Baseline Biological Survey
The Westerly Town Forest, Westerly, Rhode Island

Rhode Island Natural History Survey
Marybeth Hanley, Contract Botanist,
with David Gregg, Nina Briggs, Erik Endrulat, and Rick Enser.

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Introduction

The Westerly Town Forest (Figure 1) encompasses 204 acres stretching north of Laurel Avenue to the south bank of the Pawcatuck River, in the Pawcatuck River watershed, in Westerly, Rhode Island. The forest parcel was purchased by the Town of Westerly with funds attainable under Rhode Island Public Law 419, 1986, titled "Open Space and Agricultural Land Conservation" (Westerly Planning Office, 1990). The stone fences that wind throughout the parcel and its relatively young vegetation provide evidence of the forest's agricultural landscape history. As the previously open agricultural fields remained unutilized, vegetation was allowed to grow so that the area now resembles that of a late successional forest. Like many forests in Rhode Island and in New England, the Westerly Town Forest has been managed for timber. Previous silvicultural practices have been documented (Westerly Planning Office, 1990) and are evidenced by the presence of cut tree stumps throughout the forest. The entire forest parcel is bordered by a highly developed landscape including paved roads and several private homes.

During the 2006 growing season, the Rhode Island Natural History Survey performed a baseline biological survey of the Forest. The purpose of the survey was to provide general information on the natural resources of the forest (including plant and animal communities) to aid in development of a forest management plan.

Methods

Survey visits to the forest for the purpose of identifying plant communities were made first in mid-June, at consecutive dates in July, and later in October and November to enable observation of as many species at varying growth stages as possible. Surveys were done by foot using the trail system that runs throughout the forest with the aim of discerning major habitats and general plant communities within the forest as a whole.

Within each plant community, in addition to dominant species recorded, other readily identifiable vascular plants were noted and are listed in the pages that follow. Because surveys began in mid-June, spring ephemerals that bloom early (e.g., violets) were likely missed. In addition, there were some plants that could only be identified to genus due to lack of required characters (e.g., flowers) at observation time. Plants were primarily identified by sight and if necessary, species designation was confirmed using a technical key (Gleason & Cronquist, 1991) in conjunction with the PLANTS Database, 2006.

Due to time restraints, some species within large complex families such as the Asteraceae (asters), Cyperaceae (sedges), and Poaceae (grasses) as well as fungi, lichens, and mosses were not identified. For these reasons, the plant species lists in this report should be considered preliminary rather than all inclusive. A baseline floristic list with plant scientific and common names follows as Appendix 1 (nomenclature follows Gould et. al., 1998).

Plant Communities

The Forest is an eastern temperate mixed evergreen-hardwood forest characterized by three distinguishable plant communities recognized in Rhode Island as follows: Oak-Pine Forest, Acer rubrum-deciduous shrub swamp, and open uplands (Rhode Island Natural Heritage Program & Rhode Island Nature Conservancy, 2006).

Oak-Pine Forest

This community type pervades the forest and is characterized by a canopy of primarily hardwood trees, the most dominant of which are oaks (*Quercus alba, Quercus coccinea, Quercus velutina),* beech (*Fagus grandifolia*), and maple (*Acer rubrum*). Interspersed throughout this community other tree species such as *Pinus strobus* (eastern white pine*), Hamamelis virginiana* (witch-hazel), *Sassafras albidum* (sassafras), and *Prunus serotina* (wild black cherry) co-occur. In the under story, the most pervasive shrub species include *Vaccinium angustifolium* (lowbush blueberry), *Gaylusaccia baccata* (black huckleberry), and *Kalmia latifoli*a (mountain-laurel) intermixed with seedling reproduction of the aforementioned tree species. Common species in the herbaceous layer throughout this community include *Aralia nudicaulis* (wild sarsaparilla), *Medeola virginiana* (indian cucumber root), *Lycopodium obscurum* (princess-pine), *Rubus hispidus* (swamp dewberry*), Aster divaricatus* (white wood-aster), and ferns such as *Dennstaedtia punctilobula* (hay-scented fern) and *Thelypteris noveboracensis* (new york fern). Although not officially listed as rare, an unusual and interesting herbaceous species *Cypripedium acaule* (pink lady's-slipper) occurs within this community (figure 2).

The oak-pine forest community shifts somewhat as the soil becomes increasingly mesic as one approaches the streams flowing south from the Pawcatuck River into the Forest. As this occurs, *Acer rubrum* (red maple) and *Nyssa sylvatica* (black gum) become more frequent in the canopy and wetland shrubs such as *Clethra alnifolia* (sweet pepperbush), *Rhododendron viscosum* (swamp-honeysuckle), and *Vaccinium corymbosum* (highbush blueberry) begin to appear.

This community generally corresponds with the “Mixed Hardwoods” stands referenced in the forest management plan generated by the Division of Forest Environment, Department of Environmental Management (Westerly Planning Office, 1990).

Table 1: Additional plant species observed

Trees	**Herbs**
Betula alleghaniensis (yellow birch)	*Aster spp.* (asters)
Carya glabra (pignut-hickory)	*Carex pensylvanica* (early sedge)
Castanea dentata (american chestnut)	*Carex spp.* (sedges)
Chamaecyparis thyoides (atlantic white cedar)	*Chimaphila maculata* (spotted wintergreen)

Ilex opaca (american holly)
Tsuga canadensis (eastern hemlock)

Shrubs
Elaeagnus umbellata (autumn olive)
Kalmia angustifolia (sheep-laurel)
Quercus ilicifolia (scrub-oak)
Rubus flagellaris (northern dewberry)
Rubus spp. (blackberries)
Vaccinium pallidum (early sweet blueberry)
Viburnum acerifolium (maple-leaved viburnum)
Viburnum nudum var. cassinoides (witherod)

