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Woodbridge Township Open Space and Flood Plain Restoration Plan
Woodbridge Township, Middlesex County New Jersey

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Figure 1. A flood-damaged house on Crampton Avenue in the Watson-Crampton Neighborhood has been purchased under the Blue Acres Program and awaits demolition

1.0 INTRODUCTION

In the aftermath of Hurricane Irene (2011) and Superstorm Sandy (2012), multiple residential properties within the Woodbridge Township flood plain were severely impacted by flooding. As a proactive approach for increasing the resiliency of its municipality, Woodbridge Township successfully secured funds through the New Jersey Department of Environmental Protection (NJDEP) Blue Acres Program to purchase flood prone properties located within the Township's flood plain. The primary objectives of this initiative were to:

- protect safety and health of Township residents by encouraging homeowners to relocate permanently to higher elevation areas;
- restore the natural function of the flood plain to promote storage and infiltration of stormwater in appropriate areas, particularly during significant storm events.

Woodbridge Township began the process of acquiring individual residential properties, and by October 2015 has secured at least 198 lots. The majority of acquisitions have largely been concentrated in the Watson-Crampton and Sewaren neighborhoods, with additional properties located in Port Reading, Avenel and Colonia. These single-family homes are being demolished and the properties converted to open space, following the mission of the Blue Acres Program.

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The Township has partnered with Rutgers Cooperative Extension (RCE) to better understand the opportunities for and benefits of these newly acquired properties to maximize flood storage, provide recreational opportunities, and support diverse wildlife habitats. Additionally, efforts include developing long-term management strategies for the area. Through this partnership, RCE has developed this open space and flood plain restoration plan that will benefit local residents and the larger community. This flood plain restoration plan provides a:

- characterization of the existing conditions within the project area, including hydrology, soils, vegetation, wildlife habitat, and current land use;
- general discussion of the open space and recreational opportunities existing within the project area, including both active and passive recreation, habitat restoration, and buffer zones;
- detailed set of recommendations for ecological restoration and public amenity enhancements, highlighting landscape and community connections, public access points, landscape buffer establishment and management, stormwater management and flood storage, invasive plant control, native vegetation community restoration, and wildlife habitat enhancement.

RCE recognizes the need to create a landscape restoration plan that addresses the multiple goals of Woodbridge Township and its residents. Our approach is to maximize the use of native vegetation to increase the ecosystem services provided by open space within the project area, particularly to maximize stormwater infiltration and flood storage. Recommendations for buffer zones between residential areas and open space will focus on maximizing aesthetic value while decreasing maintenance requirements. Public access will highlight scenic vistas and habitat features, while working to physically connect neighborhoods to surrounding open space resources.

2.0 EXISTING CONDITIONS

2.1 Site Conditions

The investigation completed by RCE focused on both the existing buy-out properties, as well as the existing open space within the tidal and flood plain lands of the project area. A total of 199 properties are proposed for acquisition, and 194 properties have been acquired to date.

2.2 Residential Properties Remaining in the Floodplain

Several residential properties have rejected offers by the Blue Acre Program or did not apply for buyout and will remain in the flood plain. The result is a "checker-boarding" of private residential property and public open space within the flood plain.

Figure 2. A house in the Watson-Crampton Neighborhood that will remain in the floodplain

Figure 3. A demolished lot adjacent to a property not participating in the Blue Acres Program. Residents have expressed concern regarding the look and feeling of the now empty lots

2.3 Hydrology

The Watson-Crampton Neighborhood Project Area is bounded by three major drainage ways that converge at or near the New Jersey Turnpike. To the north, the neighborhood is bounded by Wedgewood Brook, which drains a watershed totaling ~150 acres and flows east approximately 1.5 miles from its headwaters near Route 1 and Regina Street Park. To the South the neighborhood is bounded by Heards Brook, which drains a watershed totaling ~135 acres and flows east through Woodbridge Township for approximately 1.8 miles. Both drainage ways converge at the Woodbridge River, which flows south along the eastern edge of the project area before flowing under the New Jersey Turnpike.

Ecotypes along the Woodbridge River naturally developed as tidally influenced salt marsh. Low salt marsh areas are regularly flooded twice a day, and high salt marsh areas transition from lower areas to uplands. These areas are subject to periodic flooding by spring and flood tides. Additionally, along Wedgewood Brook and Heards Brook low-lying floodplain areas likely flood annually in spring with higher zones flooding more irregularly.

With major drainage ways bounding the neighborhood to the north and south along with the tidally influenced Woodbridge River to the east, significant portions of the Watson-Crampton neighborhood exist in a zone prone to flooding and potentially damaging water flows (Appendix 2 – Hydrology Map).

The Woodbridge River flows south under the New Jersey Turnpike to form the western boundary of the Sewaren Neighborhood Project Area (Appendix 3 – Sewaren Project Area and Hydrology Maps). This neighborhood lies to the east of the river with drainage flowing from residential neighborhoods into small tidal creeks. Significant areas of tidally influenced salt marsh remain. These areas are subject to periodic flooding by spring and flood tides and have been designated as Flood Zones by the Federal Emergency Management Agency (FEMA).

2.4 Soils

Soils in both the Watson-Crampton Neighborhood Project Area and the Sewaren Neighborhood Project Area range from tidal marsh peat, to sandy flood plain soils, to urban land complexes (Appendix 2 and 3 - Soils Maps). Developed landscapes with streets and homes are predominantly located on either Boonton or Haledon urban soil complexes. The Boonton-urban land soil complex is characterized as loam or silty loam to a depth of 30 inches before becoming a gravelly or sandy loam to a depth of 72 inches. The soils are well drained, with water table depths >80 inches. The topography is relatively flat to gently sloping with slopes ranging from 0 to 8 percent. Haledon-Urban land soil complex is characterized as a silty loam to a depth of 24 inches and then becoming a sandy or gravelly loam to a depth of 70 inches. It is a somewhat poorly drained soil with water table depths ranging from 6 to 18 inches. Slopes range from 0 to 3 percent.

Unmanaged and undeveloped landscape areas are predominately located on Psamments or Pawcatuck-Transquaking soil complexes. In the southern portion of the study area, marsh and deciduous forests are present on two variations of Psamments soil complexes. Psamments soils are fine sands formed under depressions or in tidal marshes. Portions of the Psamments soils are underlain with mucky peat. As sands, they are moderately well drained to well drained soils. Slopes range from 0 to 3 percent. The Pawcatuck-Transquaking complex is frequently flooded and consists of tidal marsh areas. Soil is characterized as mucky peat to a depth of 45 inches overlaying loamy sand or sand to a depth of 90 inches. This is a very poorly drained soil with water tables at or near the surface and high salinity.

2.5 Vegetation

Watson-Crampton Neighborhood

The project area is a mosaic of moderate to highly disturbed habitats characteristic of the central New Jersey urban landscape (Appendix 2 – Vegetation Survey Map). Dominant ecotypes within the currently unmanaged portions of the Watson-Crampton neighborhood include saline and *Phragmites*-dominated marshlands, deciduous woodland, and scrub/shrub habitat. The unmanaged landscape areas total approximately 75 acres. RCE conducted vegetation surveys throughout the project area and identified the following ecotypes:

Bare:
In the southern portion of project area, there exists a significant patch (~1 acre) of bare soils adjacent to a relatively intact stand of deciduous woodlands. The area appears to be routinely used by recreational dirt bikes or ATVs, and the soils are quite compacted.

Deciduous Woodland:
The majority of upland habitats (~12 acres) within the project area can be classified as either dense (>50% canopy cover) or sparse (<50% canopy cover) deciduous woodland. Maples (*Acer* spp.) and oaks (*Quercus* spp.) dominate the canopy, with elms (*Ulnus* spp.), sweet gum (*Liquidambar styraciflua*), black locust (*Robinia pseudoacacia*), and black cherry (*Prunus serontina*) also common. In the central portion of the project area just beyond the northern extent of Hedleberg Ave, there exists a remnant patch of river (*Betula nigra*) and paper birch (*B. papyrifera*).

The subcanopy layers of the deciduous woodlands are fairly degraded, which is typical of disturbed habitats in urban areas. Common native shrubs observed include greenbriar (*Smilax* spp.), wild raspberry (*Rubus occidentalis*), poison ivy (*Toxicodendron radicans*), and wild grape (*Vitis* spp.). Other less common native shrubs observed include arrowwood viburnum (*Viburnum dentatum*), serviceberry (*Amelanchier canidensis*) and winged sumac (*Rhus copallinum*).

The herbaceous layer is dominated with invasive plants, primarily mugwort (*Artemisia vulgaris*), mile-a-minute (*Polygonum perfoliatum*) and Japenese stiltgrass (*Microstegium vimineum*). However, there are small patches of native wildflowers outcompeting invasives in some areas. Milkweeds (*Asclepias* spp.), goldenrods (*Solidago* spp.) and white snakeroot (*Ageratina altissima*) dominated the remnant patches of herbaceous native plants, as these species either flower during the fall (when surveys were conducted) or are easily identified as standing dead plants. It is possible that other small patches of earlier flowering herbs are present; however, the invasive plants likely suppress growth of most native herbs.

Edge Habitat:
Along riparian and woodland edges not dominated by common reed (*Phragmites australis*), edge habitats (~5.5 acres) include a mix of deciduous trees and shrubs that are tolerant of both dry and wet conditions. Common species include green ash (*Fraxinus pennsylvanica*), silver maple (*Acer saccharinum*), pin oak (*Quercus palustris*), and marsh elder (*Iva annua*). In many of these transition areas, *Phragmites* is encroaching on existing vegetation.

Mowed Lawn:
Managed open space within the project area can be classified as mowed lawn, which is a mix of turf grass and common weeds (clover, crabgrass, spurge, etc.) routinely maintained. Approximately 5 acres of existing residential property and parkland are currently maintained as turf or mown landscape.

Phragmites-dominated Marsh:
Approximately 28% (~15 acres) of the unmanaged portion of the Watson-Crampton Neighborhood can be classified as a *Phragmites* monoculture. Within these zones exist some patches of remnant habitat, typically small stands of trees (maples, birches, etc.) that are producing enough shade to limit *Phragmites* growth. Bordering *Phragmites* monoculture zones are saline marsh, edge habitats, or deciduous woodlands, depending upon the surrounding topography.

Saline Marsh:
Relatively healthy saline marsh occurs along the northern, eastern and southern fringes of the project area totaling approximately 13.5 acres. Dominant vegetation includes salt marsh cordgrass (*Spartina alterniflora*) and salt-meadow grass (*Spartina patens*), indicating relatively normal tidal dynamics. Bordering the majority of the marsh edges are *Phragmites*-dominated marsh and edge habitats, likely resulting from elevation increases due to historic fill.

Scrub/Shrub:
At the northern extent of Pearl, Vesper and Heidelberg Avenues, there exists an approximately 3-acre patch of scrub/shrub habitat, dominated by marsh elder (*Iva annua*) and herbaceous vegetation. The boundaries of this habitat are delineated by a steep elevation change from the surrounding edge habitat.

Sewaren Neighborhood

The Sewaren neighborhood contains ~67 acres of open space, which consists of a small range of habitat types. Saline marsh occupies the majority of the open space with the project area, and small pockets of open-canopy deciduous woodland and edge habitat are also present. RCE conducted vegetation surveys throughout the project area and delineated the following ecotypes:

Deciduous Woodland <50% Canopy Cover:
Two notable patches of deciduous woodland exist comprising approximately 6 acres of the Sewaren Neighborhood. This area is a mosaic of moisture-tolerant vegetation types, ranging from herbaceous plants to young trees. Specific species distribution data could not be attained due to access restraints. Based upon surrounding congruent ecotypes, the vegetative community likely includes common native species, such as marsh elder, as well as non-native species (e.g., *Phragmites*).

Edge Habitat:
A series of thin patches of edge habitat separates the marsh from the residential zone in the eastern portion of the project area, comprising ~1.3 acres of the Sewaren Neighborhood. Transition zones between residential development and open space are variable and support a diversity of non-native vegetation tolerant of wet and dry conditions. RCE documented considerable cover of *Phragmites* and mugwort along this edge habitat. However, native woody species, including pin oak, silver maple, and black cherry are also common.

Herbaceous Wetlands:
A slight rise in elevation created a unique 2.5-acre peninsula extending south from an industrial zone. The vegetative community resembles that of characteristic disturbed edge habitat with typical vegetation consisting of a very sparse woody open canopy with marsh elder and other moisture-tolerant shrubs, as well as *Phragmites*.

Saline Marsh:
Saline marsh dominates the extent of open space within the Sewaren Neighborhood (~44 acres). The marsh appears generally in good to moderate health and consists primarily of typical salt marsh vegetation, such a salt marsh cordgrass and salt-meadow grass. Like the salt marsh bordering the Watson-Crampton Neighborhood, these species indicate a normal tidal pattern. *Phragmites* often borders the saline marsh transitioning into the surrounding land.

Demolition Zones throughout Woodbridge Township

During vegetation surveys, RCE catalogued the existing trees on the residential properties that have either been demolished or are slated for demolition. In addition to ornamental trees and shrubs, such as star magnolia (*Magnolia stellata*), ornamental apple (*Malus* spp.) and cherry (*Prunus* spp.) trees, and arborvitae (*Thuja* spp.), there are several native trees that can be incorporated into future planting plans. The existing native trees >5 inches dbh are listed in Appendix I. There are several Norway maples (*Acer platanoides*) within the demolition zone. These trees should be removed, as they create dense shade that hinders the establishment of understory vegetation.

2.6 Invasive Species

The majority of habitats within the project bounds have considerable coverage of various invasive plant species. RCE documented at least 20 invasive plant species during vegetation surveys. *Phragmites* is the most abundant invasive plant, dominating a significant portion of wetland habitat and wetland transition zones. The extensive coverage of this species is typical of highly disturbed natural habitats, most often where hydrology has been altered.

Within wooded areas, mugwort appears to be the dominant invasive plant. RCE also observed several patches of Japanese knotweed (*Fallopia japonica*) along riparian fringes. Other woody invasive plants observed include tree-of-heaven (*Ailanthus altissima*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), and Amur honeysuckle (*Lonicera maackii*), and other herbaceous invasive plants include mile-a-minute (*Polygonum perfoliatum*) and Japenese stiltgrass.

2.7 Wildlife

RCE used existing landscape level GIS data from both NJDEP and the Rutgers Center for Remote Sensing and Spatial Analysis (CRSSA) to evaluate the habitat potential of the open space areas within the project bounds. The NJDEP Landscape Project classifies undeveloped portions of the project area as either Rank 1 or Rank 3. Rank 1 habitats do not have any confirmed occurrences of threatened or endangered species or species of special concern; however, the land is still considered generally suitable for wildlife. The remaining open space areas are classified as Rank 3, indicating that there are confirmed occurrences of one or more state-threatened species. The project area has confirmed sightings of the NJ-threatened black-crowned night heron (*Nycticorax nycticorax*), justifying the Rank 3 classification, and also the little blue heron (*Egretta caerulea*), a state species of special concern (Appendix 2 and 3 – Wildlife Habitat).

RCE also assessed the project area for potential vernal ponds, which are required breeding habitats for both salamanders and frogs. Vernal habitats are defined as topographic depressions that temporarily store water (e.g., snowmelt) in late winter/early spring long enough for amphibious eggs to complete metamorphosis to adults, but not long enough to allow fish to reside. There are no documented potential vernal habitats within the project bounds.

Birds:
RCE conducted two 3-hr fixed point bird surveys within the project area. Survey points were located at (Appendix 2 – Bird Survey Locations). Surveys were conducted during the hours of 0600 – 1000 on clear mornings to maximize detection probability. A full list of species observed is included as Table 1. The majority of species observed are common in suburban and urban areas with significantly human-modified habitats (e.g., American goldfinch, blue jay, northern

cardinal). However, it is noteworthy to point out that RCE did observe several large wading birds (i.e. great blue herons and great egrets) within the saline marsh areas. In addition, RCE documented the presence of a belted kingfisher (*Megaceryle alcyon*). Because both the large waders and the kingfisher rely on non-turbid (clear) waters for foraging, their presence suggests water quality is fair (at a minimum). RCE also noted four warbler species and a red-eyed vireo (*Vireo olivaceus*), which typically use wooded habitats for breeding and migratory stopovers. These observations suggest that existing woodland areas can be enhanced to improve habitat quality for these and other avian species.

Deer:

RCE conducted two deer transect surveys along the border between the demolition zones and the open space areas to assess potential browse pressure on future restoration plantings. RCE identified two distinct herds (potentially a third) consisting of approximately 8 individuals each. These groups were largely concentrated in the open space areas created by the demolition of properties or on other mowed areas throughout the neighborhood. Deer paths were also detected in virtually all wooded or *Phragmites*-dominated areas. Although these apparently resident herds are small in number, they can pose a significant risk to restoration plantings. In addition, the open space habitats are connected from the north, east and south to larger open spaces, indicating the deer browse pressure may be particularly severe during certain times of the year as herds move about the landscape. Protection of small plants must be considered during restoration planning.

