natural conditions in wetlands.
FACW	Facultative Wetland: Usually occur in wetlands but occasionally found in nonwetlands.
FAC	Facultative: Equally likely to occur in wetlands or nonwetlands.
FACU	Facultative Upland: Usually occur in nonwetlands, but occasionally found in wetlands.
UPL	Obligate Upland: Occur in wetlands in another region, but occur almost always under natural conditions in nonwetlands in the region specified.
NA	No Agreement: Regional panel was not able to reach a unanimous decision on a species.
NI	No Indicator: Applied to those species for which insufficient information was available to determine an indicator status.
NP	Applied to those species not found in Reed (1988).
*	Identifies tentative assignments based on limited information from which to determine the indicator status.
+	Indicates frequency toward the higher end of the category (more frequently found in wetlands).
-	Indicates frequency toward the lower end of the category (less frequently found in wetlands).

Water
WATER
NA
NA
REF NA
ABIO NP

Mineral Soil
MINSO
NA
NA
REF NA
ABIO NP

Forest Soil
FORSO
NA
NA
REF NA
BIOD NP

Logs
LOGSS
NA
NA
REF NA
BIOD NP

Row Litter
ROWLI
NA
NA
REF NA
BIOD NP

Stumps
STUMP
NA
NA
REF NA
BIOD NP

Bryophytes
BRYOP
Bryophyta
Mosses and Liverworts
REF NA
MOSS NP

Pteridophytes
PTERI
NA
Fern and Fern Allies
REF NA
FEAL NP

Graminoids
GRAMI
NA
Grasses, Sedges, and Rushes
REF NA
GRAL NP

Grasses
GRASS
Poaceae (Gramineae)
Grasses
REF NA
GRKS NP

Sedges and Rushes
SEDGE
NA
Sedges, Rushes, etc.
REF NA
GRCJ NP

Forbs
FORBS
NA
NA
REF NA
FOAL NP

Unknown Forbs
UNFO#
NA
Collection Number
REF NA
UNKN NP

Unknown Graminoides
UNGR#
NA
Collection Number
REF NA
UNKN NP

Quercus Black Oak Group
QUEBK
Fagaceae
Black Oaks
REF NA
TREE NP

Quercus White Oak Group
QUEWH
Fagaceae
White Oaks
REF NA
TREE NP

Unknown Ferns
UNFE#
NA
Collection Number
REF NA
UNKN NP

Unknown Woody Plant
UNWD#
NA
Collection Number
REF NA
UNKN NP

Acer nigrum
ACENI
Aceraceae
Black Maple
G2, p. 506
TREE FACU

Acer rubrum
ACERU
Aceraceae
Red Maple
V2, p. 549
TREE FAC

Acer saccharum
ACESC
Aceraceae
Sugar Maple
V2, p. 547
TREE FACU

Acer saccharinum
ACESA
Aceraceae
Silver Maple
V2, p. 549
TREE FACW

Acer rubrum/saccharinum
ACERS
Aceraceae
Hybrid Maple
V2, p. 545
TREE NP

Achillea millefolium
ACHMI
Asteraceae (Compositae)
Yarrow
G3, p. 385
FODI FACU

Actaea pachypoda
ACTPA
Ranunculaceae
White Baneberry
V2, p. 208
FODI NP

Actaea rubra
ACTRU
Ranunculaceae
Red Baneberry
V2, p. 207
FODI NP

Agrimonia gryposepala
AGMGR
Rosaceae
Agrimony
V2, p. 443
FODI FACU+

Agrostis gigantea
AGRGI
Poaceae (Gramineae)
Redtop
V1, p. 201
GRPO NI

Agrostis hyemalis var. *stenuis*
AGRHY
Poaceae (Gramineae)
Ticklegrass
V1, p. 202
GRPO FAC-

Alisma plantago-aquatica
ALIPL
Alismataceae
Water Plantain
V1, p. 104
FOMO OBL

Alnus rugosa
ALNRU
Betulaceae
Speckled Alder
V2, p. 64
TREE OBL

Ambrosia artemisiifolia
AMBAR
Asteraceae (Compositae)
Ragweed
G3, p. 374
FODI FACU

Amelanchier arborea
AMEAR
Rosaceae
Serviceberry
V2, p. 382
TREE FACU

Amelanchier bartramiana
AMEBA
Rosaceae
Mountain Serviceberry
V2, p.382
TREE FAC

Amphicarpaea bracteata
AMPBR
Fabaceae
Hog-peanut
V2, p. 460
FODI FAC

Anemone quinquefolia
ANEQU
Ranunculaceae
Wood Anemone
V2, p. 228
FODI FAC*

Anemone virginiana
ANEVI
Ranunculaceae
Thimbleweed
V2, p. 229
FODI NI

Apocynum androsaemifolium
APOAN
Apocynaceae
Dogbane
G3, p. 72
FODI NP

Apocynum sibiricum
APOSI
Apocynaceae
Indian Hemp
G3, p. 72
FODI FAC+

Aralia nudicaulis
ARANU
Araliaceae
Wild Sarsaparilla
V2, p. 645
FODI FACU

Aralia racemosa
ARARA
Araliaceae
Spikenard
V2, p. 645
FODI NP

Arisaema triphyllum
ARITR
Araceae
Jack-in-the-pulpit
V1, p. 366
FODI FACW-

Aronia prunifolia
AROPR
Rosaceae
Choke Berry
V2, p. 377
SHRU FACW

Asclepias incarnata
ASCIN
Asclepiadaceae
Swamp Milkweed
G3, p. 75
FODI OBL

Asclepias syriaca
ASCSR
Asclepiadaceae
Milkweed
G3, p. 76
FODI NP

Aster lateriflorus
ASTLA
Asteraceae (Compositae)
Wild Aster
G3, p. 464
FODI FACW-

Aster macrophyllus
ASTMA
Asteraceae (Compositae)
Wild Aster
G3, p. 444
FODI NP

Aster ontarionis
ASTON
Asteraceae (Compositae)
Michaelmas Daisy
G3, p. 464
FODI FAC

Aster puniceus
ASTPU
Asteraceae (Compositae)
Aster
G3, p. 454
FODI OBL

Aster sagittifolius
ASTSA
Asteraceae (Compositae)
Wild Aster
G3, p. 448
FODI NP

Aster simplex
ASTSI
Asteraceae (Compositae)
Wild Aster
G3, p. 464
FODI FACW

Aster umbellatus
ASTUM
Asteraceae (Compositae)
Aster
G3, p. 458
FODI FACW

Athyrium filix-femina
ATHFI
Polypodiaceae
Lady Fern
G1, p. 42
FERN FAC

Betula papyrifera
BETPA
Betulaceae
Paper Birch
V2, p. 68
TREE FACU+

Bidens frondosu
BIDFR
Asteraceae (Compositae)
Beggar-ticks
G3, p. 355
FODI NP

Botrychium virginianum
BOTVI
Ophioglossaceae
Rattlesnake Fern
G1, p. 18
FERN FACU

Brachyelytrum erectum
BRAER
Poaceae (Gramineae)
Grass Family
V1, p. 178
GRPO NP

Bromus ciliatus
BROCI
Poaceae (Gramineae)
Fringed Brome
V1, p. 136
GRPO FACW

Bromus inermis
BROIN
Poaceae (Gramineae)
Smooth Brome
V1, p. 134
GRPO NP

Bromus japonicus
BROJA
Poaceae (Gramineae)
Japanese Brome
V1, p. 139
GRPO FACU

Calamagrostis canadensis
CALCA
Poaceae (Gramineae)
Blue Joint
V1, p. 196
GRPO OBL

Carex annectens
CARAN
Cyperaceae
Sedge
V1, p. 264
GRCY FACW

Carex aurea
CARAU
Cyperaceae
Sedge
V1, p. 292
GRCY FACW+

Carex bebbii
CARBE
Cyperaceae
Sedge
V1, p. 280
GRCY OBL

Carex bromoides
CARBR
Cyperaceae
Sedge
V1, p. 272
GRCY FACW+

Carex crinita
CARCI
Cyperaceae
Sedge
V1, p. 316
GRCY FACW+

Carex cristatella
CARCR
Cyperaceae
Sedge
V1, p. 281
GRCY FACW+

Carex gracillima
CARGR
Cyperaceae
Sedge
V1, p. 304
GRCY FACU*

Carex intumescens
CARIN
Cyperaceae
Sedge
V1, p. 327
GRCY FACW+

Carex lacustris
CARLA
Cyperaceae
Sedge
V1, p. 322
GRCY OBL

Carex lupulina
CARLU
Cyperaceae
Sedge
V1, p. 328
GRCY OBL

Carex lurida
CARLR
Cyperaceae
Sedge
V1, p. 320
GRCY OBL

Carex normalis
CARNO
Cyperaceae
Sedge
V1, p. 282
GRCY FACW

Carex pedunculata
CARPE
Cyperaceae
Sedge
V1, p. 290
GRCY NP

Carex rosea
CARRO
Cyperaceae
Sedge
V1, p. 261
GRCY NP

Carex scoparia
CARSC
Cyperaceae
Sedge
V1, p. 282
GRCY FACW

Carex stipata
CARST
Cyperaceae
Sedge
V1, p.267
GRCY NP

Carex stricta
CARSR
Cyperaceae
Sedge
V1, p. 315
GRCY OBL

Carex tenera
CARTE
Cyperaceae
Sedge
V1, p. 282
GRCY FAC+

Carex tuckermanii
CARTU
Cyperaceae
Sedge
V1, p. 325
GRCY OBL

Carex vulpinoidea
CARVU
Cyperaceae
Sedge
V1, p. 264
GRCY OBL

Carpinus caroliniana
CAPCA
Betulaceae
Hornbeam
V2, p. 71
TREE FAC

Centaurea maculosa
CENMA
Asteraceae (Compositae)
Star-Thistle
G3, p. 515
FODI NP

Cephalanthus occidentalis
CEPOC
Rubiaceae
Buttonbush
G3, p. 278
SHRUB OBL

Cerastium fontanum
CERFO
Caryophyllaceae
Mouse-ear Chickweed
V2, p. 167
FODI FACU

Chelone glabra
CHEGL
Scrophulariaceae
Turtlehead
G3, p. 220
FODI OBL

Cicuta maculata
CICMA
Apiaceae (Umbelliferae)
Water-hemlock
V2, p. 673
FODI OBL

Cinna arundinacea
CINAR
Poaceae (Gramineae)
Wood Reed
V1, p. 199
GRPO FACW

Circaea lutetiana
CIRLU
Onagraceae
Enchanter's-nightshade
V2, p. 617
FODI FACU

Cirsium arvense
CISAR
Asteraceae (Compositae)
Canada Thistle
G3, p. 512
FODI FACU

Cirsium vulgare
CISVU
Asteraceae (Compositae)
Bull Thistle
G3, p. 508
FODI FACU-

Clintonia borealis
CLIBO
Liliaceae
Corn Lily
V1, p. 409
FOMO FAC+

Comptonia peregrina
COMPE
Myricaceae
Sweetfern
V2, p. 55
SHRUB NP

Conyza canadensis
CONCA
Asteraceae (Compositae)
Horseweed
G3, p. 475
FODI FAC-

Cornus canadensis
CORCA
Cornaceae
Bunchberry
V2, p. 677
FODI FAC

Cornus foemina
CORFO
Cornaceae
Gray Dogwood
V2, p. 680
TRES FACW-

Cornus stolonifera
CORST
Cornaceae
Red-osier Dogwood
V2, p. 679
SHRU FACW

Corydalis sempervirens
COYSE
Fumariaceae
Pink or Pale Corydalis
V2, p. 249
FODI NP

Crataegus punctata
CRAPU
Rosaceae
Dotted Hawthorn
V2, p. 401
TREE NP

Crepis tectorum
CRETE
Asteraceae (Compositae)
Hawk's Beard
G3, p. 528
FODI NP

Cryptotaenia canadensis
CRYCA
Apiaceae (Umbelliferae)
Honewort
V2, p. 669
FODI FAC

Cyperus erythrorhizos
CYPER
Cyperaceae
Nut Grass
V1, p. 336
GRCY OBL

Cypripedium acaule
CYRAC
Orchidaceae
Pink Lady-Slipper
V1, p. 436
FOMO FACW

Cypripedium calceolus
CYRCA
Orchidaceae
Yellow Lady-Slipper
V1, p. 436
FOMO FAC+

Dactylis glomerata
DACGL
Poaceae (Gramineae)
Orchard Grass
V1, p. 116
GRPO FACU

Daucus carota
DAUCA
Apiaceae (Umbelliferae)
Wild Carrot
V2, p. 655
FODI NP

Desmodium canadense
DESCA
Fabaceae
Tick Trefoil
V2, p. 466
FODI FAC-

Desmodium glutinosum
DESGL
Fabaceae
Tick Trefoil
V2, p. 464
FODI NP

Dianthus armeria
DIAAR
Caryophyllaceae
Deptford Pink
V2, p. 174
FODI NP

Diervilla lonicera
DIELO
Caprifoliaceae
Bush Honeysuckle
G3, p. 297
SHRU NP

Dryopteris austriaca var. *spinulosa*; DRYAU
Polypodiaceae
Spinulose Shield-fern
G1, p. 52
FERN FACW-

Echinochloa crusgalli
ECHCR
Poaceae (Gramineae)
Barnyard Grass
V1, p. 219
GRPO FACW

Echinochloa walteri
ECHWA
Poaceae (Gramineae)
Grass
V1, p. 219
GRPO OBL

Elaeagnus umbellata
ELAUM
Elaeagnaceae
Oleaster
V2, p. 608
FODI NP

Eleocharis obtusa
ELEOB
Cyperaceae
Spike-Rush
V1, p. 345
GRCY OBL

Elymus virginicus
ELYVI
Poaceae (Gramineae)
Wild Rye
V1, p. 154
GRPO FACW-

Epilobium ciliatum
EPICI
Onagraceae
Willow-herb
V2, p. 622
FODI FACU

Epilobium coloratum
EPICO
Onagraceae
Willow-herb
V2, p. 622
FODI OBL

Equisetum arvense
EQUAR
Equisetaceae
Common Horsetail
G1, p. 13
FERN FAC

Erigeron annuus
ERIAN
Asteraceae (Compositae)
Daisy Fleabane
G3, p. 472
FODI FAC-

Erigeron philadelphicus
ERIPH
Asteraceae (Compositae)
Daisy Fleabane
G3, p. 470
FODI FACW

Erigeron stigosus
ERIST
Asteraceae (Compositae)
Daisy Fleabane
G3, p. 470
FODI FAC-

Euonymus obovata
EUOOB
Celastraceae
Running Strawberry Bush
V2, p. 544
VINE NP

Eupatorium perfoliatum
EUPPE
Asteraceae (Compositae)
Boneset, Thoroughwort
G3, p. 491
FODI FACW+

Eupatorium purpureum
EUPPU
Asteraceae (Compositae)
Purple Joe-Pye Weed
G3, p. 486
FODI FAC

Fagus grandifolia
FAGGR
Fagaceae
Beech
V2, p. 84
TREE FACU

Festuca arundinacea
FESAR
Poaceae (Gramineae)
Tall Fescue
V1, p. 141
GRPO FACU+

Festuca obtusa
FESOB
Poaceae (Gramineae)
Nodding Fescue
V1, p. 141
GRPO FACU+

Festuca ovina
FESOV
Poaceae (Gramineae)
Sheep Fescue
V1, p. 144
GRPO NP

Festuca pratensis
FESPR
Poaceae (Gramineae)
Meadow Fescue
V1, p. 141
GRPO FACU-

Fragaria virginiana
FRGVI
Rosaceae
Wild Strawberry
V2, p. 424
FODI FAC-

Fraxinus nigra
FRANI
Oleaceae
Black Ash
G3, p. 50
TREE FACW+

Fraxinus pennsylvanica
FRAPE
Oleaceae
Ash, Green
G3, p. 48
TREE FACW

Galium aparine
GALAP
Rubiaceae
Bedstraw
G3, p.284
FODI FACU

Galium asprellum
GALAS
Rubiaceae
Bedstraw
G3, p. 287
FODI OBL

Galium boreale
GALBO
Rubiaceae
Bedstraw
G3, p. 284
FODI FAC

Galium obtusum
GALOB
Rubiaceae
Bedstraw
G3, p. 288
FODI FACW+

Galium tinctorium
GALTI
Rubiaceae
Bedstraw
G3, p. 289
FODI OBL

Galium triflorum
GALTR
Rubiaceae
Bedstraw
G3, p. 285
FODI FACU+

Gaultheria procumbens
GAUPR
Ericaceae
Wintergreen
G3, p. 21
FODI FACU

Geranium maculatum
GERMA
Geraniaceae
Geranium Family
V2, p. 505
FODI FACU

Gerardia tenuifolia
GRATE
Scrophulariaceae
Figwort
G3, p. 242
FODI NP

Geum canadense
GEUCA
Rosaceae
Avens
V2, p. 437
FODI FAC

Glyceria striata
GLYST
Poaceae (Gramineae)
Fowl Manna Grass
V1, p. 146
GRPO OBL

Gnaphalium obtusifolium
GNAOB
Asteraceae (Compositae)
Old-Field Balsam
G3, p. 482
FODI NP

Gnaphalium uliginosum
GNAUL
Asteraceae (Compositae)
Cudweed
G3, p. 492
FODI FAC

Goodyera sp.
GOOSP
Orchidaceae
Rattlesnake-plantain
V1, p. 458
FOMO NP

Habenaria lacera
HABLA
Orchidaceae
Ragged Fringed Orchid
V1, p. 443
FOMO FACW

Habenaria psychodes
HABPS
Orchidaceae
Purple Fringed Orchid
V1, p. 443
FOMO FACW

Hamamelis virginiana
HAMVI
Hamamelidaceae
Witch-hazel
V2, p. 334
SHRUB FACU

Helianthus giganteus
HELGI
Asteraceae (Compositae)
Sunflower
G3, p. 327
FODI FACW

Hieracium aurantiacum
HIEAU
Asteraceae (Compositae)
Hawkweed
G3, p. 523
FODI NP

Hieracium canadense
HIECA
Asteraceae (Compositae)
Hawkweed
G3, p. 527
FODI NP

Hieracium florentinum
HIEFL
Asteraceae (Compositae)
Hawkweed
G3, p. 524
FODI NP

Hieracium pratense
HIEPR
Asteraceae (Compositae)
Hawkweed
G3, p. 523
FODI NP

Hieracium traillii
HIETR
Asteraceae (Compositae)
Hawkweed
G3, p. 525
FODI NP

Hypericum canadense
HYPCA
Clusiaceae (Guttiferae)
St. John's-wort
V2, p. 582
FODI FACW

Hypericum majus
HYPMA
Clusiaceae (Guttiferae)
St. John's-wort
V2, p. 582
FODI FACW

Hypericum perforatum
HYPPE
Clusiaceae (Guttiferae)
Common St. John's-wort
V2, p. 579
FODI NP

Hypericum punctatum
HYPPU
Clusiaceae (Guttiferae)
Spotted St. John's-wort
V2, p. 579
FODI FAC+

Ilex verticillata
ILEVE
Aquifoliaceae
Michigan Holly
V2, p. 540
TRES FACW+

Impatiens capensis
IMPCA
Balsaminaceae
Spotted Touch-me-not
V2, p. 556
FODI FACW

Iris virginica
IRIVI
Iridaceae
Southern Blue Flag
V1, p. 432
FOMO OBL

Juglans nigra
JUGNI
Juglandaceae
Black Walnut
V2, p. 56
TREE FACU

Juncus acuminatus
JUNAC
Juncaceae
Rush
V1, p. 389
GRJU OBL

Juncus alpinus
JUNAL
Juncaceae
Rush
V1, p. 391
GRJU OBL

Juncus articulatus
JUNAR
Juncaceae
Rush
V1, p. 392
GRJU OBL

Juncus brevicaudatus
JUNBR
Juncaceae
Rush
V1, p. 388
GRJU OBL

Juncus bufonius
JUNBU
Juncaceae
Toad Rush
V1, p. 386
GRJU FACW+

Juncus canadensis
JUNCA
Juncaceae
Rush
V1, p. 388
GRJU OBL

Juncus dudleyi
JUNDU
Juncaceae
Rush
V1, p. 387
GRJU FAC

Juncus effusus
JUNEF
Juncaceae
Rush
V1, p. 384
GRJU OBL

Juncus nodosus
JUNNO
Juncaceae
Rush
V1, p. 389
GRJU OBL

Juncus tenuis
JUNTE
Juncaceae
Path Rush
V1, p. 387
GRJU FAC

Juncus vaseyi
JUNVA
Juncaceae
Rush
V1, p. 385
GRJU FACW

Lactuca biennis
LACBI
Asteraceae (Compositae)
Biennial Lettuce
G3, p. 537
FODI FAC

Lactuca canadensis var. *lonifolia*;
LACCA
Asteraceae (Compositae)
Tall Yellow Lettuce
G3, p. 535
FODI FACU+

Lechea sp.
LECSP
Cistaceae
Pinweed
V2, p. 585
FODI NP

Leersia virginica
LEEVI
Poaceae (Gramineae)
White Grass
V1, p. 211
GRPO FACW

Lilium michiganense
LILMI
Liliaceae
Michigan Lily
V1, p. 408
FOMO FAC+

Linaria vulgaris
LINVU
Scrophulariaceae
Butter-and-eggs
G3, p. 228
FODI NP

Lobelia cardinalis
LOBCA
Lobeliaceae
Cardinal-Flower
G3, p. 318
FODI OBL

Lobelia inflata
LOBIN
Lobeliaceae
Indian Tobacco
G3, p. 322
FODI FACU-

Lolium perenne
LOLPE
Poaceae (Gramineae)
Ryegrass
V1, p. 158
GRPO FACU

Lonicera dioica
LONDI
Caprifoliaceae
Wild Honeysuckle
G3, p. 301
SHRU FACU

Lotus corniculata
LOTCO
Fabaceae
Birdfoot Trefoil
V2, p. 493
FODI FAC-

Ludwigia polycarpa
LUDPO
Onagraceae
False Loosestrife
V2, p. 618
FODI OBL

Lycopodium clavatum
LYOCL
Lycopodiaceae
Clubmoss
G1, p. 4
FERN FAC

Lycopodium obscurum
LYOOB
Lycopodiaceae
Clubmoss
G1, p. 4
FERN FACU

Lycopodium tristachyum
LYOTR
Lycopodiaceae
Clubmoss
G1, p. 6
FERN NP

Lycopus americanus
LYCAM
Lamiaceae (Labiatae)
Water Horehound
G3, p. 185
FODI OBL

Lycopus virginicus
LYCVI
Lamiaceae (Labiatae)
Bugle-weed, Water Horehound
G3, p. 213
FODI OBL

Lythrum salicaria
LYTSA
Lythraceae
Purple Loosestrife
V2, p. 611
FODI OBL

Maianthemum canadense
MAICA
Liliaceae
Wild Lily-of-the-Valley
V1, p. 417
FOMO FAC

Malus pumila
MALPU
Rosaceae
Apple
V2, p. 418
TREE NP

Matricaria maritima
MATMA
Asteraceae (Compositae)
Matricaria
G3, p. 388
FODI FAC

Medeola virginiana
MEDVI
Liliaceae
Indian Cucumber Root
V1, p. 405
FOMO NP

Medicago lupulina
MEILU
Fabaceae (Leguminosae)
Black Medick
V2, p. 457
FODI FAC-

Melampyrum lineare
MEMLI
Scrophulariaceae
Cowwheat
G3, p. 250
FODI FAC-

Melilotus alba
MELAL
Fabaceae (Leguminosae)
White Sweet-clover
V2, p. 450
FODI FACU

Mentha arvensis
MENAR
Lamiaceae (Labiatae)
Mint
G3, p. 186
FODI FACW

Mimulus ringens
MIMRI
Scrophulariaceae
Monkey-flower
G3, p. 213
FODI OBL

Mitella diphylla
MITDI
Saxifragaceae
Bishop's-cap
V2, p. 323
FODI FACU+

Mollugo verticillata
MOLVE
Molluginaceae
Carpetweed
V2, p. 151
FODI FAC

Monarda fistulosa
MONFI
Lamiaceae (Labiatae)
Wild Bergamot
G3, p. 170
FODI FACU

Muhlenbergia mexicana
MUHME
Poaceae (Gramineae)
Muhly
V1, p. 186
GRPO FACW

Naumburgia thyrsiflora
NAUTH
Ongraceae
Primrose Family
G3, p. 40 & 42
FODI NP

Oenothera biennis
OENBI
Ongraceae (Primulaceae)
Evening Primrose
V2, p. 630
FODI FACU

Onoclea sensibilis
ONOSE
Polypodiaceae
Sensitive Fern
G1, p. 37
FERN FACW

Osmorhiza claytonii
OSMCL
Apiaceae (Umbelliferae)
Sweet-cicely
V2, p. 659
FODI FACU-

Osmorhiza longistylis
OSMLO
Apiaceae (Umbelliferae)
Sweet-cicely
V2, p. 659
FODI FACU-

Osmunda cinnamomea
OMUCI
Osmundaceae
Cinnamon Fern
G1, p. 25
FERN FACW

Osmunda regalis
OMURE
Osmundaceae
Royal Fern
G1, p. 25
FERN OBL

Oxalis fontana
OXAFO
Oxalidaceae
Wood-sorrel
V2, p. 501
FODI NP

Oxalis stricta
OXAST
Oxalidaceae
Wood-sorrel
V2, p. 501
FODI FACU

Panicum boreale
PANBO
Poaceae (Gramineae)
Panic Grass
V1, p. 235
GRPO FACU+

Pancium capillare
PANCA
Poaceae (Gramineae)
Witch Grass
V1, p. 228
GRPO FAC

Panicum implicatum
PANIM
Poaceae (Gramineae)
Panic Grass V1, p. 238
GRPO FAC

Parthenocissus quinquefolia
PARQU
Vitaceae
Woodbine
V2, p. 561
VINE FAC-

Penthorum sedoides
PENSE
Penthoraceae
Ditch Stone Crop
V2, p. 319
FODI OBL

Phalaris arundinacea
PHAAR
Poaceae (Gramineae)
Reed Canary Grass
V1, p. 211
GRPO FACW+

Phleum pratense
PHLPR
Poaceae (Gramineae)
Timothy
V1, p. 201
GRPO FACU

Plantago major
PLAMA
Plantaginaceae
Common Plantain
G3, p. 269
FODI FAC+

Plantago rugelii
PLARU
Plantaginaceae
Plantain
G3, p. 269
FODI FAC

Poa compressa
POACO
Poaceae (Gramineae)
Canada Bluegrass
V1, p. 128
GRPO FACU+

Poa palustris
POAPA
Poaceae (Gramineae)
Fowl Meadow Grass
V1, p. 129
GRPO FACW+

Poa pratensis
POAPR
Poaceae (Gramineae)
Kentucky Bluegrass
V1, p. 129
GRPO FAC-

Podophyllum peltatum
PODPE
Berberidaceae
May Apple
V2, p. 232
FODI FACU

Polygala paucifolia
POGPA
Polygalaceae
Fringed Polygala, Gay Wings
V2, p. 513
FODI FACU

Polygala polygama
POGPO
Polygalaceae
Milkwort
V2, p. 514
FODI FACU-

Polygala verticillata
POGVE
Polygalaceae
Milkwort
V2, p. 514
FODI NP

Polygonatum pubescens
POLPU
Liliaceae
Solomon's Seal
V1, p. 399
FOMO NP

Polygonum amphibium var. *stripulaceum*;
PONAM
Polygonaceae
Water Smartweed
V2, p. 120
FODI OBL

Polygonum lapathifolium
PONLA
Polygonaceae
Nodding Smartweed
V2, p. 123
FODI FACW+

Polygonum pensylvanicum
PONPE
Polygonaceae
Pinkweed
V2, p. 121
FODI FACW+

Polygonum virginianum
PONVI
Polygonaceae
Jumpseed
V2, p. 118
FODI FAC

Populus deltoides
POPDE
Salicaceae
Cottonwood
V1, p. 52
TREE FAC+

Populus grandidentata
POPGR
Salicaceae
Big-toothed Aspen
V2, p. 53
TREE FACU

Populus tremuloides
POPTR
Salicaceae
Quaking Aspen
V2, p. 53
TREE FAC

Potentilla argentea
POTAR
Rosaceae
Silvery Cinquefoil
V2, p. 432
FODI FACU

Potentilla norvegica
POTNO
Rosaceae
Rough Cinquefoil
V2, p. 429
FODI FAC

Potentilla recta
POTRE
Rosaceae
Rough-fruited Cinquefoil
V2, p. 432
FODI NP

Potentilla simplex
POTSI
Rosaceae
Common Cinquefoil
V2, p. 429
FODI FACU-

Prenanthes alba
PREAB
Asteraceae (Compositae)
White Rattlesnake-Root
G3, p. 520
FODI FACU

Prenanthes altissima
PREAL
Asteraceae (Compositae)
White Lettuce
G3, p. 521
FODI FACU

Prunella vulgaris
PRNVU
Lamiaceae (Labiatae)
Self-heal
G3, p. 154
FODI FAC

Prunus pensylvanica
PRUPE
Rosaceae
Pine Cherry
V2, p. 371
TREE FACU-*

Prunus serotina
PRUSE
Rosaceae
Wild Black Cherry
V2, p. 369
TREE FACU

Prunus virginiana
PRUVI
Rosaceae
Choke Cherry
V2, p. 369
TREE FAC-

Pteridium aquilinum
PTEAQ
Polypodiaceae
Bracken Fern
G1, p. 28
FERN FACU

Pyrola elliptica
PYREL
Ericaceae
Shinleaf
G3, p. 6
FODI NP

Pyrola rotundifolia
PYRRO
Ericaceae
Shinleaf
G3, p. 6
FODI FAC-

Quercus bicolor
QUEBI
Fagaceae
Swamp White Oak
V2, p. 81
TREE FACW+

Quercus palustris
QUEPA
Fagaceae
Pink Oak
V2, p. 78
TREE FACW

Quercus rubra
QUERU
Fagaceae
Red Oak
V2, p. 77
TREE FACU

Ranunculus abortivus
RANAB
Ranunculaceae
Small-flowered Buttercup
V2, p. 219
FODI FACW-

Ranunculus pensylvanicus
RANPE
Ranunculaceae
Bristly Crowfoot
V2, p. 220
FODI OBL

Ranunculus recurvatus
RANRE
Ranunculaceae
Hooked Crowfoot
V2, p. 219
FODI FACW

Ranunculus sceleratus
RANSC
Ranunculaceae
Cursed Crowfoot
V2, p. 219
FODI OBL

Rhamnus alnifolia
RHAAL
Rhamnaceae
Alder-leaved Buckthorn
V2, p. 559
VINE OBL

Ribes americanum
RIBAM
Grossulariaceae
Wild Black Currant
V2, p. 332
BRAM FACW

Ribes cynosbati
RIBCY
Grossulariaceae
Prickly Gooseberry
V2, p. 329
BRAM NP

Rorippa palustris
RORPA
Brassicaceae
Water Cress
V2, p. 269
FODI OBL

Rosa palustris
ROSPA
Rosaceae
Swamp Rose
V2, p. 360
BRAM OBL

Rubus allegheniensis
RUBAL
Rosaceae
Common Blackberry
V2, p. 353
BRAM FACU+

Rubus hispidus
RUBHI
Rosaceae
Swamp Dewberry
V2, p. 348
BRAM FACW

Rubus pubescens
RUBPU
Rosaceae
Dwarf Raspberry
V2, p. 347
BRAM FACW+

Rubus strigosus
RUBST
Rosaceae
Wild Red Raspberry
V2, p. 347
BRAM FACW-

Rudbeckia hirta
RUDHI
Asteraceae (Compositae)
Black-eyed Susan
G3, p. 346
FODI FACU

Rumex crispus
RUMCR
Polygonaceae
Curly Dock
V2, P. 110
FODI FAC+

Salix amygdaloides
SALAM
Salicaceae
Peach-leaved Willow
V2, p. 48
TREE FACW

Salix bebbiana
SALBE
Salicaceae
Beaked Willow
V2, p. 44
TREE FACW+

Salix discolor
SALDI
Salicaceae
Pussy Willow
V2, p. 45
TREE FACW

Salix eriocephala
SALER
Salicaceae
Willow
V2, p. 41
TREE FACW

Salix exigua
SALEX
Salicaceae
Sandbar Willow
V2, p. 40
TREE OBL

Salix fragilis
SALFR
Salicaceae
Crack Willow
V2, p. 47
TREE FAC+

Salix lucida
SALLU
Salicaceae
Shining Willow
V2, p. 48
TREE FACW+

Salix nigra
SALNI
Salicaceae
Black Willow
V2, p. 40
TREE OBL

Sanicula gregaria
SANGR
Apiaceae (Umbelliferae)
Black Snakeroot
V2, p. 654
FODI FAC+

Sanicula marilandica
SANMA
Apiaceae (Umbelliferae)
Black Snakeroot
V2, p. 655
FODI NI

Scirpus atrovirens
SCIAT
Cyperaceae
Bulrush
V1, p. 357
GRCY OBL

Scirpus cyperinus
SCICY
Cyperaceae
Wool-Grass
V1, p. 359
GRCY OBL

Scirpus pendulus
SCIPE
Cyperaceae
Bulrush
V1, p. 358
GRCY OBL

Scutellaria lateriflora
SCULA
Lamiaceae (Labiatae)
Skullcap
G3, p. 148
FODI OBL

Sisyrinchium angustifolium
SISAN
Iridaceae
Blue-eyed-grass
V1, p. 428
FOMO FACW-

Sisyrinchium montanum
SISMO
Iridaceae
Blue-eyed-grass
V1, p. 430
FOMO FAC+

Sium suave
SIUSU
Apiaceae (Umbelliferae)
Water Parsnip
V2, p. 663
FODI OBL

Smilacina racemosa
SMLRA
Liliaceae
False Spikenard
V1, p. 417
FOMO FACU

Smilax tamnoides
SMITA
Liliaceae
Bristly Greenbrier
V1, p. 397
VINE NP

Solidago altissima
SOLAL
Asteraceae (Compositae)
Goldenrod
G3, p. 434
FODI FACU

Solidago gigantea
SOLGI
Asteraceae (Compositae)
Goldenrod
G3, p. 432
FODI FACW

Solidago graminifolia
SOLGR
Asteraceae (Compositae)
Goldenrod
G3, p. 438
FODI FACW-

Solidago hispida
SOLHI
Asteraceae (Compositae)
White Goldenrod
G3, p. 418
FODI NP

Solidago juncea
SOLJU
Asteraceae (Compositae)
Goldenrod
G3, p. 426
FODI NP

Solidago rugosa
SOLRU
Asteraceae (Compositae)
Goldenrod
G3, p. 430
FODI FAC+

Solidago ulmifolia
SOLUL
Asteraceae (Compositae)
Goldenrod
G3, p. 428
FODI NP

Sonchus arvensis
SONAR
Asteraceae (Compositae)
Sow Thistle
G3, p. 534
FODI FAC-

Sonchus uliginosus
SONUL
Asteraceae (Compositae)
Sow Thistle
G3, p. 534
FODI FAC-

Spiraea alba
SPIAL
Rosaceae
Meadowsweet
V2, p. 376
SHRU FACW+

Steironema ciliatum
STECI
Primulaceae
Primrose Family
G3, p. 40
FODI FACW

Stellaria longifolia
STLLO
Caryophyllaceae
Chickweed
V2, p. 164
FODI FACW+

Taraxacum officinale
TAROF
Asteraceae (Compositae)
Common Dandelion
G3, p. 532
FODI FACU

Thelypteris palustris
THEPA
Polypodiaceae
Marsh Fern
G1, p. 50
FERN FACW+

Tilia americana
TILAM
Tiliaceae
Basswood, Linden
V2, p. 567
TREE FACU

Toxicodendron radicans
TOXRA
Anacardiaceae
Poison Ivy
V2, p. 533
VINE FAC+

Trientalis borealis
TREBO
Primulaceae
Chickweed Wintergreen
G3, p. 42
FODI FAC

Trifolium aureum
TRIAU
Fabaceae (Leguminosae)
Hop Clover
V2, p. 453
FODI NP

Trifolium hybridum
TRIHY
Fabaceae (Leguminosae)
Alsike Clover
V2, p. 453
FODI FAC-

Trifolium repens
TRIRE
Fabaceae
White Clover
V2, p. 453
FODI FACU+

Trillium grandiflorum
TRLGR
Liliaceae
Common Trillium
V1, p. 403
FOMO NP

Typha angustifolia
TYPAN
Typhaceae
Narrow-leaved Cat-Tail
V1, p. 70
FOMO OBL

Typha xglauca
TYPGL
Typhaceae
Blue Cat-Tail
V1, p. 70
FOMO OBL

Typha latifolia
TYPLA
Typhaceae
Common Cat-Tail
V1, p. 70
FOMO OBL

Ulmus americana
ULMAM
Ulmaceae
American Elm
V2, p. 87
TREE FACW-

Uvularia grandiflora
UVUGR
Liliaceae
Bellwort
V1, p. 415
FOMO NP

Vaccinium atrococcum
VACAT
Ericaceae
Heath Family
G3, p. 31
SHRU FACW

Verbascum thapsus
VEBTH
Scrophulariaceae
Mullein
G3, p. 218
FODI NP

Verbena hastata
VERHA
Verbenaceae
Vervain
G3, p. 129
FODI FACW+

Verbena urticifolia
VERUR
Verbenaceae
Vervain
G3, p. 129
FODI FAC+

Veronica scutellata
VEOSC
Scrophulariaceae
Speedwell
G3, p. 237
FODI OBL

Viburnum acerifolium
VIBAC
Caprifoliaceae
Arrow-wood
G3, p. 292
SHRU NP

Viburnum cassinoides
VIBCA
Caprifoliaceae
Withe-rod
G3, p. 292
SHRU FACW

Viburnum lentago
VIBLE
Caprifoliaceae
Sheepberry
G3, p. 293
TRES FAC+

Vicia cracca
VICCR
Fabaceae (Leguminosae)
Bird Vetch
V2, p. 489
FODI NP

Viola blanda
VIOBL
Violaceae
Sweet White Violet
V2, p. 599
FODI FACW-

Viola conspersa
VIOCO
Violaceae
Dog Violet
V2, p. 596
FODI FACW-

Viola macloskeyi
VIOMA
Violaceae
Smooth White Violet
V2, p. 598
FODI NP

Viola pubescens
VIOPU
Violaceae
Yellow Violet
V2, p. 595
FODI FACU-

Vitis riparia
VITRI
Vitaceae
River-bank Grape
V2, p. 564
VINE FACW-

Appendix B:

Summary of Field Trips

Appendix B: Summary of Field Trips

October 25-28, 1990

Investigator: J.R. Rastorfer

Observations and Activities: The ROW segments at each site had a substantial amount of standing dead herbaceous plant cover interspersed with a few green shoots of graminoids and numerous leafless shoots of woody plants. The standing dead vegetation was more uniformly spread over the ROW segment at Site 1 than at Site 2, an observation that was also true for the standing green vegetation during the growing season. In contrast to the vascular plants, the moss layer was conspicuously green and appeared to cover more soil surface than during the growing season. The ROW soil was wet at both sites, but Site 2 had considerably more surface-water coverage than Site 1. Very rough water-coverage estimates were 45-50% and 30-40%, respectively.

