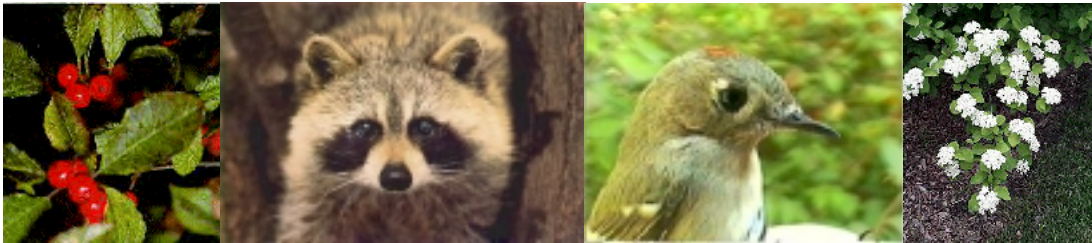


Pompeston Creek Environmental Inventory

December 2002



December 11, 2002

Michael Robinson
Borough of Riverton Environmental Commission
Riverton Library
306 Main Street
Riverton, NJ 08077

Re: Pompeston Creek Environmental Inventory

Dear Mr. Robinson:

Enclosed please find 6 copies of the following reports:

- A Preliminary Report on the Vegetation in the Pompeston Creek Watershed, Riverton, New Jersey, December 2002, prepared by Gerry Moore, Ph.D., Brooklyn Botanic Garden
- A Preliminary Report on the Wildlife Habitat Values of the Pompeston Creek Marsh and Forest Complex, Riverton, New Jersey, December 2002, prepared by Kristi MacDonald, Rutgers University
- A Survey of the Benthic Macroinvertebrate Community of Pompeston Creek, Riverton, New Jersey, December 2002, prepared by Lisa Galloway Evrard, Rutgers Cooperative Extension
- A Visual Assessment of the Lower Section of Pompeston Creek, Riverton, New Jersey, December 2002, prepared by Christopher C. Obropta, Ph.D., P.E., Rutgers Cooperative Extension.

These reports provide an assessment of the plants and animals of the Pompeston Creek and the immediate stream corridor, as well as an evaluation of the biological and physical condition of Pompeston Creek, from the Delaware River to the Cinnaminson border. Also enclosed are copies of 12 plant specification sheets for species found along the corridor. These may be appropriate for your website.

If you have any questions or comments, please do not hesitate to contact me at 732-932-4917 or at obropta@envsci.rutgers.edu.

Sincerely,

Christopher C. Obropta, Ph.D., P.E.

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- A. A PRELIMINARY REPORT ON THE VEGETATION IN THE POMPESTON CREEK WATERSHED, RIVERTON, NEW JERSEY
Prepared by: Gerry Moore, Ph.D. Brooklyn Botanic Garden, Brooklyn, New York, December 2002

- B. A PRELIMINARY REPORT ON THE WILDLIFE HABITAT VALUES OF THE POMPESTON CREEK MARSH AND FOREST COMPLEX, RIVERTON, NEW JERSEY
Prepared by: Kristi MacDonald, Ecology and Evolution Graduate Program, Rutgers University, New Brunswick, NJ, December 2002

- C. A SURVEY OF THE BENTHIC MACROINVERTEBRATE COMMUNITY OF POMPESTON CREEK, RIVERTON, NEW JERSEY
Prepared by: Lisa Galloway Evrard, Rutgers Cooperative Extension, December 2002

- D. A VISUAL ASSESSMENT OF THE LOWER SECTION OF POMPESTON CREEK, RIVERTON, NEW JERSEY
Prepared by: Christopher C. Obropta, Ph.D., P.E., Rutgers Cooperative Extension, December 2002

- E. PLANT SPECIFICATION SHEETS

A PRELIMINARY REPORT ON THE VEGETATION IN THE
POMPESTON CREEK WATERSHED|
RIVERTON, NEW JERSEY

Prepared by

Gerry Moore, Ph.D.
Brooklyn Botanic Garden
Brooklyn, New York

December 2002

Introduction

In 2002, through the Center for Urban Restoration Ecology (Rutgers University), staff at the Brooklyn Botanic Garden were asked to conduct a survey in the Pompeston Creek watershed. The goal of this survey was to describe the vegetation that was present. The presence of any rare, threatened or endangered species was also to be documented. Also the presence and potential threats (to the native vegetation) that invasives may pose in the watershed was also of interest. On 21 October, Gerry Moore of the Brooklyn Botanic Garden visited the site along with Lisa Galloway Evrard and Christopher Obropta, Ph.D. of Rutgers University along with Jessica Hayes-Conroy of Riverton.

Methods

Gerry Moore spent only one day (21 October 2002) surveying the site. He recorded all vascular plants noted. Collections were occasionally made of material that could not be identified or where a museum specimen of material was needed (e.g., the kudzu vine). Plants were identified using Gleason and Cronquist (1991) and Fernald (1950). These manuals were also used in determining a plant's native or non-native status.

During this survey, three different areas were visited. The first survey area included an area near the border of Cinnaminson and Riverton (Site 1 in Table 1). The second area surveyed was near County Route 543 on both sides of the road (Site 2 in Table 1). The third area that was surveyed was the area near the confluence of the Pompeston Creek with the Delaware River (Site 3 in Table 3).

Results and Discussion

Along the Creek, Site 1 consisted of an open freshwater tidal marsh. Common freshwater marsh species noted here included *Acnida cannabina* (salt marsh water hemp), *Bidens laevis* (large bur-marigold), *Impatiens capensis* (jewelweed), *Typha x glauca* (cat-tail), and *Zizania aquatica* (wild rice). The one submerged aquatic species that was noted was *Ceratophyllum demersum* (coontail). The aggressive invasive *Phragmites australis* (common reed) was also noted here. Bordering the marsh was a narrow zone of forested wetlands dominated by such trees as *Acer rubrum* (red maple) and *Nyssa sylvatica* (black gum). Adjacent to the forested wetlands were forested oak uplands.

Along the Creek, Site 2 was also an open marshy area. Many plants found in the marsh at Site 1 were also present here. There was very little forested wetland adjacent to the Creek in this area. Much of the land adjacent to the Creek in this area was open disturbed ground dominated by non-native weeds.

Site 3 near the confluence of the Creek with the Delaware River was a mostly sandy forested area. Here there were large stands of the non-native tree *Robinia pseudoacacia* (black locust), usually with the non-native vine *Clematis ternifolia* (Japanese clematis) growing over them. *Ilex opaca* (American holly) was also common here. See Table 1 for a complete list of all plants noted at the three sites, to include common names. There were also some areas of open disturbed ground here where non-native weeds predominated.

No endangered plant species were noted during the survey. This should not be construed to mean that no rare plant species occur in the watershed. The survey was only for one day, and it took place very late in the growing season when many plants would not be recognizable.

The most striking aspect of the survey was how prevalent invasive species are in the watershed. Of the 99 species noted during this survey 27 (27%) are not native to New Jersey (see Table 1). Furthermore, several aggressive invasive native species were also noted, such as *Phragmites australis* (common reed) and *Toxicodendron radicans* (poison ivy). Every region visited during the survey appeared to be under stress from the spread of invasive plant species. Some of the invasives that were most common in the area included *Acer platanoides* (Norway maple), *Ampelopsis brevipedunculata* (porcelain-berry), *Alliaria petiolata* (garlic mustard), *Arundinaria* sp. (bamboo), *Celastrus orbiculatus* (Oriental bittersweet), *Clematis ternifolia* (Japanese clematis), *Humulus japonicus* (Japanese hops), *Lonicera japonica* (Japanese honeysuckle), *Phragmites australis* (common reed), *Polygonum aviculare* (prostrate knapweed), *Polygonum cupidatum* (Japanese knotweed), *Pueraria Montana* (kudzu), and *Robinia pseudoacacia* (black locust).

Most surprising was finding a large population of kudzu vine near the Creek at the confluence with the Delaware River. In the South, it is one of the worst invasives, and it is oftentimes referred to as the “vine that ate the South.” It is not a common plant north of Delaware, but it is becoming established in the Northeast in some areas. Also of interest was the abundance of bamboo at Sites 2 and 3. This large grass species is clearly spreading at each site

and has formed large colonies. It is not currently known to be a problematic invasive in New Jersey, but it certainly is a concern in this watershed.

The most pressing concern regarding the native vegetation of the Pompeston Creek watershed is clearly the spread of invasive plant species in the area. Without intervention (e.g., monitoring and control) this problem is only going to worsen.

TABLE 1

Plants found in Pompeston Creek watershed during 21 October 2002 survey

Site 1: area near the Cinnaminson/Riverton border; Site 2: area adjacent to County Route 543; Site 3: area near confluence with the Delaware River; * - non-native species

LATIN NAME	COMMON NAME	SITES
<i>Acer negundo</i>	box elder	1,2
<i>Acer platanoides</i> *	Norway maple	1,2
<i>Acer rubrum</i>	red maple	1,2
<i>Acer sacharinum</i>	sugar maple	1,2,3
<i>Achillea millefolium</i>	Yarrow	3
<i>Acnida cannabina</i>	saltmarsh water hemp	1,2
<i>Ailanthus altissima</i> *	tree-of-heaven	1,3
<i>Alliaria petiolata</i> *	garlic mustard	1,2,3
<i>Allium vineale</i>	field garlic	1,2,3
<i>Amelopsis brevipedunculata</i> *	porcelain-berry	1,2,3
<i>Amorpha fruticosa</i>	bastard indigo	1,2,3
<i>Artemisia annua</i> *	fragrant wormwood	3
<i>Artemisia vulgaris</i> *	common mugwort	3
<i>Arundinaria sp.</i> *	Bamboo	2,3
<i>Aster spp.</i>	Aster	1,2,3
<i>Bidens laevis</i>	large bur-marigold	1,2
<i>Catalpa bignonioides</i> *	Catalpa	1,2,3
<i>Celastrus orbiculatus</i> *	Oriental bittersweet	1
<i>Celtis occidentalis</i>	Hackberry	1,2,3
<i>Ceratophyllum demersum</i>	Coontail	1
<i>Chenopodium album</i>	lamb's quarters	3
<i>Chenopodium spp</i>	Goosefoot	2,3
<i>Clematis ternifolia</i> *	Japanese clematis	1,2,3
<i>Clethra alnifolia</i>	sweet pepperbush	1,2,3
<i>Conyza canadensis</i>	Horseweed	3
<i>Cornus amomum</i>	silky dogwood	2
<i>Cornus florida</i>	flowering dogwood	2
<i>Daucus carota</i> *	Queen Anne's lace	3
<i>Dechampsia flexuosa</i>	crinkled hairgrass	2
<i>Digitaria sp.</i>	Crabgrass	2
<i>Eupatorium rugosum</i>	white snakeroot	1,2
<i>Euthamia graminifolia</i>	flat-topped goldenrod	3
<i>Fagus grandifolia</i>	Beech	1,2,3
<i>Fraxinus americana</i>	white ash	1,2,3

