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Biological Surveys of a Transect Through South Bay and Adjoining Uplands, Town of Greenport and City of Hudson, Columbia County, New York

by
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Hudsonia Ltd.

Report to
Scenic Hudson, Inc.

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Contents

ABSTRACT

At the request of Scenic Hudson, Hudsonia conducted biological surveys along a 1.8-mile (2.9-kilometer) transect on a portion of the property of Holcim (US) Inc. in Columbia County, New York. The study area transect was 343 acres (139 hectares) and included parts of tidal Hudson South Bay, nontidal wetlands, upland forests and meadows, and the area around an abandoned cement plant and associated conveyor route. We mapped habitats in the study area transect, and conducted exploratory surveys for rare vascular plants, dragonflies and damselflies, amphibians, reptiles, breeding birds, and mammals. Much of the site had been greatly altered by industry through its history, but nonetheless we found a diverse and interesting flora and fauna. Some of the most prominent features of the site were clay bluffs and ravines, alkaline deposits of cement kiln dust and other industrial waste, a high proportion of invasive, nonnative plants, and evidence of a large deer population. We found several state-listed rare plants and animals, other species of conservation concern, and habitats that could support other rare species. The tidal channels, basin, and wetlands of Hudson South Bay supported state-listed rare plants, high densities of painted and snapping turtles, breeding marsh birds such as marsh wren, swamp sparrow, and Virginia rail, and a mammal community including muskrat, mink, and river otter. The old causeway bisecting Hudson South Bay was used by northern leopard frog, many breeding birds, and by turtles for nesting. Clay ravines in the study area supported mature hardwood forests with forest-dependent species such as Cooper's hawk, eastern wood-pewee, scarlet tanager, and southern flying squirrel. Large meadows had nesting vesper sparrow and foraging northern harrier, and others have reported other grassland breeding birds such as bobolink and eastern meadowlark. The abandoned buildings attracted breeding birds such as American kestrel and common raven. An intermittent woodland pool provided breeding habitat for spotted salamander, wood frog, and Jefferson salamander. Box turtle, coyote, and American woodcock used the complex of field, shrubland, and forest. Meadows and tidal wetlands supported a diverse assemblage of odonates—two dragonflies are new records for Columbia County. We provide some specific and some general conservation recommendations for species of conservation concern, and discuss preliminary considerations for ecological restoration.

INTRODUCTION

Hudsonia was asked by Scenic Hudson to conduct biological surveys on the property of Holcim (US) Inc., along a transect that runs from the City of Hudson waterfront to US Route 9 (USGS 7.5 minute Hudson South quadrangle). Our study area transect had a width of 1380 ft (420 m) at the waterfront, increasing to 2150 ft (655 m) near Route 9 (Figure 1). Within the transect, we identified habitats and conducted surveys for rare vascular plants, dragonflies, damselflies, amphibians, reptiles, birds, and mammals. Surveys were not intended to be comprehensive (due to the time available), but rather to provide a preliminary assessment of biodiversity on the site. This report presents the results of the surveys, along with discussion of other species that could occur on the site and conservation considerations for these species.

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STUDY AREA

The study area transect comprises 343 acres, stretching across a portion of Hudson South Bay south and then east to US Route 9 (Figure 1). It includes tidal habitats north and immediately south of NYS Route 9G, clay bluff and ravine areas south of Route 9G, and then gentler terrain as the land rises gradually toward Route 9. Most of the study area has been disturbed in the past by activities associated with the cement industry (and other industrial, urban, and agricultural land uses); waste dumps, fill, abandoned buildings, internal roadways and railroads, and evidence of old impoundments are still visible.

According to Fisher et al. (1970) most of the study area transect is underlain by Normanskill Shale (with minor mudstone and sandstone); the northwest edge borders on Taconic Mélange (pebbles and blocks of various composition in a shale matrix); and the northeast corner is underlain by the Mt. Merino formation (shale, slate, and chert). Case et al. (1989) mapped very deep Saprists and Aquents soils in much of Hudson South Bay. As the land rises above tidal influence, poorly drained silt loam makes up the flat valley floors of tributary streams. Most of the upland parts of the study area transect are underlain by Hudson and Vergennes soils, characterized by their clayey texture and a perched water table (due to slow permeability) in places; these soils are highly erodible in steep areas. The "clay bluff and ravine" terrain typical of these soils (Kiviat and Stevens 2001) is a prominent feature of the study area. Within the Hudson and Vergennes areas are wetlands on small patches of very poorly drained Canandaigua silt loam. The southern end of the transect, which includes the abandoned cement plant, a large dump, and currently-used offices and parking lots, is underlain by well-drained Udorthents (cut and fill material). Udorthents also underlie the old causeway, railroad tracks, and industrial development in Hudson South Bay, as well as areas just south of Route 9G (Case et al. 1989).

Hudson South Bay is bordered by an active railroad to the north, industrial development to the east, and the base of Mount Merino to the southwest. Route 9G cuts across the southern part of the bay, and an old causeway bisects the bay into eastern and western halves. Both 9G and the causeway partially restrict tidal flows. There is an old domestic waste dump in the northeast part of the bay.

The upland parts of the transect include an old cement plant—now deserted—and several large meadow areas that appear to be old dumps. Presumably, much rock debris and cement kiln dust associated with cement production was disposed of on the site. Black-and-white aerial photos from 1942-52 show a series of three impoundments downstream from the plant that appear white with suspended sediment, probably cement kiln dust. In the photos, this sediment is also evident in the streams and tidal wetlands flowing into the Hudson. Other evidence of past and current disturbance includes construction and demolition waste visible at other dumps, old internal roads, highly eroded clay bluffs and ravines, and a currently-maintained underground gas pipeline. Despite the varied and intensive past land uses (or perhaps because of them), the study area contains a variety of interesting habitats and species.

Below we present the methods, results, and discussion for each taxonomic group separately. Appendix A gives an overview of the field schedule and total field time spent on each survey, Appendix B gives an explanation of the rarity ranks mentioned in the report, and Appendix C gives brief summaries of personnel qualifications.

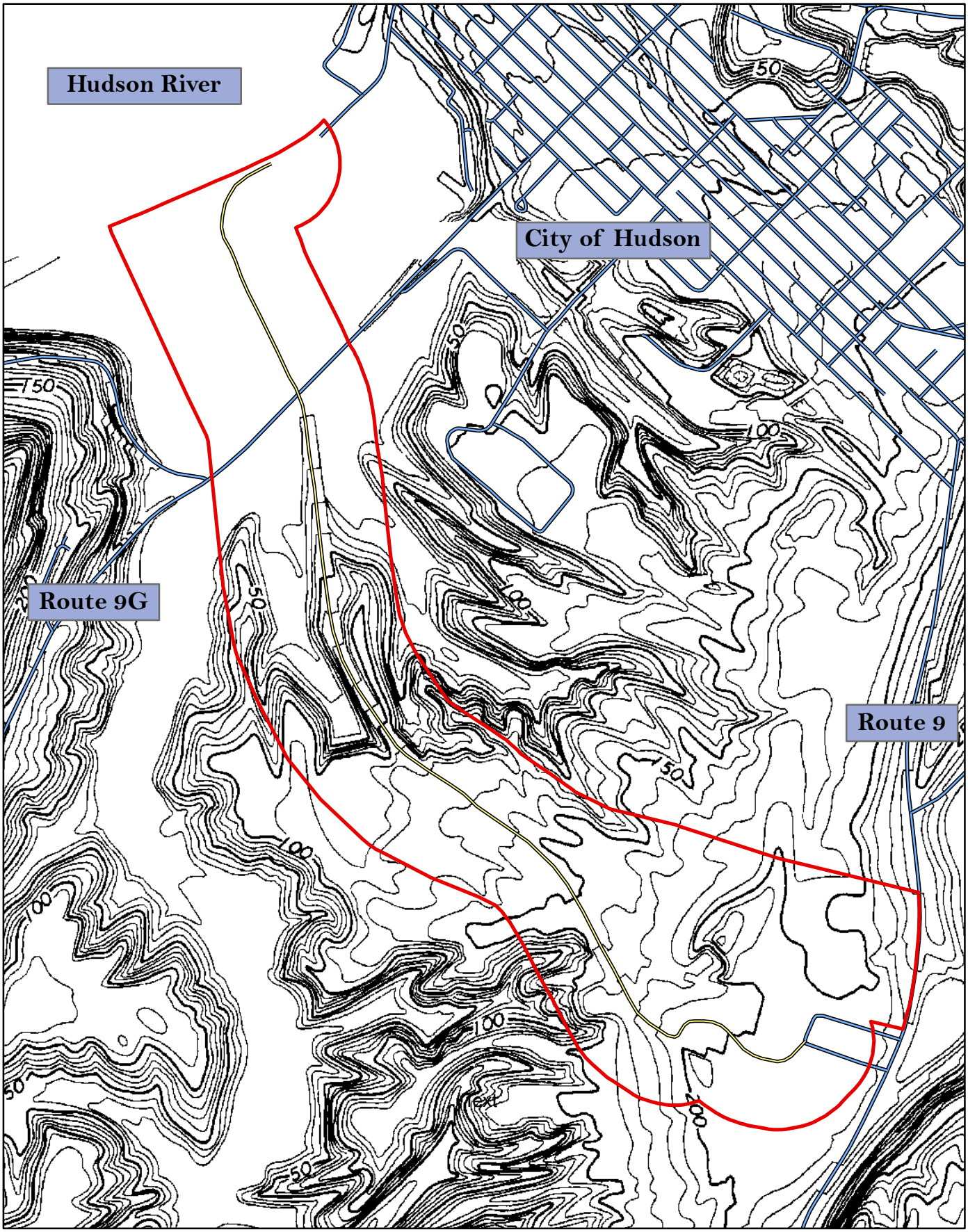


Figure 1. Hudsonia's study area transect on the property of Holcim (US) Inc., Town of Greenport and City of Hudson, Columbia County, New York. Base map is USGS topographic map with 10-foot contour intervals.

Figure 2. Habitats in the Holcim (US) Inc. study area transect. Hudsonia Ltd., 2008.

Sheet 1 (of 3)

- study area
- roads
- 5-m (16.5-ft) contours
- streams
- springs
- seeps
- probable fill/dump areas
- old impoundments

Tidal wetlands

- reed tidal marsh (rtm)
- open water tidal marsh (owtm)
- cottonwood-maple tidal swamp (cmts)
- cottonwood-willow-reed tidal swamp (cwrts)
- tidal tributary mouth (ttm)

Nontidal wetlands

- intermittent woodland pool (iwp)
- hardwood & shrub swamp (hs)
- marsh (ma)
- wet meadow (wm)
- reed wet meadow (rwm)
- wet clay meadow (wcm)
- constructed pond (cp)

Forests

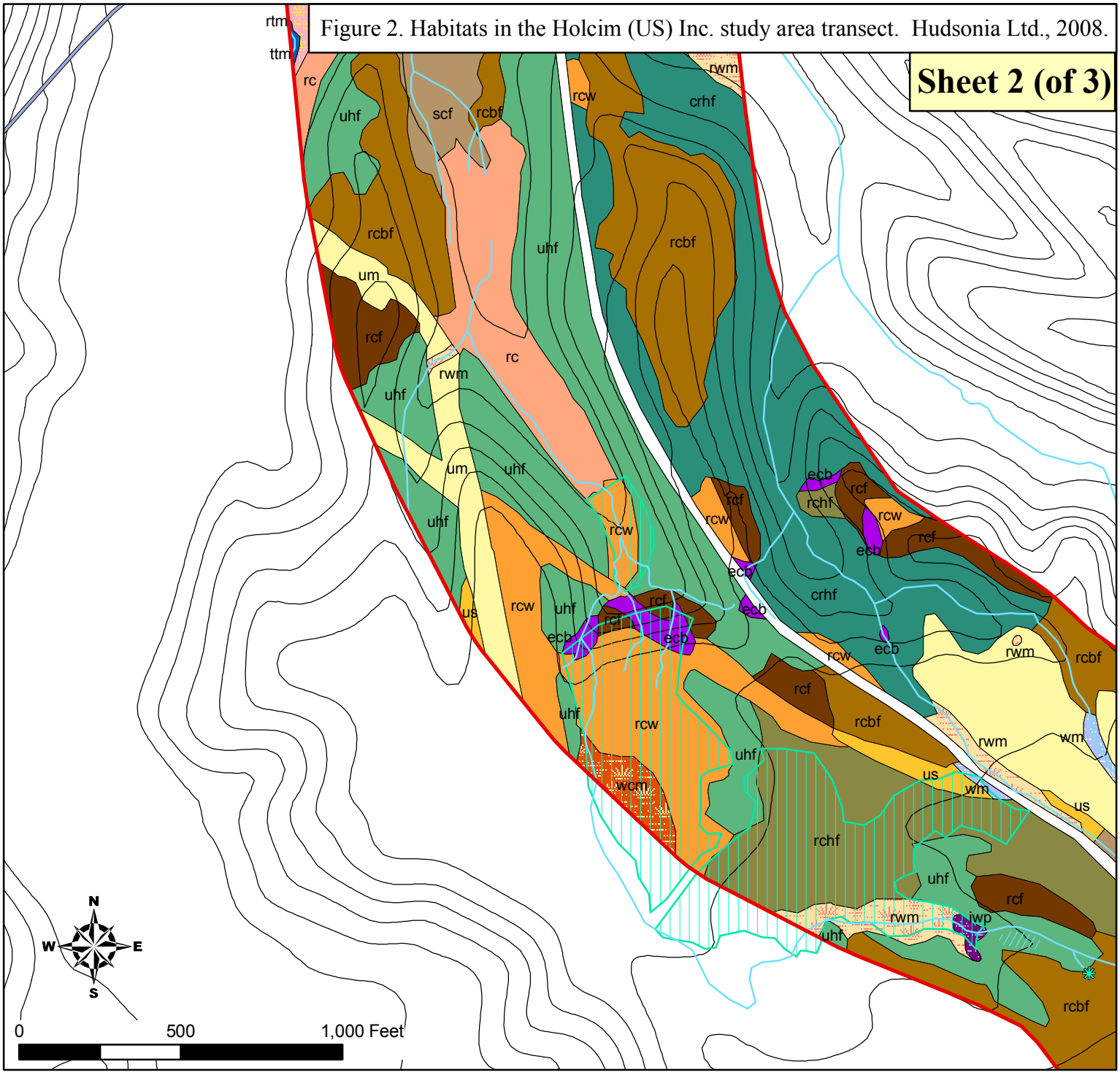
- upland hardwood forest (uhf)
- clay ravine hardwood forest (crhf)
- hemlock ravine forest (hrf)
- successional cottonwood forest (scf)
- cottonwood-black cherry forest (cbf)
- red cedar forest (rcf)
- red cedar-buckthorn forest (rcbf)
- red cedar-hardwood forest (rchf)
- red cedar woodland (rcw)

Nonforested uplands

- reed-cottonwood (rc)
- upland meadow (um)
- upland shrubland (us)
- eroded clay bank (ecb)
- cement block talus (cbt)
- waste ground (wg)
- developed (d)

Figure 2. Habitats in the Holcim (US) Inc. study area transect. Hudsonia Ltd., 2008.