The understory vegetation in the forested portions of both sites was mostly composed of standing dead shoots of herbaceous plants and leafless seedlings of woody plants; however, some green clumps of sedges were scattered about, and even a few green forbs were seen. Mosses and liverworts were in luxurious growth, especially on old logs, old stumps, and around the bases of large trees. The forest soil was wet at both sites, but (as was observed on the ROW segments) there was much more surface water coverage at Site 2 than at Site 1. Again, rough water-coverage estimates were 40-50% and 15-25%, respectively. Also at Site 2, there was more standing water in the southern half than in the northern half of the site's forested portion, perhaps because of the logs that still remain along the northern edge of the ROW segment.

Selected mosses were collected on the ROW in the area between Sites 1 and 2, on the ROW segment of Site 1, and in the forested portion of Site 2. Collections were not possible on the ROW segment of Site 2 because of its extensive standing water coverage. Some mosses were collected with sporophytes for the first time, which will be important for taxonomic work. Two species of vascular plants were collected, including one late-blooming species of the Asteraceae.

Recent data-reduction efforts on the diameter measurements for the tree and shrub taxa revealed some questions about the diameter (DBH) and/or identification of several individuals. The questionable data were either confirmed or corrected by relocating the individuals by means of the tree/shrub maps for each 10×10-m overstory plot.

Two galvanized pipes (1 1/2 × 24 in., with flanges) were emplaced on the ROW of the sites to provide permanent markers for one transect on each ROW segment. The relative locations were the same for both sites. The pipes were positioned one meter west and one meter east of the 100-m ROW transects, number 503 for Site 1 and number 603 for Site 2. At their respective

positions, the pipes were driven into the ROW soil until their flanges were impressed into the soil surface.

The wooden lath stakes used to mark the understory transects at 10-m intervals for transect numbers 105, 113, 141, 205, 213, and 241 were reset by using a heavy hammer and were repainted with John Deere yellow spray paint; the faded labels on numerous stakes were enhanced with a black felt-tip marker pen. The steel marker rods for each of the transects mentioned above were repainted with the same source of paint and checked to see if they still retained their identification tags.

May 20-23, 1991

Investigators: S.D. Zellmer and J.R. Rastorfer

Observations and Activities: The ROW segments at both sites had dense vegetational coverage, except in areas of standing water. The vascular plant component consisted mostly of sedges, grasses, and cottonwood seedlings. The bryophyte component was abundant and composed mostly of pioneer mosses. Site 1 had more vegetational coverage than did Site 2; however, the standing water coverage was greater at Site 2 than at Site 1, roughly 45-50% at Site 2 and 20-30% at Site 1. One vascular plant with flowers and several mosses with sporophytes were collected from the ROW, but not in transect sampling zones.

The growth of the vascular plant understory (pteridophytes, graminoids, forbs, and woody plant seedlings) was impressive. Fronds of *Onoclea sensibilis* (Sensitive Fern) made a dense understory layer, but as yet they had not reached their maximum enlargement. Numerous flowering plants were in bloom, such as *Aralia nudicaulis* (Wild Sarsaparilla), *Trillium grandiflorum* (Common Trillium), *Polygala paucifolia* (Fringed Polygala), *Rubus pubescens* (Dwarf Raspberry), *Fragaria virginiana* (Wild Strawberry), *Cornus canadensis* (Bunchberry), *Trientalis borealis* (Starflower), *Carex rosea* (Sedge), *Smilacina racemosa* (False Spikenard), *Iris virginica* (Southern Blue Flag), and *Maianthemum canadense* (Wild Lily-of-the-valley). The growth of mosses on the forest floor, on logs, and around the bases of trees was luxuriant, and many taxa had mature or nearly mature sporophytes. Several specimens of mosses bearing sporophytes were collected from the forested portions of both sites, but not in the transect sampling zones.

While we were enroute to the west end of the sites, we collected several specimens of vascular plants with flowers. Specimens included three species of *Salix* (Willow) bearing pistillate catkins (aments); however, the leaves on these specimens were still not fully developed. Among other plants in bloom, *Cypripedium acaule* (Pink Lady-slipper Orchid) was seen off the south edge of the unimproved Gordonville Road.

Although they had not been anticipated for this field trip, samaras (seeds/fruits) of *Acer* (Maple) were collected at 0, 20, 40, 60, 80, and 100 m along the 30-m north transect at each site. At each interval the first ten samaras, if available, were picked up and placed in labeled brown paper bags. The samaras were collected for taxonomic studies in reference to the *Acer rubrum* (Red Maple) and *Acer saccharinum* (Silver Maple) population complexes.

June 4-6, 1991

Investigators: J.R. Rastorfer and J.E. Frelichowski

Observations and Activities: Initially, cover-class values were recorded for surface water along four transects at each site by using the same procedure as for understory vegetation. One transect was used in the forested portion of each site (transect numbers 130 and 230), which were the same transects used for water coverage estimates on June 12, 1989, and June 6, 1990. In addition, cover-class values were recorded for surface water along three transects on the ROW segments of each site (transect numbers 503, 507.6, 514, 603, 607.6, and 614).

The sites were inspected in more detail, and several vascular plants were collected. The plants constituting the sites had considerable vegetative growth, especially the herbaceous taxa. Although the display of showy spring flowers was past its peak, the following forbs were in bloom: *Geranium maculatum* (Geranium), *Potentilla argentea* (Silvery Cinquefoil), *Potentilla recta* (Rough-fruited Cinquefoil), *Typha angustifolia* (Narrow-leaved Cat-tail), *Typha latifolia* (Common Cat-tail), and *Sisyrinchium angustifolium* (Blue-eyed-grass). The shrub *Viburnum lentago* (Sheepberry) was in flower throughout the area; *Amelanchier arborea* (Serviceberry) was in the succulent fruit stage, edible but not especially tasty. Also, *Smilax tamnoides* (Bristly Greenbrier), a woody vine, was seen with flowers for the first time during any field trip.

A gas pipeline (pre-1989) ROW in the vicinity of the sites was surveyed on foot southwestward from where it crosses unimproved Gordonville Road to Castor Road. Impressive wet meadows, with standing water more than knee-deep and covered with *Iris virginica* (Southern Blue Flag), were traversed. These meadows had much more standing water than the forest on either side of the ROW, which would indicate a post-construction hydrological change on the ROW. In other areas, *Sphagnum* (peat moss) communities on the ROW extended into the forest on either side of the ROW, indicating that the hydrological conditions might have remained nearly the same as before ROW construction. Several moss specimens were collected during this survey.

The library at the Chippewa Nature Center, located several miles southwest of Midland, was visited in a continuing search for published works pertaining to the flora of Midland County. With the help of Ms. Meg Ulery, two significant reports were made available for the team's examination. The reports document floristic surveys made of portions of the Chippewa Nature Center lands. The plant lists and plant community classifications within the reports are of particular interest in reference to comparative studies.

June 27 - July 2, 1991

Investigators: J.R. Rastorfer and J.E. Frelichowski

Observations and Activities: No surface water was found on the ROW segments at either site; however, a few spots of moist soil were seen on the ROW at Site 2. Even the ditch between the ROW and the unimproved Gordonville Road was without standing water, but here too some moist soil was seen. The only surface water seen on the ROW was in deep depressions, such as in the set of vehicular ruts just off the west edge of the ROW transects at Site 2. Herbaceous plant and tree seedling growth was robust on the ROW segments at both sites, but Site 1 had a more uniform coverage of vegetation.

No standing water was seen in the forest portions of either site; the forest floors were essentially dry. As was mentioned for the ROW, the flowering and fruiting stages for many herbaceous plants, especially the graminoids and shrubs, seemed seasonally advanced compared with previous years. On the other hand, the vegetative shoots of some of the normally late seasonal plants, such as Asters and Goldenrods, appeared to be somewhat underdeveloped. *Lilium michiganense* (Michigan Lily) was seen flowering for the first time in the forest portions of both sites. It occurred as widely scattered individuals in the understory, but seemingly more abundant than in prior years, when it was without flowers.

In preparation for the next sampling period, all lath stakes used to mark the understory line transects and the forest belt transects of each site were repainted and relabeled as needed, or else replaced with newly painted and labeled stakes. About 20 stakes were replaced at each site. Also, yellow-marked lath stakes were placed at 0, 40, and 100 m on each ROW transect to facilitate the laying of the transect tape for the upcoming sampling period.

Plant taxa seen on the ROW segments of each site were checked against lists of taxa taken from last year's sampling data sheets. Also, new taxa not on the lists were recorded. The surveys were made by walking through the ROW segments on each side of the pipeline zones, but not in the transect sampling zones. Information from these surveys will be used to prepare field data sheets for the forthcoming sampling period.

Several vascular plant specimens were collected for herbarium vouchers and/or field cards. Also, flowering plants seen in bloom or fruiting were recorded.

List of Forbs in Flower:

Cicuta maculata	Water-hemlock
Rudbeckia hirta	Black-eyed Susan
Lotus corniculata	Birdfoot Trefoil

Prunella vulgaris	Self-heal
Lilium michiganense	Michigan Lily
Habenaria lacera	Ragged Fringed Orchid
Alisma plantago-aquatica	Water Plantain
Mimulus ringens	Monkey-flower
Trifolium repens	White Clover
Melilotus alba	Sweet-white Clover
Penthorum sedoides	Ditch Stone Crop
Desmodium canadense	Tick Trefoil
Desmodium glutinosum	Tick Trefoil
Sisyrinchium angustifolium	Blue-eyed Grass
Achillea millefolium	Yarrow
Hypericum sp.	St. John's Wort
Dianthus armeria	Deptford Pink
Potentilla recta	Rough-fruited Cinquefoil
Potentilla argentea	Silvery Cinquefoil
Anemone virginiana	Thimbleweed
Apocynum sibiricum	Indian Hemp
Trifolium agrarium	Hop Clover (Yellow)
Lycopus americanus	Water Horehound
Eupatorium perfoliatum	Boneset
Erigeron sp.	Fleabane
Asclepias incarnata	Swamp Milkweed
Steironema ciliatum	Fringed Loosestrife
Verbena hastata	Blue Vervain

List of Shrubs in Fruit:

Rubus strigosus	Wild Red Raspberry
Lonicera dioica	Wild Honeysuckle
Vaccinium corymbosum	Wild Blueberry

July 22 - August 4, 1991

Investigators: J.R. Rastorfer, G.D. Van Dyke, and J.E. Frelichowski

Observations and Activities: No standing water was seen on the ROW segments, even after rain showers. Only very small amounts of surface water were seen in the ditch between the ROW segment of Site 1 and the unimproved Gordonville Road. The vegetation was robust at both sites, but coverage was more uniform at Site 1 than at Site 2. Although *Agrostis gigantea* (Redtop) was still very common at both sites, it was less conspicuous than in 1990 because of increasing coverage by taller plants, such as *Scirpus atrovirens* and *Scirpus cyperinus* (Bulrushes), *Eupatorium perfoliatum* (Boneset), and seedlings of *Populus deltoides* (Cottonwood).

No standing water was seen on the forest floors at either site, before or after rain showers. The understory vegetation was generally robust, with *Onoclea sensibilis* (Sensitive Fern) forming the most conspicuous herbaceous understory component. As in 1990, the forest trees looked healthier than in 1989 because defoliation by larvae of the Gypsy moth was less apparent.

Cover-class estimates were made in 40 plots (1 × 1 m) along each of 14 transects. Six of the transects (three at each site) were on the ROW segments, and eight transects (four per site) were within the forested areas. When applicable, the following environmental components were given cover-class values: mineral soil, forest floor soil (nonproductive), logs, stumps, and standing water. Collective coverage was estimated for bryophytes (mosses and liverworts), pteridophytes (fern and fern allies), graminoids, grasses, sedges (and rushes), and forbs. In addition, cover-class values were assigned to species of ferns, fern allies, grasses, sedges, rushes, forbs, vines, brambles, and seedlings (DBH less than 2 cm) of shrubs and trees. A total of 560 plots were evaluated in terms of the above-named abiotic and biotic constituents.

Concurrently with the cover-class estimates, the numbers of shoots of vines, brambles, and seedlings of shrubs and trees were recorded in each of the plots (1 × 1 m). The cover-class estimates and density counts accounted for more than three-fourths of the total field effort.

Specimens of uncertain and unknown species were collected and preserved to confirm tentative field identifications made while preparing the cover-class estimates. Some additional plants were selectively collected for voucher specimens.

Individuals of selected tree taxa (DBH 2 cm and greater) were re-examined in the 10 × 10-m forest plots of each site. In particular, the identifications of species of *Acer* (Maples), *Fraxinus* (Ashes), and *Quercus* (Oaks) were evaluated. In addition to *Acer saccharum* (Sugar Maple) and *Acer nigra* (Black Maple), we recognized *Acer rubrum* (Red Maple), *Acer saccharinum* (Silver Maple), and a hybrid between *Acer rubrum* and *Acer saccharinum* (Red/Silver Maple). *Fraxinus pennsylvanica* (Green Ash) was distinguished from *Fraxinus nigra* (Black Ash), and *Quercus palustris* (Pin Oak) was distinguished from *Quercus rubra* (Red Oak). It was noted that several trees had died since 1990.

The section of unimproved Gordonville Road from the junction of Castor Road westward to the McGrudder Road section line was reworked by people from the Midland County Highway Department. During the period of our field work, they had widened and raised the level of the road by trucking in sandy soil, past Site 2 but not completely past Site 1. The reworking operations included pushing over trees along the northern edge of the road onto the ROW, including the study sites. Some of the uprooted trees even extended across the pipeline ditch area. In addition, the ditch between the unimproved Gordonville Road and the ROW was filled with sandy soil. We do not know whether the uprooted trees will be removed from the ROW or whether a ditch will be opened along the northern edge of the road, with or without culverts across to the southern edge of the road. We saw no indication that culverts were going to be installed. Whether roadside ditching is done or not, the hydrological conditions of the sites are likely to be affected. The sites are likely to change toward more hydric conditions if roadside ditching does not occur and (conversely) toward more xeric conditions if roadside ditching does occur.

August 30 - September 2, 1991

Investigators: J.R. Rastorfer and J.A. Clemente

Observations and Activities: The overall appearance of the vegetation on the ROW segments was essentially the same as that described for the preceding field trip, except that many plants were senescing, especially graminoids, such as *Agrostis gigantea* (Red Top), *Scirpus atrovirens* and *Scirpus cyperinus* (Bulrushes), and numerous *Carex* spp. (Sedges). No standing water was seen on the ROW segments. In contrast, standing water was noted on the ROW segments of both sites during last year's fall field trip in late October (1990).

The general appearance of the understory vegetation was about the same as that seen and noted during the preceding field trip. Plant senescence was evident, but it was not so advanced as that seen on the ROW segments. No standing water was seen in the forested area of either site.

Several selected vascular plant specimens were collected from ROW segments and forested portions of the sites. The collected specimens are needed to help confirm the tentative identifications of immature taxa made during the recent cover-class sampling period. *Prenanthes* sp. (White Lettuce) was particularly sought, but only one nearly mature individual was found. Although more than a dozen other individuals were seen, they were lacking the upper portions of their shoots, including the inflorescence. Apparently, deer selectively browsed approximately the upper one-third of this taxon.

Incremental bore specimens were taken from five individuals of *Quercus bicolor* (Swamp White Oak) near the eastern edge of Site 2 and from six individuals of the same species near the eastern edge of Site 1. In both cases, the sampled trees were growing in Lenawee soil.

No evidence was observed of further work on Gordonville Road (Greendale Township, Section 25) since the previous field trip. Trees pushed over onto the ROW, including the study sites, had not been removed.

June 4-7, 1992

Investigators: J.R. Rastorfer and J.A. Clemente

Observations and Activities: The first day of field work was marked by persistent rain throughout the day; nevertheless, cover-class values for surface water across four transects were recorded at Site 1. Because of the worsening weather conditions, water coverage estimates were not made at Site 2.

The second day of field work was a rain-free day with a complete overcast during the forenoon followed by a broken cloud cover during the afternoon. Cover-class values were recorded for four transects at each site. Site 1 was measured again for water coverage on the second day to provide data comparable with those from Site 2 (i.e., following a full day of rain). The team noted the apparent lack of additional surface water at Site 1 in comparison with observations made the previous day. One transect was sampled for water coverage estimates in the forested portions of each site, whereas three transects were sampled in the ROW portions of each site.

Herbaceous plants showed appreciable growth; however, few flowering plants were in bloom. The most conspicuous plant in flower was *Lotus corniculata* (Birdfoot Trefoil), located mostly on sandy slopes of the ROW. The most noticeable vegetation on the ROW portions of the sites consisted of trees, especially *Populus deltoides* (Cottonwood). Many seedlings were over 1.5 m tall. *Onoclea sensibilis* (Sensitive Fern) and *Pteridium aquilinum* (Bracken Fern) formed the most obvious understory layer in the forested portion of each site.

Trees that had been pushed over onto the ROW, including the transects of Site 2, still remained on the ROW.

Two fences had been installed across the ROW since the preceding summer. Their locations appeared to correspond with property boundaries. The east fence was near the west boundary of the State Forest Land, and the west fence was near the Magrudder section line. Temporary barriers, in line with the fences, also had been placed across the Gordonville Road. Standard road signs labeled "Road Ends" were placed to the right side of Gordonville Road but in front of the temporary barriers.

July 7-11, 1992

Investigators: J.R. Rastorfer and J.A. Clemente

Observations and Activities: Surface water was noticeable at both sites; Site 2 had more standing water than Site 1. The ROW portions of both sites (1 and 2) had lush vegetational growth. In addition to *Populus deltoides* (Cottonwood) and *Salix* spp. (Willows) seedlings, plants of *Scirpus atrovirens* and *Scirpus cyperinus* (Bulrush) were very conspicuous.

The ROW transects and the forest transect one meter north of the ROW were prepared for the forthcoming coverage sampling period. Three labeled lath stakes were placed at 0, 50, and 100 m west-east along each ROW transect to facilitate the laying of transect tapes during the upcoming sampling period. A long sighting pole (3-5 m) will be needed to help lay the transect tapes because of the tall tree seedlings on the ROW.

Labeled lath stakes were placed at 10-m intervals along the one-meter north transect. Also, oak stakes (18 in.) were placed at 10, 30, 70, and 90 m. This had not been done previously, when oak stakes were placed at 0, 20, 40, 50, 60, and 80 m.

Two used car axle shafts were placed in the ROW of each site. They were positioned at 18.5 m south of the northern edge of the ROW, one meter west and one meter east of the 0 m and 100 m west-east transect boundaries. The placement of these axle shafts completed the installation of a set of six permanent reference points at each site that can be used to relocate all of the transects, should the need arise. (Note: Each axle shaft is about 75 cm long, and the flanged end is about 17.5 cm in diameter.)

The team surveyed the ROW vegetation of both sites for comparison with last year's taxon list. Field identifications of *Salix* spp. (Willow) seedlings were difficult; therefore, specimens were collected (and pressed) from both sites for laboratory examination.

Fronds (leaves) and rhizomes of the ferns *Onoclea sensibilis* (Sensitive Fern) and *Pteridium aquilinum* (Bracken Fern) were collected and pressed to make herbarium specimens. Although these ferns are major components of the forest understory vegetation, adequate voucher specimens had not been collected previously.

July 21-28, 1992

Investigators: J.R. Rastorfer, G.D. Van Dyke, and J.E. Frelichowski

Observations and Activities: Standing water was seen on the ROW segments of both sites; however, there was more surface water on the ROW of Site 2 than of Site 1. Up to about 50 cm

of water was in the ditch between the ROW segments and Gordonville Road. The ROW vegetation was robust at both sites. Although *Agrostis gigantea* (Red Top Grass) was still common, the most conspicuous plants were *Scirpus* spp. (Bulrushes), *Eupatorium perfoliatum* (Boneset), and seedlings of *Populus deltoides* (Cottonwood) and *Salix* spp. (Willows). Trees pushed onto the ROW, including the study sites, during last summer's reworking of Gordonville Road had not been removed. These abandoned dead trees did cause some inconvenience during field sampling, not only with respect to walking, but also as a source of hornets in one region of dense branches.

Cover-class values were recorded for biotic and abiotic components in 40 (1 × 1-m) plots along each of eight transects. Six of the transects (three at each site) were on the ROW segments, and two transects (one at each site) were in the first meter along the northern edge of the ROW. When appropriate, the following nonliving components were given cover-class values: mineral soil, litter-covered soil, logs, stumps, and standing water. Collective coverage estimates were made for bryophytes, pteridophytes, graminoids (grasses, sedges, and rushes), and forbs. In addition, cover-class values were assigned to species of ferns, fern allies, graminoids, forbs, vines, brambles, and seedlings (DBH less than two centimeters) of shrubs and trees. A total of 320 plots were evaluated in terms of the above biotic and abiotic constituents.

Concurrently with the assignment of cover-class values, the number of seedlings for taxa of trees and three selected shrubs were recorded for each plot. The coverage estimates and counts for density accounted for about four-fifths of the field effort.

Specimens of uncertain and unknown species were collected and preserved to confirm tentative field identifications made during the coverage estimates. Several plants were selectively collected for voucher specimens.

Appendix C:

Herbarium Sheet Labels

Appendix C:

Herbarium Sheet Labels

VASCULAR PLANTS OF MIDLAND COUNTY, MICHIGAN

TAXON: *Rosa palustris*
AUTHOR: Marsh.
LOCATION: SW 1/4 Section 25; T.14N,R.2W; north of Gordonville Road

NOTES: Site 1; deciduous forest component; Lenawee soil

COL NO: 502 COL DATE: 08 August 1989
COLLECTORS: J.R. Rastorfer & G.D. Van Dyke

VOUCHER — Argonne National Laboratory for the Gas Research Institute Right-of-Way Research Project, Manager S.D. Zellmer

VASCULAR PLANTS OF MIDLAND COUNTY, MICHIGAN

TAXON: *Circaea lutetiana*
AUTHOR: L.
LOCATION: SW 1/4 Section 25; T.14N,R.2W; north of Gordonville Road

NOTES: Site 1; deciduous forest component; Lenawee soil

COL NO: 503 COL DATE: 08 August 1989
COLLECTORS: J.R. Rastorfer & G.D. Van Dyke

VOUCHER — Argonne National Laboratory for the Gas Research Institute Right-of-Way Research Project, Manager S.D. Zellmer

VASCULAR PLANTS OF MIDLAND COUNTY, MICHIGAN

TAXON: *Solidago rugosa*
AUTHOR: Mill.
LOCATION: SW 1/4 Section 25; T.14N,R.2W; north of Gordonville Road

NOTES: Site 1; deciduous forest component; Lenawee soil

COL NO: 504 COL DATE: 08 August 1989
COLLECTORS: J.R. Rastorfer & G.D. Van Dyke

VOUCHER — Argonne National Laboratory for the Gas Research Institute Right-of-Way Research Project, Manager S.D. Zellmer

Appendix D:

Tree Maps (Selected Examples)

Appendix D:

Tree Maps (Selected Examples)

A key to the two-letter codes for the taxa appears below. The numbers on the tree maps give the diameter at breast height (DBH) for each individual in centimeters.

List of Overstory (Tree) Species for the Study Sites in Midland County, Michigan

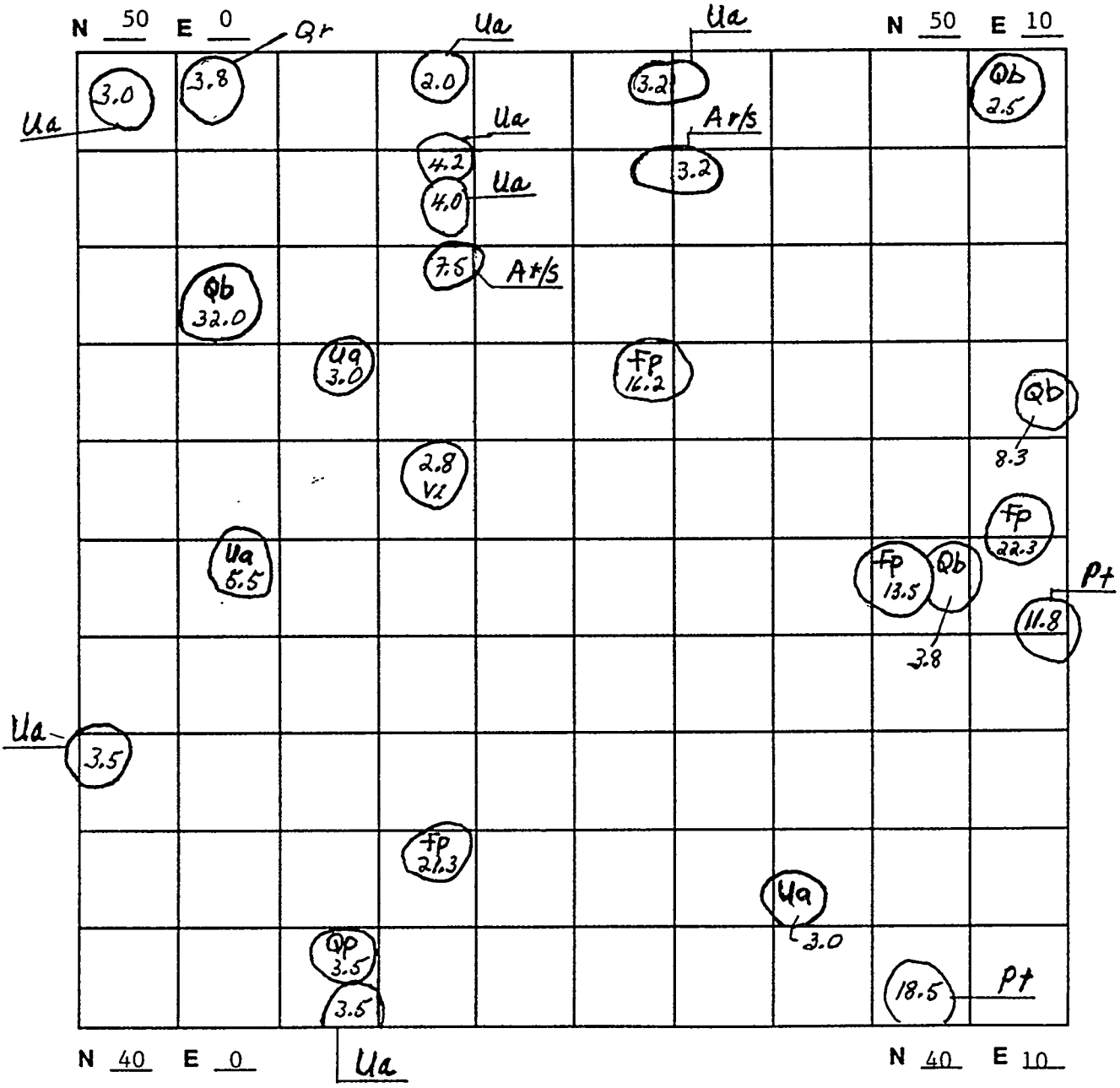
Taxon Code	Map Code	Taxon Scientific Name	Common Name
ACENI	An	*Acer nigrum*	Black Maple
ACERS	Ar/s	*Acer rubrum/saccharinum*	Hybrid Maple
ACERU	Ar	*Acer rubrum*	Red Maple
ACESA	As	*Acer saccharinum*	Silver Maple
ACESC	Ac	*Acer saccharum*	Sugar Maple
ALNRU	Al	*Alnus rugosa*	Speckled Alder
AMEAR	Am	*Amelanchier arborea*	Serviceberry
BETPA	Bp	*Betula papyrifera*	Paper Birch
CAPCA	Ca	*Carpinus caroliniana*	Hornbeam
CORFO	Cf	*Cornus foemina*	Gray Dogwood
CRASP	Cr	*Crataegus species*	Hawthorn
FAGGR	Fg	*Fagus grandifolia*	Beech
FRANI	Fn	*Fraxinus nigra*	Black Ash
FRAPE	Fp	*Fraxinus pennsylvanica*	Ash
ILEVE	Il	*Ilex verticillata*	Michigan Holly
POPDE	Pd	*Populus deltoides*	Cottonwood
POPGR	Pg	*Populus grandidentata*	Big-toothed Aspen
POPTR	Pt	*Populus tremuloides*	Quaking Aspen
PRUSE	Ps	*Prunus serotina*	Wild Black Cherry
PRUVI	Pv	*Prunus virginiana*	Choke Cherry
QUEBI	Qb	*Quercus bicolor*	Swamp White Oak
QUEPA	Qp	*Quercus palustris*	Pin Oak
QUERU	Qr	*Quercus rubra*	Red Oak
TILAM	Ta	*Tilia americana*	Basswood; Linden
ULMAM	Ua	*Ulmus americana*	American Elm
VIBLE	Vi	*Viburnum lentago*	Sheepberry

TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1400 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 0-10

Investigators:

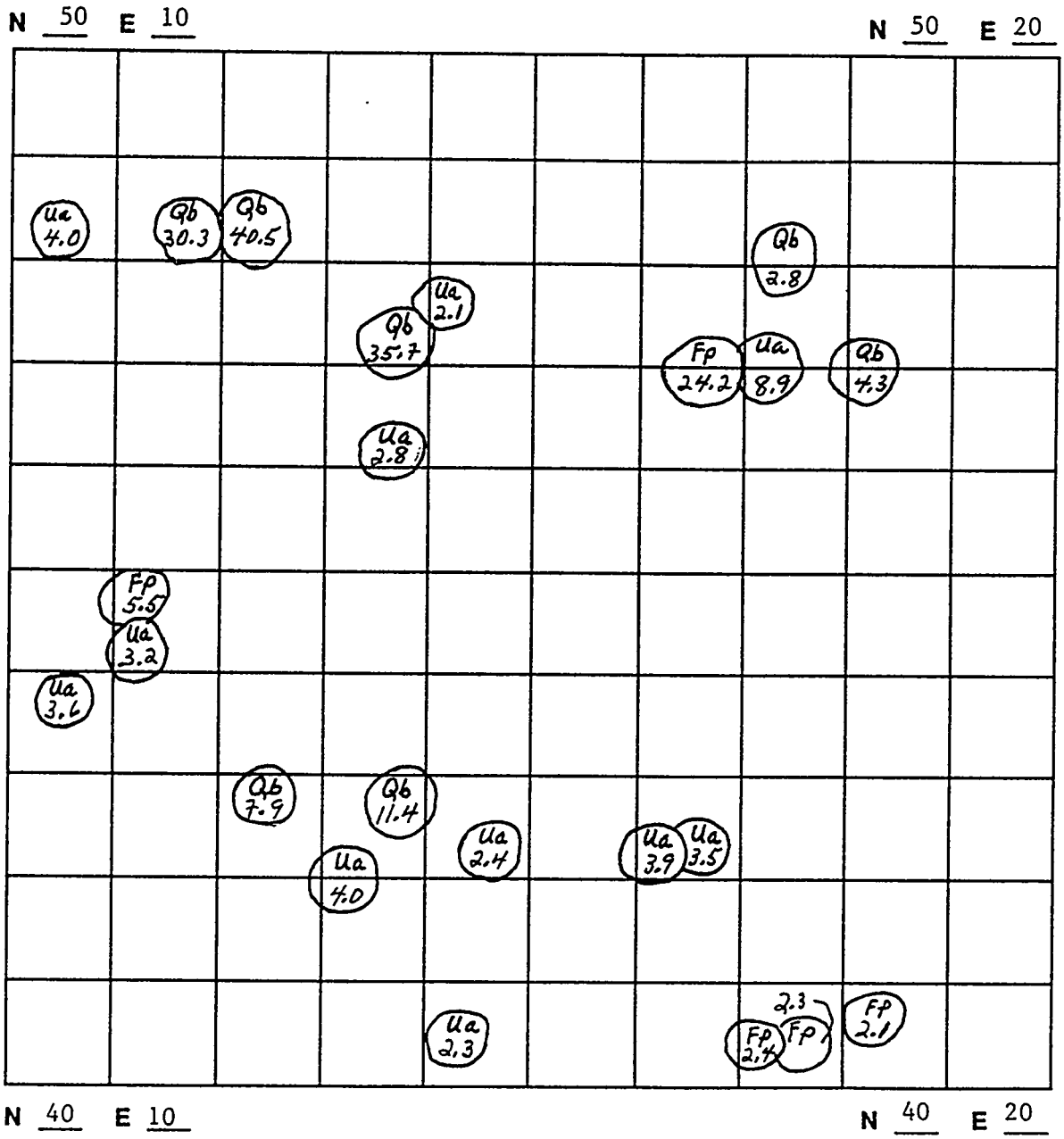


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1401 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 10-20

Investigators:

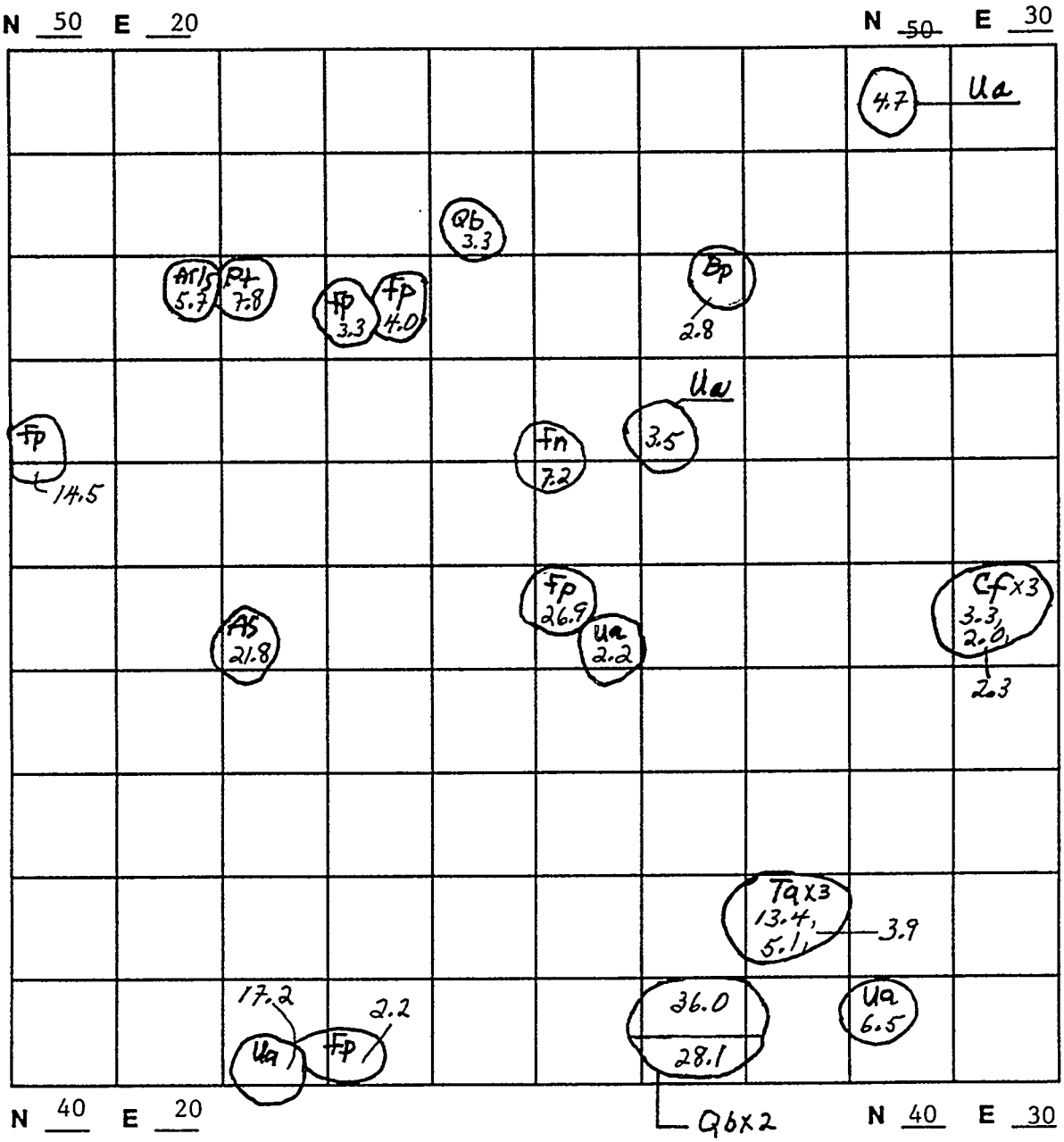


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1402 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40–50 **East (Meters):** 20–30