<i>Hedera helix*</i>	English ivy	1
<i>Heterotheca subaxillaris</i>	camphorweed	3
<i>Humulus japonicus*</i>	Japanese hops	2,3
<i>Ilex opaca</i>	American holly	1,3
<i>Ilex verticillata</i>	Winterberry	1
<i>Impatiens capensis</i>	Jewelweed	1,2
<i>Juniperus virginiana</i>	red cedar	1
<i>Kalmia latifolia</i>	mountain laurel	1,2
<i>Leersia oryzoides</i>	rice cutgrass	1,2
<i>Lindera benzoin</i>	Spicebush	1
<i>Liriodendron tulipifera</i>	tulip poplar	2
<i>Lonicera japonica*</i>	Japanese honeysuckle	1,2,3
<i>Lycopus sp.</i>	Horehound	1,2
<i>Malus sp.*</i>	Crabapple	2
<i>Morus alba*</i>	white mulberry	1,2,3
<i>Nuphar advena</i>	Spatterdock	1,2
<i>Nyssa sylvatica</i>	black gum	1,2,3
<i>Oenothera biennis</i>	evening primrose	3
<i>Onoclea sensibilis</i>	sensitive fern	1,2
<i>Panicum clandestinum</i>	deer-tongue grass	2
<i>Parthenocissus quinquefolia</i>	Virginia creeper	1,2,3
<i>Paulownia tomentosa*</i>	princess tree	2
<i>Peltandra virginiana</i>	arrow arum	2
<i>Philadelphus coronarius*</i>	mock orange	2
<i>Phragmites australis</i>	common reed	1
<i>Physocarpus opulifolius</i>	Ninebark	2
<i>Phytolacca americana</i>	Pokeweed	2,3
<i>Pilea pumila</i>	Clearweed	1,2
<i>Platanus occidentalis</i>	Sycamore	1,2,3
<i>Polygonum aviculare</i>	prostrate knapweed	2
<i>Polygonum cespitosum</i> var. <i>longisetum*</i>	long-bristled smartweed	1,2,3
<i>Polygonum cuspidatum*</i>	Japanese knotweed	2
<i>Polygonum punctatum</i>	dotted smartweed	1,2,3
<i>Polygonum sagittatum</i>	arrow-leaved tearthumb	1,2
<i>Polygonum virginianum</i>	Virginia knotweed	1
<i>Prunus serotina</i>	black cherry	1,2,3
<i>Pueraria montana*</i>	kudzu	3
<i>Quercus alba</i>	white oak	1,2
<i>Quercus montana</i>	chestnut oak	1
<i>Quercus palustris</i>	pin oak	2
<i>Quercus velutina</i>	black oak	1,2,3
<i>Robinia pseudoacacia*</i>	black locust	1,2,3
<i>Rosa multiflora*</i>	multiflora rose	2
<i>Rubus pensilvanicus</i>	leafy-flowered blackberry	2
<i>Rubus spp.</i>	Blackberry	1,2,3
<i>Sagittaria latifolia</i>	broad-leaved arrowhead	1,2
<i>Salix babylonica*</i>	weeping willow	2
<i>Salix nigra</i>	black willow	1,3
<i>Sambucus canadensis</i>	Elderberry	1
<i>Saponaria officinalis*</i>	bouncing bet	2,3

<i>Sassafras albidum</i>	Sassafras	1,2
<i>Sicyos angulatus</i>	star cucumber	3
<i>Smilacina racemosa</i>	false solomon's seal	1
<i>Smilax glauca</i>	glaucous greenbrier	2
<i>Smilax rotundifolia</i>	common greenbrier	1,2,3
<i>Solidago</i> spp.	Goldenrod	1,2,3
<i>Taxus cuspidata</i> *	Japanese yew	1
<i>Toxicodendron radicans</i>	poison ivy	1,2,3
<i>Typha x glauca</i>	cat-tail	1
<i>Ulmus americana</i>	American elm	1,2
<i>Urtica dioica</i>	stinging nettle	1
<i>Verbsacum thapsus</i> *	common mullein	3
<i>Vernonia noveboracensis</i>	New York ironweed	2
<i>Viburnum dentatum</i>	arrow-wood	1,2
<i>Vitis labrusca</i>	fox grape	1,2,3
<i>Zizania aquatica</i>	wild rice	1,2

A PRELIMINARY REPORT ON THE WILDLIFE HABITAT VALUES OF THE
POMPESTON CREEK MARSH AND FOREST COMPLEX
RIVERTON, NEW JERSEY

Prepared by

Kristi MacDonald
Ecology and Evolution Graduate Program
Rutgers University, New Brunswick, NJ

December 2002

Introduction

As part of a larger assessment of the ecological values of the Pompeston Creek watershed, a review of the wildlife habitat values of the creek, its tidal wetlands, and adjacent forested areas was conducted. On 1 November 2002, areas from the confluence of Pompeston Creek and the Delaware River to approximately 1 mile upstream were visited in order to obtain firsthand observations of the habitat at several sites. As outlined in Gerry Moore's report on vegetation, the sites referred to herein are the tidal marshes and adjacent forests near the Cinnaminson/Riverton border and on either side of County Rt. 543 (Sites 1 and 2, respectively), and the small forested area at the confluence of the Creek with the Delaware River (Site 3). On 1 November only sites 2 and 3 were visited. A second visit to the creek that would have included all three sites was planned for 17 November, but was postponed due to inclement weather.

It should be noted that the species composition of animals within the marshes and forests at Pompeston Creek change with the season. The middle of autumn is generally a time of transition and is not typically the time of year when surveys will provide useful information on bird and herpetological fauna. This issue is addressed further in the sections below. This review of the potential habitat values of the marsh and forest complex for vertebrate taxa is mainly based on limited observations, documented occurrences of wildlife (J. H. Taylor), and published literature on animals commonly occurring in tidal freshwater marshes and small forests. Therefore, this information should be considered preliminary until additional visits are

made in the near future as well as during the taxonomically appropriate seasons for wildlife surveys.

Wildlife Habitat Values

Tidal freshwater wetlands support a high diversity of plants and animals. Bird species diversity is highest in this wetland type as compared to other wetlands. Mitsch and Gosselink (1983) describe these wetlands as existing at a midpoint on the continuum of wetland types between salt marshes and inland wetlands, which probably contributes to the high number of species found here. Species that are not tolerant of saltwater (e.g., most amphibians) are able to utilize tidal freshwater wetlands.

Tidal wetlands may be used as feeding, nesting, and/or protection by wildlife at a given time. Several species are *wetland obligates* and spend all of their time in the wetlands and creeks. Many of the species found in freshwater tidal wetlands are *facultative* wetland species. They benefit greatly from the wetland habitat for some aspect of their existence, but are also capable of utilizing other types of habitat. Many obligate and facultative species found in tidal wetlands require adjacent upland habitats for some part of their daily activities and life cycles. Forests and other upland habitats adjacent to tidal wetlands provide many important functions. Terrestrial species that utilize the marshes at lower tides move into shallow waters and dry uplands to escape high tides. Several bird species that feed within the wetlands use adjacent forests as nesting areas. Forest edges provide perching sites overlooking hunting grounds for some raptor species. Turtles leave wetlands to lay their eggs in sunny embankments adjacent to wetlands. Some turtles burrow into creek embankments lined with roots to hibernate. Muskrats make their burrows in these embankments. The diversity of wildlife species in a forest is generally related to the structural diversity of the vegetation (i.e., ground, shrub, and canopy layers) both vertically and horizontally, as well as the presence of unique habitats such as vernal pools and other features.

The species composition of tidal wetlands varies seasonally. During spring and fall, the marshes contain many transitory bird species in addition to year-round residents. Birds migrating along the Delaware River reach high concentrations in these rich habitats. Some of these migrants will join residents to breed in the marshes or adjacent uplands during late spring

and summer. Fish move into the marshes to spawn at this time. In winter, the marshes provide shelter and foraging habitat for resident species.

The food chain in tidal freshwater wetlands is detrital based with the exception of a few grazers such as muskrat, some fish species and some insects. Invertebrates including mollusks, as well as fish, provide a food source for the abundant bird and small mammal community. In turn, these species are consumed by top predators including hawks, owls, and mammalian carnivores such as fox and raccoons. Extreme fluctuations of water levels in tidal marshes, dense vegetation, and soft substrate may deter successful foraging by some species of predators such as raccoons. However, locally high concentrations of some species at patchy, rich food sources on the marsh may attract high densities of predators (see Kiviat in Day et al. 1989, Mitsch and Gosselink 1983).

The major limitations on available habitat in the surrounding urban and agricultural landscape increases the local and regional value of Pompeston Creek and its associated habitats for wildlife. The rarity of undegraded natural habitats in urbanized landscapes may result in the funneling of species into remaining habitats and thereby inflate the importance of such places in maintaining regional wildlife diversity. Furthermore, it should be noted that the absence of a species in an area does not always mean that the habitat is not suitable for that species. Historical land use practices, hunting, and other alterations to species and their habitats may leave a long-term imprint on the wildlife community. Some species are limited in their ability to recolonize an area once they are extirpated due to low dispersal abilities and/or difficulty crossing inhospitable landscapes such as is found in urban areas.

Note: The following discussion of potential vertebrate taxa that might be found in the marsh-forest complex does not necessarily mean that the species is actually present unless otherwise stated in the section titled "Site Discussions." Likewise, several species may be present that are not mentioned in this review.

See Appendix A for Common and Latin Names of species mentioned in this review.

Birds

Waterfowl: This group includes ducks and geese. The shoots and seeds of emergent vegetation as well as small aquatic invertebrates of the tidal wetlands provide a rich food resource for waterfowl. Breeding: Species that may utilize Pompeston Creek's tidal wetlands for breeding include Mallard, Black Duck, and Canada Goose. Wood Ducks may be nesting in tree cavities in the wetlands or in adjacent woodlands. Wintering: Wintering waterfowl require open water in winter and are therefore forced to move when water freezes over. Many species of wintering waterfowl probably utilize the open water of the River as well as the Creek and its marshes. During extremely windy and harsh weather, the Pompeston Creek marshes may provide important shelter habitat. In addition to Mallard, Black Duck, Wood Duck and Canada Goose, Blue-winged Teal, and Green-winged Teal, and Gadwall wintering species may include Ruddy Duck, Common Merganser, Redhead, American Wigeon, Northern Shoveler, Northern Pintails, Ring-necked Ducks, Greater and Lesser Scaup, and Bufflehead.

Pied-billed Grebe: This species may nest in the marshes. It is a state-endangered species. They are less likely to be found in the area during winter because they move to more coastal areas.

Rails and their Allies: These species are obligate wetland species and are more or less specialized for breeding in wetlands with emergent vegetation like those found at Pompeston Creek. Rails build up their hummock nests of vegetation to about 6" above water level. A common problem for breeding rails is the flooding of nests. King Rail, Virginia Rail, Yellow Rail and Sora Rail are potentially nesting at Pompeston Creek marshes. They eat seeds and small invertebrates. Clapper, King, and Sora rails, American Coot and Common Moorhen are also very likely to be breeding in the marshes. All the species in this group with the exception of American Coot migrate south after the breeding season.

Cormorants: Double-crested Cormorants (year round) and Great Cormorants (winter) may be found feeding in the open water of the tidal wetlands or at the mouth of Pompeston Creek.

Wading Birds: Bitterns, herons and egrets (with the exception of Cattle Egret) are dependent on wetland habitats. Breeding: Least Bittern and American Bittern may nest on the ground, over

water or low in shrubs and emergent vegetation at Pompeston Creek. The breeding population American Bittern is listed as endangered in New Jersey. Green Herons are very common breeding species and may be nesting in forests adjacent to the wetlands. Great Blue Heron and Great Egret nest colonially in shrubs and trees but are not currently breeding at Pompeston Creek. Colonies of these two species are increasing in number in New Jersey. Historically, Black-crowned Night Heron colonies were found in more inland areas of New Jersey (including Burlington County) but are now limited to coastal marshes. Black-crowned Night Heron is listed as threatened as a breeding species in the state. Wintering: Depending on the severity of the winter, a few bitterns and herons may over winter in New Jersey, especially in the southern part of the state. With the exception of Great Blue Heron, most of the species migrate south. Foraging: All of the species mentioned above may be observed foraging in the marshes and along the Pompeston Creek, regardless of whether they are breeding there.

Kingfishers: Belted Kingfisher may build their nest burrows in the banks at the edges of the marshes at Pompeston Creek. Kingfishers forage by diving into open water to capture fish. They may be seen year-round.

