Technical Memorandum

Dupuis Reserve Environmental Assessment

by

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INTRODUCTION

The Dupuis Reserve was purchased by the South Florida Water Management District (District) on December 18, 1986 through the "Save Our Rivers" (SOR) land acquisition program enacted in 1981. This program was created to acquire land for water supply, water management, and conservation and protection of water resources.

This report represents a revision of the draft environmental assessment completed in October 1989 as a result of field work conducted between June 1987 and January 1989. This assessment was initiated to identify environmental characteristics of the property and propose management recommendations to meet SOR objectives set forth in Chapter 373.59 Florida Statutes, which mandates that SOR lands be managed with the intent to "restore and protect the natural state and condition." Recommendations discussed in this assessment will adhere to general guidelines adopted in the District Land Management Policy (No. 5001) which states:

1) Management shall be directed towards conservation and protection of water resources

2) Attempts shall be made to restore a more natural hydroperiod on land where drainage patterns have been substantially altered

3) Management shall seek to establish and maintain an appropriate number and variety of indigenous game and non-game species

4) Emphasis shall be placed on identification and management of critical habitat for endangered or threatened species with additional protection for endangered species

5) Management shall seek to restore and maintain an appropriate variety and distribution of native plant communities

6) Recreation activities shall be encouraged that do not interfere with protection or management of environmental resources.

Site Description

The Dupuis Reserve encompasses 21,620 acres (8,746 ha) of which approximately 14,000 acres (5,600 ha) are in northwest Palm Beach County with the remaining acreage in southwest Martin County (Fig. 1). An additional 35 acres (14 ha) are included on the right-of-way between the St. Lucie Canal and State Road 76. The property is located two miles (3.2 km) from the eastern shore of Lake Okeechobee and 40 miles (64 km) northwest of West Palm Beach. The south and west boundaries of the property are formed by the L-8 canal and associated tie-back levee (Fig. 2). The Florida Power and Light (FP&L) easement, incorporated in the J. W. Corbett Wildlife Management Area (Corbett), borders eight miles (13 km) on the eastern perimeter of the Reserve. With the exception of the Corbett Area, the property is mostly surrounded by intensive agricultural development. Citrus, in various stages of development, borders the property to the east and west in Martin County. To the south and west in Palm Beach County, adjacent to the L-8

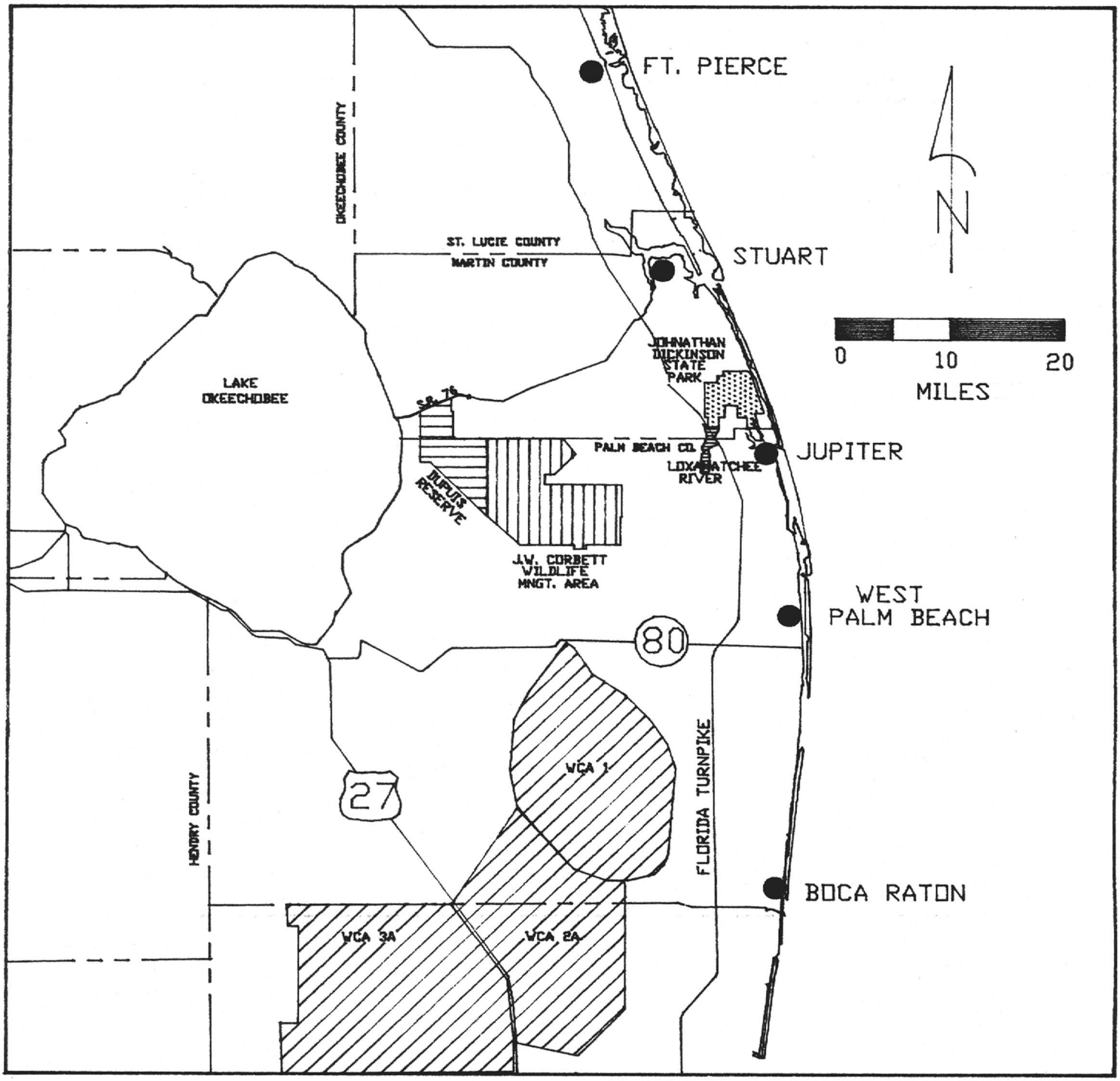
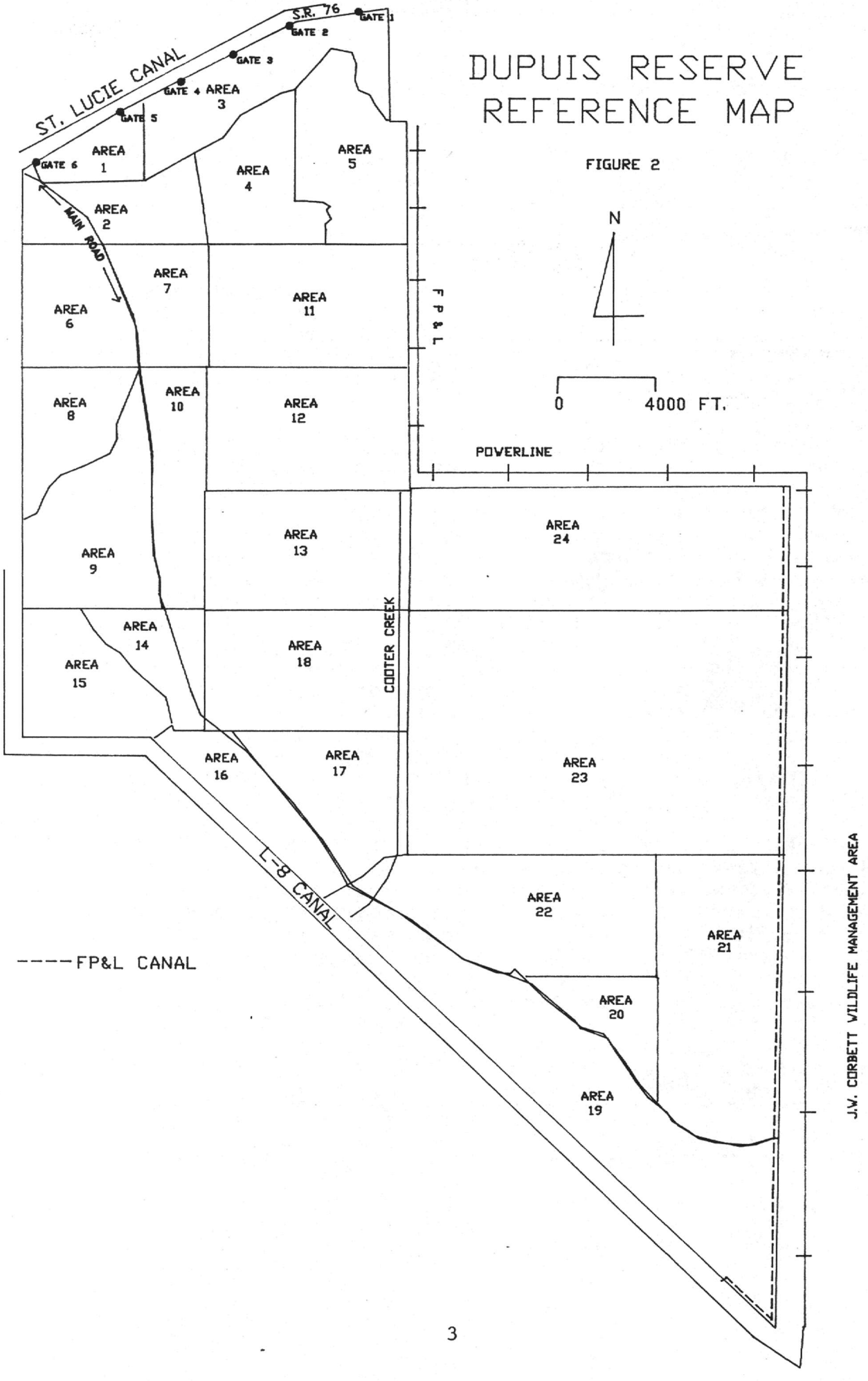


FIGURE 1. DUPUIS RESERVE LOCATION MAP (1991)

DUPUIS RESERVE REFERENCE MAP

FIGURE 2



canal, lies the Everglades Agricultural Area containing sugarcane fields operated by U.S. Sugar Corporation.

Access to the property is provided by six numbered gates along State Road 76. Gates 1, 2 and 3 grant public access for hunting, hiking and camping, and equestrian use, respectively.

History of land use

Several Indian mounds, located along the L-8 marsh, provide evidence that native Americans inhabited this area possibly into the nineteenth century. These mounds represent agricultural and burial centers, and one habitual center, referred to as "Billy Bowlegs Mound." A similar site, the Big Mound complex on the adjacent Corbett Area, is believed to be of Calusa origin, dating back to approximately 500 B.C.

Effects of overdrainage from construction of the St. Lucie canal, completed in 1924, are discernible in 1940 aerial photography. This canal severed the southerly flow of water to the property from the Eastern Flatlands, a region of Martin County that included an extensive wetland system, Allapattah Marsh (Davis, 1943). Completion of the L-8 canal in 1953 resulted in further drainage of the property and contributed to accelerated development of agriculture south of the canal. Secondary ditches completed in the late 1950's and early 1960's, including Cooter Creek, provided more efficient drainage of Everglades marsh and interior wetlands (Fig. 2). In 1977, construction of the FP&L canal and roadway severed the flow of water to the Reserve from several tributaries of the Hungryland Slough, located on the adjacent Corbett Wildlife Management Area. This cessation of sheet flow resulted in severe overdrainage of cypress forest and other wetland habitat. Drainage improvements prompted additional land modification including extensive seeding of bahia (Paspalum notatum) and other tame grasses, to improve cattle forage during formation of White Belt Dairy Farms, Inc. Prior to purchase by the District, the ranch had average stocking rates of 2,500 cattle and 2,000 sheep. All livestock were removed from the property by October 1987.

Figure 3 depicts the general vegetation composition of the property during the 1940's based on interpretation of aerial photography. These photographs indicate that the habitat consisted primarily of broadleaf marsh, wet prairie, cypress, and low pine flatwoods. Sheet flow occurred through wet prairie and cypress strands, eventually flowing into an extensive series of broadleaf marsh and sawgrass communities (Davis, 1943). These wetlands represented the northern extent of the vast Everglades ecosystem which originated at the eastern shore of Lake Okeechobee and encompassed approximately 2,500 acres (1,000 ha) of the present Dupuis Reserve. This area is now referred to as the L-8 marsh. Over half of the property consisted of wet prairie and wet pine flatwoods, maintained by frequent inundation and intermittent fires, which impeded vegetative succession and stimulated growth of native wet prairie grasses and wildflowers (Duever, 1986). At slightly higher elevations (i.e., above 25 ft. NGVD), flatwoods were characterized by south Florida slash pine (Pinus elliotti var. densa) and wiregrass (Aristida sp.), and maintained by more frequent fire.

Distinct changes in vegetation communities have occurred between 1940 and 1988 (Fig. 4, Table 1). Substantial conversion of wet prairie, broadleaf marsh, and

TABLE 1. Vegetative Comparison of Dupuis Reserve

	1940			1988		
Vegetation type	Acres	Hectares	% of total	Acres	Hectares	% of total
Low pine flatwoods	7,931	3,210	36	3,757	1,521	17
Wet prairie	5,325	2,155	25	458	185	2
Broadleaf marsh	3,127	1,265	14	1,114	451	5
Cypress	2,948	1,193	14	2,549	1,031	12
Sawgrass	1,362	551	6	285	115	1
Mesic flatwoods	409	165	3	9,383	3,797	43
Willow	304	123	2	_	_	_
Hardwood swamp	214	87	<1	_	_	_
Improved pasture	_	_	_	2,576	1,043	12
Hardwoods	_	_	_	306	124	1
Other improved, (groves,buildings,etc.)	_	_	_	138	56	<1
Exotics	_	_	_	41	16	<1
Cypress scrub*	_	_	_	1,013	410	5
Totals	21,620	8,749	100	21,620	8,749	100

*Probably present in 1940, difficult to distinguish from wet prairie in aerial photography.

sawgrass marsh to homogeneous pasture was accomplished through drainage and introduction of exotic grasses. Dense even-aged stands of slash pine, accompanied by a thick understory of saw palmetto (Serenoa repens), wax myrtle (Myrica cerifera) and live oak (Quercus virginiana), typify pine flatwoods where drainage and fire suppression have been most severe.

Topography

In general, relief is slight with ground elevations ranging between 23 and 25 ft National Geodetic Vertical Datum (NGVD) over most of the property, declining gradually from northeast to southwest (Appendix A1). The greatest change in elevation occurs in the L-8 marsh where elevation declines from 20 ft at the treeline to less than 15 ft at several locations near the canal levee. From the treeline, elevation increases gradually reaching 24 to 25 ft in the north and northeast sections of the property.

Elevations of pine flatwood communities in Martin County approximate 25 ft with slight declines to 23-24 ft at the west property boundary. Broadleaf marsh and wet prairie depressions occur between the elevations of 22.0-23.8 ft. Cypress domes are situated at elevations of 20-23 ft, with the dome centers representing the lowest elevations (20-21 ft).

In the Palm Beach County portion of Dupuis, pine flatwoods and wet prairie communities fluctuate between 24 and 25 ft with cypress domes and strands occurring at elevations between 20 and 23 ft. Elevations decline to the southwest towards the L-8 marsh where elevations range from 15 ft to 19 ft.

Hydrology

Historically, overland sheet flow on the property occurred in a south-southwest direction through a connected series of wet prairie, marsh and cypress wetlands. In general, these wetlands were frequently inundated for long periods, beginning with the wet season. However, extended dry seasons resulted in wide fluctuations of water levels which influenced formation of these wetland systems (Davis, 1943). Under normal rainfall, hydroperiods may have ranged from less than two months in pine/wire grass communities to twelve months in the Everglades marsh.

Presently, sheet flow is virtually nonexistent, having been substantially altered by an extensive network of canals and ditches built to facilitate drainage of water to the L-8 and St. Lucie canals (Fig. 5). Loss of sheet flow resulted in fragmentation of wetland systems, which now become inundated only when there is sufficient local rainfall. In addition, adjacent citrus development may be contributing to a shortened hydroperiod by lowering the ground water table.

The three drainage basins on the property are dominated by the L-8 system (18,583 acres, 7,520 ha). A second basin (2,482 acres, 1,004 ha), roughly outlined by areas 1-5 (Fig. 5), drains directly north to the St. Lucie canal. An additional 800 acre (324 ha) drainage basin is concentrated around a large wetland system in area 11, which flows east to a private canal, ultimately draining into the St. Lucie canal.

The property is transversed by several major ditches which drain to the L-8 canal

and tie-back levee/canal, via a series of culvert structures equipped with flash board risers (#22,24,25,26 and 27). Culverts #22 and #24 provide drainage into L-8 indirectly through the tie-back canal located at the western property boundary. Culverts #25, #26 and #27 facilitate drainage directly into the L-8 canal. Culvert 27 is the terminus for Cooter Creek, a major ditch bisecting and draining the property interior. These culverts are in varying stages of structural decline and are incapable of being utilized for water management purposes. South of culvert #27, water flows along an interior ditch which runs parallel to, and eventually drains through a gap in the levee into the L-8 canal.

The FP&L canal flows south along the eastern boundary to the property's southeast corner where it discharges into the L-8 canal via culvert #17A. Six culvert and riser structures (17,17A,18,19,20, and 21) are located in the FP&L canal, all of which are in extremely poor condition due to structural erosion. A series of 24" culverts in the west berm of this canal continue to drain cypress on the east side of the property. Culvert structure 17B was washed out in 1987, increasing the drainage of several large cypress strands in area 19.

Soils

Dupuis Reserve contains a variety of soil types, many typifying those found in wetland communities (Appendix A2). The Martin County section of the property is dominated by nearly level, poorly drained Riviera, Pineda, and Malabar sands which are characterized by very slow percolation rates. Waveland sand, more common on the property's west side, contains a weakly cemented hard pan usually at 30-50 inches (76-127 cm) in depth, resulting in a perched water table during the wet season (McCollum and Cruz, 1979). Riviera and Florida fine sand comprise the major soils found in former broadleaf marsh communities that historically were ponded for 6 to 12 months per year (McCollum and Cruz, 1979). Tequesta muck is a very poorly drained, nearly level soil which is more common in depressions closer to the Palm Beach/Martin county line.

Tequesta, Okeelanta and Sanibel Muck are among the dominant soil types found in Palm Beach County, particularly associated with the Everglades. Okeelanta is a very poorly drained organic soil derived from a willow-sawgrass plant association (Davis, 1943). Tequesta represents a peaty muck associated with broadleaf and sawgrass marsh, and at least a 4-6 month hydroperiod under natural conditions (McCollum et al., 1978). Sanibel muck, characterized by a thin organic surface layer and a 2-6 month hydroperiod, is considered transitional between sandy flatwood soils and organic Everglades soils (McCollum et al., 1978). This soil appears to be representative of wet prairie which formerly bordered and drained into the Everglades. Basinger and Myakka sands, depressional, and Anclote fine sand are nearly level, very poorly drained sandy soils with long hydroperiods typical in cypress dominated communities. Immokalee fine sand, another soil type located along the edge of the Everglades, may delineate an area originally dominated by wet prairie/flatwoods. Most of these soils are characterized by a weakly cemented hard pan layer, resulting in perched water tables during the wet season.

Towards Dupuis' eastern boundary, Pineda, Pinellas and Riviera sands represent the dominant soils in the region of cypress forest. The slow to very slow permeability of these soils induces water to pond in cypress domes or sheet flow

across wet prairie rather than percolate down to the surficial aquifer. Riviera sand, one of the more common soils on the property, is found within cypress domes where up to two feet of water may be ponded for nearly the entire year.

VEGETATION

Sixteen vegetative communities, based primarily on classification by U.S. Fish and Wildlife Service (Cowardin et al., 1979) for wetlands, and Soil Conservation Service (1985), were identified on the property. The following descriptions represent the vegetation community codes utilized in vegetation maps and corresponding acreage tables (Appendix B3-B18):

1) Mesic flatwoods. This is the dominant community, distinguished by the south Florida slash pine overstory and an open or dense understory, depending on degree of drainage and fire frequency. Where drainage has been most severe, particularly areas 1-8, the understory consists of dense saw palmetto and to a lesser extent live oak. These flatwoods may represent a more advanced stage of succession between wet prairie and a climax hardwood community (Duever, 1986). Flatwoods retain a more open understory where grazing and burning have been most intense. Further south, in areas 9-15, the height and density of saw palmetto decreases, and other native species, such as gallberry, tarflower, beauty berry, and bluestem grasses are more common. Flatwoods are further subdivided by slash pine size classes.

1a) Pole size (>8" diameter at breast height (dbh)) slash pine
1b) Sapling size (<8" dbh) slash pine

Soils: Pineda sand, Riviera fine sand, Malabar sand (Martin Co.), Immokalee fine sand, Pinellas fine sand (Palm Beach Co.).

Vegetation:
TREES: Slash pine, cabbage palm, live oak
SHRUBS: Saw palmetto, gallberry (Ilex glabra), wax myrtle, shiny blueberry (Vaccinium myrsinites), rusty lyonia (Lyonia ferruginea), beauty berry (Callicarpa americana), tar flower (Befaria racemosa)
HERBACEOUS: black root (Pterocaulon pycnostachyum), caesar weed (Urena lobata),
GRAMINOIDS: Bahia grass, creeping bluestem (Schizachryum stoloniferum), south Florida bluestem (S. rhizomatum)

2) Low pine flatwoods. Historically, low pine flatwoods, composed of scattered slash pine, and native grasses and wildflowers, were the dominant community on the property. These flatwoods were influenced primarily by fire, which occurred naturally every 3 to 10 years (FNAI, 1990), and frequent flooding during the wet season. Presently, low pine flatwoods are inundated for short durations, usually less than two months, and are now confined to the least drained areas (20,21,22 and 24) within the cypress forest. Subsequent drainage has resulted in the conversion of low pine flatwoods to mesic flatwoods.

Soils: Pinellas fine sand, Riviera sand, Holopaw fine sand

Vegetation:

TREES: slash pine, cabbage palm
SHRUBS: wax myrtle, St. John's wort (Hypericum fasciculatum), saw palmetto
HERBACEOUS: marsh pink (Sabatia bartramii)
GRAMINOIDS: wiregrass (Aristida stricta), chalky bluestem (Andropogon capillipes, bushybeard bluestem (Andrpogon glomeratus), yellow-eyed grass (Xyris spp.), beaked-rush (Rhynchospora microcarpa)

3) Cabbage palm flatwoods. This habitat is characterized by scattered cabbage palm with a relatively open understory of bahia pasture, sparse saw palmetto and wax myrtle. Historically, these flatwoods may have been wiregrass/palmetto prairie which had a fire frequency of every 1 to 4 years (Florida Natural Areas Inventory, 1990). However, these flatwoods may also represent drained wet prairie that has been intensively managed by fire or grazing, which has restricted slash pine recruitment.

Soils: Malabar sand, Pineda sand

Vegetation:

TREES: cabbage palm
SHRUBS: saw palmetto, wax myrtle
GRAMINOIDS: bahia grass, sand cordgrass (Spartina bakeri), smut grass (Sporobolus poiretii)

4) Scrub shrub. A community dominated by dwarf or stunted pond cypress reaching 10 meters in height, accompanied by a sparse wet prairie understory. Scrub cypress forest is characterized by shallow sandy soils (7-15 cm) overlying bedrock, low productivity, and a 4-6 month period of inundation with depths of 15-20 cm (Craighead, 1971). Under natural conditions, fires were infrequent due to the sparse vegetation and seasonally wet conditions. However, shortened hydroperiods have increased fire risk by encouraging invasion by slash pine and wax myrtle.