Vines
Celastrus orbiculatus (oriental bittersweet)
Parthenocissus quinquefolia (virginia creeper)
Smilax glauca (sawbrier)
Smilax rotundifolia (bullbrier)

Ferns
Dryopteris carthusiana (spinulose wood-fern)
Osmunda cinnamomea (cinnamon fern)
Polystichum acrostichoides (christmas fern)
Pteridium aquilinum (bracken fern)

Cypripedium acaule (pink lady's-slipper)
Danthonia spicata (poverty-grass)
Diphasiastrum digitatum (creeping jenny)
Hyperzia lucidula (shining clubmoss)
Hypoxis hirsuta (yellow star-grass)
Juncus tenuis (path-rush)
Luzula multiflora (common woodrush)
Lysimachia quadrifolia (whorled loosestrife)
Maianthemum canadense (canada mayflower)
Mitchella repens (partridge-berry)
Monotropa uniflora (indian pipe)
Poaceae spp. (grasses)
Solidago spp. (goldenrods)
Toxicodendron radicans (common poison ivy)
Trientalis borealis (starflower)
Uvularia sessifolia (wild oats)

Acer rubrum-deciduous shrub swamp

As one approaches the streams in the northwestern portion of the forest, the plant community most closely resembles that of an *Acer rubrum*-deciduous shrub swamp. Hence, the canopy is primarily composed of red maple, along with a mix of wetland shrub species such as *Lindera benzoin* (northern spicebush), *Cornus amomum* (silky dogwood), and *Ilex laevigata* (smooth winterberry). Immediately adjacent to the streams, herbaceous plants such as *Symplocarpus foetidus* (skunk cabbage), *Veratrum viride* (false hellebore), and *Arisaema triphyllum* (jack-in-the-pulpit) are common. As this community nears the Pawcatuck River the vegetation becomes dense and at least along the one trail that leads to the river itself *Kalmia latifolia* (mountain-laurel) was a noticeably dominant part of the shrub layer. This community generally corresponds with the "Hardwood Swamp" stands referenced in the previous forest management plan (Westerly Planning Office, 1990).

Table 2: Additional plant species observed

Trees
Carya glabra (pignut-hickory)
Fagus grandifolia (american beech)
Hamamelis virginiana (witch-hazel)
Nyssa sylvatica (black gum)
Pseudotsuga menziesii (douglas-fir)
Quercus alba (white oak)
Quercus coccinea (scarlet oak)
Quercus velutina (black oak)

Ferns
Dryopteris carthusiana (spinulose wood-fern)
Onoclea sensibilis (sensitive fern)
Osmunda cinnamomea (cinnamon fern)
Thelypteris noveboracensis (new york fern)
Thelypteris simulata (massachusetts fern)

Herbs
Arisaema triphyllum (jack-in-the-pulpit)

Salix sp. (willow)

Shrubs

Clethra alnifolia (sweet pepperbush)
Ilex verticillata (winterberry)
Kalmia latifolia (mountain-laurel)
Lyonia ligustrina (maleberry)
Rhododendron viscosum (swamp-honeysuckle)
Rosa spp. (roses)
Sambucus canadensis (common elderberry)
Vaccinium corymbosum (highbush blueberry)

Vines

*Smilax rotundifolia (*bullbrier)
Toxicodendron radicans (common poison ivy)
Vitis labrusca (fox-grape)
Vitis sp. (grape)

Carex intumescens (bladder-sedge)
Equisetum arvense (common horsetail)
Iris sp. (iris)
Juncus effusus (soft rush)
Lycopodium obscurum (princess-pine)
Maianthemum canadense (canada mayflower)
Solanum dulcamara (climbing nightshade)
Sphagnum spp. (sphagnum moss)
Thalictrum pubescens (tall meadow-rue)
Toxicodendron radicans (common poison ivy)
Uvularia sessifolia (wild oats)
Viola spp. (violets)

Open uplands

An open upland community exists underneath the power line easement portion of the forest. This disturbed area is primarily dominated by shrubs such as *Kalmia latifolia* (mountain-laurel), *Gaylussacia baccata* (black huckleberry), and *Vaccinium pallidum* (early sweet blueberry), with occasional outcroppings of *Juniperis virginiana* (red cedar) trees. The herbaceous layer is a mosaic of common plants – Asters and Goldenrods as well as several species of grasses and other herbs (see list below).

Table 3: Additional plant species observed

Trees

Betula (birch) reproduction
Quercus coccinea (scarlet oak)
Quercus velutina (black oak)

Shrubs

Clethra alnifolia (sweet pepperbush)
Comptonia perigrina (sweet fern)
Corylus americana (american hazelnut)
Elaeagnus umbellata (autumn olive)
Ilex glabra (inkberry)
Kalmia angustifolia (sheep-laurel)
Lonicera japonica (japanese honeysuckle)
Lonicera tatarica (tartarian honeysuckle)
Lyonia ligustrina (maleberry)
Myrica pensylvanica (northern bayberry)
Prunus serotina (wild black cherry)
Quercus alba (white oak) reproduction
Quercus coccinea (scarlet oak)
Rhododendron viscosum (swamp-honeysuckle)
Rhus copallinum (winged sumac)

Herbs

Achillea millefolium (common yarrow)
Aralia hispida (bristly sarsaparilla)
Asclepias syriaca (common milkweed)
Aster novi-belgii (new york aster)
Aster spp. (asters)
Baptisia tinctoria (yellow wild indigo)
Cypripedium acaule (pink lady's-slipper)
Danthonia compressa (woodland-oatgrass)
Daucus carota (queen anne's lace)
Dichantheliumsp. (panic-grass)
Diphasiastrum digitatum (creeping jenny)
Festuca filiformis (hair fescue)
Hieracium caespitosum (yellow hawkweed)
Juncus greenei (greene's rush)
Juncus tenuis (path-rush)
Lespedeeza hirta (hairy bush-clover)
Linaria canadensis (blue toadflax)
Lycopodium obscurum (princess-pine)
Lysimachia quadrifolia (whorled loosestrife)
Melampyrum lineare (cow-wheat)