Passerines and Woodpeckers: Red-winged Blackbirds and Marsh Wrens are likely breeding in high abundance in the tidal wetlands of the Pompeston Creek. Both of these wetland species are build their nests in tall, emergent vegetation such as cattails and reeds. Common Yellowthroat also nests on emergent marsh vegetation and shrubs and is probably present here. Swamp sparrows are also likely to be breeding in the marshes but this low-nesting species is more limited by water levels. Other species that are not wetland-dependent, including American Goldfinch, Song Sparrow, and Rufous-sided Towhee are also known to nest in freshwater marshes (W. E. Odum et al. 1984 in Mitsch and Gosselink 1983). The forests, forest edges and narrow riparian woodlands adjacent to the marshes likely support a wide-range of breeding passerines and woodpeckers. These may include Yellow Warblers, Willow Flycatchers, Great-crested Flycatchers, Indigo Buntings, Tree Swallows, Wood Thrushes, American Robin, Blue Jay, Catbird, and Baltimore Oriole, and Red-bellied Woodpecker (see Appendix B for complete list of potential songbirds breeding in the forests). Many songbirds, especially Neotropical migrants, will not breed in small forests. Foraging: Several Passerines may forage on the seeds

of marsh plants and the insects on leaf surfaces as well as in the air. The species nesting in the marsh may eat a combination of seeds, insects, and invertebrates (snails) found in the marsh. Bobolink, a state-endangered species, may be found feeding on the seeds of marsh plants. Species such as Great-crested Flycatchers may perch in trees along the marsh edges to search for aerial insects. Several swallow species probably exploit swarming insects in the air over the marsh. Migration: During spring and fall migrations, many species of warblers and other Neotropical migrants will stop over in the woodlands adjacent to the marsh before continuing north.

Shorebirds: Breeding: Killdeer, Woodcock and Spotted Sandpipers are potentially breeding in the marshes or at the edges of the marshes. Migration: Large numbers of shorebirds pass through New Jersey en route to and from their northern breeding grounds and southern wintering grounds. They congregate in large flocks along the shores of the Delaware Bay. During migration, it is highly likely that the mudflats and shallower marshes of the Pompeston Creek are heavily utilized by many of these species.

Gulls and Terns: During fall, spring, and winter, several species of gulls may be found along the River. It is likely that some individuals may be found foraging and loafing in the open water, mudflats, and marshes of the Pompeston Creek. This group of birds breeds along the coast.

Birds of Prey: Breeding: The shallower portions of the tidal marsh or slightly raised areas may provide nesting habitat for Northern Harrier, a ground-nesting raptor. This species' breeding population is listed as endangered by the state of New Jersey. Trees within or adjacent to the marsh may provide nesting habitat for Osprey, a state threatened species. Many raptors are forest-nesting species that typically nest in forest tracts much larger than those remaining around Pompeston Creek. One exception is the Red-tailed Hawk which is possibly nesting in the forest at Site 1 and perhaps in the narrower woodlands along the marshes at site 2. Great-horned Owls may also breed in small forests such as these. Wintering: Long-eared and Short-eared Owls (state-threatened and endangered, respectively) and Rough-legged Hawks may winter in and around the marshes. Foraging: Additional species that may utilize the marsh to hunt for rodents, small birds, and insects are Sharp-shinned Hawk, Cooper's Hawk (state-threatened), American

Kestrel, Broad-winged Hawk, and Red-shouldered Hawk (state-endangered). Bald Eagles, a state and federal endangered species, may also visit the Creek and its wetlands.

Turkey and Quail: Wild Turkey, Bobwhite Quail, and Ring-necked Pheasants may utilize the marsh edges for foraging. Wild Turkey may use the small forests adjacent to the marshes upstream for breeding.

Birds listed by J. H. Taylor: See Appendix C for J.H. Taylor's list of birds.

Mammals

Muskrat: Muskrat are most likely common inhabitants of the Creek and its marshes. This species thrives in both freshwater and estuarine environments where it consumes large amounts of marsh vegetation. They live in burrows and lodges within and adjacent to marshes. Muskrat activities clear or thin dominant marsh vegetation and allow for smaller marsh plants to grow. Their burrowing activities aerate the soil and create varied surfaces that may be exploited by different species. Their burrows and lodges are often used many other species as nesting and foraging sites. (See Kiviat 1994)

Beaver: This species was likely present historically. The recovery of this wetland species in some areas of New Jersey indicates that there is some potential for it to be found at Pompeston Creek.

River Otter, Mink, and Long-tailed Weasel: Charismatic, wetland-dependent species such as Mink and River Otter were probably present historically but may have been extirpated due to trapping or habitat degradation. The highly urbanized nature of the surrounding landscape may not be conducive to River Otter and Mink. Long-tailed Weasel, more of a habitat generalist, may be present along the marsh edges and utilize the marshes during low tide.

Small Mammals: Insectivores such as Masked Shrew, Least Shrew, Shorttail Shrew, Star-nosed Mole, and Eastern Mole are potentially present along the marsh/forest edges. Rodents including White-footed Mouse, House Mouse, and Norway Rat are likely present in the woodlands

adjacent to the marshes and probably utilize the marsh during low tide. Woodland Jumping Mouse may also be present in and around the marshes. Meadow voles are probably common and are capable of persisting in very wet marsh conditions due to their ability to swim. Rice Rat, a semiaquatic wetland species, is at the northern extreme of its range near this area and may be present in the marshes.

Bats: Bats may be roosting in the adjacent forests and building structures and utilizing the marshes to forage for insects. Possible species include Little Brown Myotis, Keen Myotis, Small-footed Myotis, Silver-haired bat, Eastern Pipistrel, Red Bat, Big Brown Bat, and Hoary Bat.

Eastern Cottontail: The Eastern Cottontail is probably common along the marsh and forest edges.

Woodchuck: Woodchucks excavate their burrows in woodlands very close to the edge. They make forays out of the forest into open areas, including lawns, to eat herbaceous vegetation. It is not known whether they regularly enter the marsh during low tide.

Squirrels and Chipmunks: The Eastern Grey Squirrel and Eastern Chipmunk are present in the woodlands and riparian strips along the Creek. These species, especially Grey Squirrel, may make short-distance forays into the marshes at low tide. Southern Flying Squirrel is most likely present within these woodlands.

Raccoon, Opossum, and Skunk: These species are likely present along the marsh edges and may make forays into the marshes to locate food. All are omnivorous and rather opportunistic in their diets. Their densities may be enhanced by the surrounding urban residential areas. Raccoons are often attributed with nest failure and adult injuries in turtles. Raccoons, opossum, Skunk, both fox species, and Coyotes are also predators of birds and their nests.

Grey Fox, Red Fox, and Coyote: Similar to Raccoon, Opossum, and Skunk, Grey and Red foxes and Coyote are potential predators on other species in the community. Their diet is also

omnivorous. Unlike the above-mentioned species, foxes and Coyote will be present in low densities. The presence of Coyote may decrease the density of feral cats and possibly dogs in the marsh and forest habitats.

Bobcat: This species is extremely secretive and little information exists about its distribution in New Jersey. It is on the State Endangered Species List. It is possible, though unlikely, that Bobcat is present in the watershed.

White-tailed deer: White-tailed Deer may be present in high densities in the forests adjacent to the marshes and may forage on young shoots and softer vegetation in the marshes. The only factor that might limit their ability to utilize the marsh would be the soft substrate, which might hinder movement.

Feral Cats and Dogs: Though cats and dogs are not native wildlife, there are few habitats in close proximity to developed areas where they are not found. Both of these species will attack native wildlife species. The impact of cat predation on native songbirds has been well documented to be a significant contributor to low survival and low nesting success. Ground- and shrub-nesting birds are especially affected by feral cats. Rodents and Insectivores (Shrews and Moles) are also eaten by feral cats.

Mammals listed by J. H. Taylor: Grey Squirrel, Raccoon, White-tailed Deer, Eastern Cottontail, Muskrat, Bat (unknown sp.), Skunk, Opossum, Meadow Mouse (unknown sp.), Vole (unknown sp.), and Kangaroo Mouse (probably incorrect).

Fish

Fish comprise an important component of the tidal freshwater ecosystem as consumers, prey, and importers and exporters of marsh nutrients. This discussion of common fish species likely to be found in freshwater tidal marshes is based on Kiviat (1996) discussion of fish species based on life history strategies in the Hudson River. These different strategies, anadromous, potamodromous, and catadromous, determine the role that tidal marsh systems play in the population dynamics of these species.

Anadromous: These species migrate from the ocean into freshwater tributaries to spawn. Juveniles spend several years in tributaries then migrate back to the ocean where they mature. Anadromous species that may be found in the freshwater tidal areas of the Delaware and its tributaries are Alewife, American Shad, Atlantic Sturgeon, Shortnose Sturgeon, “river herring”, Blueback herring, Sea Lamprey, and Striped Bass. These species are particularly vulnerable to barriers such as dams that prevent them from migrating into tributaries to spawn. The Shortnose Sturgeon is listed as endangered on the federal and state level.

Potamodromous: These species migrate from a large body of freshwater (e.g., the Delaware River) into tributary streams for spawning. Some species that may be found in the freshwater tidal areas of the Delaware and its tributaries include Smallmouth Bass, and Yellow Perch. Other potential species include Spottail Shiner, White Perch, and White Sucker.

Catadromous: These species spawn in the ocean but live adult life in freshwater; a rare life history strategy in the Northern Hemisphere. The American Eel is a catadromous species found in freshwater tidal areas of the Delaware River. The American Eel will undertake a long-distance migration to the Sargasso Sea where it shares its spawning ground with the European eel.

Reptiles

Turtles: Snapping Turtle is probably very abundant in the marshes (Kiviat 1998). Other species that may be present in the marshes include Painted Turtle (Kiviat 1998), Redbelly Turtle, Musk Turtle (Stinkpot) (Kiviat 1998), Eastern Mud Turtle, Spotted Turtle (Kiviat 1998), and Map Turtle (Kiviat 1998). Wood Turtle (state-threatened species; Kiviat 1998) and Eastern Box Turtle (Kiviat 1998) may be present in the forests and fields adjacent to the marshes and these species may move into the marsh at low tide. Turtles common in the marsh require adjacent upland areas, including train embankments and levees, for nesting.

Lizards: Five-lined Skink (Kiviat 1998) may be present in the watershed.

Snakes: Northern Water Snake (Kiviat 1998), Eastern Garter Snake (Kiviat 1998), Milk Snake (Kiviat 1998), Black Racer (Kiviat 1998), Black Rat (Kiviat 1998), Eastern Ribbon Snake, Northern Brown Snake (Kiviat 1998), Northern Ringneck Snake (Kiviat 1998), and Rough Green Snake are species that may exist in the surrounding uplands and utilize the marsh for foraging at low tide.

Reptiles listed by J. H. Taylor: Box Turtle, Red-bellied Slider (probably Redbelly Turtle), Painted Turtle, Spotted Turtle, Snapping Turtle, Eastern Garter Snake, and Northern Water Snake.

Amphibians

Salamanders: Amphibians may be limited as common breeding species in the tidal wetlands due to strong currents and the presence of fish that consume eggs and larvae. One exception is the aquatic Red-spotted Newt (Kiviat 1998), which may be present in the tidal wetlands and in its terrestrial stage, Red Eft, it may inhabit slightly elevated areas at the wetland edges. Eastern Tiger Salamander (state-endangered species), Marbled Salamander, and Spotted Salamander (Kiviat 1998) may be present in the forested wetlands where they breed in vernal pools then burrow underground for much of the year. Redback Salamander is a common species in forested areas and is most likely present in the woods adjacent to the marshes.

Frogs: Along the forest/marsh edges, New Jersey and/or upland Chorus Frog, Northern Spring Peeper (Kiviat 1998), Gray Treefrog (Southern species state-endangered), and Northern Cricket Frog may be found. In addition, Green Frog (Kiviat 1998), Bullfrog (Kiviat 1998), Southern Leopard Frog, Pickerel Frog (Kiviat 1998), Wood Frog (Kiviat 1998), and American Toad (Kiviat 1998) may be found in the marsh and in surrounding uplands.