Table 1. Avian species documented within the project area

Common Name	Latin Binomial
American crow	*Corvus brachyrhynchos*
American goldfinch	*Carduelis tristis*
American robin	*Turdus migratorious*
Belted kingfisher	*Megaceryle alcyon*
Black and white warbler	*Mniotilta varia*
Blue jay	*Cyanocitta cristata*
Brown-headed cowbird	*Molothrus ater*
Canada goose	*Branta canadensis*
Carolina wren	*Thryothorus ludovicianus*
Common grackle	*Quiscalus quiscula*
Cooper's hawk	*Accipiter cooperii*
Domestic goose	*Anser* sp.
Downy woodpecker	*Picoides pubescens*
European starling	*Sturnus vulgaris*
Great blue heron	*Ardea Herodias*
Great egret	*Ardea alba*
Herring gull	*Larus argentatus*
House finch	*Carpodacus mexicanus*
House sparrow	*Passer domesticus*
House wren	*Troglodytes aedon*
Mallard	*Anas platyrhynchos*
Mourning dove	*Zenaida macroura*
Northern cardinal	*Cardinalis cardinalis*
Northern flicker	*Colaptes auratus*
Northern mockingbird	*Mimus polyglottos*
Palm warbler	*Setophaga palmarum*
Red-eyed vireo	*Vireo olivaceus*
Red-winged blackbird	*Agelaius phoeniceus*
Ring-billed gull	*Larus delawarensis*
Rock dove (pigeon)	*Columba livia*
Savannah sparrow	*Passerculus sandwichensis*
Song sparrow	*Melospiza melodia*
Turkey vulture	*Cathartes aura*
Yellow-rumped warbler	*Setophaga coronata*
Yellowthroat warbler	*Geothlypis* sp.

2.8 Stormwater Management Infrastructure

Existing stormwater infrastructure, including catchbasins and pipes, capture runoff during storm events in the Watson-Crampton neighborhood and direct flow towards the east and south (Appendix 2 – Hydrology). A system along Port Reading Avenue captures stormwater and discharges it directly into the Woodbridge River. A second system carries stormwater runoff from the neighborhood along Von Vetchen Avenue. The system flows east and discharges into existing wetland areas at the eastern terminus of Von Vetchen Avenue. In the most southerly portion of the neighborhood, pipes along Brookfield Avenue capture flow and discharge stormwater into the wooded landscape near the intersection of Brookfield and Watson. Finally, two stormwater pipe systems discharge into existing park areas near the Woodbridge Playground at the southern end of Garden Avenue. Stormwater from the east and from the north flow towards the site and discharge into a concrete lined tributary channel of Heards Brook.

In the Sewaren Neighborhood, the stormwater infrastructure captures runoff with pipes flowing west and discharges into small tidal creeks that drain to the Woodbridge River (Appendix 3 – Hydrology). South of Woodbridge Avenue, catchbasins and pipes along Roberts, Dunlop and Arbor Streets capture stormwater and discharge it directly into the tidal creeks and marsh areas. Areas to the north of Woodbridge Avenue are managed with a system directing stormwater runoff to infrastructure along North Robert, Central, and Vernon Streets and discharging to a tidal creek near the NJ Turnpike Grover Cleveland Service Area.

3.0 OPEN SPACE AND RECREATIONAL OPPORTUNITIES

3.1 Active Recreation Opportunities

Community demand for active recreational facilities continues to increase in many areas of New Jersey. Organized sports including soccer, lacrosse, and football require large turf fields with adequate drainage. Baseball and softball require similar facilities. Organized sports also require significant supporting infrastructure, such as parking, restroom facilities, seating, and potentially lighting. Siting these types of facilities in flood prone areas and immediately adjacent to residential homes can be problematic. To provide a suitable playing surface, these facilities must first be designed for proper drainage. Without proper drainage, the fields can quickly become unusable. Proper drainage requires site grading and may involve filling and raising the field area to ensure that water drains away from playing surfaces following rain events.

While development of active recreation facilities are being considered within the study areas, their construction should only be proposed in locations where they will not reduce flood storage capabilities and where supporting infrastructure will not be subject to frequent damaging floods.

3.2 Passive Recreation Opportunities

Large contiguous open space areas can support a range of passive recreation activities. Trails and boardwalks to support hiking, walking, biking, canoeing or kayaking, as well as bird watching and wildlife observation, are cost-effective improvements that can be integrated easily into flood plain open spaces. Mown paths through meadows and stormwater and flood-storing rain gardens place minimal burden on local resources and infrastructure and allow for passive recreation. These types of passive activities also minimize impacts on the natural resources of the area that provide protection from future flooding. Properly locating and designing improvements for trails, launches, overlooks and public access is an important first step. Additionally, these improvements can help the community connect the area to other open spaces resources to promote a larger interconnected system of recreational infrastructure.

3.3 Buffer Areas

Much of the newly purchased land will be adjacent to natural areas and will be encouraged to naturalize. Through successional dynamics, these areas will integrate into the matrix of native plant communities sustained by this dynamic landscape. However, areas will remain adjacent to occupied residential homes. These areas will require management. Buffer areas between residential homes and natural areas can support a variety of functions while ensuring that encroachment and disturbance to protected resources is limited. A limited maintenance program along with appropriate landscape improvements will provide the community with a transitional landscape to enhance the residential neighborhood while preserving natural areas.

3.4 Habitat Restoration Opportunities

Unmanaged open space portions of the project area are currently degraded due to surrounding human pressures and invasive plant colonization. In addition, the habitats are highly fragmented by roads and other barriers. Targeted habitat restoration and ecological design can significantly improve both the quality of these habitats as well as the connectivity between them. The area currently is comprised of five major habitat types, including deciduous woodland, edge habitat, *Phragmites*-dominated marsh, saline marsh, and scrub/shrub habitat. There are also portions of the project area that have little to no vegetation or are maintained as mowed lawn, including the ~28 acres of buy-out properties. Enhancement of the open space landscape though invasive species control and native plant restoration can improve its quality and occupancy by several taxonomic groups.

Increasing vegetative cover and restoring vertical structure to woodland, edge and scrub/shrub habitats will increase the availability of foraging, roosting and nesting areas for breeding birds, while also providing safe refuge sites for migratory birds during their stopover. The addition of fruiting trees and shrubs offers additional food resources as well, particularly in winter when

resources are scarce. Finally, dense vegetation will promote stormwater infiltration and reduce erosion, ultimately improving the quality of adjacent surface waters.

Adding to the total area of saline marsh will improve quality of tidal waters, provisioning prime nursery grounds for several ecologically and economically important aquatic species. Wading birds (egrets, herons) also benefit from improved foraging in tidal creeks. The most significant potential for salt marsh restoration occurs within the southern portion of the Watson-Crampton neighborhood, south of Heards Brook. However, Woodbridge Township owns only a small fraction of this land. Therefore, restoration in this area would require partnerships with the NJ Turnpike Authority, who owns the land.

There is also opportunity to introduce additional habitat diversity into the existing matrix, improving the overall ecological quality of the project area and increasing biodiversity potential. Meadow habitats support native pollinators and other beneficial insects and represent critical foraging areas for forest birds [indigo buntings (*Passerina cyanea*), flycatchers]. Managed open space also offers habitat for species less sensitive to human presence. Butterfly and hummingbird gardens, shade fern gardens, and even community edible gardens are an ecologically sustainable alternative to mowed turf and provide breeding and foraging grounds for many animals (in addition to adding intrinsic value for human enjoyment).

Finally, the habitats can be enhanced through the addition of manmade structures. Avian nest boxes for a variety of species, including kestrels (*Falco sparverius*), owls, and tree swallows (*Tachycineta bicolor*). Bat roost boxes can provide habitat for several species of conservation concern. Perching posts allow birds of prey to diversify vantage points for prey detection. Encouraging the presence of these animals result in the provisioning of insect and rodent control services from these animals.

4.0 MASTER PLAN RECOMMENDATIONS

4.1 Landscape and Community Connections

Floodplains and waterways are part of a larger system of interconnected drainage networks. The target neighborhoods within Woodbridge and the adjacent landscape are impacted by activities beyond their immediate borders. More importantly, connected open space systems provide benefits to the entire Woodbridge community. Understanding how these systems are interconnected and enhancing connections where possible provides the larger community with a better understanding and appreciation of the environmental resources that contribute to the sustainability and resiliency of the community. Physically connecting open spaces and ensuring that contiguous flood plains and greenways remain intact will help to minimize impacts from future storms.

4.2 Public Access

The new publicly owned open space is a tremendous opportunity to improve and expand the community's network of publicly accessible recreation areas. A series of public access points as well as a variety of passive recreation improvements have been proposed for consideration. These proposed improvements take advantage of existing amenities and informal activities while protecting and preserving the ecological integrity of the area. Additionally, the design of these facilities and improvements should be carefully considered to avoid conflict with the adjacent residential neighborhood.

Figure 4. Active Recreation at Heards Brook Currently, East Green Street Park is cut short by a concrete stormwater channel, a fence and dense vegetation. Additionally, a large field directly behind the park is currently under-utilized. By opening the vegetation between these two areas, installing a pedestrian bridge and replacing the concrete channel with a vegetated swale, the park becomes integrated with stormwater management and multiple recreational uses.

Figure 5. A kayak launch at Port Reading Avenue and Watson Avenue can be combined with a boardwalk over the saline marsh and management of invasive *Phragmites*

4.3 Landscape Buffers

Edges and transition zones between the residential community and naturalized habitat areas provide opportunities to enhance and define the neighborhood while establishing additional protection from tidal surges and damaging winds. Multiple landscape buffer design and management strategies have been proposed that provide visual interest, minimal maintenance, screening of undesirable views, and protection from storm impacts.

Mowed Edge

In areas where remaining residential properties border open space natural areas, we recommend maintenance of a "hard" edge. A 6- to 10-ft buffer strip of turf grass that is routinely mowed provides a clear separation between human-dominated and natural areas. A mowed strip can also protect natural areas from invasive plant colonization by blocking a seed dispersal pathway.

Low Maintenance Transition Zone

Where space allows, the landscape buffers can be designed to more gradually transition into natural areas. These low maintenance transition zones can be planted with low-lying wildflowers and grasses. This ecotype provides a clear separation between managed and unmanaged landscapes, but requires much less maintenance than a mowed strip (i.e. mowing can occur once per year). Wildflowers and native grasses provide an aesthetically pleasing landscape, which can be enjoyed by the community. Mown paths can be maintained through the meadow to encourage residents to enjoy the landscape.

Figure 6: An example of a meadow path. Meadows served as both a buffer between remaining properties and the flood plain forest, and as stormwater wetlands that manage stormwater from existing stormwater pipes. Such wetlands also provide flood storage.

4.4 Stormwater Management and Flood Storage

Improvements for stormwater management are recommended throughout the project area, particularly at or near the stormwater pipe discharge locations. As roads and houses are removed, existing stormwater pipes can be routed into designed stormwater wetland areas to provide additional flood storage as well as filter pollutants. Stormwater wetland systems support diverse habitats as well as provide improvements to the dynamics of existing stormwater infrastructure. There are several green infrastructure components that can be installed or enhanced.

Bioswales

Bioswales are designed to convey (move) water across the landscape and provide some filtration services prior to discharging into surface waters. In contrast to concrete channels, bioswales are planted with native vegetation (grasses, sedges, rushes) that can tolerate a wide range of moisture conditions. Several areas within Woodbridge Township can benefit from bioswale installation (Appendix VI).

Stormwater Wetlands

Stormwater wetlands are features designed to temporarily or permanently store water. Creating stormwater wetlands in buffer areas adjacent to residential properties as well as enhancing and expanding existing wetland habitats will provide additional flood storage, particularly during significant storm events. These wetlands can be enhanced with both aquatic and emergent native vegetation to increase infiltration capabilities.

Vernal Pools

Vernal pools are topographic depressions, typically in wooded areas, that seasonally store excess water. These features remain dry for most of the year and usually become inundated during the late winter and early spring, filling with snowmelt and spring rains. Vernal ponds will not be obvious features in the landscape, yet have the ability to provide significant flood storage depending on their size. These features are also critical breeding habitat for amphibians. Currently, no vernal pools exist in the project area.

4.5 Invasive Vegetation Control and Maintenance Recommendations

Invasive non-indigenous plant species are a serious threat to the biodiversity of natural areas and must be aggressively managed to ensure overall health of the Woodbridge Township flood plain and open space landscape. Appendix IV provides a summary of significant invasive plant species identified during RCE's field investigation and suggested control methods.

Implementation of Invasive Species Control

Invasive species control should be administered in defined restoration areas prior to native species plantings. To further protect restoration plantings from invasive species encroachment, restoration areas should be monitored for invasive species for at least 3 years while young plants establish. A buffer area of at least 15 ft surrounding the restoration area should be clear of invasive plant species as well.

Although groups of untrained volunteers (e.g., boy/girl scouts, community/corporate volunteers, etc.) can be successful in eradicating small infestations of invasive plant species, effective control of larger areas requires professional services. Licensed herbicide applicators, as well as heavy-duty machinery, are typically needed for initial eradications. Properly coordinated volunteer groups can be effective at monitoring and maintaining invasive species management zones after initial work is completed.

4.6 Native Plant Community Restoration

RCE propose to either introduce or enhance five habitats within the project area: meadow, floodplain forest, high marsh edge, saline marsh, and scrub/shrub habitat. Proposed locations of these restoration zones are illustrated in the Open Space and Flood Plain Resotration Concept Plan (Appendix VI).

Edge habitat

Edge habitats are located throughout the project area and represent transition zones between wetland and upland habitats, as well as adjoining upland habitat types. These areas typically include a mix of dense shrubs and young trees and vary by elevation and topography. During restoration planning, proposed edge habitats should be inspected thoroughly prior to generation of detailed planting palettes and plans. RCE recommends establishment of bioswales and stormwater wetlands in some areas.

Flood Plain forest (modified)

RCE suggests enhancement and expansion of existing forested areas into modified flood plain forest in several locations within the project area. Historic fill has likely elevated the floodplain of the Woodbridge River, Wedgewood Brook and Heards Brooks significantly enough to prevent the establishment of true flood plain forest habitat here. Therefore, RCE proposes to modify the selection of native vegetation, incorporating facultative native species that can tolerate a wide range of moisture conditions. A proposed representative planting palette is included in Table 2.

Figure 7. Red maple (*Acer rubrum*) and ash (*Fraxinus* spp) forest in New York

Table 2. Suggested representative planting palette for floodplain forest habitat

Common Name	Latin Binomial
Trees	
American elm	*Ulmus americana*
pin oak	*Quercus palustris*
red maple	*Acer rubrum*
river birch	*Betula nigra*
silver maple	*Acer saccharinum*
swamp white oak	*Quercus bicolor*
sweet gum	*Liquidumbar styraciflua*
Shrubs	
arrowood viburnum	*Viburnum dentatum*
elderberry	*Sambucus canadensis*
silky dogwood	*Cornus amomum*
smooth alder	*Alnus serrulata*
spicebush	*Lindera benzoin*
swamp azalea	*Rhododenron viscosum*
sweet pepperbush	*Clethra alnifolia*
Herbs	
bloodroot	*Sanguineria canadensis*
cinnamon fern	*Osmunda cinnamomea*
sensitive fern	*Onoclea sensibilis*
jack-in-the-pulpit	*Arisaema triphyllum*
Pennsylvania sedge	*Carex pensylvanica*
spring beauty	*Claytonia virginica*
trout lily	*Erythronium americanum*

Meadow

A perennial meadow will not only diversify the mosaic of existing habitat types within the project area, but it will also create enjoyable passive recreational opportunities for Woodbridge Township residents. Vegetation can be chosen based upon a detailed topography assessment of the designated locations. Typical species present in a warm-season grass/wildflower meadow are included in Table 3.

Figure 8. Typical warm season grass and wildflower meadow vegetation in mid-summer, against a deciduous woodland backdrop

Table 3. Common species found in perennial meadows in New Jersey

Common Name	Latin Binomial
black-eyed Susan	*Rudbeckia hirta*
big bluestem	*Andropogon gerardii*
butterflyweed	*Asclepias tuberosa*
coastal panicgrass	*Panicum amarum*
common milkweed	*Asclepias syriaca*
goldenrod	*Solidago spp.*
Indian grass	*Sorghastrum nutans*
New England aster	*Aster novae-angliae*
switchgrass	*Panicum virgatum*
wild bergamot	*Monarda fistulosa*

Saline Marsh

The defining feature of saline marshes is regular tidal inundation, making restoration of saline marsh habitat unlikely without re-grading of existing topography. Given the close proximity of

urban/suburban development throughout most of the project area, RCE proposes a salt marsh restoration in the southern extent of the project area, south of Heards Brook. Successful restoration here would require eradication of *Phragmites*-dominated marsh and restoration of the normal tidal regime. Typical saline marsh plants are included in Table 4.

Table 4. Representative plant species of saline marsh habitats

Common Name	Latin Binomial
Low marsh	
salt marsh cordgrass	*Spartina alterniflora*
salt meadow grass	*Spartina patens*
spike grass	*Distichlis spicata*
black rush	*Juncus gerardi*
High Marsh	
groundsel tree	*Baccharis halimifolia*
marsh elder	*Iva frutescens*
salt marsh bulrush	*Scirpus robustus*
beaked spikegrass	*Eleocharis rostellata*

Scrub/Shrub

Scrub-shrub is a unique habitat type within the project area. RCE proposes to retain these features and enhance them by removing invasive species and supplanting existing shrubs with additional native species. Potential restoration alternatives are included in Table 5.

Table 5. Suggested plants to enhance existing scrub/shrub habitat

Common Name	Latin Binomial
box elder	*Acer negundo*
cockspur hawthorn	*Crataegus crus-galli*
gray dogwood	*Cornus racemosa*
fragrant sumac	*Rhus aromatica*
maple-leaf viburnum	*Viburnum acerifolium*
New Jersey tea	*Ceanothus americanus*
serviceberry	*Amelanchier canadensis*
smooth sumac	*Rhus glabra*
winged sumac	*Rhus copallinum*

4.7 Installation of Pocket Parks

Both within the Watson-Crampton neighborhood, as well as throughout Woodbridge Township, there are demolition zones located within viable remaining developments. These properties, surrounded by private residential property, represent small pockets of open space within residential neighborhoods. This "checkerboarding" does provide a challenge for design, given their small size and proximity to development, and site interventions must be amenable to the surrounding residents. RCE recommends that these properties be transformed into "pocket parks", based on several possible designs.