Soils: Riviera fine sand, depressional

Vegetation:

TREES: pond cypress (Taxodium ascendens), slash pine
SHRUBS: wax myrtle, corkwood (Stillingia aquatica), St. John's wort
HERBACEOUS: bladderwort (Utricularia spp.), wild pine (Tillandsia spp.)
GRAMINOIDS: maidencane (Panicum hemitomon), cutgrass (Leersia sp.), tracy's beaked rush (Rhyncospora tracyi), yellow-eyed grass

5) Pasture. These former marsh and wiregrass prairie areas have been converted to pasture by improved drainage and seeding of bahia and pangola grasses. Maidencane, blue maidencane and bermuda grass occur adjacent to natural depressions and drainage ditches.

Soils: Malabar sand, Pineda sand, Immokalee fine sand

Vegetation:

GRAMINOIDS: bahia, vasey (Panicum urvellei), smut, blue maidencane

(Amphicarpum muhlenbergianum), torpedo (Panicum repens), bermuda (Cynodon dactylon), pangola (Digitaria decumbens)

6) Emergent marsh-broadleaf. A wetland community, characterized by long hydroperiods, and once common throughout the property interior and L-8 marsh, is now confined to small isolated depressions. The majority of remaining broadleaf associations are composed of pickerelweed and/or arrowhead. These marshes are situated at the lowest elevations, and therefore are seasonally inundated under normal rainfall conditions.

Soils: Riviera fine sand, depressional, Tequesta variant muck

Vegetation:

HERBACEOUS: pickerelweed (Pontederia spp.), arrowhead (Sagittaria spp.), smartweed (Polygonum punctatum), climbing aster (Aster carolinianus), southern blue flag (Iris hexagona), fire flag (Thalia geniculata), lizard's tail (Saururus cernuus)
GRAMINOIDS: maidencane, cutgrass

7) Shrub swamp. Coastal plain willow and primrose willow dominate this wetland habitat. Extensive willow heads once occurred along the Everglades margin, but are now confined to a few small isolated stands. Shrub swamp, consisting of pond apple and buttonbush, occurs by natural succession in the center of cypress domes where fire has been excluded.

Soils: Floridana fine sand, depressional, Chobee loamy sand

Vegetation:

TREES AND SHRUBS: coastal plain willow (Salix caroliniana), pond apple (Annona glabra), buttonbush (Cephalanthus occidentalis)
HERBACEOUS: primrose willow (Ludwigia peruviana)
GRAMINOID: sawgrass (Cladium jamaicensis)

8) Emergent marsh-sawgrass. This community has been severely reduced by excessive drainage and loss of sheet flow, especially in the L-8 marsh. Sawgrass stands are currently limited to scattered depressional areas and cypress dome centers, where the penetration of peat fires have eliminated shrubs and created soil depressions with extended hydroperiods.

Soils: Okeelanta muck, Tequesta muck

Vegetation:

GRAMINOID: Sawgrass

9) Other habitat. Habitats that are not represented by other designated habitat types are placed in this category. An example would be emergent marsh-cattail, which forms a minor component of the property's vegetative community and has become established only in disturbed areas (e.g., ditches, canals and cattle ponds).

10) Emergent wet prairie. This community once extended throughout the property, but has been severely reduced by loss of sheet flow and less frequent occurrence

of fire. Remnant wet prairie is present in association with cypress domes, scrub cypress, and other wetlands that flood occasionally. Natural wet prairie had 4-6 month hydroperiods and burned every 2-4 years usually during the dry season. This is the most diverse community on the property due to the large number of wildflowers, including several endangered flora.

Soils: Florida fine sand, depressional, Pineda sand

Vegetation:

SHRUBS: corkwood, St. John's wort
HERBACEOUS: marsh pink (Sabatia compunulata), bachelor button (Polygala spp.), butterwort (Pinguicula spp.),
GRAMINOIDS: Many spiked sedge (Cyperus polystachyos), grass like beaked rush (Rhyncospora microcarpa), beaked rush (Rhyncospora spp.), hat pins (Eriocaulon decangulare), yellow-eyed grass, maidencane

11) Hardwood hammock. These hammocks, which consist of live or laurel oak, are considered a hardwood climax community, and generally exist at elevations 1-3 feet (30-90 cm) above surrounding wetlands (Davis, 1943). Although oaks are a natural component in several vegetative communities, many of these hammocks have been planted intentionally. Other naturally occurring hammocks, composed primarily of cabbage palm, are situated at slightly lower elevations, interspersed among pine flatwoods and cypress. Cabbage palm hammocks are considered a sub-climax hardwood community (Soil Conservation Service, 1989)

Soils: Anclote fine sand, Jupiter fine sand

Vegetation:

TREES: live oak, laurel oak (Quercus laurifolia), cabbage palm, persimmon (Diaspyros virginiana), cabbage palm, strangler fig (Ficus aurea)
SHRUBS: wild coffee (Psychotria nervosa), red bay (Persea borbonia), virginia creeper (Parthenocissus quinquefolia), poison oak (Toxicodendron radicans)
HERBACEOUS: spanish moss (Tillandsia usneoides), resurrection fern (Polypodium polypodiodes)

12) Pine-cypress strand. This habitat is representative of cypress strands that have been invaded by slash pine due to overdrainage and/or lack of fire. These strands contain species of both pine flatwoods and cypress communities.

13) Cypress swamp. Cypress domes (i.e., cypress stands shaped by circular depressions and fire) are predominant throughout sections 22, 23 and 24 in depressional areas with hydroperiods of 4-6 months. Longest hydroperiods occur in dome centers which contain sawgrass, broadleaf marsh, or shrub swamp. Sawgrass and broadleaf marsh dominated cypress dome centers are maintained by frequent fire which penetrates the cypress interior during drought. Without periodic fire, succession to hardwood shrubs and eventually to cypress forest results (Duever et al., 1986). Other associated species include maidencane, spike rush, bladderwort, wild pine, spanish moss and numerous ferns.

Soils: Riviera sand, depressional, Basinger and Myakka sands, depressional

Vegetation:

TREES: Bald cypress (Taxodium distichum), pond cypress, pond apple (Annona glabra), swamp bay (Persea palustris)
SHRUBS: Wax myrtle, myrsine (Myrsine guianensis), buttonbush (Cephalanthus occidentalis), willow
HERBACEOUS: Pickerelweed, bladderwort (Utricularia cornuta), strap fern (Campyloneuron phyllitidis), swamp fern (Blechnum serrulatum), quill leaf (Tillandsia fasciculata), strap fern (Campyloneurum phyllitidis)
GRAMINOIDS: Sawgrass, maidencane

14) Open water. Ponds, canals.

15) Other land use. Buildings, orchard, road.

16) Exotics. As in most of south Florida, there is serious threat of encroachment by cajeput tree (Melaleuca quinquenervia) and Brazilian pepper (Schinus terebinthifolius). Brazilian pepper is dispersed throughout the property but occurs in dense concentrations among overdrained cypress strands in areas 19 and 21. There are several large infestations of Melaleuca which were chemically treated in 1988, with smaller areas being mapped and scheduled for treatment. Other exotics, Eucalyptus sp., norfolk pine (Araucaria excelsa), common guava (Psidium guajava), Indian rosewood (Dalbergia sissoo), and Japanese climbing fern (Lygodium japonicum) presently have limited distribution.

17) Swamp hardwoods. This community consists of red maple with a variety of ferns and vines in the understory. The dominance of maple in the overstory may be due to past logging practices that removed the cypress overstory (Duever, 1979).

Soils: Anclote fine sand

Vegetation:

TREES: Red maple (Acer rubrum), cypress
HERBACEOUS: Royal fern (Osmunda regalis), boston fern (Nephrolepis exaltata), spanish moss, catbrier (Smilax laurifolia)

A partial species list of flora occurring on the Reserve can be found in Appendix C1-3.

General Vegetation Descriptions

Vegetation descriptions are based on vegetation community maps located in appendices B3-B18. Numbered areas represent general land units separated by reference landmarks such as fencelines, roads, drainage ditches and property boundaries. Due to their irregular dimensions, areas may overlap more than one vegetation community map.

Areas 1-5

These areas have been most heavily impacted by construction of the St. Lucie canal. Overdrainage has resulted in a drastic reduction of wetland habitat, accelerated dense shrub growth, rapid growth of pine, and increased pine

reproduction. This area supports the property's largest slash pine and live oak trees which benefit from drier conditions. Nearly 90% of the area's understory has been converted to bahia grass, and recent suppression of fire has encouraged succession to hardwoods. Scattered remnant broadleaf marsh occurs in topographic depressions (i.e., below 24 ft NGVD). Mesic flatwoods consisting of slash pine, live oak, saw palmetto, wax myrtle and bahia grass, covers most of areas 1,2, and 3 (Appendix B3). Cabbage palm flatwoods occur in areas 4 and 5.

Areas 6-12

Areas 6, 8 and 9 are characterized by dense stands of even-aged (dbh < 25 cm) slash pine, and a thick understory of saw palmetto, gallberry and scattered live oak. Area 7 is comprised of cabbage palm flatwoods, pine flatwoods and bahia pasture (Appendix B5). Small isolated wetlands containing broadleaf marsh, maidencane and sawgrass are dispersed throughout the area. At the south end of areas 9 and 10, a variety of habitat types border the L-8 marsh (Appendix B7). This area is distinct due to the juxtaposition of broadleaf marsh, maidencane slough, willow thicket, swamp hardwoods, oak hammock and cabbage palm hammock. Area 11 contains numerous isolated wetlands that exhibit distinct flow patterns, evidence of an extensive slough system that existed prior to drainage. Cypress domes and remnant wet prairie typify the habitat in area 12, which appears to be situated in a transition zone between the wet prairie/flatwoods region to the north and the cypress forest described by Davis (1943) to the south and east. Fragments of wet prairie are vestiges of extensive sloughs that once facilitated sheet flow to the Everglades marsh. Exotics are generally confined to small infestations, and include a 3 acre Melaleuca stand chemically treated in 1988.

Areas 13-15, & 18

Areas 13 and 18 are dominated by mesic pine flatwoods with dense understory growth, and cypress domes heavily invaded by wax myrtle (Appendix B7). Duever (1976) reported similar invasion by this shrub in cypress domes where hydroperiods had been reduced to 45-155 days. Saw palmetto, gallberry and other native shrubs comprise the pine flatwood understory. Cooter Creek and several secondary ditches bisect these areas and create unnaturally dry conditions. This overdrainage has encouraged pine to invade cypress, transforming pure cypress communities into mixed stands. Hardwood hammock, consisting of live oak and cabbage palm are prevalent in area 14, along the L-8 marsh border. These hammocks occur at elevations around 20 ft NGVD, generally several feet above overdrained marsh. At slightly lower elevations, shallow hardwood swamp (maple) prevails, occasionally mixed with cypress. Area 15 encompasses 540 acres (218 ha) of remnant broadleaf marsh mixed with native grasses and terrestrial herbs, which have increased following the recent drought. Approximately 32 acres (13 ha) of Melaleuca in area 18 were chemically treated in 1988.

Areas 16 & 17

Area 16 contains mostly improved pasture with remnants of broadleaf marsh at elevations generally below 17.5 ft NGVD. During seasons with near normal precipitation, these marshes may be inundated for several months in the wet season. Peripheral areas around these marshes are inundated for shorter duration, creating transitional wetland zones of mixed grass, spike rush, beaked

rush and other sedges. Shallow hardwood swamp occurs along remnant sloughs at the marsh perimeter, and live oaks occupy slightly elevated terrain (e.g., Indian mounds). Area 17 features mostly mesic flatwoods with scattered cypress domes, sawgrass and broadleaf marsh (Appendix B9). Cypress/hardwood stands represent former sloughs that contributed flow to the Everglades marsh.

Area 19

Area 19 contains the largest contiguous section of L-8 marsh, which due to overdrainage consists primarily of dog fennel (Eupatorium sp.), bahia, knotroot bristlegrass, chalky bluestem, red top panicum (Panicum rigidulum) and other grasses. Scattered depressional areas (i.e., areas below 16 ft NGVD) contain remnants of broadleaf and sawgrass marsh (Appendices B9, B11, and B13). These marshes are surrounded by areas of pasture that are attaining old field succession with the absence of cattle. Towards the southeast corner of the property, succession has resulted in a stand of elderberry (Sambucus simpsonii). Several relict stands of willow and sawgrass occur at lower elevations along the eastern edge of the marsh.

Areas 20-22

This area is dominated by mesic pine flatwoods, low pine flatwoods, scrub cypress and cypress domes (Appendices B11 and B13). To the west, flatwoods are dominated by sapling-pole size slash pine, accompanied by an understory of saw palmetto, rusty lyonia, shiny blueberry and gallberry. To the east, there are low pine flatwoods, which are occasionally inundated during the wet season. Cypress domes and cypress scrub have retained relatively natural vegetative characteristics due to frequent inundation during the wet season. However, depth and duration of flooding has been reduced following construction of the FP&L road and canal in 1972, which severed the flow of water through these wetland systems. Encroachment of slash pine, wax myrtle and brazilian pepper into cypress habitat is indicative of this altered hydrology. Invasion of Brazilian pepper into cypress communities, has been particularly heavy in area 21. Ewel and Mitsch (1978) suggest that decomposition of cypress needles is slower in overdrained cypress domes, resulting in greater accumulation of organic material which creates conditions favorable for more destructive fires. Area 22 contains one Melaleuca infestation, 8 acres (3.2 ha), which was chemically treated in 1988.

Area 23

Area 23 encompasses nearly 3,400 acres (1,360 ha) of relatively natural cypress, low pine flatwoods, and wet prairie (Appendix B15). Many of these areas are exhibiting initial signs of overdrainage, most evident in the vicinity of the FP&L canal. Declining health of cypress trees, and dense slash pine regeneration in scrub cypress communities above 23 ft NGVD, are indicative of reduced hydroperiod. The interior of area 23 remains in relatively natural condition primarily due to wet season inundation and the absence of drainage influence. Cypress domes situated at lower elevations (i.e., < 23 ft NGVD) have longer hydroperiods (6-8 months) than other cypress habitat on the property and are less impacted by overdrainage. Encroachment of exotics is minimal in the interior, however Brazilian pepper and Japanese climbing fern (Lygodium japonica) have become well established adjacent to the FP&L canal.

Area 24

Similar to area 23, this section is typical of the cypress forest dominated by low pine flatwoods, wet prairie, scrub cypress and cypress domes (Appendix B17). This area also contains considerable scrub cypress, and several extensive sawgrass marshes which occur in cypress domes. Scrub cypress on the area's east side, near the FP&L canal, has been heavily invaded by slash pine. Future citrus development on adjacent land, immediately north of area 24, may have further deleterious effects on these wetlands by lowering the groundwater table.

Endangered Flora

At least 13 species of plants designated by the Florida Department of Agriculture and Consumer Services as endangered, threatened or commercially exploited have been identified as occurring on Dupuis Reserve (Appendices C1-C3). Another species, little bluestem (Schizachyrium rhizomatum), is currently under review by the U.S. Fish and Wildlife Service. Further surveys for endangered plants are needed to supplement this partial list.

WILDLIFE RESOURCES

The diversity and juxtaposition of habitat types supports a wide variety of wildlife, including at least 14 species considered rare, endangered, threatened, or of special concern (Table 2). The status of two species, Bachman's sparrow (Aimophilia aestivalis) and round-tailed muskrat Neofiber alleni) is currently under review. An assortment of wildlife species have been observed utilizing the property including, 105 bird species, 24 mammal species, 16 species of fish, 18 reptilian species and 9 species of amphibians (Appendices B4-B7). Healthy populations of white-tailed deer (Odocoileus virginianus) and feral pig (Sus scrofa) could sustain a substantial harvest. Other potential game species, wild turkey (Meleagris gallopavo), mourning dove (Zenaida macroura), gray squirrel (Sciurus carolinensis) and northern bobwhite (Colinus virginianus) are present in small numbers.

Endangered Species

Eight of the listed endangered species, the red-cockaded woodpecker (Picoides borealis), Florida sandhill crane (Grus canadensis), southern bald eagle (Haliaeetus leucocephalus), little blue heron (Egretta caerulea), tricolored heron (Egretta tricolor), American alligator (Alligator mississippiensis), eastern indigo snake (Drymarchon corais) and sherman's fox squirrel (Sciurus niger) are probable or verified breeders on the property. River otter (Lontra canadensis), northern harrier (Circus cyaneus), eastern American kestrel (Falco sparverius), merlin (Falco columbarius), osprey (Pandion haliaetus), and cooper's hawk (Accipiter cooperi) have been observed on the property and are listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Floras (CITES). In addition, four bird species, white ibis (Eudocimus albus), least bittern (Ixobrychus exilis), yellow-crowned night heron (Nyctanassa violacea), and black-crowned night heron (Nycticorax nycticorax) are currently registered as special vertebrates by the Florida Natural Areas Inventory.

Table 2. ENDANGERED, THREATENED, RARE AND SPECIES OF SPECIAL CONCERN OBSERVED ON DUPUIS RESERVE

ENDANGERED (E)
UNDER REVIEW (UR)
SPECIES OF SPECIAL CONCERN (SSC)
THREATENED (T)

MAMMALS		
Florida panther	*Felis concolor*	(E)
Round-tailed muskrat	*Neofiber alleni*	(UR)
Sherman's fox squirrel	*Sciurus niger*	(SSC)
BIRDS		
Bachman's sparrow	*Aimophila aestivalis*	(UR)
Florida grasshopper sparrow	*Ammodramus savannarum*	(E)
Limpkin	*Aramus guarauna*	(SSC)
Little blue heron	*Egretta caerulea*	(SSC)
Snowy egret	*Egretta thula*	(SSC)
Tricolored heron	*Egretta tricolor*	(SSC)
Florida sandhill crane	*Grus canadensis*	(T)
Bald eagle	*Haliaeetus leucocephalus*	(T)
Woodstork	*Mycteria americana*	(E)
Red-cockaded woodpecker	*Picoides borealis*	(T)
Snail kite	*Rostrhamus socialbilis*	(E)
AMPHIBIANS AND REPTILES		
American alligator	*Alligator mississippiensis*	(SSC)
Eastern indigo snake	*Drymarchon corais*	(T)

Repeated sightings indicate that Dupuis could provide important habitat for the federally endangered Florida panther. Numerous signs (e.g., scats, kills), and the illegal shooting of two panthers in 1983-1984, produced evidence of substantial use of the area by these cats (Regan; unpub. rep.). Additional sightings have occurred as recently as April 1988.

Round-tailed muskrat breed in the area and are currently under review for listing by the U.S. Fish and Wildlife Service. Although the present status of this mammal in Florida is undetermined, there appears to be a healthy local population inhabiting densely vegetated marsh on the property.

An active red-cockaded woodpecker nest was located in area 11, however the cavity tree was subsequently burned by wildfire in May 1989 (Fig. 6). This cavity appears to be the last active nesting site on the property. Other abandoned colony sites have been located in areas 5 and 10, indicating that a larger population may have existed at one time. Overdrainage and fire suppression have encouraged dense understory growth, conditions not conducive to nesting woodpeckers, and past logging practices may have reduced the availability of potential cavity sites.

Five active bald eagle nests are present in areas 3, 7, 12 and 13 (Fig. 6). Three of these nests successfully fledged young during 1989, and one nest in area 7 has produced young for at least 4 consecutive years.

In spring 1987, a 5 acre bird rookery in area 4 contained nests of eight species of wading birds, including little blue and tricolored heron. Normal precipitation during the 1987 wet season inundated interior wetlands and provided adequate foraging habitat for nesting birds in spring 1988. During the succeeding drought years (1989 and 1990), wetland foraging habitat was eliminated, and the ground under the rookery site was dry, resulting in failed nesting attempts.

Nesting sandhill cranes are also influenced by spring conditions of the interior marshes. The combination of open flatwoods for feeding and isolated wetlands create an ideal situation for nesting cranes, and several pair were observed throughout the breeding season in 1987. Cranes were sighted infrequently in 1989 and 1990 probably due to the extended drought conditions.

Snowy egret (Egretta thula), wood stork (Mycteria americana) and snail kite (Rostrhamus sociabilis) occasionally utilize Dupuis for feeding. Additional surveys are needed to determine breeding status of the Florida grasshopper sparrow (Ammodramus savannarum).

Non-game Species

A total of 105 bird species have been observed on the property, 66 of which have been recorded during the annual breeding bird survey (1987-1990) as possible or probable breeders (Table 3). The total number of breeding birds at Dupuis is comparable to those at Corbett and other similar locations in south Florida. Patterns of bird use on Dupuis are also comparable to other natural areas where bird densities are low during the summer breeding season, with both density and diversity increasing during the migratory and winter periods. The number of

Table 3. PROBABLE/CONFIRMED AND POSSIBLE BIRDS BREEDING AT DUPUIS RESERVE

Probable/Confirmed

American anhinga
American coot
Little blue heron
Cattle egret
Black-crowned night heron
Green-backed heron
Least bittern
Sandhill crane
Wild turkey
Northern bobwhite
Red-shouldered hawk
Red-tailed hawk
Bald eagle
Screech owl
Barred owl
Common barn owl
White-winged dove
Mourning dove
Ground dove
Smooth-billed ani
Common nighthawk
Chuck-wills-widow
Northern flicker
Red-bellied woodpecker
Red-cockaded woodpecker
Downy woodpecker
Pileated woodpecker
Eastern kingbird
Great crested flycatcher
Northern rough-winged swallow
Fish crow
Blue jay
Blue-gray gnatcatcher
Carolina wren
Brown thrasher
Gray catbird
Northern mockingbird
Eastern bluebird
Loggerhead shrike
White-eyed vireo
Prothonotary warbler
Pine warbler
Prairie warbler
Common yellowthroat
Red-winged blackbird
Boat-tailed grackle
Eastern meadowlark
Northern cardinal
Rufous-sided towee
Bachman's sparrow

Possible

Mottled duck
Wood duck
Pied-billed grebe
Limpkin
White ibis
Killdeer
Black vulture
Turkey vulture
American kestrel
Great horned owl
Yellow-billed cuckoo
Belted kingfisher
Barn swallow
Common grackle
American redstart

birds recorded in the Dupuis breeding bird survey declined during the drought years, 1989 and 1990, in comparison to 1988. Several species, eastern bluebird (Sialia sialis), white-eyed vireo (Vireo griseus) and prothonotory warbler (Protonotaria citrea), that were common during the 1988 survey, were visibly absent during the last two surveys.

The most common breeding birds associated with the mesic pine flatwood communities include red-bellied woodpecker (Melanerpes carolinus), crested flycatcher (Myiarchus crinitis), northern mockingbird (Mimus polyglottos), brown thrasher (Toxostoma rufum), loggerhead shrike (Lanius ludovicianus) and pine warbler (Dendroica pinus). Red shouldered hawk (Buteo lineatus), barred owl (Strix varia), chuck-wills widow (Caprimulgus carolinensis), pileated woodpecker (Drycopus pileatus) and carolina wren (Thryothorus ludovicianus) are more common among cypress domes and hardwood hammocks. Considering the intensive agriculture surrounding Dupuis, the property may represent an important migratory stop for many species.

Despite the abundance of favorable habitat, diversity of reptiles and amphibians appears to be low. Loss of permanent wetlands, and the destructive foraging habits of a large feral pig population may have contributed to the decline of amphibian and reptile numbers. Pig rooting may be similar to soil scarification which has been suggested to adversely affect herpetofauna populations (Marion and O'Meara, 1982). In north Florida, Vickers et al. (1985) indicated that ditching of cypress ponds changed herpetofauna species composition (i.e., more terrestrial species), and resulted in a decline of species richness in dry weather.