Amphibians listed by J. H. Taylor: Spring Peeper, Leopard Frog, Bullfrog, and Common Toad.

Site Discussions

Site 1: Not surveyed. From Gerry Moore's description this area contains tidal wetlands bordered by forested wetlands and upland oak forest. The forested areas are more extensive in this area

than in Sites 2 and 3 and provide important habitat functions for species that utilize the marshes. During high tides, many species will move into upland areas. These woodlands provide important nesting, wintering, and stopover habitat for birds (see above). Several amphibian species are likely breeding in these forests. Many of the turtle species found in the marsh will also utilize adjacent forested uplands. It also buffers the tidal wetlands from disturbances and pollution that may enter the marsh from surrounding residential areas.

Site 2: This site contains a tidal marsh with areas of deep water behind a breached levee/trail that crosses the marsh. It is bordered by narrow woodland strips, a public park, residential development, and Rt. 543. Raccoon tracks were observed in the exposed mud at low tide. A small flock of Ruby-crowned Kinglets was observed at the edge of the marsh gleaning insects from emergent vegetation. White-throated Sparrows and a Song Sparrow were heard in the dense emergent vegetation at the marsh edge and in the shrubby woodland edge. American Goldfinches were heard and observed in the marsh as well as on the edges. Large numbers of Mallards was seen at various locations within the deep open water of the Creek. Within the narrow woodland corridor a Grey Catbird, Red-tailed Hawk, Common Grackles, White-breasted Nuthatch, Blue Jays, Yellow-shafted flicker, and Juncos were seen and/or heard. A Woodchuck was observed as well as one or more Woodchuck burrows. It should be noted that a couple of invasives were observed in this area of the Creek: Japanese Knotweed and Phragmites. The spread of these species should be monitored and potential control measures undertaken. Japanese Knotweed is capable of forming dense, impermeable stands along river edges in some of the urban areas in northern New Jersey.

Site 3: The forest at the confluence of Pompeston Creek and the Delaware River appears to be very poor habitat for most species. The kudzu vine covering the trees and ground layer prevents a richly structured understory from developing, and there was only a very sparse tree canopy. Japanese Knotweed was growing along the Creek banks. This forest has potential for a major restoration initiative.

Survey Needs

1. Breeding bird surveys: Should be conducted 3 times in a given season (May-July).

2. Winter bird surveys: Should be conducted a few times between January and February.
3. Herpetological surveys: Should be conducted in late spring and summer.
4. Mammal surveys: Anytime, but especially informative in winter just after snow when tracks are visible. Tracks may also be visible in exposed mudflats.
5. Fish data should be gathered from NJDEP. Fish may also be sampled directly.
6. Surveys of butterflies, moths, dragonflies and other insects. Invertebrate sampling in general.

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Further Reading/Resources on Wildlife

Websites:

<http://data.acnatsci.org/vireo/index.html> (contains publishable photos of birds)
<http://birds.cornell.edu> (info on bird ID, research, and publishable photos)
<http://www.mp2-pwrc.usgs.gov/bbs> (Breeding Bird Survey website; population info)
<http://endangered.fws.gov/wildlife.html#species> (info on federally endangered species)
<http://www.state.nj.us/dep/fgw> (info on fish and game species in N.J.)
<http://www.state.nj.us/dep/fgw/ensphome.htm> (info on non-game and endangered spp)
<http://www.njaudubon.org> (information on birds, butterflies, etc. in N.J.)

Other:

The Birds of North America publications, contains highly detailed information summarizing all available information on each species.

List of Freshwater Tidal Reprints from Hudsonia, 18pp.

N. J. Endangered and Nongame Species Program List of Threatened and Endangered Species.

APPENDIX A: Common and Latin Names of Species Mentioned in This Review

Common Name	Latin Name
Geese	
Canada goose	<i>Branta canadensis</i>
Dabbling Ducks	
American black duck	<i>Anas rubripes</i>
American wigeon	<i>Anas americana</i>
Blue-winged teal	<i>Anas discors</i>
Northern pintail	<i>Anas acuta</i>
Gadwall	<i>Anas strepera</i>
Green-winged teal	<i>Anas crecca</i>
Mallard	<i>Anas platyrhynchos</i>
Northern shoveler	<i>Anas clypeata</i>
Wood duck	<i>Aix sponsa</i>
Diving Ducks	
Common merganser	<i>Mergus merganser</i>
Bufflehead	<i>Bucephalavalbeola</i>
Greater scaup	<i>Aythya marila</i>
Lesser scaup	<i>Aythya affinis</i>
Redhead	<i>Aythya americana</i>
Ring-necked duck	<i>Aythya collaris</i>
Ruddy duck	<i>Oxyura jamaicensis</i>
Wading Birds	
American bittern	<i>Botaurus lentiginosus</i>
Black-crowned night heron	<i>Nycticorax nycticorax</i>
Cattle egret	<i>Bubulcus ibis</i>
Great blue heron	<i>Ardea herodias</i>
Great egret	<i>Casmerodius albus</i>
Green heron	<i>Butorides striatus</i>
Least bittern	<i>Ixobrychus exilis</i>
Rallids	
American coot	<i>Fulica americana</i>
Common gallinule (Moorhen)	<i>Gallinula chloropus</i>
King rail	<i>Rallus elegans</i>
Sora rail	<i>Porzana carolina</i>
Virginia rail	<i>Rallus limicola</i>
Yellow rail	<i>Coturnicops noveboracensis</i>
Shorebirds	
Killdeer	<i>Charadrius vociferus</i>
Spotted sandpiper	<i>Actitis macularia</i>
Woodcock	<i>Scolopax minor</i>

Other Waterbirds	
Belted kingfisher	<i>Ceryle alcyon</i>
Double-crested cormorant	<i>Phalacrocorax auritus</i>
Great cormorant	<i>Phalacrocorax carbo</i>
Pied-billed grebe	<i>Podilymbus podiceps</i>
Birds of Prey	
American kestrel	<i>Falco sparverius</i>
Bald eagle	<i>Haliaeetus leucocephalus</i>
Broad-winged hawk	<i>Buteo platypterus</i>
Cooper's hawk	<i>Accipiter cooperii</i>
Great horned owl	<i>Bubo virginianus</i>
Long-eared owl	<i>Asio otus</i>
Northern harrier	<i>Circus cyaneus</i>
Osprey	<i>Pandion haliaetus</i>
Red-shouldered hawk	<i>Buteo lineatus</i>
Red-tailed hawk	<i>Buteo jamaicensis</i>
Rough-legged hawk	<i>Buteo lagopus</i>
Sharp-shinned hawk	<i>Accipiter striatus</i>
Short-eared owl	<i>Asio flammeus</i>

Songbirds	
Marsh wrens	<i>Cistothorus palustris</i>
Red-winged blackbird	<i>Agelaius phoeniceus</i>
Common yellowthroat	<i>Geothlypis trichas</i>
Yellow warbler	<i>Dendroica petechia</i>
Swamp sparrow	<i>Melospiza georgiana</i>
Indigo bunting	<i>Passerina cyanea</i>
Barn swallow	<i>Hirundo rustica</i>
Gray catbird	<i>Dumetella carolinensis</i>
Willow flycatcher	<i>Empidonax traillii</i>
Tree swallow	<i>Tachycineta bicolor</i>
Bank swallow	<i>Riparia riparia</i>
Song sparrow	<i>Melospiza melodia</i>
Bobolink	<i>Dolichonyx oryzivorus</i>
American goldfinch	<i>Carduelis tristis</i>
American robin	<i>Turdus migratorius</i>
Baltimore oriole	<i>Icterus galbula</i>
Common grackle	<i>Quiscalus quiscula</i>
Ruby-crowned kinglet	<i>Regulus calendula</i>
White-breasted nuthatch	<i>Sitta carolinensis</i>
Wood thrush	<i>Hylocichla mustelina</i>
Red-bellied woodpecker	<i>Melanerpes carolinus</i>
Blue jay	<i>Cyanocitta cristata</i>
Northern cardinal	<i>Cardinalis cardinalis</i>
Great-crested flycatcher	<i>Myiarchus crinitus</i>
White-throated sparrow	<i>Zonotrichia albicollis</i>
Dark-eyed junco	<i>Junco hyemalis</i>
Rufous-sided towhee	<i>Pipilo chlorurus</i>
Woodpeckers	
Yellow-shafted flicker	<i>Colaptes auratus</i>
Red-bellied woodpecker	<i>Melanerpes carolinus</i>
Pheasants	
Bobwhite quail	<i>Colinus virginianus</i>
Ring-necked pheasant	<i>Phasianus colchicus</i>
Wild Turkey	<i>Meleagris gallopavo</i>
Mammals	
Muskrat	<i>Ondatra zibethica</i>
Beaver	<i>Castor canadensis</i>
River otter	<i>Lutra canadensis</i>
Mink	<i>Mustela vison</i>
Longtail weasel	<i>Mustela frenata</i>
Masked shrew	<i>Sorex cinereus</i>
Least shrew	<i>Cryptotis parva</i>
Shorttail shrew	<i>Blarina brevicauda</i>
Starnose mole	<i>Condylura cristata</i>

Eastern mole	<i>Scalopus aquaticus</i>
White-footed mouse	<i>Peromyscus leucopus</i>
Norway rat	<i>Rattus norvegicus</i>
House mouse	<i>Mus musculus</i>
Woodland jumping mouse	<i>Napaeozapus insignis</i>
Meadow vole	<i>Microtus pennsylvanicus</i>
Rice rat	<i>Oryzomys palustris</i>
Little brown myotis	<i>Myotis lucifugus</i>
Keen myotis	<i>Myotis keeni</i>
Small-footed myotis	<i>Myotis subulatus</i>
Silver-haired bat	<i>Lasionycteris noctivagans</i>
Eastern pipistrel	<i>Pipistrellus hesperus</i>
Red bat	<i>Lasiurus borealis</i>
Big brown bat	<i>Eptesicus fuscus</i>
Hoary bat	<i>Lasiurus cinereus</i>
Eastern cottontail	<i>Sylvilagus nuttalli</i>
Woodchuck	<i>Marmota monax</i>
Gray squirrel	<i>Sciurus carolinensis</i>
Southern flying squirrel	<i>Glaucomys volans</i>
Eastern chipmunk	<i>Tamias striatus</i>
Raccoon	<i>Procyon lotor</i>
Opossum	<i>Didelphis marsupialis</i>
Striped skunk	<i>Mephitis mephitis</i>
Gray fox	<i>Urocyon cinereoargenteus</i>
Red fox	<i>Vulpes fulva</i>
Coyote	<i>Canis latrans</i>
Bobcat	<i>Lynx rufus</i>
White-tailed deer	<i>Odocoileus virginianus</i>
Domestic cat (feral)	<i>Felis catus</i>
Domestic dog (feral)	<i>Canis familiaris</i>
Fish	
American shad	<i>Alosa sapidissima</i>
Atlantic sturgeon	<i>Acipinser oxyrinchus</i>
Shortnose sturgeon	<i>Acipenser brevirostrum</i>
Blueback herring	<i>Alosa aestivalis</i>
Sea lamprey	<i>Petromyzon marinus</i>
Striped bass	<i>Morone saxatilis</i>
Alewife	<i>Alosa pseudoharengus</i>
Smallmouth bass	<i>Micropterus dolomieu</i>
Yellow perch	<i>Perca flavescens</i>
Spottail shiner	<i>Notropis hudsonius</i>
White perch	<i>Morone americana</i>
White sucker	<i>Catostomus commersoni</i>
Atlantic tomcod	<i>Microgadus tomcod</i>
American eel	<i>Anguilla rostrata</i>