After several discussions with Woodbridge Township to identify the needs of both the Township and its residents, RCE has developed five potential pocket park design options within the project area. These templates can be offered to the residents of Woodbridge who reside adjacent to or near individual demolished properties. Each design boasts its own unique identity and serves a different recreational use (e.g., active recreation, nature enjoyment, etc.), and collectively the suite of designs will accommodate the needs of all Township residents. We detail below 5 pocket park design templates below:

Shared Common "Backyard" Space

Homeowners adjacent to a demolished property may enter into a long-term agreement with Woodbridge Township, whereas the homeowner maintains the space as mowed lawn in exchange for use of the site as additional backyard. So long as homeowners erect no permanent structures (i.e. pools, decks), they can use the space freely. Demolished lots located between two remaining properties may be maintained and shared by both homeowners through amended cooperative agreements with the Township.

Figure 9. Remaining homeowners can maintain adjacent buy-out properties as manicured lawn or gardens in exchanges for using space as an extended backyard.

Community Garden

Urban and dense suburban landowners often lack the space required to successfully cultivate fresh fruits and vegetables. Some Woodbridge Township residents may enjoy implementing a community garden program within their neighborhood. These gardens will also cultivate community partnerships, as residents must engage in this endeavor jointly to determine whether a garden is communal or has individual plots, appropriately design the garden to meet the community needs, work together to apply an integrated pest management strategy, and prepare guidelines for safe and effective fertilization. Several grant opportunities exist to support viable community garden projects and promote their sustainability over time (e.g., I Can Grow Youth Garden Award, Nature's Path Gardens for Good Grant, Home Depot's Building Healthy Communities Grant Program).

Figure 10. Community gardens can act as a community gathering place as well as space to cultivate fruit, vegetables, flowers and herbs.

Playground

Some communities may benefit tremendously from a playground located within walking distance. Playgrounds provide crucial and vital opportunities for children to play, and they enhance brain development, motor skills, and social capabilities, particularly in children under 5 years. RCE recommends playgrounds that contain both a combination of traditional amenities (e.g., swings, slides), as well as more contemporary "superstructures" and loose materials. The latter amenities allow children to create their own play opportunities and promote cognitive and social development.

Figure 11. Neighborhood play equipment, particularly in areas where existing park space is several blocks away, provide children with an opportunity to play while close to home. Benches and flower beds also provide a sitting area.

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Hummingbird/Butterfly Garden

A bright and sunny wildlife garden adds a beautiful amenity to any neighborhood while also offering additional habitat area for birds and butterflies. Perennial plants, such as bee balm (*Monarda fistulosa*), butterfly weed (*Asclepias tuberosa*), and goldenrod (*Solidago* species) offer color from spring through fall, and blades of tall warm-season grasses, such as little bluestem (*Schizachyrium scoparium*) provide all-season interest. Dried seed heads also provide colors and textures in winter, particularly against the backdrop of snow, and can be a haven for wintering neighborhood birds. Trellises can provide both seating and a place for flowering vines that attract hummingbirds. Community workshops can be held to perform seasonal maintenance, such as cutting back stems in the spring. A properly designed hummingbird/butterfly garden, once established, also requires very little maintenance and can tolerate both wet and dry conditions.

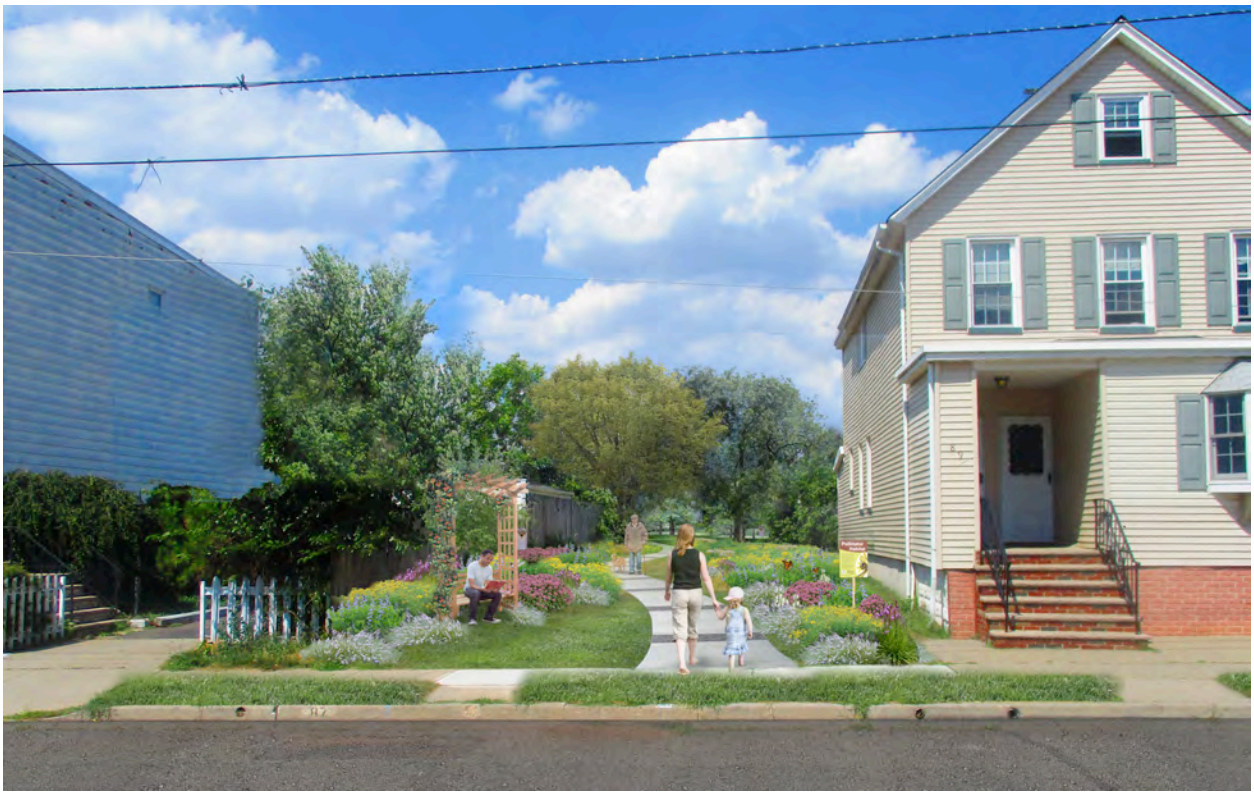


Figure 12. Sunny flower gardens can attract butterflies and hummingbirds. Paths and seating areas provide residents an opportunity to stroll or relax outdoors.

Shade Garden

In contrast to an open and sunny park space, a pocket park can be designed to offer a shade throughout the year. In summer, residents can enjoy a cool spot to escape the summer heat. In winter, a shade garden provides a windbreak to the seating areas within. A canopy of shade trees, including maples and oaks, and understory shrubs, such as azaleas and native viburnums, create a tranquil environment. Adding flowering shrubs and herbaceous plants to the ground layer will complete the garden and transform this former residential lot to a quiet, shady retreat.

Figure 13. Trees with dappled shade and low understory plantings create a tranquil place to relax on a hot summer's day. Evergreens also provide windbreaks in winter months.

Trail Entrance

Some buy-out properties can connect with existing trail or park systems in Woodbridge. Dogwoods and "Woodbridge Greenway" signage can frame trail entrances while providing residents with a scenic walk in their neighborhood.

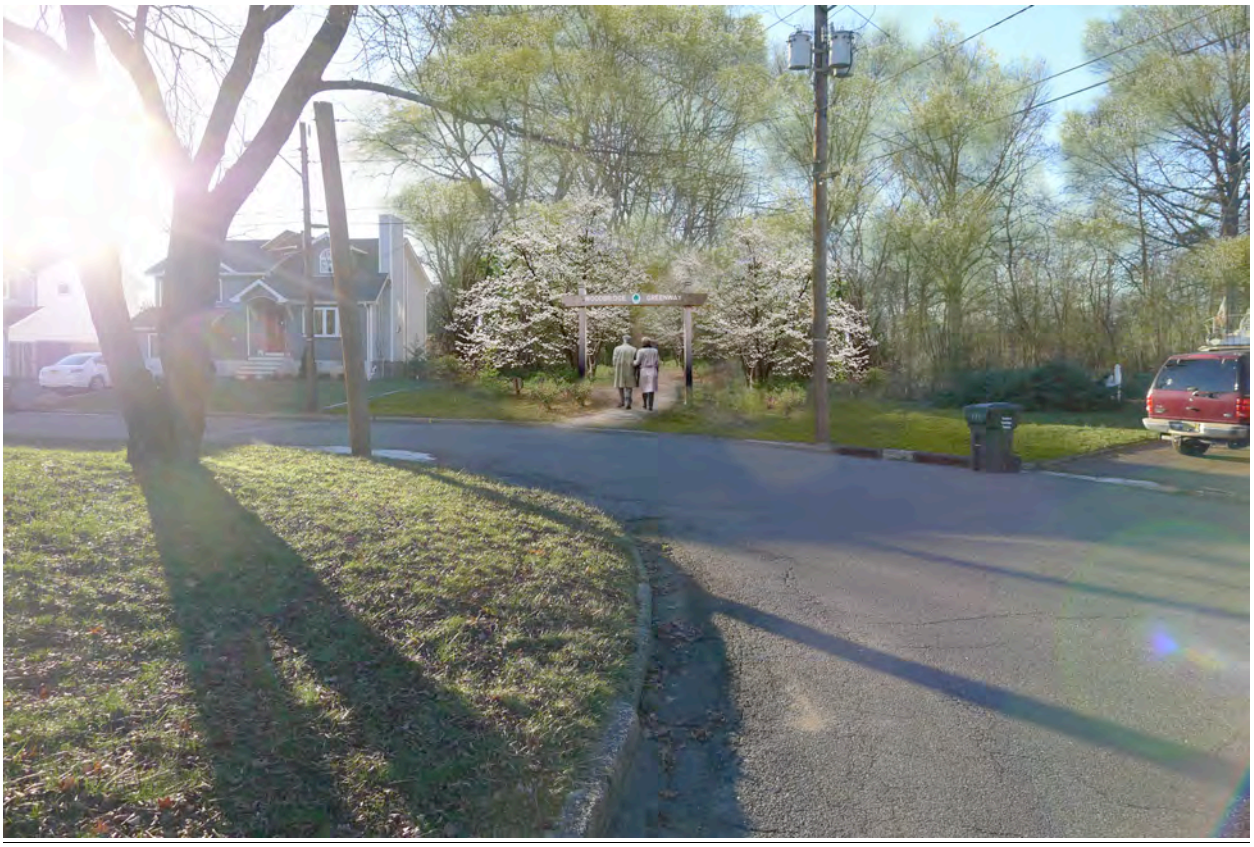


Figure 14. Dogwoods and foot paths provide residents with a scenic walk in their neighborhood.

5.0 COST ESTIMATES

RCE prepared preliminary cost estimates for the landscape amendments proposed in this plan. These estimates are based on accepted best management practices for habitat restoration and green infrastructure design. Estimates are included in Appendix V.

APPENDIX I

Appendix I: Existing Trees (>5 in dbh) within the Watson-Crampton Demolition Zone

	572 Bamford	77 Crampton	94 Crampton	98 Crampton	115 Crampton	21 E. Green	29 E. Green	560 Heidleberg	11 Melbourne	556 Vesper	558 Vesper	561 Vesper
**** Acer platanoides,* Norway Maple**						X						
***Acer rubrum,* Red Maple**							X					
***Acer saccharinum,* Silver Maple**	X			X	X	X				X		X
***Acer saccharum,* Sugar Maple**						X						
***Aesculus hippocastanum,* Horse Chestnut**												
***Betula papyrifera,* Paper Birch**		X										
Catalpa spp.					X							
***Conium maculatum,* Hemlock**												
***Cornus florida,* Flowering Dogwood**												
***Elaeagnus umbellata,* Autumn Olive**												
***Fraxinus pennsylvanica,* Green Ash**												
***Gleditsia triacanthos,* Honey Locust**											X	
***Ilex opaca,* American Holly**						X						
***Juglans nigra,* Eastern Black Walnut**												
Juniperus spp.						X						
***Juniperus virginiana,* Eastern Red Cedar**											X	
***Lagerstroemia indica,* Crepe Myrtle**											X	
***Liquidambar styraciflua,* Sweet Gum**												
***Malus spp.,* Crabapple**												
***Morus spp.,* Mulberry**				X						X	X	
***** Picea punegens* , Blue Spruce**						X						
***Pinus strobus,* White Pine**						X						
***Prunus serotina,* Black Cherry**						X						
***Prunus spp.,* Cherry**											X	
***Quercus palustris,* Pin Oak**						X			X		X	
***Robinia pseudoacacia,* Black Locust**		X		X						X		
***Ulmus americana,* American Elm**										X		
***Viburnum dentatum,* Arrowwood**						X						

* Invasive

** Non-native, but non-invasive

Appendix I: Existing Trees (>5 in dbh) within the Watson-Crampton Demolition Zone

	52 Watson	56 Watson	58 Watson	84 Watson	87 Watson	91 Watson	610 Watson	612 Watson	616 Watson	10 Wedgewood	135,141,145 Crampton	680, 684 Lewis	515 - 529 Watson	555 - 581 Watson	520 - 534 Watson	561 Vesper, 558 Watson	81, 85, 87, 105 Crampton	562 - 570 Watson	563, 569 Vesper
* ***Acer platanoides,*** **Norway Maple**														X	X		X		
Acer rubrum, **Red Maple**												X				X		X	
Acer saccharinum, **Silver Maple**				X	X	X			X	X	X	X		X		X		X	X
Acer saccharum, **Sugar Maple**																			
Aesculus hippocastanum, **Horse Chestnut**	X																X		
Betula papyrifera, **Paper Birch**																			
Catalpa spp.										X							X		
Conium maculatum, **Hemlock**	X																		
Cornus florida, **Flowering Dogwood**						X													
Elaeagnus umbellata, **Autumn Olive**														X					
Fraxinus pennsylvanica, **Green Ash**							X		X										
Gleditsia triacanthos, **Honey Locust**												X							
Ilex opaca, **American Holly**						X						X			X				
Juglans nigra, **Eastern Black Walnut**												X							
Juniperus spp.												X				X			
Juniperus virginiana, **Eastern Red Cedar**				X															
Lagerstroemia indica, **Crepe Myrtle**																			
Liquidambar styraciflua, **Sweet Gum**												X						X	
Malus spp., **Crabapple**																X			
Morus spp., **Mulberry**		X			X		X		X			X						X	
** ***Picea punegens*** **, Blue Spruce**																			
Pinus strobus, **White Pine**																			
Prunus serotina, **Black Cherry**												X	X			X			
Prunus spp., **Cherry**					X										X				
Quercus palustris, **Pin Oak**					X			X				X					X		
Robinia pseudoacacia, **Black Locust**		X																	
Ulmus americana, **American Elm**	X		X																
Viburnum dentatum, **Arrowwood**																			

* Invasive

** Non-native, but non-invasive

Appendix I: Existing Trees (>5 in dbh) within the Sewaren Demolition Zone

	65 Robert	68 Robert	69 Robert	72 Robert	79 Robert	80 Robert	84 Robert	88 Robert	89 Robert	92 Robert	70 Sewaren	48 Sewaren	54 Sewaren	40 Sewaren	71 Sewaren	15 Sewaren
**** Acer platanoides,*** **Norway Maple**					X											
Acer rubrum, **Red Maple**		X														
Acer saccharinum, **Silver Maple**	X		X		X											
Acer saccharum, **Sugar Maple**							X									
Gleditsia triacanthos, **Honey Locust**														X		
Juniperus spp.																X
Ligustrum spp., **Privet**																
Magnolia spp., **Magnolia**																
Morus spp., **Mulberry**				X						X						
***** Picea punegens ,*** **Blue Spruce**																X
Picea spp., **Spruce**			X													
Pinus spp., **Pine**																X
Prunus spp., **Cherry**											X			X		
Quercus alba , **White Oak**												X				
Quercus palustris, **Pin Oak**						X	X					X	X			
Quercus rubra, Red **Oak**																
Robinia pseudoacacia, **Black Locust**								X	X	X						
Thuja spp., **Arborvitae**															X	X
Pyrus calleryana, **Callery Pear**									X							

* Non-native, but naturalized

** Non-native, but non-invasive

Appendix I: Existing Trees (>5 in dbh) within the Sewaren Demolition Zone

	55 Arbor	59, 65 Arbor	27 S Robert	10, 123 S Robert	180 Woodbridge	139 S Robert	20 Austin	332 Vernon	328 Vernon	324 Vernon	329 Vernon	79 Wesley	326 Vernon	77, 80 Wesley	323 Vernon	43 Dunlop	55, 61 Sewaren
**** Acer platanoides,*** **Norway Maple**																	X
Acer rubrum, **Red Maple**																	
Acer saccharinum, **Silver Maple**	X			X	X	X										X	X
Acer saccharum, **Sugar Maple**																	
Gleditsia triacanthos, **Honey Locust**																	
Juniperus spp.																	
Ligustrum spp., **Privet**																	X
Magnolia spp., **Magnolia**															X		
Morus spp., **Mulberry**		X															
***** Picea punegens*** **, Blue Spruce**																	
Picea spp., **Spruce**			X														X
Pinus spp., **Pine**															X		
Prunus spp., **Cherry**																	
Quercus alba **, White Oak**												X				X	
Quercus palustris, **Pin Oak**	X							X	X	X	X	X					
Quercus rubra, Red **Oak**							X										
Robinia pseudoacacia, **Black Locust**																	
Thuja spp., Arborvitae																	
Pyrus calleryana, **Callery Pear**		X															