Game Species

Through a "Memorandum of Agreement" contract with the District, the Florida Game and Freshwater Fish Commission (Game Commission) developed Dupuis Reserves' first public hunting program for three species, white-tail deer, feral pigs and turkey. This program was designed to provide a low intensity, high quality hunting experience by restricting vehicle access to the east perimeter roads, controlling hunter densities, and excluding the use of dogs.

White-tail deer

A popular game species, the white-tailed deer is relatively abundant on the Reserve. Preliminary densities of 1 deer per 40 acres was estimated based on spotlight surveys conducted by the Game Commission in July 1990 (Carbonneau, unpub. rept.). This density was not significantly different from the 1 deer per 37 acre estimate from the 1989 survey. These densities are higher than Corbett and other areas in south Florida and comparable to management areas in central Florida (Ruhl and Carbonneau, 1988). A sex ratio of 1 buck per 42 does in the 1990 survey indicates a small number of bucks, however problems in identifying bucks during the survey may have resulted in the skewed sex ratio (Carbonneau, unpub. rept.). Additional surveys are needed to better define population characteristics of the herd.

Feral Pigs

This exotic species originated from feral stock introduced to Florida in the 16th

century, and has become well established throughout the state. Pigs have become a popular game animal and until recently were stocked at Corbett and other management areas. While Dupuis was under private ownership, 300-400 pigs were harvested annually through a private trapping agreement. Although no population estimates are available, the amount of habitat degradation indicates that the number of pigs has increased dramatically since District acquisition. Soil disturbance created by the digging or rooting behavior of these animals results in aesthetic damage, potentially eliminates ground dwelling reptiles, and provides favorable conditions for invasion by exotic plant species.

To control the pig population, the Game Commission established liberal hunting quotas and extended hunting seasons. Despite hunter selectivity (i.e., preferred size and/or sex) and limited hunting access, 585 pigs were harvested during twelve, three-day hunting periods between September and December 1989. Based on these harvest figures the density of pigs on Dupuis was estimated at 1 pig per 19 acres, a conservative estimate considering hunter access was limited to the eastern half of the Reserve. This is an extremely high number of pigs when compared to the adjacent Corbett Area, which has an estimated population of 500 pigs on 57,892 acres, or 1 pig per 116 acres (Dunford, pers. comm.). Lower population numbers on Corbett can be attributed to greater hunting pressure and hunter access, a longer history of sustained harvest, and less favorable habitat conditions (i.e., longer hydroperiods) for feral pigs.

Turkey

Turkey have been observed frequently in the transitional vegetation of areas 11, 12 and 13. This habitat is characterized by wet prairie, broadleaf marsh, and small cypress domes interspersed among pine flatwoods. Turkey do not appear to be particularly abundant, although at least one flock of 15-20 birds has been observed periodically. There is evidence that turkey cross regularly between Corbett and the Dupuis Reserve; therefore numbers on either property may be quite variable.

A spring turkey hunting season was initiated by the Game Commission in March 1990. No birds were harvested during the nine day season. A subsequent turkey survey was completed by the Game Commission to begin monitoring population trends.

Waterfowl

Four species of waterfowl have been recorded at Dupuis compared to 14 at Corbett, which features less impacted wetland habitat. Resident species such as wood duck (Aix sponsa) and Florida duck (Anas fulvigula) have been rarely observed. Experimental flooding of the L-8 marsh in 1988 attracted a large number of ducks, including American widgeon (Anas americana) and green-winged teal (Anas crecca), demonstrating that marsh restoration will enhance this area for waterfowl.

Other game animals

Overdrainage of Dupuis has probably been most beneficial to several small game species such as gray squirrel, northern bobwhite, mourning dove, and fox squirrel (protected, but legally harvested in some areas). Quail populations could be

increased to harvestable numbers through intensive land management (e.g., prescribed burning). Although numerous furbearers such as otter and raccoon are present on the property, trapping is not considered compatible with SOR objectives.

Fish

Appendix C4 lists sixteen species of fish that have been collected from Dupuis including several game species, largemouth bass (Micropterus salmoides), warmouth (Lepomis gulosus) and bluegill (Lepomis macrochirus). However, except major canals, recreational fishing is mostly limited to a series of shallow cattle ponds which appear to have low species density and diversity. The black acara (Cichlasoma bimaculatum), an exotic, has been collected from several interior ditches and ponds.

MANAGEMENT RECOMMENDATIONS

WETLAND AND HYDROPERIOD RESTORATION PLAN

The major objective of this plan is to preserve, enhance or reestablish native plant communities on Dupuis by restoring a more natural hydroperiod (i.e., historic depth, duration, and timing of inundation). Secondary goals for this project include: 1) restoration of historic Everglades marsh, 2) enhancement of wildlife habitat 3) impeding encroachment of exotic species 4) improvement of aquifer recharge capabilities, and 5) maintenance of a high water quality source. The plan consists of three phases: 1) back filling ditches (ditch plugs) at strategic locations to restore interior wetland hydroperiods, 2) development of a hydrologic and hydraulic analysis to design water control structures for impounding water in the L-8 marsh, and 3) reestablish the natural hydrologic connection with the adjacent Corbett Area.

Background

Historically, the Everglades originated along the eastern shore of Lake Okeechobee and included nearly 2,500 acres (1,012 ha) of land presently on the Dupuis Reserve, referred to as the L-8 marsh. Hydrology of the property was dominated by overland sheet flow from northeast to southwest through a series of wet prairies and cypress sloughs. These wetlands represented an extension of a vast marsh system to the northeast called the Allapatah slough, which provided a natural source of flow to the Everglades. This flow was eliminated following construction of the St. Lucie Canal in the 1920's. Completion of the L-8 canal resulted in further drainage of the remaining Everglades, and prompted the installation of additional ditch systems which facilitated drainage off the property. In 1977, construction of the FP&L east transmission line access road severed the hydrologic connection with the adjacent Corbett Management Area, resulting in further overdrainage of the Reserve.

Three drainage systems have had a major influence on the hydrology of the property, the St. Lucie canal to the north, the L-8 canal to the west and south and the Florida Power and Light powerline canal on the east boundary with Corbett. In addition, Cooter Creek and an extensive network of shallow ditches

have successfully drained much of the property's interior wetlands. The extent of overdrainage is exhibited by the tremendous loss of wetland habitat, invasion of exotics, accelerated shrub growth and vegetative fuel accumulation, encroachment of slash pine into wet prairie and cypress habitat, and the declining condition of cypress trees.

The following section provides a brief description of habitat and current hydrologic conditions in each drainage basin, and proposes a strategy for accomplishing the restoration goals and objectives.

Areas 1-5

Mesic flatwoods and improved pasture characterize this area which historically was comprised of wet prairie and low pine flatwoods that drained southwest towards the Everglades. The area is severely overdrained by a series of shallow ditches which connect and drain wetland systems, resulting in fragmented remnant wetlands. The dominant soil types, Riviera fine sand, Pineda sand, and Malabar sand, are all typical of low pine flatwoods, wet prairie or native grassland (McCollum and Cruz, 1979), and would support these vegetative communities with proper hydroperiod and management (e.g., prescribed burning).
This area delineates approximately 2,482 acres (1,004 ha) that presently drains north to the St. Lucie Canal through four major drainage ditches (Fig. 7). Ditch plugs and operable water control structures will be utilized to restrict drainage to the north, and restore interior wetlands.

Area 4 contains the only active wading bird rookery on the property, located in a willow thicket island, in a pond at the end of a series of wetlands draining north to the St. Lucie canal. In past years without sufficient rainfall, marshes throughout the area dried completely, and water levels in the pond surrounding the rookery decreased rapidly, resulting in poor wading bird nesting and feeding conditions. Specific restoration goals for this area are: 1) restrict drainage off the property to the St. Lucie canal, 2) inundate wetlands sufficiently to increase marsh productivity, 3) allow natural recession of water levels in the winter and spring to concentrate wading bird food organisms, and 4) maintain sufficient water levels in the rookery to stimulate wading bird nesting. To accomplish these goals, it will be necessary to install a water control structure at the north road to replace the present culvert (Appendix D1). The riser structure should be placed on the downstream (north) end of the culvert to provide water control, while maintaining the integrity of the road. This structure accompanied by plugs 4A and 4B will restore 175 acres (71 ha) of marsh communities, and during heavy periods of rainfall create sheet flow to the south.

Considerable restoration can be accomplished in areas 2, 3 and 5 by modifying the present drainage system with ditch plugs placed at strategic locations. Ditch plugs at 2A and 2C will inundate 30+ acres of wetlands, and eliminate drainage to the St. Lucie canal (Appendices D2 and D3). In addition, ditch plug 2B and control structure 36 will reduce water flow to the St. Lucie, and extend hydroperiods in several wetlands (Appendix D4). Appendix D5 and D6 depict locations for construction of ditch plugs to restore over 100 acres (40 ha) of drained marsh in areas 3 and 5.

Areas 6-10

Dense stands of even-aged slash pine with an impenetrable understory of saw palmetto, in areas 6 and 8, is indicative of the area's past overdrainage. Two major ditch systems bisect the area, eventually discharging into the L-8 north tieback canal. Wetlands are scattered along major drainageways in depressional areas which receive some seasonal inundation. Melaleuca and Brazilian pepper have become well established in parts of area 10.

Ditch plugs are proposed for several wetland systems that extend into area 12, west of the main road. The restoration goal is to reestablish sheet flow in a southerly direction from area 11 through areas 12 and 10. Ditch plugs 10A, 10B and 10E will restore hydroperiods in cypress domes and impede the encroachment of exotics (Appendix D7). Ditch plugs 10C, 10D, and 12C are proposed for another wetland directly to the north which extends into area 12 (Appendix D8). Smaller isolated wetlands can be restored with individual ditch plugs at 6A, 9C, and 9D (Appendices D3, D9 and D10). Water control structure 1 contains a 60" flash board riser which can be utilized to inundate a 10 acre marsh adjacent to the main road (Appendix D11). Additional backfilling of the major ditches at 8A, 8B, 9A, and 9B will reduce drainage off the property and encourage sheet flow towards the L-8 marsh (Appendices D9 and D10).

Area 11

Area 11 contains 180 acres (73 ha) of former broadleaf and sawgrass marsh, most of which has been converted to improved pasture. This marsh may represent a critical foraging area for wading birds nesting in the area 4 rookery. The remainder of the area is comprised primarily of pine flatwoods. The dominant soils, Floridana fine sand, depressional and Riviera fine sand, depressional would support sawgrass and broadleaf marsh, respectively, under natural hydroperiods (i.e., 6 to 9 months). Remnants of both wetland types provide a potential seed source.

The area 11 basin encompasses several hundred acres, presently draining east into an adjacent citrus development canal, which eventually discharges into the St. Lucie canal. Restoration for this area depends upon stable backfill at the east side of the marsh where water exits the marsh (Appendix D12). To encourage sheet flow and reduce the velocity of flow, ditch plugs will be placed along the drainage ditch at B, C, and D. The intent of this design is to restore wetlands, and with excess water, re-create natural sheet flow to the south into areas 12 and 10.

Areas 12-15

These areas represent a transition zone between the improved pasture and overdrained pine flatwoods to the north, and more natural cypress forest to the south and east. These areas were characterized historically by vast areas of low pine flatwoods and wet prairie, which facilitated sheet flow towards the Everglades marsh. Area 13 contains several cypress domes with abbreviated hydroperiods due to the proximity of Cooter Creek.

Ditch plugs at 12A, 12B, and 12C will restore hydroperiods in several wetland

systems (Appendices D8 and D13). During extreme storm events this area may receive excess sheet flow from area 11. The plug at 12B will reduce water losses through a culvert located under the FP&L east powerline road which discharges into a canal on the adjacent citrus development. Water control structure 31 has been utilized to maintain higher water levels in Cooter Creek, thus reducing this drainage influence. Additional restoration efforts downstream in Cooter Creek, and in adjacent areas should assist in prolonging hydroperiods in area 13.

A series of ditch plugs are proposed for a major drainage ditch which is located in areas 14 and 15 at the perimeter of the L-8 marsh. Ditch plugs 14A, 14B, and 14C will reduce drainage into this ditch and restore broadleaf marsh and cypress in area 14 (Appendix D14). Ditch plug 15A will eliminate drainage into the L-8 canal and encourage water to flow into the surrounding marsh.

Areas 17 and 18

These areas are characterized by pine flatwoods and cypress domes which are overdrained as a result of several ditches draining to the L-8 canal. Consequently, a severe Melaleuca infestation has occurred in area 18, and heavy vegetative fuel accumulation has produced several wildfires. Historically, several large cypress/hardwood strands bisected this area, providing sheet flow to the Everglades.

The goal for this area is to re-create historic sheet flow to the L-8 marsh by backfilling Cooter Creek and tributary ditches. Backfilling is proposed at 18A, 17A, and 23A (Appendix D15).

Areas 19-24

Despite loss of sheet flow, and excessive drainage from Cooter Creek and the FP&L canal, these areas include natural cypress domes, scrub cypress strands, wet pine flatwoods, wet prairie, and cabbage palm hammock characteristic of the cypress forest. This region has been most affected by construction of the FP&L road which severed a source of sheet flow from the adjacent Corbett Area wetlands. Consequently, the shortened hydroperiod has encouraged dense shrub growth and pine regeneration in wetlands. Disturbance from ditch and road construction, in conjunction with drier conditions, has resulted in severe encroachment of Melaleuca and Brazilian pepper, particularly in areas 21 and 22. A citrus grove under development just north of area 24 may have additional deleterious impacts by lowering the ground water table.

The restoration objective for this region consists of reestablishing the historic sheet flow by re-creating a hydrologic connection between Dupuis Reserve and the Corbett Area. This can be accomplished by constructing gaps in the road where it has severed historic sloughs (Fig. 8). During the wet season, these gaps should divert excess water from the Corbett Area, elevating water levels in the canal. Degradation of the canal's west berm and backfilling sections of the canal downstream of each gap will encourage sheet flow south and west across the Dupuis Reserve. Each gap would be set at natural ground elevation to promote wet season flow without overdraining wetlands on the Corbett Area. These gaps will be designed with gradual slopes and filled with shell rock, concrete or other

material that allows access regardless of flow levels. This project will yield numerous benefits to the District, FP&L and the Game Commission:

1) Help restore structure and function of major wetland systems on Dupuis Reserve, and meet SOR objectives by preserving or enhancing native wetland communities

2) Provide an additional source of sheet flow for Everglades marsh restoration

3) Relieve underdrainage problem on the Corbett Area which has developed due to impoundment of water against the FP&L road

4) Create a dependable all-season road for District and FP&L staff. Due to hydrostatic pressure resulting from water being impounded on the Corbett Area, the road has washed out at several locations becoming temporarily impassable. Corbett's L-8 marsh restoration project will result in higher water levels on the east side of the road. This may result in further damage to the road and considerable maintenance cost to FP&L

5) Protect FP&L transmission pads from flooding which occurred during several storm events in October 1990.

Appendices D16 and D17 depict ditch plugs 19A and 19B that will alleviate the overdrainage of cypress and hardwood swamp in area 19. However, these ditch plugs will eventually become obsolete during final phases of this restoration plan because water levels will be elevated in the FP&L canal, and the L-8 marsh will be impounded.

L-8 marsh (areas 15, 16 and 19)

The L-8 marsh represents approximately 2,500 acres (1,012 ha) of former Everglades that was drained and converted to pasture following construction of the L-8 canal and secondary ditches. Dominant marsh soil types, Okeelanta muck, Jupiter fine sand, and Sanibel muck represent wetland soils which would accommodate restoration of marsh vegetation communities. Viable seed sources are present in remnant broadleaf and sawgrass marsh located in isolated depressional areas.

The objective for this area is to restore form and function of the marsh by re-creating a more natural hydroperiod (6-12 months) in the marsh. Four steps are necessary to accomplish this objective; 1) removal of present water control structures from L-8, 2) application of spoil material to improve and stabilize L-8, 3) design and construction of a water control weir structure for L-8, and 4) installation of interior ditch plugs to encourage sheet flow and attenuate flow to the marsh.

This restoration plan proposes construction of forty ditch plugs and use of several water control structures to re-create historic sheet flow and restore a portion of the Everglades system (Fig. 9). The plan may require additional installation or replacement of water control structures to maintain the integrity of property roadways, and promote additional hydroperiod restoration. Important water control structures (e.g., #1 and #31) are modified boiler pipes installed

by previous landowners to facilitate drainage. Consequently, these structures need to be replaced with proper corrugated metal pipe culverts and riser structures.

GRAZING

In consideration of past use of the property as a cattle ranch, the U.S.D.A. Soil Conservation Service was enlisted to conduct a forage inventory and develop a grazing plan. This plan was modified to reflect changes requested by District staff to exclude cattle from environmentally sensitive areas. Consequently, the final grazing plan did not include the L-8 marsh and most of the native cypress forest in Palm Beach County. The remaining 8,400 acres (3,399 ha) of areas 1-13 were included in the draft grazing lease which recommended stocking of 676 animal units to be rotated among 13 pastures.

Grazing has been widely accepted as a land management technique to impede succession of shrubs and reduce vegetative fuel accumulation. However, improved pasture has minimal habitat value for most wildlife species, and there is evidence that prolonged grazing may be detrimental to some species (Hunt, 1987), or may change the structure of natural vegetative communities (Duever, 1978). Grazing may also conflict with recreational use and other management efforts such as prescribed burning. Prolonged grazing tends to maintain improved pasture, thus it is not consistent with SOR objectives of restoring or preserving native vegetative communities. Therefore, it is recommended that grazing be utilized only in modified habitat (i.e., improved pasture) and only where other management strategies (e.g., prescribed burning, hydroperiod restoration) are not considered adequate.

EXOTIC PLANT CONTROL

Control of two exotic species, Brazilian pepper and Melaleuca, was initiated in 1988. Five major infestations of Melaleuca, totalling 30 acres (12 ha) were successfully treated with the herbicide Velpar L, applied by truck mounted spray unit and/or helicopter. Several smaller Melaleuca infestations were treated in 1989 by small crews using hand sprayers and machetes. Machetes were used to slash open a wound through the basal cambium layer into which the herbicide was applied. Despite control efforts, further spread of this species is imminent, especially in burned and other disturbed areas. Therefore, continuation of an aggressive control program is critical in restricting further infestation. This program should emphasize elimination of seed producing mature trees, with second treatments to eliminate root sprouting seedlings. Secondary treatments must be completed shortly after initial treatments, since seedlings can begin producing seeds two to three years after germination (Langeland, 1990).

The Melaleuca control program should include: 1) survey and mapping of infested areas, 2) an intensive monitoring program to assess success of treatments and schedule second applications, and 3) secondary treatments of herbicide or prescribed burning to eliminate seedlings before they mature.

Due to the wide distribution of Brazilian pepper, control of this species may be extremely difficult and expensive. Approximately 1,000 acres (400 ha) of recently burned land, with moderate pepper invasion, were experimentally treated

by District staff in 1989. Brazilian pepper trees that were stressed from fire were judged to be more susceptible to herbicide treatments, which consisted of a basal handsprayer application of Garlon 4 mixed with diesel fuel. Future control efforts should focus on eliminating dense pepper encroachment from native cypress stands in areas 19 and 21. These stands have reached a mature successional stage where a majority of the pepper trees have exceeded 10 cm dbh, resulting in complete elimination of the herbaceous ground layer. In mature stands of this species, prescribed burning may not be effective due to reduced fuel levels. In addition, prescribed burning of these mature stands appears to result in rapid recolonization by pepper seedlings, therefore extensive and expensive chemical treatments of these stands are necessary (Doren and Whiteaker, 1990).

The following measures can be taken to further control Brazilian pepper encroachment: 1) removal of seedlings from disturbed areas (e.g., firelanes), 2) avoid creating additional disturbed areas, 3) initiate aggressive prescribed burning and hydroperiod restoration programs to eliminate seedlings, and 4) conduct additional treatments of Brazilian pepper in prescribed burn areas if they are successful and cost effective.

Several other exotic species including bamboo (Bambusa sp.), guava (Psidium guajava), eucalyptis (Eucalyptis sp.) and Indian rosewood (Dalbergia sissoo) are present in small numbers and can be mechanically removed. Japanese climbing fern (Lygodium japonicum) has become well established throughout the overdrained cypress in areas 19 and 21.

Bahia and pangola grass were planted extensively to improve cattle forage on native rangeland. Consequently, the thick growth characteristic of these species has succeeded in displacing many native plant species. Wetland and hydroperiod restoration, prescribed burning, and selective roller chopping should provide conditions more conducive to native grasses and herbaceous vegetation.

PRESCRIBED BURNING

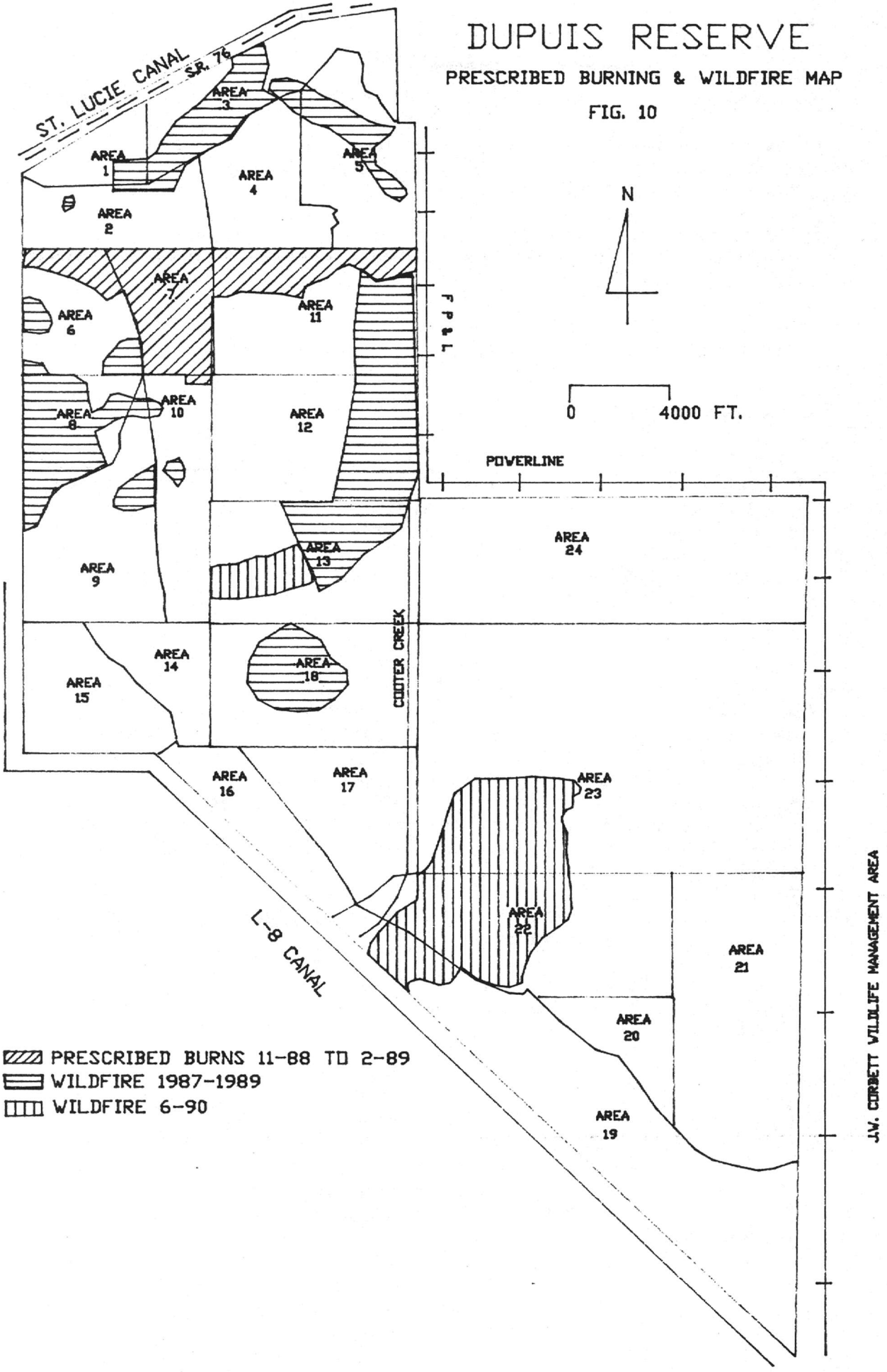
Prescribed burning may be the most cost effective management technique available to increase density and diversity of native flora and fauna. A prescribed burning program was implemented at Dupuis in November 1988 by the District's Land Management Department in cooperation with the Game Commission and Division of Forestry. The initial intent of this program was reducing vegetative fuel and protecting the property resources. Nearly 1,000 acres (400 ha) were burned in areas 6, 7 and 11 to create an east-west firebreak (Fig. 10). Due to extremely dry conditions in spring 1989, an additional 1,000 acres were consumed by wildfires resulting in 60-80% mortality of slash pine in some areas. In addition to reduction of hazardous fuel loads, prescribed burning can also be utilized to set back succession and increase yield of indigenous plants, thus improving the habitat for numerous wildlife species. Prescribed burns will provide additional benefits by breaking up bahia pasture and encouraging growth of native range species.