Reptiles	
Snapping turtle	<i>Chelydra serpentina</i>
Eastern painted turtle	<i>Chrysemys picta picta</i>
Redbelly turtle	<i>Pseudemys rubriventris</i>
Musk turtle (Stinkpot)	<i>Sternotherus odoratus</i>
Eastern Mud turtle	<i>Kinosternon subrubrum subrubrum</i>
Spotted Turtle	<i>Clemmys gutata</i>
Map turtle	<i>Graptemys geographica</i>
Wood turtle	<i>Clemmys insculpta</i>
Eastern box turtle	<i>Terrapene carolina carolina</i>
Five-lined skinks	<i>Eumeces fasciatus</i>
Northern water snake	<i>Nerodia sipedon sipedon</i>
Eastern garter snakes	<i>Thamnophis sirtalis sirtalis</i>
Milk snake	<i>Lampropeltis triangulum triangulum</i>
Black racer	<i>Coluber constrictor constrictor</i>
Black rat snake	<i>Elaphe obsoleta obsoleta</i>
Eastern ribbon snake	<i>Thamnophis sauritus sauritus</i>
Northern brown snake	<i>Storeria dekayi dekayi</i>
Northern ringneck snake	<i>Diadophis punctatus edwardsii</i>
Rough green snake	<i>Opheodrys aestivus</i>
Amphibians	
Red-spotted newt	<i>Notophthalmus viridescens viridescens</i>
Eastern tiger salamander	<i>Ambystoma tigrinum tigrinum</i>
Marbled salamander	<i>Ambystoma opacum</i>
Spotted salamander	<i>Ambystoma maculatum</i>
Redback salamander	<i>Plethodon cinereus</i>
Upland chorus frog	<i>Pseudacris triseriata feriarum</i>
New Jersey chorus frog	<i>Pseudacris triseriata kalmi</i>
Spring peeper	<i>Pseudacris crucifer</i>
Gray treefrog	<i>Hyla versicolor and Hyla chrysoscelis</i>
Northern cricket frog	<i>Acris crepitans crepitans</i>
Green frog	<i>Rana clamitans melanota</i>
Bullfrog	<i>Rana catesbeiana</i>
Southern leopard frog	<i>Rana utricularia</i>
Pickerel frog	<i>Rana palustris</i>
Wood frog	<i>Rana sylvatica</i>
American toad	<i>Bufo americanus</i>

APPENDIX B: Potential Songbirds and Woodpeckers Breeding in Small Forests

Common Name	Scientific Name	Common Name	Scientific Name
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>	Yellow-throated Vireo	<i>Vireo flavifrons</i>
Hairy Woodpecker	<i>Picoides villosus</i>	White-eyed Vireo	<i>Vireo griseus</i>
Downy Woodpecker	<i>Picoides pubescens</i>	Red-eyed Vireo	<i>Vireo olivaceus</i>
Common Flicker	<i>Colaptes auratus</i>	Warbling Vireo	<i>Vireo gilvus</i>
Pileated Woodpecker	<i>Melanerpes erythrocephalus</i>	Yellow Warbler	<i>Dendroica petechia</i>
Eastern Wood-Pee-wee	<i>Contopus virens</i>	Black-and-White Warbler	<i>Mniotilta varia</i>
Eastern Phoebe	<i>Sayornis phoebe</i>	American Redstart	<i>Setophaga ruticilla</i>
Acadian Flycatcher	<i>Empidonax virescens</i>	Ovenbird	<i>Seiurus auropellus</i>
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	Kentucky Warbler	<i>Oporornis formosus</i>
Willow Flycatcher	<i>Empidonax crinitus</i>	Common Yellowthroat	<i>Geothlypis trichas</i>
Eastern Kingbird	<i>Tyrannus tyrannus</i>	Canada Warbler	<i>Wilsonia canadensis</i>
Blue Jay	<i>Cyanocitta cristata</i>	Hooded Warbler	<i>Wilsonia citrina</i>
American Crow	<i>Corvus brachyrhynchos</i>	Yellow-rumped Warbler	<i>Dendroica coronata</i>
Black-capped Chickadee	<i>Parus atricapillus</i>	Worm-eating Warbler	<i>Helmitheros vermivorus</i>
Tufted Titmouse	<i>Parus bicolor</i>	Scarlet Tanager	<i>Piranga olivacea</i>
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	Northern Cardinal	<i>Cardinalis cardinalis</i>
White-breasted Nuthatch	<i>Sitta carolinensis</i>	Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>
Carolina Wren	<i>Thyrothorus ludovicianus</i>	Indigo Bunting	<i>Passerina cyanea</i>
House Wren	<i>Troglodytes aedon</i>	Rufous-sided Towhee	<i>Pupilo erythrophthalmus</i>
Veery	<i>Catharus fuscescens</i>	Swamp Sparrow	<i>Melospiza georgiana</i>
Wood Thrush	<i>Hylocichla mustelina</i>	Chipping Sparrow	<i>Spizella passerina</i>
American Robin	<i>Turdus migratorius</i>	Song Sparrow	<i>Melospiza melodia</i>
Gray Catbird	<i>Dumetella carolinensis</i>	House Sparrow	<i>Passer domesticus</i>
Northern Mockingbird	<i>Mimus polyglottos</i>	Orchard Oriole	<i>Icturus spurius</i>
Brown Thrasher	<i>Taxostoma rufum</i>	Baltimore Oriole	<i>Icturus galbula</i>
European Starling	<i>Sturnus vulgaris</i>	Purple Finch	<i>Caprodacus purpureus</i>
Common Grackle	<i>Quiscalus quiscula</i>	House Finch	<i>Caprodacus mexicanus</i>
Brown-headed cowbird	<i>Molothrus ater</i>	American Goldfinch	<i>Carduelis tristis</i>
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>		

APPENDIX C: Bird Species Listed by J. H. Taylor

Red-Throated Loon
Pied-Billed Grebe
Double-Crested Cormorant

Common Loon
Horned Grebe

American Bittern
Great Blue Heron
Snowy Egret
Cattle Egret
Black-Crowned Night Heron

Least Bittern
American Egret
Little Blue Heron
Green Heron
Glossy Ibis

Canada Goose
Green-Winged Teal
Mallard
Blue-Winged Teal
Canvasback
Greater Scaup
Common Goldeneye
Hooded Merganser
Red-Breasted Merganser

Wood Duck
American Black Duck
Northern Pintail
American Wigeon
Redhead Duck
Lesser Scaup
Bufflehead
Common Merganser
Ruddy Duck

Turkey Vulture
Bald Eagle
Sharp-Shinned Hawk
Red-Shouldered Hawk
Red-Tailed Hawk
Kestrel (Sparrow Hawk)
Peregrine Falcon

Osprey
Marsh Hawk
Cooper's Hawk
Broad-Winged Hawk
Rough-Legged Hawk
Merlin (Pigeon Hawk)

Ring-Necked Pheasant
Virginia Rail
American Coot

Bob White Quail
Common Gallinule

Killdeer
Lesser Yellowlegs
Ruddy Turnstone
American Woodcock

Greater Yellowlegs
Spotted Sandpiper
Common Snipe

Laughing Gull
Ring-Billed Gull
Great Black-Backed Gull

Bonapart's Gull
Herring Gull
Common Tern

Rock Dove (Pigeon)
Black-Billed Cuckoo
Barn Owl

Mourning Dove
Yellow-Billed Cuckoo
Screech Owl

Great Horned Owl
Saw-Whet Owl
Chimney Swift
Belted Kingfisher

Short-Eared Owl
Nighthawk
Ruby-Throated Hummingbird

Red-Headed Woodpecker
Yellow-Bellied Sapsucker
Hairy Woodpecker

Red-Bellied Woodpecker
Downy Woodpecker
Flicker

Wood Peewee
Least Flycatcher
Great Crested Flycatcher

Willow Flycatcher
Phoebe
Kingbird

Horned Lark
Tree Swallow
Barn Swallow
Common Crow

Purple Martin
Bank Swallow
Blue Jay
Fish Crow

Black-Capped Chickadee
Tufted Titmouse
White-Breasted Nuthatch
Carolina Wren
Winter Wren

Carolina Chickadee
Red-Breasted Nuthatch
Brown Creeper
House Wren
Marsh Wren

Golden-Crowned Kinglet
Blue-Gray Gnatcatcher
Veery
Swainson's Thrush
Wood Thrush
Catbird
Brown Thrasher

Ruby-Crowned Kinglet
Bluebird
Gray-Cheeked Thrush
Hermit Thrush
Robin
Mockingbird

Cedar Waxwing

Starling

White-Eyed Vireo
Blue-Winged Warbler
Parula Warbler
Chestnut-Sided Warbler
Cape May Warbler
Blackburnian Warbler
Palm Warbler
Blackpoll Warbler
American Redstart
Ovenbird
Common Yellowthroat

Red-Eyed Vireo
Tennessee Warbler
Yellow Warbler
Magnolia Warbler
Black-Throated Blue Warbler
Pine Warbler
Bay-Breasted Warbler
Black and White Warbler
Worm-Eating Warbler
Northern Waterthrush
Yellow-Breasted Chat

Scarlet Tanager
Rose-Breasted Grosbeak
Towhee (Chewink)
Chipping Sparrow
Lark Sparrow
Fox Sparrow
Swamp Sparrow
White-Crowned Sparrow

Bobolink
Meadowlark
Boat-Tailed Grackle
Cowbird
Baltimore Oriole
Pine Siskin
House Sparrow

Cardinal
Indigo Bunting
Tree Sparrow
Field Sparrow
Savannah Sparrow
Song Sparrow
White-Throated Sparrow
Junco

Red-Winged Blackbird
Rusty Blackbird
Common Grackle
Orchard Oriole
House Finch
Goldfinch

A SURVEY OF THE BENTHIC MACROINVERTEBRATE COMMUNITY
OF POMPESTON CREEK, RIVERTON, NEW JERSEY

Prepared by
December 2002

Lisa Galloway Evrard
Rutgers Cooperative Extension

Introduction

Many different types of communities are present within a stream system, but the community of choice to assess surface water quality has been the benthic macroinvertebrates for a variety of reasons. Benthic macroinvertebrates are good indicators of local conditions due to their limited mobility. This limited mobility restricts the benthic macroinvertebrates to the stream and therefore makes it difficult for them to escape pollutants and other disturbances, so they are ideal for assessing site-specific impacts. Because benthic macroinvertebrates have complex life cycles which may span several weeks to more than a year, the benthic macroinvertebrate community reflects current conditions, as well as changes over time and cumulative effects. They are sensitive to environmental impacts from both point and non-point sources of pollution. Sampling is relatively easy and inexpensive. They are normally abundant in most natural surface waters. They serve as a primary food source for many recreational and commercially important species of fish. They can be used to assess non-chemical impacts to the benthic habitat, such as thermal pollution or excessive siltation from sediment loading. Also, to the general public, impacts to the resident aquatic biota are usually more tangible measurements of water quality than listings of chemical analysis results.

A survey of the benthic macroinvertebrate community was conducted on October 21, 2002 as part of an inventory of the plants and animals of the Pompeston Creek and the immediate stream corridor from the mouth of the Creek at the Delaware River in Riverton to the border with Cinnaminson. The results of the inventory will be published as a booklet that will serve as a guide to hiking, boating, and nature study in and along the Pompeston Creek. The intent is to increase public awareness of the biological diversity and aesthetic and recreational value of the Creek; encourage appropriate land use among residents whose property borders the Creek; and further ongoing efforts to preserve the stream corridor.

Methods

Benthic macroinvertebrates were collected at two locations along Pompeston Creek. Location 1 is situated near the Cinnaminson/Riverton border. Location 2 is situated southeast from Route 543 along Riverton Park, closer to the mouth of the Creek. Both locations are tidally influenced, which implies that, at a minimum, the water surface elevation regularly rises and falls over a time period of 12.4 hours (i.e., one tidal cycle). The direction of flow also reversed during the tidal cycle within the study area.