Sheet 2 (of 3)



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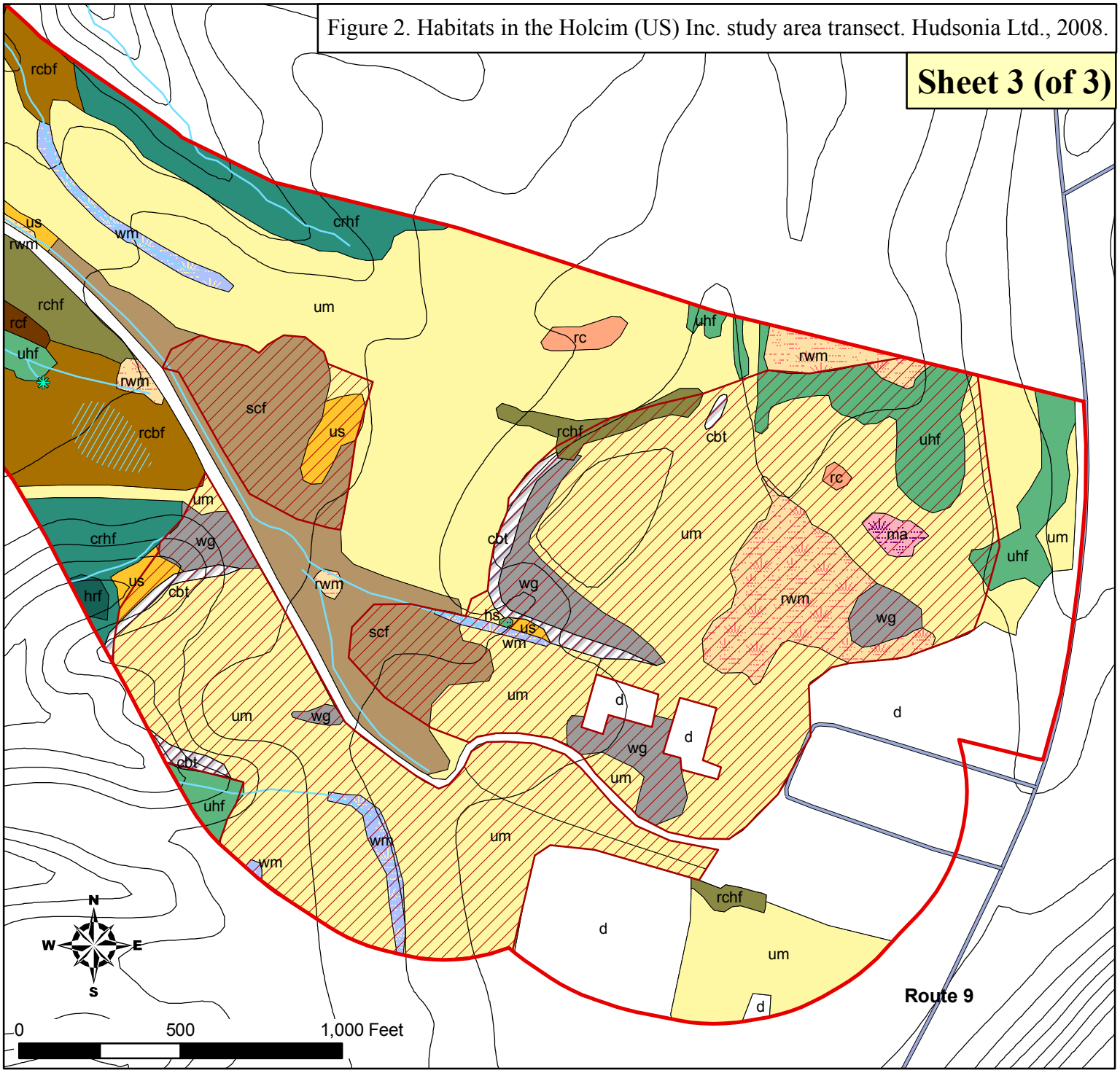

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HABITATS

The study area transect extends from sea level (tidal Hudson South Bay) south and east up to 230 ft (70 m) above sea level at US Route 9, and encompasses a diverse array of habitats, including tidal and nontidal wetlands, clay bluffs and ravines, mature and early-successional forests, and large open meadows.

We identified and mapped the habitats in the transect using remote sensing (analysis of topographic and soils maps, and interpretation of aerial photos), and revised the maps according to observations in the course of biological survey work. The habitat map (Figure 2) should be treated as an approximation only; habitat boundaries were drawn remotely or sketched in the field, but without the use of GPS or other land survey equipment. To supplement our own observations in Hudson South Bay we referred to a habitat map and report prepared by Creative Habitat Corp. (2007).

The extent and location of tidally-influenced wetlands in Hudson South Bay have been significantly altered by road and railroad construction. In some cases we distinguished tidal from non-tidal habitats on the basis of soils and topographic maps rather than observation of tidal inundation. Determining the actual extent of tidal influence would require detailed hydrological studies. Within the habitats we mapped as tidal, some areas are regularly flooded (those below Mean High Water) and others are irregularly flooded, or supratidal (at or slightly above Mean High Water). The ecology of communities in these different tidal regimes can be quite distinct. Again, distinguishing tidal from supratidal habitats would require detailed hydrological studies.

Two of the most commonly-encountered plant species in the transect were eastern cottonwood (*Populus deltoides*) and common reed (*Phragmites australis*), both of which thrive in disturbed soils. We assume all common reed on the site to be the invasive Eurasian subspecies, *Phragmites australis australis*, because we observed no plants with characteristics of the native subspecies, *Phragmites australis americanus*. However, on nearby Middle Ground Island (see Barbour and Kiviat 2007) we found reeds that resembled the native subspecies (a specimen has been sent to an expert for identification), so it is possible that *Phragmites australis americanus* occurs in or near Hudson South Bay.

Below we describe each habitat in the study area transect (lower-case letter codes are used in maps and tables), the dominant plant species, and other plants of interest that we encountered (scientific names according to Mitchell and Tucker 1997). Figure 2 depicts the approximate extent of each habitat unit.

FORESTS

Upland hardwood forest (uhf)

Upland hardwood forests on the site ranged from early successional to mature, and common trees included sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), oaks (black, red, chestnut, pin, white) (*Quercus velutina, Q. rubra, Q. montana, Q. palustris, Q. alba*), shagbark hickory (*Carya ovata*), pignut hickory (*C. glabra*), white ash (*Fraxinus americanus*), black birch (*Betula lenta*), hop-hornbeam (*Ostrya*

virginiana), slippery elm (*Ulmus rubra*), and eastern cottonwood. In general, forests had open understories—which could be due in part to a large local deer population—but a few had substantial understories of common buckthorn (*Rhamnus cathartica*) or multiflora rose (*Rosa multiflora*). Herbaceous plants included bracken (*Pteridium aquilinum*), New York fern (*Thelypteris noveboracensis*), Pennsylvania sedge (*Carex pensylvanica*), other sedges (*Carex squarrosa*, *Carex laxiflora* var. *laxiflora*), trout-lily (*Erythronium americanum*), wood anemone (*Anemone quinquefolia*), wild sarsaparilla (*Aralia nudicaulis*), narrow-leaved wild-licorice (*Galium lanceolatum*), sweet-scented bedstraw (*G. triflorum*), stickseed (*Hackelia virginiana*), hog-peanut (*Amphicarpaea bracteata*), gray goldenrod (*Solidago nemoralis*), and white snakeroot (*Eupatorium rugosum*). Many areas had herbaceous vegetation indicative of rich (calcareous) soils, such as small-flowered agrimony (*Agrimonia parviflora*), bloodroot (*Sanguinaria canadensis*), rue-anemone (*Thalictrum thalictroides*), early meadow-rue (*Thalictrum dioicum*), early blue violet (*Viola palmata*), and may-apple (*Podophyllum peltatum*). We found the uncommon Bush's sedge (*Carex bushii*, NYNHP S3) at one location. Some forests had abundant garlic-mustard (*Alliaria petiolata*), copious earthworm casts, a shallow and sparse litter layer, large areas of exposed soil, and root sprouts heavily browsed by deer.

We identified several sub-types of upland hardwood forest:

Clay ravine hardwood forest (crhf)

Clayey soils underlie much of the site (Case et al. 1989). Because of the erodibility of clayey soils, steep bluffs and ravines are characteristic landscape features of clayey areas near the Hudson River. Some of the ravines in the study area supported mature, rich hardwood forest. On drier slopes, these forests were dominated by oaks and hickories, and on more mesic slopes by sugar maple, American beech (*Fagus grandifolia*), red oak, hop-hornbeam, and basswood (*Tilia americana*). Wildflowers and ferns associated with calcareous conditions occurred in the ravine forests, including miterwort (*Mitella diphylla*), wild ginger (*Asarum canadense*), white baneberry (*Actaea pachypoda*), maidenhair fern (*Adiantum pedatum*), and broad beech fern (*Phegopteris hexagonoptera*). Some floodplains in these clay ravines were covered in recently-deposited sediment, and may include patches of wetland that we did not map.

Successional cottonwood forest (scf)

Eastern cottonwood readily becomes established in areas with disturbed soils. Many parts of the study site have apparently been disturbed by earth-moving or waste deposition in the past, and some now support young cottonwood-dominated forest. These forests have a high proportion of non-native and early-successional species such as tree-of-heaven (*Ailanthus altissima*), eastern red cedar (*Juniperus virginiana*), Japanese barberry (*Berberis thunbergii*), poison ivy (*Toxicodendron radicans*), common reed, and coltsfoot (*Tussilago farfara*). Other species include box-elder (*Acer negundo*), white ash (*Fraxinus americana*), and elm (*Ulmus*). A variant of this type was **cottonwood-black cherry forest** found at just one location, an old domestic waste dump on the eastern side of Hudson South Bay. Cottonwood and black cherry (*Prunus serotina*) were codominant; other abundant trees included tree-of-heaven, common buckthorn , and black locust (*Robinia pseudoacacia*). Bell's honeysuckle (*Lonicera* x *bella*) and garlic-mustard were abundant.

Hemlock ravine forest (hrf)

Hemlock forest (eastern hemlock, *Tsuga canadensis*) covered one side of one of the clay ravines; this area was very steep and shaded, with little understory vegetation. Larger patches of hemlock ravine forest occurred just outside the study area.

Many of the areas that were meadow in 1947 (we had access to georeferenced 1947 aerial photographs) have since grown up to some combination of eastern red cedar, common buckthorn, and young hardwood trees.

Red cedar forest (rcf)

The areas we mapped as "red cedar forest" had very closely-spaced red cedar trees with few other tree species. Places with dense red cedars had a deeply-shaded and sparsely vegetated understory.

Red cedar-buckthorn forest (rcbf)

In a few areas, common buckthorn was the dominant canopy species or was co-dominant with eastern red cedar. These forests had a low canopy and closely-spaced trees but the canopy was not quite as dense as that of the red cedar forest. Among the herbaceous species able to grow under this canopy were Japanese stiltgrass (*Microstegium vimineum*), small-flowered agrimony, sedge (*Carex*) and sensitive fern (*Onoclea sensibilis*) (the latter three species found in a seepy area).

Red cedar-hardwood forest (rchf)

These forests had red cedar with a mixture of young hardwood trees and shrubs, and a variety of meadow plants in the ground layer.

Red cedar woodland (rcw)

We use the term "red cedar woodland" for places where red cedar was a dominant tree, but trees were widely spaced enough to allow a sunlight-dependent community of meadow plants to thrive. Some of these woodlands occurred in the locations of old impoundments and basins where deposits of cement kiln dust or other calcareous sediment had probably influenced the plant community. The herbaceous understory was often quite diverse, including scouring rush (*Equisetum hyemale*), Queen Anne's lace (*Daucus carota*), false beard-tongue (*Penstemon digitalis*), birdsfoot trefoil (*Lotus corniculata*), yellow sweet clover (*Melilotus officinalis*), hawkweeds (*Hieracium*), black-eyed Susan (*Rudbeckia hirta* var. *pulcherrima*), field pussytoes (*Antennaria neglecta*), coltsfoot, common reed, and other graminoids. Woody species included dewberry (*Rubus flagellaris*), gray dogwood (*Cornus foemina* var. *racemosa*), and autumn olive (*Elaeagnus umbellata*).

NONFORESTED UPLANDS

Upland meadow (um)

"Upland meadows" were areas dominated by grasses and forbs, and with less than 20% shrub cover. Much of the mapped meadow area appeared to be on fill; these areas had gravelly soils, with patches of bare gravel. Most of the meadows in the study area appeared to be maintained by infrequent

mowing. A broad corridor (~ 80 ft [24 m] wide) of meadow was being maintained along a buried gas line. Meadow areas were large (the largest over 50 acres), and some included (non-wetland) patches of common reed and scattered cottonwoods. Upland meadows at the site were commonly dominated by non-native species such as spotted knapweed (*Centaurea maculosa*), mugwort (*Artemisia vulgaris*), wild madder (*Galium mollugo*), yellow sweet clover (*Melilotus officinalis*), low smartweed (*Polygonum cespitosum*), smooth brome (*Bromus inermis*), and other non-native grasses.

Upland shrubland (us)

Shrub-dominated patches occurred mainly at the edges of meadows and internal roadways. Typical plant species were eastern red cedar, Bell's honeysuckle, gray dogwood, apple (*Malus*), and common milkweed (*Asclepias syriaca*).

Reed-cottonwood (rc)

Several areas had common reed and cottonwood as the dominant plants. Some of these were mainly reed meadows with scattered cottonwoods; others were cottonwood forests with a dense reed understory. Most of these areas did not appear to be wetland, but probably included some small wetland patches. Soils appeared sandy-clayey (they may have had a large cement kiln dust component), mostly nonhydric, and seemed quite disturbed (perhaps by frost-heave). Coltsfoot was abundant. Other plants included common buckthorn, silky dogwood (*Cornus amomum*), birdsfoot trefoil, and black-eyed Susan.

Eroded clay bank (ecb)

In several places we found high, steep, actively eroding clay banks—as much as 40 ft (12 m) high in one instance—with very little vegetation. These areas may have started eroding many years ago with human-caused changes in the natural runoff patterns in the vicinity. Impoundments, floods, and high-intensity seasonal flows may all have contributed to these dramatic patterns of erosion. The tops of the banks had unstable soils with sparse vegetation.

Cement block talus (cbt)

Calcareous, artificial "talus" habitats have been created at the edges of old dumps in the study area. We also included in this category one area of artificial "ledge," apparently formed from hardened, poured cement. This area had eastern red cedar, gray dogwood, Japanese barberry, common buckthorn, common mullein (*Verbascum thapsus*), spotted knapweed, common St. Johnswort (*Hypericum perforatum*), wild madder, and thyme-leaved sandwort (*Arenaria serpyllifolia*).

Waste ground (wg)

We mapped areas of mostly bare soil or gravel as "waste ground" (see Kiviat and Stevens 2001). These areas occurred near railroad tracks, old buildings, and parking lots, and on fill deposits or waste dumps. Vegetation was sparse, and typically had species such as wild madder, spotted knapweed, Bell's honeysuckle, poison-ivy, and young common buckthorn and eastern cottonwood.

Developed (d)

We mapped paved and gravel roads, railroads, buildings, and parking lots as "developed."

TIDAL WETLANDS AND STREAMS

Cottonwood-maple tidal swamp (cmts)

Two areas of Hudson South Bay were tidal swamps dominated by eastern cottonwood and silver maple (*Acer saccharinum*). Understory shrubs included silky dogwood, winterberry (*Ilex verticillata*), and nannyberry (*Viburnum lentago*), and one patch had a dense stand of scouring rush.

Cottonwood-willow-reed tidal swamp (cwrts)

Cottonwood and willows (*Salix*) were the dominant trees in this type of tidal swamp. Trees occurred at variable densities, amid an understory of dense common reed and scattered common buckthorn and eastern red cedar.

Open water tidal marsh (owtm)

East of the causeway was a fairly large area of tidal open water with some floating-leaved aquatic plants such as lesser and giant duckweeds (*Lemna minor*, *Spirodela polyrhiza*), submerged aquatics—mostly Eurasian water-milfoil (*Myriophyllum* cf. *spicatum*), and small islands of purple loosestrife (*Lythrum salicaria*), yellow iris (*Iris pseudacorus*), and reed canary-grass (*Phalaris arundinacea*). Water horehound (*Lycopus*), bulb-bearing water hemlock (*Cicuta bulbifera*), and sedges (*Carex*) were found in a 1-3 ft (0.3 – 1 m) transition zone between open water and reed tidal marsh.

Reed tidal marsh (rtm)

Most of Hudson South Bay was tidal marsh consisting of dense stands of common reed with relatively few other species. The eastern side of the bay had patches of narrow-leaved cattail (*Typha angustifolia*).

Tidal tributary mouth (ttm)

The lower reaches of two tidal streams join within the study area, and flow out to the Hudson under the railroad. These streams had a variety of submersed and floating-leaved aquatic plants. Within the study area, the stream banks were mostly dominated by common reed, but some areas (especially downstream) had other species such as arrow arum (*Peltandra virginica*), narrow-leaved cattail, chairmaker's rush (*Scirpus pungens*), sweetflag (*Acorus*), broad-leaf arrowhead (*Sagittaria latifolia*), and Long's bittercress (*Cardamine longii*, NYS Threatened, NYNHP S2). Mudflats supporting plant species such as strap-leaf arrowhead and kidneyleaf mud-plantain (*Sagittaria subulata* and *Heteranthera reniformis*, both NYNHP S3) were noted just outside (downstream of) the study area, along with goldenclub (*Orontium aquaticum*, NYS Threatened, NYNHP S2) in the stream channel. Submersed aquatics in the tributary included wild celery (*Vallisneria americana*), sago pondweed (*Coleogeton pectinatum*), water stargrass (*Heteranthera dubia*), other pondweeds (*Potamogeton pusillus* var. *pusillus*, *Potamogeton natans*), and common coontail (*Ceratophyllum demersum*).