Rubus flagellaris (northern dewberry)
Rubus hispidus (swamp-dewberry)
Rubus spp. (blackberries)
Spiraea alba (meadowsweet)
Spiraea tomentosa (steeple-bush)
Vaccinium angustifolium (lowbush blueberry)
Viburnum dentatum (northern arrowwood)
Viburnum nudum var. cassinoides (witherod)

Vines
Celastrus orbiculatus (oriental bittersweet)
Smilax glauca (sawbrier)

Ferns
Dennstaedtia punctilobula (hay-scented fern)
Pteridium aquilinum (bracken fern)

Panicum virgatum (switchgrass)
Phleum pratense (common timothy)
Poaceae spp. (grasses)
Potentilla simplex (common cinquefoil)
Pyrola rotundifolia (round-leaved pyrola)
Rubus spp. (blackberries)
Rudbeckia hirta (black-eyed susan)
Rumex acetosella (sheep-sorrel)
Schizachrium scoparium (little bluestem)
Solidago spp. (goldenrods)
Verbascum thapsus (common mullein)
Vicia sp. (vetch)
Viola spp. (violets)

Non-native Plants

Eleven non-native introduced plant species were observed within the forest and at its boundaries as follows:

Table 4: Non-native plants
Berberis thunbergii (japanese barberry)
Celastrus orbiculatus (oriental bittersweet)
Elaeagnus umbellata (autumn olive)
Holcus lanatum (common velvet-grass)
Lonicera japonica (japanese honeysuckle)
Lonicera tatarica (tartarian honeysuckle)
Phragmites australis (common reed)
Rosa multiflora (multiflora-rose)
Rumex acetosella (sheep-sorrel)
Solanum dulcamara (climbing nightshade)
Verbascum thapsus (common mullein)

Because most of these species have demonstrated invasive spread potential elsewhere, they threaten the biodiversity of the forest's plant communities. Such threats are well described by the Invasive Plant Atlas of New England (IPANE), 2006.

Perhaps the most concerning occurrences in terms of size were those of *Celastrus orbiculatus* (oriental bittersweet) and *Elaeagnus umbellata* (autumn olive). Oriental bittersweet vines were observed climbing up trees on the edge of the interface between the power line easement and the forest interior off the yellow trail heading north into the forest. In addition, reproductive vines were observed directly off the yellow trail in the northern part of the forest (figure 3). Large autumn olive shrubs were also seen in the open area community underneath power lines and encroaching into the forest. Large stands of autumn olive also exist in the gravel pit open area west of the northernmost point of the yellow trail where they were seen among patches of *Phragmites australis* (common reed), *Rosa multiflora* (multiflora rose), and *Celastrus orbiculatus*. In the northwestern part of the forest right along the Pawcatuck River and in the

edges of nearby cleared fields and forests both oriental bittersweet and autumn olive were extremely abundant. In addition, along the river shoreline a stout grass species was observed that could not be identified due to lack of flowers but that should be reexamined at flowering time.

In another large cleared area adjacent to a house site in the southeast corner of the forest off the orange trail there was a mosaic of exotic species observed including both oriental bittersweet and autumn olive, as well as *Rosa multiflora, Berberis thunbergii* (japanese barberry), and *Holcus lantatum* (common velvet-grass). The presence of japanese barberry is concerning as it has been found to be extremely aggressive in forested habitats. Plants were also seen in small amounts in the forest directly off trails and once along a stream (figure 4). The honeysuckle species (*Lonicera japonica* and *Lonicera tatarica*) were observed in the open area community under the power lines, as was *Rumex acetosella* (sheep-sorrel) and *Verbascum thapsus* (common mullein). A small amount of *Solanum dulcamara* (climbing nightshade) was found in proximity with one of the streams in the northern part of the forest.

Animal Communities

Breeding Birds

A breeding bird survey was conducted at the Westerly Town Forest on June 12, 2006. Using the established trail system, survey points were established at 10 locations throughout the property, each point at least 300 meters from adjacent points. Beginning at 05:45 AM, each point was sampled for 10 minutes with all birds heard and observed recorded. A total of 28 species were recorded, the five most common being Tufted Titmouse, Ovenbird, Wood Thrush, Veery, and Great-crested Flycatcher. Finishing time at the last point was 08:35, or approximately 2 hours and 50 minutes spent conducting survey. Complete results are listed in taxonomic order as follows:

Table 5: Bird species observed

Species	Point Number										
	1	2	3	4	5	6	7	8	9	10	Total
Mourning Dove								1			1
Black-billed Cuckoo										1	1
Ruby-throated Hummingbird*	1										1
Red-bellied Woodpecker						1					1
Eastern Wood Pewee		1									1
Great-crested Flycatcher			2	1			1	2			6
Black-capped Chickadee				1							1
Tufted Titmouse	2	1	2	1	2	2	1	2	1	1	15
White-breasted Nuthatch					1						1
House Wren	2										2
Wood Thrush	1		2		3	1	2			1	10
Veery		3				2		1	1	2	9
American Robin				1						1	2
Gray Catbird	1					3				1	5
Brown Thrasher									1		1
Red-eyed Vireo	1		1	1			1				4
Yellow-throated Vireo						1					1
Blue-winged Warbler*	1										1
Black-and-White Warbler									1	1	2
Ovenbird		1	1	1	1	1	2		2	2	11
Common Yellowthroat	1					1					2

Scarlet Tanager	1		1	1	1	1			5
Northern Cardinal				1	1		1	1	4
Rufous-sided Towhee	1		1				1		3
Chipping Sparrow*	1								1
Field Sparrow*	1								1
Brown-headed Cowbird*	3								3
Baltimore Oriole				1					1

(*) species recorded only at point #1 which was located in center of powerline right-of-way

The results should be considered preliminary based on one sample day. The wood thrush, veery, ovenbird, and tananger, among other species, are consistent with expectations for a substantial, intact forest block in this season and region. In Rhode Island's increasingly fragmented forests, these types of species are often pressured by edge species such as cowbirds and blue jays. The blue-winged warbler is a specialist of low shrub habitat. This habitat is increasingly rare in Rhode Island due to succession and long term changes in land use. Actively cleared areas such as powerline rights of way are potential refugia for species that require these conditions. A more complete list of breeding birds may be compiled by conducting multiple surveys during one breeding season (to account for seasonal activity periods which vary between species), as well as nocturnal surveys for owls.