Location 1, which was sampled during low tide, was surrounded by open freshwater tidal wetlands bordered by forested wetlands and upland oak forest. The center of the channel contained coarse sand, gravel, and small cobbles. The substrate closer to the banks was

comprised of fine sand, silt, and muck. Large schools of *Fundulus sp.* (killifish) were noted, as well as crayfish and water striders. A small American eel (approximately six inches in length) was found. Small stands of the aquatic macrophytes *Ceratophyllum sp.* (coontail) and *Elodea sp.* (waterweed) were observed. Larger stands of *Nuphar sp.* (yellow water lily) were also found. The width of the creek ranged from 5 to 20 feet, creek depth ranged from less than 0.5 feet to 1.5 feet, and creek velocity ranged from 0 to 0.7 feet/second.

Location 2, which was sampled close to the time of high tide, was surrounded by open freshwater tidal wetlands and open disturbed ground (i.e., residential backyards and a community park). The center channel substrate, as well as the substrate closer to the banks was similar to that observed at Location 1. The creek width ranged from 50 to 75 feet, creek depth ranged from 4 to over 6 feet in the center of the channel, and creek velocity ranged from 0.8 to 1.1 feet/second. Large stands of *Nuphar sp.* (yellow water lily) were noted, and water striders were also observed.

Samples were collected by jabbing a standard aquatic D-frame dip net in habitats thought to be productive and stable a total of 20 times at each sampling location (Kurtenbach, 1994; NJDEP, 1998). Productive habitats included snags, banks, macrophytes, and the bottom substrate. Samples were sorted and processed in the field using a U.S. Standard No. 30 sieve, composited (i.e., the contents from the 20 jabs were combined into a single container), and preserved in 80% ethanol for later identification and enumeration in the laboratory. Standard taxonomic references were used and included Merritt and Cummins, 1988; Pennak, 1989; Peckarsky, et al., 1990; and Thorp and Covich, 1991.

A supplemental sample of coarse particulate organic matter (CPOM) was collected at both locations. Sampling of the CPOM component involved a composite collection of a variety of forms of CPOM (e.g., leaves, bark, twigs, floating debris, etc.). Several handfuls of CPOM were collected at each location and placed in a one gallon sized plastic bag with stream water. The bag was then stored in a cooler on ice for subsequent processing in the laboratory using a U.S. Standard No. 30 sieve. Organisms collected from the CPOM were added to the composite sample for each sampling location.

A habitat assessment, as modified for Coastal Plain streams (Kurtenbach, 1994) was also conducted at each location. The habitat assessment, which has been designed to provide a measure of habitat quality, involves a visual based technique for assessing stream habitat structure. The findings from the habitat assessment are used to interpret survey results and identify obvious constraints on the attainable biological potential within the study area.

Results and Discussion

Habitat:

The habitat assessment is designed to provide an estimate of habitat quality based upon qualitative estimates of selected habitat attributes. The assessment involves the numerical scoring of seven habitat parameters which include general characteristics (overall physical configuration of the stream), instream measures (habitat conditions within the water column), stream bank measures (habitat conditions along the stream bank where the water surface meets the land), and riparian zone measures (habitat conditions next to the stream within a distance of 60 feet). Table 1 outlines the habitat scoring criteria developed by Kurtenbach (1994) for Coastal Plain streams or more specifically for low gradient streams. Scores for Locations 1 and 2 are summarized in Table 2. The two sites were similar and assessed as having good habitat for supporting aquatic biota.

Benthic Macroinvertebrates:

The results of the benthic macroinvertebrate survey are presented in Table 3. These results are organized by order, family, and then by generic taxonomic levels. Common names of the invertebrate groups are also provided. A total of 14 different taxa of benthic macroinvertebrates were collected within the study area. The majority of the specimens collected were from the CPOM samples, rather than from the available substrates sampled. Future surveys may benefit from the deployment of artificial substrates which allow sample collection in locations that are typically difficult to sample effectively (e.g., shifting substrates, deep water, high velocity water, etc.). Locations 1 and 2 were similar in terms of species composition and were found to support a moderately pollution tolerant community, as opposed to a community characteristic of pristine waters or a community characteristic of polluted waters. The benthic macroinvertebrates observed at Locations 1 and 2 are characteristic of good to fair quality water. Unfortunately, both locations support the introduced Asian clam, *Corbicula fluminea*. *C. fluminea* was introduced from Asia into the Pacific Northwest in the early 1900's. It has spread throughout the entire continental United States except for the northernmost tier of states. This species has been reported to competitively displace native bivalves and has caused economic problems by attaching to and clogging intake cooling pipes for power plants.

To evaluate the biological condition of the sampling locations, several community measures were calculated from the data presented in Table 3 and included the following:

1. **Taxa Richness:** Taxa richness is a measure of the total number of benthic macroinvertebrate families identified. A reduction in taxa richness typically indicates the presence of organic enrichment, toxics, sedimentation, or other factors.
2. **EPT (Ephemeroptera, Plecoptera, Trichoptera) Index:** The EPT Index is a measure of the total number of Ephemeroptera, Plecoptera, and Trichoptera families (i.e., mayflies, stoneflies, and caddisflies). These organisms typically require clear moving water habitats.
3. **%EPT:** Percent EPT measures the numeric abundance of the mayflies, stoneflies, and caddisflies within a sample. A high percentage of EPT taxa are associated with good water quality.
4. **% CDF (percent contribution of the dominant family):** Percent CDF measures the relative balance within the benthic macroinvertebrate community. A healthy community is characterized by a diverse number of taxa that have abundances somewhat proportional to each other.
5. **Family Biotic Index:** The Family Biotic Index measures the relative tolerances of benthic macroinvertebrates to organic enrichment based on tolerance scores assigned to families ranging from 0 (intolerant) to 10 (tolerant).

This analysis integrates several community parameters into one easily comprehended evaluation of biological integrity referred to as the New Jersey Impairment Score (NJIS). The NJIS has been established for three categories of water quality bioassessment for New Jersey streams: non-impaired, moderately impaired, and severely impaired. A non-impaired site has a benthic community comparable to other high quality “reference” streams within the region. The community is characterized by maximum taxa richness, balanced taxa groups, and a good representation of intolerant individuals. A moderately impaired site is characterized by reduced macroinvertebrate taxa richness, in particular the EPT taxa. Changes in taxa composition result in reduced community balance and intolerant taxa become absent. A severely impaired site is one in which the benthic community is significantly different from that of the reference streams. The macroinvertebrates are dominated by a few taxa which are often very abundant. Tolerant taxa are typically the only taxa present.

The scoring criteria developed by Kurtenbach (1994) are outlined in Table 4. It is important to note that the entire scoring system is based on comparisons with reference streams and a historical database consisting of 200 benthic macroinvertebrate samples collected from New Jersey streams. While a low score indicates “impairment,” the score may actually be a consequence of habitat or other natural differences between the subject stream and the reference stream. Impairment scores for Locations 1 and 2 are provided in Table 5. Both locations were assessed as being severely impaired.

The benthic macroinvertebrate community occurring along the last mile of Pompeston Creek is apparently under some type of stress as evidenced by overall low abundance, the lack of representation of EPT taxa, and high family biotic index scores. The types of organisms found, or the lack thereof, indicate that possible chemical perturbations are occurring within the system, and/or the benthic community may be subject to physical constraints. Chemical testing was not part of this survey. Tidal influences, which are not accounted for in the habitat assessment scoring, such as flushing, scouring of the substrate, or surface water elevation changes, may place severe physical constraints on the benthic macroinvertebrate community in Pompeston Creek, which may explain the assessment of severely impaired. Furthermore, given the highly developed nature of the watershed, sediment loads are probably high. Excessive sediment deposition can have a significant negative impact on the benthic macroinvertebrate community, as well as the fish community within the Pompeston Creek watershed.

To learn more and see a picture of the invasive nonindigenous species, *Corbicula fluminea*, see http://nas.er.usgs.gov/mollusks/docs/co_flumi.html. To learn more and see pictures of sensitive, moderately tolerant, and pollution tolerant benthic macroinvertebrates, see <http://www.epa.gov/bioindicators/html/benthosclean.html>.

References

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- Pennak, R.W. 1989. Fresh-water Invertebrates of the United States, Protozoa to Mollusca, Third Edition.
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TABLE 1
Scoring Criteria for Habitat Assessment - Coastal Plain Region (Kurtenbach, 1994)

<i>Habitat Condition:</i>	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>
General Characteristics:				
1. Channel Modification	Natural channel, bends frequent, good diversity of bends and runs. 20-16	Natural channel, long runs, bends infrequent. 15-11	Modified channel with bends; OR stream meanders within a straight channel. 10-6	Modified channel without bends. 5-0
Instream Measures:				
2. Instream Habitat types: snags, riffles, macrophytes, vegetative/ undercut banks	3-4 types present & greater than 50% available habitat 20-16	3-4 types present & less than 50% available habitat 15-11	1-2 types present & greater than 50% available habitat. 10-6	1-2 types present & less than 50% available habitat. 5-0
3. Pools	Deep and shallow pools present and pools are abundant 20-16	Deep and shallow pools present and pools are rare or stream is uniformly deep. 15-11	All pools shallow and pools are abundant. 10-6	All pools shallow and pools are rare or pools are absent. 5-0
Stream Bank Measures:				
4. Bank Stability	Very stable. No evidence of erosion or bank failure 20-16	Moderately stable, areas of erosion mostly healed over. 15-11	Moderately unstable. Moderate frequency & size of erosional areas <10% of streambank shows signs or erosion. 10-6	Unstable. Many eroded areas. "Raw" areas common along straight sections and bends. >10% of streambank shows signs of erosion. 5-0
5a./b. Bank Vegetative Type (left bank) (right bank)	Dominant vegetation is shrub. 10-9 10-9	Dominant vegetation is of tree form. 8-6 8-6	Dominant vegetation is grass or herbaceous plants. 5-3 5-3	<50% of the streambank vegetated; dominant material is rock, soil, bridge material, etc. 2-0 2-0
Riparian Zone Measures:				
6. Shading	25-90% shaded. A mixture of conditions. 20-16	>90% shaded 15-11	No scoring in this category. --	<25% shaded 5-0
7a./b. Riparian Zone Width (left bank) (right bank)	No evidence of human activity within 18 meters of stream. 10-9 10-9	No evidence of human activity within 12 meters of stream. 8-6 8-6	No evidence of human activity within 6 meters of stream. 5-3 5-3	Evidence of human activity within 6 meters of stream. 2-0 2-0
Habitat Condition:	Total Score			
<i>Excellent</i>	140-116			
<i>Good</i>	107-79			
<i>Fair</i>	60-36			
<i>Poor</i>	33-0			

TABLE 2
Habitat Assessment Results

<i>Location:</i>	<i>1</i>	<i>2</i>
<i>General Characteristics:</i>		
1. Channel Modification	18	18
<i>Instream Measures:</i>		
2. Instream Habitat	13	13
3. Pools	13	13
<i>Stream Bank Measures:</i>		
4. Bank Stability	8	8
5a. Bank Vegetative Type (left bank)	4	7
5b. Bank Vegetative Type (right bank)	4	4
<i>Riparian Zone Measures:</i>		
6. Shading	3	18
7a. Riparian Zone Width (left bank)	9.5	4
7b. Riparian Zone Width (right bank)	9.5	1
<i>Total Score:</i>	82	86
<i>Habitat Condition:</i>	Good	Good