Investigators: _____

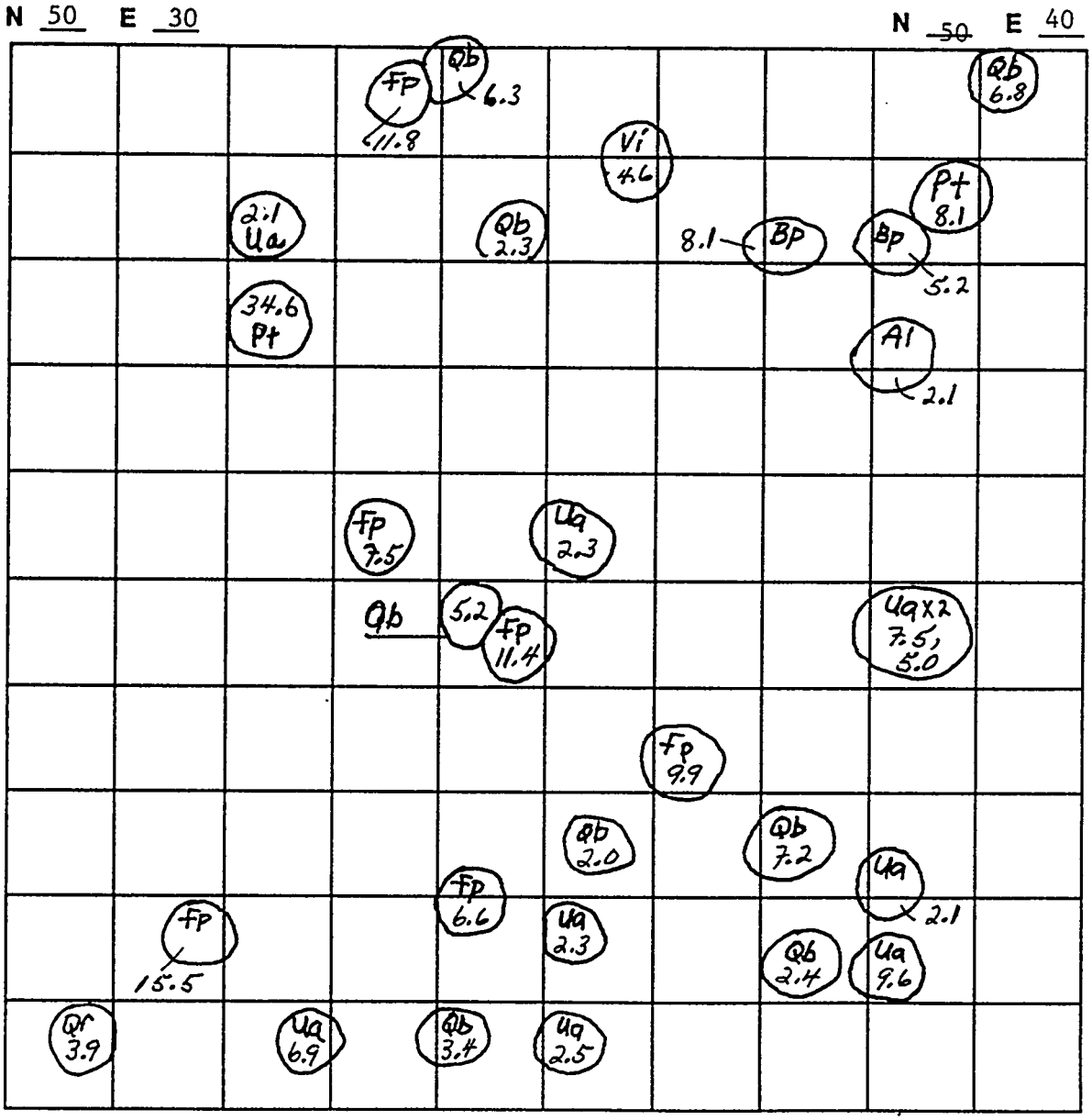


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1403 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40–50 **East (Meters):** 30–40

Investigators:

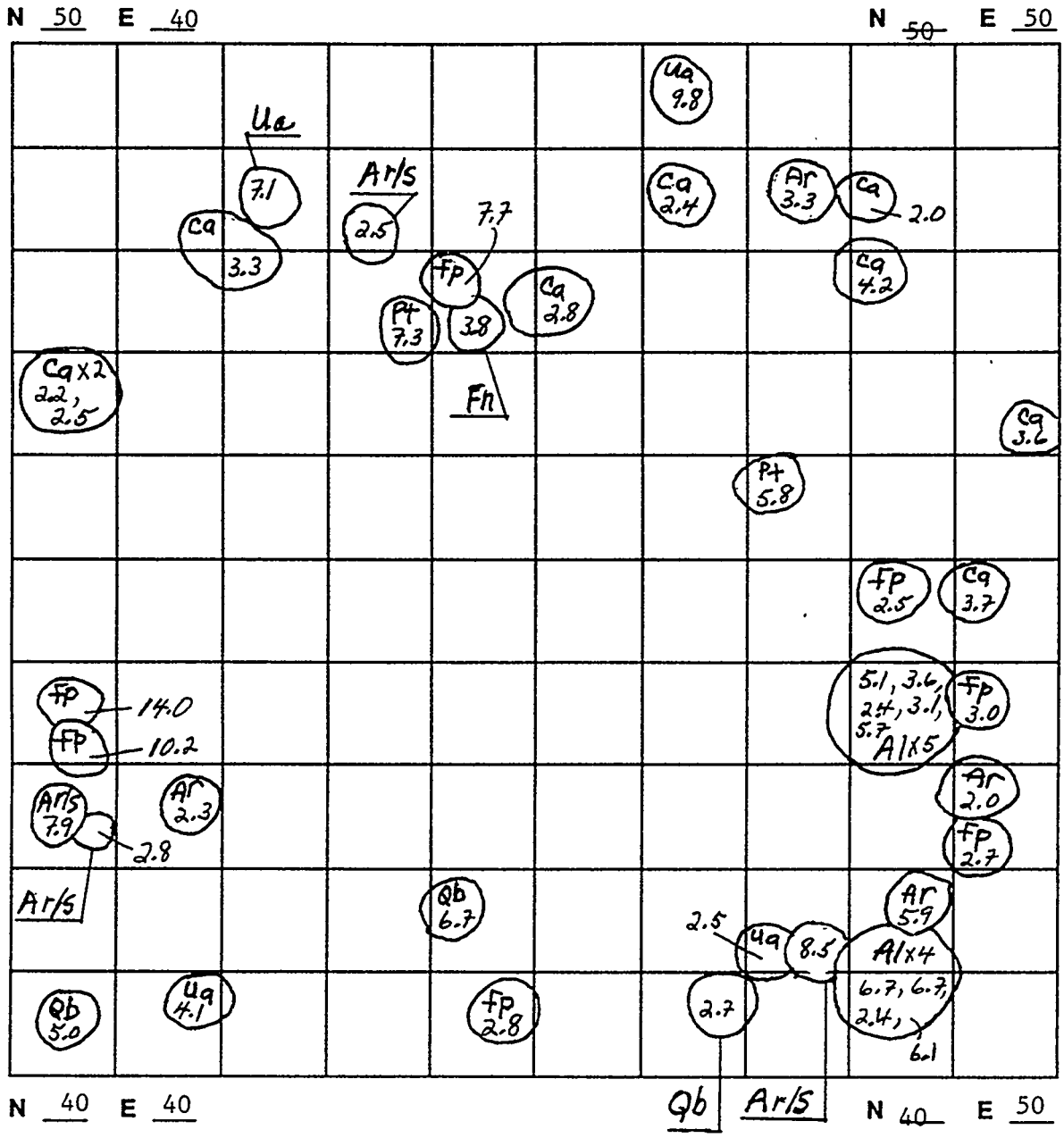


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1404 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40–50 **East (Meters):** 40–50

Investigators:

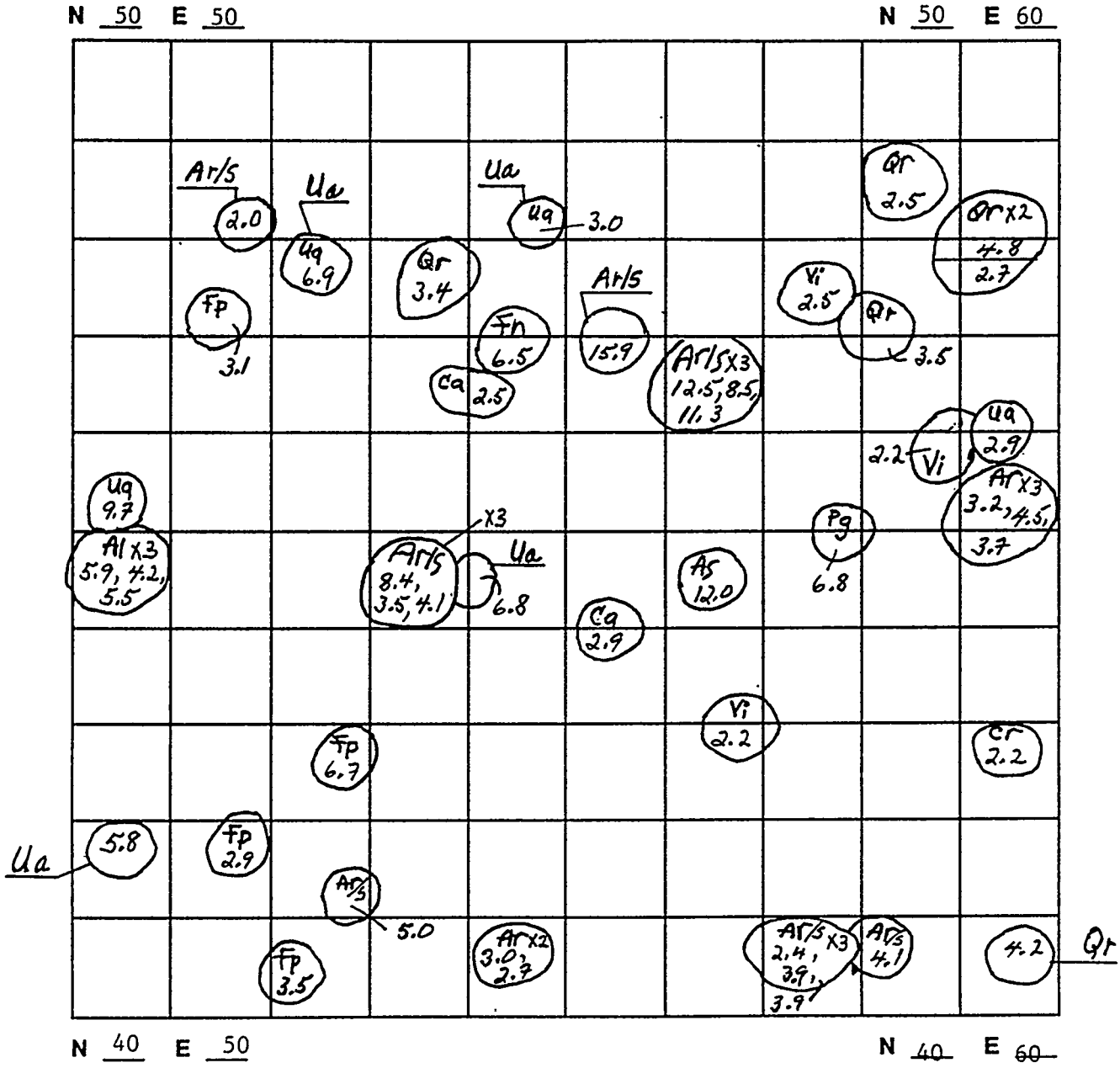


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1405 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 50-60

Investigators:

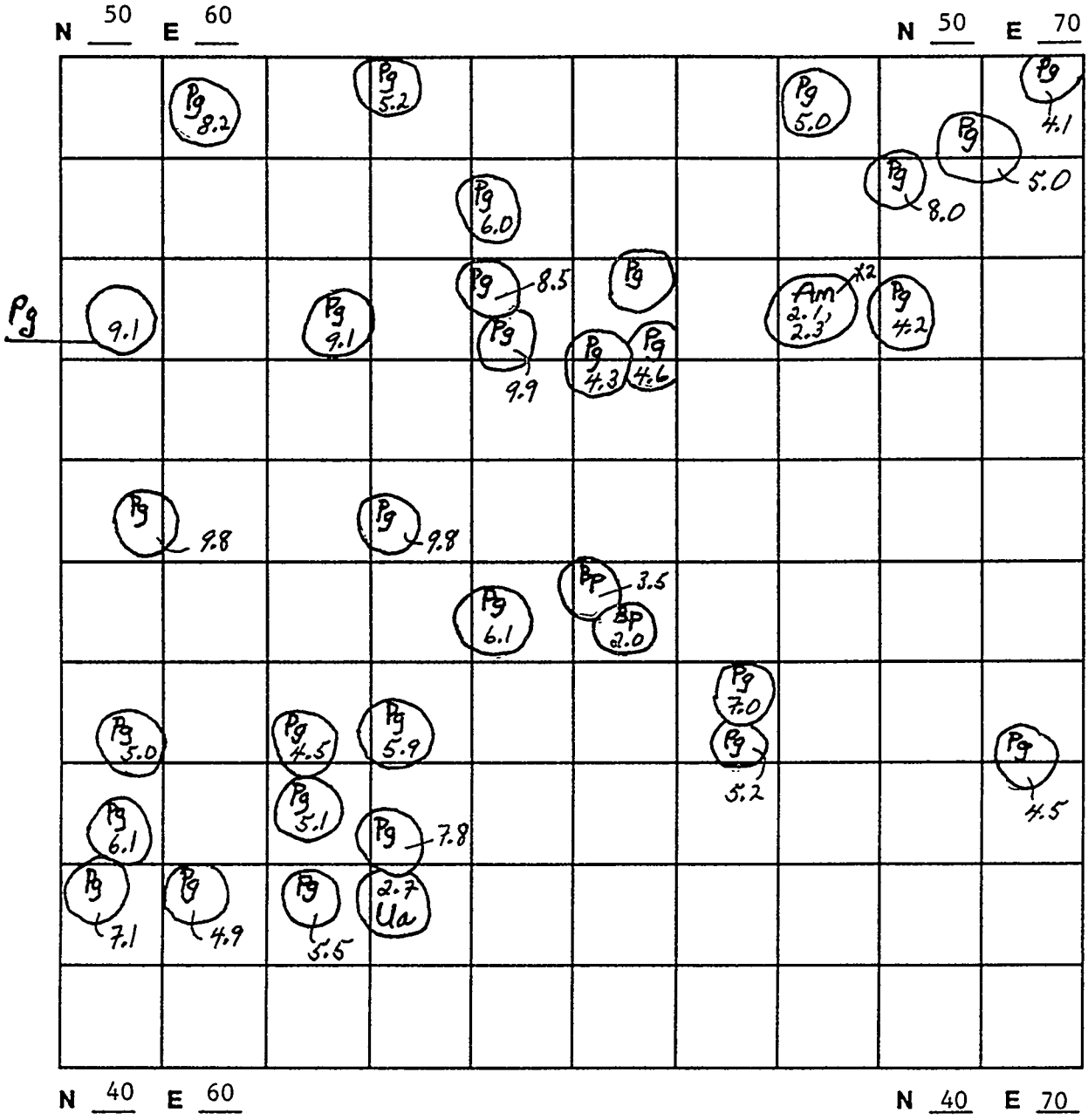


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1406 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 60-70

Investigators:

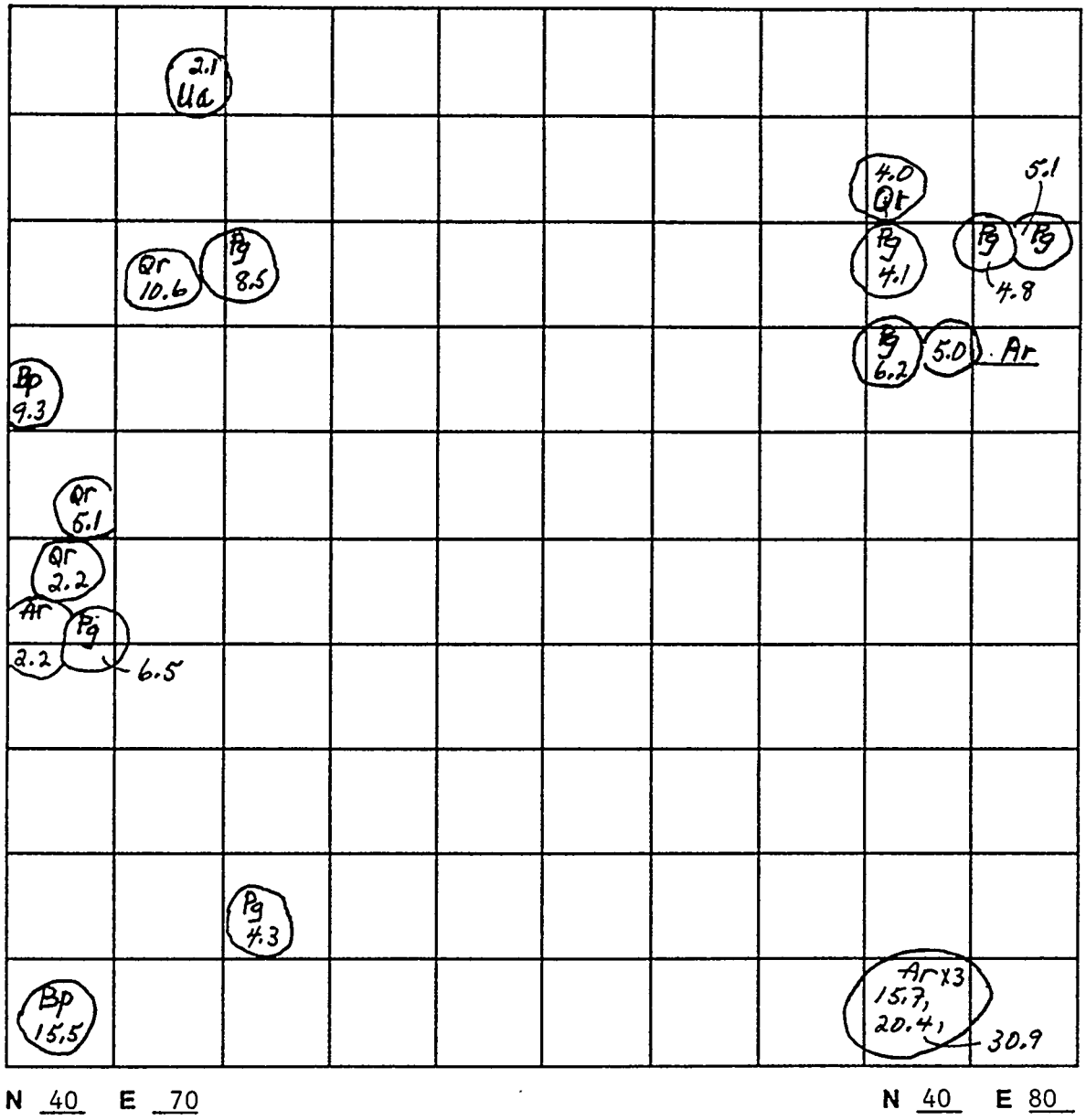


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1407 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 70-80

Investigators:

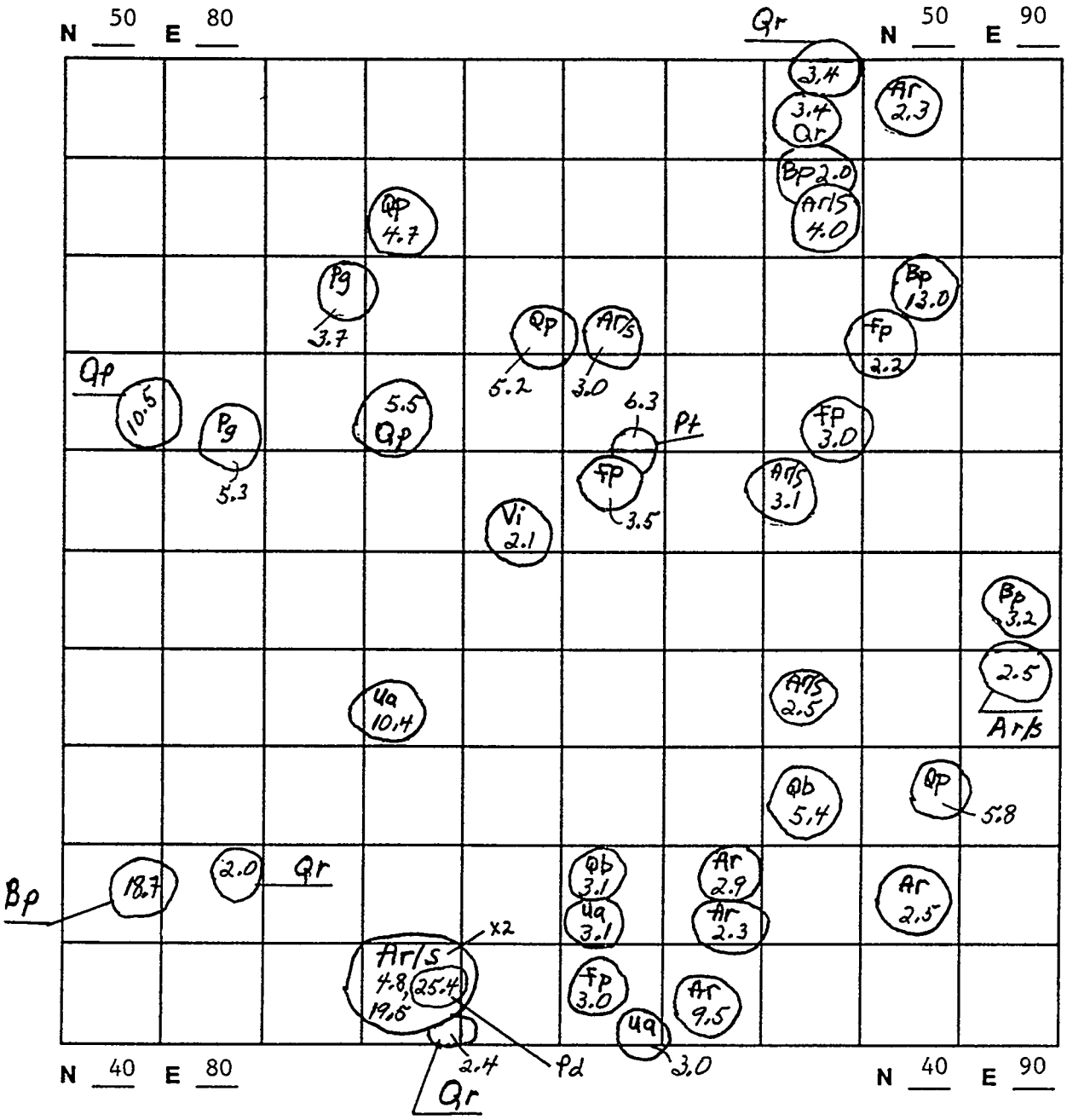


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1408 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 80-90

Investigators:

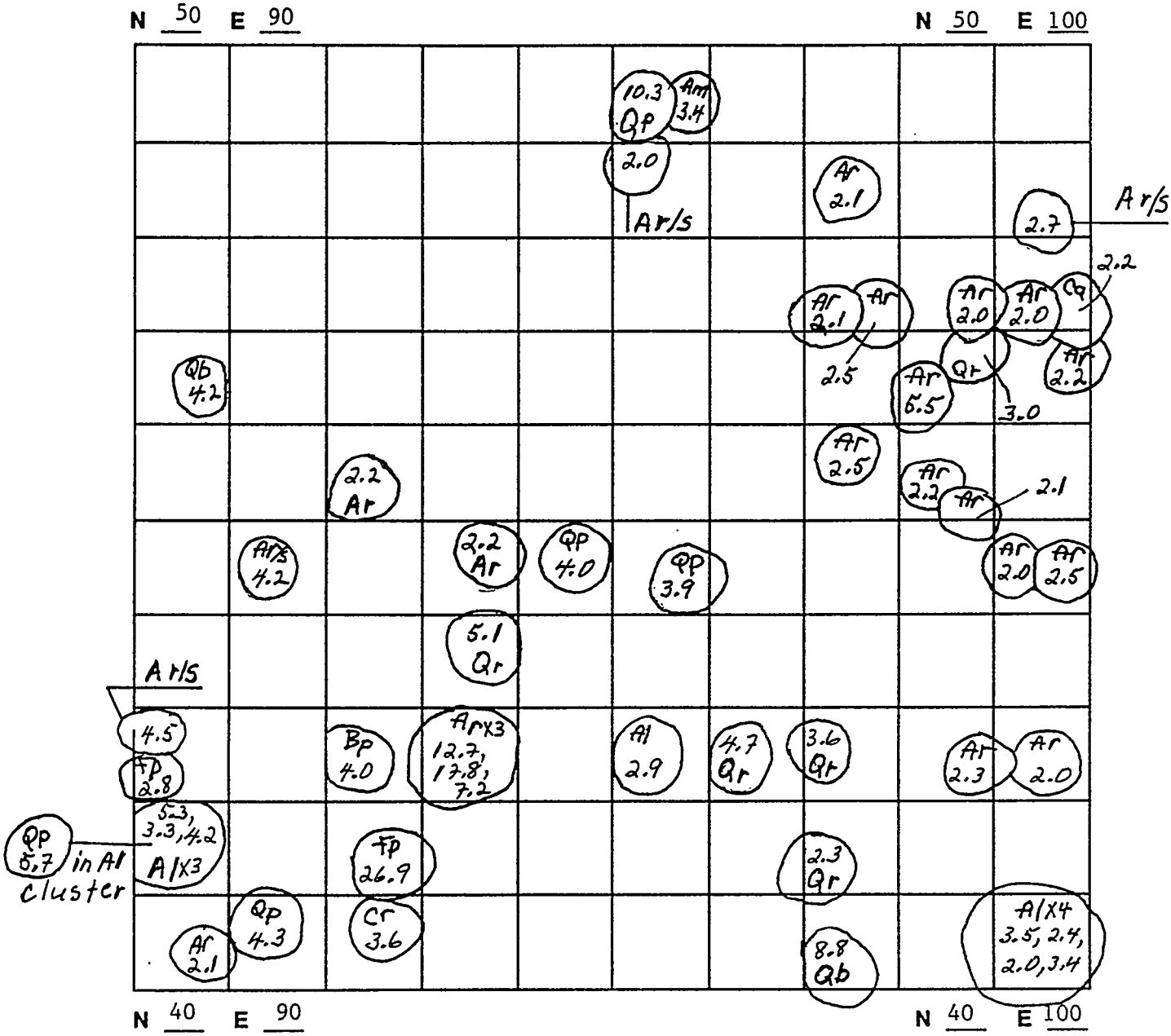


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 1 **Plot No.:** 1409 **Date:** 14 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 90-100

Investigators:

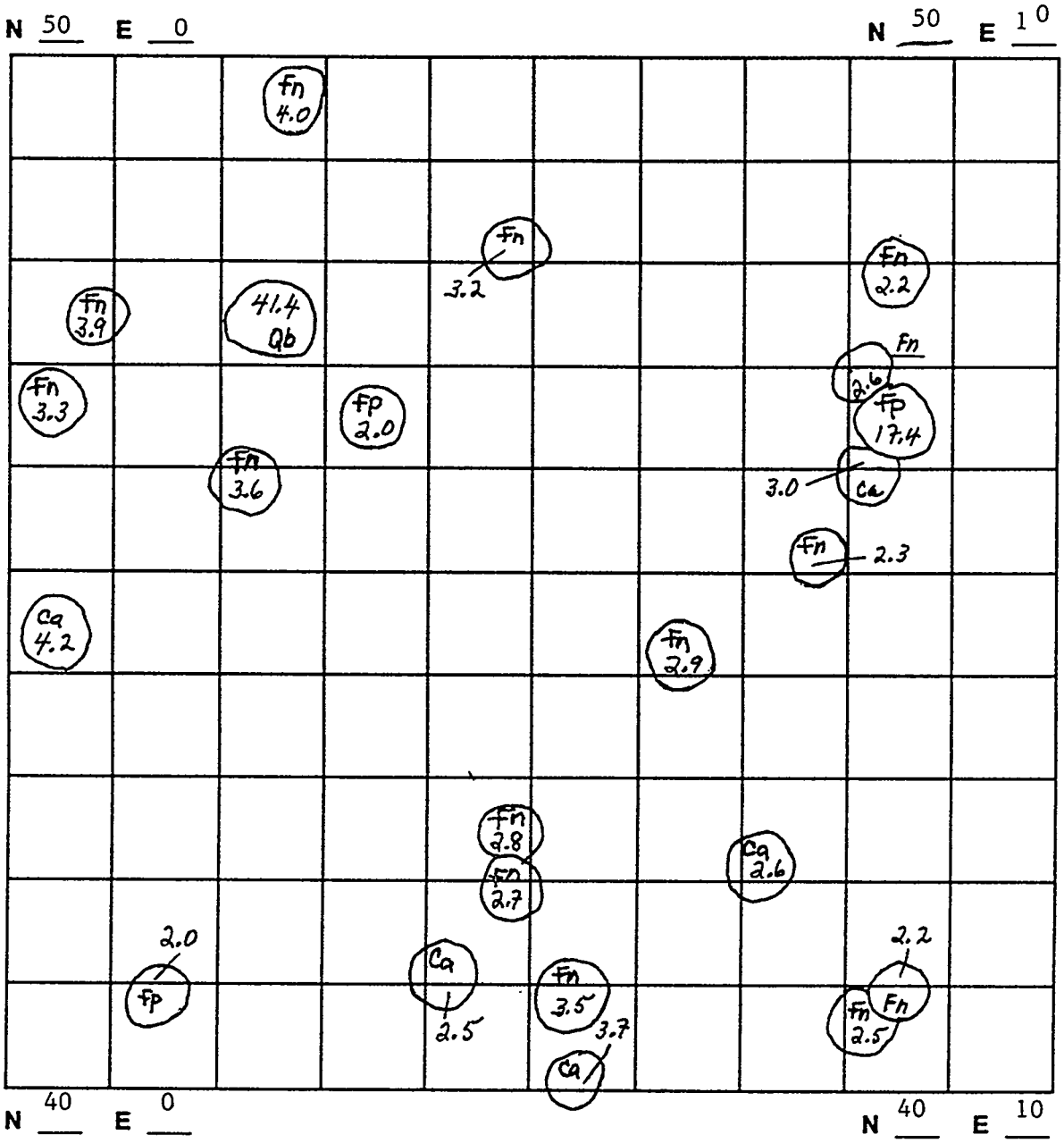


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2400 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40–50 **East (Meters):** 0–10

Investigators:

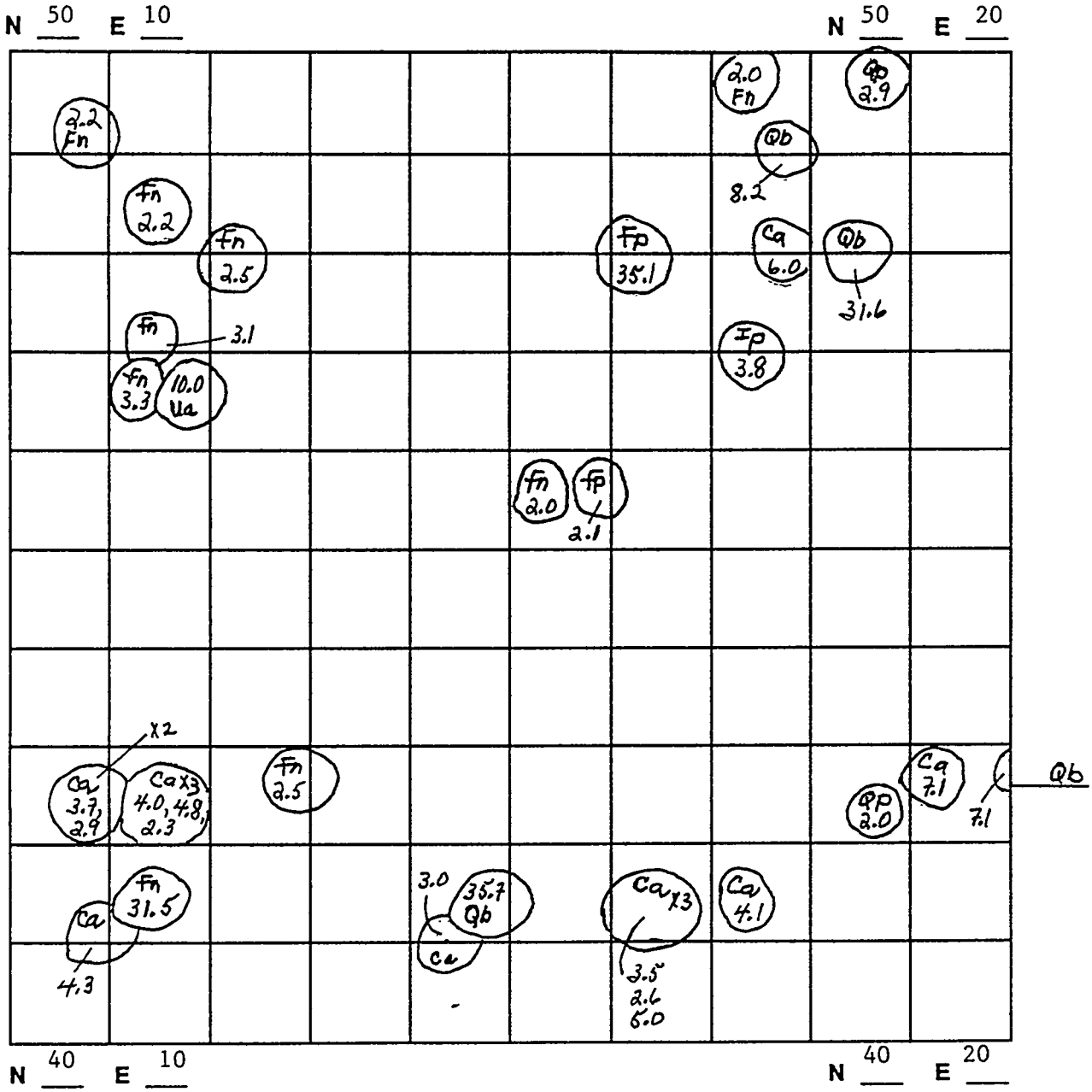


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2401 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 10-20

Investigators:

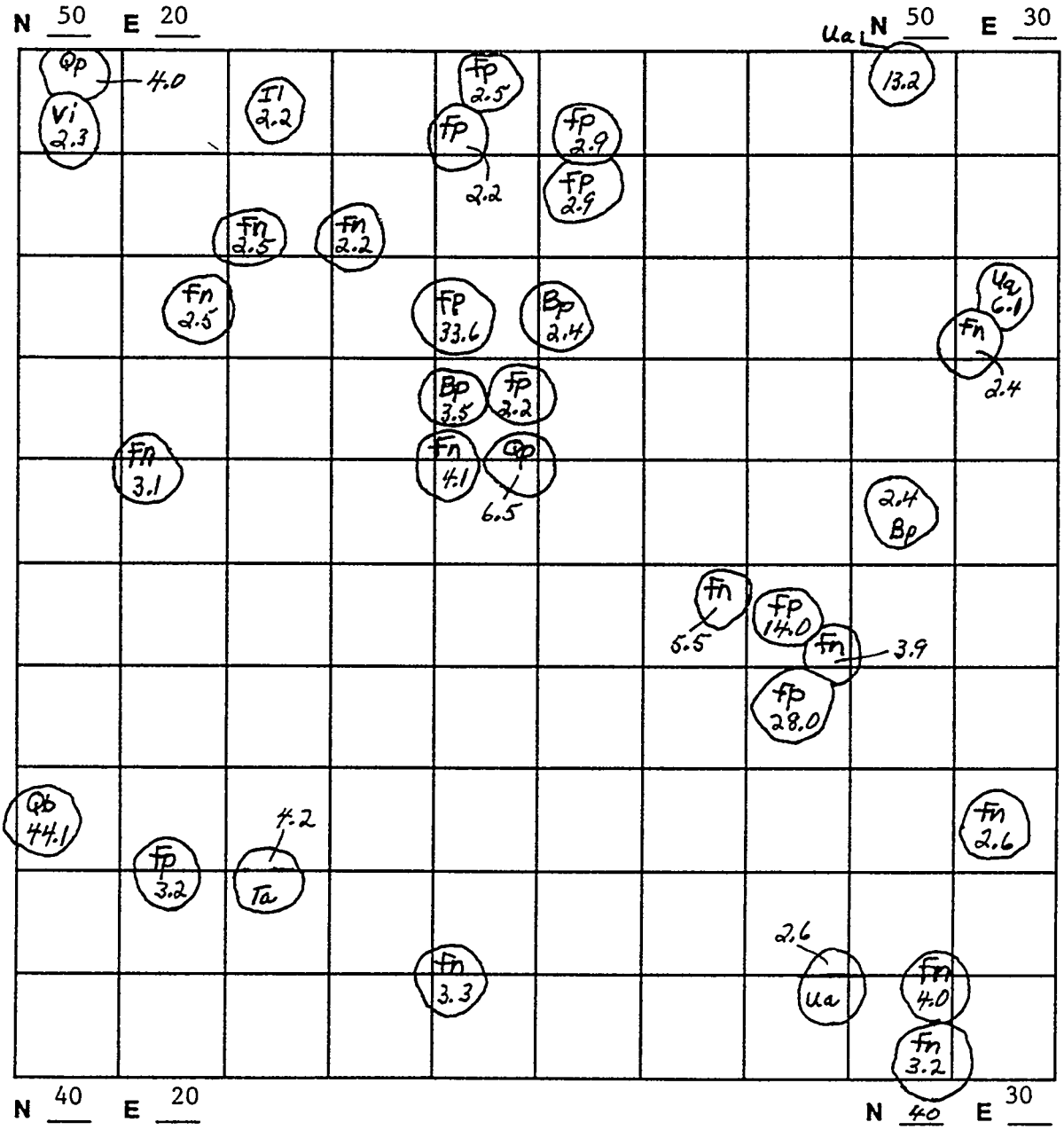


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2402 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 20-30