NONTIDAL WETLANDS AND STREAMS

Constructed pond (cp)

We found three ponds on the site, all in the Hudson South Bay area, that were either constructed or altered by earth-moving. The eastern-most pond had a plastic or rubber liner and supported no vegetation. The pond just east of the causeway ("Central Pond") appeared to be supratidal (irregularly flooded by high tides). It was at least 3 ft (1 m) deep, with floating filamentous algae and a deep, mucky substrate, and was surrounded by common reed and some Japanese knotweed

(*Fallopia japonica*) near the causeway. The pond west of the causeway ("Western Pond") was isolated from tidal flow. It also appeared deep, and had clear water, dense charophyte (*Chara globularis*) growth, some aquatic vegetation including curly pondweed (*Potamogeton crispus*), and common reed around the edges.

Hardwood and shrub swamp (hs)

Hardwood and shrub swamps were dominated by some combination of red maple, eastern cottonwood, green ash (*Fraxinus pennsylvanica*), elm, willows, and shrubs such as silky dogwood, northern arrowwood (*Viburnum dentatum* var. *lucidum*), common buckthorn, common elder (*Sambucus canadensis*), and Bell's honeysuckle. Common reed was often a significant component of the understory. Herbaceous plants included fowl bluegrass (*Poa palustris*), skunk-cabbage (*Symplocarpus foetidus*), and golden alexanders (*Zizia aurea*). One swamp adjacent to reed tidal marsh (just south of Route 9G) may have some tidal influence. This swamp had green ash, hickories, sedge (*Carex squarrosa)*, bottlebrush grass (*Elymus hystrix*), Virginia wild-rye (*Elymus virginicus*), small-flowered agrimony, clearweed (*Pilea*), hog-peanut, scouring rush, spotted jewelweed (*Impatiens capensis*), moneywort (*Lysimachia nummularia*), beggar-ticks (*Bidens*), and jumpseed (*Polygonum virginianum*).

Intermittent woodland pool (iwp)

We mapped one intermittent woodland pool at the site. In early April, the pool was about 4 ft (1.2 m) deep and milky with suspended sediments. By 20 May the water had dropped by about 3 ft (1 m), and on 22 July the pool was dry, but by mid-August it again had standing water over 1 ft (0.3 m) deep. A broad zone of common reed circled about half the pool perimeter; other plants at the pool edge were sensitive fern, rice cutgrass (*Leersia oryzoides*), beggarticks, clearweed, and wood sorrel (*Oxalis*). The pool was surrounded by upland hardwood forest and reed wet meadow. Another small, intermittent pool next to a large fill area appeared to hold water for very brief periods, and appeared to be poor habitat for intermittent woodland pool vertebrates. We mapped this pool as hardwood and shrub swamp.

Marsh (ma)

Just west of Route 9 was a small open water area surrounded by dense common reed, with eastern cottonwood at one edge. It appeared to have fairly deep, standing water for much of the year.

Wet meadow (wm)

We use the term "wet meadow" for any area of seasonally saturated or flooded soils dominated by herbaceous vegetation. Wet meadows on the site were grassy; many contained common reed; some had scouring rush; other common taxa were green ash, black willow (*Salix nigra*), gray dogwood, autumn olive, common buckthorn, poison-ivy, tall early goldenrod (*Solidago gigantea*), wild madder, and grasses. We found one individual of shrubby St. Johnswort (*Hypericum prolificum*, NYS Threatened, NYNHP S2) in a wet meadow with a significant shrub/small tree component. Two wet meadow subtypes are described below:

Reed wet meadow (rwm)

Throughout the study area there were patches of wet meadow dominated by common reed. In most of these areas, the reed was dense, and other plants were few. The largest reed meadow was just south of Route 9G, and is likely partially tidal.

Wet clay meadow (wcm)

We found one area that we have classified as "wet clay meadow"—part of a very flat area previously within an impoundment (visible on 1947 aerial photos) associated with the cement plant. It is likely that the plant community we observed was influenced by deposits of cement kiln dust, a highly alkaline substance. The western part of the meadow had a dense stand of common reed; as it graded into the red cedar woodland to the north and east there were scattered small quaking aspen (*Populus tremuloides*), autumn olive, and eastern red cedar, and a fairly diverse assemblage of meadow plants, including scouring rush, fox sedge (*Carex vulpinoidea*), false beard-tongue, Queen Anne's lace, mountain-mint (*Pycnanthemum*), birdsfoot trefoil, yellow sweet clover, purple loosestrife, yarrow (*Achillea millefolium*), golden ragwort (*Senecio aureus*), black-eyed Susan, spotted knapweed, and other graminoids, forbs, and mosses.

Streams

There were two perennial and many intermittent streams in the study area, many of which had been ditched or otherwise altered. Channel substrates were variously gravelly or silty; the banks were clayey at some locations. The two perennial streams entered Hudson South Bay near the eastern and western edges of the study area transect. Several intermittent streams had carved deep channels through clay bluffs just north of the wet clay meadow-red cedar woodland plateau. When flowing, these streams were milky with suspended clay and/or cement kiln dust. Just southwest of the old cement plant a stream emerged from a culvert – it may be conducted by culvert the long distance from the wetland east of Route 9 under the highway and developed areas. This stream disappeared again after about 800 ft (250 m), and re-emerged from the bottom of a fill area 450 ft (140 m) to the northwest.

Seeps and Springs

A "spring" is an area where groundwater emerges at the ground surface at a single location, and a "seep" is where groundwater emerges diffusely. Springs appeared to originate several of the small (intermittent) streams in the study area, where deeply eroded stream channels began abruptly with no visible swales or basins to feed them. We found two seepage areas on the site, and there could be others. The largest of these had a canopy of common buckthorn and eastern red cedar with a few green ash, a shrub layer of Bell's honeysuckle and gray dogwood, and a ground layer of sensitive fern, fowl bluegrass, golden alexanders, small-flowered agrimony, and yellow violet (*Viola pubescens*). Another had a similar overstory with buckthorn and red cedar trees spaced 6-10 ft (1.8 – 3 m) apart, a deeply shaded forest floor with large areas of bare soil, and scattered openings with herbaceous plants such as Japanese stiltgrass, clearweed, Indian-tobacco (*Lobelia inflata*), small-flowered agrimony, and smaller amounts of fowl mannagrass (*Glyceria striata*), false beard-tongue, jumpseed, dotted smartweed (*Polygonum punctatum*), heal-all (*Prunella vulgaris*), white avens (*Geum canadense*), white wild-licorice (*Galium circaezans*), beggarticks, garlic-mustard, and arrow-leaf violet (*Viola sagittata*). Soils were very moist in mid-August (after recent rains), and there were occasional small shallow pools of approximately 1.5 ft (0.5 m) in diameter.

OTHER AREAS

Potential dump/fill areas

These are areas that appear to have substrates of non-native material. We identified these areas by their current appearance (gravelly soils, topography, presence of construction and demolition materials), evidence on old aerial photos, and the areas mapped as Udorthents by Case et al. (1989).

Old impoundment areas

Aerial photos from 1942-52 showed three impoundments in the study area containing turbid water (likely suspended cement kiln dust). We do not know when the impoundments were drained, but their historical presence helps to explain the current plant communities.

Intermittent stream turbid with suspended sediment (clay and/or cement kiln dust), flowing through red cedar woodland.

Eroded clay bank just north of wet clay meadow.

RARE VASCULAR PLANTS

METHODS

Nava Tabak and Gretchen Stevens spent 48.5 person-hours in the field during May, June, July, and August surveying for rare vascular plants and describing habitats. We compiled a list of rare plants potentially occurring in the study area, on the basis of reports and records from the site and vicinity. Sources consulted included the NY Natural Heritage Program (NYNHP), field notes from McVaugh (1958), and plant lists from S. Barbour (pers. comm.), Kiviat and Stevens (1990), Barbour (1998b), Stevens (1998), and Creative Habitat Corp. (2007). We planned field visits to coincide with periods when these target species were most visible and identifiable. We surveyed accessible areas of Hudson South Bay by boat as well as on foot. We focused our search effort on locations most likely to support rare species, especially tidal creek banks, wetland-upland margins, tidal swamps, mudflats, mature forests, calcareous uplands (including artificial cement block talus), a wet clay meadow, and eroded clay banks. We recorded the locations of all rare species we encountered.

RESULTS AND DISCUSSION

We discovered seven species of state-listed rare plants in or just outside the study area. Table 1 lists these and other rare plants that could occur here.

State-Listed Rare Plants

Bush's sedge (*Carex bushii*) (NYNHP S3) is a plant of calcareous wet meadows and especially wet clay meadows in the mid-Hudson Valley, sometimes occurring in large numbers. We found a few individuals in an open-canopy upland hardwood forest in the study area.

Goldenclub (*Orontium aquaticum*) (NYS Threatened) is a rare plant that usually occurs on tidal mudflats and in tidal marshes (see Kiviat 1976). We discovered a small number of individuals of this plant in a tidal tributary mouth just outside the study area transect. Creative Habitat Corp. (2007) observed it there as well.

Kidneyleaf mud-plantain (*Heteranthera reniformis*) (NYNHP S3) occurs on muddy substrates on tidal creek banks, mudflats, or in marshes. It is rarely abundant but occurs regularly in Hudson River tidal habitats (Stevens 1998). We observed this plant on a tidal tributary mouth mudflat just outside the study area transect; Creative Habitat Corp. (2007) also found it there.

Long's bittercress (*Cardamine longii*) (NYS Threatened) is a plant of tidal marshes and swamps, always occurring in partial shade. It prefers creek banks, mudflats, and shores (Stevens 1998). We found it on the bank of a tidal tributary mouth west of the causeway; it was observed last year as well (Creative Habitat Corp. 2007).

Shrubby St. Johnswort (*Hypericum prolificum*) (NYS Threatened) is a rare shrub usually found in disturbed sites (wet and upland meadows, shrublands, and forest edges). In western New York and perhaps elsewhere in the state, this species sometimes occurs in large populations, but such occurrences are few in the Hudson Valley. We know of a population at several locations on the Olana State Historic Site (Barbour 1998a,b), and small occurrences on private lands at the south end of Mt. Merino and eastward on NYS Route 23, not far from the study area. We have seen this species at only one other place in the Hudson Valley. In the study area transect we found a single individual in a shrubby wet meadow, but there are likely to be other plants in or near the study area.

Side-oats grama (*Bouteloua curtipendula* var. *curtipendula*) (NYS Endangered) is a native warm-season grass that occurs from southern Canada through most of the United States and southward to Argentina. Side-oats grama is considered secure in its global range (G5) and very rare in New York (S1); it is listed as Endangered in New York and several neighboring states. Side-oats grama is deep-rooted and drought resistant, and often grows in harsh habitats. It does well in calcareous (calcium-rich) soils, and in the Hudson Valley seems to be restricted to calcareous soils. Occurrence near the Hudson River seems unusual, as we think of this species as more typical of the Harlem Valley.

Strap-leaf arrowhead (*Sagittaria subulata*) (NYNHP S3) is a plant of tidal mudflats that is locally abundant along the Hudson shore (Stevens 1998). We observed this plant on a tidal tributary mouth mudflat just outside the study area transect.

Plants of Regional Interest

In addition to these state-rare plants, we encountered populations of two regionally-scarce plants, may-apple (*Podophyllum peltatum*) and broad beech fern (*Phegopteris hexagonoptera*) (Kiviat and Stevens 2001). May-apple occurs on calcium-rich soils in open-canopy forests or forest edges (sometimes in shrubby old fields). We found at least five patches of may-apple in upland hardwood forests to the west of the gravel road. We found broad beech fern in two patches in clay ravine hardwood forests, along with diverse calcicolous (preferring calcium-rich soils) wildflowers.

We also found a large population of a charophyte in the Western Pond. (Charophytes are a group of highly organized algae superficially resembling submergent vascular plants). A specialist at the New York Botanical Garden identified this species as *Chara globularis* (K. Karol, pers. comm.). In our region, charophytes are typically associated with springfed, clear, calcium-rich waters; they rarely occur in the tidal Hudson River. The presence of a dense charophyte population in Western Pond may indicate unusual ecological conditions and suggest rare species of plants or animals may also be present.

Table 1. Rare plants found and potentially occurring in the Hudson South Bay study area transect. Common and scientific nomenclature according to NY Natural Heritage Program Rare Plant Status Lists (Young 2008). Rarity ranks are described in Appendix B. For plants found in the study area, habitats where found are listed; for potentially occurring plants, general habitats are listed. Surveys were conducted April-August 2008. Hudsonia Ltd.

Common name	Scientific name	Rarity†	Habitat*
Found in the study area			
Plants of tidal habitats			
Arrowhead, strap-leaf	*Sagittaria subulata*	S3	tmf
Bittercress, Long's	*Cardamine longii*	S2, T	ttm (bank)
Goldenclub	*Orontium aquaticum*	S2, T	ttm
Mud-plantain, kidneyleaf	*Heteranthera reniformis*	S3	tmf
Plants of nontidal habitats			
Grama, side-oats	*Bouteloua curipendula* var. *curtipendula*	S1, E	rcw
Sedge, Bush's	*Carex bushii*	S3	uhf
St. John'swort, shrubby	*Hypericum prolificum*	S2, T	rwm
Potentially occurring in the study area			
Plants of tidal habitats			
Arrowhead, spongy	*Sagittaria montevidensis* var. *spongiosa*	S2, T	tmf, tsh
Beggarticks, Delmarva	*Bidens bidentoides*	S3	tsr, tm
Beggarticks, estuary	*Bidens hyperborea* var. *hyperborea*	S1, E	tsr, tm
Bur-marigold, smooth	*Bidens laevis*	S2, T	tm
Hatpins, estuary	*Eriocaulon parkeri*	SX	tmf
Lousewort, swamp	*Pedicularis lanceolata*	S2, T	ts
Micranthemum	*Micranthemum micranthemoides*	SX	tsr, tm
Monkeyflower, winged	*Mimulus alatus*	S3	ts
Pigmyweed, water	*Crassula aquatica*	S1, E	tsh
Plantain, heartleaf[1]	*Plantago cordata*	S3	tsr, ttm
Sedge, Fernald's	*Carex merritt-fernaldii*	S2S3	tm, ts
Sedge, Davis'	*Carex davisii*	S2, T	ts
Spikerush, tidal	*Eleocharis aestuum*	S1	tmf, tsr
Water-nymph, Hudson River	*Najas guadalupensis* ssp. *muenscheri*	S1, E	ttm, owtm
Waterwort, American	*Elatine americana*	S1, E	tmf

(continued)

† NY state ranks: S1 = critically imperiled, S2 = imperiled, S3 = rare, SX = apparently extirpated; NY state legal status: E = endangered, T = threatened.

* Habitats: hs = hardwood & shrub swamp, owtm = open water tidal marsh, rcw = red cedar woodland, rwm = reed wet meadow, tm = tidal marsh, tmf = tidal mudflats, ttm = tidal tributary mouth, ts = tidal swamp, tsh = tidal shallows, tsr = tidal shore, uhf = upland hardwood forest, um = upland meadow, umf = upland mixed forest, us = upland shrubland, wm = wet meadow.

[1] Based on an unconfirmed report by Malcolm Pirnie (Kiviat 2001).

Table 1 *(continued)*

Common name	Scientific name	Rarity†	Habitat*
Potentially occurring in the study area *(continued)*			
Plants of nontidal habitats			
Bush-clover, violet	*Lespedeza violacea*	S2S3	uhf
Culver's-root	*Veronicastrum virginicum*	S2, T	wm, hs
Golden-seal	*Hydrastis canadensis*	S2, T	uhf
Goldenrod, Ohio	*Oligoneuron ohioense*	S2, T	us, um
Goldenrod, stiff-leaf	*Oligoneuron rigidum* var. *rigidum*	S2, T	us, um
Indian-paintbrush, scarlet	*Castilleja coccinea*	S1, E	rcw, us, um
Milkweed, purple	*Asclepias purpurascens*	S2S3	us
Mock-pennyroyal	*Hedeoma hispida*	S2S3	rcw, us, um
Mountain-mint, basil	*Pycnanthemum clinopodioides*	S1, E	us, um
Mountain-mint, Torrey's	*Pycnanthemum torrei*	S1, E	us, um
Mountain-mint, whorled	*Pycnanthemum verticillatum* var. *verticillatum*	S1S2, T	us, um
Rattlebox	*Crotalaria sagittalis*	S1, E	us, um
Reedgrass, New England northern	*Calamagrostis stricta* ssp. *inexpansa*	S2, T	um?
Rock-cress, Drummond's	*Boechera stricta*	S2, E	us
Rock-cress, green	*Boechera missouriensis*	S2, T	us
Sedge, Bicknell's	*Carex bicknellii*	S3	rcw, us, um
Sedge, cat-tail	*Carex typhina*	S1, T	hs
Sedge, glaucous	*Carex glaucodea*	S2S3, E	us, uhf
Sedge, reflexed	*Carex retroflexa*	S2S3, E	uhf
Sedge, Reznicek's	*Carex reznicekii*	S1S2	uhf
Sedge, Schweinitz's	*Carex schweinitzii*	S2S3, T	wm, hs
Sedge, thicket	*Carex abscondita*	S1, T	
Sedge, Willdenow's	*Carex willdenowii*	S2S3	uhf
Starwort, terrestrial	*Callitriche terrestris*	S2S3, T	uhf, umf
Tick-trefoil, little-leaf	*Desmodium ciliare*	S2S3, T	um, us
Wand, fairy	*Chamaelirium luteum*	S1S2, T	uhf, rcw, us
Whitlow-grass, Carolina	*Draba reptans*	S2, T	rcw, us, um
Wild flax, yellow	*Linum sulcatum*	S2, T	rcw, us, um

† NY state ranks: S1 = critically imperiled, S2 = imperiled, S3 = rare, SX = apparently extirpated; NY state legal status: E = endangered, T = threatened.