A prescribed burning plan should be completed for the property and include the following provisions:

DUPUIS RESERVE

PRESCRIBED BURNING & WILDFIRE MAP

FIG. 10



1) A map of areas with particularly heavy fuel loads for planning future burns

2) A map of special wildlife habitat such as oak hammocks and cabbage palm hammocks that require special attention (e.g., roller chopping, back burning, firelines) as protection against wildfires

3) Identify wildlife management areas accessible to hunters where controlled burning can be used to increase populations of turkey, quail and other game species by stimulating production of native food species

4) Identify areas infested with melaleuca where herbicide treatments may be needed to eliminate seedling growth following a controlled burn

5) Prepare special burn plans for active or potential red-cockaded woodpecker colony sites, and active bald eagle nests.

In conjunction with this plan, a series of permanent fire breaks should be established, utilizing existing roads, canals and fencelines, and maintained, thus reducing the need for temporary plow lines that create soil disturbance, and disrupt hydropatterns. Firelines that redirect surface water flows need to be identified and graded to natural ground elevation. Fire breaks can be used to subdivide the property into approximately 100 acre (40 ha) prescribed burn units to be managed individually to benefit endangered or special species.

FOREST MANAGEMENT

Over 60% of the property is comprised of pine flatwoods characterized by low tree densities and low timber volume. A dearth of marketable timber would make a commercial timber operation on the property unfeasible. However, there are several dense stands of young slash pine in areas 6 and 8 which could be selectively thinned. Selective thinning could be beneficial by stimulating tree growth near potential red-cockaded woodpecker colonies, perhaps providing future cavity trees. Although oak and maple are present in small stands, they have immense value as wildlife habitat and should not be harvested. Cypress, although plentiful, is mostly second growth and would not be economically or ecologically feasible to harvest. In general, any commercial timber operation would not be compatible with SOR goals due to potential aesthetic problems, degradation of water quality and other disturbance factors.

Oaks have been successfully planted at several locations and additional plantings could be attempted on drier sites. Pine regeneration is excellent throughout the property precluding the need for additional tree planting.

WILDLIFE MANAGEMENT

In 1988, a Memorandum of Understanding was signed to acquire the Game Commission's support in managing Dupuis' wildlife resources in consultation with the District. This agreement appointed the Game Commission specific responsibilities to conduct: 1) population surveys of game and non-game species, 2) quota hunts, 3) wildlife law enforcement, and 4) surveys and management for endangered or threatened species.

In general, management will be directed towards enhancing species richness and improving habitat conditions for endangered or featured species. Restoration of wetland habitat combined with controlled burning will be utilized to promote growth of indigenous species, create ecotones, and maintain community heterogeneity. The following sections will discuss management strategies for individual endangered species, game and non-game species.

ENDANGERED SPECIES

Numerous endangered species utilize Dupuis Reserve and several breed on the property. Sound habitat management as prescribed will benefit most endangered species however, some will require specific protection and management.

Red-cockaded Woodpecker

Although historically present, it appears that the last remaining active red-cockaded woodpecker nest cavity was destroyed by wildfire in 1989. There is evidence that several active colonies existed on the property. However, the combination of habitat degradation and logging eliminated most of the breeding population. Future management strategies should include the following:

1) additional surveys to search for active cavity sites

2) identification and mapping of old or potential colony sites for management

3) monitoring and protection of any active colony sites

4) controlled burning during fall/winter to reduce shrubs and enhance potential colony sites

5) selective thinning of pine stands in potential colony sites

There is evidence that red-cockaded woodpeckers prefer stands of pine that are released (i.e., provided conditions for increased growth) following long periods (50-100 years) of stress or suppression (Ligon et al., 1986). Pine stands that have been stressed by flooding, or dense stands with heavy competition can be selectively thinned to stimulate growth, possibly inducing birds to nest. Management must be oriented towards recruiting birds from active colonies on the adjacent Corbett Area. However, there is no documentation that these birds will establish new colony sites where no cavities previously existed. Therefore, preservation of any active or potentially active colony sites may be critical in reestablishing red-cockaded woodpecker populations on Dupuis Reserve.

The absence of cavity trees may be the determining factor limiting colony success. Copeyan (1990) reported that man-made cavities and cavity starts were successful in reestablishing breeding populations of red-cockaded woodpeckers in abandoned or vacant colony sites. This technique can be used in several former colony sites, which have been identified, and enclosed within 100 or 200 acre land units to be managed exclusively for this species. It is recommended that the District coordinate with the Game Commission and Division of Forestry to initiate an intensive red-cockaded woodpecker management program.

Bald Eagle

Florida has one of the largest remaining reproductive populations of bald eagles in the United States and there are at least five active eagle nests on Dupuis Reserve. Although active management is probably not required, protection of these nests is essential. Provisions for protection should include:

1) Safeguard nest tree from wildfires by constructing firelines, and/or back burning or roller chopping saw palmetto around the tree base

2) Limit human disturbance within one-half mile of nests during the critical nesting period, approximately November to June

3) Restrict spring turkey hunters from areas surrounding nests

4) Emphasize legal protection of eagles and other raptors at the hunter check station, and hiking and equestrian trail heads.

Wading Birds

At one time the property probably contained numerous nesting areas, but presently only one active wading bird rookery remains. Success of this rookery appears to be directly dependent on water conditions throughout the property's north end. When dry conditions prevail in the spring, foraging areas are completely eliminated. Therefore, management should be directed towards restoring structure and function of wetlands in nearby areas 4 and 11. Additional protection from fire should be afforded all active or potentially active rookery sites (i.e., willow heads).

Indigo Snake

Historically, this rare species may not have been very common given the wet conditions on the property, consequently, it has been observed infrequently. It is possible that the large population of feral pigs has had a deleterious effect on these snakes and other reptilian species. Reduction in the numbers of feral pigs should be a major objective aimed at increasing the potential survival of indigo snakes and other ground dwelling reptiles.

Florida Panther

Occasional signs and direct observations in the area during recent years indicates that Dupuis and Corbett may represent important panther habitat. An adequate supply of deer and feral pig exist, and recent kills and scats have been reported but not verified. Illegal kills of panthers in 1983 and 1984 demonstrates that protection is crucial to their survival. Additional management should include hunter education at check stations and continued deer counts to monitor the prey population. Future management should include enhancement of habitat and acquisition of available lands in adjacent areas to create wildlife corridors.

NON-GAME SPECIES

In general, wetland restoration and prescribed burning will benefit most non-game species. Nest boxes have been placed in various habitats to encourage wood duck, screech owl (Otus asio), kestrel (Falco sparverius) and other cavity nesters to breed on the property. These boxes need to be mapped, maintained and monitored for use, with additional boxes installed where needed. A series of bluebird boxes could also be established along fencerows, and combined with prescribed burns might induce more of these birds to nest.

It is recommended that breeding bird surveys be continued as part of a monitoring program to assess restoration progress. The game commission should be encouraged to conduct additional surveys for non-game species. This information will continue to expand the present species inventory which can be entered into a computer data base.

GAME SPECIES

Game management will include harvest of several species on a sustained yield basis. Hunting regulations and quotas have been developed by the Game Commission in concert with District staff and SOR objectives. By restricting hunter numbers (50 per day), quotas, dogs and off-road vehicles, a goal of providing low intensity, high quality hunting opportunities will be attained. Proposed habitat manipulation (i.e., prescribed burning) for specific species will be incorporated in the operational management and prescribed burn plans.

Turkey and Quail

The population of turkey on Dupuis appears to be quite variable from year to year and may depend on food availability. Turkey have been observed regularly in areas 12, 13, 18 and move frequently to the eastern boundary where they cross between Dupuis and Corbett. Recent burning will begin to improve conditions for turkey, however regular prescribed burns on a 2 to 4 year rotation are necessary to remove the dense hardwood understory and provide optimal turkey habitat. No birds were harvested during the initial spring turkey season, indicating that numbers may be low. Turkey populations should benefit from prescribed burning and the recent drought because excessive rainfall during the nesting season appears to be a limiting factor (Powell, 1967). Game Commission staff should continue annual surveys to monitor trends in the turkey population.

Quail populations will benefit from prescribed burning, considered the best tool for quail management. However, management for quail would require a shorter burning rotation (1-2 years) with burning completed prior to the nesting season (Wade and Lewis, 1987). This burning rotation stimulates the production of preferred plant species and arthropods, a critical food item for young quail. Several 100 acre (40 ha) quail management areas could be isolated for prescribed burning on an annual rotation. The Game Commission should initiate quail surveys to monitor population fluctuations.

White-tailed Deer

A small number of deer were harvested annually through private hunting leases

with the previous land owner. The Game Commission initiated the first general public hunt in September 1989, resulting in a harvest of 27 deer during eight three-day hunting periods. Eighteen deer were subsequently harvested during the 1990 season out of the maximum allowable harvest of 40. This maximum harvest quota may not be attainable due to limited hunter access to the property. Therefore, the hunt should have minimal impact on the Dupuis deer herd. Harvest data should be collected at check stations to provide biologists with data to better evaluate age structure and health of the deer population.

In general, sound habitat management, including wetland restoration and controlled burning, should be beneficial to deer herds. Continuation of spotlight counts is essential to monitor fluctuations in deer numbers.

Feral Pigs

Feral pigs had not been harvested at Dupuis for several years resulting in a sharp increase in their numbers, and extensive habitat destruction. The pig season runs concurrently with the deer season, with an additional four three-day pig hunts scheduled at the conclusion of the regular season. Hunters have been able to harvest unlimited number of pigs with no size restrictions, resulting in a harvest of 585 pigs in 1989. However, only 216 pigs were harvested in 1990, a considerable decrease considering similar hunter access and pressure between the two years. Fewer pigs have been observed during daylight hours, perhaps reflecting a change in behavior patterns (i.e., nocturnal feeding habits) in response to an increase in hunting pressure. Carbonneau (1990 unpub. rept.) reported a significant increase in average number of pig observations during the 1990 spotlight counts in comparison to 1989 counts.

Although the hog season was developed to provide recreational opportunities, the primary objective was to reduce hog numbers to controllable levels to protect the property's resources. It appears that harvest numbers under the present hunting format will not accomplish this goal. Therefore, it is recommended that a commercial trapping operation be pursued to produce the desired population reduction. Once the population has decreased to reasonable levels, an expanded hunting season with improved access (after culvert and road repair) should adequately control pigs on a sustained yield basis.

There have been no reliable survey techniques developed in North America to estimate feral pig populations. Hone (1988) found rooting was a more accurate indicator of pig numbers in forested habitat than pellet or direct counts. This method was utilized due to poor visibility in forested habitat, and might be applied to Dupuis Reserve. The Game Commission should consider the various methods available and develop a survey to at least establish pig population trends.

Fisheries

Although fish resources are limited, recreational fishing could be promoted in canals where harvestable populations exist. Restoration of the L-8 marsh and other wetlands should create new spawning areas for prey fish, which may result in substantial improvements to the fish resources. Return of sheet flow may provide additional water sources to help maintain water levels in marginal

fishing ponds. Game Commission staff could be enlisted to determine the feasibility of stocking game species.

RECREATION

The location of Dupuis Reserve, within one hour's drive of West Palm Beach, creates an excellent opportunity for a large segment of the population to enjoy outdoor recreation in this unique area. In addition to hunting, the property offers a chance to enjoy hiking, horseback riding, bird watching and camping. To encourage outdoor recreation, a public access point and parking facility was developed at gate 2 off state road 76. The District has also entered into a "memorandum of understanding" with the Florida Trail Society resulting in a series of trail loops which eventually will connect with the L-8 canal and Corbett Area. Similar arrangements were made with the Dupuis Horseman Association to develop an equestrian trail system, originating from the stable facilities present at gate 3. In conjunction with the completed trail system, primitive camping sites were established to help promote a wilderness experience.

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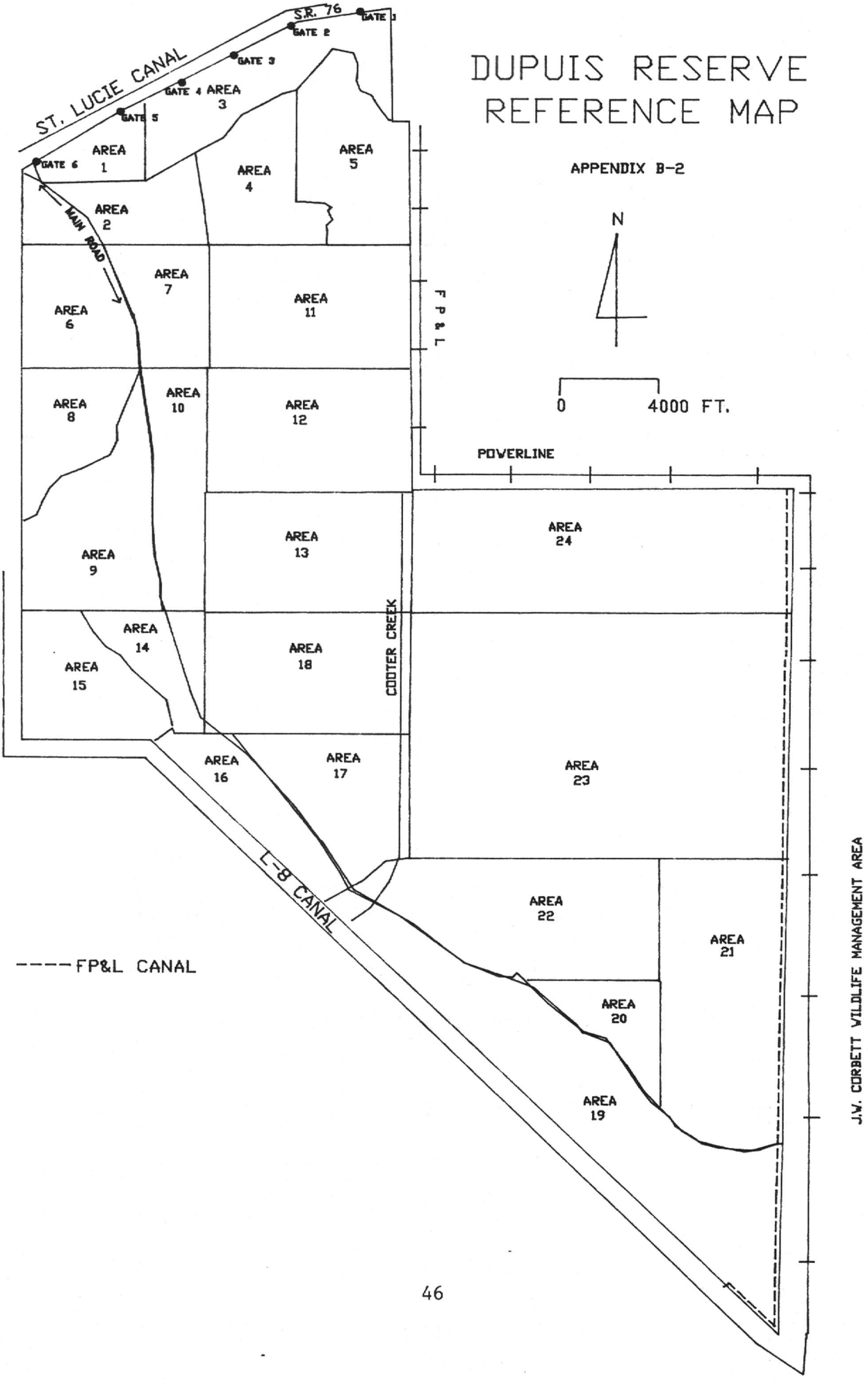
APPENDIX B

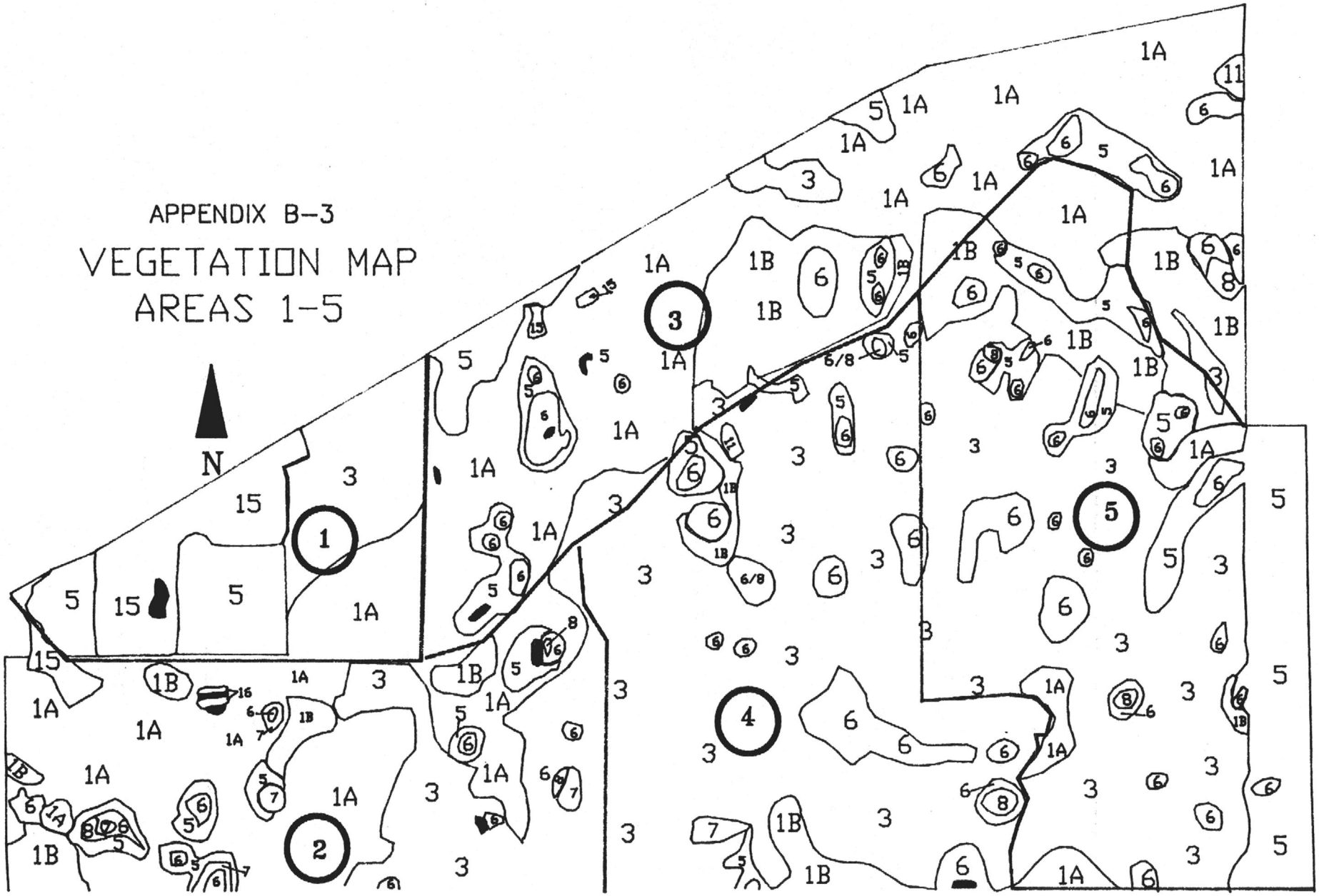
APPENDIX B-1. List of Vegetation Community Codes

1) Mesic flatwoods
2) Low pine flatwoods
3) Cabbage palm flatwoods
4) Scrub shrub
5) Pasture
6) Emergent marsh-broadleaf
7) Shrub swamp
8) Emergent marsh-sawgrass
9) Other habitat
10) Emergent wet prairie
11) Hardwood hammock
12) Pine-cypress strand
13) Cypress swamp
14) Open water
15) Other land use
16) Exotics
17) Swamp hardwoods


DUPUIS RESERVE
REFERENCE MAP
APPENDIX B-2
N
0
4000 FT.
S.R. 76
ST. LUCIE CANAL
GATE 1
GATE 2
GATE 3
GATE 4
GATE 5
GATE 6
AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AREA 6
AREA 7
AREA 8
AREA 9
AREA 10
AREA 11
AREA 12
AREA 13
AREA 14
AREA 15
AREA 16
AREA 17
AREA 18
AREA 19
AREA 20
AREA 21
AREA 22
AREA 23
AREA 24
MAIN ROAD
F P & L
POWERLINE
COOTER CREEK
L-8 CANAL
FP&L CANAL
J.W. CORBETT WILDLIFE MANAGEMENT AREA