TABLE 3
Results of Benthic Macroinvertebrate Sampling

<i>Taxa:</i>	<u>Location 1</u> <i>Number:</i>	<u>Location 2</u> <i>Number:</i>
Tricladida (flatworms)		
Planariidae		
<i>Dugesia sp.</i>	1	2
Tubificida (worms)		
Naididae	2	2
Arhynchobdellida (leeches)		
Erpobdellidae		
<i>Erpobdella punctata</i>	1	
Rhynchobdellida (leeches)		
Glossiphoniidae		
<i>Helobdella stagnalis</i>		1
<i>Placobdella ornata</i>	1	
Limnophila (freshwater snails)		
Physidae		
<i>Physa sp.</i>		1
Heterodonta (freshwater clams)		
Corbiculidae		
<i>Corbicula fluminea</i>	8	15
Amphipoda (scuds/side swimmers)		
Gammaridae		
<i>Gammarus sp.</i>	44	67
Odonata (damselflies)		
Coenagrionidae		
<i>Enallagma sp.</i>	9	3
Hemiptera (true bugs)		
Hebridae		
<i>Hebrus sp.</i> (semi-aquatic)		3
Coleoptera (beetles)		
Dytiscidae		
<i>Dytiscus sp.</i>		7

TABLE 3 (continued)
Results of Benthic Macroinvertebrate Sampling

<i>Taxa:</i>	<u>Location 1</u> <i>Number:</i>	<u>Location 2</u> <i>Number:</i>
Diptera (true flies)		
Chironomidae		
Chironominae	2	2
Orthocladiinae	1	
Tanypodinae	1	
<i>Total # taxa:</i>	<i>10</i>	<i>10</i>
<i>Total # individuals:</i>	<i>70</i>	<i>103</i>

TABLE 4
Scoring Criteria for Rapid Bioassessments in New Jersey Streams

<i>Biological Condition Score:</i>	<i>Non-impaired</i>	<i>Moderately Impaired</i>	<i>Severely Impaired</i>
	6	3	0
<i>Biometrics:</i>			
1. Taxa Richness	>10	10-5	4-0
2. EPT Index - Northern, NJ	>5	5-3	2-0
- Southern, NJ	>4	4-2	1-0
3. %CDF	<40	40-60	>60
4. %EPT	>35	35-10	<10
5. Family Biotic Index	0-4	4-6	6-10
<i>Biological Condition:</i>	Total Score		
Non-impaired	24-30		
Moderately impaired	9-21		
Severely impaired	0-6		

TABLE 5
Calculation of Biological Condition

<i>Taxa</i>	<i>Tolerance Value</i>	<i>Location 1 Number of Individuals</i>	<i>Location 2 Number of Individuals</i>
Planariidae	4	1	2
Naididae	7	2	2
Erpobdellidae	1	1	0
Glossiphoniidae	8	1	1
Physidae	7	0	1
Corbiculidae	8	8	15
Gammaridae	4	44	67
Coenagrionidae	9	9	3
Hebridae	8	0	3
Dytiscidae	4	0	7
Chironomidae	6	4	2
<i>Analysis</i>			
Taxa Richness		8	10
EPT Index		0	0
%CDF		62.9% Gammaridae	65% Gammaridae
%EPT		0	0
Family Biotic Index		5.3	5.0
NJIS Rating		6	6
Biological Condition		severely impaired	severely impaired

A VISUAL ASSESSMENT OF THE LOWER SECTION
OF POMPESTON CREEK, RIVERTON, NEW JERSEY

Prepared by

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December 2002

Introduction

A haphazard approach to watershed restoration and storm water Best Management Practice (BMP) implementation for controlling nonpoint source pollution can result in high costs with little benefit to water quality. One way to avoid this problem is to develop a Stream Corridor Restoration Master Plan that identifies specific impairments, the root causes of those impairments and potential solutions within the watershed. Although the Riverton Environmental Commission is presently only interested in the section of the Pompeston Creek that traverses their municipality, in order for the Stream Corridor Restoration Master Plan to be truly effective the plan needs to focus on the entire watershed. This project will begin the efforts needed to develop such a plan for the watershed by focusing initial efforts on the portion of Pompeston Creek in Riverton.

The first step in developing a restoration master plan is to complete physical surveys of the waterways to:

- (1) assess the health of riparian corridors,
- (2) identify potential nonpoint pollution sources,
- (3) assess the cause of impairments, and
- (4) document potential Best Management Practices (BMPs).

On October 21, 2002, two physical surveys were conducted at each of the macroinvertebrate sampling locations described in Ms. Evrard's report. The data collected from these surveys are incorporated into this report and include physical assessment data such as: riparian buffers, bank erosion, bank stability, and lack of vegetative buffer, health conditions of fish and invertebrate habitat is also evaluated.

Methods

The first step in the assessment process was to review NJDEP's GIS data, including sub basin outlines, streams, land use/land cover data, and aerial photographs. These data allowed for an initial assessment of the overall character of Riverton to be completed. The Borough of Riverton is at the mouth of the Pompeston Creek. At the mouth of the creek, the tidal range is six feet while the tidal range at the upstream portion of the stream where it leaves the Township of Cinnaminson and enters Riverton is only approximately three feet. Based upon the land use

data from NJDEP, Riverton is highly developed although there are significant open space areas along the stream corridor.

On October 21, 2002, an assessment of stream corridor conditions using the USDA Stream Visual Assessment Protocol (SVAP) was performed at two locations along the Pompeston Creek. The first location was at the Cinnaminson/Riverton border. The second location was immediately upstream of County Route 543. The protocol ranks conditions for several elements using a scoring system from 1 (worst) to 10 (best). The protocol clearly illustrates the scores that should be given for various types of conditions. All scores are then averaged to determine a final assessment of the overall condition of the stream. Below are the elements that are scored in the assessment process:

- Channel Conditions: natural and stable versus channelized and/or eroding
- Hydrologic Alteration: stream can access floodplain vs. incised/structured condition
- Riparian Zone: wide, vegetated buffer vs. narrow, disturbed vegetated buffer
- Bank Stability: low, stable banks vs. actively eroding, failing banks
- Water Appearance: clear vs. turbid or muddy water appearance
- Nutrient Enrichment: clear water with diverse aquatic community vs. greenish water with dense macrophytic vegetation
- Barriers to Fish Movement: no barriers vs. dams, culverts or other structures
- Instream Fish Cover: diverse cover (logs, boulders, pools, riffles, overhanging vegetation, etc.) vs. no cover
- Invertebrate Habitat: clean water with gravel/organic substrate vs. cloudy water with sediment laden substrate

The scoring ranges used for the assessment are as follows:

< 6.0	Poor
6.1-7.4	Fair
7.5-8.9	Good
>9.0	Excellent

In addition to completing the assessment protocol, the existing conditions were documented using photographs.

Results and Discussion

The assessment process found stream corridors at the first site (Cinnaminson/Riverton Border) in fair condition with a very health riparian zone. Even though the riparian zone at this location is healthy, the banks are moderately unstable. These unstable banks are most likely due to changes in watershed hydrology. Over the years, upstream development in Moorestown and Cinnaminson has dramatically increased impervious area, thereby creating flashy hydrology which tends to cause bank instabilities. This section also received a relatively low score for the instream fish cover category. The invertebrate habitat category score was good and confirms the habitat assessment prepared by Ms. Evrard.

For the second site (upstream of Route 543), the assessment process found the stream corridor to be at the high end of the fair condition range. The two ranking categories that brought the overall score down were the riparian zone and the water appearance. The water appearance was considerably cloudy, most likely a result of the high tidal flooding currents. The proximity to the roadway limited the riparian zone on the north side of the creek, thereby resulting in a low riparian zone score.

Because of upstream changes in land use, the character of the Pompeston Creek in Riverton has changed. Specifically, the increased impervious surface due to rapid development has dramatically altered stream flows. These upstream changes in land use coupled with the highly developed community of Riverton also have increased the sediment load to the Pompeston Creek. Areas at the first survey site exhibited excessive sediment deposition. Sedimentation can have a significant impact on the macroinvertebrate community and the health of the waterway. This increased sediment load is also partially responsible for both sites not receiving higher water appearance scores.

The photographs of each site are presented in Appendix A. Appendix B contains copies of the data sheets for each site.

Recommendations

A Regional Stormwater Management Plan and a Stream Corridor Restoration Master Plan should be developed for the Pompeston Creek. This will require the cooperation of Riverton, Cinnaminson, and Moorestown. These plans will provide detailed solutions to the

problems of the entire system. Efforts to restore the downstream portions of the creek without addressing upstream development issues may provide little benefit to the health of the waterway.

The Borough of Riverton should also consider conducting additional physical surveys of the Pompeston Creek within their community. Although NJDEP has been promoting the development of River Assessment Teams (RATs) of volunteers to complete physical surveys using a RATs protocol, the USDA Stream Visual Assessment Protocol has a major advantage over the RATs protocol in that it provides a numeric ranking system. This numeric ranking system make the data collected easy to incorporate into a GIS system. Once incorporated into a GIS system, the physical stream assessment data can be linked to the physical features of the watershed, thereby providing a very powerful tool for stakeholders.

Rutgers Cooperative Extension has submitted a proposal to NJDEP to prepare a Regional Stormwater Management Plan for the Pompeston Creek. If the Riverton Environmental Commission wished to move forward with conducting more physical surveys of the waterway, Rutgers Cooperative Extension is available to train and supervise volunteers in this effort. For your convenience, a copy of the USDA Stream Visual Assessment Protocol has been included as Appendix C.

APPENDIX A
Photographs of Survey Sites



Looking Downstream at the First Location (Cinnaminson/Riverton Boundary)



**Looking Upstream at the First Location (Cinnaminson/Riverton Boundary)
Evidence of Sedimentation and Bank Erosion**



Looking Downstream at the Second Location (East of County Route 543)



Looking Upstream at the Second Location (East of County Route 543)

APPENDIX B
Survey Data Sheets

APPENDIX C
USDA Stream Visual Assessment Protocol

PLANT SPECIFICATION SHEETS

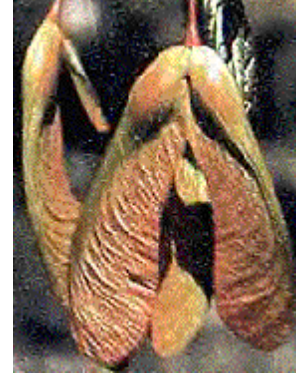
Acer rubrum
Red Maple



Fall Foliage



Fall Foliage



Spring Seed

Characteristics: Broad-leaved, deciduous tree

Appearance:

Height - 75 to 100 ft.

Aerial Spread - 50 to 75 ft.

Flower Color - Red flowers and buds

Flowering Period - Late March through early April

Fruit Color - Green changing to brown

Fruiting Period - Late April through mid June

Habitat (Community): Fresh tidal marsh or swamp, non tidal marsh or swamp, moist uplands, and alluvial woods

Hydrology:

Indicator status - Facultative wetland

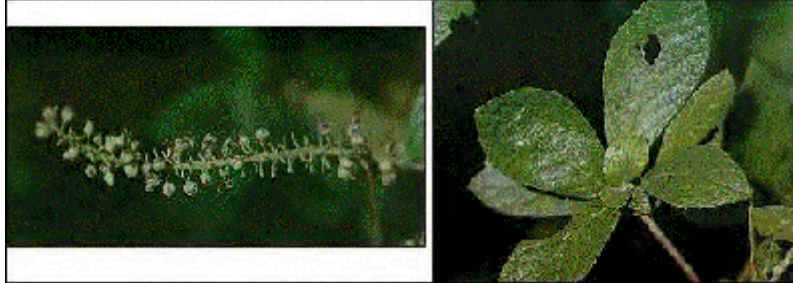
Salinity - Fresh water

Non-Tidal Regime - Irregularly to Seasonally inundated or saturated

Wildlife Benefits: (Seed, Sap, and Buds) food for bobwhite, yellow-bellied sapsucker, cardinal, evening and pine grosbeaks, waterbirds, squirrels, and chipmunks; (Cover, and Nesting) for American robin and American goldfinch

Distribution: Quebec to Manitoba, south to southern Florida, Oklahoma, and Texas

Clethra alnifolia
Sweet Pepperbush



Summer Foliage and Flowers

Characteristics: Broad-leaved, deciduous shrub

Appearance:

Height - 6 to 12 ft.