Investigators:

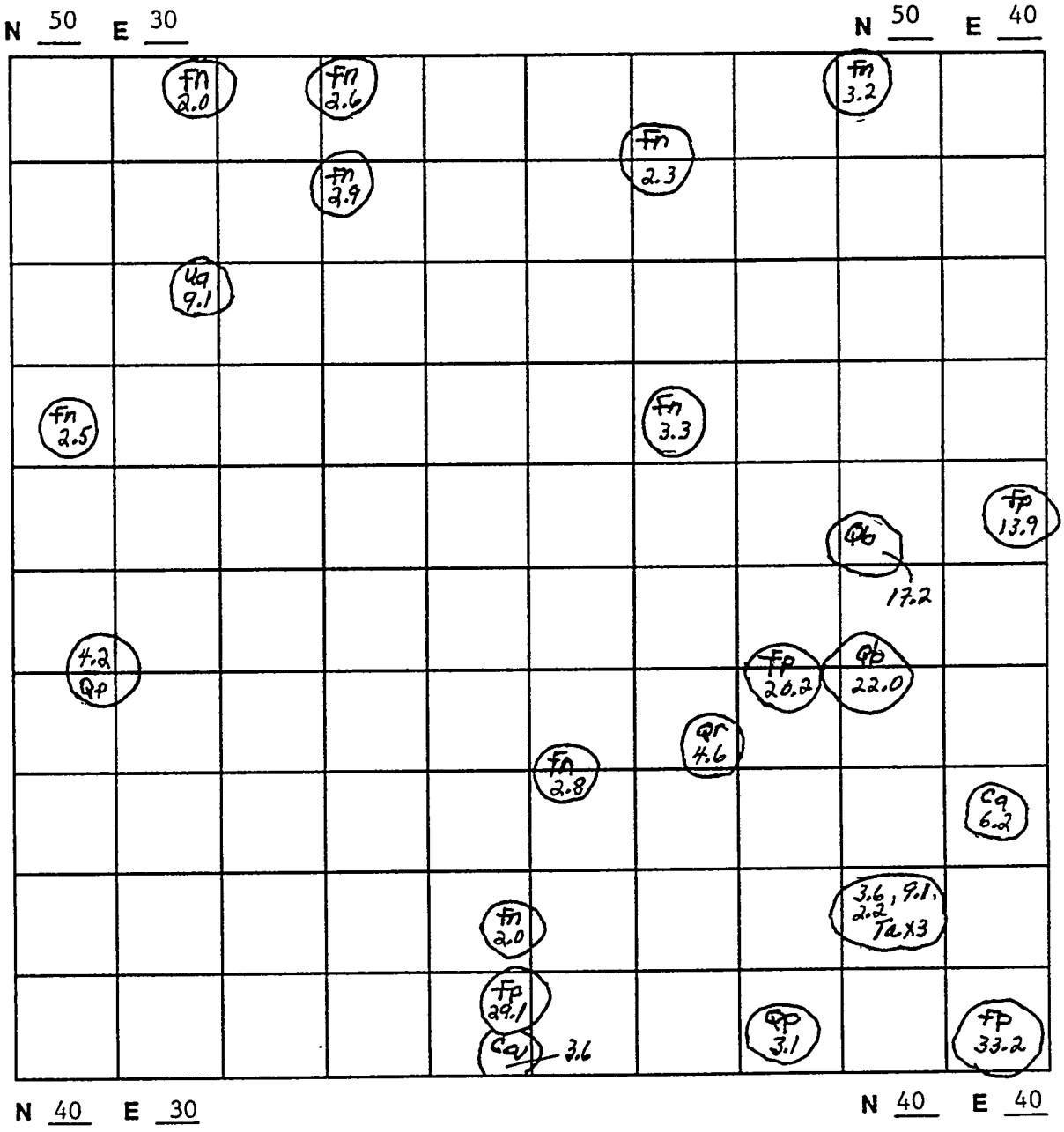


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2403 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 30-40

Investigators:

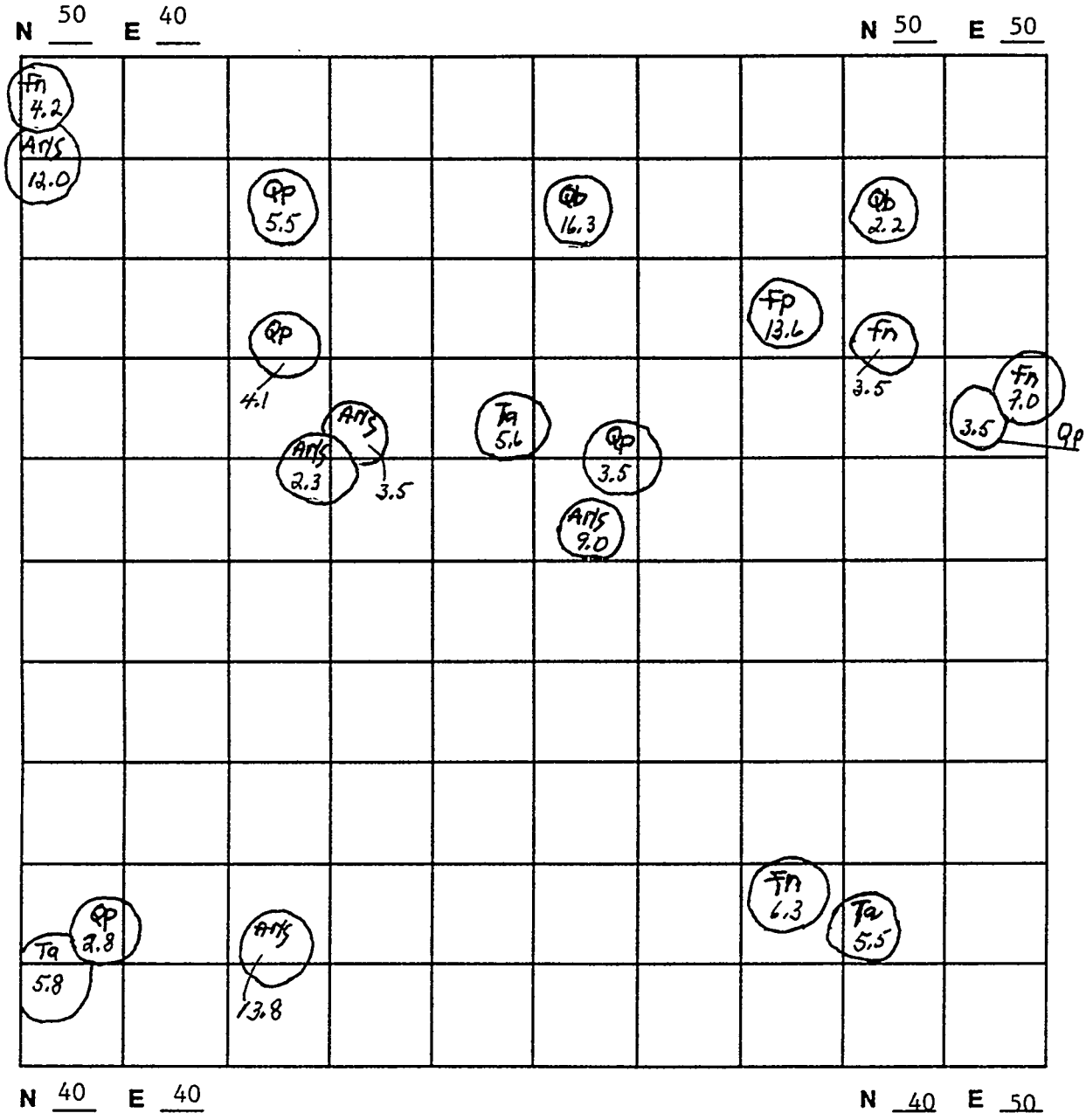


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2404 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 40-50

Investigators:

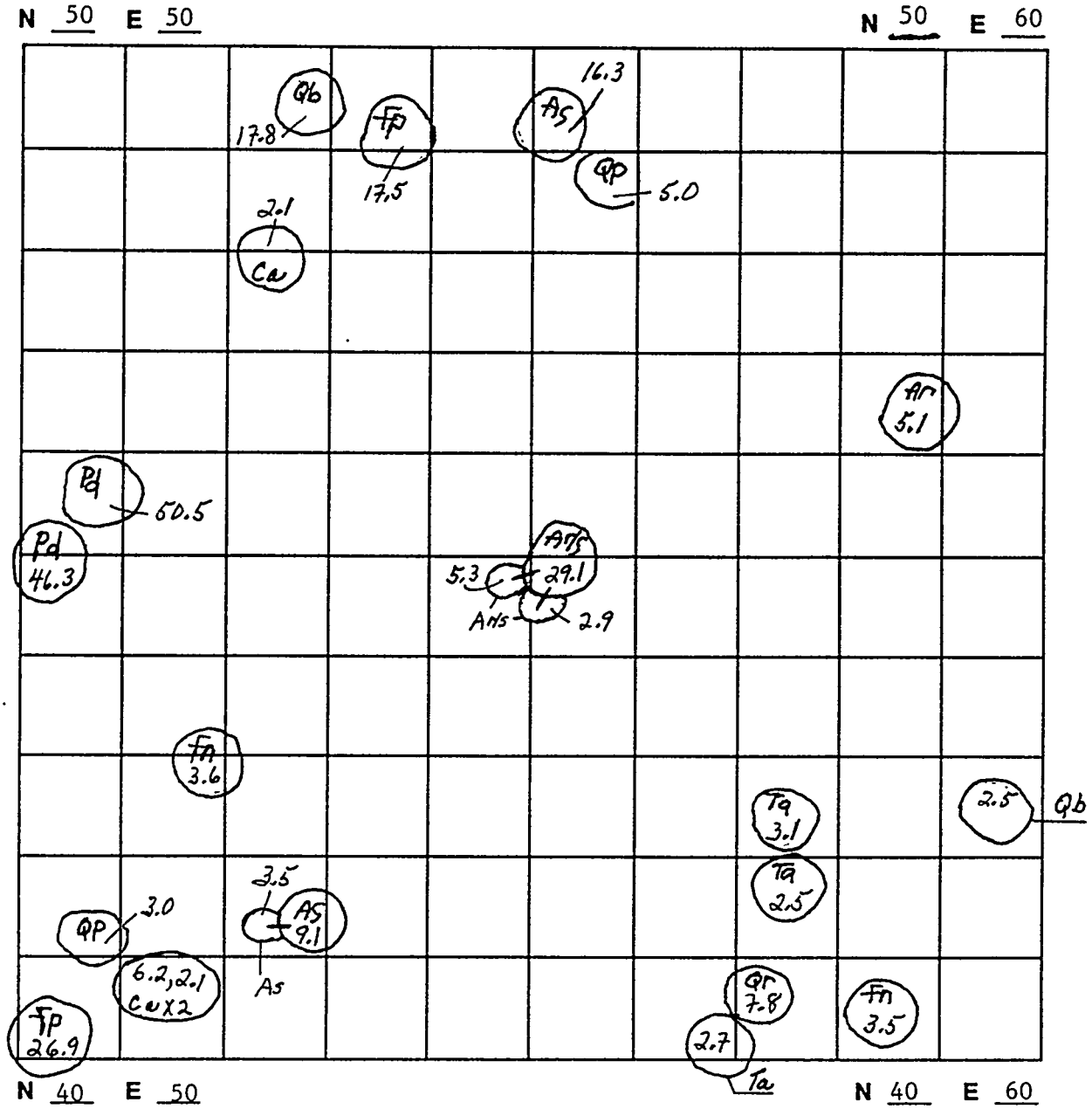


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2405 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40–50 **East (Meters):** 50–60

Investigators: _____

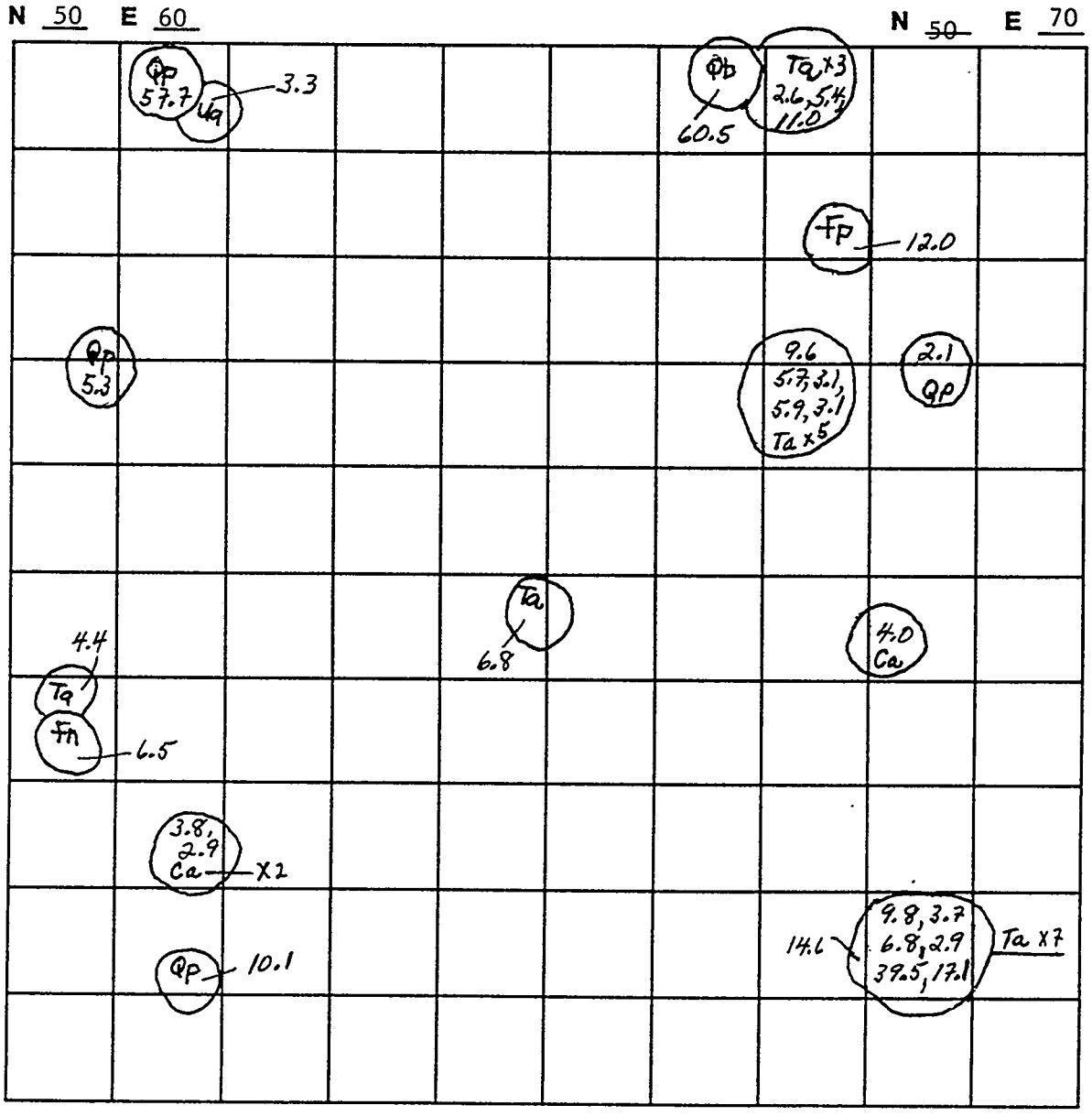


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2406 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 60-70

Investigators: _____

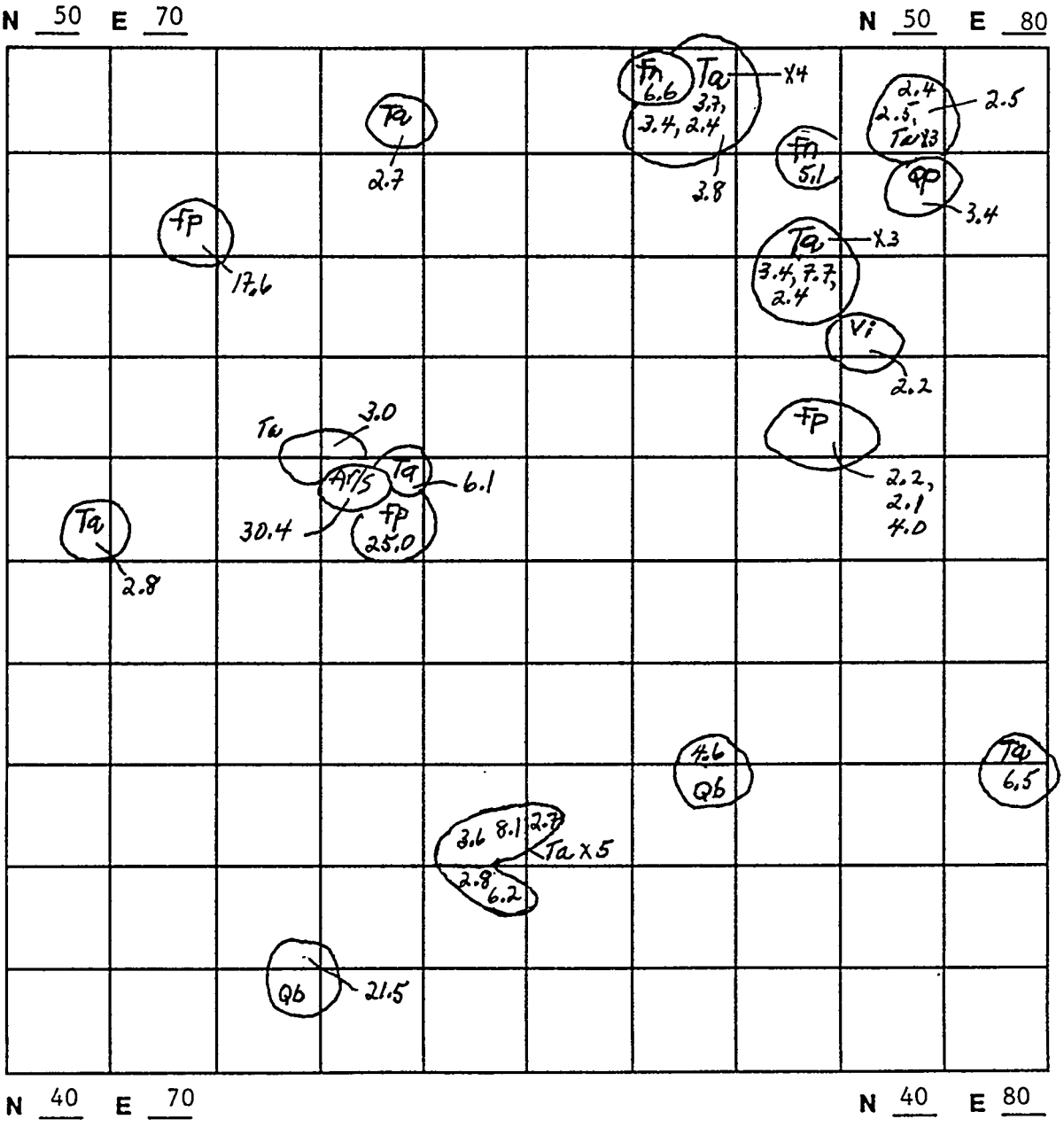


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2407 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 70-80

Investigators:

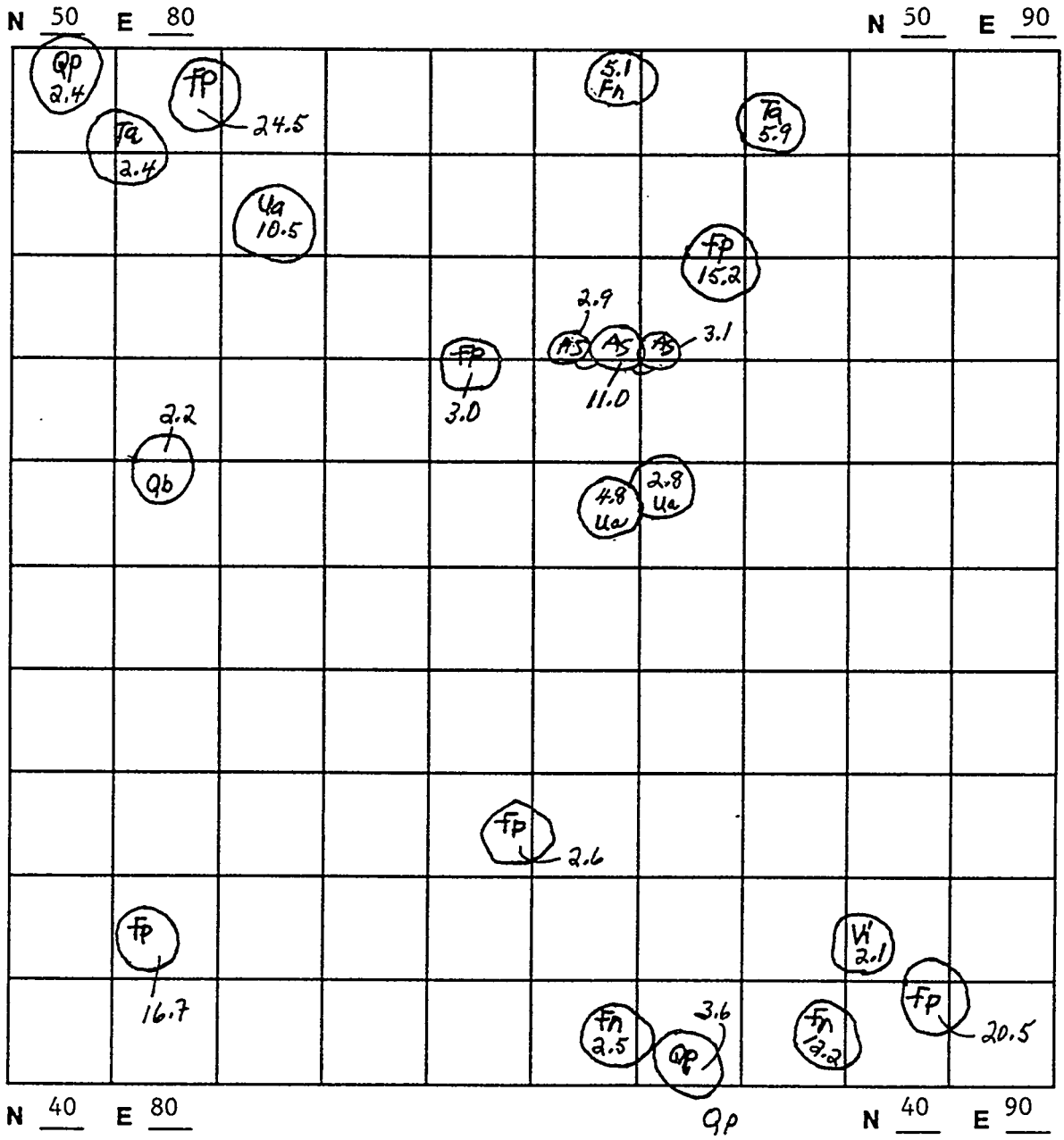


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2408 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40–50 **East (Meters):** 80–90

Investigators:

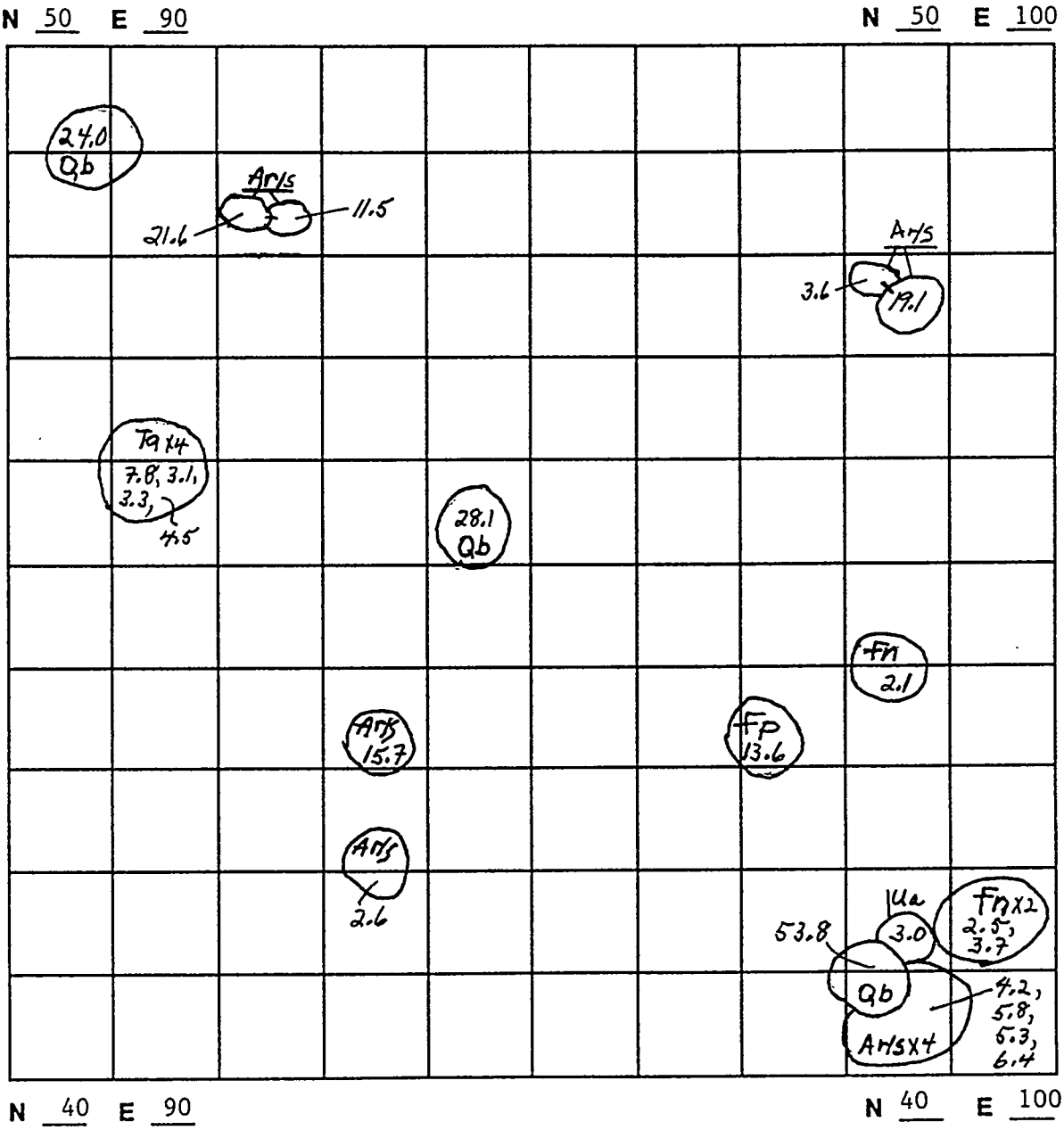


TREE DATA FOR ANL/GRI ROW PROJECT MIDLAND CO., MI

Site: 2 **Plot No.:** 2409 **Date:** 15 August 1989

Plot Location: **North (Meters):** 40-50 **East (Meters):** 90-100

Investigators:



Appendix E:

Overstory Data (Selected Examples)

Appendix E:

Overstory Data (Selected Examples)

The number in the column headed NOTE refer to a list of annotations at the end of the appendix, following the overstory data tables.

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 1400
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	52.22	2	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	1096	4	[1]
Fraxinus nigra	Fn	0	0	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	378.2	2	[2]
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	874.6	4	
Quercus palustris	Qp	9.621	1	
Quercus rubra	Qr	11.34	1	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	101.8	10	[3]
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	6.158	1	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
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Plot Number: 1401
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	495.9	5	
Fraxinus nigra	Fn	0	0	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	3182	7	[1]
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	145.4	11	[2]
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
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Plot Number: 1402
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	373.2	1	
Acer rubrum x saccharinum	Ar/s	25.52	1	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	6.158	1	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	758.4	5	
Fraxinus nigra	Fn	40.72	1	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	47.78	1	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	1646	3	[1]
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	173.4	3	
Ulmus americana	Ua	296.3	5	
Cornus foemina	Cf	15.85	3	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
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Plot Number: 1403
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	3.464	1	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	72.77	2	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	555.5	6	
Fraxinus nigra	Fn	0	0	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	991.8	2	[1]
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	150.3	8	[2]
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	11.94	1	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	193.7	9	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	16.62	1	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
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Plot Number: 1404
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	34.64	3	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	116.8	4	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	172.4	9	
Amelanchier arborea	Am	8.553	1	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	65.87	9	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp [1,2]	306.0	7	
Fraxinus nigra	Fn	11.34	1	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt [3,4]	68.27	2	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	60.62	3	
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	133.1	4	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 1405
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	47.49	5	
Acer saccharinum	As	113.0	1	
Acer rubrum x saccharinum	Ar/s	620.9	13	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	64.95	3	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	11.51	2	
Crataegus species	Cr	3.801	1	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	59.03	4	
Fraxinus nigra	Fn	33.18	1	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	36.32	1	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	0	0	
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	61.28	6	[1]
Tilia americana	Ta	0	0	
Ulmus americana	Ua	187.7	6	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	12.51	3	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 1406
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	7.618	2	[1]
Betula papyrifera	Bp	12.76	2	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	0	0	
Fraxinus nigra	Fn	0	0	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	1029	30	[2]
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	0	0	
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	5.726	1	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 1407
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	1294	5	[1]
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	256.6	2	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	0	0	
Fraxinus nigra	Fn	0	0	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	186.4	7	[2,3,4]
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	0	0	
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	125.0	4	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	3.464	1	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 1408
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	90.70	5	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	353.7	7	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	418.6	4	[1]
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	27.56	4	
Fraxinus nigra	Fn	0	0	
Populus deltoides	Pd	506.7	1	[2]
Populus grandidentata	Pg	32.81	2	[3]
Populus tremuloides	Pt	31.17	1	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	30.44	2	
Quercus palustris	Qp	185.2	5	
Quercus rubra	Qr	25.82	4	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	99.56	3	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	3.464	1	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
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Plot Number: 1409
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	500.5	20	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	38.62	4	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	77.44	8	[1]
Amelanchier arborea	Am	9.079	1	
Betula papyrifera	Bp	12.56	1	
Carpinus caroliniana	Ca	3.801	1	
Crataegus species	Cr	10.18	1	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	574.4	2	
Fraxinus nigra	Fn	0	0	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	74.68	2	
Quercus palustris	Qp	142.5	5	
Quercus rubra	Qr	67.98	5	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	0	0	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 2400
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	41.89	5	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	244.0	3	
Fraxinus nigra	Fn	101.4	14	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	1346	1	
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	0	0	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
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Plot Number: 2401
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	189.4	13	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	982.4	3	[1]
Fraxinus nigra	Fn	819.1	9	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	1838	3	[2,3]
Quercus palustris	Qp	9.746	2	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	0	0	
Ulmus americana	Ua	78.54	1	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
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Plot Number: 2402
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	18.66	3	[1]
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	1690	9	
Fraxinus nigra	Fn	109.0	12	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	1527	1	[2]
Quercus palustris	Qp	45.74	2	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	13.85	1	
Ulmus americana	Ua	171.4	3	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	3.801	1	
Viburnum lentago	Vi	4.154	1	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
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Plot Number: 2403
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	40.36	2	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	2003	4	
Fraxinus nigra	Fn	50.01	9	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	612.4	2	[1]
Quercus palustris	Qp	21.40	2	
Quercus rubra	Qr	16.62	1	
Tilia americana	Ta	79.02	3	
Ulmus americana	Ua	65.04	1	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 2404
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	340.0	5	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	145.2	1	
Fraxinus nigra	Fn	93.13	4	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	212.4	2	
Quercus palustris	Qp	62.36	5	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	74.80	3	
Ulmus americana	Ua	0	0	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 2405
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	20.42	1	
Acer saccharinum	As	283.3	3	[1]
Acer rubrum x saccharinum	Ar/s	693.8	3	[2]
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	37.12	3	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	808.8	2	
Fraxinus nigra	Fn	19.80	2	
Populus deltoides	Pd	3686	2	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	253.8	2	
Quercus palustris	Qp	26.70	2	
Quercus rubra	Qr	47.78	1	
Tilia americana	Ta	18.18	3	
Ulmus americana	Ua	0	0	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 2406
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	30.51	3	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	113.0	1	
Fraxinus nigra	Fn	33.18	1	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	2874	1	
Quercus palustris	Qp	2718	4	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	2066	17	
Ulmus americana	Ua	8.553	1	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 2407
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	725.8	1	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	754.0	5	[1]
Fraxinus nigra	Fn	54.64	2	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	379.6	2	[2]
Quercus palustris	Qp	9.079	1	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	295.3	20	
Ulmus americana	Ua	0	0	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	3.801	1	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 2408
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	109.2	3	[1]
Acer rubrum x saccharinum	Ar/s	0	0	
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	1214	6	
Fraxinus nigra	Fn	142.2	3	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	3.801	1	
Quercus palustris	Qp	14.70	2	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	31.86	2	
Ulmus americana	Ua	110.8	3	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	3.464	1	

ROW PROJECT MIDLAND COUNTY, MICHIGAN
TREE DATA - 1989

Plot Number: 2409
Code: Two letter codes for taxa on plot maps. B.A.:Basal area in square centimeters. N.I.: Number of individuals. Plot size: 10X10 meters.

Taxon	Code	B.A.	N.I.	NOTE
Acer rubrum	Ar	0	0	
Acer saccharinum	As	0	0	
Acer rubrum x saccharinum	Ar/s	1060	10	[1,2]
Acer saccharum	Ac	0	0	
Acer nigrum	An	0	0	
Alnus rugosa	Al	0	0	
Amelanchier arborea	Am	0	0	
Betula papyrifera	Bp	0	0	
Carpinus caroliniana	Ca	0	0	
Crataegus species	Cr	0	0	
Fagus grandifolia	Fg	0	0	
Fraxinus pennsylvanica	Fp	145.2	1	
Fraxinus nigra	Fn	19.12	3	
Populus deltoides	Pd	0	0	
Populus grandidentata	Pg	0	0	
Populus tremuloides	Pt	0	0	
Prunus serotina	Ps	0	0	
Prunus virginiana	Pv	0	0	
Quercus bicolor	Qb	3346	3	[3]
Quercus palustris	Qp	0	0	
Quercus rubra	Qr	0	0	
Tilia americana	Ta	79.78	4	
Ulmus americana	Ua	7.068	1	
Cornus foemina	Cf	0	0	
Ilex verticillata	Il	0	0	
Viburnum lentago	Vi	0	0	

ANNOTATIONS [#] FOR OVERSTORY TAXA PER PLOT - 1989

1400 [1] Fp (13.5; 4.5 m N, 8.3 m E) dead in 1990.
[2] Pt (18.5 cm; 0.4 m N, 8.4 m E) dead in 1990.
[3] Ua (5.5 cm; 4.8 m N, 1.7 m E) dead in 1990.

1401 [1] Qb (40.5, 30.3 cm; 8.3 m N, 2.0 m E) two trunks fused at base measured separately.
[2] Ua (8.9 cm; 7.0 m N, 7.3 m E) dead in 1990.

1402 [1] Qb (36.0, 28.1 cm; 0.7 m N, 6.5 m E) two trunks fused at base measured separately.

1403 [1] Pt (8.1 cm; 8.7 m N, 8.7 m E) dead in 1991.
[2] Qb (2.0 cm; 2.6 m N, 5.5 m E) dead in 1991.

1404 [1] Fp (2.5 cm; 4.7 m N, 8.3 m E) dead in 1991.
[2] Fp (7.7 cm; 7.8 m N, 4.2 m E) dead in 1990.
[3] Pt (7.3 cm; 7.3 m N, 3.7 m E) dead in 1990.
[4] Pt (5.8 cm; 5.7 m N, 7.1 m N) dead in 1990.

1405 [1] Qr (4.8, 2.7 cm; 8.0 m N, 8.4 m E) two trunks fused at base, but measured separately.

1406 [1] Am (2.3, 2.1 cm; 7.4 m N, 7.3 m E) trunk with basal branches measured separately.
[2] Pt (6.0 cm; 8.4 m N, 4.2 m E) nearly dead in 1991.

1407 [1] Ar (30.9, 20.4, 15.7 cm; 0.6 m N, 8.5 m E) three trunks fused at base measured separately.
[2] Pg (4.1 cm; 7.7 m N, 8.3 m E) dead in 1990.
[3] Pg (4.8 cm; 7.8 m N, 9.2 m E) dead in 1990.
[4] Pg (5.1 cm; 7.8 m N, 9.6 m E) dead in 1990.

1408 [1] Bp (18.7 cm; 1.6 m N, 0.8 m E) dead in 1990.
[2] Pd (25.4 cm; 0.5 m N, 3.6 m E) dead in 1990.
[3] Pg (3.7 cm; 7.8 m N, 2.8 m E) dead in 1990.
1409 [1] Al (2.9 cm; 2.5 m N, 5.4 m E) clustered with seedlings less than 2.0 cm; 2.9 cm individual dead in 1991.

2400 [0] No Remarks

2401 [1] Fp (2.2 cm; 8.4 m N, 1.4 m E) nearly dead in 1991.
[2] Qb (31.6 cm; 8.0 m N; 8.4 m E) dead in 1990.
[3] Qb (7.1 cm; 2.7 m N; 9.9 m E) dead in 1991.

2402 [1] Bp (2.4 cm; 7.4 m N, 5.1 m E) dead in 1990.
[2] Qb (44.1 cm; 2.5 m N, 0.2 m E) dead in 1990.

2403 [1] Qb (17.2 cm; 5.2 m N, 8.2 m E) dead in 1991.