Dragonflies and Damselflies

Dragonflies and damselflies (order Odonata) are well suited for inventories as they are a small group of insects, for the most part are readily identified in the field, and require both aquatic and terrestrial habitats to complete their life cycle. The purpose of the inventory was to record the number of different adult dragonfly and damselfly species at the Westerly Town Forest, including those that did not breed within the preserve. If reproductive behavior was observed in available habitat within the preserve, that was also noted.

The trails in the property were walked twice, once in the spring and once in the late summer. Emphasis was placed on those trails where there was the most water. Those trails included the designated Yellow Trail that meanders through an upland forested habitat, paralleling and crossing a small stream. The small stream adjacent to the Yellow Trail was waded and the edges observed to search for exuvia (the cast skin of a larval dragonfly). The designated White Trail that leads off of the Yellow Trail, goes through a forested wetland and opens on the Pawcatuck River. The designated Orange Trail was walked a short distance where there were openings in the canopy to observe if there was dragonfly feeding behavior. The power line right of way that bisects the western edge of the preserve was also walked. This power line right of way, with its combination of mowed path, shrub growth, and trees, is a good foraging area for dragonflies. The mowed path is sunny and warm, which is conducive to adult feeding behavior; the shrubs and trees provide perches for dragonflies as well as cover from predators.

A 5’ aerial net was used to capture dragonflies on the wing. Adult dragonflies and damselflies were only netted when aerial identification was not possible. All netted individuals were identified and released.

Ten different species were identified at the property (see Table 6). Five other dragonflies and damselflies were seen, but were only identified to genus as they couldn’t be caught and needed closer inspection for identification to species.

Table 6: Dragonfly and damselfly species observed:

Species List		
Family	**Scientific name**	**Common name**
Aeschnidae	*Epiaeschna heros*	swamp darner
	Anax junius	common green darner
	Aeschna sp	
	Aeschna sp	
Macromiidae	*Didymops transversa*	stream cruiser
Libellulidae	*Libellula semifasciata*	four-spotted skimmer
	Pachydiplax longipennis	blue dasher
	Sympetrum internum	cherry-faced meadowhawk
	Sympetrum vicinum	yellow-legged meadowhawk
Calopterygidae	*Calopteryx maculata*	ebony jewelwing
Lestidae	*Lestes sp*	
	Lestes sp	
	Lestes sp	
Coenagrionadae	*Argia fumipennis*	variable dancer
	Ischnura posita	fragile forktail

The forest canopy on the Yellow Trail is so dense that most dragonfly activity was almost nonexistent. Only one stream cruiser dragonfly (*Didymops transversa*) and variable dancer damselfly (*Argia fumipennis*) were observed flying low along the trail during the first visit; none were observed during the second visit.

On the White Trail that threads through the forested wetland, activity was also inhibited by dense canopy. One ebony jewelwing, (*Calopteryx maculata*) was observed perched on the boardwalk that crosses the marsh area during the spring inventory. There was no activity in the late summer.

The Pawcatuck River forms the northern border the property. In this location it is not particularly good dragonfly habitat, being deep, with steep sides and little emergent vegetation and the shore being densely covered by shrubs and briar. The river bed adjacent to the shore appears to be sandy. More odonates were observed flying along the opposite shore of the river. The reasons for this are possibly two-fold: the opposite side of the river is southwest facing and was in the sun. Most odonates fly on the sunnier side of a river. Also, it appeared that there was more emergent vegetation on the opposite side, affording cruising odonates more cover from predators, as well as potential breeding vegetation.

The power line right of way was an active upland habitat for foraging odonates on both visits. In the spring there was a temporary wetland at the southeast edge of the property, complete with a small sphagnum mat and Atlantic white cedar. Here a pair of four-spotted skimmers, (*Libellula quadrimaculata*) was observed and a single fragile forktail, (*Ischnura posita*) was observed. Also in the spring, two swamp darners, (*Epiaeschna heros*), and four stream cruisers were observed foraging along the mowed path of the right of way. In the late summer, 15 – 20 common green darners, (*Anax junius*), 5 cherry-faced meadowhawks, (*Sympetrum internum*), 10 yellow-legged meadowhawks, (*Sympetrum vicinum*), 15 blue dashers, (*Pachydiplax*

longipennis), and 2 darners, (*Aeschna sp.*) were observed both foraging and perching. Two of the species, the common green darner and the blue dasher, are migratory species.

It would appear that the two most interesting habitats for odonates on the property are the Pawcatuck River and the upland habitat of the power line right of way. The Pawcatuck provides potential breeding and feeding habitat for odonates. While odonates were observed on the river, most were observed flying along the opposite shore of the river where the habitat was better. The poor quality of the southern bank for odonates is a natural state, however, and should not be modified. In fact, while openings could improve odonate habitat and provide viewing opportunities for visitors, experience shows such openings often become swimming areas for people and dogs, resulting in seriously degraded water quality parameters such as turbidity and temperature and disrupting important habitat for other aquatic organisms such as fish and small mammals.