* Habitats: hs = hardwood & shrub swamp, owtm = open water tidal marsh, rcw = red cedar woodland, rwm = reed wet meadow, tm = tidal marsh, tmf = tidal mudflats, ttm = tidal tributary mouth, ts = tidal swamp, tsh = tidal shallows, tsr = tidal shore, uhf = upland hardwood forest, um = upland meadow, umf = upland mixed forest, us = upland shrubland, wm = wet meadow.

DRAGONFLIES and DAMSELFLIES

We conducted surveys of dragonflies and damselflies (odonates) to get a general sense of odonate abundance and diversity within the study area, and to detect the occurrence of species of conservation concern.

METHODS

Spider Barbour analyzed the phenology of odonates that could occur in the study area transect to determine the best timing for surveys. In order to detect as many species as possible, we spread the three-day survey over three months, and sampled on 12 June (Barbour and Kristen Bell), 22 July (Barbour and Tabak), and 13 August (Barbour). These were visual surveys for adult odonates, and did not include sampling of odonate larvae or cast larval exoskeletons. We identified species visually with and without binoculars, and netted species that required identification in the hand. Photographs and/or specimens were taken when necessary for verification of species. Odonate survey efforts focused on surface waters and adjacent upland areas at Hudson South Bay (on foot and by boat), and upland and wet meadows and woodlands north of Route 9.

RESULTS AND DISCUSSION

We observed at least 25 species of odonates—7 damselflies and 18 dragonflies—on the site, 24 of these confidently identified to species. We also observed several unidentified *Aeshna* and unidentified female or teneral damselflies, probably *Enallagma*. Fourteen species were found only in estuarine habitats of Hudson South Bay, and four occurred only in the eastern uplands in various open and wooded habitats. Seven species were found in both estuarine and upland areas. Table 2 lists all the odonate species observed and the habitats where they were found.

Two of the species we found are apparently unreported for Columbia County (White 2008): spot-winged glider and wandering glider. It is curious that the two glider (*Pantala*) species, wide-ranging itinerant dragonflies, have not previously been reported for Columbia County. Barbour saw a glider along the Hudson River in the City of Kingston in 2005 (Barbour 2005).

None of the observed species is listed as rare on the current New York Natural Heritage Program or NYSDEC lists. The nine species discussed below, however, are either rare or scarce in the region, specialized in habitat affinity, or otherwise of ecological interest or relevance to the study site.

Marsh bluet (*Enallagma ebrium*)

Marsh bluet and Hagen's bluet (*Enallagma hageni*) are distinguishable only by microscopic examination of the male terminal appendages or the female thoracic plates. Both species live in open, herbaceous wetland habitats. Hagen's bluet is reported to prefer more acidic waters, including bogs. Nikula et al. (2003) states that the two species seldom occur together. All of our observations of damselflies consistent in appearance with marsh bluet were in the intertidal channel and marsh complex west of the causeway, with circumneutral waters and soils of the Hudson River estuary. We

did not collect specimens for identification, but are confident that the individuals observed here were marsh bluet.

Big bluet (*Enallagma durum*)
Big bluet is a resident of coastal (fresh and brackish) ponds and large rivers (Nikula et al. 2003). Its New York range is restricted to Long Island and the Hudson River corridor (NYNHP 2008).

Ebony jewelwing (*Calopteryx maculata*)
Ebony jewelwing is a common species of wooded streams. The tidal habitat where we observed a single male on 12 June is not typical for this species. It would be interesting and worthwhile to investigate whether ebony jewelwing and other common and widespread odonates breed in Hudson South Bay tidal habitats.

Powdered dancer (*Argia moesta*)
Powdered dancer is a damselfly of rocky rivers and lakeshores, perching frequently on rocks, wood, and vegetation. Mated pairs crawl down submerged objects or vegetation, and females oviposit in decaying wood, living mosses, or other submersed vegetation (Nikula et al. 2003). This habit might make powdered dancer well adapted to low-energy intertidal habitats such as those at South Bay.

Dusky clubtail (*Gomphus spicatus*)
Dusky clubtail inhabits ponds and slow streams with herbaceous margins, including bogs and marshes (Nikula et al. 2003). Barbour identified this species from photographs taken by Bell on 12 June 2008 in the deep tidal channel running west of the causeway. The similar **lancet clubtail (***G. exilis*) and **ashy clubtail** (*G. lividus*) were ruled out by visual characters clearly evident in the photographs, and a difference in habitat (small streams with sandy substrates) for ashy clubtail.

Black-shouldered spinyleg (*Dromogomphus spinosus*)
Black-shouldered spinyleg, another species of slow streams and rivers, flies later in the season than dusky clubtail. Barbour identified a male of this species from photographs taken by Tabak on 13 August 2008 in approximately the same location where we observed dusky clubtail. This species has a wider club than dusky clubtail, with a yellow terminal abdominal segment. Nikula et al. (2003) state that, unlike most clubtails, the black-shouldered spinyleg is tolerant of degraded water quality. The similarly disturbance-tolerant unicorn clubtail (*Arigomphus villosipes*) was found in the same tidal channel, and also in the impoundment east of the causeway.

Lance-tipped darner (*Aeshna constricta*)
Barbour observed a female lance-tipped darner resting on a common buckthorn in open woodland habitat west of the old cement plant. This is a large, brightly marked darner with sharp-tipped terminal appendages, distinguished by amber-tinted wings and thoracic stripes that shift from yellowish to blue down the abdomen. The habit of daylight perching in low herbs, shrubs, or small

trees is unusual among darners (Nikula et al. 2003). Females lay eggs in soft-stemmed emergent plants such as cattail and sweetflag, which are present in the Hudson South Bay marshes.

Spot-winged glider (*Pantala hymenaea*) and **wandering glider** (*Pantala flavescens*)
These two "rainpool gliders" are of interest because breeding habitat exists in disturbed areas of the site, along the causeway and the unvegetated roads between Routes 9 and 9G. Females of both species lay eggs in exposed, unvegetated basins—essentially puddles—that fill with rainwater and persist for several weeks. *Pantala* species are wide-ranging itinerants. Adults are not tied ecologically to any particular habitat, and are often seen patrolling and foraging in open corridors (unpaved roads, other areas of barren ground) with large puddles. Most puddles in the study area transect were not especially large and deep, but it is possible that *Pantala* breeds there, if only infrequently. Both species are newly reported for Columbia County.

Black-shouldered spinyleg, observed in tidal tributary mouth.

Unicorn clubtail on common reed in the eastern basin of Hudson South Bay.

Table 2. Dragonflies and damselflies observed in the Hudson South Bay study area transect, habitats where they were found, and month in which they were observed. Habitats are described and mapped elsewhere in the report. Surveys were conducted June-August 2008. Hudsonia Ltd.

Common Name	Scientific Name	Habitat†	Month
Ebony jewelwing	*Calopteryx maculata*	ttm	Jun
Powdered dancer	*Argia moesta*	owtm	Jun
Familiar bluet	*Enallagma civile*	owtm, ttm, um, wcm	Jun, Jul, Aug
Big bluet	*Enallagma durum*	ttm	Jul
Marsh bluet	*Enallagma ebrium*	ttm	Jun
Orange bluet	*Enallagma signatum*	ttm	Jul
Eastern forktail	*Ischnura verticalis*	owtm	Jun
Lance-tipped darner	*Aeshna constricta*	um	Aug
Green-striped darner	*Aeshna verticalis*	rcw	Aug
Common green darner	*Anax junius*	owtm,ttm	Jun
Unicorn clubtail	*Arigomphus villosipes*	owtm,ttm, cp	Jun, Jul
Black-shouldered spinyleg	*Dromogomphus spinosus*	ttm	Jul
Dusky clubtail	*Gomphus spicatus*	ttm	Jun
Prince baskettail	*Epitheca (Epicordulia) princeps*	owtm	Jun
Common baskettail	*Epitheca (Tetragoneuria) cynosura*	owtm, ttm	Jun
Eastern pondhawk	*Erythemis simplicicollis*	um, wcm, rcw, ttm	Jul, Aug
Widow skimmer	*Libellula luctuosa*	ttm, wcm, owtm	Jun, Jul, Aug
Twelve-spotted skimmer	*Libellula pulchella*	wcm, owtm, ttm	Jun, Jul
Blue dasher	*Pachydiplax longipennis*	owtm	Jun, Jul
Wandering glider	*Pantala flavescens*	um	Aug
Spot-winged glider	*Pantala hymenaea*	owtm, um	Jun
Eastern amberwing	*Perithemis tenera*	owtm, ttm	Jun, Jul
Common whitetail	*Plathemis lydia*	owtm, ttm, um	Jun, Jul, Aug
Ruby *or* cherry-faced meadowhawk	*Sympetrum internum* or *Sympetrum rubicundulum*	um, wcm	Aug
Black saddlebags	*Tramea lacerata*	owtm, um	Jun, Aug

† Habitats: cp = constructed pond, owtm = open water tidal marsh, rcw = red cedar woodland, ttm = tidal tributary mouth, um = upland meadow, wcm = wet clay meadow.

AMPHIBIANS and REPTILES

We conducted surveys to find which species of reptiles and amphibians occur within the study area transect and to detect species of conservation concern. Reptiles and/or amphibians appear to use most or all of the habitats in the transect. Habitats of particular importance for these groups include an intermittent woodland pool, mature forests, open meadows and waste ground areas, and the tidal Hudson South Bay.

METHODS

We searched for reptiles and amphibians by visual encounter surveys, cover object surveys, and live-trapping in wetland and terrestrial habitats. In addition to these formal surveys, all investigators recorded incidental observations of reptiles and amphibians in the course of other field work on the site.

We performed visual encounter and cover object surveys on four days in April, May, and June. Kristen Bell, Tanessa Hartwig, and Michael Klemens searched the site on foot, looking for reptiles and amphibians on the ground surface, and actively checking under rocks, logs, boards, trash, and other moveable objects. In addition, these and other investigators noted reptiles and amphibians found in the course of other field work.

We set ten minnow traps for one night (7 April) in the site's single intermittent woodland pool, looking for ambystomatid salamanders.

Bell, Hartwig, Erik Kiviat, and field assistant Regina Vaicekonyte trapped turtles in Hudson South Bay using baited commercial hoop nets modified to float with about ¾ of the trap submerged. Two traps were set in tidal tributary mouths, three in open water tidal marsh, and four in constructed ponds (Central and Western). Traps were anchored to stakes set in the bottom or attached to stationary vegetation, and floated up and down with the changing tides. Traps were baited daily with canned sardines (in soya oil). We set nine traps on 2 June and checked traps daily around high tide through 6 June, for a total of 36 trap-days (864 trap-hours). During the same period (2-6 June) we also inspected the causeway and other areas around the periphery of South Bay for nesting turtles and nests.

We intended to install five-gallon pitfall traps with drift fencing in April to catch spring-migrating amphibians. We were unable to do this due to difficulty in obtaining permission from Holcim. By August we had received permission to dig the pitfalls, and we performed five nights of pitfall trapping for small mammals (see Mammals section for trap locations). We captured a few amphibians in these traps, even though August was not the best time of year for detecting amphibians.

RESULTS

We found 11 amphibian and 6 reptile species on the site (see Table 3). Individuals caught in pitfall traps during mammal survey are listed in Table 6.

Visual encounter/cover object surveys

Red-backed salamanders were common under cover objects in mature forest areas, although their distribution in these areas seemed patchy. On 20 May we found an adult Jefferson salamander under a log next to a small stream in a forested clay ravine. On this date we also encountered a

northern leopard frog in upland meadow on the Hudson South Bay causeway; it escaped into the adjacent reed tidal marsh. We found and photographed another (or the same) individual on 4 June at the same location. In spring and summer we observed eggs and larvae of wood frog and spotted salamander in the intermittent woodland pool. Larvae of other ambystomatid salamanders could have been present as well—this pool appears to be the nearest breeding habitat for the Jefferson salamander that we found. Bullfrog and green frog were common in Hudson South Bay, and American toad, pickerel frog, and red-spotted newt were found in the upland section of the study area transect. Gray treefrog was heard calling in both tidal swamp and upland forest. We encountered fewer snakes than expected, based on the amount of potential basking habitat in the study area. We saw one northern water snake in Hudson South Bay and three garter snakes and a black rat snake in upland areas (waste ground near the old cement plant seemed to be good habitat). At an edge between upland hardwood forest and red cedar woodland we found an adult male box turtle (at least 13 years old).

Minnow trapping

We caught nothing in our one night of minnow trapping in the intermittent woodland pool. We suspect that salamander breeding was already finished for the season and adults had returned to the forest.

Turtle trapping

The 864 trap-hours in South Bay yielded total captures of 54 painted turtles and 32 snapping turtles. These numbers may have included recaptures; we gave painted turtles a temporary mark (which in some cases may have been overlooked), and did not mark snapping turtles. Most painted turtles were trapped in the Central and Western ponds; in the tidal bay we only caught two. Most of the snapping turtles, on the other hand, were caught in the tidal bay—only ten of 32 were caught in the ponds. We saw plentiful evidence of turtles nesting on the causeway (tracks, excavations, old nests, and one painted turtle digging a nest); it is likely that both snapping and painted turtles nest here successfully. Two dead painted turtle hatchlings were found on the causeway in June (These were probably hatchlings that overwintered in the nest, a common phenomenon).

DISCUSSION

Hudson South Bay supports large populations of painted and snapping turtles. Based on capture rate, the population density of both species appears to be much higher here than in Tivoli North Bay in Dutchess County (Kiviat 1980, Rozycki and Kiviat 1996) and five Hudson tidal marsh sites in Columbia and Greene counties (Stevens 1998). However, in the other surveys, non-floating traps baited with local fish were set between high tides; this different trapping technique could have accounted for some of the differences in capture rate. The turtles use the tidal areas and constructed ponds for foraging, and the upland meadow, gravel road, and waste ground along the causeway for nesting.

We did not detect northern map turtle (*Graptemys geographica*) in Hudson South Bay. Map turtles have been observed nearby in tidal marshes and large tributary streams near the Hudson. They may use the tidal tributary mouths west of the causeway but are probably deterred from entering the east side of the bay by the round culvert under the causeway. Spotted turtle (*Clemmys guttata*), a NYS Special Concern species, almost certainly occurs in or near the study area transect. The DEIS for the previously proposed St. Lawrence Cement plant and conveyor development project on this property reported that a spotted turtle was found dead on Route 9G (Kiviat 2001). Wood turtle (*Glyptemys insculpta*) may also occur on the site. Both spotted and wood turtles are rare in Hudson

River tidal habitats but have been found at nearby sites in Columbia and Greene counties (Kiviat and Barbour 1996, Stevens 1998). Apparently suitable habitat exists for these turtles in the study area transect; both species are difficult to detect, and could have been missed in our surveys.

We were pleasantly surprised to find box turtle in the study area. Columbia County is near the northern edge of the box turtle's range, and populations here are difficult to find. Even though the turtles are much more abundant in other parts of their range, they are threatened everywhere by habitat fragmentation, road mortality, and collecting. Favored habitat is a complex of meadow, shrubland, forest, and wetland, which describes the study area transect well.

Garter snake and northern water snake are both common species. Black rat snake is a NYS Species of Greatest Conservation Need, and its distribution in this region appears patchy. Ribbon snake, which seems to be rare in our region, was reported in the St. Lawrence Cement DEIS (but no location information was given), and the species has been found in the quarry across Route 9 from our study area (Kiviat 2001).

Snakes are often cryptic and hard to find, so surveys of the types we conducted are unlikely to efficiently sample the species that may be present. Several other snake species could occur in the study area, including black racer, northern hognose snake, northern copperhead (all NYS Species of Greatest Conservation Need), brown snake, northern ringneck snake, milk snake, and smooth green snake. The first three species are probably of unlikely occurrence. Milk snake and brown snake are urban-tolerant species and are probably present in the study area. Either species could be found almost anywhere in the study area except in the more deeply-flooding portions of the intertidal marsh.