* Non-native, but naturalized

** Non-native, but non-invasive

Appendix I: Existing Trees (>5 in dbh) within the Avenel Demolition Zone

	131 Seventh	106 Homer	194 Homer	1054 Homer	1063 Homer	54 Borman	60 Borman	96 Borman	955-963 Blandford	38 E Coddington, 400 Thayer
** ***Acer palmatum,*** **Japanese Maple**						X				
Acer saccharinum, **Silver Maple**					X					X
Fraxinus spp., **Ash**			X	X						
Juniperus spp.		X			X					
Malus spp., **Apple**	X					X	X			X
Picea spp., **Spruce**		X								
Platanus occidentalis, **American Sycamore**					X					
Prunus serotina, Black **Cherry**	X	X								
Prunus spp., **Cherry**							X			
Pyrus calleryana, **Callery Pear**				X		X	X	X		
Quercus palustris, **Pin Oak**	X	X					X			

** Non-native, but non-invasive

Appendix I: Existing Trees (>5 in dbh) within the Port Reading Demolition Zone

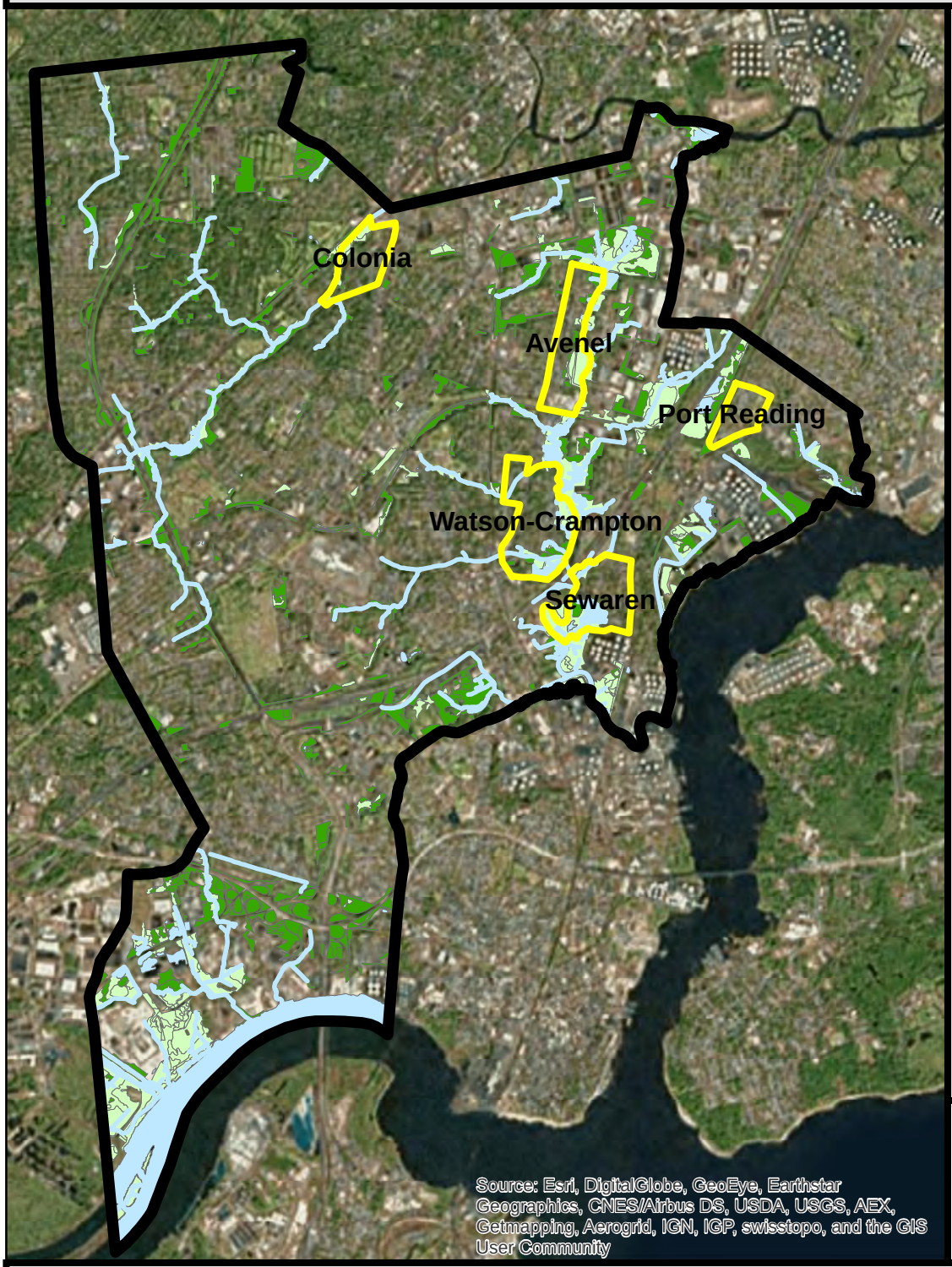
	82 Fourth	88 Fourth
***Ailanthus altissima,* Tree of Heaven**	X	
***Morus spp.,* Mulberry**		X
***Pyrus calleryana,* Callery Pear**		X
***Thuja spp.,* Arborvitae**	X	
* Invasive		

Appendix I: Existing Trees (>5 in dbh) within the Colonia Demolition Zone

	17 Brookside	168 N Hill	177 N Hill	192 N Hill	201 N Hill	205 N Hill
**** Acer palmatum,* Japanese Maple**			X		X	X
**** Acer platanoides,* Norway Maple**						X
***Acer rubrum,* Red Maple**					X	
***Acer saccharinum,* Silver Maple**		X				
***Gleditsia triacanthos,* Honey Locust**	X					
Juniperus spp.	X					
***Morus spp.,* Mulberry**					X	
***Picea spp.,* Spruce**	X					
***Quercus palustris,* Pin Oak**	X			X	X	
***Quercus rubra,* Red Oak**	X					
* Invasive						

APPENDIX II

Woodbridge Township Open Space and Flood Plain Restoration Plan



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Projection: NAD83 SP NJ
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

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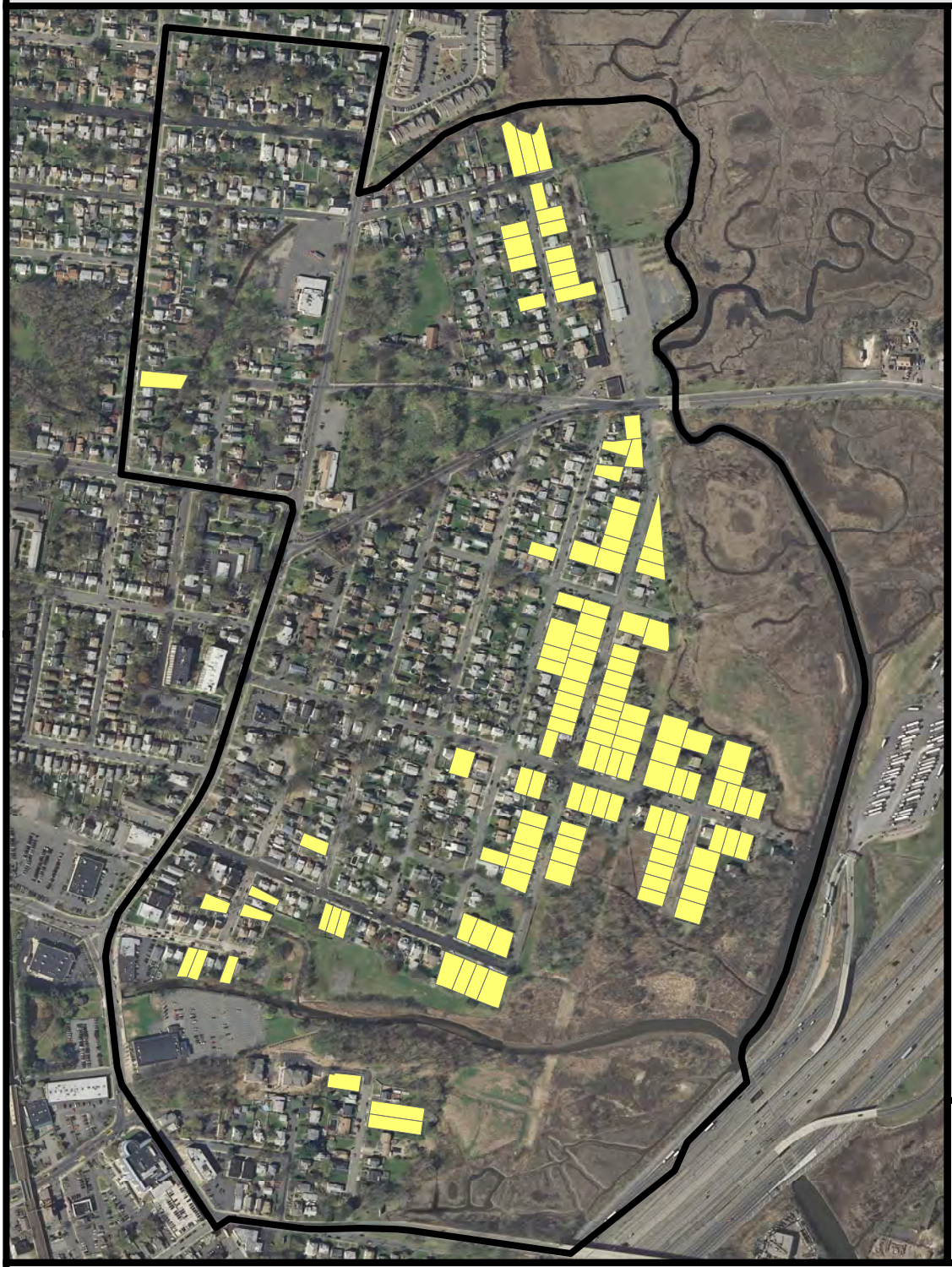
Woodbridge Open Space Overview

- Woodbridge
- Neightborhood Boundaries
- Streams (NJDEP)
- Forests
- Wetlands
- Waterbodies (NJDEP)

Woodbridge Township Open Space and Flood Plain Restoration Plan



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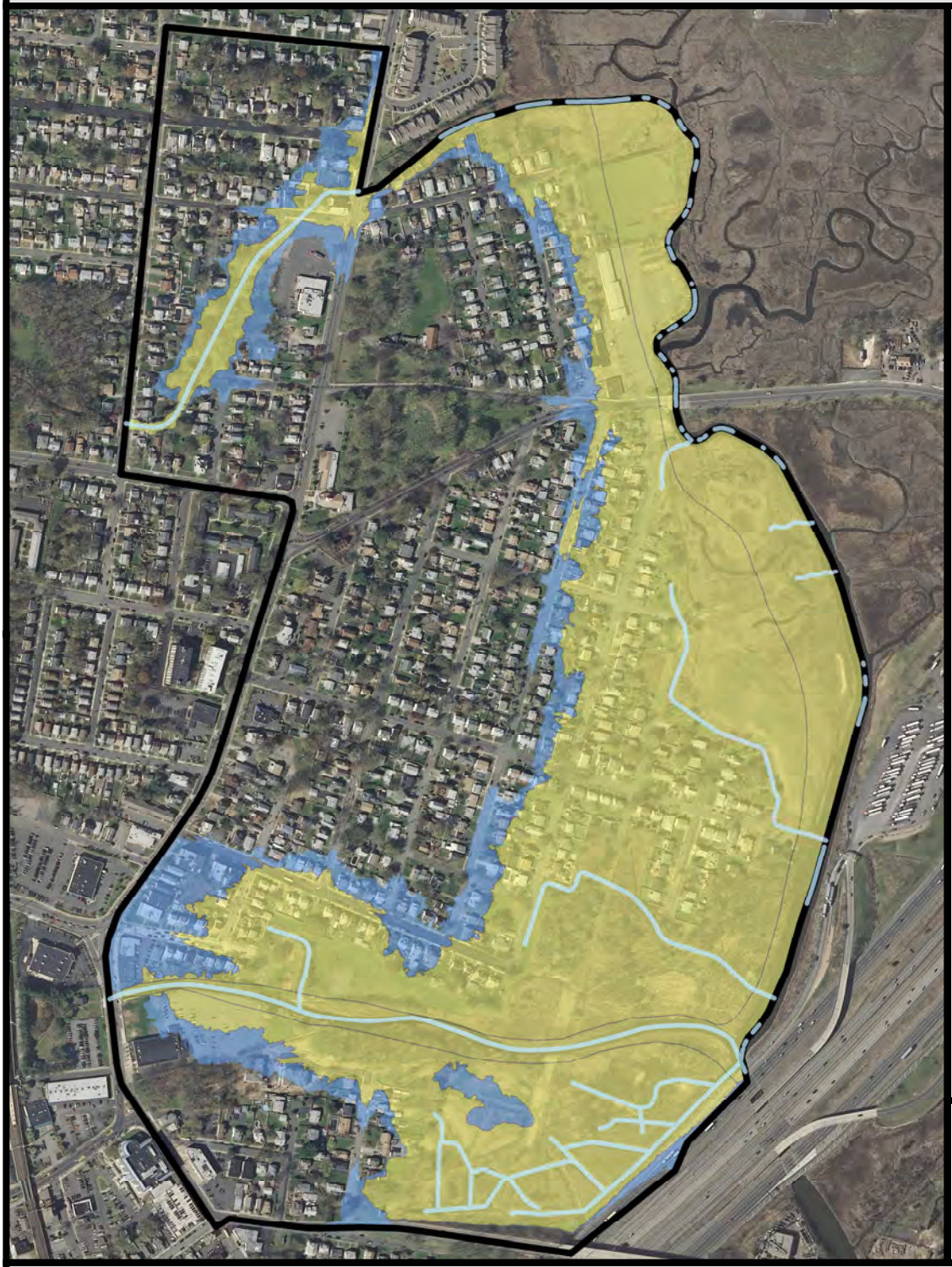
Watson-Crampton Neighborhood Project Area

Neighborhood Boundary

Buyout Properties

Woodbridge Township Open Space and Flood Plain Restoration Plan



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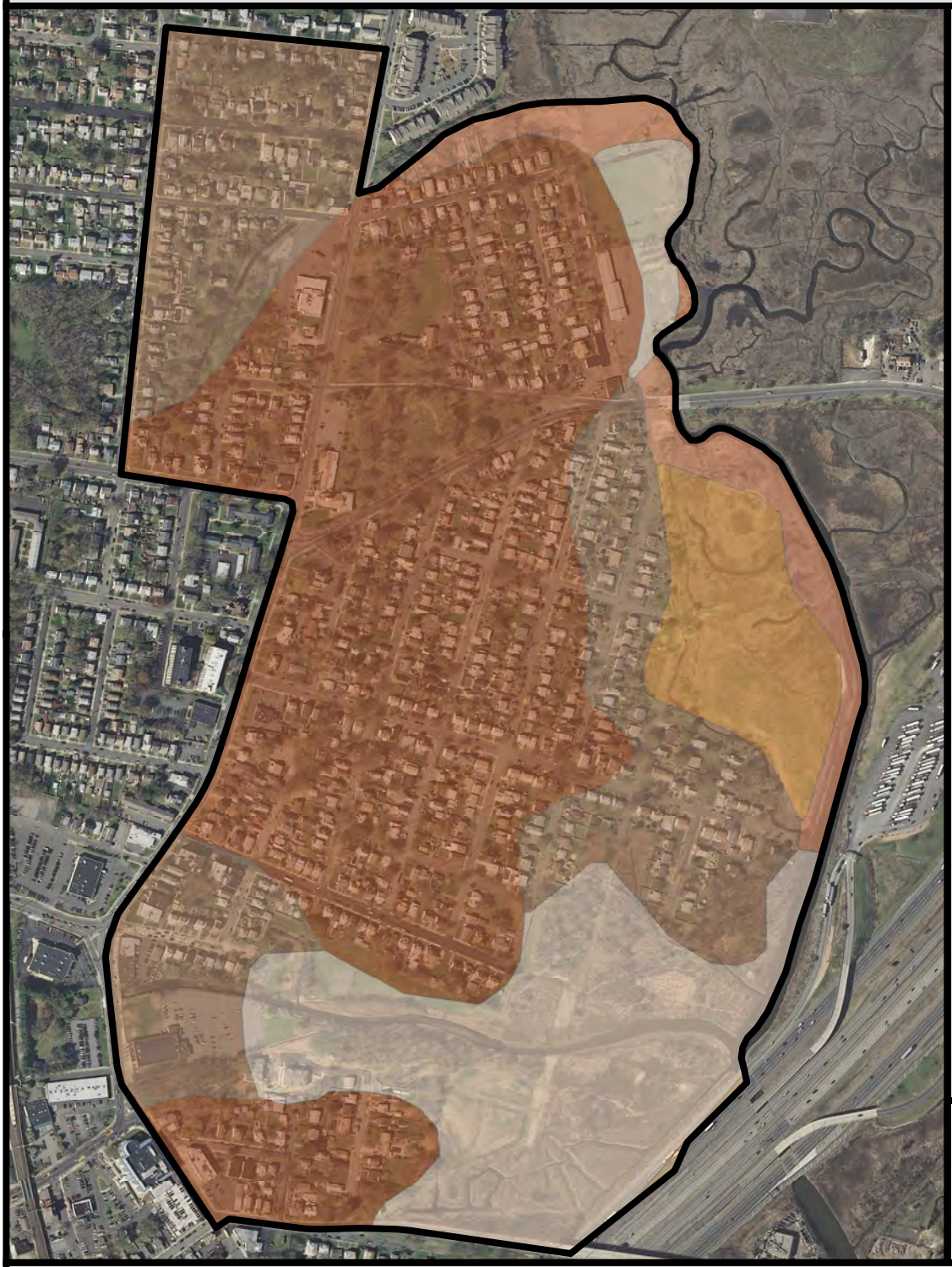
Watson-Crampton Neighborhood Flood Plain