2404 [0] No Remarks

2405 [1] As (9.1, 3.5 cm; 1.4 m N, 2.7 m E) trunk with basal branch measured separately.
[2] Ar/s (29.1, 5.3, 2.9 cm; 4.9 m N, 5.1 m E) trunk with two basal branches measured separately.

2406 [0] No remarks

2407 [1] Fp (4.0, 2.2, 2.1 cm; 6.4 m N, 7.7 m E) three shoots from old stump; 2.1 cm shoot dead in 1990; 2.2 cm shoot dead in 1991.
[2] Qb (21.5 cm; 1.0 m N, 2.9 m E) dead in 1991.

2408 [1] As (11.0, 3.1, 2.9 cm; 6.9 m N, 5.8 m E) trunk with two basal branches measured separately.

2409 [1] Ar/s (19.1, 3.6 cm; 7.6 m N, 8.6 m E) trunk with basal branches measured separately.
[2] Ar/s (21.1, 11.5 cm; 8.5 m N, 2.5 m E) two trunks fused at bases measured separately.

[3] Qb (24.0 cm; 9.0 m N, 0.9 m E) nearly dead in 1991.

Appendix F:

Understory and Right-of-Way (ROW) Data

(Selected Examples)

Note: The columns headed "SR No.," "% C," "% F," and "D" represent serial number, percent cover, percent frequency, and density, respectively. "ND" in the density column indicates that the density was not determined for those taxa.

Appendix F:

Understory and Right-of-Way (ROW) Data (Selected Examples)

Cover and Frequency Data for Forest Understory, MI Project
Site 1 - Transect 141 - 30 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Growth
FORSO	066	8.5	45	ND	BIOD	NP
LOGSS	066	2.31	20	ND	BIOD	NP
RUBPU	066	8.13	47.5	234	BRAM	FACW+
RUBST	066	0.938	12.5	10	BRAM	FACW-
RUBHI	066	0.813	7.5	25	BRAM	FACW
RUBAL	066	0.5	7.5	4	BRAM	FACU+
RIBCY	066	0.125	5	8	BRAM	NP
PTERI	066	35.8	67.5	ND	FEAL	NP
PTEAQ	066	23.6	42.5	ND	FERN	FACU
ONOSE	066	9.56	25	ND	FERN	FACW
THEPA	066	0.938	2.5	ND	FERN	FACW+
DRYAU	066	0.125	5	ND	FERN	FACW-
FORBS	066	31.3	97.5	ND	FOAL	NP
ARANU	066	10.1	40	ND	FODI	FACU
AMPBR	066	9.06	50	ND	FODI	FAC
SMLRA	066	5.5	40	ND	FODI	FACU
ASTUM	066	4.88	27.5	ND	FODI	FACW
FRGVI	066	2.19	37.5	ND	FODI	FAC-
CORCA	066	1.81	22.5	ND	FODI	FAC
GALTR	066	1.13	20	ND	FODI	FACU+
ASTLA	066	1.06	17.5	ND	FODI	OBL
LYCVI	066	0.813	20	ND	FODI	OBL
VIOSP	066	0.75	30	ND	FODI	NP
SOLRU	066	0.688	15	ND	FODI	FAC+
SCULA	066	0.625	25	ND	FODI	OBL
GAUPR	066	0.563	22.5	ND	FODI	FACU
CICMA	066	0.5	7.5	ND	FODI	OBL
PRESP	066	0.375	15	ND	FODI	NP
NAUTH	066	0.313	12.5	ND	FODI	NP
SOLGI	066	0.25	10	ND	FODI	FACW
ASTPU	066	0.125	5	ND	FODI	OBL
STECI	066	0.063	2.5	ND	FODI	FACW
OXAFO	066	0.063	2.5	ND	FODI	NP
VIOPU	066	0.063	2.5	ND	FODI	FACU-
CHEGL	066	0.063	2.5	ND	FODI	OBL
PYREL	066	0.063	2.5	ND	FODI	NP
MAICA	066	4.88	45	ND	FOMO	FAC
SMIRA	066	0.375	2.5	ND	FOMO	FACU
POLPU	066	0.063	2.5	ND	FOMO	NP
GRAMI	066	44.6	97.5	ND	GRAL	NP
SEDGE	066	35.2	87.5	ND	GRCJ	NP

Site 1 Serial No. 66 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Growth
CARSR	066	19.8	60	ND	GRCY	OBL
CARLA	066	5.56	40	ND	GRCY	OBL
CARTE	066	3.19	42.5	ND	GRCY	FAC+
CARCR	066	1.88	15	ND	GRCY	FACW+
CARGR	066	1.06	17.5	ND	GRCY	FACU*
CARRO	066	0.063	2.5	ND	GRCY	NP
CARSP	066	0.063	2.5	ND	GRCY	NP
GRASS	066	7.94	85	ND	GRKS	NP
CALCA	066	5.5	62.5	ND	GRPO	OBL
BRAER	066	1.69	17.5	ND	GRPO	NP
FESSP	066	1.56	15	ND	GRPO	NP
CINAR	066	0.188	7.5	ND	GRPO	FACW
BRYOP	066	11.6	100	ND	MOSS	NP
DIELO	066	3.44	27.5	56	SHRU	NP
LONDI	066	0.563	22.5	17	SHRU	FACU
VACAT	066	0.438	5	15	SHRU	FACW
SPIAL	066	0.375	2.5	2	SHRU	FACW+
CORST	066	0.125	5	1	SHRU	FACW
FRAPE	066	7	47.5	21	TREE	FACW
ACESP	066	6.81	97.5	223	TREE	NP
ULMAM	066	5.63	32.5	17	TREE	FACW-
QUEWH	066	4.06	40	27	TREE	NP
PRUVI	066	1.81	12.5	10	TREE	FAC-
ACERU	066	1.81	12.5	4	TREE	FAC
AMEAR	066	1.38	7.5	4	TREE	FACU
ALNRU	066	1.19	10	1	TREE	OBL
PRUSE	066	1.13	10	9	TREE	FACU
QUEBK	066	1.13	20	11	TREE	NP
FRANI	066	1	5	5	TREE	FACW+
BETPA	066	0.563	10	8	TREE	FACU+
FRASP	066	0.563	22.5	15	TREE	NP
CAPCA	066	0.5	20	8	TREE	FAC
POPTR	066	0.063	2.5	1	TREE	FAC
SALSP	066	0.063	2.5	1	TREE	NP
CRASP	066	0.063	2.5	1	TREE	NP
CORFO	066	7.38	65	133	TRES	FACW-
VIBLE	066	2.81	15	4	TRES	FAC+
ILEVE	066	1.25	25	17	TRES	FACW+
UNFO3	066	1.31	5	ND	UNKN	NP
UNFO1	066	1.19	35	ND	UNKN	NP
UNGR1	066	0.313	12.5	ND	UNKN	NP
UNFO2	066	0.063	2.5	ND	UNKN	NP
PARQU	066	4.5	47.5	65	VINE	FAC-
TOXRA	066	2.44	25	35	VINE	FAC+
EUOOB	066	1.81	22.5	83	VINE	NP
VITRI	066	1	5	5	VINE	FACW-
TOTAL NUMBER OF TAXA:				87		

Cover and Frequency Data for Forest Understory, MI Project
Site 1 - Transect 113 - 28-30 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
FORSO	065	1.25	12.5	ND	BIOD	NP
LOGSS	065	2.81	17.5	ND	BIOD	NP
RUBPU	065	20.2	90	624	BRAM	FACW+
RUBST	065	5.81	30	54	BRAM	FACW-
RUBHI	065	0.188	7.5	8	BRAM	FACW
ROSPA	065	0.125	5	4	BRAM	OBL
PTERI	065	70.1	100	ND	FEAL	NP
ONOSE	065	50.3	80	ND	FERN	FACW
PTEAQ	065	19.1	42.5	ND	FERN	FACU
THEPA	065	0.5	7.5	ND	FERN	FACW+
FORBS	065	45.2	100	ND	FOAL	NP
ARANU	065	30	70	ND	FODI	FACU
GALTR	065	5.56	32.5	ND	FODI	FACU+
FRGVI	065	4.81	80	ND	FODI	FAC-
ARARA	065	1.56	2.5	ND	FODI	NP
ASTUM	065	1.31	27.5	ND	FODI	FACW
STECI	065	1.19	10	ND	FODI	FACW
SOLGI	065	1.13	20	ND	FODI	FACW
VIOPU	065	0.563	22.5	ND	FODI	FACU-
PREAL	065	0.563	22.5	ND	FODI	FACU
LYCAM	065	0.375	2.5	ND	FODI	OBL
TREBO	065	0.313	12.5	ND	FODI	FAC+
ASTLA	065	0.313	12.5	ND	FODI	FACW-
SOLRU	065	0.25	10	ND	FODI	FAC+
GAUPR	065	0.188	7.5	ND	FODI	FACU
LYCVI	065	0.125	5	ND	FODI	OBL
SCULA	065	0.125	5	ND	FODI	OBL
NAUTH	065	0.063	2.5	ND	FODI	NP
CICMA	065	0.063	2.5	ND	FODI	OBL
MAICA	065	8.31	77.5	ND	FOMO	FAC
POLPU	065	0.563	22.5	ND	FOMO	NP
SMLRA	065	0.375	2.5	ND	FOMO	FACU
TRLGR	065	0.125	5	ND	FOMO	NP
GOOSP	065	0.125	5	ND	FOMO	NP
TRLSP	065	0.063	2.5	ND	FOMO	NP
LILMI	065	0.063	2.5	ND	FOMO	FAC+
GRAMI	065	23.8	97.5	ND	GRAL	NP
SEDGE	065	14.4	85	ND	GRCJ	NP
CARSR	065	5.13	27.5	ND	GRCY	OBL
CARRO	065	3.38	27.5	ND	GRCY	NP
CARTE	065	2	20	ND	GRCY	FAC+
CARGR	065	1.63	40	ND	GRCY	FACU*
CARLA	065	1.56	25	ND	GRCY	OBL
CARLU	065	0.375	2.5	ND	GRCY	OBL
CARTU	065	0.125	5	ND	GRCY	OBL
CARBR	065	0.063	2.5	ND	GRCY	FACW+

Site 1 Serial No. 65 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
GRASS	065	6.81	77.5	ND	GRKS	NP
CALCA	065	4.63	50	ND	GRPO	OBL
FESOB	065	1.25	15	ND	GRPO	FACU+
CINAR	065	0.25	10	ND	GRPO	FACW
BROCI	065	0.125	5	ND	GRPO	FACW
BRYOP	065	5	100	ND	MOSS	NP
DIELO	065	0.625	12.5	16	SHRU	NP
LONDI	065	0.563	10	7	SHRU	FACU
FRAPE	065	6.75	30	31	TREE	FACW
QUEWH	065	6.5	32.5	21	TREE	NP
PRUVI	065	4.63	30	33	TREE	FAC-
ULMAM	065	2.94	32.5	11	TREE	FACW-
ACESP	065	2.81	75	161	TREE	NP
ALNRU	065	2.44	2.5	16	TREE	OBL
PRUSE	065	1.81	12.5	6	TREE	FACU
BETPA	065	1.69	7.5	3	TREE	FACU+
CAPCA	065	1.63	17.5	10	TREE	FAC
QUEBK	065	1.25	15	7	TREE	NP
ACERS	065	0.938	2.5	2	TREE	NP
POPTR	065	0.875	10	3	TREE	FAC
ACERU	065	0.438	5	3	TREE	FAC
TILAM	065	0.375	2.5	0	TREE	FACU
FRASP	065	0.188	7.5	3	TREE	NP
FAGGR	065	0.063	2.5	1	TREE	FACU
CORFO	065	5.63	57.5	81	TRES	FACW-
ILEVE	065	4.88	40	45	TRES	FACW+
VIBLE	065	1.94	17.5	9	TRES	FAC+
UNFO1	065	1.31	52.5	ND	UNKN	NP
UNFO2	065	0.063	2.5	ND	UNKN	NP
UNFE1	065	0.063	2.5	ND	UNKN	NP
PARQU	065	3.75	50	82	VINE	FAC-
VITRI	065	2.94	20	2	VINE	FACW-
EUCOB	065	2.88	40	130	VINE	NP
SMITA	065	0.563	10	9	VINE	NP
TOXRA	065	0.563	10	18	VINE	FAC+
TOTAL NUMBER OF TAXA:				81		

Cover and Frequency Data for Forest Understory, MI Project
Site 1 - Transect 105 - 27-28 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
FORSO	064	2.38	10	ND	BIOD	NP
LOGSS	064	2.06	20	ND	BIOD	NP
RUBPU	064	13.7	65	359	BRAM	FACW+
RUBST	064	3.94	25	43	BRAM	FACW-
RUBHI	064	2.88	17.5	77	BRAM	FACW
ROSPA	064	1.75	32.5	31	BRAM	OBL
RIBAM	064	0.375	2.5	4	BRAM	FACW
RUBAL	064	0.375	2.5	1	BRAM	FACU+
RIBSP	064	0.188	7.5	6	BRAM	NP
PTERI	064	61.1	92.5	ND	FEAL	NP
ONOSE	064	51.2	85	ND	FERN	FACW
PTEAQ	064	10.7	25	ND	FERN	FACU
THEPA	064	0.813	7.5	ND	FERN	FACW+
DRYAU	064	0.25	10	ND	FERN	FACW-
FORBS	064	23.8	92.5	ND	FOAL	NP
FRGVI	064	4.19	47.5	ND	FODI	FAC-
ARANU	064	2.75	15	ND	FODI	FACU
VIOSP	064	1.88	50	ND	FODI	NP
AMPBR	064	1.88	27.5	ND	FODI	FAC
SOLGI	064	1.63	27.5	ND	FODI	FACW
SOLRU	064	1.25	25	ND	FODI	FAC+
LYCVI	064	1.06	30	ND	FODI	OBL
ASTUM	064	1	15	ND	FODI	FACW
GALTR	064	1	27.5	ND	FODI	FACU+
LACSP	064	0.625	12.5	ND	FODI	NP
STECI	064	0.563	10	ND	FODI	FACW
CIRLU	064	0.5	7.5	ND	FODI	FACU
SOLGR	064	0.375	2.5	ND	FODI	FACW-
ASTLA	064	0.25	10	ND	FODI	FACW-
PRESP	064	0.25	10	ND	FODI	NP
CORCA	064	0.188	7.5	ND	FODI	NP
NAUTH	064	0.063	2.5	ND	FODI	NP
EUPPE	064	0.063	2.5	ND	FODI	FACW+
SCULA	064	0.063	2.5	ND	FODI	OBL
RANRE	064	0.063	2.5	ND	FODI	FACW
TAROF	064	0.063	2.5	ND	FODI	FACU
CISSP	064	0.063	2.5	ND	FODI	NP
CISAR	064	0.063	2.5	ND	FODI	FACU
DESGL	064	0.063	2.5	ND	FODI	NP
ARARA	064	0.063	2.5	ND	FODI	NP
MAICA	064	1.63	52.5	ND	FOMO	FAC
POLPU	064	0.938	12.5	ND	FOMO	NP
SMLRA	064	0.063	2.5	ND	FOMO	FACU
TRLSP	064	0.063	2.5	ND	FOMO	NP
GRAMI	064	56.3	100	ND	GRAL	NP
SEDGE	064	44.1	95	ND	GRCJ	NP

Site 1 Serial No. 64 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
CARSR	064	20.1	55	ND	GRCY	OBL
CARLA	064	6	57.5	ND	GRCY	OBL
CARTE	064	3.06	25	ND	GRCY	FAC+
CARGR	064	2.94	32.5	ND	GRCY	FACU*
CARCR	064	1.25	12.5	ND	GRCY	FACW+
CARRO	064	0.5	7.5	ND	GRCY	NP
CARBR	064	0.5	7.5	ND	GRCY	FACW+
CARST	064	0.125	5	ND	GRCY	NP
CARSC	064	0.125	5	ND	GRCY	FACW
CARLU	064	0.063	2.5	ND	GRCY	OBL
CARTU	064	0.063	2.5	ND	GRCY	OBL
SCICY	064	0.063	2.5	ND	GRCY	OBL
CARAU	064	0.063	2.5	ND	GRCY	FACW+
CARSP	064	0.063	2.5	ND	GRCY	NP
GRASS	064	13.3	77.5	ND	GRKS	NP
CALCA	064	7.19	60	ND	GRPO	OBL
POAPR	064	2.25	7.5	ND	GRPO	FAC-
AGRGI	064	2	10	ND	GRPO	NI
BRAER	064	0.875	10	ND	GRPO	NP
FESOB	064	0.375	15	ND	GRPO	FACU+
PANBO	064	0.188	7.5	ND	GRPO	FACU+
CINAR	064	0.125	5	ND	GRPO	FACW
BROCI	064	0.063	2.5	ND	GRPO	FACW
BRYOP	064	5.25	97.5	ND	MOSS	NP
SPIAL	064	6.56	25	68	SHRU	FACW+
DIELO	064	0.375	2.5	10	SHRU	NP
LONDI	064	0.188	7.5	4	SHRU	FACU
FRAPE	064	10.3	42.5	42	TREE	FACW
ACESP	064	3.44	77.5	112	TREE	NP
BETPA	064	2.25	17.5	75	TREE	FACU+
QUEWH	064	2.25	40	18	TREE	NP
ULMAM	064	1.81	22.5	15	TREE	FACW-
PRUSE	064	1.75	10	7	TREE	FACU
PRUVI	064	1.63	17.5	14	TREE	FAC-
FRASP	064	1.38	42.5	35	TREE	NP
ALNRU	064	1.13	7.5	4	TREE	OBL
QUEBK	064	0.438	17.5	5	TREE	NP
POPTR	064	0.438	17.5	6	TREE	FAC
CAPCA	064	0.375	15	14	TREE	FAC
POPDE	064	0.188	7.5	4	TREE	FAC+
CORFO	064	11.6	67.5	100	TRES	FACW-
ILEVE	064	6.38	40	61	TRES	FACW+
VIBLE	064	1.81	12.5	6	TRES	FAC+
UNFO1	064	1.63	52.5	ND	UNKN	NP
UNWD1	064	0.125	5	ND	UNKN	NP
PARQU	064	8.81	62.5	201	VINE	FAC-
VITRI	064	5.81	17.5	3	VINE	FACW-

Site 1 Serial No. 64 Page 3 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
TOXRA	064	2.06	20	40	VINE	FAC+
EUCOB	064	0.688	15	25	VINE	NP
SMITA	064	0.375	15	10	VINE	NP
TOTAL NUMBER OF TAXA:				96		

Cover and Frequency Data for Ecotone Understory, MI Project
Site 1 - Transect 101 - 27 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	063	8.38	70	ND	ABIO	NP
FORSO	063	1.88	15	ND	BIOD	NP
LOGSS	063	0.375	15	ND	BIOD	NP
ROSPA	063	0.875	22.5	11	BRAM	OBL
RUBPU	063	0.813	7.5	8	BRAM	FACW+
RUBHI	063	0.125	5	2	BRAM	FACW
PTERI	063	11.6	87.5	ND	FEAL	NP
ONOSE	063	10.6	85	ND	FERN	FACW
PTEAQ	063	0.5	7.5	ND	FERN	FACU
THEPA	063	0.125	5	ND	FERN	FACW+
FORBS	063	45.1	100	ND	FOAL	NP
LOTCO	063	27	62.5	ND	FODI	FAC-
EUPPE	063	7.19	80	ND	FODI	FACW+
ASTON	063	3.5	20	ND	FODI	FAC
LYCVI	063	2.81	75	ND	FODI	OBL
ASTUM	063	1.38	17.5	ND	FODI	FACW
LUDPO	063	1	5	ND	FODI	OBL
FRGVI	063	0.938	25	ND	FODI	FAC-
SCULA	063	0.875	35	ND	FODI	OBL
TRISP	063	0.563	22.5	ND	FODI	NP
LYCAM	063	0.5	20	ND	FODI	OBL
MIMRI	063	0.438	5	ND	FODI	OBL
VIOSP	063	0.375	15	ND	FODI	NP
AMPBR	063	0.375	2.5	ND	FODI	FAC
NAUTH	063	0.25	10	ND	FODI	NP
SOLGI	063	0.188	7.5	ND	FODI	FACW
STECI	063	0.188	7.5	ND	FODI	FACW
ASTLA	063	0.125	5	ND	FODI	FACW-
HYPPU	063	0.125	5	ND	FODI	FAC+
TRIHY	063	0.125	5	ND	FODI	FAC-
GALTI	063	0.063	2.5	ND	FODI	OBL
MAICA	063	0.125	5	ND	FOMO	FAC
GRAMI	063	89	100	ND	GRAL	NP
SEDGE	063	47.3	92.5	ND	GRCJ	NP
CARTE	063	10.3	52.5	ND	GRCY	FAC+
CARCR	063	6.38	62.5	ND	GRCY	FACW+
CARLU	063	6.31	45	ND	GRCY	OBL
CARLA	063	6.06	27.5	ND	GRCY	OBL
CARSR	063	3.44	27.5	ND	GRCY	OBL
CARST	063	3.13	27.5	ND	GRCY	NP
SCICY	063	2.81	37.5	ND	GRCY	OBL
SCIAT	063	0.625	12.5	ND	GRCY	OBL
CARBE	063	0.125	5	ND	GRCY	OBL
	063	0.063	2.5	ND	GRCY	FACW
CARGR	063	0.063	2.5	ND	GRCY	FACU*
JUNEF	063	3	32.5	ND	GRJU	OBL

Site 1 Serial No. 63 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
JUNSP	063	0.125	5	ND	GRJU	NP
GRASS	063	58.1	97.5	ND	GRKS	NP
ARGRI	063	46.6	97.5	ND	GRPO	NI
FESPR	063	2.5	27.5	ND	GRPO	FACU-
GLYST	063	2.31	20	ND	GRPO	OBL
PHLPR	063	2.19	62.5	ND	GRPO	FACU
FESOV	063	1.25	37.5	ND	GRPO	NP
CALCA	063	1.19	22.5	ND	GRPO	OBL
PANBO	063	0.188	7.5	ND	GRPO	FACU+
ECHCR	063	0.125	5	ND	GRPO	FACW
BRYOP	063	5.19	97.5	ND	MOSS	NP
SPIAL	063	3.81	20	35	SHRU	FACW+
LONDI	063	0.063	2.5	1	SHRU	FACU
POPDE	063	18.6	97.5	389	TREE	FAC+
FRAPE	063	2	17.5	9	TREE	FACW
SALAM	063	1.75	45	23	TREE	FACW
ACESP	063	1.63	65	43	TREE	NP
SALNI	063	1.44	45	36	TREE	OBL
SALEX	063	0.813	32.5	22	TREE	OBL
FRASP	063	0.625	12.5	7	TREE	NP
SALER	063	0.375	2.5	2	TREE	FACW
BETPA	063	0.125	5	5	TREE	FACU+
QUEWH	063	0.125	5	2	TREE	NP
POPTR	063	0.063	2.5	1	TREE	FAC
ULMSP	063	0.063	2.5	1	TREE	NP
QUEBK	063	0.063	2.5	1	TREE	NP
CORFO	063	0.25	10	4	TRES	FACW-
VIBLE	063	0.188	7.5	3	TRES	FAC+
ILEVE	063	0.125	5	2	TRES	FACW+
UNFO1	063	1.5	60	ND	UNKN	NP
UNGR1	063	0.063	2.5	ND	UNKN	NP
UNFO2	063	0.063	2.5	ND	UNKN	NP
PARQU	063	1.69	30	24	VINE	FAC-
VITRI	063	0.938	2.5	0	VINE	FACW-
SMITA	063	0.188	7.5	5	VINE	NP
EUOOB	063	0.063	2.5	1	VINE	NP
TOTAL NUMBER OF TAXA:				81		

Cover and Frequency Data for ROW, MI Project
Site 1 - Transect 503 - 25 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	060	11.6	60	ND	ABIO	NP
LOGSS	060	0.625	12.5	ND	BIOD	NP
RUBPU	060	0.188	7.5	3	BRAM	FACW+
ROSPA	060	0.063	2.5	2	BRAM	OBL
RUBHI	060	0.063	2.5	1	BRAM	FACW
PTERI	060	4.13	77.5	ND	FEAL	NP
ONOSE	060	4.13	77.5	ND	FERN	FACW
EQUAR	060	0.063	2.5	ND	FERN	FAC
FORBS	060	32.9	97.5	ND	FOAL	NP
LOTCO	060	21.9	65	ND	FODI	FAC-
EUPPE	060	3.38	72.5	ND	FODI	FACW+
LYCVI	060	1.88	62.5	ND	FODI	OBL
LYCAM	060	1.69	20	ND	FODI	OBL
STECI	060	1	15	ND	FODI	FACW
ASTUM	060	0.813	20	ND	FODI	FACW
FRGVI	060	0.75	17.5	ND	FODI	FAC-
TRISP	060	0.75	30	ND	FODI	NP
SCULA	060	0.188	7.5	ND	FODI	OBL
CISSP	060	0.188	7.5	ND	FODI	NP
LUDPO	060	0.188	7.5	ND	FODI	OBL
VIOSP	060	0.188	7.5	ND	FODI	NP
POTNO	060	0.125	5	ND	FODI	FAC
VERHA	060	0.125	5	ND	FODI	FACW+
LACSP	060	0.125	5	ND	FODI	NP
ASTLA	060	0.125	5	ND	FODI	OBL
GALTI	060	0.125	5	ND	FODI	OBL
TAROF	060	0.063	2.5	ND	FODI	FACU
MIMRI	060	0.063	2.5	ND	FODI	OBL
RORPA	060	0.063	2.5	ND	FODI	OBL
NAUTH	060	0.063	2.5	ND	FODI	NP
PENSE	060	0.063	2.5	ND	FODI	OBL
TRIHY	060	0.063	2.5	ND	FODI	FAC-
GALSP	060	0.063	2.5	ND	FODI	NP
TYPAN	060	0.063	2.5	ND	FOMO	OBL
GRAMI	060	89.4	100	ND	GRAL	NP
SEDGE	060	38	95	ND	GRCJ	NP
CARCR	060	5.19	37.5	ND	GRCY	FACW+
SCICY	060	5.06	55	ND	GRCY	OBL
CARST	060	4.81	57.5	ND	GRCY	NP
CARSC	060	4.5	37.5	ND	GRCY	FACW
CARLU	060	3.94	57.5	ND	GRCY	OBL
CARTE	060	1.44	20	ND	GRCY	FAC+
CARLA	060	0.313	12.5	ND	GRCY	OBL
CARSP	060	0.313	12.5	ND	GRCY	NP
CARVU	060	0.125	5	ND	GRCY	OBL
CYPSP	060	0.125	5	ND	GRCY	NP

Site 1 Serial No. 60 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
CARGR	060	0.063	2.5	ND	GRCY	FACU*
JUNEF	060	8.38	57.5	ND	GRJU	OBL
JUNTE	060	0.063	2.5	ND	GRJU	FAC
GRASS	060	64.1	95	ND	GRKS	NP
ARGRI	060	60.4	90	ND	GRPO	NI
FESPR	060	2.81	37.5	ND	GRPO	FACU-
FESOV	060	2.06	45	ND	GRPO	NP
PHLPR	060	0.75	30	ND	GRPO	FACU
PANCA	060	0.5	7.5	ND	GRPO	FAC
GLYST	060	0.375	2.5	ND	GRPO	OBL
PANBO	060	0.25	10	ND	GRPO	FACU+
ECHCR	060	0.125	5	ND	GRPO	FACW
PANIM	060	0.125	5	ND	GRPO	FAC
BRYOP	060	10.9	95	ND	MOSS	NP
POPDE	060	15	87.5	321	TREE	FAC+
SALAM	060	4.38	50	36	TREE	FACW
SALNI	060	3.75	40	36	TREE	OBL
SALEX	060	1.94	27.5	19	TREE	OBL
ACESP	060	0.438	17.5	8	TREE	NP
FRAPE	060	0.125	5	2	TREE	FACW
BETPA	060	0.125	5	2	TREE	FACU+
FRASP	060	0.063	2.5	1	TREE	NP
UNFO1	060	1.69	67.5	ND	UNKN	NP
UNFO3	060	0.313	12.5	ND	UNKN	NP
UNFO2	060	0.063	2.5	ND	UNKN	NP
PARQU	060	0.188	7.5	2	VINE	FAC-
TOXRA	060	0.063	2.5	1	VINE	FAC+
VITRI	060	0.063	2.5	1	VINE	FACW-
TOTAL NUMBER OF TAXA:				74		

Cover and Frequency Data for ROW, MI Project
Site 1 - Transect 507.6 - 25-26 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	061	31.6	92.5	ND	ABIO	NP
LOGSS	061	0.375	15	ND	BIOD	NP
ROSPA	061	0.375	2.5	1	BRAM	OBL
RUBST	061	0.063	2.5	2	BRAM	FACW-
PTERI	061	7.93	77.5	ND	FEAL	NP
ONOSE	061	5.56	77.5	ND	FERN	FACW
EQUAR	061	2.5	15	ND	FERN	FAC
PTEAQ	061	0.063	2.5	ND	FERN	FACU
FORBS	061	38.1	97.5	ND	FOAL	NP
LOTCO	061	12.5	50	ND	FODI	FAC-
ASTUM	061	4.44	32.5	ND	FODI	FACW
LYCVI	061	4.06	65	ND	FODI	OBL
LYCAM	061	3.5	52.5	ND	FODI	OBL
EUPPE	061	3.13	62.5	ND	FODI	FACW+
FRGVI	061	3.06	37.5	ND	FODI	FAC-
TRISP	061	1.25	37.5	ND	FODI	NP
SCULA	061	1.06	30	ND	FODI	OBL
SOLSP	061	0.938	12.5	ND	FODI	NP
STECI	061	0.813	20	ND	FODI	FACW
NAUTH	061	0.625	12.5	ND	FODI	NP
VIOSP	061	0.625	25	ND	FODI	NP
TAROF	061	0.563	22.5	ND	FODI	FACU
TRIHY	061	0.5	7.5	ND	FODI	FAC-
LUDPO	061	0.438	17.5	ND	FODI	OBL
ASTLA	061	0.313	12.5	ND	FODI	FACW-
SOLRU	061	0.313	12.5	ND	FODI	FAC+
OXAFO	061	0.188	7.5	ND	FODI	NP
CISSP	061	0.188	7.5	ND	FODI	NP
SOLGI	061	0.125	5	ND	FODI	FACW
ACHMI	061	0.125	5	ND	FODI	FACU
RANRE	061	0.125	5	ND	FODI	FACW
RORPA	061	0.125	5	ND	FODI	OBL
CONCA	061	0.125	5	ND	FODI	FAC-
ASTON	061	0.063	2.5	ND	FODI	FAC
HYPCA	061	0.063	2.5	ND	FODI	FACW
PRNVU	061	0.063	2.5	ND	FODI	FAC
AMBAR	061	0.063	2.5	ND	FODI	FACU
HYPSP	061	0.063	2.5	ND	FODI	NP
SONUL	061	0.063	2.5	ND	FODI	FAC-
RUDHI	061	0.063	2.5	ND	FODI	FACU
GALTR	061	0.063	2.5	ND	FODI	FACU+
EPICO	061	0.063	2.5	ND	FODI	OBL
POTNO	061	0.063	2.5	ND	FODI	FAC
TYPLA	061	0.375	2.5	ND	FOMO	OBL
MAICA	061	0.063	2.5	ND	FOMO	FAC
TYPSP	061	0.063	2.5	ND	FOMO	NP

Site 1 Serial No. 61 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
GRAMI	061	72.2	100	ND	GRAL	NP
SEDGE	061	43.8	90	ND	GRCJ	NP
CARLU	061	5.63	60	ND	GRCY	OBL
SCICY	061	5.25	62.5	ND	GRCY	OBL
CARSR	061	3.94	15	ND	GRCY	OBL
CARCR	061	3.88	57.5	ND	GRCY	FACW+
CARTE	061	3.56	45	ND	GRCY	FAC+
CARST	061	2.44	37.5	ND	GRCY	NP
CARLA	061	1.94	17.5	ND	GRCY	OBL
CARSC	061	1.13	20	ND	GRCY	FACW
CARSP	061	0.438	5	ND	GRCY	NP
SCIAT	061	0.438	5	ND	GRCY	OBL
CARBE	061	0.313	12.5	ND	GRCY	OBL
CYPSP	061	0.188	7.5	ND	GRCY	NP
CARAU	061	0.063	2.5	ND	GRCY	FACW+
CARVU	061	0.063	2.5	ND	GRCY	OBL
JUNEF	061	16.8	52.5	ND	GRJU	OBL
JUNAR	061	0.5	7.5	ND	GRJU	OBL
JUNVA	061	0.063	2.5	ND	GRJU	FACW
JUNBU	061	0.063	2.5	ND	GRJU	FACW+
GRASS	061	23.9	75	ND	GRKS	NP
AGRGI	061	20.1	55	ND	GRPO	NI
PANCA	061	1.56	2.5	ND	GRPO	FAC
PANIM	061	1.56	37.5	ND	GRPO	FAC
FESPR	061	1.5	22.5	ND	GRPO	FACU-
FESOV	061	1.44	32.5	ND	GRPO	NP
PHLPR	061	0.875	35	ND	GRPO	FACU
GLYST	061	0.438	5	ND	GRPO	OBL
PANBO	061	0.313	12.5	ND	GRPO	FACU+
CALCA	061	0.25	10	ND	GRPO	OBL
ECHCR	061	0.188	7.5	ND	GRPO	FACW
AGRHY	061	0.063	2.5	ND	GRPO	FAC-
BRYOP	061	15.8	97.5	ND	MOSS	NP
SPIAL	061	0.063	2.5	1	SHRU	FACW+
POPDE	061	27.8	100	606	TREE	FAC+
SALAM	061	4.69	52.5	26	TREE	FACW
SALNI	061	3.75	42.5	31	TREE	OBL
SALEX	061	1.44	32.5	17	TREE	OBL
ACESP	061	1.25	50	38	TREE	NP
FRANI	061	0.375	2.5	2	TREE	FACW+
BETPA	061	0.125	5	6	TREE	FACU+
FRASP	061	0.125	5	2	TREE	NP
SALSP	061	0.063	2.5	1	TREE	NP
UNFO2	061	2.44	85	ND	UNKN	NP

Site 1 Serial No. 61 Page 3 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
UNGR3	061	0.063	2.5	ND	UNKN	NP
UNFO1	061	0.063	2.5	ND	UNKN	NP
PARQU	061	0.938	12.5	9	VINE	FAC-
TOTAL NUMBER OF TAXA:				93		

Cover and Frequency Data for ROW, MI Project
Site 1 - Transect 514 - 26 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	062	3	35	ND	ABIO	NP
STUMP	062	1.56	2.5	ND	BIOD	NP
LOGSS	062	1.13	32.5	ND	BIOD	NP
RUBPU	062	0.438	17.5	7	BRAM	FACW+
RUBSP	062	0.375	2.5	1	BRAM	NP
ROSPA	062	0.063	2.5	0	BRAM	OBL
PTERI	062	5.63	92.5	ND	FEAL	NP
ONOSE	062	3.81	90	ND	FERN	FACW
EQUAR	062	1.94	7.5	ND	FERN	FAC
THEPA	062	0.188	7.5	ND	FERN	FACW+
FORBS	062	36.5	100	ND	FOAL	NP
LOTCO	062	18.9	45	ND	FODI	FAC-
EUPPE	062	6.5	97.5	ND	FODI	FACW+
LYCVI	062	5.25	77.5	ND	FODI	OBL
LYCAM	062	1.38	30	ND	FODI	OBL
CISSP	062	1.31	5	ND	FODI	NP
TRISP	062	1.06	42.5	ND	FODI	NP
GRATE	062	0.75	5	ND	FODI	NP
SOLGR	062	0.688	15	ND	FODI	FACW-
VIOSP	062	0.625	25	ND	FODI	NP
NAUTH	062	0.625	25	ND	FODI	NP
LUDPO	062	0.625	12.5	ND	FODI	OBL
SONSP	062	0.625	12.5	ND	FODI	NP
ASTUM	062	0.563	10	ND	FODI	FACW
MELAL	062	0.5	7.5	ND	FODI	FACU
SOLGI	062	0.438	5	ND	FODI	FACW
SCULA	062	0.375	15	ND	FODI	OBL
TRIRE	062	0.375	2.5	ND	FODI	FACU+
TRIHY	062	0.375	2.5	ND	FODI	FAC-
VERHA	062	0.313	12.5	ND	FODI	FACW+
MIMRI	062	0.313	12.5	ND	FODI	OBL
TAROF	062	0.25	10	ND	FODI	FACU
SOLRU	062	0.188	7.5	ND	FODI	FAC+
FRGVI	062	0.125	5	ND	FODI	FAC-
STECI	062	0.125	5	ND	FODI	FACW
VEBTH	062	0.125	5	ND	FODI	NP
PENSE	062	0.125	5	ND	FODI	OBL
PLAMA	062	0.125	5	ND	FODI	FAC+
ASTLA	062	0.063	2.5	ND	FODI	OBL
CICMA	062	0.063	2.5	ND	FODI	OBL
OXAFO	062	0.063	2.5	ND	FODI	NP
CONCA	062	0.063	2.5	ND	FODI	FAC-
ACHMI	062	0.063	2.5	ND	FODI	FACU
MAICA	062	0.125	5	ND	FOMO	FAC
TYPSP	062	0.063	2.5	ND	FOMO	NP
GRAMI	062	92.1	100	ND	GRAL	NP