The single intermittent woodland pool in the transect supports populations of pool-breeding amphibians, including wood frog, spotted salamander, and possibly Jefferson salamander (NYS Special Concern). Wood frog and spotted salamander, although common, are regionally vulnerable species because their breeding habitats (small, seasonal pools) are often excluded from federal and state wetland protections, their upland habitats are frequently fragmented and otherwise degraded, and they are prone to road mortality during seasonal migrations. Intermittent woodland pools also provide breeding habitat for Jefferson salamander; we found an adult in the transect that may be using this pool. Columbia County is near the northern range limit of marbled salamander (NYS Special Concern). We know of no records in the county, but they could occur here.

We found adult northern leopard frogs near the road causeway in South Bay, and this species undoubtedly crosses the causeway and may forage on it. Although fairly common from the Albany area northward, in the Hudson Valley the northern leopard frog is rare and mostly occurs in the immediate vicinity of the Hudson River. On the east side of the river, northern leopard frog occurs from Barrytown northward. Northern leopard frogs are found in a variety of tide-affected habitats. They breed in supratidal pools or low-energy sheltered areas of intertidal marshes. Nonbreeding activity occurs in intertidal and supratidal swamps, tidal marshes, and meadows near tide-affected habitats. Frog call surveys were not within our scope of work. We would expect leopard frogs in the study area to breed in the Central and Western ponds, and in the eastern basin of the tidal marsh. Breeding may also occur south of Route 9G, for example in the common reed marsh.

CONSERVATION CONSIDERATIONS

We found northern leopard frog in an area of upland meadow (on the causeway) adjacent to tidal marsh; this is typical of the species' habitat preferences. In order to maintain the South Bay population, upland meadow should be maintained near or adjacent to the tidal marsh. Any mowing of meadows should be done after the growing season, to avoid harming frogs, nesting birds, and hatchling turtles.

Box turtle could be affected by any sort of development, especially road construction or increased traffic on or near the site. Painted turtle and snapping turtle could be similarly affected. Maintenance of turtle nesting habitat and safe travelways between nesting areas and tidal marsh habitats would be important for protecting those populations.

Because they lack fish and certain other predators, intermittent woodland pools provide critical breeding and nursery habitat for several amphibian species—Jefferson salamander, spotted salamander, and wood frog—that do not successfully reproduce in other wetlands. During the non-breeding season, these amphibians are exclusively terrestrial and require the deep shade, deep leaf litter, uncompacted soil, and coarse woody debris of the surrounding upland forest for foraging and shelter. Upland forests within a 750 ft (230 m) radius of the intermittent woodland pool is considered necessary to support populations of amphibians that breed in intermittent woodland pools (Calhoun and Klemens 2002). Disturbance of vegetation or soils within this area can have significant adverse effects on the amphibians, including the direct loss of pool and forest habitats, alteration of the pool hydroperiod, and degradation of pool water quality or forest floor habitat quality. To help protect pool-breeding amphibians and the habitat complex they require, Calhoun and Klemens (2002) recommend that the pool itself and the upland area within 100 ft (30 m) of the pool remain undisturbed, and that at least 75% of the area within 750 ft (230 m) of the pool remain substantially unfragmented, undeveloped, and with an undisturbed forest floor.

Jefferson salamander found in clay ravine hardwood forest.

Northern leopard frog found on causeway.

Table 3. Amphibians and reptiles observed in the Hudson South Bay study area transect, habitats where they were found, notes, and rarity. Habitats are mapped and described elsewhere in this report. Rarity ranks are described in Appendix B. Surveys were conducted April-August 2008. Hudsonia Ltd.

Common Name	Scientific Name	Habitat†	Notes	Rarity*
Spotted salamander	*Ambystoma maculatum*	iwp	Eggs found in iwp	RG
Jefferson salamander	*Ambystoma jeffersonianum*	crhf	One adult under log in clay ravine	SC
Red-spotted newt	*Notophthalmus viridescens*	crhf	One red eft captured in pitfall trap	
Eastern red-backed salamander	*Plethodon cinereus*	uhf, crhf	Common in mature forests	
American toad	*Bufo americanus*	crhf	One caught in pitfall trap	
Gray treefrog	*Hyla versicolor*	rcbf, cmts	Heard calling	
Bullfrog	*Rana catesbeiana*	owtm, rtm	Female in edge of common reed	
Green frog	*Rana clamitans*	str, cp	Common on the site, wherever there is water	
Pickerel frog	*Rana palustris*	str	Seen in intermittent streams	
Northern leopard frog	*Rana pipiens*	um, rtm	One adult seen on causeway on two occasions.	RG
Wood frog	*Rana sylvatica*	iwp, uhf, str	Eggs, tadpoles found in iwp; adults found in uhf, stream	RG
Snapping turtle	*Chelydra serpentina*	owts, cp, ttm	Abundant in tidal bay, cp, ttm	SGCN
Painted turtle	*Chrysemys picta*	owts, cp, um	Abundant in cp, some in tidal bay	
Eastern box turtle	*Terrapene carolina*	uhf, rcw	One adult male found at edge of uhf/rcw	S3, SC
Eastern rat snake	*Elaphe alleghaniensis*	wg	One adult seen near old cement plant	SGCN
Northern water snake	*Nerodia sipedon*	ttm	One seen in tidal tributary mouth	
Common garter snake	*Thamnophis sirtalis*	wg, uhf	One adult seen near old cement plant, one in forest	

† Habitats: cp = constructed pond, cmts = cottonwood-maple tidal swamp, crhf = cool ravine hardwood forest, iwp = intermittent woodland pool, owtm = open water tidal marsh, rcw = red cedar woodland, rtm = reed tidal marsh, str = stream, ttm = tidal tributary mouth, uhf = upland hardwood forest, um = upland meadow, wg = waste ground.

* NY state ranks: S3 = rare, SGCN = species of greatest conservation need; NY state legal status: SC = special concern; Regional rarity: RG = regionally rare or scarce.

BREEDING BIRDS

METHODS

Rodney Johnson visited the site on nine days from 5 June to 27 July 2008. He identified birds by sound and sight, estimated numbers, and noted any evidence of active breeding. He used the Breeding Bird Atlas guidelines to categorize the breeding status of each species as possible, probable, or confirmed. Species were classified as "possible" breeders if individuals were seen in possible nesting habitat or a singing male was present during the breeding season. Species were listed as "probable" breeders if a singing male was present on more than one date in the same place; a pair was observed in suitable habitat in breeding season; a bird (or pair) was apparently holding territory; a bird was engaged in courtship and display or agitated behavior; a bird was seen visiting a probable nest site; or nest building or excavation of a nest hole was observed. Breeding status was "confirmed" if a bird was observed performing a distraction display or injury-feigning; a used nest was found; recently fledged young were observed; adult(s) were seen entering or leaving a nest site, carrying a fecal sac or food, or feeding young; or a nest with eggs or young, a bird on nest, or eggshells beneath nest were observed.

Many surveys were conducted during the early morning hours traditionally used for breeding bird surveys (on 22, 28, and 30 June, and 13, 20, 24, 26, and 27 July). Dusk or nighttime surveys were also conducted to detect roosting birds, marsh birds, and owls (on 5 and 22 June, and 13, 20, 24, and 26 July). Human-imitated bird vocalizations were used selectively in surveying for owls, rails, bitterns, and pied-billed grebe. In addition to these formal surveys, biologists conducting other field investigations on the site (December-August) recorded incidental bird observations.

RESULTS AND DISCUSSION

We detected a total of 104 bird species in the study area. Seventy of these were confirmed breeding in the study area; 15 were probably breeding, and 12 were possibly breeding. Six species were categorized as non-breeding, and one as an early migrant. Table 4 lists the species, their breeding status, habitats in which they were found, and state and regional rarity ranks.

Due to difficulties in obtaining access to the property and minor personnel injury (not project-related), our sampling period (5 June-27 July) was later than planned, so little survey time was spent during the peak of the breeding season. Also, we spent more survey time in and around Hudson South Bay than on the upland portions of the transect. We feel confident, however, that we detected most of the breeding bird species that were on the site in 2008, because we spent a significant amount of field time at the site and detected a large number of species. Below we discuss our observations as well as other species that could occur along the study area transect. We include information from the most recent New York State Breeding Bird Atlas (BBA) surveys (2000-2005, from the two 3 x 3 mile survey blocks that include the study area), and records from William Cook of the Alan Devoe Bird Club from 1975-present (most are from the past 15 years) for the Hudson area. Records from these two sources are not necessarily from Hudson South Bay and our study area, but refer to a limited area that includes the site.

Birds of Hudson South Bay (marsh birds, waterfowl, shorebirds, heron, cormorant). The tidal marshes and channels of Hudson South Bay seem to provide medium-quality habitat for these birds. We found lower diversity and abundance of these groups than we expected based on our observations at certain other Hudson River tidal bays. We observed wood duck, mute swan, and double-crested cormorant, and confirmed breeding in mallard and Canada goose. American black duck and blue-winged teal were recorded by BBA and Cook; these could breed at the site in some years. In 1948, black duck and wood duck were the most abundant breeding waterfowl along the lower Hudson (Foley and Taber 1951), but black duck has become a very rare breeder in this region, and wood duck is regionally vulnerable. We confirmed breeding in great blue heron and green heron. Cook has also seen (non-breeding) great egret in the bay. Spotted sandpiper was a probable breeder at the site, and we observed an early southbound migrant least sandpiper. We confirmed breeding in swamp sparrow and alder flycatcher (a regionally scarce breeder). Virginia rail and marsh wren, both regionally scarce breeders, were probably breeding in the marsh. Virginia rail was the only rail encountered in the marsh areas; rails are elusive species, and their presence and density can be difficult to determine. Other marsh birds that could occur in Hudson South Bay are least bittern, common moorhen, sora, and Wilson's snipe. These were all documented in the area by BBA and Cook. We could have missed least bittern, because it is a cryptic species and does not always respond to playback. The other species could use the marsh in some years. Pied-billed grebe (NYS Threatened) was listed in the DEIS for the previously proposed St. Lawrence Cement plant and conveyor development project (Kiviat 2001).

Dense stands of reed in the tidal marsh provided roosting habitat for large flocks of birds in winter. In December we observed tens of thousands of American robins and European starlings flocking to the reed marsh and surrounding trees at dusk to roost. These same stands harbored roughly 100,000 swallows (five species) in late July, presumably serving as a staging location for fall migration.

Diurnal raptors. The study area transect provides good habitat for raptors, with its tidal marshes, large upland meadows, and patches of mature forest. Most of our surveys were conducted when trees were in full leaf and woodland hawks difficult to find; therefore, we could easily have missed other species or evidence of breeding. Two raptors were confirmed as breeding in the transect: red-tailed hawk and American kestrel. Kestrel is declining in the region (Kiviat and Stevens 2001) so a breeding pair in the study site is noteworthy. It depends on combinations of meadows for foraging and large trees with cavities for nesting, both of which occur in the study area.

Broad-winged hawk is a probable breeder in the transect. Red-shouldered hawk and Cooper's hawk (both NYS Special Concern) were possibly breeding onsite. Both species hunt and nest in forests, and their presence indicates good-quality forest in the study area or nearby. Both are in recovery following the severe declines that affected many birds of prey during the last century. Cooper's hawk nests in hardwood or conifer forests, often choosing areas with trees of less than approximately 30 cm (12 inches) diameter-at-breast-height. Red-shouldered hawk generally requires extensive areas of

well-developed forest with a closed canopy and large crowns, either swamp forest or upland forest. This species is sensitive to forest fragmentation which usually causes replacement by the red-tailed hawk.

Osprey (NYS Special Concern) and bald eagle (NYS Threatened) were observed from Hudson South Bay; both could potentially nest there if appropriate nest sites were present. We observed one or more northern harriers foraging over upland meadow and reed tidal marsh in December 2007, and found harriers foraging on multiple occasions at other seasons, but saw no evidence of their breeding in the study area. Harriers have historically nested in Hudson River tidal marshes, but there are no recent records of confirmed breeding here. Still, we consider tidal marshes potential breeding habitat for northern harrier (Kiviat and Stevens 2001). The meadows of the study area (and possibly also the tidal marshes) may have significance as foraging habitat for nonbreeding harriers, and there may be enough habitat for harriers to eventually breed at the site. There is a large complex of meadow habitats in the Coxsackie area of Greene County, not far from this study area, that has a significant amount of use by nonbreeding harriers and may also have breeding activity. Harriers associated with the Coxsackie habitats could be commuting or pioneering into our Hudson study area.

Owls. Great horned owl and barred owl were confirmed as breeding in the study area transect. Barred owl is the nocturnal analog of the red-shouldered hawk, and is also associated with extensive, well-developed, closed canopy swamp or upland forests. It prefers large areas of mature forest or swamp with patches of conifers, and nests in cavities in large trees. Barred owl occurrence is threatened by forest fragmentation and loss of large trees (Kiviat and Stevens 2001). Eastern screech owl was reported in the BBA; it is a common forest species and could well be present on the site. Barn owl could breed here in some years. Short-eared owl may overwinter here; it prefers meadows and marshes (Levine 1998).

Corvids. Four corvid species were confirmed as breeding in the study area: blue jay, American crow, fish crow, and common raven. Fish crow is a regionally-scarce breeder, although populations are apparently increasing in the Hudson Valley. Raven is a regionally-rare breeder. Ravens use abandoned buildings at the buildings compound just west of Route 9. Ravens may be nesting on a built structure, or in the quarry east of Route 9 (where Kiviat observed this species several years ago). In addition to observing live ravens, we found a dead raven at the buildings compound in 2008, possibly a victim of accidental electrocution. The common raven has repopulated the Hudson Valley during the past 20+ years. Although now often seen and heard, the actual numbers of ravens are not large and this species may still be limited by the availability of nesting habitat, winter food, or a mortality factor.

American woodcock. The American woodcock uses a complex of forest, shrubland, and meadow habitats for foraging, uses meadows for courtship displays, and typically nests in young forests or shrublands. It has been declining throughout its range, probably due to a variety of stresses including

reduction in open field habitat as farm fields become forested or developed. American woodcock was probably breeding in our study area, which has some shrubland and extensive meadow and young woodland areas.

Forest songbirds. We found a surprisingly diverse array of forest songbird species that were probable or confirmed breeders on the site. Several of these (e.g., eastern wood-pewee, ovenbird, wood thrush, scarlet tanager) need landscapes with large forest patches for successful breeding, and are threatened by forest fragmentation. The decline of extensive forests in the Northeast has been implicated in the declines of numerous "area-sensitive" songbird species such as these.

Meadow songbirds. Several grassland-nesting songbirds were found to be probable or confirmed breeders on the site: vesper sparrow, field sparrow, eastern bluebird, blue-winged warbler, and prairie warbler. Sedge wren could nest in wet meadows in the study area (our surveys could have missed this species because it nests late in the season). In addition, the 2001-2005 Breeding Bird Atlas survey found bobolink, eastern meadowlark, and savannah sparrow in the area. Savannah sparrow, vesper sparrow, bobolink, and meadowlark (the latter three are NYS Species of Greatest Conservation Need) require large meadows for nesting, and are threatened by loss and fragmentation of meadows, by nest predation by human-subsidized predators (such as striped skunk and raccoon), and by nest parasitism by brown-headed cowbird.

CONSERVATION CONSIDERATIONS

The relatively low abundance and diversity of marsh avifauna at Hudson South Bay could be due to one or several of the following factors. Some species may use the bay in some years but not others. Tidal flows have been much restricted by the causeway, where water flows through a single round culvert. Large populations of predators—including raccoon, striped skunk, opossum, and others—could deter ground-nesting birds of marshes. A disturbed site so near the city of Hudson is likely to have large populations of human-subsidized predators such as raccoons and skunks. The high density of large snapping turtles that we found in South Bay could also affect ground-nesting marsh birds, although this idea is not well supported by existing data on snapping turtles. Finally, Hudson South Bay is a relatively small tidal wetland—roughly 80 acres (approximately 30 ac [12 ha] of tidal swamp and 50 ac [20 ha] of tidal marsh, including 10 ac [4 ha] of open water). Craig (2008), who studied bird occurrence in small (3.7-7.4 ac [1.5-3 ha]) and large (64-324 ac [26-131 ha]) marshes in the Connecticut River estuary, found that marsh area was a better predictor of species richness than all other factors. In his study, blue-winged teal, American bittern, least bittern, sora, and spotted sandpiper were only present in the large marshes even though suitable habitat was found in the small marshes (Craig 2008), and this list mirrors the list of potentially-occurring marsh birds that we failed to observe at Hudson South Bay. Virginia rail, marsh wren, and swamp sparrow have smaller home ranges (Craig 2008), and these are the species we observed in the South Bay marsh.