Of at least as great ecological interest is the power line right of way. This upland and shrub habitat provides feeding areas for both maturing and migrating odonates. Both breeding and foraging habitat are equally important for completing a dragonflies' life cycle. Indeed, many of the dragonflies observed on the right of way certainly did not breed within the preserve's boundaries due to lack of specific breeding requirements (see Table 7) but utilized the upland for foraging.

Table 7: Species breeding habitat requirements (from Carpenter, Dunkle, and Lam)

Aeschnidae

Anax junius – **common green darner**: habitat – still, marshy waters, including temporary or slightly brackish waters particularly fishless waters. Season: early April migrants from south; breeding with larval emergence through September. Adults are migrate south in fall.

Epiaeschna heros – **swamp darner**: habitat – shady woodland ponds and slow streams, including swamps and temporary ponds. Season: early spring through summer. Migrate south in fall.

Macromiidae

Didymops transversa – **stream cruiser**: habitat – streams, rivers, and lakes, often forested with a sandy bottom. Season: primarily early spring.

Libellulidae

Libellula semifasciata – **four-spotted skimmer**: habitat – marshy or boggy lakes and ponds as well as fens, slow streams and borrow pits. It prefers acid waters of bog pools smaller than 10 square yards, but tolerates salinity. One of the earliest dragonflies.

Pachydiplax longipennis – **blue dasher**: habitat – most still waters with or without fish, except bogs, including marshes, bays, ditches, and swamps. Sometimes flowing water, but uncommon there. Season: mid-June through September. Migrant.

Sympetrum internum – **cherry-faced meadowhawk**: habitat – ponds, lakes, marshes, bogs and slow streams. Season: mid-June through September.

Sympetrum vicinum – **yellow-legged meadowhawk**: habitat – Marshes, ponds, bogs, lakes, and slow streams, usually wooded and permanent but sometimes temporary. Season: late summer into fall – can survive into December in RI.

Calopterygidae

Calopteryx maculata – **ebony jewelwing**: habitat – wide variety of running water, particularly shaded forest streams. Season: spring through September.

Coenagrionidae

Argia fumipennis – **variable dancer**: habitat – slow, vegetated streams, sometimes still water. Season: spring through early fall.

Ischnura posita – **fragile forktail**: habitat – widespread, found among the thick weeds around ponds, bogs, and streams. Season: May through September.

Further surveys would probably result in additional species observations but not necessarily change the assessment of habitats based on these preliminary results. An exception would be finds of crepuscular and forest dwelling species such as shadowdragons (genus *Neurocordulia*) or some clubtails (genus *Gomphus*) which can be cryptic and difficult to observe without repeated visits.

Rare Species

No plant or animal species from the U.S. Federal or Rhode Island lists of rare and endangered species were observed during this survey. Consultation was made of the Biota of Rhode Island database, which includes all data from the Rhode Island Natural Heritage Program, and no records of rare plants or animals on the property were found (Rhode Island Natural History Survey, 2006).

Nonetheless, records exist for two rare animal species occurrences in close proximity to the forest. The eastern spadefoot toad (*Scaphiopus holbrookii*), listed as "Threatened" in Rhode Island, has been recorded approximately ¼ mile west of the forest boundary. In addition, the dragonfly *Cordulegaster oblique* (arrowhead spiketail), a species of concern, has been found using the power line corridor approximately 1.5 miles east of the forest (Rhode Island Natural History Survey, 2006).

Discussion and Recommendations

The Westerly Town Forest is a valuable natural resource in a variety of ways, both in and of itself and because it protects the watershed area of the Pawcatuck River. That watershed contributes to the Town's well fields (Westerly Planning Office, 1990).

a) Inarguably, the overall protection of the parcel is crucial to the protection of this watershed including the processing of runoff.

b) The forest also provides a cross section of major habitat transitions from upland forest to forested wetlands to river. As such, it may be useful for various educational and research purposes from interpretive programs on native plants, animals, and ecosystems to specific research questions such as invasive species management.

c) The forest is also important as a foraging habitat and dispersal corridor for animals using other nearby parcels.

d) Because of its large and unbroken extent, the forest also represents a valuable habitat for certain species that while not officially listed as rare, have populations whose viability is under increasing pressure due to the consequences of habitat reduction. In particular these

include observed forest birds. Although no survey of nocturnal insects was made, nonetheless, hardwood and mixed deciduous forests with large areas protected from artificial lights can have large and diverse insect fauna, particularly among the moths and beetles. Likewise, bats were not surveyed for, but old, passively managed hardwood stands are more likely to retain roosting and brooding opportunities than areas of suburban development, active forest management, or early successional growth.

e) The power line right of way is serving as a significant wildlife habitat that although not under the same degree of pressure as unbroken forest tracts, is nonetheless worth some care for its birds, insects, plants, and other organisms.

f) The forest provides passive recreational opportunities to a significant number of users.

Passive Uses

According to information provided by the Westerly Conservation Commission, the property is currently in passive use for recreation and both environmental and physical education. With minor work to ensure erosion from trails does not enter the swamp or river, and vigilance for new invasive species, these uses are unlikely to affect the environmental qualities of the property in the foreseeable future. Care should be exercised that any new openings to the river bank do not become overused by pedestrians and dogs.

Even if remaining in passive use only, regular natural and anthropogenic processes such as ecological succession, invasion of introduced species, and climate change will nonetheless change the overall character of the property over time. The stakeholders may choose to accept these regular processes or manage them actively. Stakeholders should opt for active management only if they can be specific about the environmental features they wish to preserve and are prepared to take responsibility not only for the substantial direct costs of management, such as cutting, burning, or mowing, but also for the substantial costs to mitigate adverse secondary effects such as erosion and siltation, ground disturbance, or biological invasion in areas being managed.