Aerial Spread - 3 to 6 ft.

Flower Color - White

Flowering Period - Early July through mid August

Fruit Color - Brown

Fruiting Period - Early September through February

Habitat (Community): Tidal and non-tidal forested wetlands, shrub swamps, sandy woods, and coastal river floodplains

Hydrology:

Indicator status - Facultative wetland

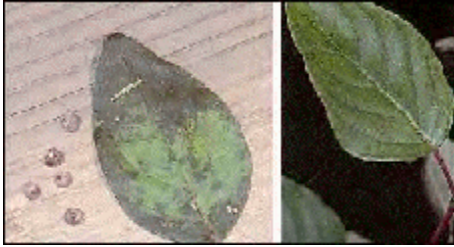
Salinity - Resistant; tolerates infrequent flooding by water containing some salt

Non-Tidal Regime - Seasonally or regularly inundated or saturated

Wildlife Benefits: (Food and Cover) for songbirds, waterfowl and upland gamebirds

Distribution: Southern Maine, south to Florida and eastern Texas

Cornus amomum
Silky Dogwood



Leaves



Fall Fruit

Characteristics: Broad-leaved, deciduous shrub

Appearance:

Height - 6 to 12 ft.

Aerial Spread - 6 to 12 ft.

Flower Color - Yellowish white

Flowering Period - May through July

Fruit Color - Blue

Fruiting Period - Early through late August

Habitat (Community): Forested seasonal wetlands, shrub wetlands, and stream and pond banks

Hydrology:

Indicator status - Facultative wetland

Salinity - Freshwater

Non-Tidal Regime - Irregularly to seasonally inundated or saturated

Wildlife Benefits: (**Fruit, Twigs, and Leaves**) food for wild turkey, ruffed grouse, bobwhite, ring-necked pheasant, common flicker, red-headed, downy, and pileated woodpeckers, eastern kingbird, brown thrasher, American robin, wood thrush, eastern bluebird, cedar waxwing, and purple finch; (**Cover and Food**) for wood duck, American woodcock, and song sparrow; (**Preferred Nesting, Cover, and Food**) for gray cat bird; (**Nesting and Cover**) for American goldfinch.

Distribution: Quebec to Ontario and southern Illinois, south to South Carolina and Alabama

Cornus florida
Flowering dogwood



Spring Flowers



Foliage
Fall Fruit



Characteristics: Broad-leaved, deciduous tree

Appearance:

Height - Up to 30 ft.

Aerial Spread - Up to 15 ft.

Flower Color - White

Flowering Period - April to June

Fruit Color - Red

Fruiting Period - September to October

Habitat (Community): Both moist and dry soils of valleys and uplands in understory of hardwood forests; also in old fields and along roadsides

Hydrology:

Indicator status - Facultative wetland

Salinity - Freshwater

Non-Tidal Regime - Dry to moist soils

Wildlife Benefits: (Fruit, Twigs, and Leaves) food for wild turkey, ruffed grouse, bobwhite, ring-necked pheasant, common flicker; red-headed and pileated woodpeckers, eastern king bird, brown thrasher, American robin, wood thrush, eastern blue bird, cedar waxwing, and purple finch; (Cover and Food) for wood duck, American woodcock, and song sparrow; (Preferred Nesting, Cover, and Food) for gray catbird; (Nesting and Cover) for American goldfinch.

Distribution: Southern Ontario to Southeast Maine, south to Florida and west to Texas

Ilex verticillata
Common winterberry



Summer Foliage



Fall Foliage



Fall/Winter Fruit



Summer Flower

Characteristics: Broad-leaved, deciduous shrub

Appearance:

Height - 6 to 12 ft.

Aerial Spread - 6 to 12 ft.

Flower Color - Greenish to white

Flowering Period - Early through late June

Fruit Color - red to orange

Fruiting Period - Late August persisting through February

Habitat (Community): Fresh tidal swamps, shrub swamps, and forested wetlands

Hydrology:

Indicator status - Facultative wetland

Salinity - Freshwater

Non-Tidal Regime - Irregularly to seasonally inundated or saturated

Wildlife Benefits: Important for emergency food in winter; **(Berries, other)** food for mockingbird, gray catbird, brown thrasher, black duck, bobwhite, common flicker, American crow, American robin, cedar waxwing, cottontail rabbit, raccoon, squirrel, an eastern bluebird; **(Food, Cover, and Nesting)** for veery, and red-winged blackbird.

Distribution: Newfoundland to Minnesota, south to Georgia and Mississippi

Liriodendron tulipifera
Tuliptree



Summer Foliage



Spring Flower



Fall/Winter Seed

Characteristics: Broad-leaved, deciduous tree

Appearance:

Height - 80 to 120 ft.

Flower Color - Yellow

Flowering Period - Spring

Fruit Color - Light brown and conelike

Fruiting Period - Fall persisting to Winter

Habitat (Community): Moist well drained soils

Hydrology:

Indicator status - Facultative

Salinity - Fresh water

Non-Tidal Regime - Irregularly inundated or saturated

Wildlife Benefits: (Fruit)

Distribution: Extreme southern Ontario east to northern Florida, west to Louisiana, and north to southern Michigan

Nyssa sylvatica
Black gum



Summer Foliage



Spring Flower



Fall Seed

Characteristics: Broad-leaved, deciduous tree

Appearance:

Height - 50 to 75 ft.

Aerial Spread - 35 to 50 ft.

Flower Color - Greenish white

Flowering Period - Late May through early June

Fruit Color - Blue

Fruiting Period - Early September through mid October

Habitat (Community): Forested seasonal wetlands, moist upland woods, and dry woods

Hydrology:

Indicator status - Facultative

Salinity - Resistant; tolerates infrequent flooding by water containing some salt

Non-Tidal Regime - Seasonally inundated or saturated

Wildlife Benefits: (Fruit) food for wood duck, common flicker, cedar waxwing, summer tanager, common flicker, red-headed and pileated woodpecker, wood thrush, and American robin

Distribution: Maine to southern Ontario, south to Florida and Texas

Platanus occidentalis
American Planetree



Summer Foliage



Spring Flower



Fall/Winter Seed

Characteristics: Broad-leaved, deciduous tree

Appearance:

Height - 75 to 100 ft.

Aerial Spread - 75 to 100 ft.

Flower Color - Yellow green

Flowering Period - Late May through early June

Fruit Color - Tan brown and globular

Fruiting Period - Early August persisting through late December

Habitat (Community): Lake and swamp edges, forested seasonal wetlands, moist alluvial woods, and dry slopes

Hydrology:

Indicator status - Facultative

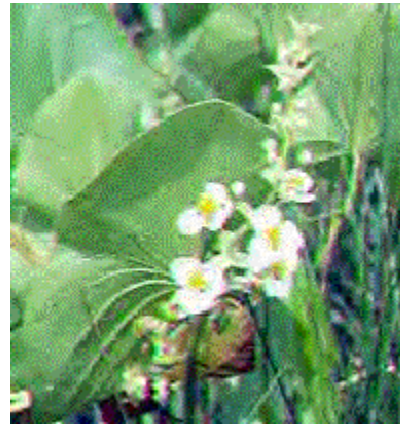
Salinity - Fresh water

Non-Tidal Regime - Irregularly to seasonally inundated or saturated

Wildlife Benefits: (Seeds) food for songbirds

Distribution: Southern Maine to Minnesota, south to Florida, and Texas

Sagittaria latifolia
Duck potato



Summer/Fall Flower and Foliage

Characteristics: Herbaceous, Perennial, Nonpersistent

Appearance:

Height - Up to 4 ft.

Flower Color - White with yellow center

Flowering Period - July through September

Fruit Description - Ball-shaped, green nutlet

Habitat (Community): Swamps, fresh tidal marshes, non-tidal marshes, forested seeps, and borders of streams, lakes and ponds wet meadows

Hydrology:

Indicator status - Obligate wetland

Salinity - Fresh water

Non-Tidal Regime - Regularly to permanent inundated up to 2.0 feet.

Wildlife Benefits: (Seeds, tuber, and plants) food for ducks

Distribution: New Brunswick to southern British Columbia, south to Florida, California, and Mexico

Salix nigra Black Willow



Summer Foliage



Fall Foliage



Spring Flower

Characteristics: Broad-leaved, deciduous tree

Appearance:

Height - 35 to 50 ft.

Aerial Spread - 20 to 35 ft.

Flower Color - Yellow green

Flowering Period - Mid March through April

Fruit Color - Yellow green strobile

Fruiting Period - Late April through mid May

Habitat (Community): Fresh tidal marshes, fresh tidal swamps, flood plains forest, forested wetlands, wet meadows

Hydrology:

Indicator status - Facultative wetland

Salinity - Freshwater

Non-Tidal Regime - Irregularly, seasonally or regularly inundated or saturated

Wildlife Benefits: (Fruit, Buds, and Flowers) food for squirrel, rabbit, mallard, wood duck, ruffed grouse, bobwhite, mourning dove; red-bellied, red-haired, and downy woodpeckers; flicker, yellow-bellied sapsucker, blue jay, tufted titmouse, Carolina wren, brown thrasher, hermit thrush, starling, meadowlark, rusty blackbird, common grackle, Cardinal, rose-breasted grosbeak; (Cover and Nesting) for American crow, northern oriole, scarlet tanager, and rose-breasted grosbeak.

Distribution: Southern Canada to central Minnesota, south to



Florida, and Texas

Sambucus canadensis

Elderberry, American Elder



Summer Foliage and Flowers

Characteristics: Broad-leaved, deciduous shrub

Appearance:

Height - 6 to 12 ft.

Aerial Spread - 6 to 12 ft.

Flower Color - White in flat-topped clusters

Flowering Period - Late June through mid July

Fruit Color - Purple to black berries

Fruiting Period - Early August through late September

Habitat (Community): Fresh tidal marshes, non tidal marshes, swamps, wet meadows, old fields, and moist woods

Hydrology:

Indicator status - Facultative wetland

Salinity - Resistant; tolerates infrequent flooding by water containing some salt

Non-Tidal Regime - Irregularly to seasonally inundated or saturated

Wildlife Benefits: **(Fruit)** food for mourning dove, yellow-bellied sapsucker, eastern king bird, American robin, starling, blue jay; **(Food, Fruit, and/or Cover)** for red-bellied and red-headed woodpecker, wood and hermit thrushes, eastern bluebird, cedar waxwing, wild turkey, ring-necked pheasant, common flicker, brown thrasher, common grackle, and cardinal. **(Food, Cover, and Nesting)** Mockingbird and gray catbird.

Distribution: Nova Scotia to Manitoba and South Dakota, south to Florida and Texas

Viburnum dentatum

Southern arrowwood



Summer Foliage



Winter Stalks



Fall Fruit



Summer Flower

Characteristics: Broad-leaved, deciduous shrub

Appearance:

Height - 6 to 12 ft.

Aerial Spread - 6 to 12 ft.

Flower Color - White in flat-topped clusters

Flowering Period - Late May through early June

Fruit Color - Blue to black berries

Fruiting Period - Early September through late November

Habitat (Community): Fresh tidal marshes, non-tidal marshes, shrub swamps, forested wetlands, moist woods

Hydrology:

Indicator status – Facultative wetland

Salinity - Resistant; tolerates infrequent flooding by water containing some salt

Non-Tidal Regime - Seasonally inundated or saturated

Wildlife Benefits: **(Fruit)** food for common flicker, eastern phoebe, brown thrasher, American robin, eastern bluebird, white and red-eyed vireos, and pileated woodpecker; **(Food, Cover, and Nesting)** for ruffed grouse, brown thrasher, and gray catbird.

Distribution: Southeastern Massachusetts, south to Florida and Texas, west to Pennsylvania, West Virginia, and Tennessee

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