APPENDIX B-3

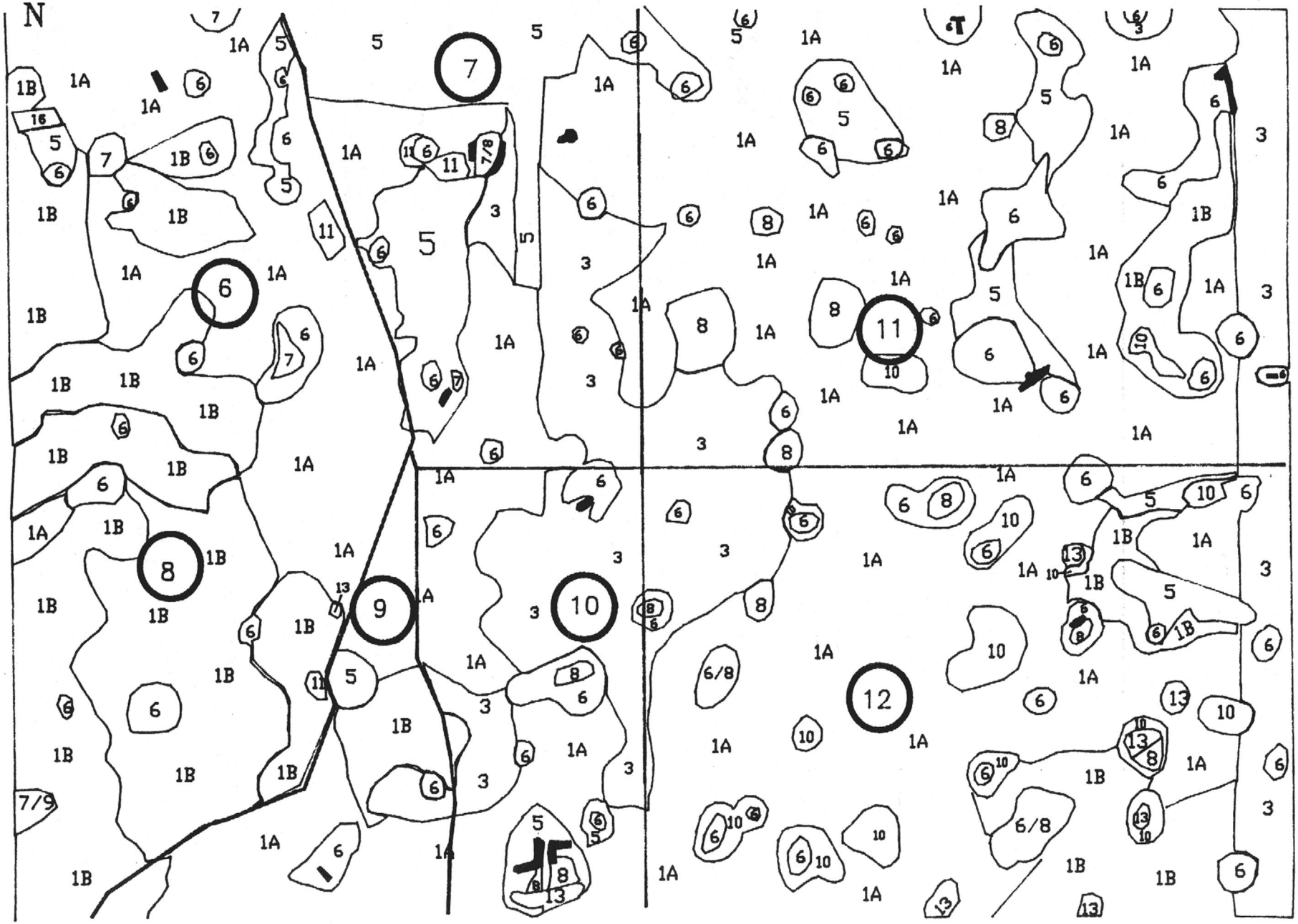
VEGETATION MAP
AREAS 1-5



APPENDIX B-4. Vegetation Communities For Areas 1-5
Dupuis Reserve

Vegetation code	Acres	Hectares	% of total
1a	742	300	30
1b	115	46	4
3	966	391	39
5	389	157	16
6	165	66	6
7	11	4	<1
8	9	4	<1
11	5	2	<1
14	5	2	<1
15	73	29	3
16	2	<1	<1
TOTALS	2,482	1,001	100

APPENDIX B-5 VEGETATION MAP AREAS 6,7,8,9,10,11 & 12

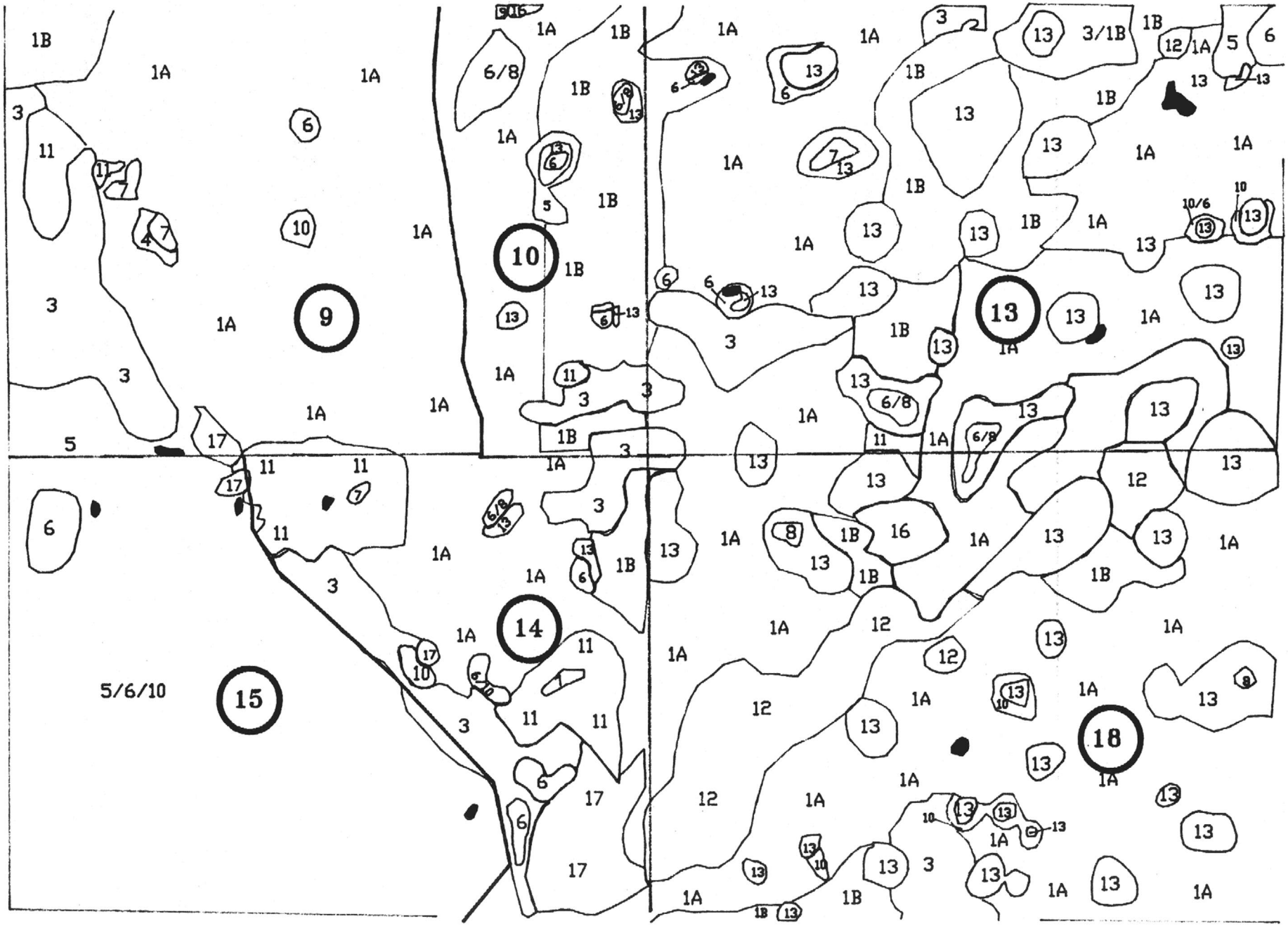


APPENDIX B-6. Vegetation Communities For Areas 6,7,8,9,10,11 & 12 Dupuis Reserve

Vegetation code	Acres	Hectares	% of total
1a	1,964	795	50
1b	731	296	18
3	464	188	12
5	284	114	7
6	512	207	13
7	13	5	<1
8	47	19	<1
10	72	29	<1
11	9	4	<1
13	13	5	<1
14	6	2	<1
16	3	1	<1
TOTALS	4,118	1,665	100

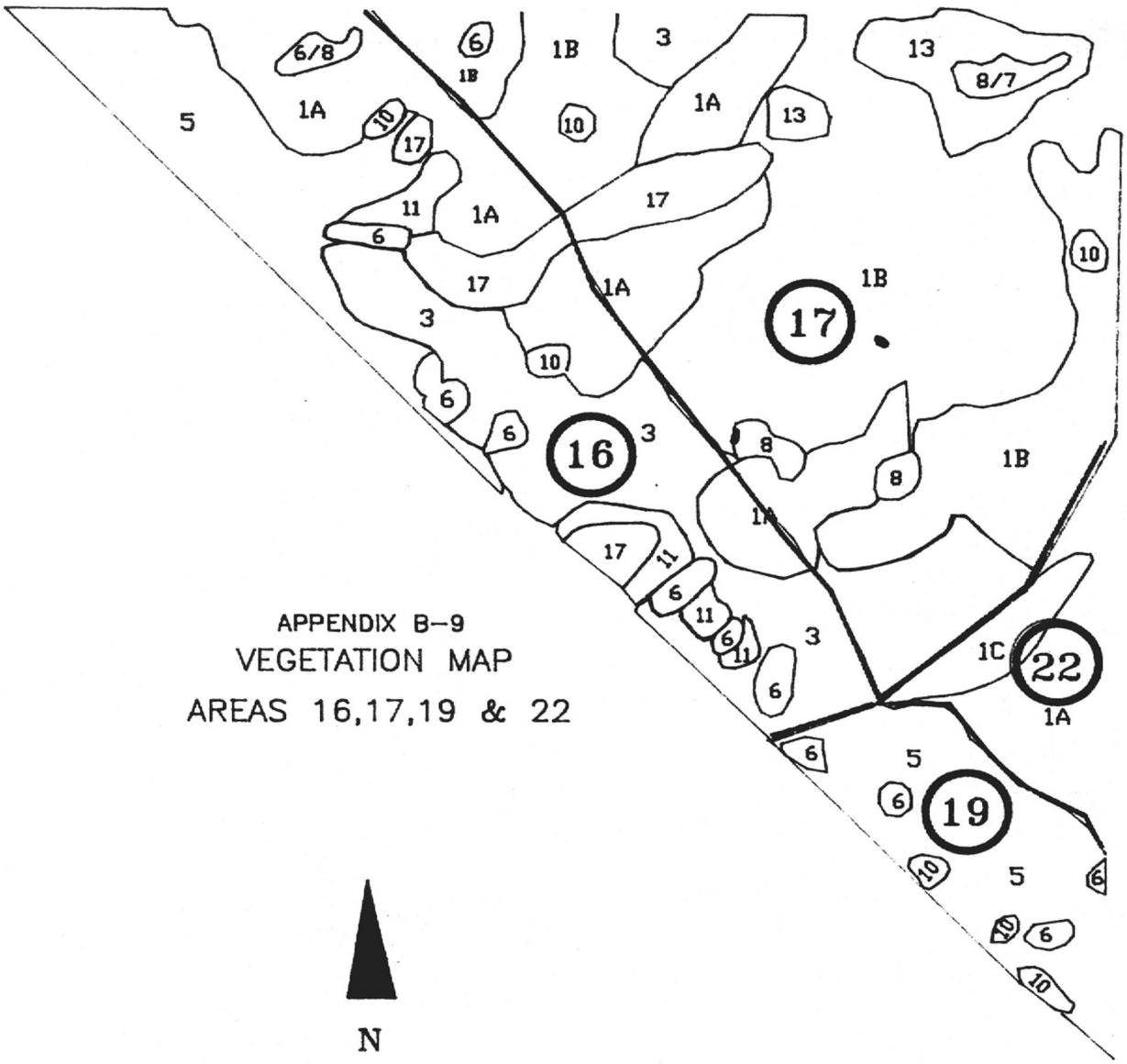
APPENDIX B–7

VEGETATION MAP AREAS 9,10,13,14,15, & 18



APPENDIX B-8. Vegetation Communities For Areas 9,10,13,14,15, & 18 Dupuis Reserve

Vegetation code	Acres	Hectares	% of total
1a	1,810	732	47
1b	356	144	10
3	280	113	7
4	3	1	<1
5	611	247	16
6	66	27	1
7	11	4	<1
8	32	13	1
9	<1	<1	<1
10	21	9	<1
11	115	47	3
12	129	52	3
13	344	139	9
14	6	2	<1
16	15	6	<1
17	56	23	1
TOTALS	3,855	1,559	100



APPENDIX B–9

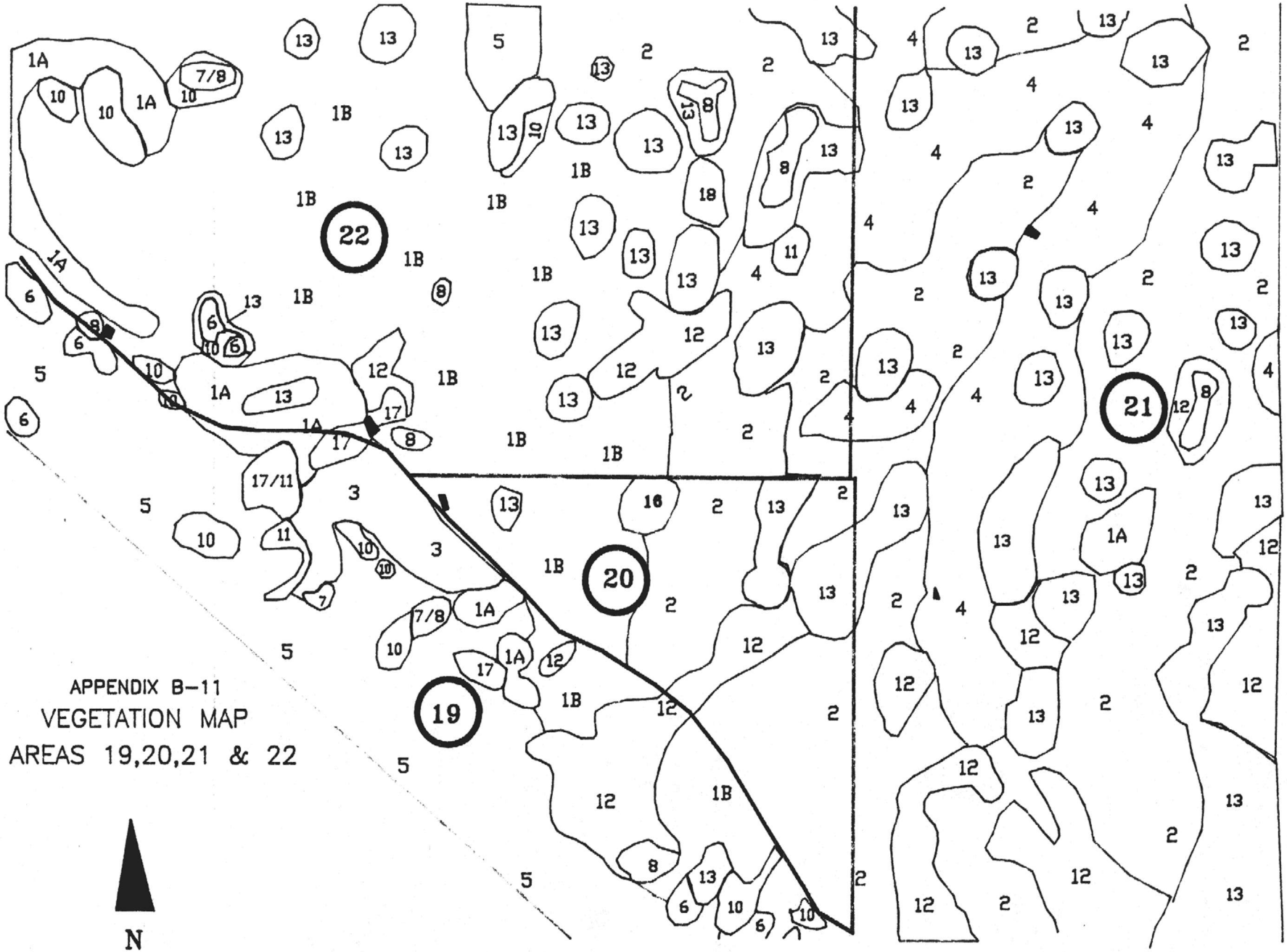
VEGETATION MAP

AREAS 16,17,19 & 22

N

APPENDIX B-10. Vegetation Communities For Areas 16,17,19 & 22

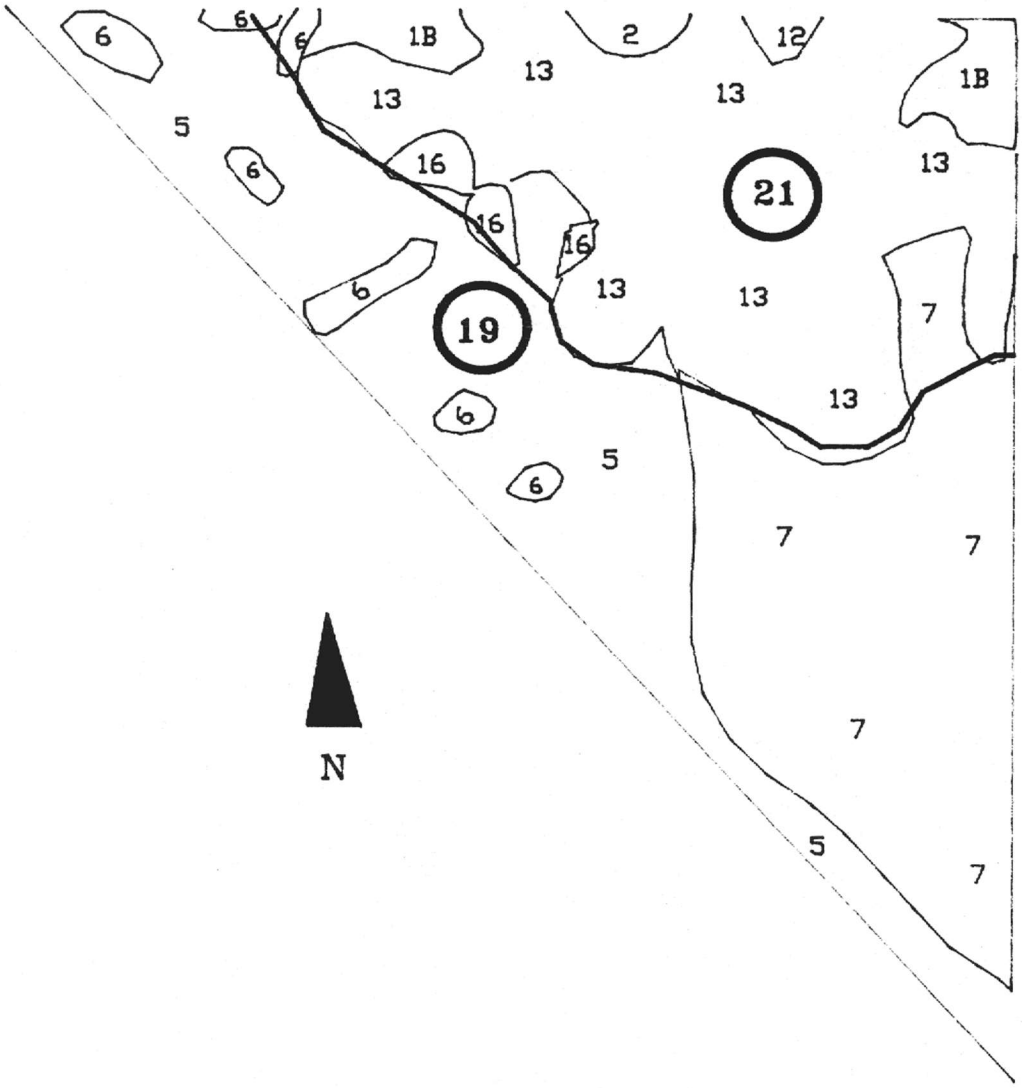
Vegetation code	Acres	Hectares	% of total
1a	233	94	23
1b	379	153	37
3	170	69	16
5	183	74	17
6	33	13	1
8	14	6	<1
10	13	5	<1
11	19	8	<1
13	37	15	1
17	49	20	4
TOTALS	1,130	457	100



APPENDIX B-11
VEGETATION MAP
AREAS 19,20,21 & 22

APPENDIX B-12. Vegetation Communities For Areas 19,20,21,& 22 Dupuis Reserve

Vegetation code	Acres	Hectares	% of total
1a	124	50	9
1b	609	246	19
2	800	324	25
3	50	20	1
4	351	142	11
5	488	197	14
6	21	9	<1
7	10	4	<1
8	28	11	<1
10	47	19	<1
11	16	7	<1
12	250	101	7
13	448	181	14
14	1	<1	<1
16	8	3	<1
17	23	9	<1
TOTALS	3,274	1,323	100



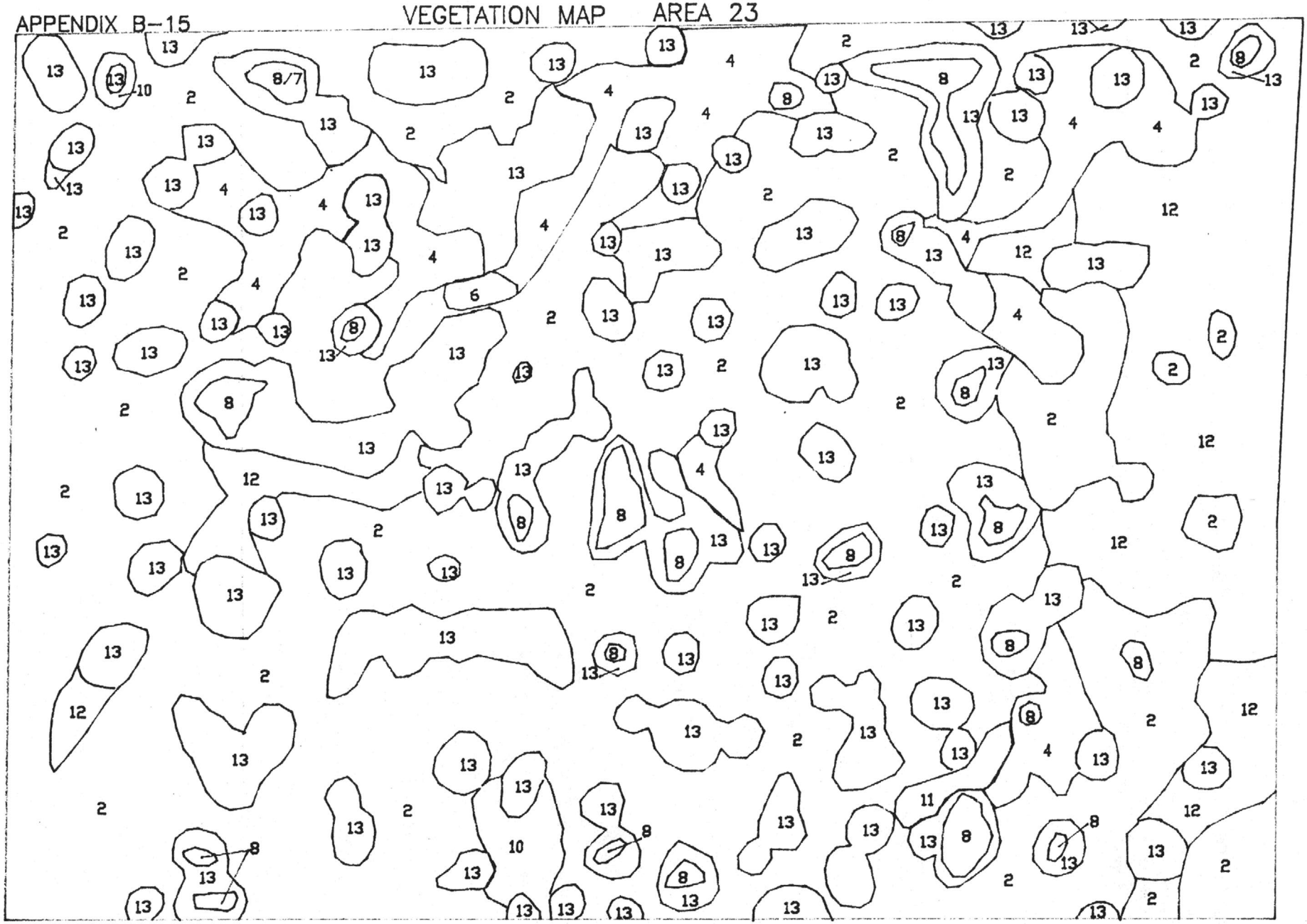
APPENDIX B–13
VEGETATION MAP
AREAS 19 & 21

APPENDIX B-14. Vegetation Communities For Areas 19 & 21
Dupuis Reserve

Vegetation code	Acres	Hectares	% of total
1a	30	12	2
2	6	3	<1
5	564	228	48
6	28	12	2
7	251	101	22
12	3	1	<1
13	285	115	24
16	13	5	<1
TOTALS	1,180	477	100