- Neighborhood Boundary
- Streams (NJDEP)
- 100 Year Flood Plain
- 500 Year Flood Plain

Woodbridge Township Open Space and Flood Plain Restoration Plan



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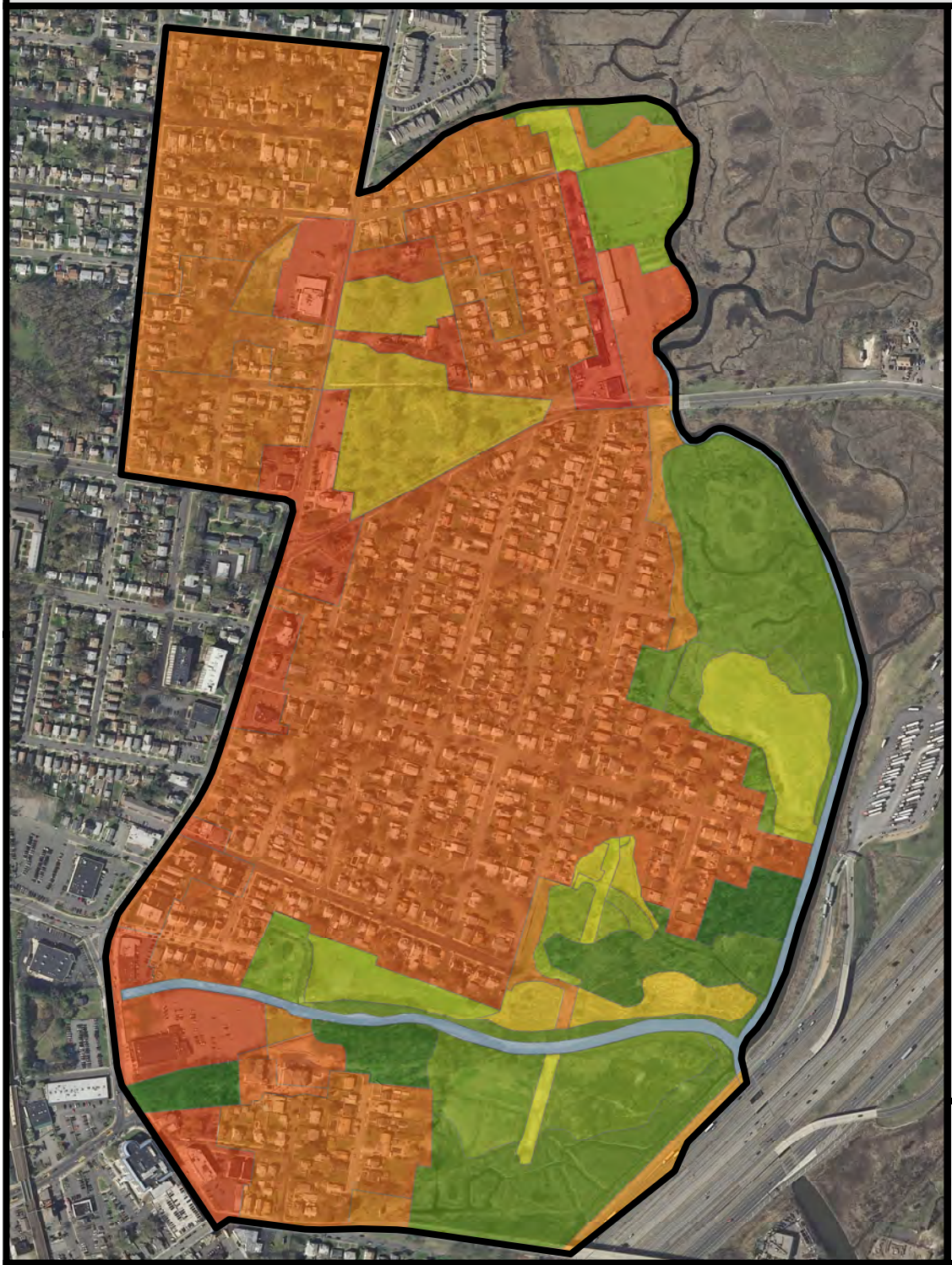
Watson-Crampton Neighborhood Soils

- Neighborhood Boundary
- BouB -Boonton
- HasA - Haledon
- PdwAv - Pawcatuck
- PssA - Psamments
- PstA - Psamments
- UR - Urban Land

Woodbridge Township Open Space and Flood Plain Restoration Plan



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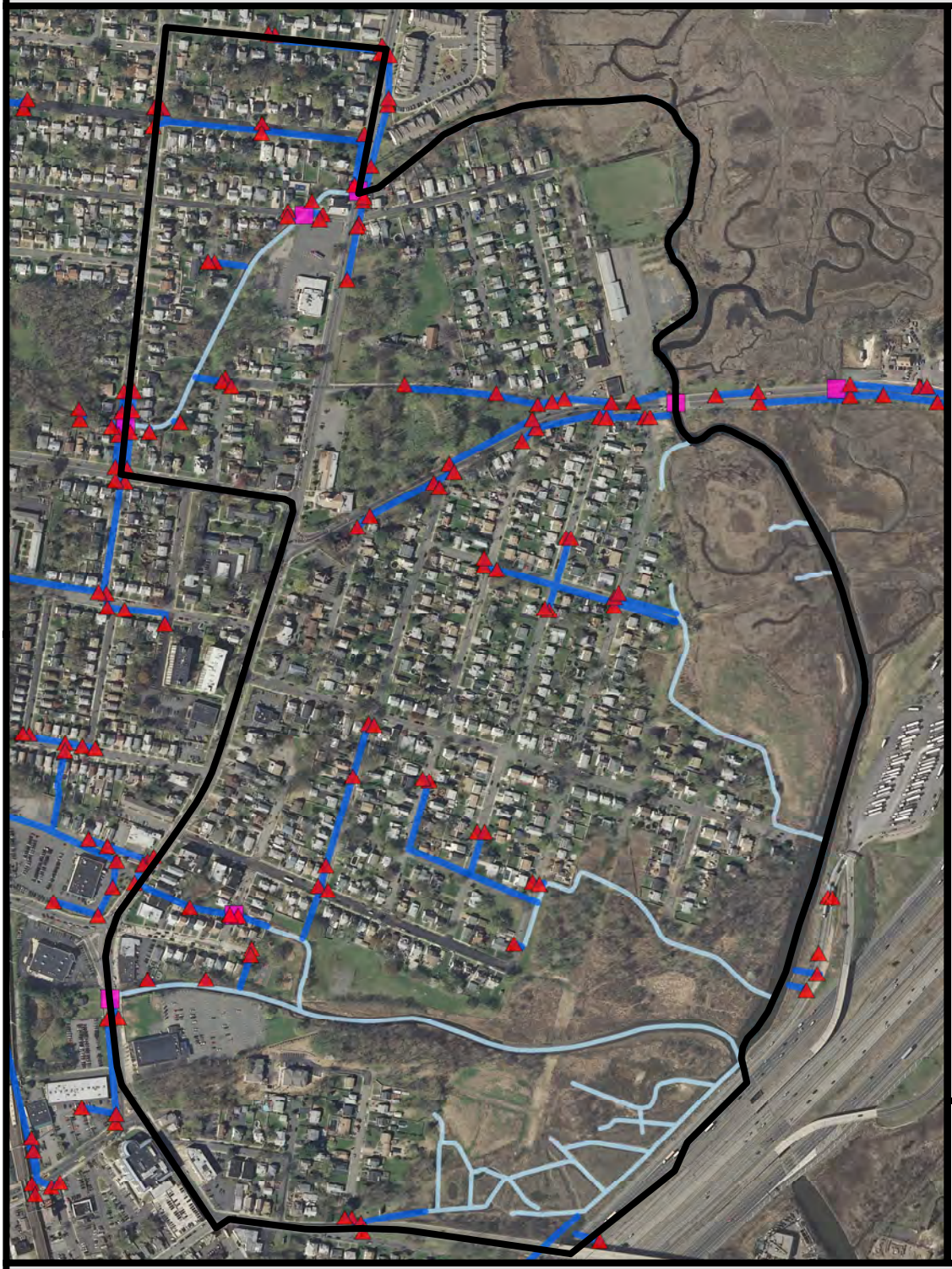
Watson-Crampton Neighborhood
Land Use / Land Cover

- Neighborhood Boundary
- Industrial
- Commercial/Services
- Residential, High Density
- Residential, Medium Density
- Other Urban or Built-Up Land
- Major Roadway
- Bridge Over Water
- Cemetery
- Old Field (< 25% Brush Covered)
- Phragmites Dominate Wetlands
- Disturbed Wetlands (Modified)
- Disturbed Tidal Wetlands
- Managed Wetland
- Deciduous Scrub/Shrub Wetlands
- Recreational Land
- Saline Marsh (High Marsh)
- Saline Marsh (Low Marsh)
- Deciduous Brush/Shrubland
- Deciduous Forest <50% Crown
- Deciduous Forest >50% Crown
- Tidal Waters

Woodbridge Township Open Space and Flood Plain Restoration Plan



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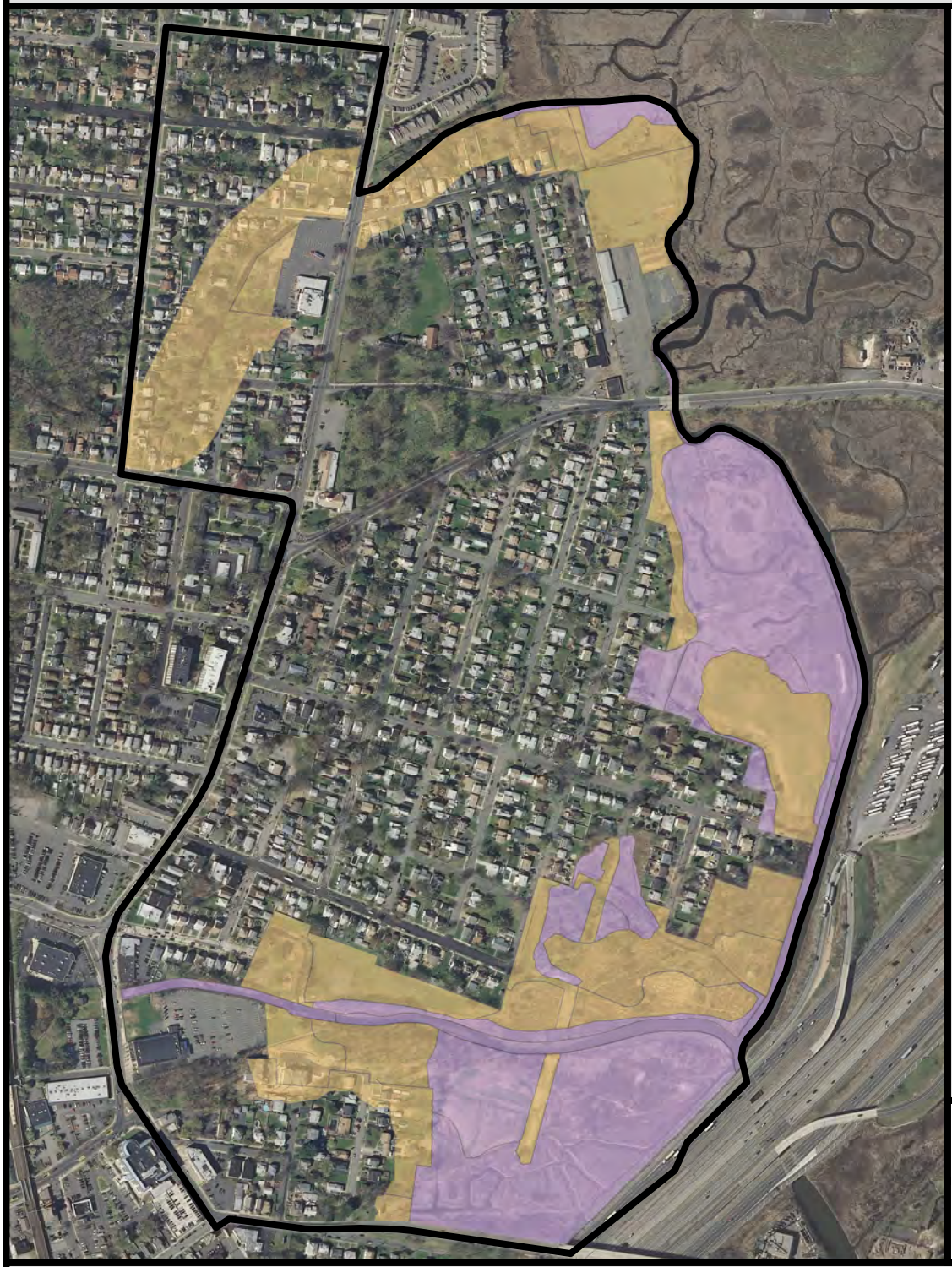
Watson-Crampton Neighborhood Hydrology

- Neighborhood Boundary
- Stormwater Inlets
- Stomwater Culverts
- Stormwater Pipes
- Streams (NJDEP)

Woodbridge Township Open Space and Flood Plain Restoration Plan



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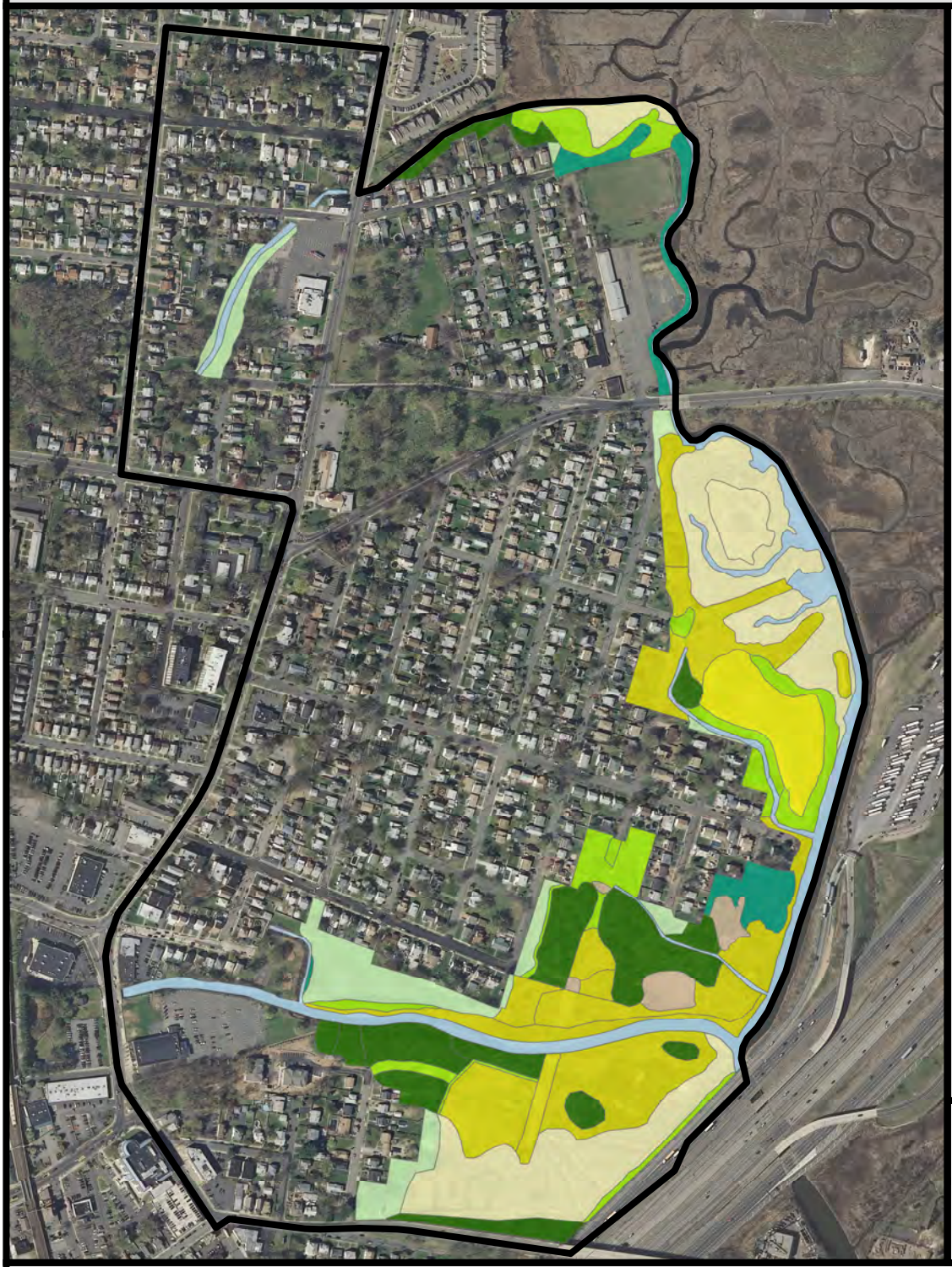
Watson-Crampton Neighborhood
NJDEP Landscape Project

- Neighborhood Boundary
- Rank 1: Habitat Specific Requirements
- Rank 3: State Threatened Species Habitat

Woodbridge Township Open Space and Flood Plain Restoration Plan



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Projection: NAD83 SP NJ
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RUTGERS
New Jersey Agricultural Experiment Station

Watson-Crampton Neighborhood Vegetation Survey

- Neighborhood Boundary
- Deciduous Woodland >50% Canopy Cover
- Deciduous Woodland <50% Canopy Cover
- Phragmites Dominant Marsh
- Scrub/Shrub (some Phragmites)
- Saline Marsh
- Edge Habitat
- Mowed Lawn
- Bare
- Water