Large forested areas are important for sustaining populations of many species of migratory songbirds and raptors, as well as other organisms of conservation concern. Maintaining (and

improving) not only the unfragmented forest footprint, but the diversity of forest types, the quality of the vegetation, and the integrity of the forest floor is important for an array of habitat-sensitive birds, including the understory- and ground-nesting species.

While there can be significant habitat value in small patches of upland meadow (e.g., for invertebrates and small mammals), large patches are especially important for grassland-breeding birds. Grassland-breeding birds have declined dramatically in the Northeast in recent decades due to habitat loss, as meadows are lost and fragmented by regrowth of forest, and conversion of grasslands to row crops or to residential or commercial development (Askins 1993, Brennan and Kuvlesky 2005). These birds require large, undivided meadows (25 to 500+ ac [10-200+ ha]) to reproduce successfully (Vickery et al. 1994). Management recommendations for maintaining large meadow habitats for grassland breeding birds include such measures as 1) light grazing by livestock, or mowing late in the season (August or later) and/or mowing only once every 1-3 years, 2) raising mower blades to six inches or more, using flushing bars, and avoiding night mowing, and 3) removing fences and hedgerows wherever possible (adapted from recommendations from Massachusetts Audubon at http://www.massaudubon.org).

Red-winged blackbird nest in common reed at edge of Western Pond.

Table 4. Birds observed in the Hudson South Bay study area transect, breeding status, habitats where they were found, and rarity. Habitat codes refer to habitats described in this report (see Habitats section); exceptions are ah (= all habitats) and afh (= all forested habitats). Determination of breeding status is described in the text. Rarity categories are described in Appendix B. Surveys were conducted December 2007-August 2008. Hudsonia Ltd.

Common Name	Scientific Name	Breeding Status	Habitat	Rarity†
Canada goose	*Branta canadensis*	Confirmed	owtm, ttm	
Mute swan	*Cygnus olor*	Possible	owtm, ttm	
Wood duck	*Aix sponsa*	Possible	iwp	RG, PIF2
Mallard	*Anas platyrhynchos*	Confirmed	owtm, ttm	
Wild turkey	*Meleagris gallopavo*	Confirmed	um, wg, rcw, uhf, rcbf, rchf	
Double-crested cormorant	*Phalacrocorax auritus*	Possible	owtm, ttm	S3
Great blue heron	*Ardea herodias*	Confirmed	iwp, owtm, ttm, ma, cp, rtm, cmts, cwrts	RG
Green heron	*Butorides virescens*	Confirmed	ow, ttm, m, cp, tm, ts	
Turkey vulture	*Cathartes aura*	Possible	fly over	RG
Osprey	*Pandion haliaetus*	Possible	owtm, ttm, rtm	SC
Bald eagle	*Haliaeetus leucocephalus*	Possible	owtm, cmts, cwrts	S2S3B, S2, T
Northern harrier	*Circus cyaneus*	Non-breeding	um, rtm, rwm, owtm	S3B, S3N, T
Cooper's hawk	*Accipiter cooperii*	Possible	rtm, arts	SC
Red-shouldered hawk	*Buteo lineatus*	Possible	rcw	SC
Broad-winged hawk	*Buteo platypterus*	Probable	rcbf	RG
Red-tailed hawk	*Buteo jamaicensis*	Confirmed	uhf, crhf, rcbf,rchf, um, rtm, wg	
American kestrel	*Falco sparverius*	Confirmed	um, wg	RG
Virginia rail	*Rallus limicola*	Probable	rtm, ttm	RG
Killdeer	*Charadrius vociferus*	Confirmed	wg, d	
Spotted sandpiper	*Actitis macularia*	Probable	ttm	
Least sandpiper	*Calidris minutilla*	Early migrant	wg	
American woodcock	*Scolopax minor*	Probable	um, rcbf	RG, PIF1
Ring-billed gull	*Larus delawarensis*	Non-breeding	owtm, ttm	

(continued)

† NY state ranks: S2 = imperiled, S3 = rare or uncommon; NY state legal status: T = threatened, SC = special cocern; Regional rarity: RG = regionally rare, scarce, or vulnerable, and may apply only to breeding birds; Partners in Flight priority watchlist: PIF1 = high continental priority, PIF2 = high regional priority.

Table 4 (*continued*)

Common Name	Scientific Name	Breeding Status	Habitat	Rarity†
Herring gull	*Larus argentatus*	Non-breeding	owtm, ttm	
Great black-backed gull	*Larus marinus*	Non-breeding	owtm, ttm	
Rock pigeon	*Columba livia*	Confirmed	d, wg	
Mourning dove	*Zenaida macroura*	Confirmed	ah	
Yellow-billed cuckoo	*Coccyzus americanus*	Confirmed	cbf, arts, rcbf, rchf	
Great horned owl	*Bubo virginianus*	Confirmed	rtm, hs, rcbf	
Barred owl	*Strix varia*	Confirmed	rcbf, rc, hs, rtm, ttm	RG
Chimney swift	*Chaetura pelagica*	Confirmed	wg, d	
Ruby-throated hummingbird	*Archilochus colubris*	Confirmed	wm, us	
Belted kingfisher	*Ceryle alcyon*	Confirmed	owtm, ttm, rtm	
Red-bellied woodpecker	*Melanerpes carolinus*	Confirmed	afh	
Downy woodpecker	*Picoides pubescens*	Confirmed	afh	
Hairy woodpecker	*Picoides villosus*	Possible	rcbf, rchf	
Northern flicker	*Colaptes auratus*	Confirmed	afh	
Pileated woodpecker	*Dryocopus pileatus*	Confirmed	cmts, cwrts, crhf, uhf, rchf, rc	
Eastern wood-pewee	*Contopus virens*	Probable	um, arts, uhf, crhf, scf	RG, PIF2
Alder flycatcher	*Empidonax alnorum*	Confirmed	rtm, cmts, cwrts	RG
Willow flycatcher	*Empidonax traillii*	Confirmed	wm, rwm, um	PIF1
Least flycatcher	*Empidonax minimus*	Confirmed	us, cmts, cwrts, cbf	
Eastern phoebe	*Sayornis phoebe*	Confirmed	ah	
Great crested flycatcher	*Myiarchus crinitus*	Confirmed	afh	
Eastern kingbird	*Tyrannus tyrannus*	Confirmed	um, wg, ma, ttm, rtm	
Yellow-throated vireo	*Vireo flavifrons*	Confirmed	uhf, crhf, rcbf, rchf, rcw, scf, us, hs, cmts, cwrts	
Blue-headed vireo	*Vireo solitarius*	Probable	uhf, crhf, rcf, hrf	RG
Warbling vireo	*Vireo gilvus*	Confirmed	um, cmts, cwrts, arts, wg	
Red-eyed vireo	*Vireo olivaceus*	Confirmed	afh	
Blue jay	*Cyanocitta cristata*	Confirmed	ah	
American crow	*Corvus brachyrhynchos*	Confirmed	ah	
Fish crow	*Corvus ossifragus*	Confirmed	owtm, ttm, rtm, cmts, cwrts	RG
Common raven	*Corvus corax*	Confirmed	wg, um	RG

(continued)

† NY state ranks: S2 = imperiled, S3 = rare or uncommon; NY state legal status: T = threatened, SC = special concern; Regional rarity: RG = regionally rare, scarce, or vulnerable, and may apply only to breeding birds; Partners in Flight priority watchlist: PIF1 = high continental priority, PIF2 = high regional priority.

Table 4 (*continued*)

Common Name	Scientific Name	Breeding Status	Habitat	Rarity†
Tree swallow	*Tachycineta bicolor*	Confirmed	ah	
Northern rough-winged swallow	*Stelgidopteryx serripennis*	Possible	owtm, rtm, ttm	
Bank swallow	*Riparia riparia*	Confirmed	ah	RG
Cliff swallow	*Petrochelidon pyrrhonota*	Possible	owtm, ttm, rtm	
Barn swallow	*Hirundo rustica*	Confirmed	ah	
Black-capped chickadee	*Poecile atricapillus*	Confirmed	afh	
Tufted titmouse	*Baeolophus bicolor*	Confirmed	afh	
White-breasted nuthatch	*Sitta carolinensis*	Confirmed	uhf, crhf, rcbf, rchf, rcw, hs, cmts, cwrts, arts	
Carolina wren	*Thryothorus ludovicianus*	Confirmed	us, um, wm, pwm, cmts, cwrts, arts	RG
House wren	*Troglodytes aedon*	Confirmed	rcw, us, um, wg, ttm	
Marsh wren	*Cistothorus palustris*	Probable	ttm, rtm	RG
Blue-gray gnatcatcher	*Polioptila caerulea*	Confirmed	afh, um, iwp, ttm, cmts, cwrts	
Eastern bluebird	*Sialia sialis*	Probable	um, wg	RG
Veery	*Catharus fuscescens*	Confirmed	rtm, uhf, crhf, rcbf	
Wood thrush	*Hylocichla mustelina*	Confirmed	uhf, crhf, rcbf, rchf, scf	RG, PIF1
American robin	*Turdus migratorius*	Confirmed	ah	
Gray catbird	*Dumetella carolinensis*	Confirmed	ah	
Northern mockingbird	*Mimus polyglottos*	Confirmed	us, um, wg, d	
Brown thrasher	*Toxostoma rufum*	Probable	wm	PIF2
European starling	*Sturnus vulgaris*	Confirmed	ah	
Cedar waxwing	*Bombycilla cedrorum*	Confirmed	ah	
Blue-winged warbler	*Vermivora pinus*	Probable	us, um, wm, pwm	PIF1
Yellow warbler	*Dendroica petechia*	Confirmed	uhf, umf, rc, um, hs, wm, ttm, rtm, cmts, cwrts	
Chestnut-sided warbler	*Dendroica pensylvanica*	Probable	wm, um	
Black-throated green warbler	*Dendroica virens*	Possible	rcbf	RG
Prairie warbler	*Dendroica discolor*	Confirmed	um	PIF1
Black-and-white warbler	*Mniotilta varia*	Probable	uhf, crhf, rcbf, rchf	
American redstart	*Setophaga ruticilla*	Confirmed	ttm, cmts, cwrts, arts, cbf	

(continued)

† NY state ranks: S2 = imperiled, S3 = rare or uncommon; NY state legal status: T = threatened, SC = special concern; Regional rarity: RG = regionally rare, scarce, or vulnerable, and may apply only to breeding birds; Partners in Flight priority watchlist: PIF1 = high continental priority, PIF2 = high regional priority.

Table 4 (*continued*)

Common Name	Scientific Name	Breeding Status	Habitat	Rarity†
Ovenbird	*Seiurus aurocapilla*	Confirmed	uhf, crhf, rcbf, rchf, rcf, hrf	RG
Louisiana waterthrush	*Seiurus motacilla*	Probable	uhf, crhf, hrf	PIF2
Common yellowthroat	*Geothlypis trichas*	Confirmed	ah	
Scarlet tanager	*Piranga olivacea*	Confirmed	afh, us, rcw, cmts, cwrts	RG, PIF2
Eastern towhee	*Pipilo erythrophthalmus*	Confirmed	uhf, crhf, rcbf, rchf, um, us	PIF2
Chipping sparrow	*Spizella passerina*	Confirmed	ah	
Field sparrow	*Spizella pusilla*	Confirmed	us, um, wg, wm, rwm	PIF2
Vesper sparrow	*Pooecetes gramineus*	Probable	um	SC
Song sparrow	*Melospiza melodia*	Confirmed	us, um, wg, ma, wm, rwm, rtm, cmts, cwrts, arts	
Swamp sparrow	*Melospiza georgiana*	Confirmed	rwm, wm, rtm, ttm, cmts, cwrts, arts	
White-throated sparrow	*Zonotrichia albicollis*	Non-breeding	um, us, scf	
Dark-eyed junco	*Junco hyemalis*	Non-breeding	um, us, scf	RG
Northern cardinal	*Cardinalis cardinalis*	Confirmed	ah	
Rose-breasted grosbeak	*Pheucticus ludovicianus*	Confirmed	uhf, crhf, rcbf, rchf, rcf, hrf, rcw, cmts, cwrts, arts	
Indigo bunting	*Passerina cyanea*	Confirmed	us, um, ma, wm, pwm, cmts, cwrts, arts	
Red-winged blackbird	*Agelaius phoeniceus*	Confirmed	rcw, us, um, wg, iwp, ma, wcm, wm, rwm, cp, owtm, ttm, rtm, cwrts	
Common grackle	*Quiscalus quiscula*	Confirmed	ah	
Brown-headed cowbird	*Molothrus ater*	Confirmed	ah	
Baltimore oriole	*Icterus galbula*	Confirmed	uhf, crhf, rcbf, rchf, rc, ttm, cmts, cwrts, arts	PIF2
Purple finch	*Carpodacus purpureus*	Probable	hrf	
House finch	*Carpodacus mexicanus*	Confirmed	d, us, um, wm, rwm, wg	
American goldfinch	*Carduelis tristis*	Confirmed	ah	
House sparrow	*Passer domesticus*	Confirmed	d, um, wg	

† NY state ranks: S2 = imperiled, S3 = rare or uncommon; NY state legal status: T = threatened, SC = special cocern; Regional rarity: RG = regionally rare, scarce, or vulnerable, and may apply only to breeding birds; Partners in Flight priority watchlist: PIF1 = high continental priority, PIF2 = high regional priority.

MAMMALS

We assessed mammal diversity on the site using a variety of techniques. We looked for mammal tracks and sign on days with and without snow cover. We conducted a winter survey for muskrat lodges, and summer surveys for small mammals using small box traps and pitfall traps. We had proposed to survey for New England cottontail (NYS Special Concern) by collecting scat for DNA analysis, but were denied access to the site during the only dates with appropriate weather conditions.

METHODS

Conrad Vispo visited the site in December 2007, and in April and August 2008 to search for tracks and animal sign. Winter is the best time for such visits, but due to limited access and unsuitable weather, he made only one visit while there was snow on the ground, this visit also serving as a site-reconnaissance.

Kiviat conducted a muskrat lodge survey on foot in and near South Bay on 26 January 2008 to get a general idea of the amount of muskrat activity in the tidal marsh.

To assess small mammal diversity we used small (2 x 2.5 x 6.5 in [5 x 5 x 16.5 cm]) and large (3 x 3.5 x 9 in [8 x 9 x 23 cm]) Sherman live traps and pitfall traps constructed from five-gallon buckets. We set the traps in three locations. The "hemlock ravine" site was a clay ravine with a small stream, just downstream of an old fill area. The northern side of the ravine was oak-hickory forest, and the south side was hemlock forest. Five pitfalls, with 50 ft (15 m) of drift fencing, were dug in the stream's floodplain, and 40 Sherman traps were placed on the hardwood- and hemlock-forested slopes. The "clay meadow" site consisted of wet clay meadow, red cedar woodland, and hardwood forest habitat. Three pitfalls (with 30 ft [9 m] of drift fencing) were placed at the edge of the hardwood forest, and 56 Sherman traps were set in the red cedar woodland and wet clay meadow areas. The "maidenhair fern ravine" site was another clay ravine, with a small stream, hardwood forest, and a diverse wildflower and fern assemblage. Four pitfalls (with 40 ft [12 m] of drift fencing) were dug in the stream's floodplain, and 41 Sherman traps were set along either side of the stream, partway up the slope. Sherman traps were placed in microhabitats known to be frequented by small mammals (e.g., next to logs, tree bases, and plant tussocks), and also where we found small mammal sign such as runways, cuttings, or scat.

Sherman traps were baited with a mixture of peanut butter, apples, tuna fish, and rolled oats. Traps were rebaited after captures, and all traps were rebaited half-way through the trapping period. Pitfall traps were unbaited; a sponge placed in the bottom of each bucket, together with holes drilled in the bucket bottoms, kept water from accumulating.

Between 10 and 15 August a total of 548 trap-nights (12,604 trap-hours) were logged with Sherman traps and 60 trap-nights (1,320 trap-hours) with pitfall traps. All animals except the *Sorex* were identified in the hand and released; the *Sorex*, which was found dead in a pitfall trap, was measured in the lab, frozen, and sent out for expert identification. No attempt was made to distinguish *Peromyscus* species.

RESULTS AND DISCUSSION

Mammals potentially and actually found at the site are listed in Table 5. Species and number of individuals trapped by site and trapping method are reported in Table 6.

The mammals of the study area transect are probably typical of a patchwork of generally dry upland forests, scattered upland and wet meadows, and tidal marsh. While all of the animals listed are characteristic of our area, a few bear special mention.