APPENDIX B-15

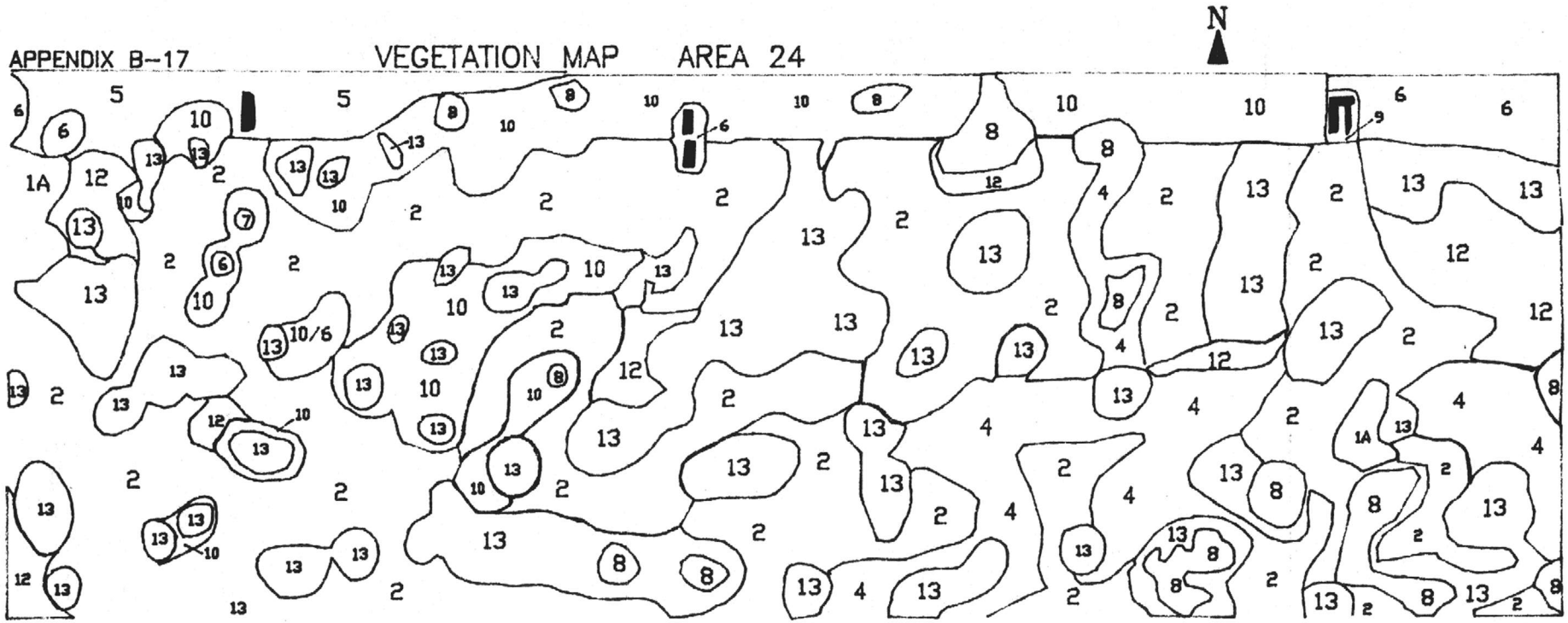
VEGETATION MAP AREA 23



APPENDIX B-16. Vegetation Communities For Area 23
Dupuis Reserve

Vegetation code	Acres	Hectares	% of total
1a	6	2	<1
1b	8	3	<1
2	1,629	659	48
4	283	114	8
6	6	2	<1
7	6	2	<1
8	83	33	2
10	31	12	<1
11	14	6	<1
12	407	161	11
13	978	395	29
14	<1	<1	<1
TOTALS	3,451	1,396	100

APPENDIX B-17 VEGETATION MAP AREA 24



APPENDIX B-18 Vegetation Communities For Area 24
Dupuis Reserve

Vegetation code	Acres	Hectares	% of total
1a	31	12	1
2	744	298	40
4	156	62	8
5	57	23	3
6	11	4	<1
7	<1	<1	<1
8	72	29	4
9	3	1	<1
10	273	109	15
12	98	39	5
13	444	178	23
14	3	1	<1
TOTALS	1,892	757	100

APPENDIX C

APPENDIX C-1. Dupuis Reserve Species Inventory
Graminoids

Blue maidencane	Amphicarpum muhlenbergianum
Chalky bluestem	Andropogon capillipes
Bushybeard bluestem	Andropogon glomeratus
Florida threeawn	Aristida stricta
Carpetgrass	Axonopus affinis
Carpetgrass	Axonopus furcatus
Carpetgrass	Axonopus compressus
Green-white sedge	Carex albalutescens
Coast sandspur	Cenchrus incertus
Finger grass	Chloris glauca
Sawgrass	Cladium jamaicense
Wrinkled jointtail	Coelorachis rugosa
Bermuda grass	Cynodon dactylon
Flatsedge	Cyperus distinctus
Chufa flatsedge	Cyperus esculentus
Yellow flatsedge	Cyperus flavescens
Flatsedge	Cyperus ligularis
Many-spiked flatsedge	Cyperus polystachyos
Flatsedge	Cyperus retrorsus
White tops	Dichromena colorata
Star rush	Dichromena latifolia
Pangola grass	Digitaria decumbens
Spikerush	Eleocharis vivipara
Love grass	Eragrostis elliotti
Slender fimbrystylis	Fimbrystylis autumnalis
Southern watergrass	Hydrochloa caroliniensis
Soft rush	Juncus effusus
Many headed rush	Juncus polycephalus
Cutgrass	Leersia sp.
Hair awn muhly	Muhlenbergia capillaris
Maidencane	Panicum hemitomon
Torpedo grass	Panicum repens
Red top panicum	Panicum rigidulum
Switch grass	Panicum virgatum
Bahia grass	Paspalum notatum
Vasey grass	Paspalum urvellei
Napier grass	Pennisetum purpureum
Common reed	Phragmites australis
Short-beaked baldrush	Psilocarya nitens
Natal grass	Rhynchelytrum repens
Grass-like beaked-rush	Rhynchospora globularis
Beaked-rush	Rhynchospora inundata
Littleseed beaked-rush	Rhynchospora microcarpa
Tracy's beaked-rush	Rhynchospora tracyi
South Florida bluestem	Schizachyrium rhizomatum
Creeping bluestem	Schizachyrium stoloniferum (UR4)

APPENDIX C-1 (cont.)

Knot root bristlegrass	Setaria geniculata
Lopsided indiangrass	Sorghastrum secundum
Sand cordgrass	Spartina bakeri
Smut grass	Sporobolus poiretii
St. Augustine's grass	Stenotaphrum secundatum
Yellow-eyed-grass	Xyris spp.

(UR4)= Under Review - United States Fish and Wildlife Service

APPENDIX C-2. Dupuis Reserve Species Inventory
Herbaceous

Colic root	Aletris farinosa
Ragweed	Ambrosia artemisiifolia
Fly poison	Amianthum muscaetoxicum
Mexican poppy	Argemone mexicana
Lanceolate milkweed	Asclepias lanceolata
Butterfly-weed	Asclepias tuberosa
Climbing aster	Aster carolinianus
Annual marsh aster	Aster subulatus
Lemon bacopa	Bacopa caroliniana
Bacopa	Bacopa monnieri
Honeycomb head	Balduina uniflora
False nettle	Boehmeria cylindrica
Grass pink	Calopogon tuberosus (T)
Cassia	Cassia sp.
Periwinkle	Catharanthus roseus
Coinwort	Centella asiatica
Butterfly pea	Centrosema virginianum
Coontail	Ceratophyllum demersum
Pigweed	Chenopodium album
Thistle	Cirsium horridulum
Pine hyacinth	Clematis baldwinii
Wild taro	Colocasia esculenta
Tickseed	Coreopsis gladiata
Swamp lily	Crinum americanum
Virginia buttonweed	Diodia virginiana
Water hyacinth	Eichhornia crassipes
Hatpins	Eriocaulon decangulare
Button snakeroot	Eryngium aromaticum
Wild coco	Eulopha alta (T)
Dog fennel	Eupatorium capillifolium
Flat-topped goldenrod	Euthamia minor
Bedstraw	Galium obtusum
Rabbit tobacco	Gnaphalium obtusifolium
Hedge hyssop	Gratiola pilosa
Whorled pennywort	Hydrocotyle verticillata
Sky flower	Hydrolea corymbosa
Musky mint	Hyptis alata
Southern blue flag	Iris hexagona
Water willow	Justica ovata
Marsh mallow	Kosteletzkya virginica
Red root	Lachnanthes caroliniana
Frog's bit	Limnobium spongia
Blue toad flax	Linaria canadensis
Carpet weed	Lippia nodiflora

APPENDIX C-2. (cont.)

Glades lobelia	Lobelia paludosa
Ludwigia	Ludwigia maritima
Ludwigia	Ludwigia peruviana
Ludwigia	Ludwigia repens
Water hoarhound	Lycopus rubellus
Prickley pear	Opuntia humifusa
Lady's sorrel	Oxalis corniculata
Water dropwort	Oxypolis filiformis
Pokeberry	Phytolacca americana
Pennyroyal	Piloblephis rigida
Blue butterwort	Pinguicula caerulea
Yellow butterwort	Pinguicula lutea
Small butterwort	Pinguicula pumila
Water-lettuce	Pistia stratiotes
Snowy orchid	Platanthera nivea (T)
Camphor weed	Pluchea odorata
Painted leaf	Poinsetta pinetorum
White bachelor button	Polygala baldwinii
Drumheads	Polygala cruciata
Yellow milkwort	Polygala lutea
Milkwort	Polygala ramosa
Bachelor button	Polygala rugellii (T)
Smartweed	Polygonum punctatum
Pickerelweed	Pontederia cordata
Mermaid weed	Proserpinaca palustris
Black root	Pterocaulon pycnostachyum
Mock bishop weed	Ptilimnium capillaceum
Meadow beauty	Rhexia nashii
Castor bean	Ricinus communis
Black-eyed Susan	Rudbeckia hirta
Ruellia	Ruellia caroliniensis
Marsh-pink	Sabatia bartramii
Slender marsh-pink	Sabatia campunulata
Lizard's tail	Saururus cernuus
Duck potato	Sagittaria falcata
Arrowhead	Sagittaria lancifolia
Common salvina	Salvina rotundiflora
Golden ragwort	Senecio glabellus
Blue-eyed grass	Sisyrinchium atlanticum
Soda apple	Solanum ciliatium
Fire flag	Thalia geniculata
Wild pine	Tillandsia balbisiana (T)
Wild pine	Tillandsia circinata
Wild pine	Tillandsia fasciculata (C)
Wild pine	Tillandsia setacea (T)
Spanish moss	Tillandsia usneoides
Caesar-weed	Urena lobata
Bladderwort	Utricularia cornuta

APPENDIX C-2. (cont.)

Bladderwort	Utricularia sp.
Long-leaf violet	Viola lanceolata
Atamasco lily	Zephyranthes atamasco (T)

FERNS

Swamp fern	Blechnum serrulatum
Strap fern	Campyloneurum phyllitidis (T)
Southern shield fern	Dryopteris ludoviciana (T)
Japanese climbing fern	Lygodium japonicum
Boston fern	Nephrolepis exaltata
Royal fern	Osmunda regalis (C)
Golden polybody	Phlebodium aureum
Resurrection fern	Polypodium polypodioides
Bracken fern	Pteridium aquilinum
Marsh fern	Thelypteris palustris (T)

(T)=Threatened - Florida Dept. of Agriculture and Consumer Services
(C)=Commercially Exploited - F.D.A.C.S.

APPENDIX C-3. Dupuis Reserve Species Inventory
Trees, Shrubs and Vines

Red maple	Acer rubrum
Pepper vine	Ampelopsis arborea
Pond apple	Annona glabra
Northfolk Island pine	Araucaria excelsa
Paw paw	Asimina reticulata
Saltbush	Baccharis halmifolia
Bamboo	Bambusa sp.
Tarflower	Befaria racemosa
Beauty berry	Callicarpa americana
Sugarberry	Celtis laevigata
Buttonbush	Cephalanthus occidentalis
Orange	Citrus aurantium
Indian rosewood	Dalbergia sissoo
Common persimmon	Diaspyros virginiana
Eucalyptus	Eucalyptus sp.
Florida strangler fig	Ficus aurea
Sandweed	Hypericum fasciculatum
St. Johnswort	Hypericum myrtifolium
Four petal St. Johnswort	Hypericum tetrapetalum
Gallberry	Ilex glabra
Morning-glory	Ipomoea indica
Arrowleaf morning-glory	Ipomoea sagittata
Southern red cedar	Juniperus silicicola
Rusty lyonia	Lyonia ferruginea
Fetterbush	Lyonia lucida
Cajeput tree	Melaleuca quinquenervia
Climbing hempweed	Mikania scandens
Wax myrtle	Myrica cerifera
Myrsine	Myrsine guianesis
Devilwood	Osmanthus americana
Virginia creeper	Parthenocissus quinquefolia
Red bay	Persea borbonia
Swamp bay	Persea palustris
Date palm	Phoenix sp.
Slash pine	Pinus elliotti
Common guava	Psidium guajava
Wild coffee	Psychotria nervosa
Laurel oak	Quercus laurifolia
Live oak	Quercus virginiana
Winged sumac	Rhus copallina
Cabbage palm	Sabal palmetto
Coastal plain willow	Salix caroliniana
Southern elderberry	Sambucus simpsonii
White-vine	Sarcostemma clausum
Brazilian pepper	Schinus terebinthifolius
Saw palmetto	Serenoa repens

APPENDIX C-3. (cont.)

Catbrier	Smilax laurifolia
Corkwood	Stillingia aquatica
Queens delight	Stillingia sylvatica
Bald cypress	Taxodium distichum
Pond cypress	Taxodium ascendens
Poison oak	Toxicodendron toxicarium
Shiney blueberry	Vaccinium myrsinites
Black haw	Viburnum obovatum

APPENDIX C-6. Dupuis Reserve Species Inventory
Birds

Pied-billed grebe	Podilymbus podiceps
American anhinga	Anhinga anhinga
Mottled duck	Anas fulvigula
American wigeon	Anas americana
Green-winged teal	Anas crecca
Wood duck	Aix sponsa
American coot	Fulica americana
Great blue heron	Ardea herodias
Great white heron	Ardea herodias
Little blue heron	Egretta caerulea
Tricolor heron	Egretta tricolor
Snowy egret	Egretta thula
Great egret	Casmerodius albus
Cattle egret	Bubulcus ibis
Black-crowned night heron	Nycticorax nycticorax
Yellow-crowned night heron	Nyctanassa violacea
Green-backed heron	Butorides straitus
Least bittern	Ixobrychus exilis
Woodstork	Mycteria americana
Sandhill crane	Grus canadensis
Limpkin	Aramus guarauna
Glossy ibis	Plegadis falcinellus
White ibis	Eudocimus albus
Common moorhen	Gallinula chloropus
Black-necked stilt	Hemantopus mexicanus
Killdeer	Charadrius vociferus
Common snipe	Gallinago gallinago
Short-billed dowitcher	Limnodromus griseus
Greater yellowlegs	Tringa melanoleuca
Lesser yellowlegs	Tringa flavipes
Solitary sandpiper	Tringa solitaria
Pectoral sandpiper	Calidris melanotos
Western sandpiper	Calidris mauri
Least sandpiper	Calidris minutilla
Wild turkey	Meleagris gallopavo
Northern bobwhite	Colinus virginianus
Everglades snail kite	Rostrhamus sociabilis
Cooper's hawk	Accipiter cooperii
Northern harrier	Circus cyaneus

APPENDIX C-6. (cont.)

Red-shouldered hawk	Buteo lineatus
Red-tailed hawk	Buteo jamaicensis
Osprey	Pandion haliaetus
Bald eagle	Haliaeetus leucocephalus
Black vulture	Coragyps atratus
Turkey vulture	Cathartes aura
American kestrel	Falco sparverius
Merlin	Falco columbarius
Screech owl	Otus asio
Barred owl	Strix varia
Barn owl	Tyto alba
Great horned owl	Bubo virginianus
White-winged dove	Zenaida asiatica
Mourning dove	Zenaida macroura
Ground dove	Columbina passerina
Yellow-billed cuckoo	Coccyzus americanus
Smooth-billed ani	Crotophaga ani
Common nighthawk	Chordeiles minor
Chuck-wills-widow	Caprimulgus carolinensis
Belted kingfisher	Ceryle alcyon
Northern flicker	Colaptes auratus
Red-bellied woodpecker	Melanerpes carolinus
Red-cockaded woodpecker	Picoides borealis
Downy woodpecker	Picoides pubescens
Pileated woodpecker	Dryocopus pileatus
Eastern kingbird	Tyrannus tyrannus
Great crested flycatcher	Myiarchus crinitus
Eastern phoebe	Sayornis phoebe
Chimney swift	Chaetura pelagica
Northern rough-winged swallow	Stelgidopteryx serripennis
Barn swallow	Hirundo rustica
Tree swallow	Tachycineta bicolor
Fish crow	Corvus ossifragus
Blue jay	Cyanocitta cristata
Blue-gray gnatcatcher	Polioptila melanura
Carolina wren	Thryothorus ludovicianus
Brown thrasher	Toxostoma rufum
Gray catbird	Dumetella carolinesis
Northern mockingbird	Mimus polyglottos
Eastern bluebird	Sialia sialis
Robin	Turdus migratorius

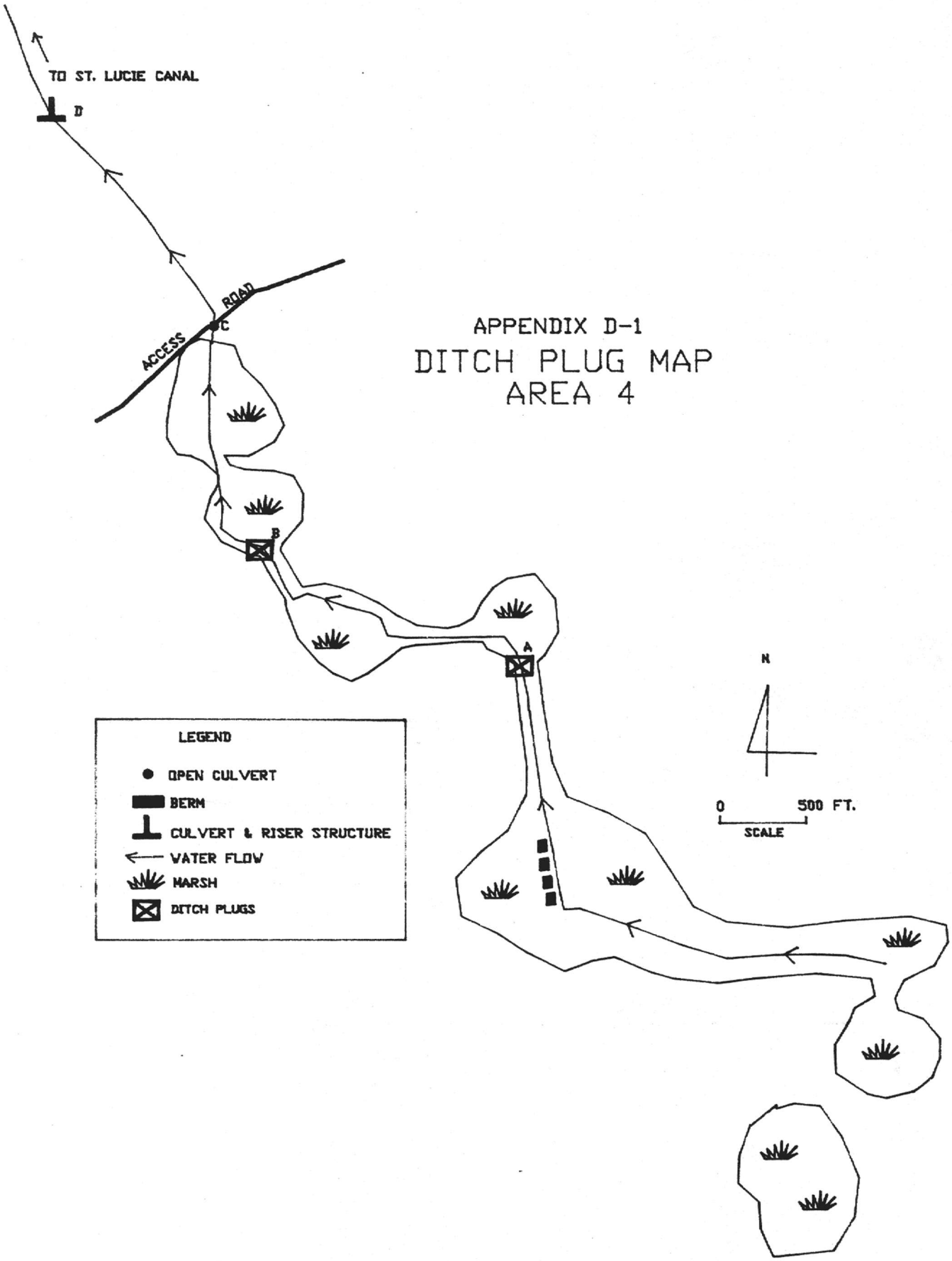
APPENDIX C-6 (cont.)