Woodbridge Township Open Space and Flood Plain Restoration Plan

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Feet

Scale = 1:7,200
1" = 600'

Source: NJAES, NJOIT-OGIS, NJDEP
Map Creation: 1/2016
Projection: NAD83 SP NJ
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RUTGERS
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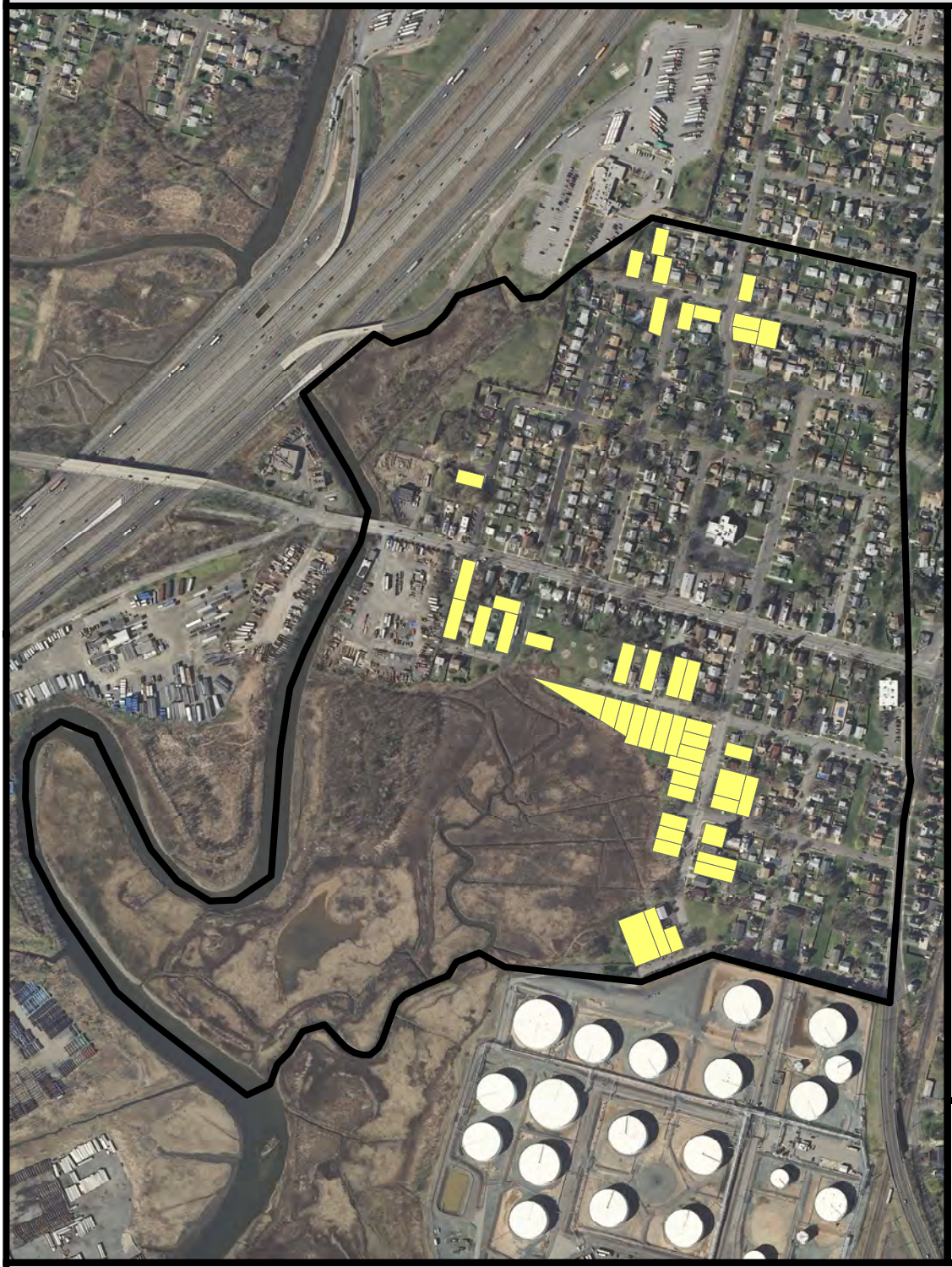
Watson-Crampton Neighborhood Bird Survey Locations

Neighborhood Boundary

Bird Survey Locations

APPENDIX III

Woodbridge Township Open Space and Flood Plain Restoration Plan



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RUTGERS
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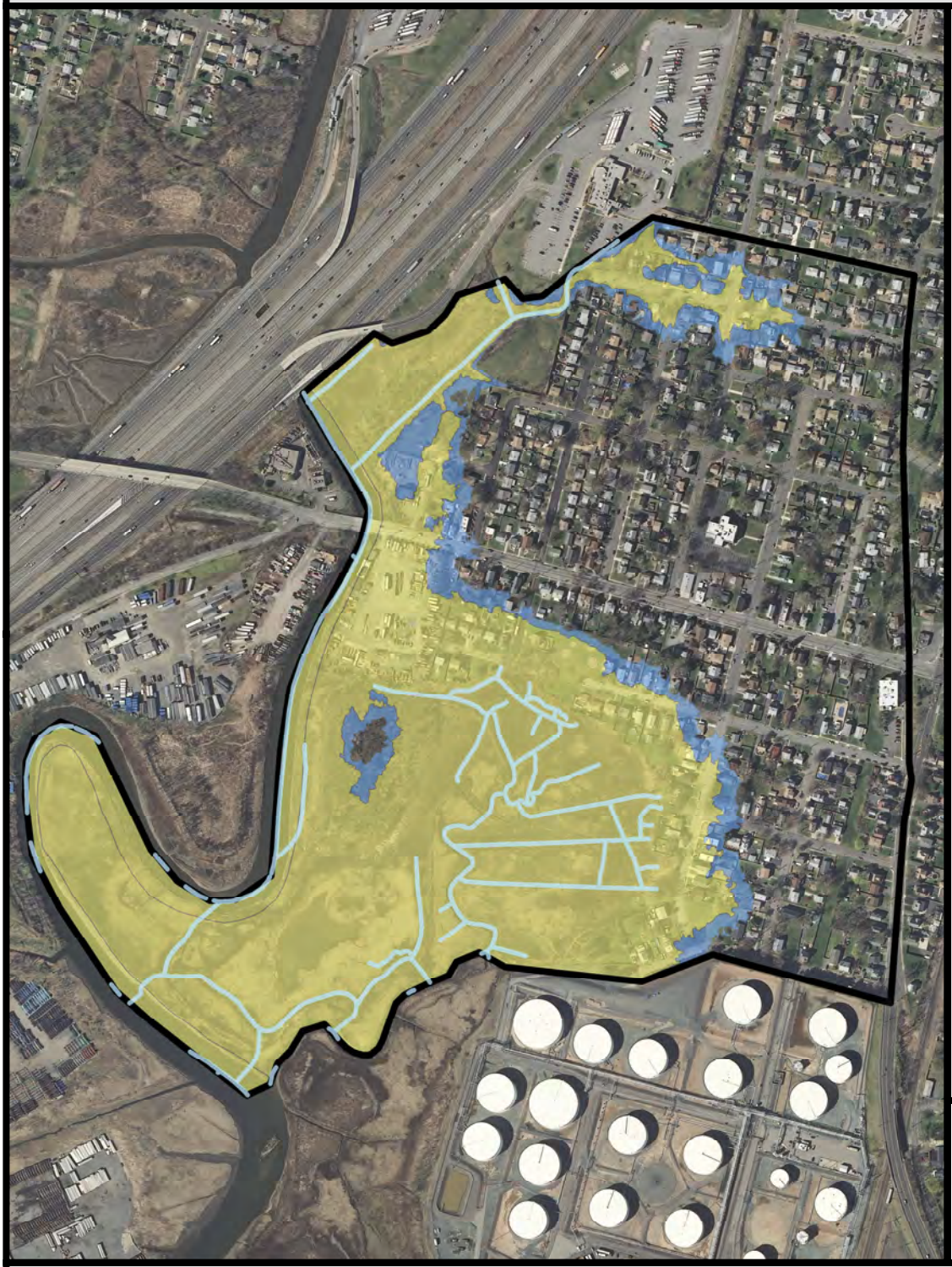
Sewaren Neighborhood Project Area

Neighborhood Boundary

Buyout Properties

Woodbridge Township Open Space and Flood Plain Restoration Plan



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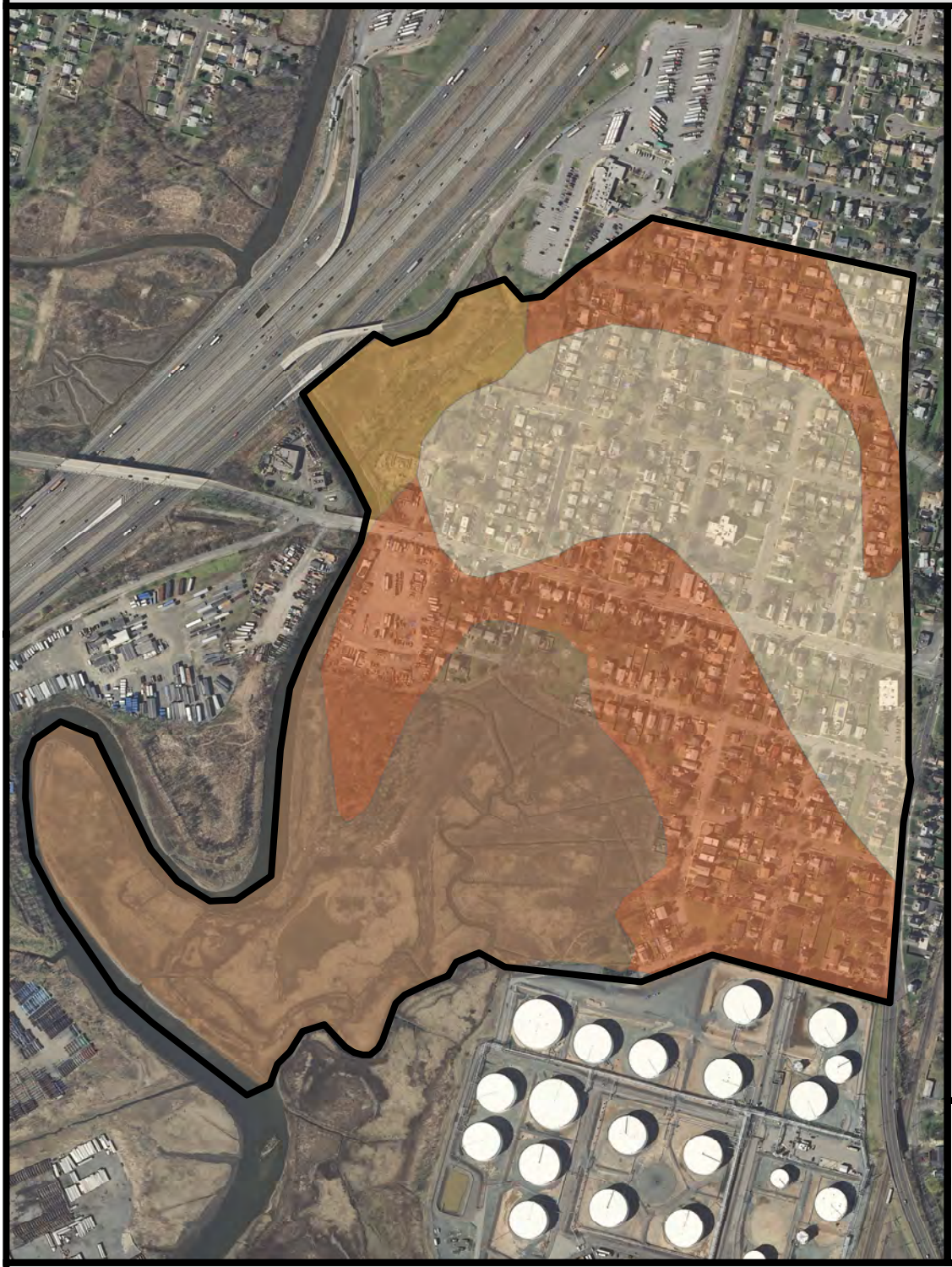
Sewaren Neighborhood Flood Plain

- Neighborhood Boundary
- Streams (NJDEP)
- 100 Year Flood Plain
- 500 Year Flood Plain

Woodbridge Township Open Space and Flood Plain Restoration Plan



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RUTGERS
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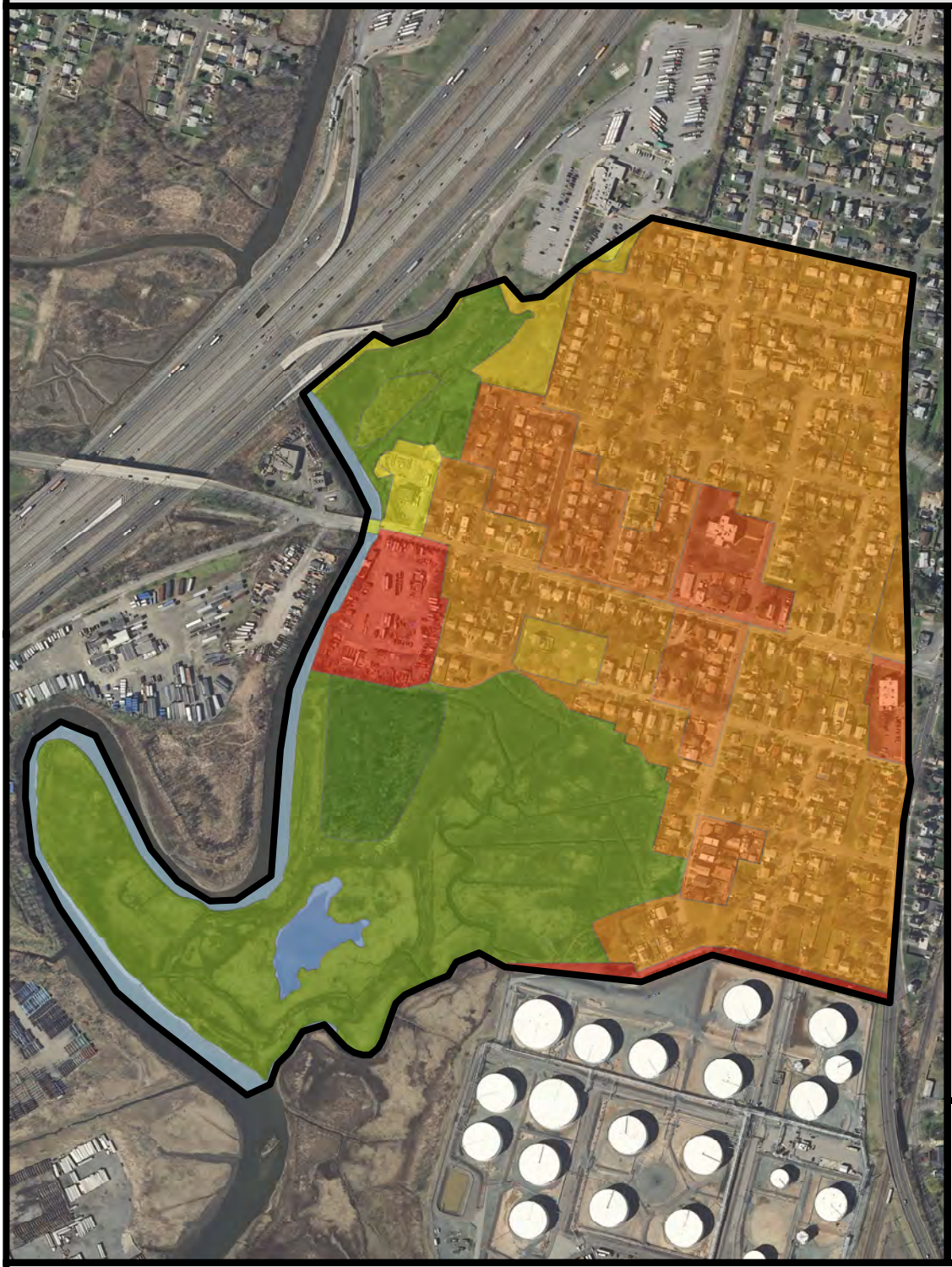
Sewaren Neighborhood Soils

- Neighborhood Boundary
- BouB - Boonton
- HasA - Haledon
- PdwAv - Pawcatuck
- PstA - Psamments