Active Uses

As evidenced by cut stumps, significant timber extraction has occurred on this property in the past. There are no ecological reasons to resume this activity unless the stakeholders envision using active management to retain a particular profile of successional habitats, in which case the town may choose to create clearings for regeneration of successional tree species such as *Prunus serotina* (wild black cherry) or *Quercus alba* (white oak). The costs of realistic plans to control erosion and the regrowth of weedy native species (e.g., red maple, white pine) as well as the establishment or spread of non-native invasive species (e.g., oriental bittersweet, multiflora rose) should be factored into the cost of any such management activities. This is particularly true if timber harvesting is being considered for economic reasons. Timber extraction in the hardwood swamp leading up to the river should be approached with particular caution because of the susceptibility of the habitat to sediment runoff, as referenced in the previous property management plan (Westerly Planning Office, 1990). In any case, no active management of the forest should be undertaken without early and ongoing input from a qualified forester.

Regardless of the stakeholders' decisions about the bulk of the property, the power line right of way is an area where active management will take place. Because the open area under the power line easement does represent a significant part of the parcel's biodiversity and ecological interest, it is recommended that the town develop a relationship with the easement holder and its maintenance personnel in order to work together to manage the habitat in a way consistent with the town's overall management goals, including preservation/maintenance of habitat and control of non-permitted uses (especially motorcycles/ATVs).

Non-permitted uses and maintenance

Evidence of vehicle use was observed off parts of the orange trail in the southeast part of the forest (figure 5), as were bike tracks in other parts of the forest along yellow trails (figure 6). Motor bikers were seen riding in the gravel pit open area at the northwestern forest boundary. Positive outreach efforts to abutters may help limit destructive incursions into the forest. The town may also want to enlist the power line easement holder's assistance in keeping motorized vehicles off trails.

Several trees were observed fallen across trails in the forest. Some crossed the yellow trail (figure 7), at least three had fallen across the southeastern part of the orange trail (figure 8), and one was found completely obscuring a segment of the orange trail about halfway between the southern part of the trail (figure 9). While safety considerations may warrant their removal, such significant obstacles may also be helping to control erosion and unauthorized motor vehicle use. The stakeholders may wish to consult land management experts and the town solicitor before deciding whether to relocate or remove such obstacles.

Large holes in the forest substrate referred to as "test pits" (Westerly Planning Office, 1990) and large white plastic drainage tubes, presumably perc pipes, were evident throughout the forest especially along the southern section of the orange trail (figures 10 and 11). These are unsightly but otherwise present no ecological problems.

Trail erosion was seen along the yellow trail (figure 12) as well as on the white trail that leads to the boardwalk where the forest abuts the river (figure 13). Erosion should be examined and mitigated especially on the trail leading to the river to control run off, and expansion of trails to the river is highly inadvisable (see above re: riverbank access). A tire swing was observed along the river at the end of the white trail (figure 14). Care should be taken to limit anthropogenic openings along the riverbank as these can lead to significant habitat alteration.

Litter, although minimal, was also observed off forest trails, and should be collected. Lastly, paint marks marking trails have faded considerably on the orange trail.

Non-native species

Non-native plants observed on the property include some of the most aggressive and hence destructive species currently present in Rhode Island--*Berberis thunbergii* (Japanese barberry), *Celastrus orbiculatus* (oriental bittersweet), *Elaeagnus umbellata* (autumn olive), *Phragmites australis* (common reed), and *Rosa multiflora* (multiflora rose). Hence, measures should be

taken to manage established populations and to prevent further spread into the forest. Mechanical removal (by hand, weed wrench, or mechanized equipment) of these species may be possible depending on the extent of the outbreak. If complete removal by mechanical means is not feasible, chemical treatment of cut stems may be required, as may be necessary with oriental bittersweet and *Phragmites* because of their extensive root systems. See IPANE (2006) for information on the biology of these invasive species and for links to management options.

As previously stated, there were sizeable areas both within the forest and at its boundaries where invasive species outbreaks were evident. These areas include the power line right of way, the gravel pit open area at the northwest corner of the forest (figure 15), a large cleared area adjacent to a house site in the southeast corner of the forest off the orange trail (figure 16), and along the river in the northwestern portion of the forest (figure 17). It is likely that the non-native invasive species observed within the forest boundary originated from populations at the aforementioned abutting sites and from others as well. For these reasons, the town should consider increasing its outreach to abutters. The outreach can educate abutters about these issues and assist them to manage the occurrences in order to prevent additional dispersal into the forest. In addition, active cooperation from abutters will help survey the entire perimeter of the forest boundaries to look for other outbreaks.

It should also be recognized that future disturbance actions within the forest (e.g., tree removal) as well as human use of the existing trails (e.g., inadvertent seed dispersal) could affect the establishment of new invasive plant species populations. It is important therefore to plan to survey for and respond promptly to new invasive species outbreaks. A species not detected in this survey that is abundant in Rhode Island and thrives in wetlands and riparian areas is *Polygonum cuspidatum* (Japanese knotweed) (figure 18). Because this is a notably aggressive plant, the town should establish a protocol for its early detection and management (see IPANE, 2006). To that end, it is suggested that the entire river boundary as well as any other open canopy wetland areas be specifically surveyed to look for this plant, as well as other likely invaders (e.g., *Phragmites australis*). Due to the limited scope of this baseline survey, it is possible that these plants are present but may not have been seen.

Follow-up studies

Suggestions for further work are mentioned in relevant sections above. While there are a number of follow-up biological surveys that could be interesting, based on our present observations, we recommend the town and other stakeholders concentrate resources (time and money) on stewardship issues such as invasive species monitoring and control, trail maintenance (including erosion control, litter cleanup, motorized vehicle control, etc.), and control of erosion at riverbank openings. We particularly recommend community involvement in stewardship activities and constructive, positive outreach by stakeholders to abutters and to the maintainers of the power line right of way. If resources permit, useful biological surveys could include a breeding bird survey to confirm the significance of the Town Forest as forest bird habitat or a moth survey to investigate the importance of the nocturnal insect fauna using the available light-free habitat.