Site 1 Serial No. 62 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
SEDGE	062	66.5	100	ND	GRCJ	NP
SCICY	062	19.1	72.5	ND	GRCY	OBL
CARLU	062	8.88	65	ND	GRCY	OBL
SCIAT	062	7.31	40	ND	GRCY	OBL
CARSR	062	6.38	20	ND	GRCY	OBL
CARCR	062	5.5	55	ND	GRCY	FACW+
CARTE	062	4.44	57.5	ND	GRCY	FAC+
CARST	062	3.69	47.5	ND	GRCY	NP
CARVU	062	1.19	22.5	ND	GRCY	OBL
CARLA	062	0.875	10	ND	GRCY	OBL
CARBE	062	0.813	20	ND	GRCY	OBL
CYPER	062	0.063	2.5	ND	GRCY	OBL
JUNEF	062	5.19	27.5	ND	GRJU	OBL
JUNAC	062	1	15	ND	GRJU	OBL
JUNAR	062	1	15	ND	GRJU	OBL
JUNBU	062	0.375	2.5	ND	GRJU	FACW+
JUNAL	062	0.125	5	ND	GRJU	OBL
JUNDU	062	0.125	5	ND	GRJU	FAC
JUNTE	062	0.063	2.5	ND	GRJU	FAC
GRASS	062	56.8	100	ND	GRKS	NP
AGRGI	062	52.1	97.5	ND	GRPO	NI
FESOV	062	2.56	65	ND	GRPO	NP
PHLPR	062	1.38	30	ND	GRPO	FACU
FESPR	062	1.13	20	ND	GRPO	FACU-
PANIM	062	0.625	25	ND	GRPO	FAC
PANBO	062	0.625	25	ND	GRPO	FACU+
GLYST	062	0.438	17.5	ND	GRPO	OBL
PANCA	062	0.375	2.5	ND	GRPO	FAC
ECHCR	062	0.063	2.5	ND	GRPO	FACW
AGRHY	062	0.063	2.5	ND	GRPO	FAC-
BRYOP	062	11.5	97.5	ND	MOSS	NP
SPIAL	062	0.063	2.5	1	SHRU	FACW+
POPDE	062	3.94	70	248	TREE	FAC+
SALAM	062	3.38	37.5	17	TREE	FACW
SALNI	062	2.38	32.5	14	TREE	OBL
SALEX	062	0.75	5	2	TREE	OBL
ACESP	062	0.5	20	8	TREE	NP
FRASP	062	0.063	2.5	1	TREE	NP
BETPA	062	0.063	2.5	1	TREE	FACU+
UNFO1	062	3.13	65	ND	UNKN	NP
UNGR2	062	0.25	10	ND	UNKN	NP
UNFO2	062	0.125	5	ND	UNKN	NP
UNGR3	062	0.063	2.5	ND	UNKN	NP
PARQU	062	0.125	5	2	VINE	FAC-

Site 1 Serial No. 62 Page 3 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
TOXRA	062	0.063	2.5	3	VINE	FAC+
VITRI	062	0.063	2.5	1	VINE	FACW-
TOTAL NUMBER OF TAXA:				92		

Cover and Frequency Data for Forest Understory, MI Project
Site 2 - Transect 241 - 1 August 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
FORSO	069	40.1	90	ND	BIOD	NP
LOGSS	069	1.56	25	ND	BIOD	NP
RUBPU	069	6.06	50	138	BRAM	FACW+
RIBAM	069	0.25	10	2	BRAM	FACW
PTERI	069	27.1	92.5	ND	FEAL	NP
ONOSE	069	24.3	87.5	ND	FERN	FACW
THEPA	069	3	12.5	ND	FERN	FACW+
EQUAR	069	0.188	7.5	ND	FERN	FAC
FORBS	069	10.9	75	ND	FOAL	NP
AMPBR	069	5.44	27.5	ND	FODI	FAC
GALOB	069	1.31	27.5	ND	FODI	FACW+
SCULA	069	0.938	25	ND	FODI	OBL
CICMA	069	0.813	7.5	ND	FODI	OBL
ASTON	069	0.75	17.5	ND	FODI	FAC
SOLRU	069	0.625	12.5	ND	FODI	FAC+
VIOSP	069	0.438	17.5	ND	FODI	NP
FRGVI	069	0.375	15	ND	FODI	FAC-
SOLUL	069	0.375	2.5	ND	FODI	NP
ASTLA	069	0.313	12.5	ND	FODI	FACW-
LYCVI	069	0.125	5	ND	FODI	OBL
CHEGL	069	0.125	5	ND	FODI	OBL
STECI	069	0.125	5	ND	FODI	FACW
ARANU	069	0.063	2.5	ND	FODI	FACU
MITDI	069	0.063	2.5	ND	FODI	FACU+
SOLGI	069	0.063	2.5	ND	FODI	FACW
TAROF	069	0.063	2.5	ND	FODI	FACU
MAICA	069	0.25	10	ND	FOMO	FAC
POLPU	069	0.125	5	ND	FOMO	NP
GRAMI	069	27.8	97.5	ND	GRAL	NP
SEDGE	069	27.5	97.5	ND	GRCJ	NP
CARBR	069	15.4	55	ND	GRCY	FACW+
CARRO	069	3.06	15	ND	GRCY	NP
CARTE	069	1.81	22.5	ND	GRCY	FAC+
CARLU	069	1.75	32.5	ND	GRCY	OBL
CARSR	069	1.06	17.5	ND	GRCY	OBL
CARGR	069	0.875	22.5	ND	GRCY	FACU*
CARCR	069	0.75	17.5	ND	GRCY	FACW+
CARPE	069	0.5	7.5	ND	GRCY	NP
CARSP	069	0.188	7.5	ND	GRCY	NP
GRASS	069	1.69	32.5	ND	GRKS	NP
CINAR	069	0.688	27.5	ND	GRPO	FACW
GLYST	069	0.063	2.5	ND	GRPO	OBL
BRYOP	069	13	95	ND	MOSS	NP
FRAPE	069	17.4	65	57	TREE	FACW
ACESP	069	13.4	97.5	623	TREE	NP
FRANI	069	9.81	35	20	TREE	FACW+

Site 2 Serial No. 69 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
CAPCA	069	2.31	32.5	20	TREE	FAC
FRASP	069	1.81	35	31	TREE	NP
QUEWH	069	1.31	40	11	TREE	NP
ULMAM	069	1.25	25	7	TREE	FACW-
TILAM	069	1.25	12.5	4	TREE	FACU
PRUSE	069	0.375	2.5	9	TREE	FACU
ACERS	069	0.375	2.5	0	TREE	NP
QUEBK	069	0.188	7.5	2	TREE	NP
POPSP	069	0.063	2.5	3	TREE	NP
ILEVE	069	5.19	30	71	TRES	FACW+
VIBLE	069	2.75	25	16	TRES	FAC+
CORFO	069	0.5	20	19	TRES	FACW-
UNFO1	069	0.438	17.5	ND	UNKN	NP
TOXRA	069	4.94	50	63	VINE	FAC+
PARQU	069	3.63	27.5	48	VINE	FAC-
VITRI	069	0.813	7.5	1	VINE	FACW-
SMITA	069	0.625	12.5	16	VINE	NP
EUCOB	069	0.5	20	17	VINE	NP
RHAAL	069	0.063	2.5	0	VINE	OBL
TOTAL NUMBER OF TAXA:				65		

Cover and Frequency Data for Forest Understory, MI Project
Site 2 - Transect 213 - 31 July - 1 August 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
FORSO	068	37.8	87.5	ND	BIOD	NP
LOGSS	068	2.75	25	ND	BIOD	NP
RUBPU	068	4.25	40	77	BRAM	FACW+
RIBAM	068	0.25	10	8	BRAM	FACW
RUBST	068	0.125	5	3	BRAM	FACW-
PTERI	068	29.8	80	ND	FEAL	NP
ONOSE	068	29.1	80	ND	FERN	FACW
DRYAU	068	0.5	7.5	ND	FERN	FACW-
PTEAQ	068	0.375	2.5	ND	FERN	FACU
FORBS	068	18.4	77.5	ND	FOAL	NP
AMPBR	068	6.44	20	ND	FODI	FAC
ASTLA	068	2.38	35	ND	FODI	FACW-
ARANU	068	2.06	10	ND	FODI	FACU
GALOB	068	1.06	7.5	ND	FODI	FACW+
FRGVI	068	0.75	17.5	ND	FODI	FAC-
SCULA	068	0.75	17.5	ND	FODI	OBL
VIOSP	068	0.75	17.5	ND	FODI	NP
GALTR	068	0.625	12.5	ND	FODI	FACU+
STECI	068	0.563	10	ND	FODI	FACW
SOLGI	068	0.5	7.5	ND	FODI	FACW
DESGL	068	0.438	5	ND	FODI	NP
ARARA	068	0.438	5	ND	FODI	NP
MITDI	068	0.375	2.5	ND	FODI	FACU+
SOLRU	068	0.375	2.5	ND	FODI	FAC+
SOLUL	068	0.25	10	ND	FODI	NP
LYCVI	068	0.188	7.5	ND	FODI	OBL
EUPPE	068	0.125	5	ND	FODI	FACW+
CHEGL	068	0.063	2.5	ND	FODI	OBL
ASTUM	068	0.063	2.5	ND	FODI	FACW
TAROF	068	0.063	2.5	ND	FODI	FACU
LACSP	068	0.063	2.5	ND	FODI	NP
POLPU	068	0.375	2.5	ND	FOMO	NP
MAICA	068	0.125	5	ND	FOMO	FAC
SMLRA	068	0.125	5	ND	FOMO	FACU
GRAMI	068	28.7	87.5	ND	GRAL	NP
SEDGE	068	27.5	87.5	ND	GRCJ	NP
CARBR	068	18.2	57.5	ND	GRCY	FACW+
CARRO	068	3.75	17.5	ND	GRCY	NP
CARTE	068	2.31	20	ND	GRCY	FAC+
CARLU	068	1.75	32.5	ND	GRCY	OBL
CARGR	068	0.75	30	ND	GRCY	FACU*
CARCR	068	0.75	17.5	ND	GRCY	FACW+
CARSP	068	0.188	7.5	ND	GRCY	NP
CARCI	068	0.063	2.5	ND	GRCY	FACW+
GRASS	068	1.25	37.5	ND	GRKS	NP
CINAR	068	1	27.5	ND	GRPO	FACW

Site 2 Serial No. 68 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
GLYST	068	0.25	10	ND	GRPO	OBL
BRYOP	068	17.8	100	ND	MOSS	NP
FRAPE	068	30.2	77.5	101	TREE	FACW
ACESP	068	5.81	85	386	TREE	NP
TILAM	068	5.06	12.5	0	TREE	FACU
ULMAM	068	3.56	32.5	22	TREE	FACW-
CAPCA	068	3.38	27.5	26	TREE	FAC
ACERS	068	2.06	10	1	TREE	NP
QUEWH	068	1.69	20	18	TREE	NP
FRASP	068	0.625	25	13	TREE	NP
QUEBK	068	0.625	12.5	14	TREE	NP
POPDE	068	0.438	17.5	20	TREE	FAC+
FRANI	068	0.438	5	1	TREE	FACW+
PRUSE	068	0.188	7.5	4	TREE	FACU
POPTR	068	0.063	2.5	1	TREE	FAC
ILEVE	068	1.31	15	18	TRES	FACW+
CORFO	068	0.375	15	10	TRES	FACW-
UNFO1	068	0.625	25	ND	UNKN	NP
UNGR1	068	0.25	10	ND	UNKN	NP
PARQU	068	3.31	32.5	62	VINE	FAC-
TOXRA	068	1.56	25	29	VINE	FAC+
VITRI	068	0.875	10	7	VINE	FACW-
EUCOB	068	0.688	15	10	VINE	NP
SMITA	068	0.438	5	15	VINE	NP
RHAAL	068	0.188	7.5	5	VINE	OBL
TOTAL NUMBER OF TAXA:				71		

Cover and Frequency Data for Forest Understory, MI Project
Site 2 - Transect 205 - 31 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	067	24.3	85	ND	ABIO	NP
LOGSS	067	18.5	82.5	ND	BIOD	NP
RUBPU	067	2.44	35	114	BRAM	FACW+
RIBAM	067	0.375	2.5	3	BRAM	FACW
PTERI	067	19.5	62.5	ND	FEAL	NP
ONOSE	067	18.4	67.5	ND	FERN	FACW
EQUAR	067	1.13	20	ND	FERN	FAC
THEPA	067	0.375	2.5	ND	FERN	FACW+
DRYAU	067	0.063	2.5	ND	FERN	FACW-
FORBS	067	21.1	82.5	ND	FOAL	NP
ASTLA	067	7.56	50	ND	FODI	FACW-
AMPBR	067	4.13	32.5	ND	FODI	FAC
FRGVI	067	1.75	45	ND	FODI	FAC-
EUPPE	067	1.56	25	ND	FODI	FACW+
LYCVI	067	1	27.5	ND	FODI	OBL
DESGL	067	1	5	ND	FODI	NP
GALOB	067	0.75	17.5	ND	FODI	FACW+
ARANU	067	0.75	5	ND	FODI	FACU
SCULA	067	0.625	25	ND	FODI	OBL
VIOSP	067	0.5	20	ND	FODI	NP
PRNVU	067	0.5	7.5	ND	FODI	FAC
ARARA	067	0.375	2.5	ND	FODI	NP
LYCAM	067	0.25	10	ND	FODI	OBL
GALTR	067	0.188	7.5	ND	FODI	FACU+
SOLGI	067	0.188	7.5	ND	FODI	FACW
SOLUL	067	0.125	5	ND	FODI	NP
STECI	067	0.125	5	ND	FODI	FACW
SOLRU	067	0.125	5	ND	FODI	FAC+
PENSE	067	0.063	2.5	ND	FODI	OBL
RANRE	067	0.063	2.5	ND	FODI	FACW
POLPU	067	0.188	7.5	ND	FOMO	NP
MAICA	067	0.188	7.5	ND	FOMO	FAC
GRAMI	067	37.5	97.5	ND	GRAL	NP
SEDGE	067	35.1	97.5	ND	GRCJ	NP
CARBR	067	13.7	45	ND	GRCY	FACW+
CARCR	067	6.75	42.5	ND	GRCY	FACW+
CARGR	067	3.56	32.5	ND	GRCY	FACU*
CARLU	067	3.56	45	ND	GRCY	OBL
CARTE	067	3.31	25	ND	GRCY	FAC+
CARRO	067	0.813	7.5	ND	GRCY	NP
CARVU	067	0.063	2.5	ND	GRCY	OBL
SCIAT	067	0.063	2.5	ND	GRCY	OBL
GRASS	067	1.69	55	ND	GRKS	NP
CINAR	067	0.875	22.5	ND	GRPO	FACW
GLYST	067	0.563	22.5	ND	GRPO	OBL
CALCA	067	0.25	10	ND	GRPO	OBL

Site 2 Serial No. 67 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
BRYOP	067	7.31	97.5	ND	MOSS	NP
FRAPE	067	33.4	75	167	TREE	FACW
ACESP	067	4.81	92.5	232	TREE	NP
FRANI	067	2.38	10	6	TREE	FACW+
CAPCA	067	2.13	25	23	TREE	FAC
ULMAM	067	1.63	5	4	TREE	FACW-
POPDE	067	1.63	40	218	TREE	FAC+
QUEWH	067	1.63	27.5	16	TREE	NP
FRASP	067	1.38	30	29	TREE	NP
TILAM	067	1.31	5	16	TREE	FACU
QUEBK	067	1.25	12.5	0	TREE	NP
ACERS	067	0.063	2.5	0	TREE	NP
SALAM	067	0.063	2.5	1	TREE	FACW
ACESA	067	0.063	2.5	0	TREE	FACW
ILEVE	067	2.5	15	38	TRES	FACW+
CORFO	067	0.938	12.5	21	TRES	FACW-
VIBLE	067	0.063	2.5	2	TRES	FAC+
UNFO1	067	1.5	47.5	ND	UNKN	NP
UNGR1	067	0.25	10	ND	UNKN	NP
PARQU	067	9.94	50	157	VINE	FAC-
TOXRA	067	1.69	42.5	43	VINE	FAC+
RHAAL	067	1.38	7.5	28	VINE	OBL
VITRI	067	0.688	15	2	VINE	FACW-
SMITA	067	0.188	7.5	6	VINE	NP
TOTAL NUMBER OF TAXA:				70		

Cover and Frequency Data for Ecotone Understory, MI Project
Site 2 - Transect 201 - 24-25 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	059	31.5	95	ND	ABIO	NP
LOGSS	059	21.1	85	ND	BIOD	NP
RUBPU	059	0.375	15	5	BRAM	FACW+
RUBST	059	0.063	2.5	NR	BRAM	FACW-
PTERI	059	13	87.5	ND	FEAL	NP
ONOSE	059	10	85	ND	FERN	FACW
EQUAR	059	1.75	20	ND	FERN	FAC
PTEAQ	059	0.125	5	ND	FERN	FACU
BOTVI	059	0.063	2.5	ND	FERN	FACU
FORBS	059	27.8	100	ND	FOAL	NP
EUPPE	059	13.8	80	ND	FODI	FACW+
AMPBR	059	3.38	27.5	ND	FODI	FAC
ASTLA	059	2.44	47.5	ND	FODI	FACW-
ASTUM	059	1.81	22.5	ND	FODI	FACW
PENSE	059	1.25	25	ND	FODI	OBL
TAROF	059	0.625	25	ND	FODI	FACU
FRGVI	059	0.625	25	ND	FODI	FAC-
CISAR	059	0.563	10	ND	FODI	FACU
LYCAM	059	0.5	20	ND	FODI	OBL
SOLRU	059	0.438	5	ND	FODI	FAC+
SCULA	059	0.375	15	ND	FODI	OBL
SOLAL	059	0.313	12.5	ND	FODI	FACU
VIOSP	059	0.188	7.5	ND	FODI	NP
LOBCA	059	0.125	5	ND	FODI	OBL
GALOB	059	0.125	5	ND	FODI	FACW+
SOLGI	059	0.125	5	ND	FODI	FACW
APOSP	059	0.125	5	ND	FODI	NP
ARARA	059	0.063	2.5	ND	FODI	NP
LYCVI	059	0.063	2.5	ND	FODI	OBL
AMBAR	059	0.063	2.5	ND	FODI	FACU
LACSP	059	0.063	2.5	ND	FODI	NP
MIMRI	059	0.063	2.5	ND	FODI	OBL
DESGL	059	0.063	2.5	ND	FODI	NP
RANRE	059	0.063	2.5	ND	FODI	FACW
SOLGR	059	0.063	2.5	ND	FODI	FACW-
LOTCO	059	0.063	2.5	ND	FODI	FAC-
STECI	059	0.063	2.5	ND	FODI	FACW
LILMI	059	0.063	2.5	ND	FOMO	FAC+
TYPSP	059	0.063	2.5	ND	FOMO	NP
GRAMI	059	60.8	97.5	ND	GRAL	NP
SEDGE	059	52.9	97.5	ND	GRCJ	NP
CARLU	059	22.2	75	ND	GRCY	OBL
CARCR	059	16.1	70	ND	GRCY	FACW+
CARTE	059	4.19	60	ND	GRCY	FAC+
SCICY	059	3.5	20	ND	GRCY	OBL
CARVU	059	2.31	7.5	ND	GRCY	OBL

Site 2 Serial No. 59 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
CARST	059	1	5	ND	GRCY	NP
CARGR	059	0.813	7.5	ND	GRCY	FACU*
SCIAT	059	0.813	7.5	ND	GRCY	OBL
CARRO	059	0.563	10	ND	GRCY	NP
CARAU	059	0.375	2.5	ND	GRCY	FACW+
CARBR	059	0.375	2.5	ND	GRCY	FACW+
CARSP	059	0.063	2.5	ND	GRCY	NP
JUNTE	059	0.125	5	ND	GRJU	FAC
JUNEF	059	0.063	2.5	ND	GRJU	OBL
GRASS	059	12.3	67.5	ND	GRKS	NP
GLYST	059	9.5	55	ND	GRPO	OBL
AGRGI	059	1.5	12.5	ND	GRPO	NI
PANIM	059	0.625	12.5	ND	GRPO	FAC
FESPR	059	0.438	5	ND	GRPO	FACU-
CINAR	059	0.25	10	ND	GRPO	FACW
BRYOP	059	6.13	100	ND	MOSS	NP
POPDE	059	28.5	92.5	806	TREE	FAC+
ACESP	059	4.38	87.5	237	TREE	NP
FRAPE	059	4.31	27.5	13	TREE	FACW
SALAM	059	2.56	40	26	TREE	FACW
SALNI	059	1.81	37.5	20	TREE	OBL
SALEX	059	0.375	15	6	TREE	OBL
FRASP	059	0.25	10	6	TREE	NP
BETPA	059	0.188	7.5	5	TREE	FACU+
SALSP	059	0.125	5	1	TREE	NP
VIBLE	059	0.063	2.5	0	TRES	FAC+
CORFO	059	0.063	2.5	0	TRES	FACW-
UNFO2	059	0.063	2.5	ND	UNKN	NP
PARQU	059	5	35	39	VINE	FAC-
TOXRA	059	0.938	12.5	10	VINE	FAC+
TOTAL NUMBER OF TAXA:				76		

Cover and Frequency Data for ROW, MI Project
Site 2 - Transect 603 - 23 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	056	25.3	90	ND	ABIO	NP
WATER	056	0	0	ND	ABIO	NP
LOGSS	056	2.69	22.5	ND	BIOD	NP
STUMP	056	1.19	12.5	ND	BIOD	NP
RUBPU	056	0.125	5	4	BRAM	FACW+
RUBST	056	0.063	2.5	1	BRAM	FACW-
RIBAM	056	0.063	2.5	1	BRAM	FACW
RUBAL	056	0.063	2.5	1	BRAM	FACU+
PTERI	056	9.38	87.5	ND	FEAL	NP
ONOSE	056	5.69	80	ND	FERN	FACW
EQUAR	056	3.12	17.5	ND	FERN	FAC
FORBS	056	37.4	100	ND	FOAL	NP
EUPPE	056	20.8	92.5	ND	FODI	FACW+
LYCAM	056	4	52.5	ND	FODI	OBL
ASTUM	056	1.38	30	ND	FODI	FACW
PENSE	056	1.19	35	ND	FODI	OBL
ASTLA	056	1.13	32.5	ND	FODI	FACW-
SCULA	056	1	27.5	ND	FODI	OBL
MIMRI	056	0.563	10	ND	FODI	OBL
CICMA	056	0.438	5	ND	FODI	OBL
CISAR	056	0.375	2.5	ND	FODI	FACU
VIOSP	056	0.25	10	ND	FODI	NP
LUDPO	056	0.188	7.5	ND	FODI	OBL
GALTR	056	0.125	5	ND	FODI	FACU+
LOBCA	056	0.125	5	ND	FODI	OBL
STECI	056	0.125	5	ND	FODI	FACW
HYPCA	056	0.063	2.5	ND	FODI	FACW
GALSP	056	0.063	2.5	ND	FODI	NP
PRNVU	056	0.063	2.5	ND	FODI	FAC
LOTCO	056	0.063	2.5	ND	FODI	FAC-
SOLGR	056	0.063	2.5	ND	FODI	FACW-
LYCVI	056	0.063	2.5	ND	FODI	OBL
TAROF	056	0.063	2.5	ND	FODI	FACU
FRGVI	056	0.063	2.5	ND	FODI	FAC-
SONUL	056	0.063	2.5	ND	FODI	FAC-
TYPAN	056	0.438	17.5	ND	FOMO	OBL
GOOSP	056	0.063	2.5	ND	FOMO	NP
TYPLA	056	0.063	2.5	ND	FOMO	OBL
TYPSP	056	0.063	2.5	ND	FOMO	NP
GRAMI	056	75.3	100	ND	GRAL	NP
SEDGE	056	60.4	97.5	ND	GRCJ	NP
CARLU	056	30.9	92.5	ND	GRCY	OBL
CARCR	056	10.1	80	ND	GRCY	FACW+
SCICY	056	7.56	37.5	ND	GRCY	OBL
CARVU	056	7.06	45	ND	GRCY	OBL
CARTE	056	1.44	45	ND	GRCY	FAC+

Site 2 Serial No. 56 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
CARST	056	1.13	20	ND	GRCY	NP
SCIAT	056	0.875	10	ND	GRCY	OBL
CARGR	056	0.25	10	ND	GRCY	FACU*
CARSC	056	0.188	7.5	ND	GRCY	FACW
CARIN	056	0.188	7.5	ND	GRCY	FACW+
CARCI	056	0.125	5	ND	GRCY	FACW+
JUNEF	056	0.25	10	ND	GRJU	OBL
JUNAC	056	0.063	2.5	ND	GRJU	OBL
GRASS	056	28	95	ND	GRKS	NP
GLYST	056	20.7	77.5	ND	GRPO	OBL
AGRGI	056	4.69	65	ND	GRPO	NI
PANBO	056	0.625	12.5	ND	GRPO	FACU+
PHLPR	056	0.5	7.5	ND	GRPO	FACU
CINAR	056	0.125	5	ND	GRPO	FACW
PANIM	056	0.125	5	ND	GRPO	FAC
FESOV	056	0.063	2.5	ND	GRPO	NP
BRYOP	056	20.2	97.5	ND	MOSS	NP
POPDE	056	27.9	97.5	1267	TREE	FAC+
SALNI	056	6.06	62.5	35	TREE	OBL
ACESP	056	3.63	95	272	TREE	NP
SALEX	056	2.56	30	22	TREE	OBL
FRANI	056	2.06	10	8	TREE	FACW+
SALAM	056	2	42.5	26	TREE	FACW
FRAPE	056	0.938	12.5	6	TREE	FACW
FRASP	056	0.125	5	2	TREE	NP
QUEWH	056	0.125	5	3	TREE	NP
PRUSE	056	0.063	2.5	1	TREE	FACU
SALSP	056	0.063	2.5	1	TREE	NP
CAPCA	056	0.063	2.5	4	TREE	FAC
QUEBK	056	0.063	2.5	1	TREE	NP
BETSP	056	0.063	2.5	1	TREE	NP
UNFO1	056	2.88	90	ND	UNKN	NP
UNFO2	056	0.25	10	ND	UNKN	NP
TOXRA	056	0.625	12.5	17	VINE	FAC+
PARQU	056	0.188	7.5	ND	VINE	FAC-
TOTAL NUMBER OF TAXA:				81		

Cover and Frequency Data for ROW, MI Project
Site 2 - Transect 607.5 - 23-24 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	057	38.8	100	ND	ABIO	NP
LOGSS	057	1.31	27.5	ND	BIOD	NP
PTERI	057	2.44	50	ND	FEAL	NP
EQUAR	057	2.18	17.5	ND	FERN	FAC
ONOSE	057	1.5	47.5	ND	FERN	FACW
FORBS	057	35.9	100	ND	FOAL	NP
LOTCO	057	21.4	67.5	ND	FODI	FAC-
EUPPE	057	4.94	87.5	ND	FODI	FACW+
PENSE	057	1.56	27.5	ND	FODI	OBL
LYCAM	057	1.06	42.5	ND	FODI	OBL
TRIRE	057	1	27.5	ND	FODI	FACU+
TRIHY	057	0.875	35	ND	FODI	FAC-
LUDPO	057	0.688	27.5	ND	FODI	OBL
ASTON	057	0.375	15	ND	FODI	FAC
MIMRI	057	0.313	12.5	ND	FODI	OBL
ASTLA	057	0.313	12.5	ND	FODI	FACW-
SCULA	057	0.25	10	ND	FODI	OBL
TAROF	057	0.188	7.5	ND	FODI	FACU
FRGVI	057	0.063	2.5	ND	FODI	FAC-
RORPA	057	0.063	2.5	ND	FODI	OBL
SOLRU	057	0.063	2.5	ND	FODI	FAC+
AMBAR	057	0.063	2.5	ND	FODI	FACU
SOLSP	057	0.063	2.5	ND	FODI	NP
PLAMA	057	0.063	2.5	ND	FODI	FAC+
GALSP	057	0.063	2.5	ND	FODI	NP
PONAM	057	0.063	2.5	ND	FODI	OBL
GRAMI	057	68.6	100	ND	GRAL	NP
SEDGE	057	30.7	97.5	ND	GRCJ	NP
CARLU	057	8.94	77.5	ND	GRCY	OBL
CARCR	057	6.13	65	ND	GRCY	FACW+
SCIAT	057	5	30	ND	GRCY	OBL
SCICY	057	4.31	50	ND	GRCY	OBL
CARVU	057	2.06	35	ND	GRCY	OBL
CARST	057	0.313	12.5	ND	GRCY	NP
ELEOB	057	0.125	5	ND	GRCY	OBL
CARTE	057	0.063	2.5	ND	GRCY	FAC+
JUNEF	057	0.813	7.5	ND	GRJU	OBL
JUNTE	057	0.063	2.5	ND	GRJU	FAC
JUNSP	057	0.063	2.5	ND	GRJU	NP
GRASS	057	46.3	100	ND	GRKS	NP
AGRGI	057	41.9	97.5	ND	GRPO	NI
FESPR	057	2.69	47.5	ND	GRPO	FACU-
FESOV	057	1.63	27.5	ND	GRPO	NP
PHLPR	057	1.25	37.5	ND	GRPO	FACU
PANIM	057	0.875	35	ND	GRPO	FAC
GLYST	057	0.625	12.5	ND	GRPO	OBL

Site 2 Serial No. 57 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
ECHWA	057	0.063	2.5	ND	GRPO	OBL
BRYOP	057	24.8	100	ND	MOSS	NP
POPDE	057	8.38	100	1371	TREE	FAC+
ACESP	057	2.69	82.5	340	TREE	NP
SALNI	057	2.56	30	14	TREE	OBL
SALAM	057	1.5	35	20	TREE	FACW
SALEX	057	0.688	15	8	TREE	OBL
FRAPE	057	0.125	5	2	TREE	FACW
UNFO1	057	2	67.5	ND	UNKN	NP
UNFO2	057	0.563	22.5	ND	UNKN	NP
UNFO3	057	0.063	2.5	ND	UNKN	NP
PARQU	057	0.188	7.5	4	VINE	FAC-
TOTAL NUMBER OF TAXA:				58		

Cover and Frequency Data for ROW, MI Project
Site 2 - Transect 614 - 24 July 1991

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
MINSO	058	41.3	85	ND	ABIO	NP
LOGSS	058	5.06	57.5	ND	BIOD	NP
STUMP	058	1.63	5	ND	BIOD	NP
RUBPU	058	0.063	2.5	1	BRAM	FACW+
PTERI	058	1.94	65	ND	FEAL	NP
ONOSE	O58	1.94	65	ND	FERN	FACW
FORBS	058	34.5	100	ND	FOAL	NP
LOTCO	058	23.5	60	ND	FODI	FAC-
EUPPE	058	3.5	90	ND	FODI	FACW+
LYCAM	058	1.81	47.5	ND	FODI	OBL
ASTLA	058	1.19	12.5	ND	FODI	FACW-
ASTUM	058	0.813	7.5	ND	FODI	FACW
TRIRE	058	0.75	17.5	ND	FODI	FACU+
PENSE	058	0.688	27.5	ND	FODI	OBL
FRGVI	058	0.625	12.5	ND	FODI	FAC-
LUDPO	058	0.5	20	ND	FODI	OBL
ASTON	058	0.5	20	ND	FODI	FAC
TRIHY	058	0.5	7.5	ND	FODI	FAC-
VIOSP	058	0.375	15	ND	FODI	NP
TAROF	058	0.313	12.5	ND	FODI	FACU
SCULA	058	0.25	10	ND	FODI	OBL
MIMRI	058	0.125	5	ND	FODI	OBL
POTNO	058	0.063	2.5	ND	FODI	FAC
EPICO	058	0.063	2.5	ND	FODI	OBL
LOBCA	058	0.063	2.5	ND	FODI	OBL
CISVU	058	0.063	2.5	ND	FODI	FACU-
CISSP	058	0.063	2.5	ND	FODI	NP
TYPSP	058	0.438	5	ND	FOMO	NP
TYPAN	058	0.063	2.5	ND	FOMO	OBL
TRLSP	058	0.063	2.5	ND	FOMO	NP
GRAMI	058	61.7	100	ND	GRAL	NP
SEDGE	058	20.8	92.5	ND	GRCJ	NP
CARLU	058	7	72.5	ND	GRCY	OBL
SCIAT	058	3.75	27.5	ND	GRCY	OBL
CARVU	058	2.56	30	ND	GRCY	OBL
SCICY	058	1.94	17.5	ND	GRCY	OBL
CARCR	058	1.88	50	ND	GRCY	FACW+
CARTE	058	0.5	7.5	ND	GRCY	FAC+
CARST	058	0.25	10	ND	GRCY	NP
CARAU	058	0.188	7.5	ND	GRCY	FACW+
CARGR	058	0.125	5	ND	GRCY	FACU*
ELEOB	058	0.125	5	ND	GRCY	OBL
CARLA	058	0.063	2.5	ND	GRCY	OBL
JUNEF	058	0.188	7.5	ND	GRJU	OBL
JUNAR	058	0.125	5	ND	GRJU	OBL
JUNSP	058	0.063	2.5	ND	GRJU	NP

Site 2 Serial No. 58 Page 2 (Cont.)

File Name	SR No.	% C	% F	D	Growth Form	Wetland Indicator
GRASS	058	31.3	82.5	ND	GRKS	NP
AGRGI	058	32.3	90	ND	GRPO	NI
FESOV	058	11.8	45	ND	GRPO	NP
BROIN	058	1.63	5	ND	GRPO	NP
GLYST	058	1.63	27.5	ND	GRPO	OBL
FESPR	058	1.56	37.5	ND	GRPO	FACU-
PANIM	058	1.5	47.5	ND	GRPO	FAC
ECHCR	058	1.13	32.5	ND	GRPO	FACW
PHLPR	058	0.875	22.5	ND	GRPO	FACU
PANBO	058	0.063	2.5	ND	GRPO	FACU+
LEEVI	058	0.063	2.5	ND	GRPO	FACW
BRYOP	058	7.88	97.5	ND	MOSS	NP
POPDE	058	12.3	80	1448	TREE	FAC+
ACESP	058	2.25	77.5	143	TREE	NP
SALAM	058	0.5	20	7	TREE	FACW
FRANI	058	0.25	10	4	TREE	FACW+
FRASP	058	0.125	5	2	TREE	NP
FRAPE	058	0.063	2.5	0	TREE	FACW
CAPCA	058	0.063	2.5	1	TREE	FAC
UNFO1	058	1.88	75	ND	UNKN	NP
UNFO2	058	0.688	27.5	ND	UNKN	NP
UNGR3	058	0.063	2.5	ND	UNKN	NP
PARQU	058	0.625	12.5	9	VINE	FAC-
TOXRA	058	0.188	7.5	5	VINE	FAC+
VITRI	058	0.125	5	1	VINE	FACW-
TOTAL NUMBER OF TAXA:				71		

Appendix G:

Vascular Plants Occurring in the Study Sites and Surrounding Areas

TABLE G.1 Vascular Plants Occurring in the Study Sites and Surrounding Areas, Midland County, Michigan

Taxon Code	Site 1	Site 2	Taxon Scientific Name
ACENI	P[a]	A[b]	*Acer nigrum*
ACERS	P	P	*Acer rubrum/saccharinum*[c]
ACERU	P	P	*Acer rubrum*
ACESA	P	P	*Acer saccharinum*
ACESC	P	A	*Acer saccharum*
ACHMI	P	A	*Achillea millefolium*
ACTPA	A	A	*Actaea pachypoda*
ACTRU	A	A	*Actaea rubra*
AGMGR	A	A	*Agrimonia gryposepala*
AGRGI	P	P	*Agrostis gigantea*
AGRHY	P	A	*Agrostis hyemalis*[d]
ALIPL	A	P	*Alisma plantago-aquatica*
ALNRU	P	P	*Alnus rugosa*
AMBAR	P	P	*Ambrosia artemisiifolia*
AMEAR	P	A	*Amelanchier arborea*
AMEBA	A	A	*Amelanchier bartramiana*
AMPBR	P	P	*Amphicarpaea bracteata*
ANEQU	A	P	*Anemone quinquefolia*
ANEVI	A	A	*Anemone virginiana*
APOAN	P	A	*Apocynum androsaemifolium*
APOSI	A	A	*Apocynum sibiricum*
ARANU	P	P	*Aralia nudicaulis*
ARARA	P	P	*Aralia racemosa*
ARITR	A	A	*Arisaema triphyllum*
AROPR	P	A	*Aronia prunifolia*
ASCIN	A	P	*Asclepias incarnata*
ASCSR	A	A	*Asclepias syriaca*
ASTLA	P	P	*Aster lateriflorus*
ASTMA	A	A	*Aster macrophyllus*
ASTON	P	P	*Aster ontarionis*
ASTPU	P	P	*Aster puniceus*
ASTSA	A	A	*Aster sagittifolius*
ASTSI	A	A	*Aster simplex*
ASTUM	P	P	*Aster umbellatus*
ATHFI	P	A	*Athyrium filix-femina*
BETPA	P	P	*Betula papyrifera*
BIDFR	P	P	*Bidens frondosa*
BOTVI	P	P	*Botrychium virginianum*
BRAER	P	P	*Brachyelytrum erectum*
BROCI	P	A	*Bromus ciliatus*
BROIN	A	P	*Bromus inermis*
BROJA	A	A	*Bromus japonicus*
CALCA	P	P	*Calamagrostis canadensis*
CAPCA	P	P	*Carpinus caroliniana*
CARAN	A	A	*Carex annectens*

TABLE G.1 (Cont.)