Wood thrush	Hylocichla mustelina
Loggerhead shrike	Lanius ludovicianus
White-eyed vireo	Vireo griseus
Prothonotary warbler	Protonotaria citrea
Cape May warbler	Dendroica tigrina
Pine warbler	Dendroica pinus
Palm warbler	Dendroica palmarum
Prairie warbler	Dendroica discolor
Yellow-rumped warbler	Dendroica cononata
Black-throated blue warbler	Dendroica caerulescens
American redstart	Setophaga ruticilla
Black and white warbler	Mniotilta varia
Connecticut warbler	Oporornis ogilis
Common yellowthroat	Geothlypis trichas
Louisiana waterthrush	Seiurus motacilla
Red-winged blackbird	Agelaius phoenicus
Boat-tailed grackle	Quiscalus major
Common grackle	Quiscalus quiscalus
Eastern meadowlark	Sturnella magna
Northern cardinal	Cardinalis cardinalis
Rufous-sided towhee	Pipilo erythrophthalmus
Chipping sparrow	Spizella passerina
Grasshopper sparrow	Ammodramus savannarum
Bachman's sparrow	Aimophila aestivalis
Indigo bunting	Passerina cyanea

APPENDIX C-7. Dupuis Reserve Species Inventory
Mammals

Florida panther	Felis concolor
Bobcat	Lynx rufus
White-tailed deer	Odocoileus virginiana
Feral pig	Sus scrofa
Gray fox	Urocyon cinereoargenteus
Raccoon	Procyon lotor
Opossum	Didelphis virginiana
River otter	Lontra canadensis
Striped skunk	Mephitis mephitis
Nine-banded armadillo	Dasypus novemcinctus
Eastern cottontail	Sylvilagus floridanus
Marsh rabbit	Sylvilagus palustris
Southern flying squirrel	Glaucomys volans
Eastern gray squirrel	Sciurus carolinensis
Sherman's fox squirrel	Sciurus niger
Oldfield mouse	Peromyscus polionotus
Hispid cotton rat	Sigmondon hispidus
Rice rat	Oryzomys palustris
Round-tailed muskrat	Neofiber alleni
Black rat	Rattus rattus
Least shrew	Cryptotis parva
Short-tailed shrew	Blarina brevicauda
Evening bat	Nycticeius humerdis
Yellow bat	Lasiurus intermedius

APPENDIX D



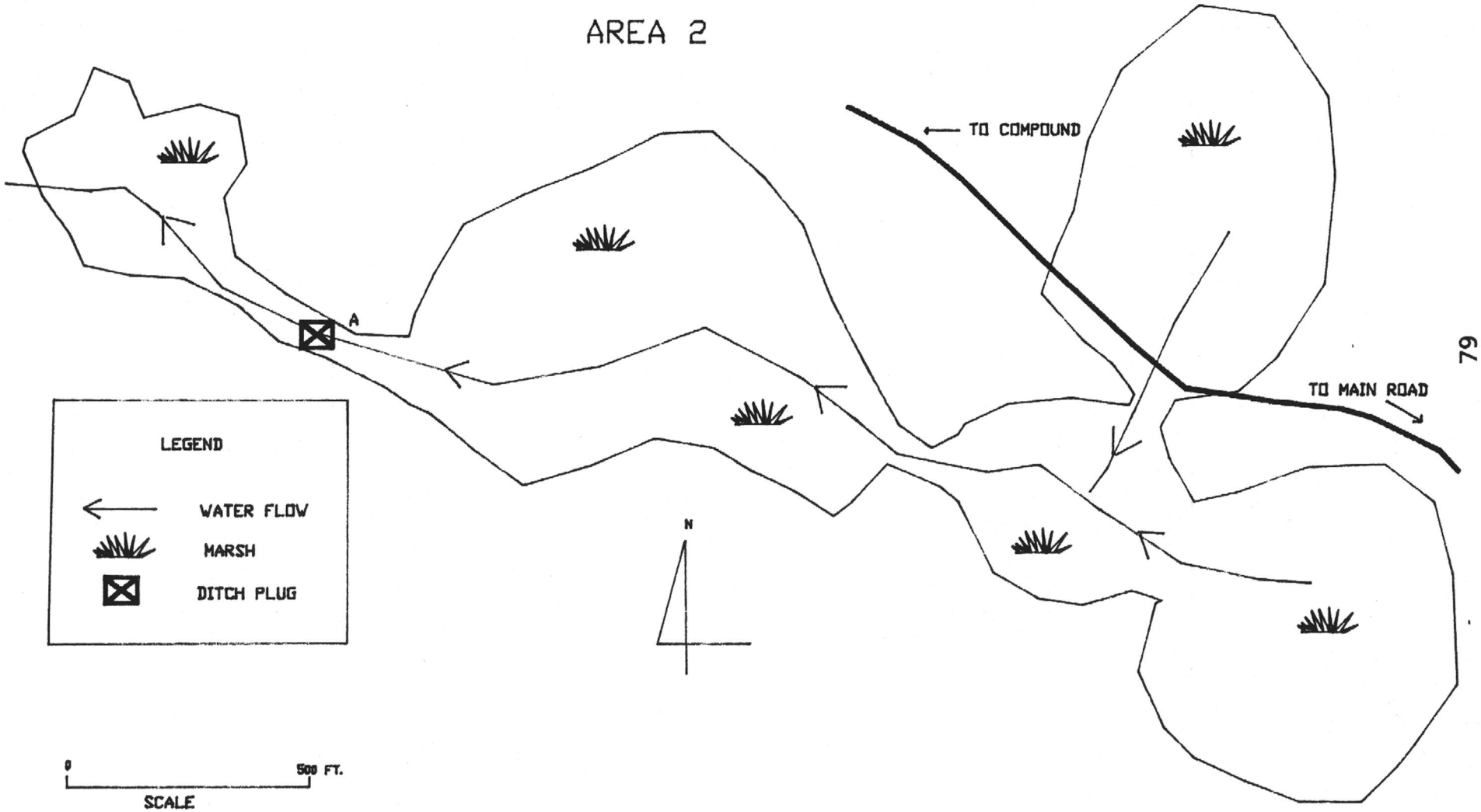
APPENDIX D-1

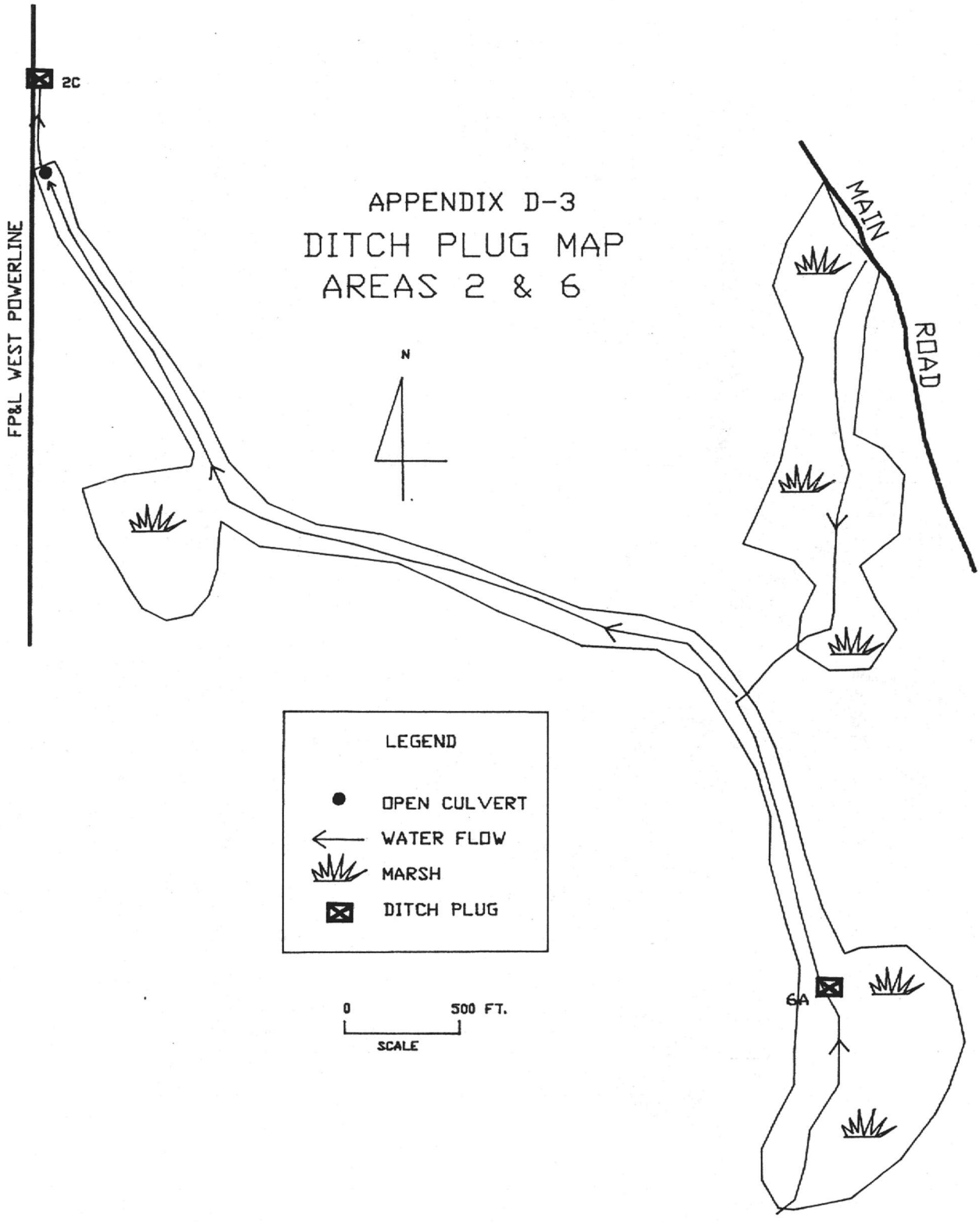
DITCH PLUG MAP
AREA 4

APPENDIX D-2

DITCH PLUG MAP

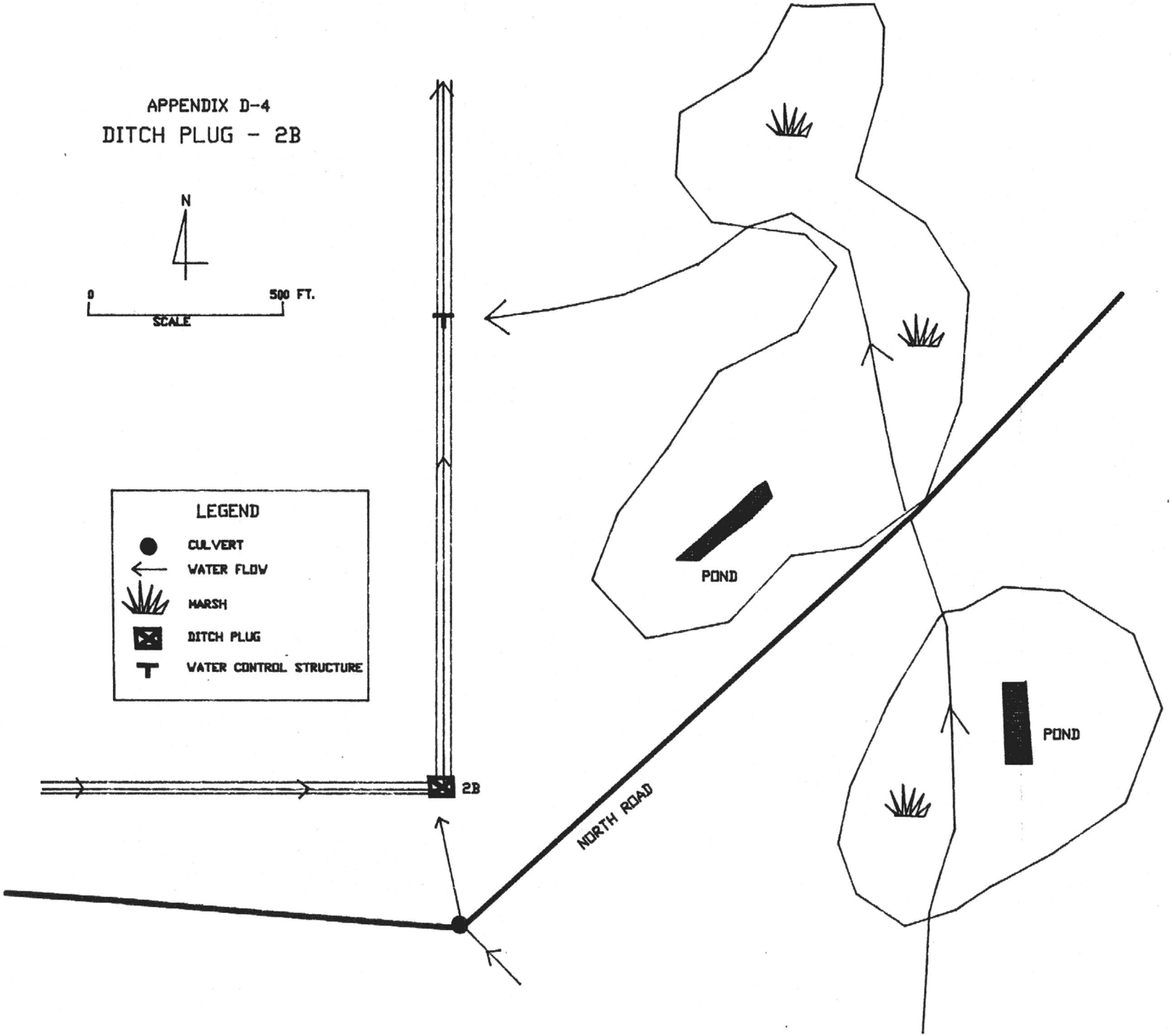
AREA 2

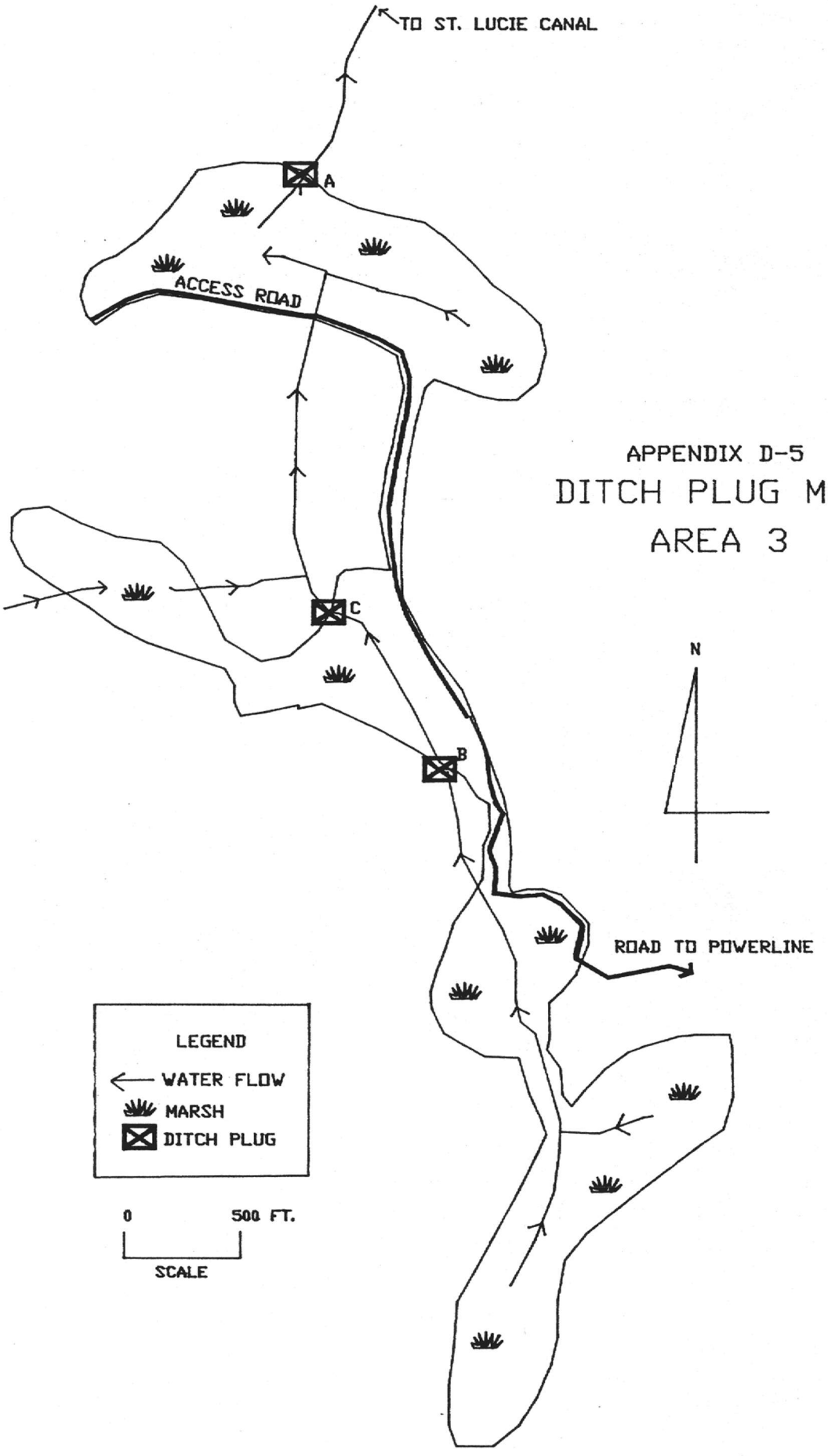



APPENDIX D-3
DITCH PLUG MAP
AREAS 2 & 6
N
2C
FP&L WEST POWERLINE
MAIN
ROAD
6A
LEGEND
OPEN CULVERT
WATER FLOW
MARSH
DITCH PLUG
0
500 FT.
SCALE