Woodbridge Township Open Space and Flood Plain Restoration Plan



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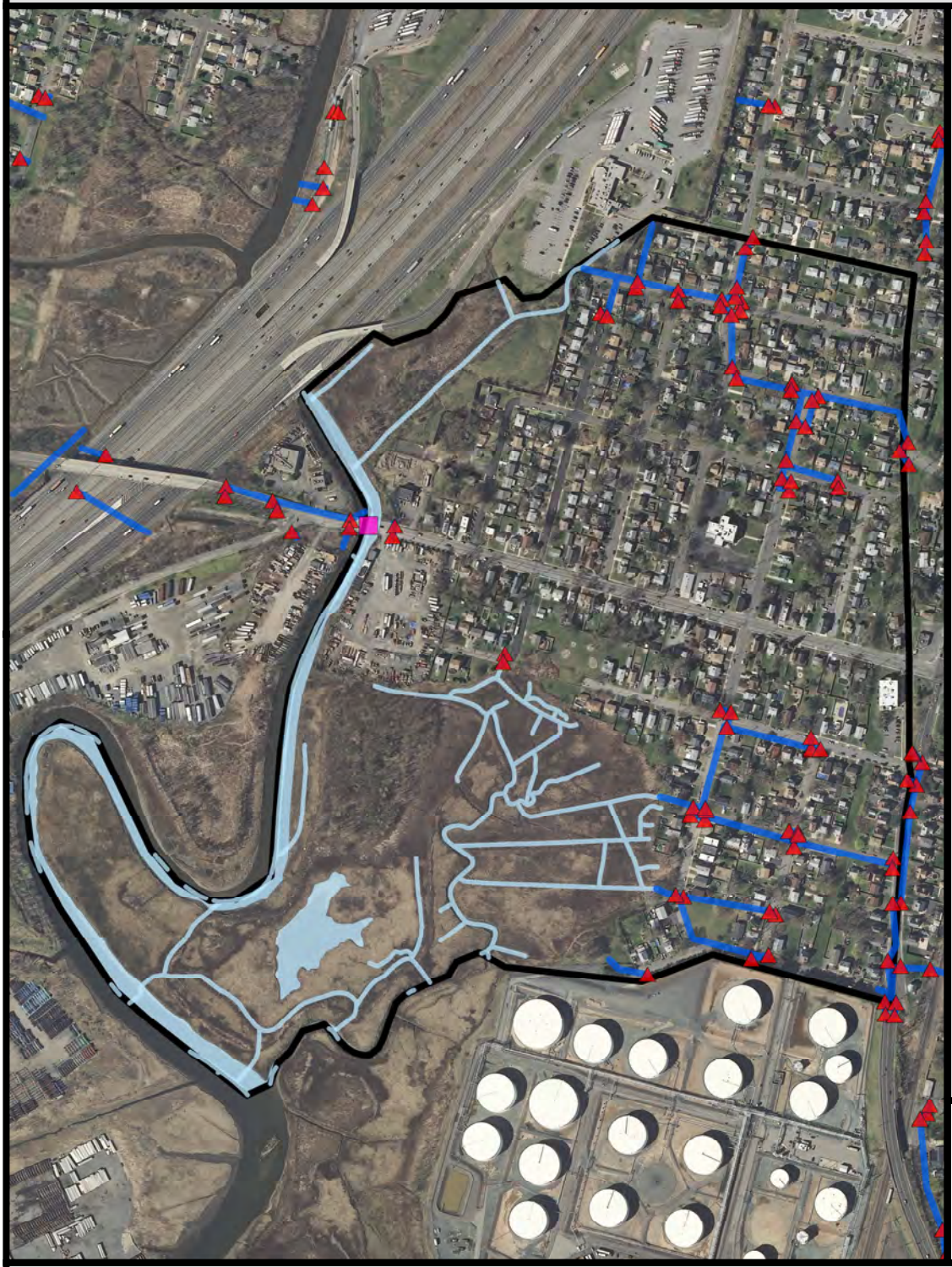
RUTGERS
New Jersey Agricultural Experiment Station

Sewaren Neighborhood
Land Use / Land Cover

- Neighborhood Boundary
- Industrial
- Commercial/Services
- Residential, High Density
- Residential, Medium Density
- Residential, Rural
- Other Urban or Built-Up Land
- Transportation/Communication/Utilities
- Major Roadway
- Bridge Over Water
- Saline Marsh (High Marsh)
- Saline Marsh (Low Marsh)
- Deciduous Brush/Shrubland
- Artificial Lakes
- Tidal Waters

Woodbridge Township Open Space and Flood Plain Restoration Plan



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RUTGERS
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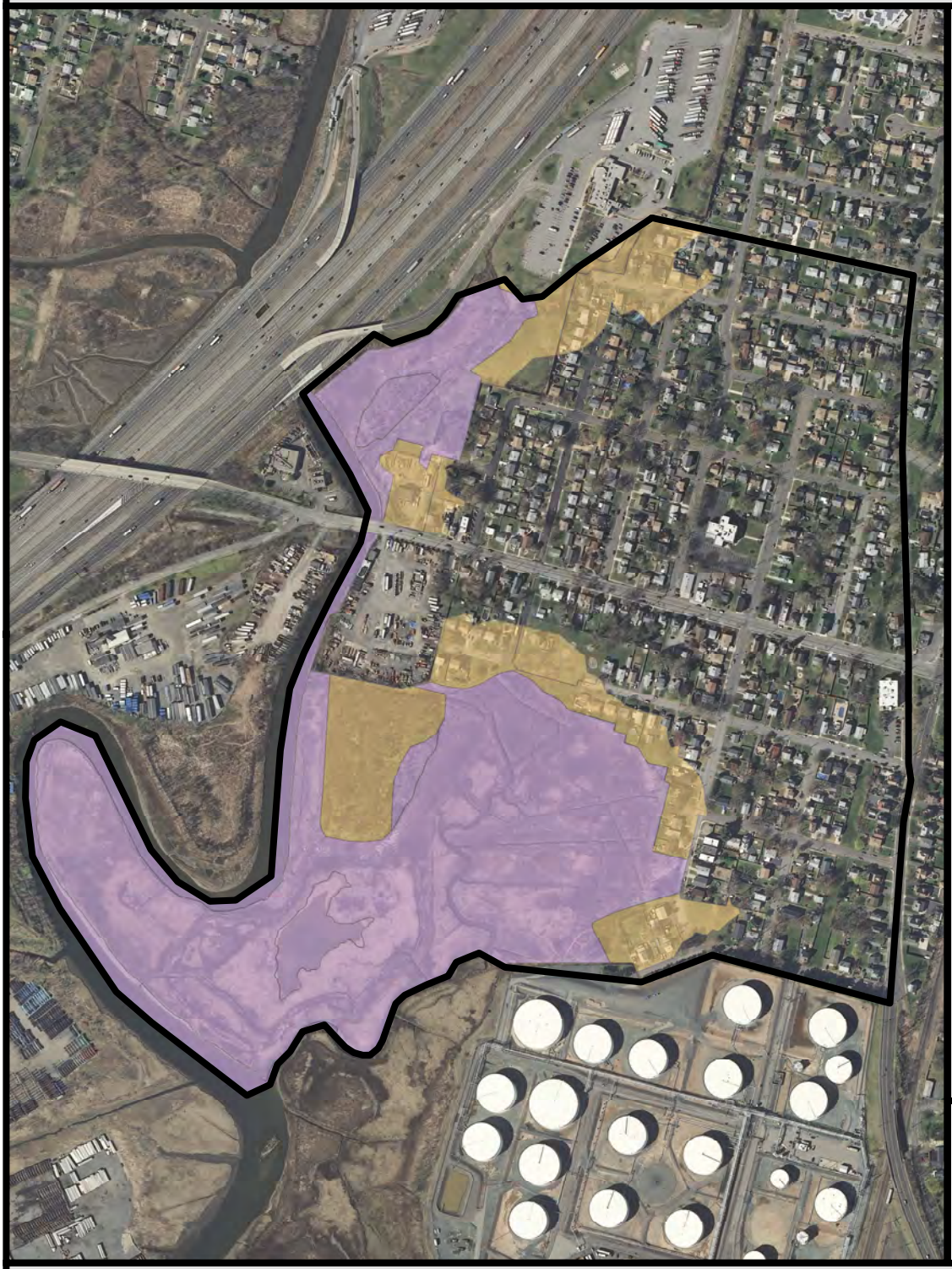
Sewaren Neighborhood Hydrology

- Neighborhood Boundary
- Stormwater Inlets
- Stomwater Culverts
- Stormwater Pipes
- Streams (NJDEP)

Woodbridge Township Open Space and Flood Plain Restoration Plan



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RUTGERS
New Jersey Agricultural Experiment Station

Sewaren Neighborhood Landscape Project

- Neighborhood Boundary
- Rank 1: Habitat Specific Requirements
- Rank 3: State Threatened Species Habitat

Woodbridge Township Open Space and Flood Plain Restoration Plan

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RUTGERS
New Jersey Agricultural Experiment Station

Sewaren Neighborhood Vegetation Survey

- Neighborhood Boundary
- Deciduous Woodland <50% Canopy Cover
- Edge Habitat
- Herbaceous Wetlands
- Saline Marsh
- Water

APPENDIX IV

Appendix IV: Invasive Species Identification and Management

Amur honeysuckle *(Lonicera maackii*)

Mechanical Control: Hand-pulling, especially after a rainfall, is effective in removing seedlings. Repeated clipping of mature plants is effective in shaded woodlands.

Chemical Control: Use the cut-stump method, and cut stems horizontally as close to the ground as possible. Paint the cut stumps with a solution of 50% glyphosate/50% water.

Autumn olive (*Elaeagnus umbellata*)

Chemical Control: Use the cut-stump method between July - September, and cut stems horizontally as close to the ground as possible. Paint the cut stumps with a solution of 20-50% glyphosate.

Callary pear (*Pyrus calleryana*)

Mechanical Control: Note recommended due to strong re-sprouting ability.

Chemical Control: Foliar application of glyphosate, or basal bark application of triclopyr ester along the bottom 2 ft of trunk.

Common privet (*Ligustrum vulgare*)

Mechanical Control: Hand-pulling, especially after a rainfall, is effective in removing seedlings. For larger stems (≤6cm), use a Weed Wrench or similar tool. Mowing or cutting can prevent the spread of sprouts.

Chemical Control: For the foliar spray method, apply (2% glyphosate +water +0.5% non-ionic surfactant) or (2% triclopyr +water +0.5% non-ionic surfactant) to leaves. For the cut-stump method, cut stems horizontally as close to the ground as possible, and paint the cut stumps with a solution of 50% glyphosate or triclopyr/50%water.

Common reed (*Phragmites australis*)

Mechanical Control: Since the species spreads clonally, rhizomes are very difficult to remove mechanically. Yearly cutting in early August (when food reserves are in the upper portion of plant) can reduce vigor, but it will take several years to eradicate the stand.

Chemical Control: Glyphosate (RODEO®) should be applied in early fall. Two to three weeks after initial spraying, mow the stems to initiate growth of suppressed rhizomes. Repeat this procedure for two years.

English Ivy (*Hedera helix*)

Mechanical Control: Hand-pulling only recommended for very small infestations.

Chemical Control: For basal bark application, remove foliage in a band a few feet from the ground and apply a solution of 20% triclopyr ester with commercially available basal oil with a penetrant to vine stems. For cut stem application, cut each vine stem at a comfortable height and again a little higher up. Remove segments and apply a 25% solution of triclopyr amine or glyphosate mixed in water to the freshly cut bottom surfaces. For foliar application, from summer to fall, apply a 2 to 5% solution of riclopyr ester mixed in water with a non-ionic surfactant to the leaves. Thoroughly wet while avoiding runoff.

Japanese barberry (*Berberis thunbergii*)

Mechanical Control: Only seedlings can be hand-pulled or removed with a spade. Larger stems must be treated with herbicides.

Chemical Control: Use the cut-stump method, and cut stems horizontally as close to the ground as possible. Paint the cut stumps with a solution of 50% glyphosate/50% water. This species vigorously resprouts, so all cut stumps must be applied with herbicide, and follow-up monitoring must be continued to locate any resprouting if stumps are left in the ground.

Japanese knotweed (*Fallopia japonica*)

Mechanical Control: Small stands can be repeated cut or mowed during the growing season, followed by immediate revegetation. It is important to remove all knotweed fragments from the site, as rhizome fragments are still viable.

Chemical Control: Large stems may be effectively treated with herbicides. Use the foliar spray method, mixing solutions according to herbicide label, and fully covering the leaves.

Japanese stiltgrass (*Microstegium vimineum*)

Mechanical Control: Hand-pulling or weed-whacking prior to seed formation can be effective for small populations and should be repeated annually over several years to exhaust the seed bank.

Chemical Control: For larger patches, targeted application of herbicides in late August (prior to seed set) has been effectively demonstrated, but must be repeatedly annually until seed bank is depleted. Adjacent native plants will also be affected, but those individuals have a poor prognosis if growing under stiltgrass.

Mile-a-minute (*Polygonum perfoliatum*)

Mechanical Control: Hand-pulling only recommended for very small infestations.

Chemical Control: Foliar application of glyphosate recommended in early season (May-June) prior to seed set.

Mugwort (*Artemisia vulgaris*)

Chemical Control: Targeted application of glyphosate in June-August (prior to seed set) has been effectively demonstrated, but must be repeatedly annually until seed bank is depleted. Adjacent native plants will also be affected, but those individuals have a poor prognosis if growing under mugwort.

Multiflora rose (*Rosa multiflora*)

Mechanical Control: Hand-digging out smaller shrubs is adequate. Mowing or cutting is not effective.

Chemical Control: For larger individuals, use the cut-stump method by cutting stems horizontally at the ground level followed by immediate glyphosate application on cut stumps.

Porcelainberry (*Ampelopsis brevipedunculata*)

Mechanical Control: Not recommended due to strong re-sprouting ability.

Chemical Control: Glyphosate or triclopyr ester application in May, prior to seed set.

Tree-of-heaven (*Ailanthus altissima*)

Mechanical Control: Seedlings can be hand-pulled before taproot is established. After root establishment, mechanical removal is extremely difficult. Aboveground plant material must be cut repeatedly over several years to kill the tree.

APPENDIX V

Costs for Restoration and Recreation Enhancements

RECREATION AREAS

DESCRIPTION	*UNIT*	*PRICE*	*QUANTIT*	*COST*	NOTES
Kayak Launch					
Gravel Parking Area	EACH	$ 2,000.00	1	$ 2,000.00	2,000 sq. ft.
Stabilized Launch Area	EACH	$ 3,500.00	1	$ 3,500.00	500 sq. ft.
Concrete Curb	LS	$ 1,000.00	1	$ 1,000.00	
Signage	LS	$ 250.00	1	$ 250.00	
Pocket Parks					
Extended Backyard	EACH	$ 1,000.00	1	$ 1,000.00	Approx. 10,000 sq. ft of seeding @ $0.10/sq.ft
Community Garden	EACH	$ 12,000.00	1	$ 12,000.00	Raised beds, soil, fencing, and shade structure
Playground	EACH	$ 30,000.00	1	$ 30,000.00	Edging, mulch, and equipment
Pollinator Garden	EACH	$ 7,500.00	1	$ 7,500.00	Trellis, perennials, walking paths, flowering shrubs
Shade Garden	EACH	$ 7,500.00	1	$ 7,500.00	Trees, shrubs, groundcover, walking paths, benches
Trail Entrance	EACH	$ 4,500.00	1	$ 4,500.00	Signage, trees, and walking paths
Boardwalks and Trails					
Elevated Boardwalk (6 ft. width)	Linear Ft.	$ 110.00	100	$ 11,000.00	
Gravel Path (6 ft. width)	Linear Ft.	$ 12.00	1000	$ 12,000.00	

NOTE: Costs shown are order-of-magnitude estimates for materials and installation. It is recommended that contracted work also include a 1-2 year maintenance guarantee of all planted material and management of invasives species.

Costs for Restoration and Recreation Enhancements

MANAGEMENT ZONES

DESCRIPTION	*UNIT*		*PRICE*	*QUANTIT*		*COST*	NOTES
Mown Buffer							
Seeding	Sq. Ft.	$	0.10	10000	$	1,000.00	
Split Rail Fencing	Linear Ft.	$	28.00	100	$	2,800.00	
COST PER 1/4 ACRE					**$**	**3,800.00**	
Bioswales							
Excavation	Sq. Ft.	$	0.75	10000	$	7,500.00	
Soil Amendments	Sq. Ft.	$	1.00	10000	$	10,000.00	
Native Shrub Plantings	Each	$	15.00	100	$	1,500.00	
Seeding and Stabilization	Sq. Ft.	$	0.15	10000	$	1,500.00	$0.15 per sq.ft. for hydroseeding and mulch
COST PER 1/4 ACRE					**$**	**20,500.00**	
Flood Storage & Stormwater Wetlands							
Excavation	Sq. Ft.	$	0.75	10000	$	7,500.00	
Soil Amendments	Sq. Ft.	$	0.75	10000	$	7,500.00	
Native Shrub Plantings	Each	$	15.00	100	$	1,500.00	
Native Herbaceous Plantings	Each	$	2.50	2500	$	6,250.00	2" Plugs planted 2 ft. O.C.
Seeding and Stabilization	Sq. Ft.	$	0.15	10000	$	1,500.00	$0.15 per sq.ft. for hydroseeding and mulch
COST PER 1/4 ACRE					**$**	**24,250.00**	
Meadow							
Invasive Species Management	Sq. Ft.	$	0.12	10000	$	1,200.00	
Seeding and Stabilization	Sq. Ft.	$	0.15	10000	$	1,500.00	$0.15 per sq.ft. for hydroseeding and mulch
COST PER 1/4 ACRE					**$**	**2,700.00**	

NOTE: Costs shown are order-of-magnitude estimates for materials and installation. It is recommended that contracted work also include a 1-2 year maintenance guarantee of all planted material and management of invasives species.