Taxon Code	Site 1	Site 2	Taxon Scientific Name
CARAU	P	P	*Carex aurea*
CARBE	P	P	*Carex bebbii*
CARBR	P	P	*Carex bromoides*
CARCI	P	P	*Carex crinita*
CARCR	P	P	*Carex cristatella*
CARGR	P	P	*Carex gracillima*
CARIN	A	P	*Carex intumescens*
CARLA	P	P	*Carex lacustris*
CARLR	A	A	*Carex lurida*
CARLU	P	P	*Carex lupulina*
CARNO	A	A	*Carex normalis*
CARPE	A	P	*Carex pedunculata*
CARRO	P	P	*Carex rosea*
CARSC	P	P	*Carex scoparia*
CARSR	P	P	*Carex stricta*
CARST	P	P	*Carex stipata*
CARTE	P	P	*Carex tenera*
CARTU	P	P	*Carex tuckermanii*
CARVU	P	P	*Carex vulpinoidea*
CENMA	A	A	*Centaurea maculosa*
CEPOC	A	A	*Cephalanthus occidentalis*
CERFO	A	A	*Cerastium fontanum*
CHEGL	P	P	*Chelone glabra*
CICMA	P	P	*Cicuta maculata*
CINAR	P	P	*Cinna arundinacea*
CIRLU	P	A	*Circaea lutetiana*
CISAR	P	P	*Cirsium arvense*
CISVU	P	P	*Cirsium vulgare*
CLIBO	A	A	*Clintonia borealis*
COMPE	A	A	*Comptonia peregrina*
CONCA	P	P	*Conyza canadensis*
CORCA	P	A	*Cornus canadensis*
CORFO	P	P	*Cornus foemina*
CORST	P	A	*Cornus stolonifera*
COYSE	A	A	*Corydalis sempervirens*
CRASP	P	A	*Crataegus* sp.
CRETE	A	A	*Crepis tectorum*
CRYCA	A	A	*Cryptotaenia canadensis*
CYPER	P	A	*Cyperus erythrorhizos*
CYRAC	A	A	*Cypripedium acaule*
CYRCA	A	A	*Cypripedium calceolus*
DACGL	A	A	*Dactylis glomerata*
DAUCA	A	A	*Daucus carota*
DESCA	P	A	*Desmodium canadense*
DESGL	P	P	*Desmodium glutinosum*
DIAAR	A	A	*Dianthus armeria*

TABLE G.1 (Cont.)

Taxon Code	Site 1	Site 2	Taxon Scientific Name
DIELO	P	A	*Diervilla lonicera*
DRYAU	P	P	*Dryopteris austriaca*[d]
ECHCR	P	P	*Echinochloa crusgalli*
ECHWA	P	P	*Echinochloa walteri*
ELAUM	A	A	*Elaeagnus umbellata*
ELEOB	A	P	*Eleocharis obtusa*
ELYVI	A	P	*Elymus virginicus*
EPICI	A	P	*Epilobium ciliatum*
EPICO	P	P	*Epilobium coloratum*
EQUAR	P	P	*Equisetum arvense*
ERIAN	A	P	*Erigeron annuus*
ERIPH	A	A	*Erigeron philadelphicus*
ERIST	A	A	*Erigeron strigosus*
EUOOB	P	P	*Euonymus obovata*
EUPPE	P	P	*Eupatorium perfoliatum*
EUPPU	A	A	*Eupatorium purpureum*
FAGGR	P	P	*Fagus grandifolia*
FESAR	P	P	*Festuca arundinacea*
FESOB	P	A	*Festuca obtusa*
FESOV	P	P	*Festuca ovina*
FESPR	P	P	*Festuca pratensis*
FRANI	P	P	*Fraxinus nigra*
FRAPE	P	P	*Fraxinus pennsylvanica*
FRGVI	P	P	*Fragaria virginiana*
GALAP	A	A	*Galium aparine*
GALAS	A	P	*Galium asprellum*
GALBO	A	A	*Galium boreale*
GALOB	P	P	*Galium obtusum*
GALTI	P	A	*Galium tinctorium*
GALTR	P	P	*Galium triflorum*
GAUPR	P	A	*Gaultheria procumbens*
GERMA	P	A	*Geranium maculatum*
GEUCA	P	A	*Geum canadense*
GLYST	P	P	*Glyceria striata*
GNAOB	A	A	*Gnaphalium obtusifolium*
GNAUL	A	A	*Gnaphalium uliginosum*
GOOSP	P	P	*Goodyera* sp.
GRATE	P	A	*Gerardia tenuifolia*
HABLA	A	A	*Habenaria lacera*
HABPS	A	A	*Habenaria psychodes*
HAMVI	A	A	*Hamamelis virginiana*
HELGI	A	A	*Helianthus giganteus*
HIEAU	A	A	*Hieracium aurantiacum*
HIECA	A	A	*Hieracium canadense*
HIEFL	A	A	*Hieracium florentinum*
HIEPR	A	A	*Hieracium pratense*
HIETR	A	A	*Hieracium traillii*

TABLE G.1 (Cont.)

Taxon Code	Site 1	Site 2	Taxon Scientific Name
HYPCA	P	P	*Hypericum canadense*
HYPMA	P	A	*Hypericum majus*
HYPPE	P	A	*Hypericum perforatum*
HYPPU	P	A	*Hypericum punctatum*
ILEVE	P	P	*Ilex verticillata*
IMPCA	A	A	*Impatiens capensis*
IRIVI	A	A	*Iris virginica*
JUGNI	A	A	*Juglans nigra*
JUNAC	P	P	*Juncus acuminatus*
JUNAL	P	A	*Juncus alpinus*
JUNAR	P	P	*Juncus articulatus*
JUNBR	A	A	*Juncus brevicaudatus*
JUNBU	P	P	*Juncus bufonius*
JUNCA	P	A	*Juncus canadensis*
JUNDU	P	P	*Juncus dudleyi*
JUNEF	P	P	*Juncus effusus*
JUNNO	A	A	*Juncus nodosus*
JUNTE	P	P	*Juncus tenuis*
JUNVA	P	A	*Juncus vaseyi*
LACBI	A	A	*Lactuca biennis*
LACCA	A	A	*Lactuca canadensis*[d]
LECSP	A	A	*Lechea* sp.
LEEVI	A	P	*Leersia virginica*
LILMI	P	P	*Lilium michiganense*
LINVU	A	A	*Linaria vulgaris*
LOBCA	A	P	*Lobelia cardinalis*
LOBIN	A	A	*Lobelia inflata*
LOLPE	P	P	*Lolium perenne*
LONDI	P	A	*Lonicera dioica*
LOTCO	P	P	*Lotus corniculata*
LUDPO	P	P	*Ludwigia polycarpa*
LYCAM	P	P	*Lycopus americanus*
LYCVI	P	P	*Lycopus virginicus*
LYOCL	A	A	*Lycopodium clavatum*
LYOOB	A	A	*Lycopodium obscurum*
LYOTR	A	A	*Lycopodium tristachyum*
LYTSA	A	A	*Lythrum salicaria*
MAICA	P	P	*Maianthemum canadense*
MALPU	A	A	*Malus pumila*
MATMA	P	A	*Matricaria maritima*
MEDVI	A	A	*Medeola virginiana*
MEILU	A	A	*Medicago lupulina*
MELAL	P	A	*Melilotus alba*
MEMLI	A	A	*Melampyrium lineare*
MENAR	A	A	*Mentha arvensis*
MIMRI	P	P	*Mimulus ringens*
MITDI	P	P	*Mitella diphylla*

TABLE G.1 (Cont.)

Taxon Code	Site 1	Site 2	Taxon Scientific Name
MOLVE	A	A	*Mollugo verticillata*
MONFI	A	A	*Monarda fistulosa*
MUHME	A	A	*Muhlenbergia mexicana*
NAUTH	P	A	*Naumburgia thyrsiflora*
OENBI	A	A	*Oenothera biennis*
OMUCI	P	A	*Osmunda cinnamomea*
OMURE	A	A	*Osmunda regalis*
ONOSE	P	P	*Onoclea sensibilis*
OSMCL	A	A	*Osmorhiza claytonii*
OSMLO	A	P	*Osmorhiza longistylis*
OXAFO	P	A	*Oxalis fontana*
OXAST	P	A	*Oxalis stricta*
PANBO	P	P	*Panicum boreale*
PANCA	P	A	*Panicum capillare*
PANIM	P	P	*Panicum implicatum*
PARQU	P	P	*Parthenocissus quinquefolia*
PENSE	P	P	*Penthorum sedoides*
PHAAR	A	P	*Phalaris arundinacea*
PHLPR	P	P	*Phleum pratense*
PLAMA	P	P	*Plantago major*
PLARU	P	P	*Plantago rugelii*
POACO	P	A	*Poa compressa*
POAPA	A	A	*Poa palustris*
POAPR	P	P	*Poa pratensis*
PODPE	A	A	*Podophyllum peltatum*
POGPA	P	P	*Polygala paucifolia*
POGPO	A	A	*Polygala polygama*
POGVE	A	A	*Polygala verticillata*
POLPU	P	P	*Polygonatum pubescens*
PONAM	A	P	*Polygonum amphibium*[d]
PONLA	A	A	*Polygonum lapathifolium*
PONPE	A	A	*Polygonum pensylvanicum*
PONVI	A	A	*Polygonum virginianum*
POPDE	P	P	*Populus deltoides*
POPGR	P	A	*Populus grandidentata*
POPTR	P	P	*Populus tremuloides*
POTAR	A	A	*Potentilla argentea*
POTNO	P	P	*Potentilla norvegica*
POTRE	A	A	*Potentilla recta*
POTSI	A	A	*Potentilla simplex*
PREAB	A	P	*Prenanthes alba*
PREAL	P	A	*Prenanthes altissima*
PRNVU	P	P	*Prunella vulgaris*
PRUPE	A	A	*Prunus pensylvanica*
PRUSE	P	P	*Prunus serotina*
PRUVI	P	P	*Prunus virginiana*
PTEAQ	P	P	*Pteridium aquilinum*

TABLE G.1 (Cont.)

Taxon Code	Site 1	Site 2	Taxon Scientific Name
PYREL	P	A	*Pyrola elliptica*
PYRRO	A	A	*Pyrola rotundifolia*
QUEBI	P	P	*Quercus bicolor*
QUEPA	P	P	*Quercus palustris*
QUERU	P	P	*Quercus rubra*
QUEVE	A	A	*Quercus velutina*
RANAB	A	A	*Ranunculus abortivus*
RANPE	P	P	*Ranunculus pensylvanicus*
RANRE	P	P	*Ranunculus recurvatus*
RANSC	A	A	*Ranunculus sceleratus*
RHAAL	P	P	*Rhamnus alnifolia*
RIBAM	P	P	*Ribes americanum*
RIBCY	P	A	*Ribes cynosbati*
RORPA	P	P	*Rorippa palustris*
ROSPA	P	A	*Rosa palustris*
RUBAL	P	P	*Rubus allegheniensis*
RUBHI	P	P	*Rubus hispidus*
RUBPU	P	P	*Rubus pubescens*
RUBST	P	P	*Rubus strigosus*
RUDHI	P	A	*Rudbeckia hirta*
RUMCR	A	A	*Rumex crispus*
SALAM	P	P	*Salix amygdaloides*
SALBE	A	A	*Salix bebbiana*
SALDI	A	A	*Salix discolor*
SALER	P	P	*Salix eriocephala*
SALEX	P	P	*Salix exigua*
SALLU	P	A	*Salix lucida*
SALNI	P	P	*Salix nigra*
SANGR	A	A	*Sanicula gregaria*
SANMA	A	A	*Sanicula marilandica*
SCIAT	P	P	*Scirpus atrovirens*
SCICY	P	P	*Scirpus cyperinus*
SCIPE	A	A	*Scirpus pendulus*
SCULA	P	P	*Scutellaria lateriflora*
SISAN	A	A	*Sisyrinchium angustifolium*
SISMO	A	A	*Sisyrinchium montanum*
SIUSU	A	A	*Sium suave*
SMITA	P	P	*Smilax tamnoides*
SMLRA	P	P	*Smilacina racemosa*
SOLAL	P	P	*Solidago altissima*
SOLGI	P	P	*Solidago gigantea*
SOLGR	P	P	*Solidago graminifolia*
SOLHI	A	A	*Solidago hispida*
SOLJU	P	A	*Solidago juncea*
SOLRU	P	P	*Solidago rugosa*
SOLUL	A	P	*Solidago ulmifolia*
SONAR	P	P	*Sonchus arvensis*

TABLE G.1 (Cont.)

Taxon Code	Site 1	Site 2	Taxon Scientific Name
SONUL	P	P	*Sonchus uliginosus*
SPIAL	P	P	*Spiraea alba*
STECI	P	P	*Steironema ciliatum*
STLLO	A	A	*Stellaria longifolia*
TAROF	P	P	*Taraxacum officinale*
THEPA	P	P	*Thelypteris palustris*
TILAM	P	P	*Tilia americana*
TOXRA	P	P	*Toxicodendron radicans*
TREBO	P	P	*Trientalis borealis*
TRIAU	A	A	*Trifolium aureum*
TRIHY	P	P	*Trifolium hybridum*
TRIRE	P	P	*Trifolium repens*
TRLGR	P	A	*Trillium grandiflorum*
TYPAN	P	P	*Typha angustifolia*
TYPGL	A	P	*Typha xglauca*
TYPLA	P	P	*Typha latifolia*
ULMAM	P	P	*Ulmus americana*
UVUGR	A	A	*Uvularia grandiflora*
VACAT	P	A	*Vaccinium atrococcum*
VEBTH	P	A	*Verbascum thapsus*
VEOSC	A	A	*Veronica scutellata*
VERHA	P	A	*Verbena hastata*
VERUR	A	P	*Verbena urticifolia*
VIBAC	A	A	*Viburnum acerifolium*
VIBCA	A	A	*Viburnum cassinoides*
VIBLE	P	P	*Viburnum lentago*
VICCR	A	A	*Vicia cracca*
VIOBL	P	P	*Viola blanda*
VIOCO	P	P	*Viola conspersa*
VIOMA	P	A	*Viola macloskeyi*
VIOPU	P	P	*Viola pubescens*
VITRI	P	P	*Vitis riparia*

[a] Species occurring in either or both sites are marked with a "P."

[b] Species marked with an "A" for both sites were found only in surrounding areas.

[c] Considered a hybrid.

[d] Also given a variety name; see Appendix A.

Appendix H:

Species Occurring in the Forest Overstory Belt Transects of Sites 1 and 2

TABLE H.1 Species Occurring in the Forest Overstory Belt Transects of Site 1, Midland County, Michigan

Taxon Scientific Name	Belt Transect No. 1400	1100	1000
Acer rubrum/saccharinum	P[a]	P	P
Acer rubrum	P	P	P
Acer saccharinum	P	P	P
Alnus rugosa	P	P	P
Betula papyrifera	P	P	P
Carpinus caroliniana	P	P	P
Cornus foemina	P	P	P
Fraxinus pennsylvanica	P	P	P
Populus deltoides	P	P	P
Populus tremuloides	P	P	P
Quercus bicolor	P	P	P
Quercus palustris	P	P	P
Tilia americana	P	P	P
Ulmus americana	P	P	P
Viburnum lentago	P	P	P
Amelanchier aborea	P	P	A[a]
Crataegus sp.	P	P	A
Fraxinus nigra	P	P	A
Quercus rubra	P	P	A
Populus grandidentata	P	A	P
Ilex verticillata	A	P	P
Prunus serotina	A	P	P
Prunus virginiana	A	P	P
Acer nigrum	A	P	A
Acer saccharum	A	P	A
Fagus grandifolia	A	P	A

[a] P = presence, A = absence.

TABLE H.2 Species Occurring in the Forest Overstory Belt Transects of Site 2, Midland County, Michigan

Taxon Scientific Name	Belt Transect No. 2400	2100	2000
Acer rubrum/saccharinum	P[a]	P	P
Betula papyrifera	P	P	P
Carpinus caroliniana	P	P	P
Fraxinus nigra	P	P	P
Fraxinus pennsylvanica	P	P	P
Quercus bicolor	P	P	P
Quercus palustris	P	P	P
Quercus rubra	P	P	P
Tilia americana	P	P	P
Ulmus americana	P	P	P
Viburnum lentago	P	P	P
Populus deltoides	P	P	A[a]
Acer rubrum	P	A	P
Ilex verticillata	P	A	P
Acer saccharinum	A	P	P
Alnus rugosa	A	P	A
Fagus grandifolia	A	P	A
Prunus serotina	A	P	A
Acer nigrum	A	A	A
Acer saccharum	A	A	A
Amelanchier arborea	A	A	A
Cornus foemina	A	A	A
Crataegus sp.	A	A	A
Populus grandidentata	A	A	A
Populus tremuloides	A	A	A
Prunus virginiana	A	A	A

[a] P = presence, A = absence.

Appendix I:

Species Occurring in the Forest Understory Transects of Sites 1 and 2

TABLE I.1 Species Occurring in the Forest Understory Transects of Site 1, Midland County, Michigan

Taxon Scientific Name	Transect No. 141	113	105	Growth Form	Wetland Indicator[a]
Acer spp.	P[b]	P	P	TREE	NP
Alnus rugosa	P	P	P	TREE	OBL
Amphicarpaea bracteata	P	P	P	FODI	FAC
Aralia nudicaulis	P	P	P	FODI	FACU
Aster lateriflorus	P	P	P	FODI	FACW-
Aster puniceus	P	P	P	FODI	OBL
Aster umbellatus	P	P	P	FODI	FACW
Betula papyrifera	P	P	P	TREE	FACU+
Brachyelytrum erectum	P	P	P	GRPO	NP
Calamagrostis canadensis	P	P	P	GRPO	OBL
Carpinus caroliniana	P	P	P	TREE	FAC
Carex crinita	P	P	P	GRCY	FACW+
Carex cristatella	P	P	P	GRCY	FACW+
Carex gracillima	P	P	P	GRCY	FACU*
Carex lacustris	P	P	P	GRCY	OBL
Carex lupulina	P	P	P	GRCY	OBL
Carex rosea	P	P	P	GRCY	NP
Carex stricta	P	P	P	GRCY	OBL
Carex stipata	P	P	P	GRCY	NP
Carex tenera	P	P	P	GRCY	FAC+
Cinna arundinacea	P	P	P	GRPO	FACW
Cornus foemina	P	P	P	TRES	FACW-
Diervilla lonicera	P	P	P	SHRU	NP
Dryopteris austriaca	P	P	P	FERN	FACW-
Euonymus obovata	P	P	P	VINE	NP
Festuca obtusa	P	P	P	GRPO	FACU+
Fraxinus spp.	P	P	P	TREE	NP
Fragaria virginiana	P	P	P	FODI	FAC-
Galium triflorum	P	P	P	FODI	FACU+
Ilex verticillata	P	P	P	TRES	FACW+
Lonicera dioica	P	P	P	SHRU	FACU
Lycopus virginicus	P	P	P	FODI	OBL
Maianthemum canadense	P	P	P	FOMO	FAC
Naumburgia thyrsiflora	P	P	P	FODI	NP
Onoclea sensibilis	P	P	P	FERN	FACW
Panicum boreale	P	P	P	GRPO	FACU+
Parthenocissus quinquefolia	P	P	P	VINE	FAC-
Poa pratensis	P	P	P	GRPO	FAC-
Polygonatum pubescens	P	P	P	FOMO	NP
Populus deltoides	P	P	P	TREE	FAC+
Populus tremuloides	P	P	P	TREE	FAC
Prunus serotina	P	P	P	TREE	FACU
Prunus virginiana	P	P	P	TREE	FAC-
Pteridium aquilinum	P	P	P	FERN	FACU

TABLE I.1 (Cont.)

Taxon Scientific Name	Transect No. 141	113	105	Growth Form	Wetland Indicator
Quercus spp., Black Oaks	P	P	P	TREE	NP
Quercus spp., White Oaks	P	P	P	TREE	NP
Ribes cynosbati	P	P	P	BRAM	NP
Rubus hispidus	P	P	P	BRAM	FACW
Rubus pubescens	P	P	P	BRAM	FACW+
Rubus strigosus	P	P	P	BRAM	FACW-
Scutellaria lateriflora	P	P	P	FODI	OBL
Smilax tamnoides	P	P	P	VINE	NP
Smilacina racemosa	P	P	P	FOMO	FACU
Solidago gigantea	P	P	P	FODI	FACW
Solidago rugosa	P	P	P	FODI	FAC+
Spiraea alba	P	P	P	SHRU	FACW+
Steironema ciliatum	P	P	P	FODI	FACW
Thelypteris palustris	P	P	P	FERN	FACW+
Toxicodendron radicans	P	P	P	VINE	FAC+
Trientalis borealis	P	P	P	FODI	FAC+
Ulmus americana	P	P	P	TREE	FACW-
Viburnum lentago	P	P	P	TRES	FAC+
Viola blanda	P	P	P	FODI	FACW-
Viola conspersa	P	P	P	FODI	FACW-
Vitis riparia	P	P	P	VINE	FACW-
Cicuta maculata	P	P	A[b]	FODI	OBL
Gaultheria procumbens	P	P	A	FODI	FACU
Prenanthes altissima	P	P	A	FODI	FACU
Viola pubescens	P	P	A	FODI	FACU-
Cornus canadensis	P	A	P	FODI	FAC
Desmodium glutinosum	P	A	P	FODI	NP
Ribes americanum	P	A	P	BRAM	FACW
Rubus allegheniensis	P	A	P	BRAM	FACU+
Taraxacum officinale	P	A	P	FODI	FACU
Amelanchier arborea	P	A	A	TREE	FACU
Chelone glabra	P	A	A	FODI	OBL
Cornus stolonifera	P	A	A	SHRU	FACW
Desmodium canadense	P	A	A	FODI	FAC-
Epilobium coloratum	P	A	A	FODI	OBL
Geranium maculatum	P	A	A	FODI	FACU
Oxalis fontana	P	A	A	FODI	NP
Polygala paucifolia	P	A	A	FODI	FACU
Populus grandidentata	P	A	A	TREE	FACU
Prunella vulgaris	P	A	A	FODI	FAC
Pyrola elliptica	P	A	A	FODI	NP
Rhamnus alnifolia	P	A	A	VINE	OBL
Vaccinium atrococcum	P	A	A	SHRU	FACW
Aralia racemosa	A	P	P	FODI	NP
Athyrium filix-femina	A	P	P	FERN	FAC
Bromus ciliatus	A	P	P	GRPO	FACW

TABLE I.1 (Cont.)

Taxon Scientific Name	Transect No. 141	113	105	Growth Form	Wetland Indicator
Carex bromoides	A	P	P	GRCY	FACW+
Carex scoparia	A	P	P	GRCY	FACW
Carex tuckermanii	A	P	P	GRCY	OBL
Ranunculus recurvatus	A	P	P	FODI	FACW
Rosa palustris	A	P	P	BRAM	OBL
Viola macloskeyi	A	P	P	FODI	NP
Apocynum androsaemifolium	A	P	A	FODI	NP
Aster ontarionis	A	P	A	FODI	FAC
Botrychium virginianum	A	P	A	FERN	FACU
Fagus grandifolia	A	P	A	TREE	FACU
Goodyera sp.	A	P	A	FOMO	NP
Lilium michiganense	A	P	A	FOMO	FAC+
Mitella diphylla	A	P	A	FODI	FACU+
Tilia americana	A	P	A	TREE	FACU
Trillium grandiflorum	A	P	A	FOMO	NP
Agrostis gigantea	A	A	P	GRPO	NI
Aronia prunifolia	A	A	P	SHRU	FACW
Carex aurea	A	A	P	GRCY	FACW+
Circaea lutetiana	A	A	P	FODI	FACU
Cirsium arvense	A	A	P	FODI	FACU
Cirsium vulgare	A	A	P	FODI	FACU-
Conyza canadensis	A	A	P	FODI	FAC-
Eupatorium perfoliatum	A	A	P	FODI	FACW+
Hypericum majus	A	A	P	FODI	FACW
Juncus tenuis	A	A	P	GRJU	FAC
Lotus corniculata	A	A	P	FODI	FAC-
Lycopus americanus	A	A	P	FODI	OBL
Osmunda cinnamomea	A	A	P	FERN	FACW
Scirpus atrovirens	A	A	P	GRCY	OBL
Scirpus cyperinus	A	A	P	GRCY	OBL
Solidago graminifolia	A	A	P	FODI	FACW-
Trifolium repens	A	A	P	FODI	FACU+

[a] See Appendix A for definitions for growth form and wetland codes.

[b] P = presence, A = absence.

TABLE I.2 Species Occurring in the Forest Understory Transects of Site 2, Midland County, Michigan

Taxon Scientific Name	Transect No. 241	213	205	Growth Form	Wetland Indicator[a]
Acer spp.	P[b]	P	P	TREE	NP
Amphicarpaea bracteata	P	P	P	FODI	FAC
Aralia nudicaulis	P	P	P	FODI	FACU
Aster lateriflorus	P	P	P	FODI	FACW-
Aster ontarionis	P	P	P	FODI	FAC
Betula papyrifera	P	P	P	TREE	FACU+
Carpinus caroliniana	P	P	P	TREE	FAC
Carex bromoides	P	P	P	GRCY	FACW+
Carex cristatella	P	P	P	GRCY	FACW+
Carex gracillima	P	P	P	GRCY	FACU*
Carex lupulina	P	P	P	GRCY	OBL
Carex rosea	P	P	P	GRCY	NP
Carex tenera	P	P	P	GRCY	FAC+
Carex tuckermanii	P	P	P	GRCY	OBL
Cinna arundinacea	P	P	P	GRPO	FACW
Cornus foemina	P	P	P	TRES	FACW-
Equisetum arvense	P	P	P	FERN	FAC
Euonymus obovata	P	P	P	VINE	NP
Fraxinus spp.	P	P	P	TREE	NP
Fragaria virginiana	P	P	P	FODI	FAC-
Galium asprellum	P	P	P	FODI	OBL
Galium obtusum	P	P	P	FODI	FACW+
Glyceria striata	P	P	P	GRPO	OBL
Ilex verticillata	P	P	P	TRES	FACW+
Lycopus virginicus	P	P	P	FODI	OBL
Maianthemum canadense	P	P	P	FOMO	FAC
Onoclea sensibilis	P	P	P	FERN	FACW
Parthenocissus quinquefolia	P	P	P	VINE	FAC-
Polygonatum pubescens	P	P	P	FOMO	NP
Prunus virginiana	P	P	P	TREE	FAC-
Pteridium aquilinum	P	P	P	FERN	FACU
Quercus spp., Black Oaks	P	P	P	TREE	NP
Quercus spp., White Oaks	P	P	P	TREE	NP
Rhamnus alnifolia	P	P	P	VINE	OBL
Ribes americanum	P	P	P	BRAM	FACW
Rubus pubescens	P	P	P	BRAM	FACW+
Scutellaria lateriflora	P	P	P	FODI	OBL
Smilax tamnoides	P	P	P	VINE	NP
Solidago gigantea	P	P	P	FODI	FACW
Solidago rugosa	P	P	P	FODI	FAC+
Solidago ulmifolia	P	P	P	FODI	NP
Steironema ciliatum	P	P	P	FODI	FACW
Taraxacum officinale	P	P	P	FODI	FACU
Tilia americana	P	P	P	TREE	FACU

TABLE I.2 (Cont.)

Taxon Scientific Name	Transect No. 241	213	205	Growth Form	Wetland Indicator
Toxicodendron radicans	P	P	P	VINE	FAC+
Ulmus americana	P	P	P	TREE	FACW-
Viola blanda	P	P	P	FODI	FACW-
Viola conspersa	P	P	P	FODI	FACW-
Viola pubescens	P	P	P	FODI	FACU-
Vitis riparia	P	P	P	VINE	FACW-
Aralia racemosa	A[b]	P	P	FODI	NP
Calamagrostis canadensis	A	P	P	GRPO	OBL
Desmodium glutinosum	A	P	P	FODI	NP
Dryopteris austriaca	A	P	P	FERN	FACW-
Eupatorium perfoliatum	A	P	P	FODI	FACW+
Galium triflorum	A	P	P	FODI	FACU+
Polygala paucifolia	A	P	P	FODI	FACU
Populus deltoides	A	P	P	TREE	FAC+
Populus tremuloides	A	P	P	TREE	FAC
Cicuta maculata	P	A	P	FODI	OBL
Thelypteris palustris	P	A	P	FERN	FACW+
Viburnum lentago	P	A	P	TRES	FAC+
Brachyelytrum erectum	A	A	P	GRPO	NP
Carex vulpinoides	A	A	P	GRCY	OBL
Conyza canadensis	A	A	P	FODI	FAC-
Ludwigia polycarpa	A	A	P	FODI	OBL
Penthorum sedoides	A	A	P	FODI	OBL
Poa pratensis	A	A	P	GRPO	FAC-
Prunella vulgaris	A	A	P	FODI	FAC
Ranunculus recurvatus	A	A	P	FODI	FACW
Salix amygdaloides	A	A	P	TREE	FACW
Scirpus atrovirens	A	A	P	GRCY	OBL
Carex crinita	P	P	A	GRCY	FACW+
Chelone glabra	P	P	A	FODI	OBL
Elymus virginicus	P	P	A	GRPO	FACW-
Mitella diphylla	P	P	A	FODI	FACU+
Prunus serotina	P	P	A	TREE	FACU
Smilacina racemosa	P	P	A	FOMO	FACU
Anemone quinquefolia	A	P	A	FODI	FAC*
Aster umbellatus	A	P	A	FODI	FACW
Carex intumescens	A	P	A	GRCY	FACW+
Carex scoparia	A	P	A	GRCY	FACW
Fagus grandifolia	A	P	A	TREE	FACU
Osmorhiza longistylis	A	P	A	FODI	FACU-
Prenanthes alba	A	P	A	FODI	FACU
Rubus strigosus	A	P	A	BRAM	FACW-
Carex pedunculata	P	A	A	GRCY	NP
Carex stricta	P	A	A	GRCY	OBL

TABLE I.2 (Cont.)

Taxon Scientific Name	Transect No. 241	213	205	Growth Form	Wetland Indicator
Carex stipata	P	A	A	GRCY	NP
Sonchus uliginosus	P	A	A	FODI	FAC-

[a] See Appendix A for definitions for growth form and wetland indicator codes.

[b] P = presence, A = absence.

Appendix J:

Species Occurring in the Ecotone Transects of Sites 1 and 2

TABLE J.1 Species Occurring in the Ecotone Transects of Sites 1 and 2, Midland County, Michigan

Taxon Scientific Name	Transect No. 101	Transect No. 201	Growth Form	Wetland Indicator[a]
Acer spp.	P[b]	P	TREE	NP
Agrostis gigantea	P	P	GRPO	NI
Amphicarpaea bracteata	P	P	FODI	FAC
Aster lateriflorus	P	P	FODI	FACW-
Aster ontarionis	P	P	FODI	FAC
Aster umbellatus	P	P	FODI	FACW
Betula papyrifera	P	P	TREE	FACU+
Bidens frondosa	P	P	FODI	NP
Carex aurea	P	P	GRCY	FACW+
Carex bebbii	P	P	GRCY	OBL
Carex bromoides	P	P	GRCY	FACW+
Carex crinita	P	P	GRCY	FACW+
Carex cristatella	P	P	GRCY	FACW+
Carex gracillima	P	P	GRCY	FACU*
Carex lupulina	P	P	GRCY	OBL
Carex rosea	P	P	GRCY	NP
Carex scoparia	P	P	GRCY	FACW
Carex stricta	P	P	GRCY	OBL
Carex stipata	P	P	GRCY	NP
Carex tenera	P	P	GRCY	FAC+
Carex vulpinoides	P	P	GRCY	OBL
Cicuta maculata	P	P	FODI	OBL
Cirsium vulgare	P	P	FODI	FACU-
Cornus foemina	P	P	TRES	FACW-
Euonymus obovata	P	P	VINE	NP
Eupatorium perfoliatum	P	P	FODI	FACW+
Festuca ovina	P	P	GRPO	NP
Festuca pratensis	P	P	GRPO	FACU-
Fraxinus spp.	P	P	TREE	NP
Fragaria virginiana	P	P	FODI	FAC-
Galium obtusum	P	P	FODI	FACW+
Galium triflorum	P	P	FODI	FACU+
Glyceria striata	P	P	GRPO	OBL
Ilex verticillata	P	P	TRES	FACW+
Juncus articulatus	P	P	GRJU	OBL
Juncus effusus	P	P	GRJU	OBL
Juncus tenuis	P	P	GRJU	FAC
Lonicera dioica	P	P	FODI	FAC-
Lotus corniculata	P	P	FODI	OBL
Ludwigia polycarpa	P	P	FODI	OBL
Lycopus virginicus	P	P	FODI	OBL
Maianthemum canadense	P	P	FOMO	FAC
Mimulus ringens	P	P	FODI	OBL
Onoclea sensibilis	P	P	FERN	FACW

TABLE J.1 (Cont.)

Taxon Scientific Name	Transect No. 101	Transect No. 201	Growth Form	Wetland Indicator
Panicum boreale	P	P	GRPO	FACU+
Panicum implicatum	P	P	GRPO	FAC
Parthenocissus quinquefolia	P	P	VINE	FAC-
Penthorum sedoides	P	P	FODI	OBL
Populus deltoides	P	P	TREE	FAC+
Potentilla norvegica	P	P	FODI	FAC
Pteridium aquilinum	P	P	FERN	FACU
Quercus spp., White Oaks	P	P	TREE	NP
Rubus pubescens	P	P	BRAM	FACW+
Rubus strigosus	P	P	BRAM	FACW-
Salix exigua	P	P	TREE	OBL
Scirpus cyperinus	P	P	GRCY	OBL
Smilacina racemosa	P	P	FOMO	FACU
Solidago gigantea	P	P	FODI	FACW
Solidago graminifolia	P	P	FODI	FACW-
Solidago ulmifolia	P	P	FODI	NP
Steironema ciliatum	P	P	FODI	FACW
Tilia americana	P	P	TREE	FACU
Trientalis borealis	P	P	FODI	FAC+
Alnus rugosa	P	A[b]	TREE	OBL
Calamagrostis canadensis	P	A	GRPO	OBL
Carex lacustris	P	A	GRCY	OBL
Echinochloa crusgalli	P	A	GRPO	FACW
Festuca obtusa	P	A	GRPO	FACU+
Galium tinctorium	P	A	FODI	OBL
Hypericum punctatum	P	A	FODI	FAC+
Lolium perenne	P	A	SHRU	FACU
Lycopus americanus	P	A	FERN	NP
Matricaria maritima	P	A	FODI	FAC
Mitella diphylla	P	A	FODI	FACU+
Naumburgia thyrsiflora	P	A	FODI	NP
Oxalis fontana	P	A	FODI	NP
Phleum pratense	P	A	GRPO	FACU
Plantago ruegelii	P	A	FODI	FAC
Populus tremuloides	P	A	TREE	FAC
Prunus virginiana	P	A	TREE	FAC-
Ranunculus abortivus	P	A	FODI	FACW-
Rosa palustris	P	A	BRAM	OBL
Rudbeckia hirta	P	A	FODI	FACU
Rumex crispus	P	A	FODI	FAC+
Salix bebbiana	P	A	TREE	FACW+
Salix lucida	P	A	TREE	FACW+
Sanicula gregaria	P	A	FODI	FAC+
Scirpus pendulus	P	A	GRCY	OBL
Sisyrinchium angustifolium	P	A	FOMO	FACW-

TABLE J.1 (Cont.)

Taxon Scientific Name	Transect No. 101	Transect No. 201	Growth Form	Wetland Indicator
Solidago hispida	P	A	FODI	NP
Sonchus uliginosus	P	A	FODI	FAC-
Stellaria longifolia	P	A	FODI	FACW+
Thelypteris palustris	P	A	FERN	FACW+
Trifolium repens	P	A	FODI	FACU+
Trillium grandiflorum	P	A	FOMO	NP
Uvularia grandiflora	P	A	FOMO	NP
Verbena urticifolia	P	A	FODI	FAC+
Vicia cracca	P	A	FODI	NP
Viola conspersa	P	A	FODI	FACW-
Vitis riparia	P	A	VINE	FACW-
Ambrosia artemisiifolia	A	P	FODI	FACU
Aralia racemosa	A	P	FODI	NP
Asclepias incarnata	A	P	FODI	OBL
Aster puniceus	A	P	FODI	OBL
Botrychium virginianum	A	P	FERN	FACU
Carpinus caroliniana	A	P	TREE	FAC
Carex tuckermanii	A	P	GRCY	OBL
Cinna arundinacea	A	P	GRPO	FACW
Cirsium arvense	A	P	FODI	FACU
Conyza canadensis	A	P	FODI	FAC-
Desmodium glutinosum	A	P	FODI	NP
Echinochloa walteri	A	P	GRPO	OBL
Equisetum arvense	A	P	FERN	FAC
Erigeron annuus	A	P	FODI	FAC-
Juncus bufonius	A	P	GRJU	FACW+
Lilium michiganense	A	P	FOMO	FAC+
Lobelia cardinalis	A	P	FODI	OBL
Phalaris arundinacea	A	P	GRPO	FACW+
Poa pratensis	A	P	GRPO	FAC-
Quercus spp., Black Oaks	A	P	TREE	NP
Ranunculus recurvatus	A	P	FODI	FACW
Rubus hispidus	A	P	BRAM	FACW
Salix amygdaloides	A	P	TREE	FACW
Salix nigra	A	P	TREE	OBL
Scirpus atrovirens	A	P	GRCY	OBL
Scutellaria lateriflora	A	P	FODI	OBL
Solidago altissima	A	P	FODI	FACU
Solidago rugosa	A	P	FODI	FAC+
Sonchus arvensis	A	P	FODI	FAC-
Spiraea alba	A	P	SHRU	FACW+
Taraxacum officinale	A	P	FODI	FACU
Toxicodendron radicans	A	P	VINE	FAC+
Trifolium hybridum	A	P	FODI	FAC-
Ulmus americana	A	P	TREE	FACW-

TABLE J.1 (Cont.)

Taxon Scientific Name	Transect No. 101	Transect No. 201	Growth Form	Wetland Indicator
Viburnum lentago	A	P	TRES	FAC+
Viola blanda	A	P	FODI	FACW-

[a] See Appendix A for definitions of growth form and wetland indicator codes.

[b] P = presence, A = absence.