APPENDIX D-4

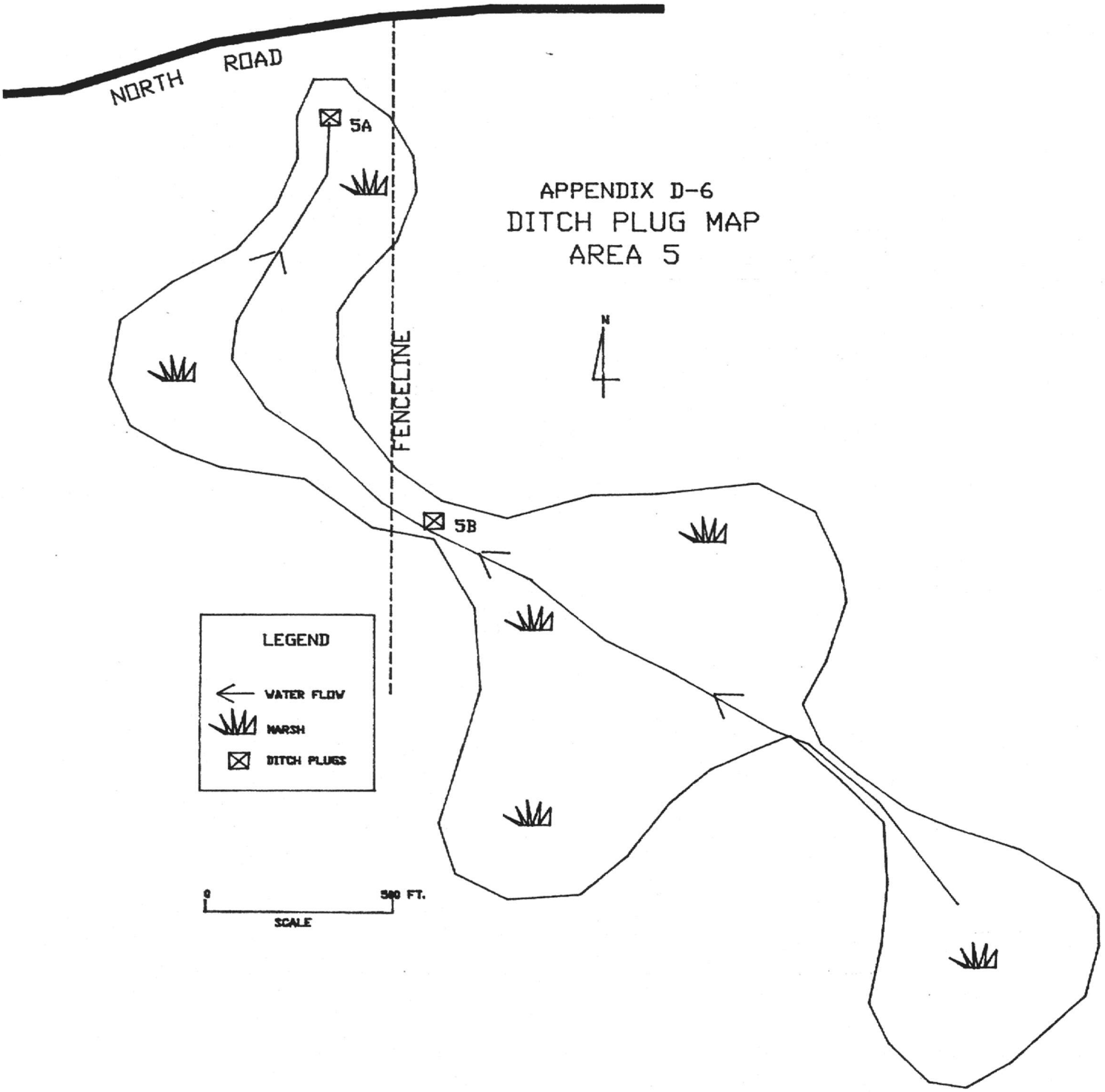
DITCH PLUG - 2B





APPENDIX D-5

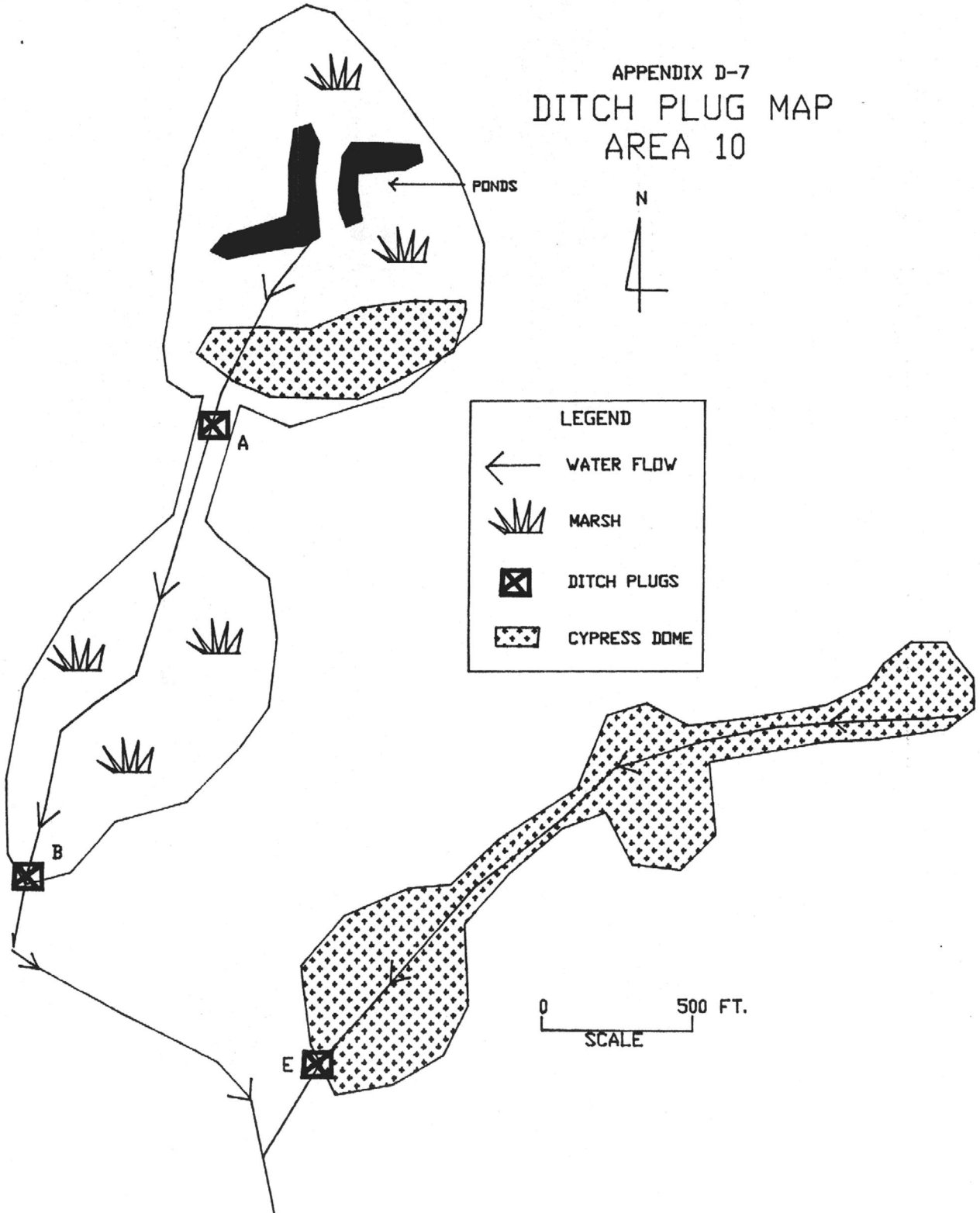
DITCH PLUG MAP
AREA 3



APPENDIX D-6
DITCH PLUG MAP
AREA 5

APPENDIX D-7

DITCH PLUG MAP
AREA 10



APPENDIX D-8

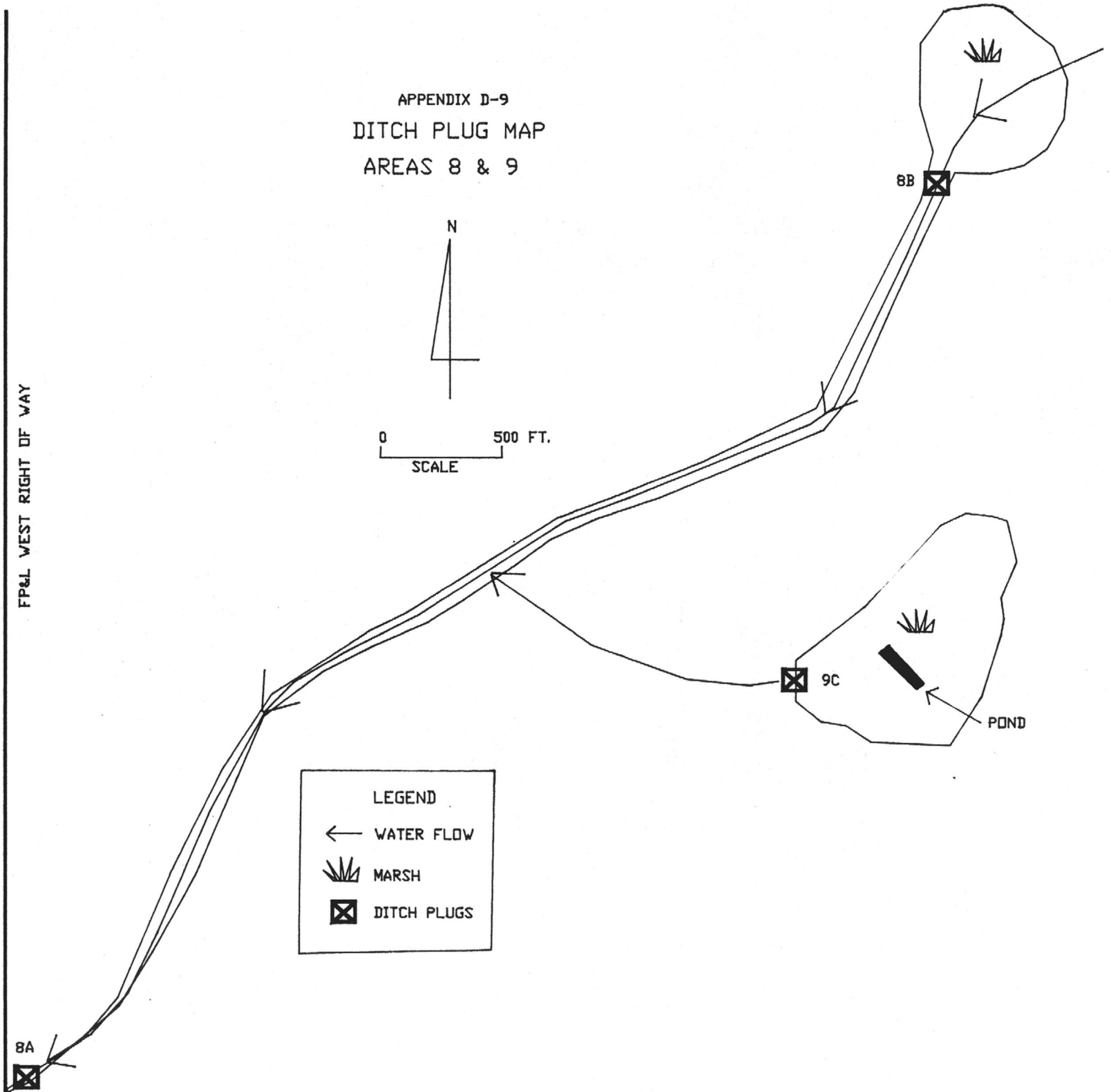
DITCH PLUG MAP

AREAS 10 & 12

APPENDIX D-9

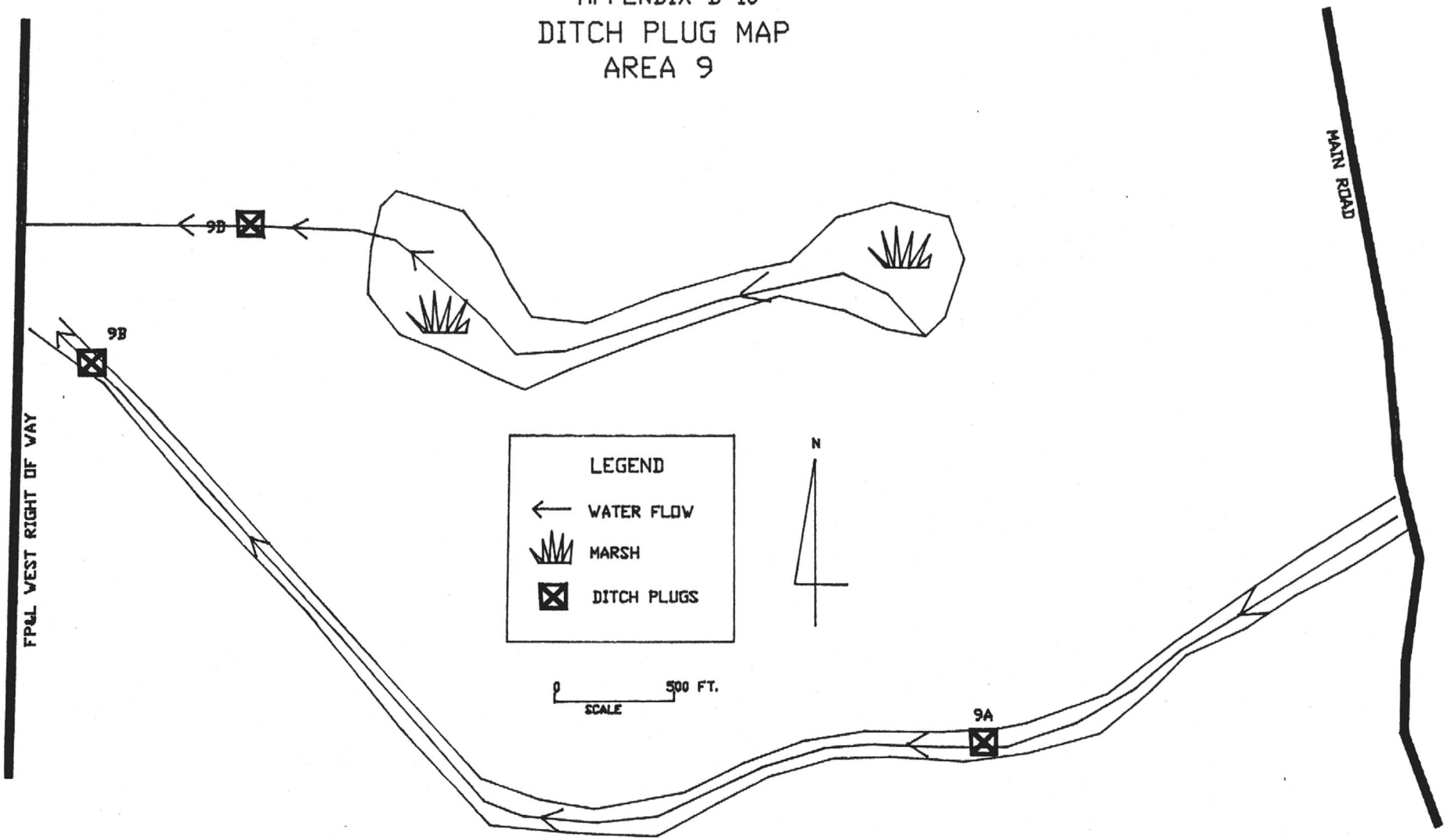
DITCH PLUG MAP

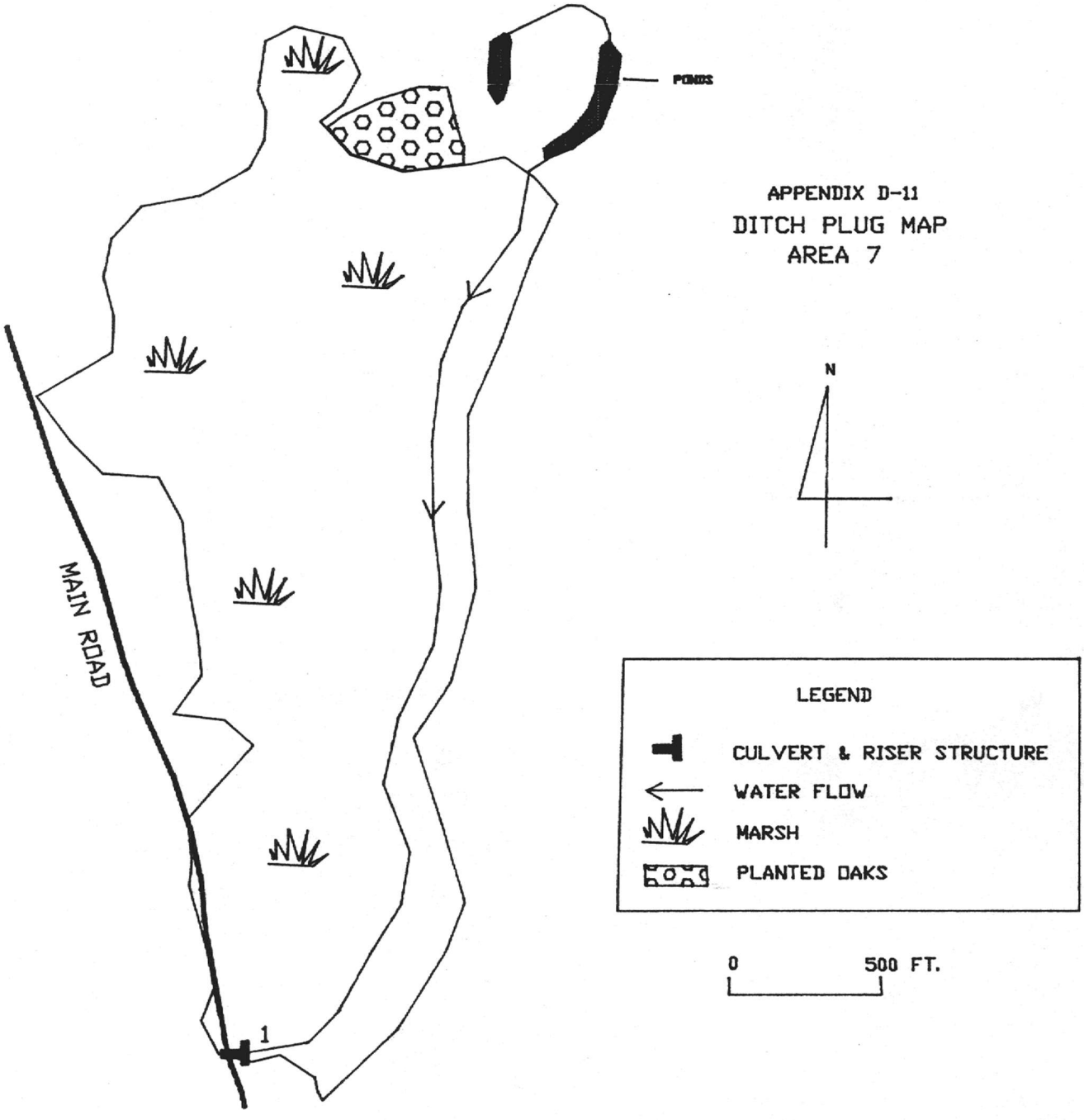
AREAS 8 & 9



APPENDIX D-10

DITCH PLUG MAP
AREA 9




PONDS
MAIN ROAD
1
APPENDIX D-11
DITCH PLUG MAP
AREA 7
N
LEGEND
CULVERT & RISER STRUCTURE
WATER FLOW
MARSH
PLANTED OAKS
0
500 FT.

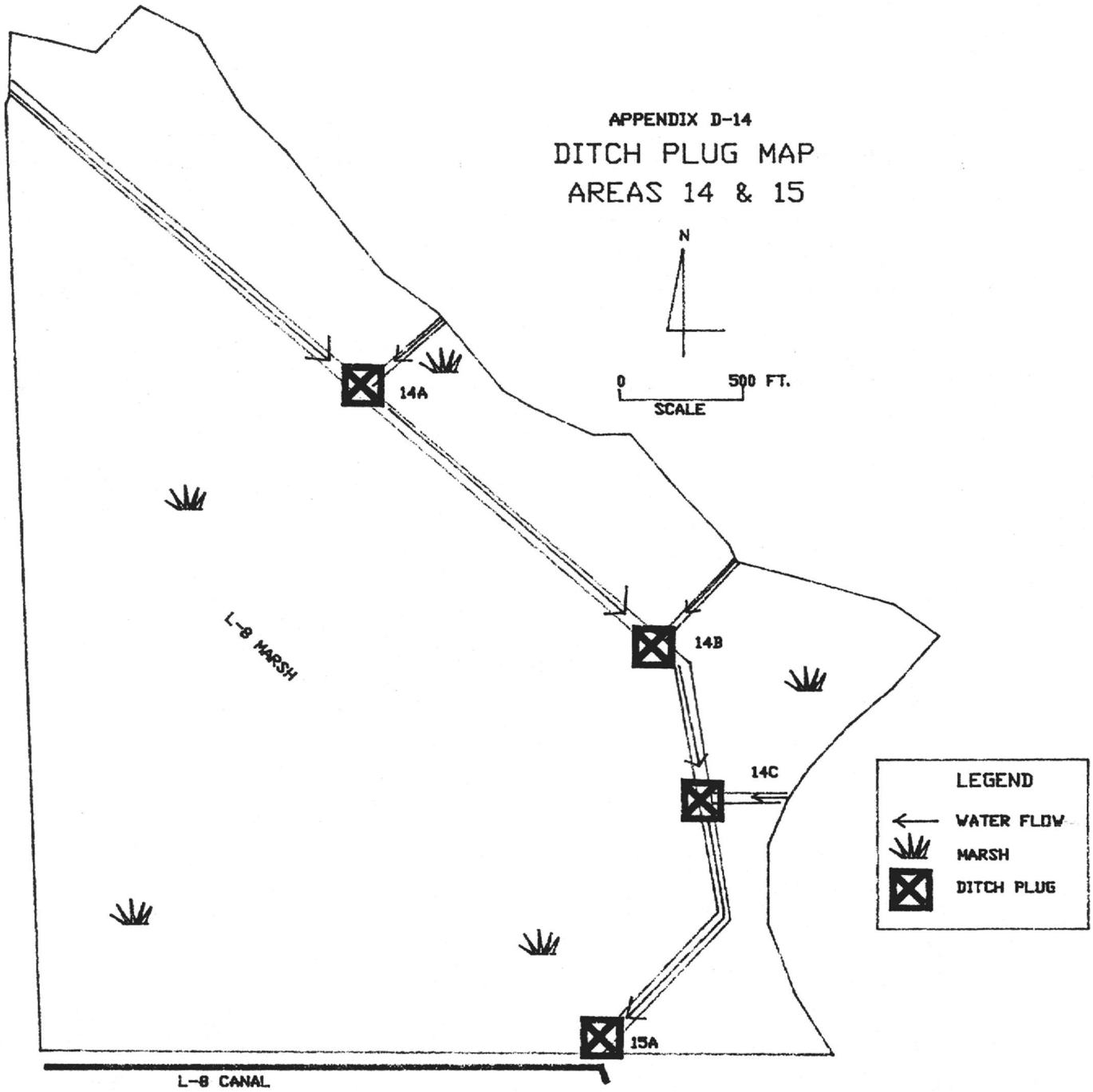
APPENDIX D-12

DITCH PLUG MAP
AREA 11

FP&L TRANMISSION
EAST RIGHT OF WAY
APPENDIX D-13
DITCH PLUG MAP
AREA 12
A
B
N
LEGEND
WATER FLOW
MARSH
DITCH PLUGS
0
500 FT

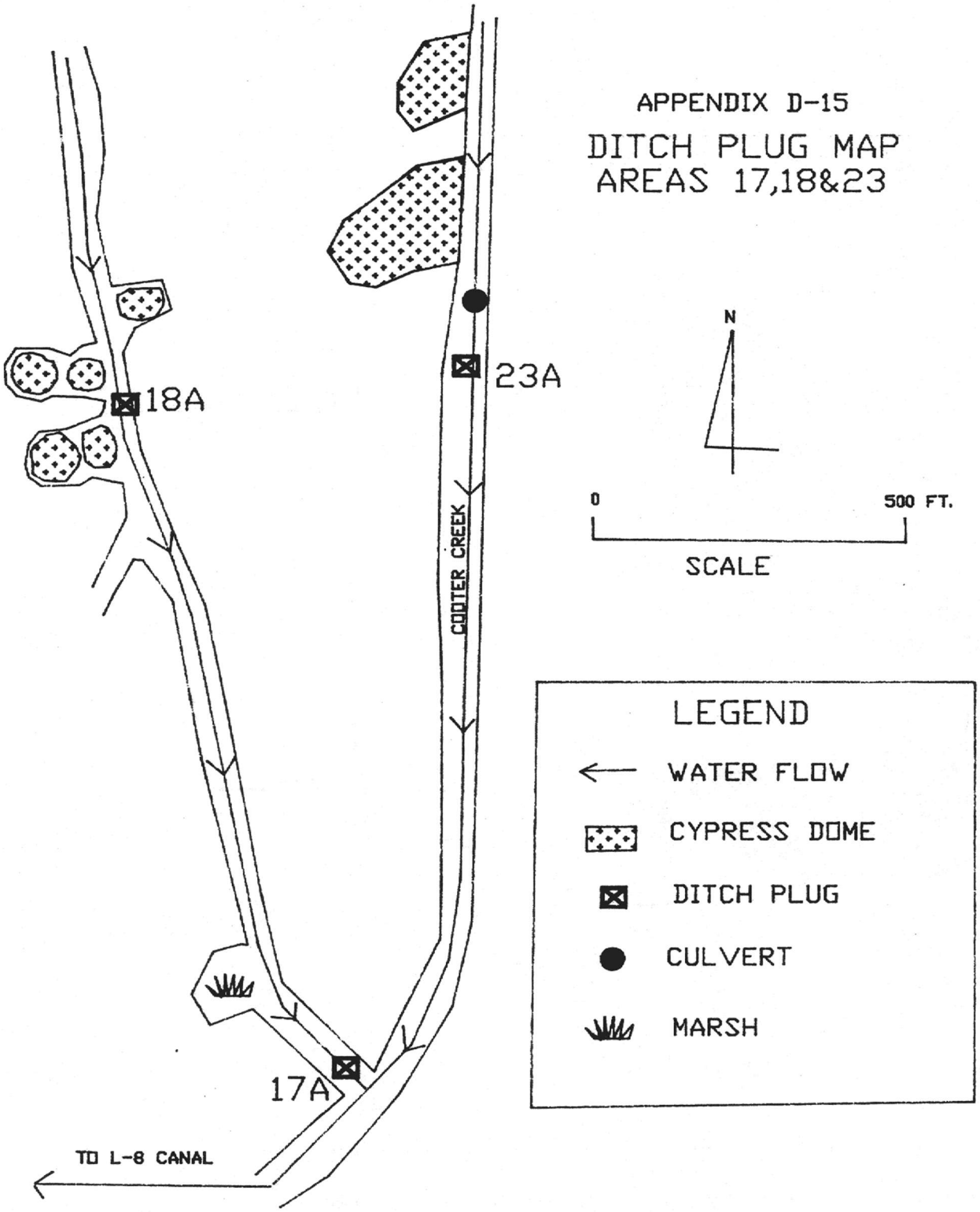
APPENDIX D-14

DITCH PLUG MAP
AREAS 14 & 15

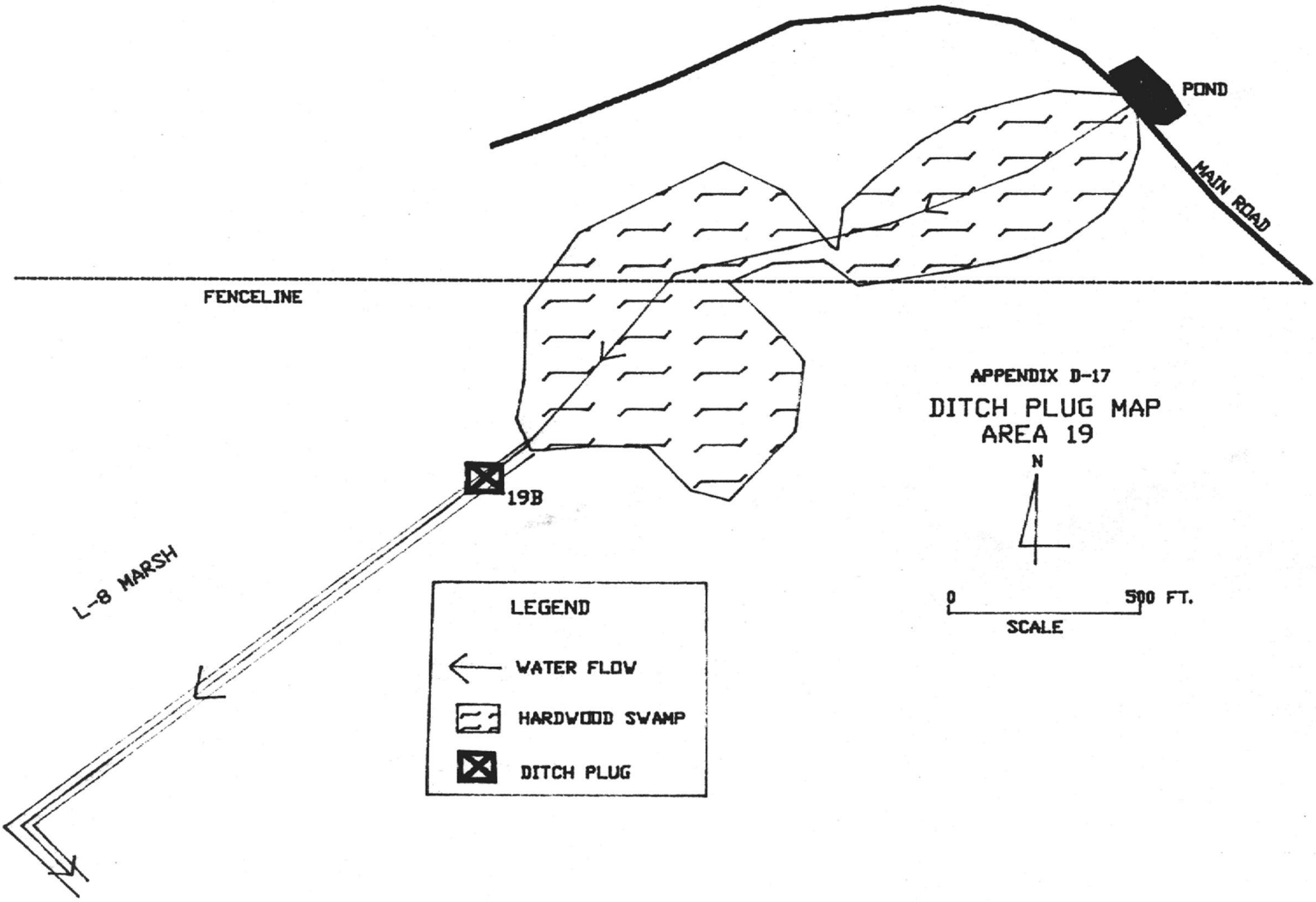


APPENDIX D-15

DITCH PLUG MAP
AREAS 17,18&23



APPENDIX D-16
DITCH PLUG MAP
AREA 19
LEGEND
WATER FLOW
CYPRESS DOME
DITCH PLUG
SCALE
0
500 FT.
N
19A
FP&L CANAL
FP&L POWERLINE ROAD


POND
MAIN ROAD
FENCELINE
19B
L-8 MARSH
LEGEND
WATER FLOW
HARDWOOD SWAMP
DITCH PLUG
APPENDIX D-17
DITCH PLUG MAP
AREA 19
N
0
500 FT.
SCALE