Costs for Restoration and Recreation Enhancements

HABITAT ZONES

DESCRIPTION	*UNIT*	*PRICE*	*QUANTIT*	*COST*	NOTES
Scrub/Shrub Habitat					
Invasive Species Management	ACRE	$ 2,000.00	1	$ 2,000.00	
Native Shrub Plantings	ACRE	$ 26,250.00	1	$ 26,250.00	plant 5 ft. O.C., total of 1,750 plants/acre @ $15/plant (#1 or #2 contain
Seeding and Stabilization	ACRE	$ 6,500.00	1	$ 6,500.00	$0.15 per sq.ft. for hydroseeding and mulch
COST PER ACRE				**$ 34,750.00**	
Flood Plain Forest Habitat					
Invasive Species Management	ACRE	$ 2,000.00	1	$ 2,000.00	
Native Tree Plantings	ACRE	$ 13,500.00	1	$ 13,500.00	plant 10 ft. O.C., total of 450 plants/acre @ $30/plant (#2 or #3 containe
Native Shrub Plantings	ACRE	$ 18,000.00	1	$ 18,000.00	plant 6 ft. O.C., total of 1,200 plants/acre @ $15/plant (#1 or #2 contain
Seeding and Stabilization	ACRE	$ 6,500.00	1	$ 6,500.00	$0.15 per sq.ft. for hydroseeding and mulch
COST PER ACRE				**$ 40,000.00**	
High Marsh Habitat					
Invasive Species Management	ACRE	$ 2,000.00	1	$ 2,000.00	
Native Herbaceous Plantings	ACRE	$ 25,000.00	1	$ 25,000.00	plant 2 ft. O.C., total of 10,000 plants/acre @ $2.50/plant (2" plug)
Native Shrub Plantings	ACRE	$ 6,750.00	1	$ 6,750.00	plant 10 ft. O.C., total of 450 plants/acre @ $15/plant (#1 or #2 containe
Seeding and Stabilization	ACRE	$ 6,500.00	1	$ 6,500.00	$0.15 per sq.ft. for hydroseeding and mulch
COST PER ACRE				**$ 40,250.00**	
Salt Marsh Habitat					
Invasive Species Management	ACRE	$ 2,000.00	1	$ 2,000.00	
Native Herbaceous Plantings	ACRE	$ 25,000.00	1	$ 47,500.00	plant 1.5 ft. O.C., total of 19,000 plants/acre @ $2.50/plant (2" plug)
Seeding and Stabilization	ACRE	$ 6,500.00	1	$ 6,500.00	$0.15 per sq.ft. for hydroseeding and mulch
COST PER ACRE				**$ 56,000.00**	

NOTE: Costs shown are order-of-magnitude estimates for materials and installation. It is recommended that contracted work also include a 1-2 year maintenance guarantee of all planted material and management of invasives species.

APPENDIX VI

IN THE FLOOD ZONE:

WOODBRIDGE TOWNSHIP OPEN SPACE AND FLOOD PLAIN RESTORATION PLAN

BY RUTGERS COOPERATIVE EXTENSION IN PARTNERSHIP WITH WOODBRIDGE TOWNSHIP / COMMUNITY PRESENTATION / JANUARY 29TH, 2016

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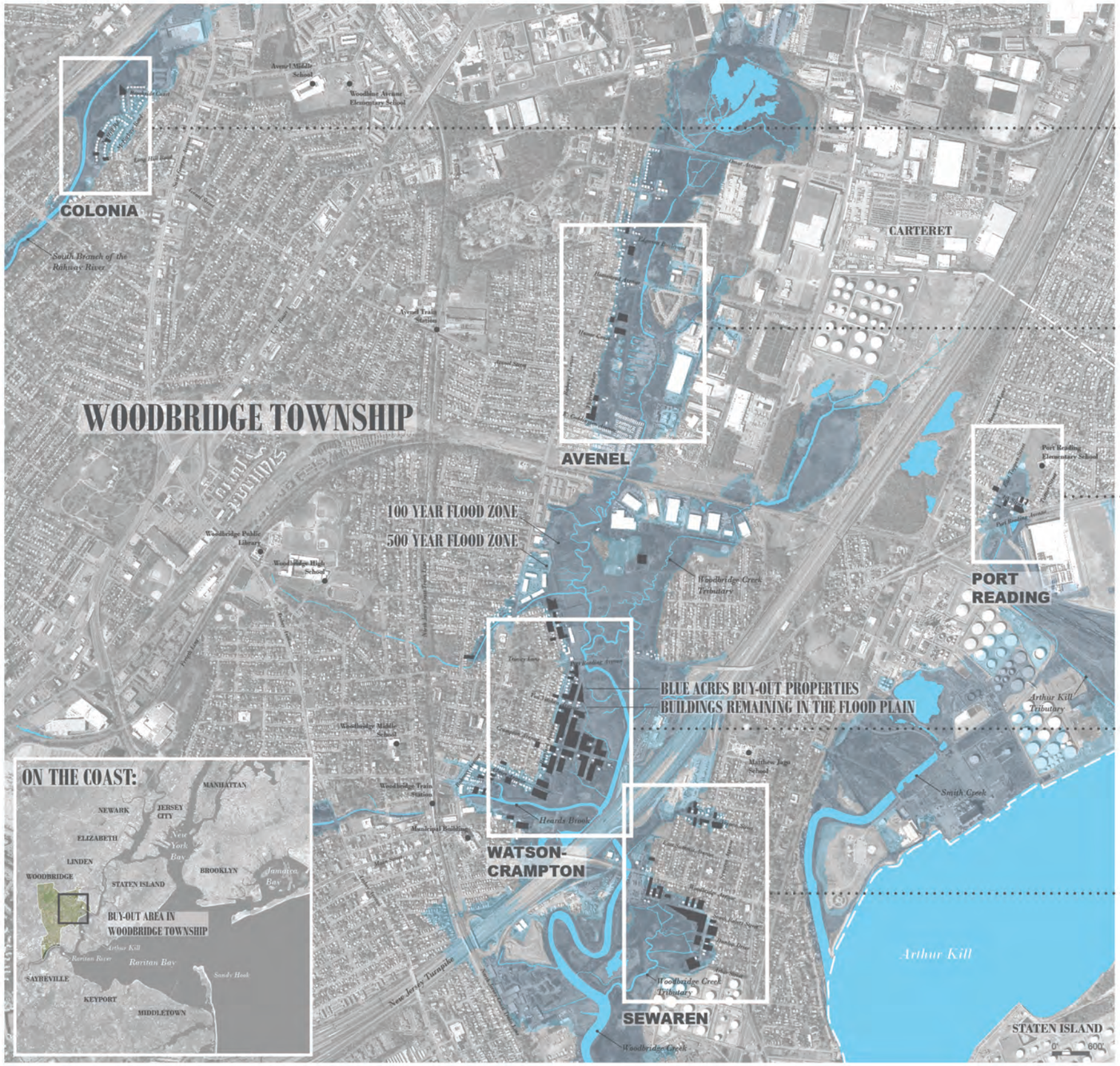
THE STATE UNIVERSITY OF NEW JERSEY



LOCATION OF BUY-OUT PROPERTIES AND NEIGHBORHOOD OPEN SPACE PROPOSALS:

COLONIA

Located adjacent to the South Branch of the Rahway River, buy-out properties in the Colonia neighborhood of Woodbridge Township can be converted into pocket parks and trail entrances that connect to existing open space along the river.

AVENEL

As part of the Woodbridge Creek flood plain, buy-out properties in the neighborhood of Avenel can be converted into pocket parks. Buy-out properties can also be transformed into forested lots to increase flood storage capacity and serve as windbreaks for remaining homes.

PORT READING

With an existing elementary school and open space nearby, buy-out properties in the Arthur Kill Tributary flood plain can be converted into pocket parks and new park entrances to enhance public amenities.

WATSON-CRAMPTON NEIGHBORHOOD

Watson-Crampton is the largest of the five flood-affected buy-out neighborhoods in Woodbridge Township. Here, buy-out properties can be converted into an extensive system of park space, flowering meadows and flood storage areas. Restoration of flood plain forest, scrub shrub, and salt marsh habitat can increase flood storage potential and provide a sound buffer from the adjacent New Jersey Turnpike.

SEWAREN

With both pocket park and large open space opportunities, buy-out properties in Sewaren can extend an existing park into a system of trails, meadows, and forested flood storage areas.

Watson-Crampton Neighborhood:

COMMUNITY OPEN SPACE & FLOOD PLAIN RESTORATION

ACTIVE AND PASSIVE RECREATION:

KAYAK LAUNCH AND EAST HEARDS BROOK PARK

Restoring the Heards Brook riverbank allows existing park space to be expanded. A kayak launch can also provide new ways of enjoying Woodbridge open space.

POCKET PARKS

Individual buy-out properties can be converted into park space to increase public amenities in each neighborhood. A variety of designs are available to community members.

BOARDWALKS AND TRAILS

Trails and boardwalks connect park space and residential areas while providing walking opportunities through flowering meadows and a variety of natural habitats.

LOW-MAINTENANCE MANAGEMENT ZONE:

MOWN BUFFER

A 10-ft mown buffer around remaining residential properties provides a neat edge between private property and new open space.

BIOSWALES

Existing swales and concrete channels that convey stormwater runoff can be converted into bioswales to treat stormwater as part of the open space network.

FLOOD STORAGE AND STORMWATER WETLANDS

A system of small berms and depressions within meadow open space can store flood water and treat stormwater runoff.

MEADOW

Flowering meadows provide a low-maintenance management strategy for the Township while creating open sight lines that integrate with residential properties.

RESTORATION ZONE:

SCRUB SHRUB

A unique hilltop within the Watson-Crampton neighborhood can be augmented with small trees and shrubs while providing an elevated pathway and look-out opportunity across the salt marsh.

FLOOD PLAIN FOREST

Forested areas can provide shaded pathways and flood and wind protection while acting as a sound and sight buffer from the nearby New Jersey Turnpike.

HIGH MARSH EDGE

Transitional areas between forested and salt marsh habitats can be planted with salt-tolerant high marsh plants to manage invasive species and erosion.

SALT MARSH

Saline marsh areas provide flood protection while enhancing tidal habitats in Woodbridge Township and allowing residents an opportunity to enjoy nature.

KAYAK LAUNCH

A kayak launch at Port Reading Avenue and Watson Avenue provides new recreational opportunities while connecting with a larger boardwalk and trail system throughout the Watson-Crampton neighborhood.

MEADOW

Flowering meadows provide space for both neighborhood paths, flood storage and treatment of stormwater runoff. With low-maintenance management, meadows also provide habitat for pollinators, butterflies and birds.

EAST HEARDS BROOK PARK

An existing park is currently cut short by a concrete stormwater channel, dense vegetation and a chain-link fence. By replacing these obstacles with a bioswale, the park becomes integrated with a larger open space network.

LOW-MAINTENANCE MANAGEMENT ZONE:

RESTORATION ZONE:

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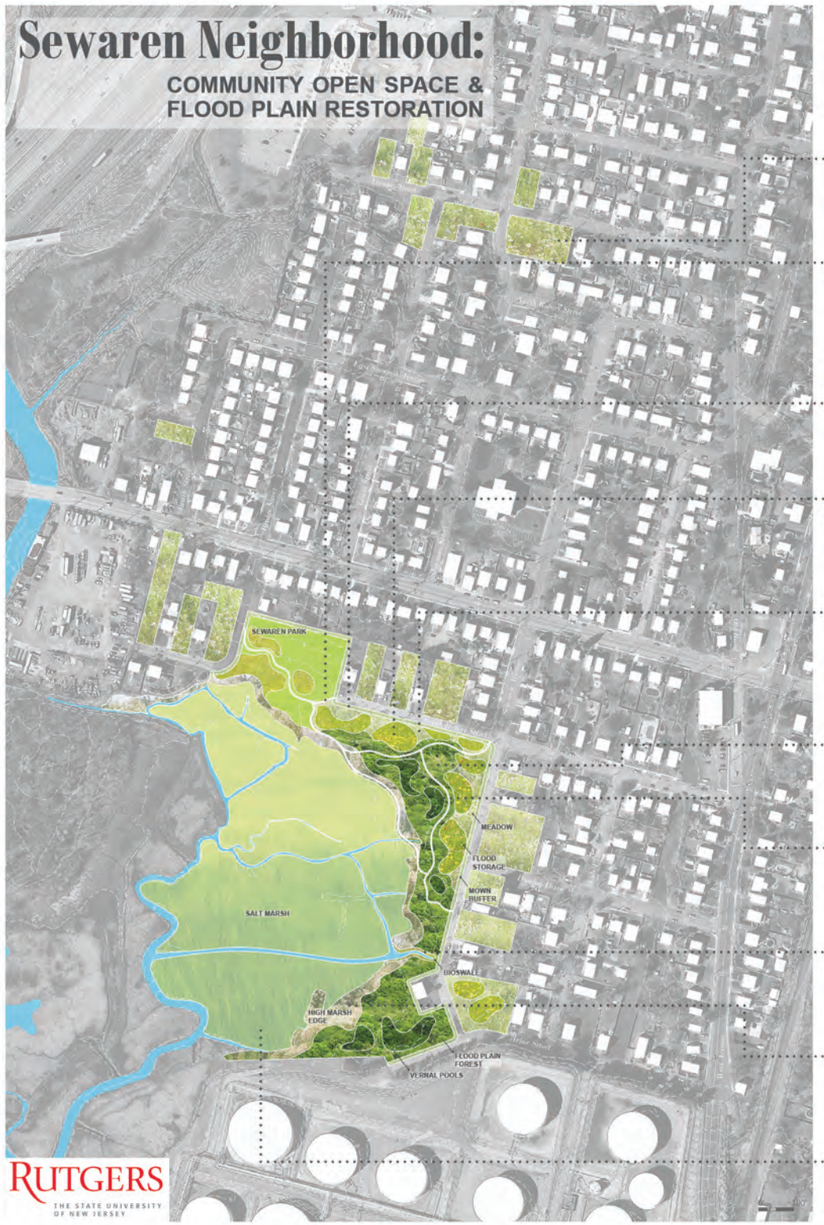
Sewaren Neighborhood:

COMMUNITY OPEN SPACE & FLOOD PLAIN RESTORATION



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ACTIVE AND PASSIVE RECREATION:

SEWAREN PARK

An existing park can be expanded and connected to the larger open space system with trails, flowering meadows and flood storage areas.

POCKET PARKS

Individual buy-out properties can be converted into park space to increase public amenities in each neighborhood. A variety of designs are available to community members.

BOARDWALKS AND TRAILS

Trails and boardwalks connect park space and residential areas while providing walking opportunities through flowering meadows and a variety of natural habitats.

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A system of small berms and depressions within meadow open space can store flood water and treat stormwater runoff.

MEADOW

Flowering meadows provide a low-maintenance management strategy for the Township while creating open sight lines that integrate with residential properties.

RESTORATION ZONE:

FLOOD PLAIN FOREST

Forested areas can provide shaded pathways and flood and wind protection while acting as a sound and sight buffer from the nearby New Jersey Turnpike.

VERNAL POOLS

Forested depressions provide additional flood storage opportunities while also creating habitat for vernal-pool-dependent amphibians.

BIOSWALES

Existing swales that convey stormwater runoff can be converted into bioswales to treat stormwater as part of the open space network.

HIGH MARSH EDGE

Transitional areas between forested and salt marsh habitats can be planted with salt-tolerant high marsh plants to manage invasive species and erosion.

SALT MARSH

Saline marsh areas provide flood protection while enhancing tidal habitats in Woodbridge Township and allowing residents an opportunity to enjoy nature.

Pocket Parks: Community Options For Individual Buy-Out Properties

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

BACKYARD

POCKET PARK EXAMPLE: SEWAREN

BEFORE

If desired, homeowners may enter into long-term agreements with Woodbridge Township to use buy-out properties as extended backyards.

AFTER

Homeowners will maintain the space as a manicured lawn or garden and erect no permanent structures. The extended backyard can be enjoyed with a variety of activities.

COMMUNITY GARDEN

POCKET PARK EXAMPLE: WATSON-CRAMPTON

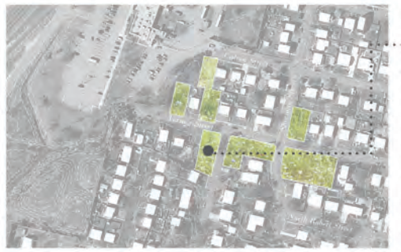
BEFORE

Some buy-out properties can be converted into community gardens to cultivate fruit, vegetables, flowers and herbs.

AFTER

Such gardens can act as a gathering place for community members to trade gardening techniques while cultivating communal or individual garden plots. Several grant opportunities also exist to support community gardens.

PLAYGROUND



POCKET PARK EXAMPLE: SEWAREN

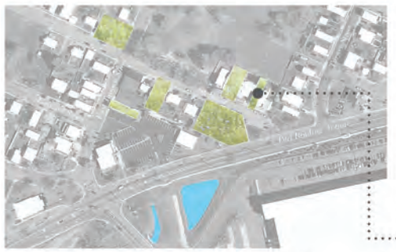
BEFORE

Pocket parks can be geared towards active recreation and exercise, especially in locations where the nearest playground is several blocks away.

AFTER

Play structures and a soft substrate provide children an opportunity to play while close to home. Benches and flower beds also provide a sitting area.

POLLINATOR GARDEN



POCKET PARK EXAMPLE: PORT READING

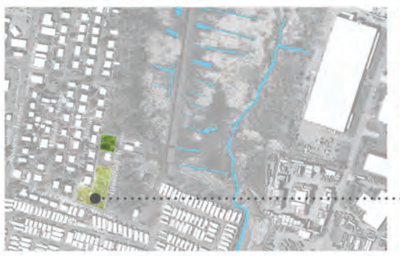
BEFORE

Buy-out properties can create new connections. In this example, a public park is located behind the buy-out property.

AFTER

Bright and sunny flower gardens can be designed to attract butterflies and hummingbirds in the neighborhood. Paths and seating areas provide residents an opportunity to stroll or relax outdoors.

SHADE GARDEN



POCKET PARK EXAMPLE: AVENEL

BEFORE

Buy-out properties can be converted into shade gardens for a cool retreat from the summer sun.

AFTER

Trees with dappled shade and low understory plantings create a tranquil place to relax on a hot summer's day. Evergreens also provide a windbreak in winter months.

TRAIL ENTRANCE

POCKET PARK EXAMPLE: COLONIA

BEFORE

Some buy-out properties can connect with existing trail systems in Woodbridge Township, such as this corner lot in Colonia.

AFTER

With dogwoods and a pervious pathway leading into the park, these trail entrances can provide residents with a scenic walk in their neighborhood.