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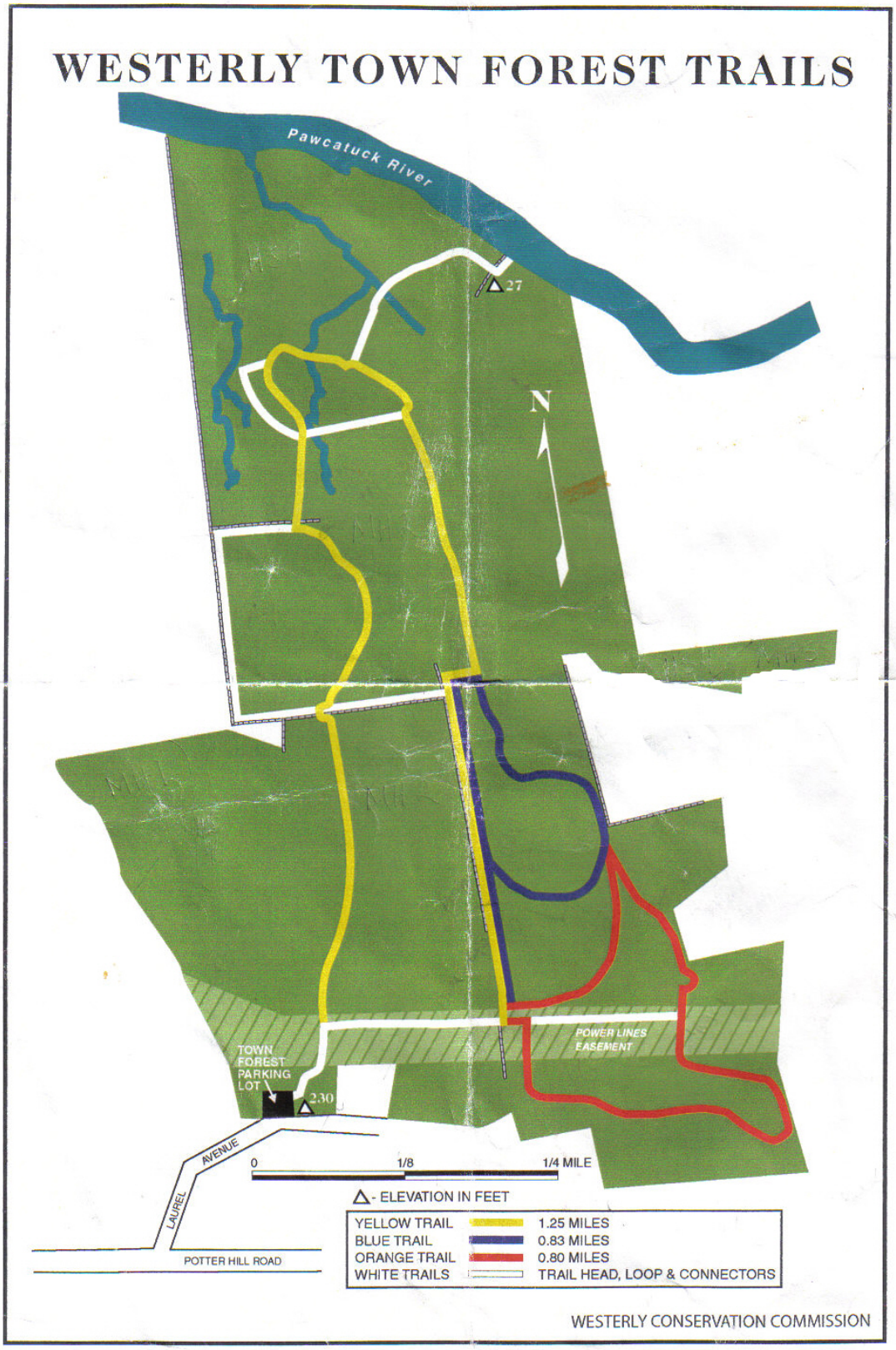

Figure 1. Westerly Town Forest Parcel showing forest trail system

Figure 2. *Cypripedium acaule* (pink lady's-slipper),
USDA, NRCS. 2006. The PLANTS Database (http://plants.usda.gov, 29 November 2006).
National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Figure 3. *Celastrus orbiculatus* reproduction growing off trail in Westerly Town Forest, MB. Hanley

Figure 4. ***Berberis thunbergii*** **in the Westerly Town Forest, MB. Hanley**

Figure 5. Vehicular tracks on Westerly Town Forest Trail, MB. Hanley

Figure 6. Bicycle tracks along yellow trail in the Westerly Town Forest, MB. Hanley

Figure 7. Fallen tree crossing yellow trail in the Westerly Town Forest, MB. Hanley

Figure 8. Fallen tree along orange trail in the Westerly Town Forest, MB. Hanley

Figure 9. Newly fallen tree along orange trail in the Westerly Town Forest, MB. Hanley

Figure 10. Test pit in the Westerly Town Forest, MB. Hanley

Figure 11. White pipe in the Westerly Town Forest, MB. Hanley

Figure 12. Erosion on yellow trail in the Westerly Town Forest, MB. Hanley

Figure 13. Erosion on white trail leading to the boardwalk~river in the Westerly Town Forest, MB. Hanley

Figure 14. Tire swing off white trail leading to the river in the Westerly Town Forest, MB. Hanley

Figure 15. Gravel pit area with *Phragmites* stands adjacent to Westerly Town Forest, MB. Hanley

Figure 16. Field with exotic plant species adjacent to Westerly Town Forest, MB. Hanley

Figure 17. Oriental bittersweet along river within the Westerly Town Forest, MB. Hanley

Figure 18. ***Polygonum cuspidatum*** **(japanese knotweed), Leslie J. Mehrhoff, IPANE, 2006**

Appendix 1. Baseline Flora of the Westerly Town Forest, Rhode Island.