Appendix K:

Species Occurring in the ROW Vegetation Transects of Sites 1 and 2

TABLE K.1 Species Occurring in the ROW Vegetation Transects of Site 1, Midland County, Michigan

Taxon Scientific Name	Transect No. 503	507	514	Growth Form	Wetland Indicator[a]
Acer spp.	P[b]	P	P	TREE	NP
Agrostis gigantea	P	P	P	GRPO	NI
Aster lateriflorus	P	P	P	FODI	FACW-
Aster ontarionis	P	P	P	FODI	FAC
Aster umbellatus	P	P	P	FODI	FACW
Betula papyrifera	P	P	P	TREE	FACU+
Calamagrostis canadensis	P	P	P	GRPO	OBL
Carex cristatella	P	P	P	GRCY	FACW+
Carex lacustris	P	P	P	GRCY	OBL
Carex lupulina	P	P	P	GRCY	OBL
Carex scoparia	P	P	P	GRCY	FACW
Carex stricta	P	P	P	GRCY	OBL
Carex stipata	P	P	P	GRCY	NP
Carex tenera	P	P	P	GRCY	FAC+
Carex vulpinoides	P	P	P	GRCY	OBL
Cicuta maculata	P	P	P	FODI	OBL
Cirsium arvense	P	P	P	FODI	FACU
Echinochloa crusgalli	P	P	P	GRPO	FACW
Equisetum arvense	P	P	P	FERN	FAC
Eupatorium perfoliatum	P	P	P	FODI	FACW+
Festuca arundinacea	P	P	P	GRPO	FACU+
Festuca ovina	P	P	P	GRPO	NP
Festuca pratensis	P	P	P	GRPO	FACU-
Fraxinus spp.	P	P	P	TREE	NP
Fragaria virginiana	P	P	P	FODI	FAC-
Glyceria striata	P	P	P	GRPO	OBL
Juncus articulatus	P	P	P	GRJU	OBL
Juncus effusus	P	P	P	GRJU	OBL
Juncus tenuis	P	P	P	GRJU	FAC
Lolium perenne	P	P	P	GRPO	FACU
Lotus corniculata	P	P	P	FODI	FAC-
Ludwigia polycarpa	P	P	P	FODI	OBL
Lycopus americanus	P	P	P	FODI	OBL
Lycopus virginicus	P	P	P	FODI	OBL
Naumburgia thyrsiflora	P	P	P	FODI	NP
Onoclea sensibilis	P	P	P	FERN	FACW
Panicum boreale	P	P	P	GRPO	FACU+
Panicum capillare	P	P	P	GRPO	FAC
Panicum implicatum	P	P	P	GRPO	FAC
Parthenocissus quinquefolia	P	P	P	VINE	FAC-
Penthorum sedoides	P	P	P	FODI	OBL
Phleum pratense	P	P	P	GRPO	FACU
Poa pratensis	P	P	P	GRPO	FAC-
Populus deltoides	P	P	P	TREE	FAC+

TABLE K.1 (Cont.)

Taxon Scientific Name	Transect No. 503	507	514	Growth Form	Wetland Indicator
Potentilla norvegica	P	P	P	FODI	FAC
Rosa palustris	P	P	P	BRAM	OBL
Rubus pubescens	P	P	P	BRAM	FACW+
Salix amygdaloides	P	P	P	TREE	FACW
Salix eriocephala	P	P	P	TREE	FACW
Salix exigua	P	P	P	TREE	OBL
Salix nigra	P	P	P	TREE	OBL
Scirpus atrovirens	P	P	P	GRCY	OBL
Scirpus cyperinus	P	P	P	GRCY	OBL
Scutellaria lateriflora	P	P	P	FODI	OBL
Solidago graminifolia	P	P	P	FODI	FACW-
Solidago rugosa	P	P	P	FODI	FAC+
Spiraea alba	P	P	P	SHRU	FACW+
Steironema ciliatum	P	P	P	FODI	FACW
Taraxacum officinale	P	P	P	FODI	FACU
Thelypteris palustris	P	P	P	FERN	FACW+
Toxicodendron radicans	P	P	P	VINE	FAC+
Trifolium hybridum	P	P	P	FODI	FAC-
Trifolium repens	P	P	P	FODI	FACU+
Vitis riparia	P	P	P	VINE	FACW-
Achillea millefolium	A[b]	P	P	FODI	FACU
Agrostis hyemalis var.	A	P	P	GRPO	FAC-
Ambrosia artemisiifolia	A	P	P	FODI	FACU
Carex aurea	A	P	P	GRCY	FACW+
Carex bebbii	A	P	P	GRCY	OBL
Cirsium vulgare	A	P	P	FODI	FACU-
Conyza canadensis	A	P	P	FODI	FAC-
Diervilla lonicera	A	P	P	SHRU	NP
Echinochloa walteri	A	P	P	GRPO	OBL
Galium obtusum	A	P	P	FODI	FACW+
Galium triflorum	A	P	P	FODI	FACU+
Gerardia tenuifolia	A	P	P	FODI	NP
Hypericum canadense	A	P	P	FODI	FACW
Hypericum punctatum	A	P	P	FODI	FAC+
Ilex verticillata	A	P	P	TRES	FACW+
Juncus bufonius	A	P	P	GRJU	FACW+
Maianthemum canadense	A	P	P	FOMO	FAC
Oxalis fontana	A	P	P	FODI	NP
Rudbeckia hirta	A	P	P	FODI	FACU
Solidago gigantea	A	P	P	FODI	FACW
Bidens frondosa	P	A	P	FODI	NP
Mimulus ringens	P	A	P	FODI	OBL
Plantago major	P	A	P	FODI	FAC+
Verbena hastata	P	A	P	FODI	FACW+
Cornus foemina	A	A	P	TRES	FACW-
Cyperus erythrorhizos	A	A	P	GRCY	OBL

TABLE K.1 (Cont.)

Taxon Scientific Name	Transect No. 503	507	514	Growth Form	Wetland Indicator
Hypericum perforatum	A	A	P	FODI	NP
Juncus acuminatus	A	A	P	GRJU	OBL
Juncus alpinus	A	A	P	GRJU	OBL
Juncus canadensis	A	A	P	GRJU	OBL
Juncus dudleyi	A	A	P	GRJU	FAC
Melilotus alba	A	A	P	FODI	FACU
Plantago rugelii	A	A	P	FODI	FAC
Ranunculus pensylvanicus	A	A	P	FODI	OBL
Rubus allegheniensis	A	A	P	BRAM	FACU+
Verbascum thapsus	A	A	P	FODI	NP
Carex bromoides	P	P	A	GRCY	FACW+
Carex gracillima	P	P	A	GRCY	FACU*
Galium tinctorium	P	P	A	FODI	OBL
Rorippa palustris	P	P	A	FODI	OBL
Rubus strigosus	P	P	A	BRAM	FACW-
Solidago altissima	P	P	A	FODI	FACU
Amphicarpaea bracteata	A	P	A	FODI	FAC
Cinna arundinacea	A	P	A	GRPO	FACW
Epilobium coloratum	A	P	A	FODI	OBL
Juncus vaseyi	A	P	A	GRJU	FACW
Osmunda cinnamomea	A	P	A	FERN	FACW
Oxalis stricta	A	P	A	FODI	FACU
Poa compressa	A	P	A	GRPO	FACU+
Prunella vulgaris	A	P	A	FODI	FAC
Pteridium aquilinum	A	P	A	FERN	FACU
Ranunculus recurvatus	A	P	A	FODI	FACW
Ribes cynosbati	A	P	A	BRAM	NP
Salix lucida	A	P	A	TREE	FACW+
Solidago juncea	A	P	A	FODI	NP
Sonchus uliginosus	A	P	A	FODI	FAC-
Typha latifolia	A	P	A	FOMO	OBL
Carex rosea	P	A	A	GRCY	NP
Geum canadense	P	A	A	FODI	FAC
Rubus hispidus	P	A	A	BRAM	FACW
Sonchus arvensis	P	A	A	FODI	FAC-
Typha angustifolia	P	A	A	FOMO	OBL

[a] See Appendix A for definitions for the growth form and wetland indicator codes.

[b] P = presence, A = absence.

TABLE K.2 Species Occurring in the ROW Vegetation Transects of Site 2, Midland County, Michigan

Taxon Scientific Name	Transect No. 603	607	614	Growth Form	Wetland Indicator[a]
Acer spp.	P[b]	P	P	TREE	NP
Agrostis gigantea	P	P	P	GRPO	NI
Aster lateriflorus	P	P	P	FODI	FACW-
Aster ontarionis	P	P	P	FODI	FAC
Bidens frondosa	P	P	P	FODI	NP
Carex bromoides	P	P	P	GRCY	FACW+
Carex cristatella	P	P	P	GRCY	FACW+
Carex lupulina	P	P	P	GRCY	OBL
Carex stipata	P	P	P	GRCY	NP
Carex tenera	P	P	P	GRCY	FAC+
Carex vulpinoides	P	P	P	GRCY	OBL
Cicuta maculata	P	P	P	FODI	OBL
Eleocharis obtusa	P	P	P	GRCY	OBL
Equisetum arvense	P	P	P	FERN	FAC
Eupatorium perfoliatum	P	P	P	FODI	FACW+
Festuca ovina	P	P	P	GRPO	NP
Festuca pratensis	P	P	P	GRPO	FACU-
Fraxinus spp.	P	P	P	TREE	NP
Fragaria virginiana	P	P	P	FODI	FAC-
Glyceria striata	P	P	P	GRPO	OBL
Juncus effusus	P	P	P	GRJU	OBL
Lobelia cardinalis	P	P	P	FODI	OBL
Lonicera dioica	P	P	P	FODI	FAC-
Lotus corniculata	P	P	P	FODI	OBL
Ludwigia polycarpa	P	P	P	FODI	OBL
Lycopus virginicus	P	P	P	FODI	OBL
Mimulus ringens	P	P	P	FODI	OBL
Onoclea sensibilis	P	P	P	FERN	FACW
Panicum boreale	P	P	P	GRPO	FACU+
Panicum implicatum	P	P	P	GRPO	FAC
Parthenocissus quinquefolia	P	P	P	VINE	FAC-
Penthorum sedoides	P	P	P	FODI	OBL
Phleum pratense	P	P	P	GRPO	FACU
Plantago major	P	P	P	FODI	FAC+
Poa pratensis	P	P	P	GRPO	FAC-
Populus deltoides	P	P	P	TREE	FAC+
Rubus pubescens	P	P	P	BRAM	FACW+
Salix amygdaloides	P	P	P	TREE	FACW
Salix exigua	P	P	P	TREE	OBL
Salix nigra	P	P	P	TREE	OBL
Scirpus atrovirens	P	P	P	GRCY	OBL
Scirpus cyperinus	P	P	P	GRCY	OBL
Scutellaria lateriflora	P	P	P	FODI	OBL
Taraxacum officinale	P	P	P	FODI	FACU

TABLE K.2 (Cont.)

Taxon Scientific Name	Transect No. 603	607	614	Growth Form	Wetland Indicator
Trifolium repens	P	P	P	FODI	FACU+
Typha angustifolia	P	P	P	FOMO	OBL
Typha xglauca	P	P	P	FOMO	OBL
Aster puniceus	P	P	A[b]	FODI	OBL
Echinochloa walteri	P	P	A	GRPO	OBL
Festuca arundinacea	P	P	A	GRPO	FACU+
Galium obtusum	P	P	A	FODI	FACW+
Hypericum canadense	P	P	A	FODI	FACW
Quercus spp., Black Oaks	P	P	A	TREE	NP
Rorippa palustris	P	P	A	FODI	OBL
Salix eriocephala	P	P	A	TREE	FACW
Spiraea alba	P	P	A	SHRU	FACW+
Steironema ciliatum	P	P	A	FODI	FACW
Amphicarpaea bracteata	P	A	P	FODI	FAC
Aster umbellatus	P	A	P	FODI	FACW
Bromus inermis	P	A	P	GRPO	NP
Carpinus caroliniana	P	A	P	TREE	FAC
Carex gracillima	P	A	P	GRCY	FACU*
Carex scoparia	P	A	P	GRCY	FACW
Ilex verticillata	P	A	P	TRES	FACW+
Juncus acuminatus	P	A	P	GRJU	OBL
Potentilla norvegica	P	A	P	FODI	FAC
Solidago graminifolia	P	A	P	FODI	FACW-
Toxicodendron radicans	P	A	P	VINE	FAC+
Typha latifolia	P	A	P	FOMO	OBL
Alisma plantago-aquatica	P	A	A	FOMO	OBL
Betula papyrifera	P	A	A	TREE	FACU+
Calamagrostis canadensis	P	A	A	GRPO	OBL
Carex crinita	P	A	A	GRCY	FACW+
Carex intumescens	P	A	A	GRCY	FACW+
Carex rosea	P	A	A	GRCY	NP
Cinna arundinacea	P	A	A	GRPO	FACW
Cirsium arvense	P	A	A	FODI	FACU
Galium triflorum	P	A	A	FODI	FACU+
Goodyera sp.	P	A	A	FOMO	NP
Prunella vulgaris	P	A	A	FODI	FAC
Prunus serotina	P	A	A	TREE	FACU
Quercus spp., White Oaks	P	A	A	TREE	NP
Ribes americanum	P	A	A	BRAM	FACW
Rubus allegheniensis	P	A	A	BRAM	FACU+
Rubus strigosus	P	A	A	BRAM	FACW-
Smilacina racemosa	P	A	A	FOMO	FACU
Sonchus arvensis	P	A	A	FODI	FAC-
Sonchus uliginosus	P	A	A	FODI	FAC-
Ulmus americana	P	A	A	TREE	FACW-
Carex aurea	A	P	P	GRCY	FACW+

TABLE K.2 (Cont.)

Taxon Scientific Name	Transect No. 603	607	614	Growth Form	Wetland Indicator
Juncus bufonius	A	P	P	GRJU	FACW+
Juncus tenuis	A	P	P	GRJU	FAC
Solidago altissima	A	P	P	FODI	FACU
Solidago gigantea	A	P	P	FODI	FACW
Solidago rugosa	A	P	P	FODI	FAC+
Solidago ulmifolia	A	P	P	FODI	NP
Trifolium hybridum	A	P	P	FODI	FAC-
Ambrosia artemisiifolia	A	P	A	FODI	FACU
Carex bebbii	A	P	A	GRCY	OBL
Juncus dudleyi	A	P	A	GRJU	FAC
Plantago rugelii	A	P	A	FODI	FAC
Polygonum amphibium	A	P	A	FODI	OBL
Carex lacustris	A	A	P	GRCY	OBL
Cirsium vulgare	A	A	P	FODI	FACU-
Echinochloa crusgalli	A	A	P	GRPO	FACW
Epilobium ciliatum	A	A	P	FODI	FACU
Epilobium coloratum	A	A	P	FODI	OBL
Erigeron annuus	A	A	P	FODI	FAC-
Juncus articulatus	A	A	P	GRJU	OBL
Leersia virginica	A	A	P	GRPO	FACW
Ranunculus pensylvanicus	A	A	P	FODI	OBL
Verbena urticifolia	A	A	P	FODI	FAC+
Vitis riparia	A	A	P	VINE	FACW-

[a] See Appendix A for definitions of growth form and wetland indicator codes.

[b] P = presence, A = absence.

Appendix L:

Importance Values for the Forest Overstory Species in the Belt Transects of Sites 1 and 2

TABLE L.1 Importance Values for the Forest Overstory Species in the Belt Transects of Site 1, Midland County, Michigan (%)

Taxon Scientific Name	Transect No. 1400	1100	1000
Quercus bicolor	45.4	39.7	55.0
Fraxinus pennsylvanica	38.3	37.9	47.2
Ulmus americana	29.5	19.1	38.5
Acer rubrum	25.5	15.3	30.5
Quercus palustris	8.1	12.1	13.4
Populus tremuloides	30.7	27.4	13.2
Cornus foemina	2.0	12.0	12.9
Betula papyrifera	14.1	12.3	12.8
Acer rubrum\saccharinum	21.0	52.5	12.1
Alnus rugosa	11.7	8.4	11.3
Viburnum lentago	6.5	6.4	11.1
Populus deltoides	4.0	6.3	9.9
Carpinus caroliniana	7.1	8.0	7.5
Prunus serotina	0.0	2.3	7.0
Populus grandidentata	21.4	0.0	5.3
Prunus virginiana	0.0	4.8	4.0
Tilia americana	2.8	4.7	3.7
Acer saccharinum	5.3	9.1	3.1
Ilex verticillata	0.0	2.9	1.7
Quercus rubra	14.0	7.6	0.0
Crataegus sp.	3.0	3.8	0.0
Fraxinus nigra	4.8	1.8	0.0
Acer nigrum	0.0	1.7	0.0
Acer saccharum	0.0	1.3	0.0
Amelanchier arborea	4.8	1.3	0.0
Fagus grandifolia	0.0	1.3	0.0

TABLE L.2 Importance Values for the Forest Overstory Species in the Belt Transects of Site 2, Midland County, Michigan (%)

Taxon Scientific Name	Transect No. 2400	2100	2000
Quercus bicolor	55.3	45.2	66.8
Fraxinus pennsylvanica	50.7	44.1	46.9
Acer saccharinum	6.2	34.6	36.0
Tilia americana	39.4	24.6	26.3
Acer rubrum\saccharinum	20.9	51.9	24.9
Fraxinus nigra	40.8	25.2	22.4
Carpinus caroliniana	18.0	27.2	22.2
Quercus palustris	27.2	16.4	17.9
Ulmus americana	13.5	17.4	14.7
Quercus rubra	3.7	3.1	9.9
Betula papyrifera	2.6	1.5	4.7
Acer rubrum	1.8	0.0	3.7
Ilex verticillata	1.8	0.0	1.8
Viburnum lentago	5.4	1.6	1.8
Acer nigrum	0.0	0.0	0.0
Acer saccharum	0.0	0.0	0.0
Alnus rugosa	0.0	2.6	0.0
Amelanchier arborea	0.0	0.0	0.0
Cornus foemina	0.0	0.0	0.0
Crataegus sp.	0.0	0.0	0.0
Fagus grandifolia	0.0	1.6	0.0
Populus deltoides	12.7	3.0	0.0
Populus grandidentata	0.0	0.0	0.0
Populus tremuloides	0.0	0.0	0.0
Prunus serotina	0.0	0.0	0.0
Prunus virginiana	0.0	0.0	0.0

Appendix M:

Percent Cover of Dominant and Noteworthy Species within Different Growth Form Categories for Three Years in the Forest Understories of Sites 1 and 2

TABLE M.1 Percent Cover of Dominant and Noteworthy Species within Different Growth Form Categories for Three Years in the Forest Understory of Site 1 (Transects 141, 113, and 105), Midland County, Michigan[a]

Growth Form Code	Taxon Code	141			113			105		
		1989	1990	1991	1989	1990	1991	1989	1990	1991
FERN	ONOSE	14	22	24	35	41	50	36	43	51
	PTEAQ	5.9	6.3	9.6	13	16	19	8.6	7.3	11
FODI	ARANU	7.7	9.6	10	23	26	30	3.3	6.4	24
	FRGVI	1.6	1.8	2.2	5	5.6	4.8	4	4.8	4.2
	ASTUM	5.6	7.8	4.9	3.6	0.9	1.3	0	1.3	1
	SOLRU	0.9	1.3	0.7	0.3	0.1	0.3	2.6	0.6	1.3
FOMO	MAICA	0.9	2.7	4.9	4.6	2.8	8.3	1.3	0.9	1.6
GRCY	CARTE	1.5	3.4	3.2	2.4	0.8	2	2.8	2.7	3.1
	CARGR	0.6	1.3	1.1	3.2	6.6	1.6	2.1	2.6	2.9
	CARCR	24	2.4	1.9	4.1	0.1	0	20	3.9	1.3
	CARSR	0	0	20	0	0	5.1	0	17	20
GRJU	JUNEF	0	0	0	0	0	0	0	0.1	0
GRPO	BRAER	0.4	1.1	1.7	0.8	1.1	0	0.2	1.4	0.9
	CALCA	0.6	1.4	5.5	0.5	2.6	4.6	0	5.4	7.2
	AGRGI	0	0	0	0	0	0	0	1.9	2
BRAM	RUBPU	5.3	9.1	8.1	17	17	20	19	13	14
VINE	PARQU	3.9	3.1	4.5	4.4	5.3	3.8	3.4	7.4	8.8
SHRU	SPIAL	0.9	0.8	0.4	0.2	0.3	0	7.1	5.2	6.6
TREE	ACESP	7.1	5.6	7.8	3.3	3.2	4.2	3.9	1.2	3.4
	FRASP	6.6	6.6	8.6	5.3	5.1	6.9	10	6.9	12
	QUEWH	5.6	2.9	4.1	2.5	5.1	6.5	2.7	1.1	2.3
	ULMAM	6.7	4.3	5.6	0.4	2.5	2.9	1.9	1.3	1.8
TRES	CORFO	7.2	7.3	7.4	9	5.8	5.6	16	12	12
	ILEVE	2	1.9	1.3	8.7	2.6	4.9	7.3	6.8	6.4

[a] For growth form and taxon codes, see Appendix A.

TABLE M.2 Percent Cover of Dominant and Noteworthy Species within Different Growth Form Categories for Three Years in the Forest Understory of Site 2 (Transects 241, 213, and 205), Midland County, Michigan[a]

Growth Form Code	Taxon Code	241			213			205		
		1989	1990	1991	1989	1990	1991	1989	1990	1991
FERN	ONOSE	13	25	24	16	20	29	10	17	18
	THEPA	1.2	2	3	0	0	0	0	0.1	0.4
FODI	ARANU	0.1	0.5	0.1	1.4	0.9	2.1	1.3	0.8	0.8
	FRGVI	0.4	0.4	0.4	0.3	0.4	0.8	1	1.8	1.8
	AMPBR	1.8	2.1	5.4	2.4	2.3	6.4	1.1	4.3	4.1
	SOLLA	0.3	0.9	0.3	0.1	0.9	2.4	0.4	1.4	7.6
FOMO	MAICA	0.1	0.3	0.3	0.1	0.8	0.1	0.3	0.8	0.2
GRCY	CARRO	8.1	2.9	3.1	8.1	4.5	3.8	5.9	1.1	0.8
	CARGR	2.9	0.4	0.9	0	1.6	0.8	2.1	4.8	3.6
	CARTE	0	13	1.8	0	12	2.3	1	8.5	3.3
	CARBR	0	0	15	0	0	18	0	0.1	14
GRJU	JUNEF	0	0	0	0	0	0	0	0	0
GRPO	CINAR	0.6	0.9	0.7	0.3	0.8	1	0.4	0.5	0.9
	CALCA	0	0	0	0.1	0	0	0.1	0.1	0.3
	GLYST	0	0	0.1	0	0.5	0.3	0	0.1	0.6
BRAM	RUBPU	2.1	4.1	6.1	1.6	2.8	4.3	2.8	3.3	2.4
VINE	PARQU	0.8	1.8	3.6	3.3	4	3.3	6.6	9.5	9.9
SHRU	SPIAL	0.3	0	0	0	0	0	0	0	0
TREE	ACESP	5.3	20	7.9	1.7	7.3	7.9	1.4	5.4	4.9
	FRASP	24	29	29	24	24	31	24	29	37
	QUEWH	0.6	0.9	1.7	1	0.4	1.7	1.4	0.4	1.6
	CAPCA	3.3	2.9	3.4	1.9	1.6	3.4	3.9	1.9	2.1
TRES	CORFO	0.2	0.1	0.5	0.3	0.7	0.4	0.2	0.9	0.9
	ILEVE	1	3.8	5.2	1.3	0.3	1.3	2.4	3.9	2.5

[a] For growth form and taxon codes, see Appendix A.

Appendix N:

Percent Cover of Dominant and Noteworthy Species within Different Growth Form Categories for Four Years in the Ecotone Understories of Sites 1 and 2

TABLE N.1 Percent Cover of Dominant and Noteworthy Species within Different Growth Form Categories for Four Years in the Ecotone Understory of Site 1 (Transect 101) and Site 2 (Transect 201), Midland County, Michigan[a]

Growth Form Code	Taxon Code	101				201			
		1989	1990	1991	1992	1989	1990	1991	1992
FERN	EQUAR	0	0	0	0	0.1	0.6	1.8	4.6
	ONOSE	3.5	8.5	11	13	1.3	5.4	10	12
FODI	EUPPE	0.6	3.4	7.2	5.5	0.5	7.9	14	11
	FRGVI	0.1	2.2	0.9	3.1	0.1	0.3	0.6	0
	LOTCO	0	29	27	31	0	0.1	0.1	0
	TRISP	9.4	23	0.7	0.7	0	0	0	0.1
	AMPBR	0	0	0.4	0.4	0.1	0.4	3.4	2.4
FOMO	MIACA	0	0.1	0.1	0.2	0.1	0.1	0	0
GRCY	CARCR	2.9	4.6	6.4	5.2	0.1	8	16	12
	CARTE	0.4	0.6	10	3.1	0	1.1	4.2	4.1
	CARLU	0	2.3	6.3	2.3	0	13	22	17
	CARSR	0	0.4	3.4	6.6	0	0.5	0	0
	SCICY	0	0.8	2.8	2.4	0	0	3.5	2.8
GRJU	JUNEF	0	0	3	5.9	0	0	0.1	0.1
GRPO	CALCA	0	0.4	1.2	3.8	0	0	0	0
	GLYST	0	0.1	2.3	0.9	0	3.6	9.5	3.1
	AGRGI	0	52	47	19	0	1.4	1.5	0.6
	FESOV	0	2.9	1.3	2.8	0	0.1	0	0
	PHLPR	0	4.2	2.2	3.4	0	0	0	0
BRAM	RUBPU	0.2	0.2	0.8	0.4	0.3	0.2	0.4	0.3
VINE	PARQU	1.1	1.4	1.7	1.6	1.1	2.5	5	4.7
SHRU	SPIAL	1.6	2.4	3.8	3.4	0.2	0	0	0.3
TREE	ACESP	0.5	1.5	1.9	1.4	0.1	3.6	4.4	11
	FRASP	0.6	0.8	2.6	1.9	0.6	4.8	4.6	5.3
	POPDE	3.7	13	19	25	3	18	29	40
	SALAM	0	1.6	1.8	3.1	0	3.4	2.6	3.3
	SALEX	0	0.5	0.8	1.2	0	0.7	0.4	2.3
	SALNI	0	0	1.4	2.1	0	0	1.8	2.5
TRES	ILEVE	0.5	0.5	0.1	0.8	0.1	0.1	0	0.4

[a] For growth form and taxon codes, see Appendix A.

Appendix O:

Percent Cover of Dominant and Noteworthy Species within Different Growth Form Categories for Three Years on the Right-of-Way of Sites 1 and 2

TABLE O.1 Percent Cover of Dominant and Noteworthy Species within Different Growth Form Categories for Three Years on the Right-of-Way of Site 1 (Transects 503, 507, and 514), Midland County, Michigan[a]

Growth Form Code	Taxon Code	503			507			514		
		1990	1991	1992	1990	1991	1992	1990	1991	1992
FERN	ONOSE	3.3	4.1	7.9	4.7	5.6	7.6	2	3.8	12
	EQUAR	0	0.1	0.4	0.1	2.5	5.9	1	1.9	0.5
FODI	EUPPE	1	3.4	7.3	3.4	3.1	7.6	2.4	6.5	17
	FRGVI	0.1	0.8	0.4	1.5	3.1	5.2	0.2	0.1	0.3
	LOTCO	19	22	34	3.3	13	23	14	19	19
	TRISP	13	0.8	0.9	9.3	1.8	0.2	23	1.8	0.9
	LYCAM	0	1.7	1.8	3.8	3.5	4	0.1	1.4	2.5
	LYCVI	2.5	1.9	1.7	3.3	4.1	2.6	1.9	5.3	3.2
	PENSE	0	0.1	0.1	0.1	0	0	0.4	0.1	0
	BIDFR	0	0	0.1	0	0	0	0	0	0.3
FOMO	MAICA	0	0	0	0.1	0.1	0	0	0.1	0
	TYPSP	0.1	0.1	0.1	0.5	0.4	0.1	0.1	0.1	0.1
GRCY	CARLU	1.9	3.9	4.9	2.2	5.6	3.4	3.2	8.9	6.6
	CARCR	3.3	5.2	4.1	1.9	3.9	2.3	1.6	5.5	3.5
	CARTE	0	1.4	0.6	0	3.6	1.1	0	4.4	0.5
	CARVU	0.1	0.1	0.5	0.1	0.1	0	0.4	1.2	1.1
	SCICY	0	5.1	5.5	0	5.3	7.8	0	19	17
GRJU	JUNEF	2.8	8.4	11	2.2	17	16	0.8	5.2	9.5
GRPO	AGRGI	54	60	47	7.7	20	21	53	52	21
	PHLPR	1.3	0.8	1.2	1.3	0.9	2.1	0.8	1.4	1.3
	FESOV	0	2.1	5.5	0	1.4	2	0	2.6	7.1
	FESPR	0	2.8	0	0	1.5	3.6	0	1.1	0.9
BRAM	RUBPU	0.9	0.2	0.1	0.3	0	0.1	0.6	0.4	0.2
VINE	PARQU	0.1	0.2	0.2	0.2	0.9	0.4	0.1	0.1	0.1
SHRU	SPIAL	0	0	0.1	0	0.1	0.1	0	0.1	0.3
TREE	ACESP	0.6	0.4	0.4	1.2	1.3	0.9	1.5	0.5	0.6
	FRASP	0	0.2	0.4	0.1	0.5	0	0	0.1	0.1

TABLE O.1 (Cont.)

Growth Form Code	Taxon Code	503			507			514		
		1990	1991	1992	1990	1991	1992	1990	1991	1992
TREE (Cont.)	POPDE	13	15	26	15	28	35	3.3	3.9	9.9
	SALAM	3.1	4.4	4.9	2.7	4.7	12	1.9	3.4	3.9
	SALEX	0.3	1.9	2.3	0.2	1.4	2.6	0.1	0.8	0.8
	SALNI	0	3.8	1	0	3.8	3.9	0	2.4	1.2
TRES	CORFO	0	0	0	0	0	0	0	0	0.1
	ILEVE	0	0	0	0	0	0.1	0	0	0.1

[a] For growth form and taxon codes, see Appendix A.

TABLE O.2 Percent Cover of Dominant and Noteworthy Species within Different Growth Form Categories for Three Years on the Right-of-Way of Site 2 (Transects 603, 607, and 614), Midland County, Michigan[a]

Growth Form Code	Taxon Code	603			607			614		
		1990	1991	1992	1990	1991	1992	1990	1991	1992
FERN	ONOSE	5.3	5.7	12	2.3	1.5	3.4	1.9	1.9	4.7
	EQUAR	0.8	3.1	5.4	0.1	2.2	2.1	0	0	0.1
FODI	EUPPE	6.1	21	11	1.8	4.9	5.1	0	3.5	4.5
	FRGVI	0.1	0.1	0	0	0.1	0.1	0.1	0.6	0.7
	LOTCO	0	0.1	0	7.5	21	11	11	24	23
	TRISP	0.9	0	0	15	1.9	0.2	14	1.3	0.8
	LYCAM	0.5	4	3.2	0.1	1.1	1.3	0	1.8	2.3
	LYCVI	1.6	0.1	0.9	0.6	0	0.6	0.5	0	0.6
	PENSE	1.3	1.2	1.9	1.1	1.6	1.8	0.7	0.7	0.9
	BIDFR	0	0	2.2	0	0	2.3	0	0	2.4
FOMO	MAICA	0	0	0	0	0	0	0	0	0
	TYPSP	0.3	0.6	1	0.1	0	0.4	0.1	0.6	0.3
GRCY	CARLU	11	31	18	1	8.9	11	2.3	7	14
	CARCR	7.6	10	9.9	3.6	6.1	4.1	1.1	1.9	3.5
	CARTE	0	1.4	4.1	0	0.1	0.8	0	0.5	0.8
	CARVU	1.1	7.1	9.7	4.4	2.1	4.8	0.5	2.6	6.2
	SCICY	0	7.6	7.6	0	4.3	10	0	1.9	4.1
GRJU	JUNEF	0	0.3	2.2	0	0.8	0.5	0	0.2	1
GRPO	AGRGI	6.3	4.7	2.6	20	42	28	29	32	22
	FESOV	0.1	0.1	0	5.2	1.6	2.6	12	12	11
	FESPR	0	0	0	0	2.7	0	0	1.6	0
	PHLPR	1.3	0.5	0	1.9	1.3	1.7	1.8	0.9	1.8
BRAM	RUBPU	0.1	0	0.2	0.1	0	0	0.1	0.1	0
VINE	PARQU	0.4	0.7	0.8	0.2	0.2	0.1	0.1	0.6	0.7
SHRU	SPIAL	0.1	0	0	0.3	0	0	0	0	0
TREE	ACESP	3.6	3.6	7.1	4.1	2.6	6.1	2.3	2.3	5.1
	FRASP	2.6	3.1	8.4	0.1	0.1	0.6	0.5	0.4	1.8
	POPDE	14	28	45	12	8.4	9.8	4	12	10
	SALAM	3.5	2	5.9	1.8	1.5	2.7	0.3	0.5	1.3
	SALEX	0.3	2.6	4.9	0.2	0.7	2.8	0	0	0.1
	SALNI	0	6.1	1.1	0	2.6	1.5	0	0	0.1
TRES	CORFO	0	0	0	0	0	0	0	0	0
	ILEVE	0	0.4	0	0	0	0	0.1	0	0.4

[a] For growth form and taxon codes, see Appendix A.

Appendix P:

Photographic Sequence Showing Vegetational Changes on the Right-of-Way

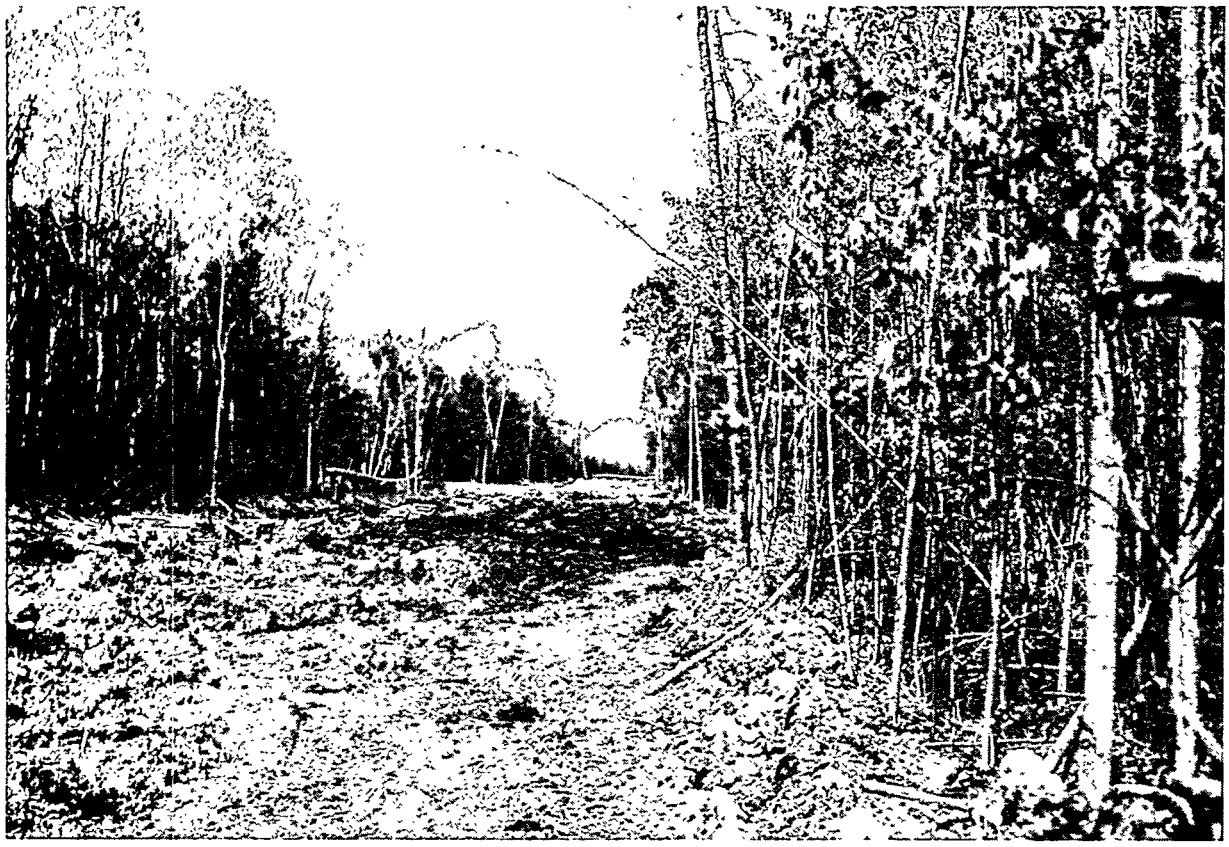

FIGURE P.1 View of Right-of-Way of Site 1 after Clearing, Midland County, Michigan

FIGURE P.2 View of Right-of-Way of Site 1 One Year after Installation of the Gas Pipeline, Midland County, Michigan

FIGURE P.3 View of Right-of-Way of Site 1 Two Years after Installation of the Gas Pipeline, Midland County, Michigan

FIGURE P.4 View of Right-of-Way of Site 1 Three Years after Installation of the Gas Pipeline, Midland County, Michigan

FIGURE P.5 View of Right-of-Way of Site 2 after Clearing, Midland County, Michigan

FIGURE P.6 View of Right-of-Way of Site 2 One Year after Installation of the Gas Pipeline, Midland County, Michigan

FIGURE P.7 View of Right-of-Way of Site 2 Two Years after Installation of the Gas Pipeline, Midland County, Michigan

FIGURE P.8 View of Right-of-Way of Site 2 Three Years after Installation of the Gas Pipeline, Midland County, Michigan