We found four active muskrat lodges and two "pushups" (feeding huts) in the eastern basin of South Bay (the entire eastern basin, including areas outside our official study area). In addition we found one active lodge and two inactive lodges in the Central Pond. There were no lodges in the Western Pond. The eastern basin is approximately 18 ac (7 ha) of emergent marsh and open water, so four lodges represent approximately 0.5 lodge per hectare. Considering that perhaps half of the eastern basin constitutes dense reedbeds with no visibility, it is likely there were more lodges we could not see. If we assume twice the number of lodges, that would equate to approximately 1 lodge per hectare, a fairly low density of active winter lodges. The Central Pond, including the central area of open water and the surrounding marsh, covers a little less than 1 ha; hence the density of active lodges was again approximately 1 per hectare. Weather and access permission issues prevented additional muskrat lodge survey work. During field work on 2 June 2008, we observed a muskrat moving through the box culvert that connects the eastern basin to the reedbed south of Route 9G. Also on that date we observed muskrat scats, several small feedbeds, and other muskrat sign in the eastern basin and Central Pond. It is safe to say that Hudson South Bay had a conspicuous but somewhat low density muskrat population during the first half of 2008. Inasmuch as muskrat populations have been generally low in Hudson River tidal marshes since the mid-1970s, our observations in Hudson South Bay in 2008 are probably normal for these habitats. It is interesting that ca. 1980, several years after Kiviat observed a sharp decline in muskrat populations on the tidal Hudson River, the eastern basin of Hudson South Bay was one of two marshes visited (the other was Piermont Marsh) where muskrat lodges were still fairly numerous. In 2008, the distribution of muskrat lodges seemed unrelated to the cattail stands in the eastern end of the eastern basin, notwithstanding that cattails are generally considered higher quality food for muskrats than common reed.

The repeated detection of river otter (*Lutra canadensis*, NYS Species of Greatest Conservation Need) sign near South Bay suggests that this species uses the area regularly. The sign—latrines and apparent rolling—suggest territorial marking. Otter are slowly returning to the Hudson River watershed after being decimated by trapping and, as top predators, perhaps also by bioaccumulation of toxins. Presence of otter in South Bay should be considered a positive ecological sign.

The meadow jumping mouse appears to have a somewhat patchy distribution in Columbia County and elsewhere in the mid-Hudson Valley, most often occurring along well-vegetated stream edges. The capture of two meadow jumping mice in the wet clay meadow suggests a habitat that has developed enough complexity to support more than just the nearly ubiquitous meadow vole.

Southern flying squirrel is a fairly common but cryptic forest and woodland animal, and seems to be a typical resident of oak-hickory forests in the drier portions of the Hudson Valley. Mature or overmature hardwood trees with cavities are used for shelter and nesting; because the squirrels often nest inside snags, they may be absent from the youngest forests. Both of the forests where this species was caught in the study area were probably at least 70–100 years old, and were in steep

ravines that may have been less accessible for logging or other human uses. While this species is not regionally rare, its local persistence will likely depend upon the maintenance of currently forested areas as forest.

Smoky shrew (*Sorex fumeus*) occurs in forest and stream edges in the Northeast, and often overlaps with masked shrew (*S. cinereus*), although it may be somewhat less tolerant of forest cutting than the latter. Like the southern flying squirrel, this is an inconspicuous species whose rarity might be more apparent than actual. The moist, well-wooded ravine where it was found may be nearly ideal habitat. (We are awaiting verification of the smoky shrew identification, and will notify Scenic Hudson when we have it; the species is morphologically similar to the masked shrew.)

White-tailed deer were abundant. At least 20 were observed grazing in one meadow; deer tracks and trails were common; and several carcasses were found.

The DEIS for the previously proposed St. Lawrence Cement plant and conveyor development project on this property reported trapping red-backed vole and woodland jumping mouse in upland habitats (Kiviat 2001). These species are regionally-rare small mammals of forest habitats, and if present (there is the possibility of misidentification) would indicate high-quality habitat.

Table 5. Mammals detected and potentially occurring in the Hudson South Bay study area transect. Surveys were conducted December 2007-August 2008. Hudsonia Ltd.

Commmon name	Scientific name	Comments
Detected in the study area		
Chipmunk, eastern	*Tamias striatus*	One observed; probably widespread in study area.
Cottontail, eastern	*Sylvilagus floridanus*	Abundant cottontail tracks and droppings; probably eastern cottontail given location but can only be distinguished from New England cottontail by DNA analyses.
Coyote	*Canis latrans*	One individual observed; likely tracks and scats seen along gravel road; increasingly common in our region; probably supported in part by abundant deer.
Deer, white-tailed	*Odocoileus virginianus*	Recorded from tracks, carcasses, and living individuals; seem very common on the site; may well be negatively affecting forest regeneration.
Flying squirrel, southern	*Glaucomys volans*	Two captured; probably relatively common and widespread, albeit not frequently seen.
Fox, red	*Vulpes vulpes*	One individual observed near Hudson South Bay; tracks also seen—these can be confused with tracks of *Urocyon,* which is less common but may also be present in the study area.
Jumping mouse, meadow	*Zapus hudsonicus*	Two captured; patchy but may be common in moist habitats.
Mink	*Mustela vison*	Tracks observed in winter; a widespread and probably common mammal, especially in wetter areas.
Mouse, house	*Mus musculus*	One captured; common around cities and farms in region.
Mouse, white-footed or deer	*Peromyscus* sp.	Numerous captures; widespread, abundant species; *P. leucopus* and *P. maniculatus* both occur in our area and apparently cannot be confidently distinguished without skull analysis; most specimens were probably *P. leucopus* given their habitat.
Muskrat, common	*Ondatra zibethicus*	Three individuals observed on different occasions; estimated density of one lodge per hectare east of the causeway.
Opossum, Virginia	*Didelphis virginiana*	One individual and tracks observed; a now widespread and common mammal.
Otter, river	*Lutra canadensis*	Two fresh pull-outs were seen (Dec. '07 & Aug. '08) where the water flows through a culvert under the South Bay causeway; populations rebounding in region but this is a sensitive species; may be affected by PCBs in Hudson.
Raccoon	*Procyon lotor*	Tracks and one individual observed; a widespread and common mammal.

(continued)

Table 5 *(continued)*

Commmon name	Scientific name	Comments
Detected in the study area (continued)		
Shrew, northern short-tailed	*Blarina brevicauda*	One captured, and one found under debris; a common, widespread mammal that is likely to occur in many habitats.
Shrew, smoky	*Sorex fumeus*	One probable specimen captured (dimensions were intermediate between this and *S. cinereus*); pelage color suggests this species. Specimen will be checked by an expert.
Skunk, striped	*Mephitis mephitis*	One individual observed; a widespread and common mammal.
Squirrel, eastern gray	*Sciurus carolinensis*	Observed in forests; a widespread and common mammal.
Vole, meadow	*Microtus pennsylvanicus*	Numerous captures in wet meadows; a widespread and abundant species in wetter areas around the county.
Weasel, long-tailed or short-tailed	*Mustela frenata* or *M. erminea*	One unidentified weasel observed; both species are widespread in region; both could be present in study area.
Woodchuck	*Marmota monax*	Observed; a widespread and common mammal.
Potentially occurring in the study area		
Bats	Chiroptera	No surveys were done for bats; several species are likely, and Columbia County is within the summer range of the NYS Endangered Indiana bat (*Myotis sodalis*). Quarry rubble on Becraft Mtn. is potential summer habitat for small-footed bat.
Beaver, American	*Castor canadensis*	Old sign in tidal bay; no evidence of recent activity; probably uses the bay in some years.
Bobcat	*Lynx rufus*	Present elsewhere in the county, and possibly present on site given habitat.
Cottontail, New England	*Sylvilagus transitionalis*	Potential habitat on site for this NYS Special Concern species; can only be distinguished from eastern cottontail by DNA analyses.
Fisher	*Martes pennanti*	Present elsewhere in the county and potentially occurring on site.
Fox, gray	*Urocyon cinereoargenteus*	None definitely detected; present but somewhat patchy in the county; may be present in study area.
Jumping mouse, woodland	*Napaeozapus insignis*	Patchy distribution in region but may be relatively common in moist, wooded habitats.
Moles	Talpidae	Three species (*Condylura cristata*, *Parascalops breweri,* and potentially *Scalopus aquaticus*) are possible.

(continued)

Table 5 *(continued)*

Commmon name	Scientific name	Comments
Potentially occurring in the study area (continued)		
Rats	*Rattus* spp.	Often common around cities and farms in the region. *R. norvegicus* is almost certainly present; *R. rattus* is possible.
Shrew, masked	*Sorex cinereus*	Present elsewhere in the county, and possibily present on site given habitat.
Squirrel, red	*Tamiasciurus hudsonicus*	Generally common but somewhat patchy in the county; may be present in study area.
Vole, southern red-backed	*Clethrionomys gapperi*	Possible but perhaps unlikely in study area given its range and habitat.
Vole, woodland	*Microtus pinetorum*	Potentially (but not probably) present in study area.

Table 6. Results of Sherman and pitfall trapping at three sites in the Hudson South Bay study area transect, August 10-15, 2008. Hudsonia Ltd.

Site	Habitat	Trap Type	Number of Traps	Species	Total Captures
"Clay Meadow"	Wet clay meadow	Sherman trap	25 small, 10 large	*Microtus pennsylvanicus*	28
				Zapus hudsonicus	2
	Red cedar woodland	Sherman trap	12 small, 9 large	*Peromyscus* sp.	6
	Upland hardwood forest	Pitfall trap w/ drift fence	3 pitfalls	No Captures	0
"Hemlock Ravine"	Upland hardwood forest	Sherman trap	15 small, 5 large	*Peromyscus* sp.	8
	Hemlock ravine forest	Sherman trap	15 small, 5 large	*Glaucomys volans*	1
				Peromyscus sp.	10
				Mus musculus	1
	Stream floodplain, clay ravine forest	Pitfall trap w/ drift fence	5 pitfalls	*Peromyscus* sp.	1
				Sorex fumeus (?)	1
				Bufo americanus	1
				Rana clamitans	1
				Notophthalmus viridescens	1
"Maidenhair Fern Ravine"	Stream floodplain, clay ravine forest	Sherman trap	31 small, 10 large	*Peromyscus* sp.	7
				Blarina brevicauda	1
				Glaucomys volans	1
	Stream floodplain, clay ravine forest	Pitfall trap w/ drift fence	4 pitfalls	*Plethodon cinereus*	2

OTHER FAUNA

BUTTERFLIES

We observed the following butterflies during other surveys:

Tidal marsh and tidal tributary mouth
Broad-winged skipper (*Poanes viator*)
Least skipper (*Ancyloxypha numitor*)

Upland meadow and gravel road
Black swallowtail (*Papilio polyxenes*)
Broad-winged skipper (*Poanes viator*)
Cabbage white (*Pieris rapae*)
Clouded sulfur (*Colias philodice*)
Common ringlet (*Coenonympha tullia*)
Common wood nymph (*Cercyonis pegala*)
Dun skipper (*Euphyes vestris*)
Eastern tailed blue (*Everes comyntas*)
Gray hairstreak (*Strymon melinus*)
Great spangled fritillary (*Speyeria cybele*)
Little wood satyr (*Megisto cymela*)
Meadow fritillary (*Boloria bellona*)
Monarch (*Danaus plexippus*)
Orange sulfur (*Colias eurytheme*)
Pearl crescent (*Phyciodes tharos*)
Silver-spotted skipper (*Epargyreus clarus*)
Viceroy (*Limenitis archippus*)

Wet clay meadow
American painted lady (*Vanessa virginiensis*)
Broad-winged skipper (*Poanes viator*)
Eastern comma (*Polygonia comma*)
Eastern tailed blue (*Everes comyntas*)
Great spangled fritillary (*Speyeria cybele*)
Orange sulfur (*Colias eurytheme*)
Silver-spotted skipper (*Epargyreus clarus*)

Red cedar woodland
Common wood nymph (*Cercyonis pegala*)
Eastern tailed blue (*Everes comyntas*)
Pearl crescent (*Phyciodes tharos*)

Unidentified habitat
Mourning cloak (*Nymphalis antiopa*)
Red-spotted purple (*Limenitis arthemis astyanax*)

FISHES

We set four minnow traps on 4 June, next to the hoop traps set in the two constructed ponds in Hudson South Bay. These were checked the next day, for a total of 96 trap-hours. In the constructed ponds we found:

- Banded killfish (*Fundulus diaphanous*)
- Central mudminnow (*Umbra limi*)
- Fathead minnow (*Pimephales promelas*)
- Pumpkinseed (*Lepomis gibbosus*)

Other fish observed in the tidal tributary mouths and tidal bay included:

- Brown bullhead (*Ameiurus nebulosus*)
- Common carp (*Cyprinus carpio*)
- A shiner (*Cyprinella* sp.)

CONCLUSIONS

HABITATS

Meadow habitats are extensive on the site and include both upland meadows and wet meadows. As agricultural lands are converted to other uses, extensive meadow habitats are becoming scarce in the Hudson Valley. The meadows in the study area support several vertebrate and plant species of conservation interest: vesper sparrow, American kestrel, northern harrier, meadow jumping mouse, shrubby St Johnswort, and small-flowered agrimony. We also found two dragonflies in the meadows that represent the first documented occurrences of these species in Columbia County: spot-winged glider and wandering glider. These meadows appear to be important for rare species. Few extensive meadow complexes in the Hudson Valley are being actively managed for rare species, and this should be considered at the site.

Forest habitats in the study area support several interesting species including eastern wood-pewee, blue-headed vireo, Cooper's hawk, red-shouldered hawk, barred owl, and southern flying squirrel. Some of these animals require large and/or mature forests, and their persistence in the region is threatened by forest fragmentation. We also found may-apple and Bush's sedge, two regionally rare or scarce species, and the endangered side-oats grama, all of which depend on calcareous environments.

We found a single intact intermittent woodland pool (vernal pool) in the study area. This pool is used by wood duck, and supports breeding (egg and larval habitat) of the Jefferson salamander, spotted salamander, and wood frog. These three amphibians depend almost entirely on intermittent, fish-less pools associated with substantial areas of forest. Woodland pool-breeding amphibians are sensitive to alterations of hydrology and water quality in their breeding pools, as well as clearing or fragmentation of the surrounding forest.

In addition to those species associated with each habitat type discussed above, another group of species—including the eastern box turtle, American woodcock, and eastern coyote, as well as other larger vertebrates—probably depends on the combination of meadow, shrubland, and forest.

The tidal marsh complex and tidal tributary mouth are used by river otter, mink, muskrat, northern harrier, Virginia rail, marsh wren, painted turtle, snapping turtle, and the northern leopard frog. We found nests of gray catbird, red-winged blackbird, and common grackle in common reed in South Bay. Large numbers of American robin, European starling, and swallows roost in the tidal marshes, especially in the common reed stand south of Route 9G. The greatest concentration of rare plants occurs in the South Bay habitat complex. The Central Pond, a shallow, supratidal (at or above Mean High Water) pond, supports muskrat activity, is used by a large number of painted turtles at least seasonally, and supports the central mudminnow, a regionally-rare fish. Painted turtles and snapping turtles nest on the gravel road causeway that crosses South Bay. Virginia rail, river otter, and other animals cross the causeway or use its edges. The Western Pond has a large population of a charophyte—an unusual occurrence in a supratidal Hudson River habitat. All of these species are using the habitats in South Bay as they currently exist. Additional species of breeding marsh birds might be found in South Bay with further study, as species such as least bittern and king rail can be present in some years and not others. Even vocal and conspicuous marsh birds such as common moorhen may be detected in certain years and not others. The eastern basin of South Bay appears to provide suitable habitat for such species.

We did not study birds in South Bay outside the breeding season. Based on knowledge of urban tidal marshes on the Hudson River and the New York – New Jersey Harbor Estuary complex (e.g., Hackensack Meadowlands, Jamaica Bay), and what we know of habitats in Hudson South Bay, the bay is likely to be an important postbreeding and migrant stopover habitat for a wide diversity of waterfowl, shorebirds, and marsh birds. We think the large shallow intertidal pool of the eastern basin, and the shallow secluded Central and Western ponds, would be especially attractive to a number of nonbreeding bird species.

Our brief study that addressed several disparate groups of animal and plant species was not designed to document all of the biological diversity of the study area, even with regard to higher vertebrates; and among invertebrates we studied only adult odonates. We would expect the open (sparse) stand of robust purple loosestrife plants on the islands in the eastern basin of South Bay to attract abundant and varied flower-visiting insects and their predators (including butterflies, moths, bees, flies, beetles, bugs, and spiders, many of them native species). This is the case in many stands of purple loosestrife in the Hudson Valley. Other flora and fauna may use this stand, including giant silk moths (Saturniidae), various other insects, American goldfinch, and other birds.