Acer rubrum (red maple)
Achillea millefolium (common yarrow)
Aralia hispida (bristly sarsaparilla)
Aralia nudicaulis (wild sarsaparilla)
Arisaema triphyllum (jack-in-the-pulpit)
Asclepias syriaca (common milkweed)
Aster divaricatus (white wood-aster)
Aster novi-belgii (new york aster)
Aster spp. (asters)
Baptisia tinctoria (yellow wild indigo)
Berberis thunbergii (japanese barberry)
Betula alleghaniensis (yellow birch)
Carex intumescens (bladder-sedge)
Carex pensylvanica (early sedge)
Carex spp. (sedges)
Carya glabra (pignut-hickory)
Castanea dentata (american chestnut)
Celastrus orbiculatus (oriental bittersweet)
Chamaecyparis thyoides (atlantic white cedar)
Chimaphila maculata (spotted wintergreen)
Clethra alnifolia (sweet pepperbush)
Comptonia perigrina (sweet fern)
Cornus amomum (silky dogwood)
Corylus americana (american hazelnut)
Cypripedium acaule (pink lady's-slipper)
Danthonia compressa (woodland-oatgrass)
Danthonia spicata (poverty-grass)
Daucus carota (queen anne's lace)
Dennstaedtia punctilobula (hay-scented fern)
Dichanthelium sp. (panic-grass)
Diphasiastrum digitatum (creeping jenny)
Dryopteris carthusiana (spinulose wood-fern)
Elaeagnus umbellata (autumn olive)
Equisetum arvense (common horsetail)
Fagus grandifolia (american beech)
Festuca filiformis (hair fescue)
Gaultheria procumbens (wintergreen)
Gaylussacia baccata (black huckleberry)
Hamamelis virginiana (witch-hazel)
Hieracium caespitosum (yellow hawkweed)
Holcus lanatum (common velvet-grass)
Hypericum gentianoides (orange-grass)
Hyperzia lucidula (shining clubmoss)
Hypoxis hirsuta (yellow star-grass)
Ilex glabra (inkberry)
Ilex laevigata (smooth winterberry)

Ilex opaca (american holly)
Ilex verticillata (winterberry)
Impatiens capensis (jewelweed)
Iris sp.(iris)
Juncus effusus (soft rush)
Juncus greenei (greene's rush)
Juncus tenuis (path-rush)
Juniperus virginiana (eastern red cedar)
Kalmia angustifolia (sheep-laurel)
Kalmia latifolia (mountain-laurel)
Lespedeeza hirta (hairy bush-clover)
Linaria canadensis (blue toadflax)
Lindera benzoin (northern spicebush)
Lonicera japonica (japanese honeysuckle)
Lonicera tatarica (tartarian honeysuckle)
Luzula multiflora (common woodrush)
Lycopodium obscurum (princess-pine)
Lyonia ligustrina (maleberry)
Lysimachia quadrifolia (whorled loosestrife)
Maianthemum canadense (canada mayflower)
Medeola virginiana (indian cucumber-root)
Melampyrum lineare (cow-wheat)
Mitchella repens (partridge-berry)
Monotropa uniflora (indian pipe)
Myrica pensylvanica (northern bayberry)
Nyssa sylvatica (black gum)
Onoclea sensibilis (sensitive fern)
Osmunda cinnamomea (cinnamon fern)
Osmunda regalis (royal fern)
Panicum virgatum (switchgrass)
Parthenocissus quinquefolia (virginia creeper)
Phleum pratense (common timothy)
Phytolacca americana (pokeweed)
Pinus strobus (eastern white pine)
Poaceae spp. (grasses)
Polystichum acrostichoides (christmas fern)
Potentilla simplex (common cinquefoil)
Prunus serotina (wild black cherry)
Pseudotsuga menziesii (douglas-fir)
Pteridium aquilinum (bracken fern)
Pyrola rotundifolia (round-leaved pyrola)
Quercus alba (white oak)
Quercus coccinea (scarlet oak)
Quercus ilicifolia (scrub-oak)
Quercus velutina (black oak)
Rhododendron viscosum (swamp-honeysuckle)
Rhus copallinum (winged sumac)
Rosa multiflora (multiflora-rose)
Rosa spp. (roses)
Rubus flagellaris (northern dewberry)
Rubus hispidus (swamp-dewberry)
Rubus spp. (blackberries)

Rudbeckia hirta (black-eyed susan)
Rumex acetosella (sheep-sorrel)
Salix sp. (willow)
Sambucus canadensis (common elderberry)
Sassafras albidum (sassafras)
Schizachrium scoparium (little bluestem)
Smilax glauca (sawbrier)
Smilax rotundifolia (bullbrier)
Solanum dulcamara (climbing nightshade)
Solidago spp. (goldenrods)
Spiraea alba (meadowsweet)
Spiraea tomentosa (steeple-bush)
Symplocarpus foetidus (skunk-cabbage)
Thalictrum pubescens (tall meadow-rue)
Thelypteris noveboracensis (new york fern)
Thelypteris simulata (massachusetts fern)
Toxicodendron radicans (common poison ivy)
Trientalis borealis (starflower)
Tsuga canadensis (eastern hemlock)
Uvularia sessifolia (wild oats)
Vaccinium angustifolium (lowbush blueberry)
Vaccinium corymbosum (highbush blueberry)
Vaccinium pallidum (early sweet blueberry)
Veratrum viride (false hellebore)
Verbascum thapsus (common mullein)
Viburnum acerifolium (maple-leaved viburnum)
Viburnum dentatum (northern arrowwood)
Viburnum nudum var. cassinoides (witherod)
Vicia sp. (vetch)
Viola spp. (violets)
Vitis labrusca (fox-grape)
Vitis sp. (grape)