ECOLOGICAL RESTORATION

In general in the northeastern states, wetland restoration policy places low value on common reed and purple loosestrife marshes, and on tidal marshes where tidal flux has been restricted by causeways, berms, and culverts. Notwithstanding policy, there is abundant evidence that altered (including tide-restricted) urban marshes, some of them common reed marshes, support diverse biotas, including economically important species and species of conservation concern. The biodiversity functions of common reed marshes have been documented in the Hackensack Meadowlands (see Kiviat and MacDonald 2002, 2004) and elsewhere (Kiviat 2006). It is important to understand a broad range of biodiversity (different groups of organisms) and ecosystem services when considering restoration decisions for South Bay. Restoration that benefits one species or group, or one ecosystem service, will not necessarily benefit another species or service. For example, the causeway at South Bay almost certainly traps organic and inorganic materials, stabilizing soils against rising sea level and storing carbon from common reed and other sources. Increased tidal flushing would reduce or reverse that service. Increased flushing of the eastern basin might benefit some of the larger predatory or anadromous fishes and diving ducks, while acting to the detriment of certain marsh birds and dabbling ducks. Removal of common reed might foster an expansion of cattail stands in the eastern basin, but cattail or other alternate plants would likely be reinvaded by common reed without frequent and possibly expensive maintenance. Common reed and the other species that now occur in South Bay, especially in the eastern basin, are able to tolerate the altered habitats and urban water quality better than many other species.

Although the southwestern portion of South Bay (i.e., just north of Route 9G and east of Mt Merino Road), and some other portions of South Bay distant from the road causeway, were outside our study area, restoration actions at or near the causeway will affect those distant areas via changes in hydrology and changes in habitat complexes. Very little, for example, is known about the supratidal common reed and large tree savanna of the southwestern area. We expect this habitat to support many birds, mammals, and other animals not typically using the more open intertidal marshes of South Bay, as well as rare mosses of supratidal swamps. Groups of organisms such as these should be surveyed before major restoration decisions are made.

We found old but no fresh beaver sign in South Bay; but beavers will undoubtedly return. Their dam building, canal digging, plant harvesting, and food caching activities may change hydrology and vegetation substantially, thus modifying the biological communities we describe in this report and any future consideration of restoration.

Low-energy supratidal ponds such as Central Pond and Western Pond often support organisms and wildlife activities not typically found in intertidal marshes. The central mudminnow, and the charophyte *Chara globularis*, are examples. Opening the supratidal ponds to greater tidal flux would likely eliminate those two species (due to predation and turbidity, respectively), and would potentially make the ponds less suitable for reptiles and amphibians.

Foremost in any consideration of management or restoration of South Bay is the inactive solid waste dump between the Central Pond and the L & B Furniture building. This dump was probably used until roughly 40 years ago, contains large quantities of bottles and other apparently domestic refuse, and was burned enough to melt some of the glass. The contents of this dump and its impacts upon biodiversity in South Bay should be examined carefully. The causeway and the common reed stands may also be stabilizing soils contaminated by the South Bay dump. Contaminant levels in these soils should be investigated before decisions are made concerning marsh restoration or management.

There are also opportunities for restoration in the rest of the study area transect, but we would need more information about site history and the contents of industrial waste deposits before assessing which areas or types of restoration would yield that greatest ecological improvements. It is likely, for example, that cement kiln dust and other waste materials continue to be carried into South Bay by the several small streams that drain the site. Efforts to stabilize these materials onsite could help to improve the water quality and the habitats of the streams themselves, of the nontidal wetlands they pass through, of South Bay, and of the Hudson River. But even without any restoration efforts *per se*, simply maintaining the large meadows and forests intact, including areas outside the study area, would help to sustain the unusual array of rare and uncommon species found on the site. The cement kiln dust or other waste deposits may, in fact, make some habitats suitable for rare species including side-oats grama.

FURTHER STUDIES

Despite some limitations on access that cost us portions of the field season, we performed a large amount of exploratory survey work. Together with the prior Creative Habitat study, we now have enough information to begin discussions with Scenic Hudson about sensitive biological resources and prospects for restoration and management. Additional biological surveys, however, would be extremely helpful in providing information to underpin complex decisions about remediation and restoration.

We recommend that biological surveys be performed for another year (2009) and on the entire Holcim property, if possible. Surveys for breeding birds, reptiles, amphibians, and rare plants, at least, should be repeated for a second season; this is especially important in the Hudson South Bay complex. More thorough surveys for side-oats grama and shrubby St. Johnswort should be conducted over a larger area. Goldenclub and possibly some of the other rare tidal habitat plants should be monitored; goldenclub appears to be declining along the Hudson (Kiviat 1976 and unpublished observations), and it might be possible to manage this small population so that it thrives.

We recommend that hydrological studies of South Bay be conducted, including tributary streams, the areas south of Route 9G, and the two constructed ponds. Knowing which areas are above and below Mean High Water will be necessary in evaluating the roles of tidal habitats in maintenance of biodiversity and ecosystem function, and for guiding any discussions of restoration.

We found a diverse group of dragonflies and damselflies in the study area. In order to understand their conservation needs, we first need to know which places serve as breeding habitat for the less common species. We recommend a survey of larvae and shed larval exoskeletons from emerging adults in order to identify breeding habitats. The western tidal tributary mouths should be a focus; this is where we found several of the less common species, and this habitat could be negatively affected by a change in tidal regime. Puddles in the dirt road should also be investigated, both for dragonfly (*Pantala*) breeding habitat and for presence of the rare clam shrimp *Caenestheriella gynecia* (Schmidt and Kiviat, in press).

We also recommend that additional groups of organisms be studied, including bryophytes (mosses and liverworts), butterflies, and land snails--groups that can provide much useful ecological information. A fish survey should be conducted in the South Bay complex and, in addition to a second year breeding bird survey, birds should be studied at other seasons to help us assess the role that the study area plays for migrant and wintering birds such as waterfowl, shorebirds, and raptors. This list of recommended studies is not comprehensive; further studies may be needed.

ACKNOWLEDGMENTS

We would like to thank Mark Wildonger of Scenic Hudson for project coordination; Michael Klemens for help with project design and field surveys; Bill Poetzsch and other staff at Holcim for coordinating access to the site; Spider Barbour, Tanessa Hartwig, Rodney Johnson, Cathy McGlynn, Nava Tabak, and Conrad Vispo for field surveys, identifications, and analysis; Jaime Hazard, Aminy Ostfeld, Erin Philp, and David Travis for digging and/or checking pitfall traps; Regina Vaicekonyte for building and checking floating hoop traps; Jenn Cairo for help with the muskrat lodge survey; William Cook of the Alan Devoe Bird Club for records; Ken Karol for identification of the charophyte; Rick Ostfeld and Shannon Duerr for shrew identification; John Litvaitis for offering to identify cottontail scat.

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Appendix A. Schedule of 2007-2008 field work in the Hudson South Bay study area transect. Number of person-hours by day and task. Hudsonia Ltd.

Task (personnel)	**Date**	**18 Dec**	**26 Jan**	**7 Apr**	**8 Apr**	**6 May**	**20 May**	**2-6 Jun**	**5 Jun**	**12 Jun**	**20 Jun**	**22 Jun**	**28 Jun**	**30 Jun**	**13 Jul**	**20 Jul**	**22 Jul**	**24 Jul**	**26 Jul**	**27 Jul**	**28 Jul**	**11-15 Aug**	**13 Aug**	**Total**
Site reconnaissance (Erik Kiviat, Michael Klemens, Andy Reinmann, Kristen Bell)		32			3																			**35**
Muskrat lodge survey (Erik Kiviat, Jenn Cairo)			13.5																					**13.5**
Rare vascular plant survey (Nava Tabak, Gretchen Stevens)						19.5					6.5						10.5						12	**48.5**
Dragonfly and damselfly survey (Spider Barbour, Kristen Bell)										16							8						8	**32**
Amphibian and reptile visual encounter survey (Kristen Bell, Tanessa Hartwig, Michael Klemens)				16	5		16	10																**47**
Turtle trapping (Erik Kiviat, Tanessa Hartwig, Kristen Bell, Regina Vaicekonyte)								50																**50**
Breeding bird survey (Rodney Johnson)									3			7	4	4	7	7		5	5	6				**48**
Mammal visual encounter survey (Conrad Vispo)		8		8																				**16**
Mammal pitfall trap set-up (Kristen Bell, Jaime Hazard, Aminy Ostfeld, David Travis)																				32				**32**
Mammal trapping (Conrad Vispo, Cathy McGlynn, Erin Philp, Kristen Bell)																					90			**90**
Total																								**412**

Appendix B. Explanation of ranks of species of conservation concern.
Explanations of New York State Ranks and New York Natural Heritage Program Ranks are from the New York Natural Heritage Program website, accessed in 2008 (http://www.dec.ny.gov/animals/29338.html).

NEW YORK STATE RANKS

For animals, categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5. For plants, the following categories are defined in regulation 6NYCRR 193.3 and apply to New York State Environmental Conservation Law section 9-1503.

ANIMALS

E **Endangered Species**. Any species which meet one of the following criteria: 1) Any native species in imminent danger of extirpation; 2) Any species listed as endangered by the US Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Any species which meet one of the following criteria: 1) Any native species likely to become an endangered species within the foreseeable future in New York; 2) Any species listed as threatened by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC **Special Concern Species**. Those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).

PLANTS

E **Endangered Species**. Listed species are those 1) with five or fewer extant sites, or 2) with fewer than 1,000 individuals, or 3) restricted to fewer than 4 USGS 7.5 minute map quadrangles, or 4) listed as endangered by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Listed species are those 1) with 6 to fewer than 20 extant sites, or 2) with 1,000 or fewer than 3000 individuals, or 3) restricted to not less than 4 or more than 7 USGS 7.5 minute map quadrangles, or 4) listed as threatened by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

NEW YORK NATURAL HERITAGE PROGRAM RANKS – ANIMALS AND PLANTS

S1 Critically imperiled in New York State. Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.

S2 Imperiled in New York State. Typically 6-20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

S3 Rare in New York State. Typically 21-100 occurrences, limited acreage, or miles of stream in New York State.

S4 Apparently secure in New York State.

S5 Demonstrably secure, though it may be quite rare in parts of its range.

SH Historically known from New York State, but not seen in the past 20 years.

SX Apparently extirpated from New York State.

B,N These modifiers indicate when the breeding status of a migratory species is considered separately from individuals passing through or not breeding within New York State. B indicates the breeding status; N indicates the non-breeding status.

SPECIES OF GREATEST CONSERVATION NEED (SGCN) IN NEW YORK - ANIMALS

Species that meet one or more of the following criteria (NYSDEC 2005):

- Species on the current federal list of endangered or threatened species that occur in New York.
- Species that are currently State-listed as endangered, threatened or special concern.
- Species with 20 or fewer elemental occurrences in the New York Natural Heritage Program database.
- Estuarine and marine species of greatest conservation need as determined by New York Department of Environmental Conservation, Bureau of Marine Resources staff.
- Other species determined to be in great conservation need due to status, distribution, vulnerability, or disease.

REGIONAL STATUS (HUDSON VALLEY) – ANIMALS AND PLANTS

RG Hudsonia has compiled lists of native plants and animals that are rare in the Hudson Valley but do not appear on statewide or federal lists of rarities (Kiviat and Stevens 2001). We use ranking criteria similar to those used by the NYNHP, but we apply those criteria to the Hudson Valley below the Troy Dam. Our regional lists are based on the extensive field experience of biologists associated with Hudsonia and communications with other biologists working in the Hudson Valley. These lists are subject to change as we gather more information about species occurrences in the region. In this report, we denote all regional ranks (rare, scarce, declining, vulnerable) with a single code (RG). Species with New York State or New York Natural Heritage Program ranks are presumed to also be regionally rare, but are not assigned an 'RG' rank. For birds, the RG code sometimes refers specifically to their breeding status in the region.

PARTNERS IN FLIGHT PRIORITY SPECIES LISTS – BIRDS

The Partners in Flight (PIF) WatchList is a list of landbirds considered to be of highest conservation concern, excluding those already designated as endangered under the federal Endangered Species Act. The WatchList is compiled jointly by several federal and private associations, including the Colorado Bird Observatory, the American Bird Conservancy, Partners in Flight, and the U.S. Fish and Wildlife Service. The current PIF WatchList is based on a series of scores assigned to each species for 7 different aspects of vulnerability: population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, population trend, and "area importance" (relative abundance of the species within a physiographic area compared to other areas in the species' range). Scores for each of these factors range from 1 (low priority) to 5 (high priority), and reflect the degree of the species' vulnerability associated with that factor. Species are assigned "**High Regional Priority**" if their scores indicate high vulnerability in a physiographic area (delineated similarly to the physiographic areas used by the Breeding Bird Survey), and "**High Continental Priority**" if they have small and declining populations, limited distributions, and deteriorating habitats throughout their entire range. The most recent WatchList was updated in August 2003. We include birds listed in physiographic area # 17 (Northern Ridge and Valley).

PIF1 High continental priority (Tier IA and IB species)
PIF2 High regional priority (Tier IIA, IIB, and IIC species)

Appendix C. Project personnel.

James (Spider) Barbour, BS, Biologist. Spider joined Hudsonia in 1984. He has 40 years of experience as a field biologist, and specializes in botanical, reptile, amphibian, and insect surveys and habitat assessments. Spider has participated in numerous Hudsonia biodiversity studies, and has worked on Hudson River shore and wetland projects for Hudsonia, West Point Military Reservation, New York State Museum, New York State Department of Environmental Conservation, and other institutions.

Kristen Bell, MS, Biologist. Kristen has a broad-based background in natural history, field work, and teaching. Before joining Hudsonia in 2005, she spent four years studying tropical ecology; her Master's research was on forest fragmentation in Costa Rica, and its effects on the community structure of frogs and lizards. She now works on habitat mapping projects, and biological assessments and surveys, and has a special interest in herpetology.

Tanessa Hartwig, MS, Biologist and Assistant Director of the Conservation Ecology Program. Tanessa has been at Hudsonia for seven years and supervises our Blanding's turtle field studies. She also works on community and habitat mapping projects, biodiversity assessments, and invasive plant studies.

Rodney Johnson, BS. Rodney has been President of the Otis T. Waterman Bird Club (Dutchess County, NY) for 12 years. He is a well-rounded naturalist with many years of experience observing birds throughout the Hudson Valley and elsewhere in the Northeast.

Erik Kiviat, PhD, Executive Director and a cofounder of Hudsonia. He has studied flora, fauna, and ecological processes of Hudson River wetlands and shores since 1971. Erik is also involved in research on the biodiversity and restoration of urban wetlands in New York City and New Jersey which provide a valuable comparison to Hudson South Bay. He is an expert on invasive plants including common reed, purple loosestrife, and water-chestnut.

Cathy McGlynn, PhD, Biologist. Cathy joined Hudsonia in 2008 and currently works on habitat mapping projects. Her doctoral research, addressing the impacts of purple loosestrife and common reed on small mammal and breeding bird communities, was conducted in several Hudson River freshwater tidal marshes.

Andy Reinmann, MS, Biologist. Andy came to Hudsonia in spring of 2006 after completing graduate studies in forest ecology. He worked on habitat mapping projects, plant and bird surveys, and other biological assessments. In summer 2008 he joined the graduate program at Boston University.

Gretchen Stevens, BS, Botanist, and Director of the Biodiversity Resources Center. Gretchen has been at Hudsonia for 18 years, and has 28 years' experience in remote sensing, habitat assessments, habitat mapping, rare plant surveys, and other field biology in the Northeast and elsewhere in the U.S. She supervises Hudsonia's habitat mapping projects and biodiversity assessment training program, and manages the herbarium of the Bard College Field Station. She has been involved in many Hudsonia biodiversity assessments and other projects on and off the Hudson River.

Nava Tabak, MS, Biologist. Nava studied botany at the University of Vermont, and the ecology of invasive plants at the University of Connecticut, and has worked on aquatic plant surveys, water sampling, wildlife rehabilitation, environmental education, and documenting, monitoring, and

controlling invasive plant occurrences. At Hudsonia she has conducted habitat mapping for the Town of Poughkeepsie, and has worked on other townwide and smaller habitat mapping projects, as well as rare plant surveys and biological assessments in Dutchess and Putnam counties.

Conrad Vispo, PhD, Coordinator of the Farmscape Ecology Program, Columbia County, NY. Conrad's academic and professional background includes studies of weasels, ground squirrels, bats, shrews, other mammals and other non-mammal groups, and curatorial work at Cornell's mammals collection. In 2003 he co-founded the Farmscape Ecology Program at the Hawthorne Valley Farm, where he has conducted camera-trap surveys for medium-sized mammals, acoustic surveys for bats, and live-trapping surveys for small mammals, as well as surveys for odonates, butterflies, birds, and amphibians to evaluate the significance of on-farm habitats to native plants and animals.